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Comparison of the RCA Between China and KOR: From the Perspective of Value-Added*

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Abstract

Purpose – This paper empirically explores the RCA of electrical equipment trade between China and Korea from the perspective of gross trade and value-added trade. The goal of this paper is to scan the electrical equipment's RCA, the decomposition of gross exports, and the impacts of an exerted shock.

Design/methodology – We applied the domestic value-added method in measuring the RCA, which could be more accurate than traditional RCA since it excludes foreign value-added. Based on the research purpose, this paper follows the framework of Koopman, Wang, and Wei (2014)—as extended by Wang, Wei, and Zhu (2018). It extracts the data from the 2019 Multi-regional Input-Output (MRIO) databases compiled by the Asian Development Bank in January 2021.

Findings – After rigorous examination, the main findings are as follows: First, the electrical equipment sector maintains a consistent comparative advantage in either assessing method. Second, China exports more gross goods of electrical equipment to the world than South Korea does, but there is a trade deficit with Korea. Third, South Korea and P.R. China are the most significant bilateral partners of foreign value-added sourcing. Finally, it is surprising that there is a shock on electrical equipment; the partner's service, as well as manufacturing sectors, would be affected.

Originality/value – This paper explores the revealed comparative advantage between Korea and China from traditional gross export and value-added perspectives. Second, we apply the information from the 2019 MRIO database compiled by the Asian Development Bank in January 2021, reflecting the current situation. Third, this paper analyzes the electrical equipment and the impacts on other parties' sectors. Finally, we carry out the subjects that deserve to be investigated in the future.

Keywords: GVC, RCA, Competitiveness, Electrical Equipment
JEL Classifications: D12, F14, O53

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1. Introduction

China and Korea play an important role in international trade. In 2020, China was the largest merchandise exporter and the second-largest importer globally, while Korea ranked 7th and 9th, respectively. On the other hand, bilateral trade between the countries is critical. From 2015 to 2020, China has been Korea's largest partner, sharing more than 20% of Korea's trade volume. Korea was listed as the 1st and the 4th largest trade partner from 2015 to 2019 to China. The United States, Hong Kong, Japan, Chinese Taipei, India, and Vietnam are their mutual export destinations.

Meanwhile, in HS-2 digital code goods, 85 (electrical machinery and equipment and parts thereof, et al.), 84 (nuclear reactors, boilers, machinery, and mechanical appliances; parts thereof), 39 (plastics and articles thereof), 90(optical, photographic, cinematographic, et al.) and 73 (articles of iron or steel) list their top ten mutual export goods. Korea and China have a close bilateral relationship, and meanwhile, they compete in the international export markets. These have drawn lots of researchers' attention to analyzing them from different aspects. Export competitiveness is one of them.

This paper focuses on assessing China and Korea's competitiveness. Furthermore, it compares traditional RCA (TRCA, hereafter) based on gross export data and RCA based on domestic value-added data (NRCA). The available academic research shows that analyzing a sector's strength based on gross export data may lead to different results than value-added terms. The divergence is so significant that the trade policies based on TRCA could induce a result in the wrong direction. Accurate measuring has rapidly become a crucial subject area because trade policies are made by fully understanding their advantages and disadvantages. The TRCA approach is beginning to show its limitations, and hence there is an immediate need to measure the competitiveness in NRCA. We hope this work will lead to new insights into competitiveness between China and Korea.

The rest of the paper proceeds as follows: Section 2 presents a literature review. Section 3 discusses the TRCA and NRCA measurement and data set based on the ADB-MRIO (Asian Development Bank Multi-Region Input-Output) database, and Section 4 uses the NRCA and TRCA to perform factual exercises on China and Korea's sectors. Finally, in Section 5, we provide some concluding comments and suggestions.

2. Literature Review

Each country has its comparative advantage as initially suggested by Ricardo. It is defined by a country's ability to produce some good/service with higher productivity and higher product differentiation than other countries in each trade area. Except for the factor endorsements such as the level of natural conditions and human capital in each country, the RCA difference may also be caused by each government policy strategically focusing on exporting or importing sectors. Starting with the pioneering work of Balassa (1965), the standard method for measuring comparative advantages is the calculation of a Revealed Comparative Advantage (RCA) index based on gross trade flows.

Over the last two decades, GVCs' ascent has profoundly altered the structure of international trade, and their emergence necessitates new techniques to evaluate international trade competitiveness. Just as Johnson (2014) and others have put it, the final export's

documented value will include domestic and imported value-added.

Standard RCA applications will frequently overestimate or underestimate a country's comparative advantage since they are calculated in gross terms of trade flow.

Recognizing the problem with traditional trade statistics, some researchers expand their competitiveness assessment by taking the Global Value Chains (GVCs) into account and broadening the scope of assessing export in two key areas: gross exports and domestic value-added in its exports. A couple of current researches report value-added measures of RCA for several of the GVC industries analyzed below.

KPWW (2010) and KWW (2014) adopt the RCA method to TiVA data and measure domestic value-added instead of total exports. They discover significant discrepancies between the outcomes produced using these two methods. MP Timmer, Los, Stehrer and De Vries (2013) measure value-added RCA for the three GVC-manufacturing industries. The results show that gross exports overstate the competitiveness of economies that rely primarily on imported intermediates, and this overestimation has gotten worse over time. Escaith and Miroudot (2016) compute the discrepancies between the standard and value-added RCAs at the sector level for 61 nations using a similar technique, and their findings suggest that the disparities can be enormous for some countries. Janet Ceglowski (2017) assesses countries' export competitiveness in five industries. Many of the most competitive exporters have higher RCA in terms of domestic value-added than gross exports. Such disclosures have sparked a debate about including market accessibility, productivity performance, training, research levels, infrastructure, and regulatory settings into competitiveness measurements in the context of GVCs (Timmer et al. 2013)

We explicitly employ the literature mentioned above as a foundation for our work. However, this paper has extended previous work into several aspects: first, we use the latest input-output data compiled by the Asian Development Bank in 2021, which can reflect the current situation; second, the conceptual framework for the decomposition of the gross export proposed by Wang, Wei, and Zhu (2015 revision date February 2018) is applied to measure the RCA, which is more rigorous and accurate than the previous method; and finally, we explicitly explore the bilateral trade relationship as well as competitiveness between Korea and China from the perspective of value-added which expands the research on the trade-related issues between them.

3. Methodology and Employed Data

3.1. Methodology

3.1.1. GVC Framework

Unlike traditional conceptions of trading, which focus on transactions involving only two nations (an exporting and an importing country), GVCs comprise manufacturing processes that frequently cross borders numerous times and involve more than two countries.

Assuming there is a world with G nations producing products in N distinct tradable sectors. Each sector's commodities can be consumed directly or as intermediate inputs, and each country exports both intermediate and final goods to all other nations.

Table 1. The Structure of a Global Input-Output Table

			Use by Country-Industries							Final use by countries			Total
			Country1			…	Country G			Country1	…	CountryG	
			Industry1	…	IndustryN	…	Industry1	…	IndustryN				Use
Supply	Country1	Industry1											
		…											
		IndustryN											
from	…												
	CountryM	Industry1											
Country-		…											
		IndustryN											
Industries													
Value-Added by Labor and Capital													
Gross Output													

Source: Timmer et al. (2015).

A country's gross production must be employed as an intermediate or final good at home or abroad.

According to Wang, Wei, and Zhu (Nov. 2013, Revised Feb. 2018), we get the decomposition formula of Country s's gross exports to Country r as follows: Equation (1) shows that gross exports from Country s to Country r may be entirely decomposed into eight broad categories. The economic explanations are as follows:

$$
\begin{aligned}
E^{sr} &= \underbrace{(V^{s}B^{ss})^{r}\#Y^{sr}}_{(1)\text{-}DVA\_FIN} + \underbrace{(V^{s}L^{ss})^{r}\#(A^{sr}B^{rr}Y^{rr})}_{(2)\text{-}DVA\_INT} \\
&+ \underbrace{(V^{s}L^{ss})^{r}\#\left[A^{sr}\sum_{t\neq s,r}^{G}B^{rt}Y^{tr} + A^{sr}B^{rr}\sum_{t\neq s,r}^{G}Y^{rt} + A^{sr}\sum_{t\neq s,r}^{G}B^{rt}\sum_{t\neq s,r}^{G}Y^{tt}\right]}_{(3)\text{-}DVA\_INTmx} \\
&+ \underbrace{(V^{s}L^{ss})\#\left[A^{sr}B^{rr}Y^{rs} + A^{sr}\sum_{t\neq s,r}^{G}B^{rt}Y^{ts} + A^{sr}B^{rs}Y^{ss}\right]}_{(4)\text{-}RDV\_G} \\
&+ \underbrace{\left[(V^{s}L^{ss})\#A^{sr}B^{rs}\sum_{t\neq s,r}^{G}Y^{st} + (V^{s}L^{ss}\sum_{t\neq s,r}^{G}A^{st}B^{ts})^{r}\#(A^{sr}X^{sr})\right]}_{(5)\text{-}DDC} \\
&+ \underbrace{\left[(V^{r}B^{rs})\#Y^{sr} + (\sum_{t\neq s,r}^{G}V^{t}B^{ts})^{r}\#Y^{sr}\right]}_{(6)\text{-}FVA\_FIN} \\
&+ \underbrace{\left[(V^{r}B^{rs})^{r}\#(A^{sr}L^{rr}Y^{rr}) + (\sum_{t\neq s,r}^{G}V^{t}B^{ts})\#(A^{sr}L^{rr}Y^{rr})\right]}_{(7)\text{-}FVA\_INT} \\
&+ \underbrace{\left[(V^{r}B^{rs})\#(A^{sr}L^{rr}E^{sr}) + (\sum_{t\neq s,r}^{G}V^{t}B^{ts})\#(A^{sr}L^{rr}E^{sr})\right]}_{(8)\text{-}FDC}
\end{aligned}
\tag{1}
$$

The first item $(V^{s}B^{ss})^{r}\#Y^{sr}$ means value-added (DVA for short) embodied in final goods exports, which is labeled as *DVA_FIN* for short.

The second item $(V^{s}L^{ss})^{r}\#(A^{sr}B^{rr}Y^{rr})$ is DVA in intermediate exports utilized by direct importers (r) to generate locally consumed final goods, which is labeled as DVA_INT for

short.

The third item is DVA in intermediate exports utilized by the direct importer (r) to create exports eventually consumed by other nations, except for s, which is labeled as DVA_INTrex for short. There are three particularized terms: $(V^{s}L^{ss})^{r}\#\ A^{sr}\sum_{t\neq s,r}^{G}B^{rt}Y^{tt}$ is DVA in intermediate exports that Country r uses to make intermediates that it then re-exports to third Country t to make local final products; $(V^{s}L^{ss})^{r}\#\ A^{sr}B^{rr}\sum_{t\neq s,r}^{G}Y^{rt}$ is DVA in intermediate exports that Country r uses to make final goods that it then re-exports to third Country t; $(V^{s}L^{ss})^{r}\#\ A^{sr}\sum_{t\neq s,r}^{G}B^{rt}\sum_{t\neq s,r}^{G}Y^{tt}$ is DVA in intermediate exports utilized by Country r to build intermediates that it then re-exports to third Country t for manufacturing of final products exports that are exported to other nations (including the direct importer, Country r), except for Country s. The first three categories, which are value-added exports connected with gross export flows based on backward industrial linkages, are all DVA reflected in Country s's gross exports to Country r and eventually absorbed overseas. We refer to them as VAX_G.

The fourth type is DVA in intermediate exports that are returned to countries and used locally, which is labeled as RDV_G. There are also three specific terms: $(V^{s}L^{ss})\#\ A^{sr}B^{rr}Y^{rr}$ is the one which returns home via the direct importer r's final imports; $(V^{s}L^{ss})\#\ A^{sr}\sum_{t\neq s,r}^{G}B^{rt}Y^{tt}$ is DVA that comes back to home country via final imports from third nations; $(V^{s}L^{ss})\#\ A^{sr}B^{rt}Y^{ts}$ is DVA that comes back home via intermediate imports and is utilized to make domestic final products.

The first four categories are DVA contained in Country s's sector-level gross exports to Country r, which comprise value-added generated in all of Country s's sectors. For brevity, we call it DVA_G.

In the fifth category, the first one $(V^{s}L^{ss})\#A^{sr}B^{rs}\sum_{t\neq s,r}^{G}Y^{rt}$ is DVA embodied in its intermediate exports to Country r, which come back as intermediate imports and are utilized to produce its final exports. They are a subset of domestic double-counted terms resulting from back-and-forth intermediate goods trade to make final product exports in country s. The second term $(V^{s}L^{ss}\sum_{t\neq s,r}^{G}A^{st}B^{ts})^{r}\#(A^{sr}X^{rs})$ is DVA in intermediary exports to Country r that are returned as intermediate imports and utilized to produce its intermediate exports. We name the sum of these DDC.

There are two terms in the sixth category: $(V^{r}B^{rs})\#Y^{rr}$ is its importer's foreign value-added (FVA) embodied in final exports, and $(\sum_{t\neq s,r}^{G}V^{rt}B^{ts})^{r}\#Y^{rr}$ is foreign value-added from other Countries (t) displayed in final exports. These two we call them FVA_FIN.

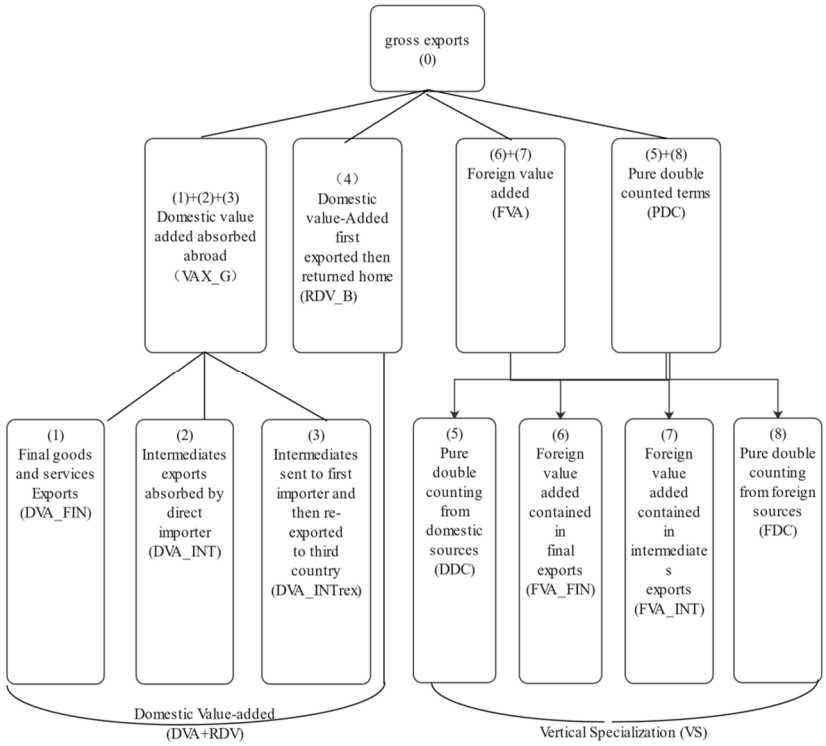
Two terms are included in the seventh category: the first one $(V^{r}B^{rs})^{r}\#(A^{sr}L^{rr}Y^{rr})$ is foreign value-added contained in intermediate exports from the importer (r), which are subsequently utilized by r to generate its domestic final goods. The second term $(\sum_{t\neq s,r}^{G}V^{rt}B^{ts})\#(A^{sr}L^{rr}Y^{rr})$ is foreign value-added from the third Country t included in intermediate exports, which are used later by Country r to make local final goods. We call them FVA_INT.

The sum of the sixth and seventh is the total foreign value-added in Country s's sector level gross exports to Country r, called FVA.

The last category includes double-counted terms in country s's gross exports stemming from other countries. The first part $(V^r B^n)\#(A^{rr} L^{rr} E^{rt})$ and the second part $(\sum_{(s),r}^{G} V^s B^n)\#(A^{rr} L^{rr} E^{rt})$ is FVA from importer r and the third Country t embodied in intermediate exports to make its exports to the rest of the world. We call them FDC for short.

The 16 comprehensive terms in the eight categories outlined above break down bilateral gross exports from Country s to Country r into various value-added and double-counted components, and the total summation equals 100% of bilateral trade flows at the sector level. Fig. 1 depicts the disaggregated accounting system generated by equation (1).

Fig. 1. Conceptual framework for gross trade accounting of Wang, Wei, and Zhu (2018). The gross export can be measured at the country-sector, country aggregate, bilateral-sector, or bilateral aggregate level.



Source: Author's Drawing, Based on Wang et al., (2018)

3.1.2. Revealed Comparative Advantage

This paper expands the competitiveness analysis in two dimensions: gross export-based indices and their domestic value-added in export transformations.

The RCA index is widely used in international economics for identifying the weak or strong export sectors of a country/region in a particular class of goods or services. Liesner (1958) first introduced this notion, and Balassa (1965) operationalized it later. The original RCA

(TRCA) index is measured by the ratio of the share of exports of product j in a country's total exports to the share of exports of product j in total world exports, that is in equation (2):

$$\mathrm{TRCA}_{ij} = \frac{X_{ij} / X_i}{X_{wj} / X_w} \tag{2}$$

Where X_{ij} denotes country's exports of product j, X_i denotes country's total exports of product, X_{wj} denotes world exports of product, and X_w implies total exports. When an index value exceeds unity, comparative advantage is revealed, indicating that its share of product j in its total exports overtakes the product's share j in world exports. A value below unity shows an observed comparative disadvantage in that product.

$$\mathrm{NRCA}_{ij} = \frac{DX_{ij} / DX_i}{DX_{wj} / DX_w} \tag{3}$$

Equation (3) illustrates when it comes to value-added term, where DX_i denotes country's domestic value-add exports of product j, DX_{wj} denotes world's total domestic value-add exports j. DX_i is country i's total domestic value-added export, DX_w is the world entire domestic value-added export. VAX_G represents the DX when calculating the NRCA. RDV_B is excluded from NRCA calculating since it is returned and absorbed at domestic finally.

3.2. Data Description

Significant advances in handling inter-country input-output tables have recently opened new options for the empirical study of global value chains. The availability of datasets that break down trade according to the source of its value-added allows for the investigation of GVC trends by nations and sectors at a degree of precision that was previously unthinkable. The UNCTAD-Eora GVC database, the World Input-Output Database (WIOD), and the OECD's Trade-in Value-added Database (TiVA) are major cross-regional value-added trade datasets. The Asian Development Bank's Asian Multi-Region Input-Output Database (ADB-MRIO) and the Economic Commission for Latin America and the Caribbean's South American (ECLAC) Input-Output Table are two major regional endeavors. Table 2 summarizes and compares the various and continuing attempts for mapping GVCs.

The Asian Development Bank (ADB) has increased the World Input-Output Tables (Timmer et al., 2015) to facilitate analysis work concerning the production and analysis of global value chain-related statistics for 25 Asian economies. It provides a 35-sector breakdown for each economy. There are advantages to the use of this database when Asian countries are put into analysis. We then use the Stata command of “ICIO” composed by Belott, Borin, and Mancini (2021) to calculate the results.

4. Stylized Fact

4.1. Overview of NRCA and TRCA

We have 63 countries/regions and 35 sectors in 2019; the total number of observations is 2205. Table 3 summarizes gross export RCA (TRCA) and value-added RCA (NRCA).

Table 2. The mapping of GVC (as of Feb. 2022)

Project	Institution	Data sources	Countries	Industries	Years
UNCTAD-EORA GVC Database	UNCTAD/ Eora	National Supply-Use and I-O tables, and I-O tables from EUROSTA,IDE-JETRO and OECD	189 countries and a "Rest of World" region	26-500 depending on the country	1990-2018
Trade in Value-added (TiVA) dataset	OECD	National I-O tables	66	45	1995 - 2018
World Input-Output Database (WIOD) : 2016 Release	Consortium of 11 institutions, EU funded	National Supply-Use tables	43	56	2000–2014
Other multi-region input-output databases					
EXIOBASE3	EU-based consortium	National supply-use tables	44	200	1995-2011
ADB Multi-Region Input-Output Database (ADB MRIO)	Asian Development Bank	An extension of WIOD which includes 19 additional Asian economies	62	35	2007-2020
Global Trade Analysis Project (GTAP) 10	Purdue University	Contributions from individual researchers and organizations	121countries plus 20 regions	65	2004, 2007, 2011, 2014
South American Input-Output table	ECLAC	National I-O tables	12	40	2005

Table 3. TRCA and NRCA summary statistics 2019

		Mean	Std.dev.	Min	Max	RCA>=0.8 (%)
World	TRCA	1.27	3.21	0	69.5	40.95%
	NRCA	1.10	1.68	0	33.74	46.80%
Korea	TRCA	0.63	0.72	0	2.87	25.71%
	NRCA	0.92	0.72	0	3.57	45.87%
China P. R.	TRCA	0.80	0.87	0	3.28	34.29%
	NRCA	0.10	0.64	0	2.89	57.14%

Source: author's calculation, Asian Development Bank- MRIO, 2021.

Table 3 summarizes NRCA and TRCA and the percentage above 0.8, which shows the share of sectors with certain revealed advantages. We can see the differences between TRCA and NRCA: For Korea, all the figures increase except for the Std.dev. and the Min; this means TRCA underestimates the revealed comparative advantage. However, dissimilarities exist in the world and China: all the indices shrink except for RCA>=0.8, which means TRCA overestimates the world's comparative advantage and China. The standard deviation measures the amount of variation or dispersion of a set of values. The lower it is, the closer the values tend to be to the expected value, and a higher standard deviation means the values are scattered over a broader range. Judging by this index, it may be concluded that NRCA is a much better criterion for assessing the competitiveness of TRCA, at least not inferior to TRCA.

Moreover, this fact is supported by the findings of previous work made by Aleksandra and Magdalena (2018). A possible reason is that globalization is more intricate in value-added terms than in gross export terms. In any case, Korea performs better than China in NRCA, which changes the TRCA result, except for the minimum and percentage accounting of RCA>=0.8. Regarding the number that RCA>=0.8, China is higher than Korea in both RCA conditions.

Furthermore, the figure was increased by 11.27% in NRCA from 8.58% in TRCA. The Sector of Coke, refined petroleum, nuclear fuel, and the electrical and optical equipment sector are the maximum competitiveness in TRCA, while the Sector of Textiles and textile products keeps the most competitive exports either in TRCA or NRCA for China. Lao's Electricity, gas, and water supply Sector and Maldives' Hotels and restaurants sector rank the first among TRCA and NRCA, respectively. The RCA of natural resource or travel-concerning sector is much higher than manufactural sectors.

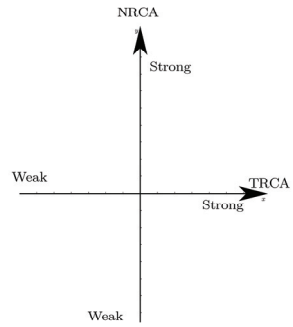
4.2. Overview of Revealed Strong and Revealed Weak Sectors

RCA indices illustrate which sectors are relatively strong (RCA>=0.8) or relatively weak (RCA<0.8). Thanks to the new methods and more detailed trade data, one can calculate the country's revealed comparative advantages based on value-added trade flow, which change the assessment process judging by gross trade flow for many years. A vital question arises just like the above analysis: Those dissimilarities or even distinct differences would be in TRCA and NRCA conclusions. Following the analytical framework of Brakman and Van (2017), we also made four possible sector classifications, depicted in Fig. 1. We call the upper right quadrant a strong-strong region, containing sectors with a comparative advantage for both TRCA and NRCA. We call the lower left quadrant a weak-weak region, revealing a comparative disadvantage for TRCA and NRCA. Things would be easy if only these two situations existed. However, there are two other possible phenomena: one is a country or sector that may have a comparative disadvantage for TRCA and a comparative advantage for NRCA, and vice versa. We call these two cases weak-strong and strong-weak regions respectively. These two parts deserve our particular attention since they convey different information.

Table 4 shows the TRCA and NRCA overview for the world, Korea, and China. Columns (a) to (d) list the first to the fourth quadrant regions. We call NRCA to confirm the sectors in the upper-right and lower-left quadrant "Total Confirmed (e)" for the results of RCA calculated by TRCA. Furthermore, we call the discrepancy between “Total TRCA Strong” and “Total NRCA Strong” Strong Changed. 799 sectors fall in the Strong-Strong region, the

number of Total TRCA Strong is 903. For Korea, all Strong-Strong sectors identified by TRCA are confirmed Strong sectors using NRCA, while in China, 11 out of 12 are confirmed.

Fig. 1. The four regions of NRCA and TRCA



Column (b) is the Weak-Weak region. There are 18 sectors in Korea and 9 sectors in China. Column (c) is the Weak-Strong region. When we analyze Column (b) together with column (c), we can see that for Korea, 18 of 26 sectors identified by TRCA are confirmed weak sectors using NRCA; the share is 69%, while for China, on the other hand, only 9 of 23 are confirmed; the share is 39%, smaller than 69%.

Table 4. Overview of the Sector Classification for World, Korea, and China, 2019

TRCA NRCA	Strong Strong	Weak Weak	Weak Strong	Strong Weak	Total Confirmed	Total TRCA Strong	Total NRCA Strong	Strong Changed
Country	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
World Total	799	1069	233	104	1868	903	1032	+129
Korea	9	18	8	0	27	9	17	+8
China	11	9	14	1	20	12	25	+13
Mean	12	17	4	2	30	14	16	2

Source: author's calculation, Asian Development Bank- MRIO, 2021.

Column (d) makes the opposite switch from Column (c). Korea has no reversal while China has one sector from the weak sector identified by TRCA turned out to be a strong sector measured by NRCA.

The last three columns illustrate the number of strong sectors identified by TRCA (Column (f)), the sum of Columns (a) and (d)), the number of strong sectors identified by NRCA (Column (g), the sum of Columns (a) and (c))) and the difference between them (Column (h)).

4.3. Specific Sectors of Strong and Weak

Accounting to the above discussion, we know that discrepancies exist in the results measured by TRCA and NRCA, and here we make the detailed analysis following the framework of Table 4 for Korea and China.

Table 5. Specific Sectors of Strong and Weak for Korea and China

TRCA NRCA	Strong Strong	Weak Weak	Weak Strong	Strong Weak
Korea	8,9,12-15,21,24,29	1-3,5-7,11,16,18-20,23,27,28,32,35	4,10,17,22,25,26,33,34	——
China	4-6,10-14,16,20,21	2,7,15,19,25-27,30-33,35	1,3,8,9,17,24,28,29,34	18
Overlap Sectors	12,13,14,21	2,7,19,23,27,30,31,32,35	17,34	——

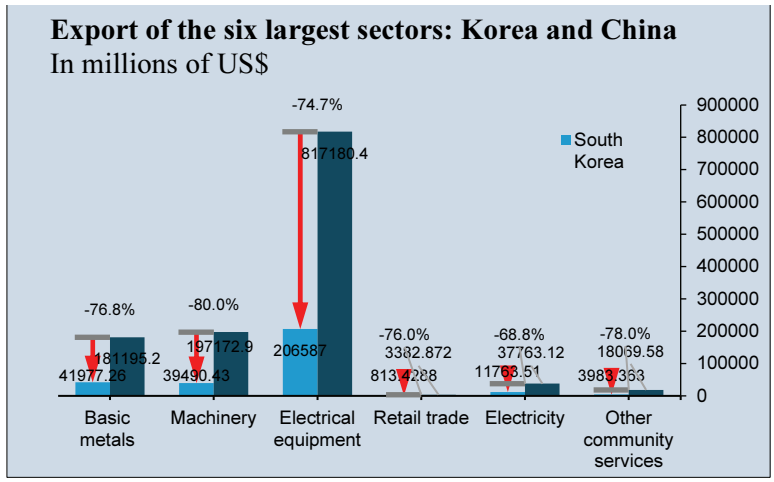
Source: Author's Calculation, Asian Development Bank- MRIO, 2021.

Table 5 summarizes specific sectors of strong and weak for Korea and China. For Korea, there are 9 sectors identified as Strong-Strong, namely Coke, Chemicals and chemical products, Basic metals, Machinery, Electrical and optical equipment, Transport equipment, Retail trade, Water transport, Real estate activities. There are 18 sectors identified as Weak-Weak, namely Agriculture, Mining, Food, Leather, Wood, Pulp, Other nonmetallic minerals, Manufacturing, Construction, Sale, Wholesale trade, Inland transport, Post and telecommunications, Financial intermediation, Education, Private households with employed persons. The Weak- Strong quadrant draws our attention. The sector includes Textiles products, Rubber and plastics, Electricity, gas, and water supply, Hotels and restaurants, Air transport, Activities of travel agencies, Health and social work, and Other community, social, and personal services. There are similar results in the former three quadrants except for the last one. We notice that most sectors identified as weak TRCA and strong NRCA are characterized as trade in services. Compared to TRCA, trade in services is apt to get the opposite results measured by NRCA. A possible reason is that the export of trade in services includes more domestic value-added than tangible goods trade. For China, Construction is a Strong-Weak reversal sector. That means the Construction sector is not as strong as it seems.

4.4. Detailed Analysis on the Electrical Equipment Sector

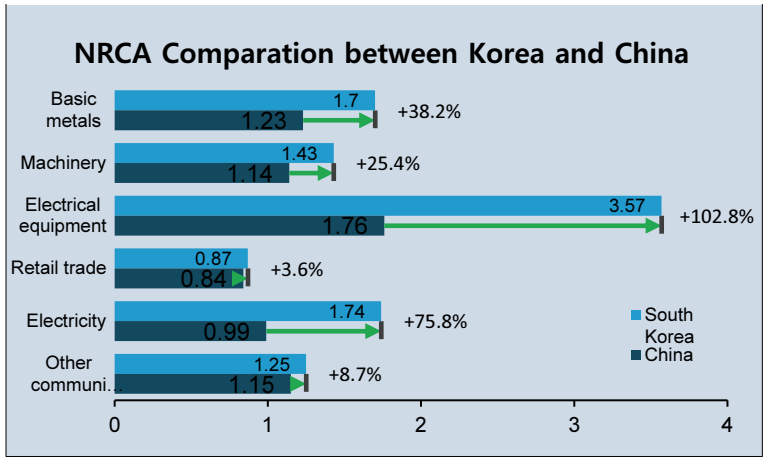
Korea and China are close neighbors with a good relationship. On the other hand, there are competitors in export markets. We get the overlap regions that fell on the same quadrant. We are interested in the Strong parts measured by NRCA. NRCA's six sectors are strong both for Korea and China, namely Basic and fabricated metal, Machinery, Electrical and optical equipment, Retail trade, Electricity, and other community, social, and personal services. Figure 2 shows the export of six sectors of Korea and China. We can see that the relative export value difference ranges from about 70% to 80%. Electrical equipment is the most important sector for both countries in absolute export value. In 2019, Korea and China exported 206587 and 817180.4 million US$ respectively.

Fig. 2. Export of the Six Largest Sectors: Korea and China, 2019



Source: author's calculation, Asian Development Bank- MRIO, 2021.

Fig. 3. NRCA Comparation between Korea and China, 2019



Source: Asian Development Bank- MRIO, 2021.

Fig. 3 illustrates the NRCA of Korea and China. All of Korea's NRCA is more prominent than China's. The gaps range from a minimum of 3.6% to a maximum of 102.8%, and the Electrical equipment is at the top. When we compare it with Figure 2, the most critical information is highlighted: Electrical equipment characterizes an enormous trade volume for both countries, and the gaps between trade volume and NRCA are the largest among the six sectors. Thus, we draw our exceptional attention to the Electrical equipment sector and analyze it from the lens of value-added.

Fig. 4 provides an overview of Korea and China's top 5 export markets of Electrical equipment. One can see that Korea and China are the other's important export markets. China is the largest importer of Korea, and Korea is the fourth largest partner for China. Among the top 5 countries, the United States and Japan are their mutual export markets. Table 6 provides us with the intriguing findings, which Electrical equipment is a highly intra-industry trade sector between the two countries, and they compete in the market of the United States and Japan. We further analyze their bilateral trade relationship from the global value chain perspective.

Table 6. Gross Export of Electrical Equipment from Korea and China, 2019

Exporter	Korea (billions of US$)		P.R. China (billions of US$)	
Importer	China	84.88	United States	198.33
	United States	25.30	Japan	66.77
	Vietnam	13.02	Germany	42.77
	Mexico	9.32	Republic of Korea	31.52
	Japan	9.01	Netherlands	27.98

Source: Author's Calculation, Asian Development Bank- MRIO, 2021.

Table 7 illustrates the decomposition of gross exports of electrical equipment. From Figure 2, we know that China exports more to the world than Korea, but from Table 6 we can see that China exports less to Korea than Korea does to China. Korea exports nearly three times larger than China and reaches 84.88 billion US dollars.

Table 7. Decomposition of Gross Exports of Electrical Equipment

	China exports to Korea		Korea exports to China	
	billions of $	% of export	billions of $	% of export
Gross Exports	31.52	100.00	84.88	100
Domestic Content	25.67	81.44	60.46	71.23
Domestic Value-Added	25.31	80.28	60.00	70.69
VAX -> DVA Absorbed Abroad	21.65	68.68	59.66	70.29
DAVAX	13.82	43.84	47.49	55.94
Reflection	3.66	11.60	0.34	0.4
Domestic Double Counting	0.37	1.16	0.46	0.54
Foreign Content	5.85	18.56	24.42	28.77
Foreign Value-Added	5.79	18.35	24.21	28.52
Foreign Double Counting	0.065	0.21	0.21	0.24

Note: DAVAX: Value-Added directly absorbed by the importer.
Source: Author's Calculation, Asian Development Bank- MRIO, 2021

All of Korea's absolute figure values are more extensive than China's. But we can get information from the relative figure values from individual part's percentage of export. As far as the Domestic content is concerned, we can see the portions of DVA absorbed abroad are nearly the same, but the DAVAX, which is the Value-Added directly absorbed by the importer, China is less than Korea. China's Reflection is much higher than Korea's. This information shows that China imports some Electrical equipment formerly exported to Korea and then processed by Korea. That means in the global value chain of Electrical

equipment, some kinds of production links must be handled in Korea before China can deal with it further. In contrast, Korea depends less on China in this chain. This observation shows that Korea's exports to China are still characterized by processing trade-oriented.

Table 8 illustrates the sources of Foreign Value-added (FVA) in the total export of Electrical equipment for Korea and China in 2019.

Table 8. Sources of FVA in the Total Export of Electrical Equipment, 2019

Korea			P.R. China		
Sources	**billions of US$**	**% of export**	**Sources**	**billions of US$**	**% of export**
P.R. China	15.97	7.73	Korea	16.98	2.08
Japan	10.47	3.72	Chinese Taipei	15.34	1.88
United States	5.30	2.57	Japan	14.30	1.75
Chinese Taipei	2.55	1.24	United States	10.76	1.32
Germany	2.13	1.03	Germany	6.29	0.77
…	…	…	…	…	…
Total	58.93	28.52	Total	149.97	18.35

Source: Author's Calculation, Asian Development Bank- MRIO, 2021.

From Table 8, we can draw the following conclusions. 1) Korea and P.R. China are the most significant FVA providers for each other; 2) Japan, Chinese Taipei, the United States, and Germany are all essential FVA sources for both, although their positions are different; 3) Korea has a lower absolute FVA, however, a much higher percentage share compared with China.

The above table shows that all of China's absolute figures are more considerable than Korea's, but export shares are the opposite. The FVA accounting for Korea's export is 10% larger than China's, ranging from 28.52% of Korea to 18.35% of China. Judging by individual countries, 7.73% from China goes on first, two times larger than Japan, followed by the United States, Chinese Taipei, and Germany. China's maximum is from Korea, but the share does not exceed 3% of its total exports. Germany is the fifth largest country, accounting for 0.77%, less than one percent.

The current industry product is characterized by fragmentation production located in different regions involving the value produced by other countries or sectors. A shock exerted on the industry may influence the others. The closer the relationship, the more substantial influence would be. We want to know to what extent Korea (China) would be exposed to a shock in China's (Korea's) exports in the Electrical equipment sector, and how these results will affect other sectors.

Table 9 illustrates the influence of VA exposed to a shock on the other's exports to the world in the Electrical equipment sector.

To both countries, The Electrical Equipment sector is the largest sector for Korea and China that would be affected, and Korea would suffer more than China. Furthermore, the manufacturing and the trade-in service sectors would be affected. The wholesale trade sector is the second-largest sector for China and the fifth-largest sector for Korea would be affected. Three services sectors in Korea and two services sectors in China mean that Korea's service

sectors are much more actively involved in China's Electrical equipment export. And broadly speaking, this demonstrated the consistency with the previous studies such as Jingxia, S. (2014), which argued that services sectors could not be overlooked in the negotiations of free trade agreements given the ever-increasing significance of services liberalization, both in global and in regional trade.

Table 9. Sectors Exposed to a Shock on the Other's Electrical Equipment Exports

Korea		P.R. China	
Sectors	**Value (Billion US $)**	**Sectors**	**Value (Billion US $)**
Electrical Equipment	7.28	Electrical Equipment	3.32
Chemicals Products	1.39	Wholesale Trade	1.35
Retail Trade	1.07	Financial Intermediation	1.34
Renting of M&Eq	1.07	Mining and Quarrying	1.24
Wholesale Trade	0.96	Basic Metals	1.20

Source: Author's Calculation, Asian Development Bank- MRIO, 2021.

5. Conclusion and Implications

The traditional RCA index based on gross export values has been widely utilized to determine the export potential of different nations in various goods. However, the index has been exposed to several critiques, and its suitability for cross-country or sector comparisons has been called into doubt. Using the 2019 MRIO data compiled by ADB in January 2021, this paper compares the traditional TRCA in gross export terms and NRCA in value-added terms between Korea and China. We've shown how the decomposition results can be used to recalculate the RCA index at the country/sector level. The results show that, since the foreign value-added is excluded from the gross export, the distributions of RCA calculated with gross exports and value-added data are indeed significantly different from each other, but there are still several relatively strong sectors that revealed comparative advantages in either of assessing method for both countries. The Electrical equipment sector is one of them.

With the decomposition of gross exports of Electrical equipment, we know in the global value chain of Electrical equipment, production procedure must be processed in Korea before China can deal with it further. In contrast, Korea depends less on China. Moreover, on the other hand, Korea and China are the most significant FVA providers for each other. Japan, Chinese Taipei, the United States, and Germany are the essential FVA sources for both. Meanwhile, if a shock exerts on one's Electrical equipment sector export, the other's manufacturing and the trade-in services department will be affected, and Korea's service sectors are much more deeply involved in this.

The implications are also prominent. First, Korea and China's important export markets are concentrated in several countries, which means they will compete, and if something is wrong with these concentrated export markets, it will bring severe effects to Korea and China, so making decentralized markets is vital to avoid the risk. Second, we notice that the United States plays an essential role in foreign value-added in China's Electrical equipment export from the lens of value-added. Considering the current bilateral relationship between China and United States, China should consider how to deal with the foreign value-added in case bilateral trade relationships get from bad to worse. Korea is particularly vulnerable to the trade conflict between the two economic giants because the United States and China are its

two largest trading partners (Jin, 2019). Third, the manufacturing sectors and the trade in services are deeply interactive with each other. The former's development induces the relative demand for service trade, and the latter promotes sustainable development by providing support, reducing cost, and stipulating the competition to the former in return.

The ASEAN's ten members and its five "Dialogue Partners" inked the Regional Comprehensive Economic Partnership (RCEP) on November 15, 2020. It covers a market of 2.2 billion people with a combined size of US$ 26.2 trillion or 29 percent of the world's GDP, which is more significant than both the US-Mexico-Canada Agreement (USMCA) and the European Union. The researchers made analyses on the FTA effect on Korea and China. As Kim and Shikher (2015) argued that the Korea-China FTA will increase Korea-China manufacturing trade by 56%, manufacturing employment in Korea by 5.7% and China by 0.55%.

On the other hand, Japan is a mutually important trading partner for Korea and China. Following the RCEP, China and Japan have established bilateral free trade ties for the first time. In the situation that GVC's are expanded, we examine the effects it will bring to these three countries in a further in-depth analysis.

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