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Re-Evaluation of Free Trade Agreement: Changes in Global Value Chain and Regional Value Contents*

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Abstract

Purpose – The purpose of this study is to evaluate the economic effects of FTAs using the concept of value-added exports. So far, the economic effects of FTAs have been dependent on decrease in import prices due to tariff cuts in importing countries, but the actual tariff reduction need to consider the value added of the exporting countries.

Design/methodology – Value-added export refers to the added value created in the exporting country out of total exports. Among value-added exports, direct value-added export is interpreted as the Regional Value Contents (RVC), from which the economic effect of the FTA can be analyzed. A modified GTAP-VA model takes into account RVC in order to estimate accurate effects of FTAs.

Findings – By the re-evaluation of the FTA based on the RVC, this paper makes it clear that the economic effects of the existing FTA methodology have the possibility of overestimation. In addition, as a new FTA with a strengthened Rules of Origin (ROO) is being initiated, a negative impact on international trade and GVC utilization may occur.

Originality/value – This study introduces the concept of value-added export in analyzing the effects of FTAs. The new analysis methodology of this paper emphasizes the importance of value-added exports. Re-organization of GVCs would change regional trade agreements and empower ROO by weakening existing GVCs and transforming the value chain from global into regional scope.

Keywords: CGE, Free Trade Agreement, Regional Value Contents, Rules of Origin, Value Added Export

JEL Classifications: F12, F14

1. Introduction

As a high-ranking country in terms of FTAs, Korea notified the WTO of its entry into FTAs with 20 countries (as of November 11, 2021). This makes Korea 8th in the world in terms of the number of FTAs (WTO, 2021). Korea has concluded FTAs with major trading partners including the US, EU, and China, and it is currently in the stage of signing mega FTAs. The RCEP(Regional Comprehensive Economic Partnership) is expected to enter into force in early 2022, and the Korean government is actively considering joining the CPTPP(Com-

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prehensive and Progressive agreement of Tans-Pacific Partnership). The economic effects of FTAs have been analyzed for years, and Korean national research institutes have long been estimating the effects of FTAs through preliminary assessments and the establishment of domestic support program. Specifically, through the preliminary impact assessment of the Korea-US FTA and the Korea-EU FTA, it was estimated that trade would increase by up to 14% (Bae, et al., 2016, 2018).

Nevertheless, it seems that the FTAs signed by Korea have yet to be fully utilized. The Korea Customs Service (2021) announced that Korea had an average FTA export utilization rate at an average of 74% in 2020, along with relatively high-level agreements with Canada (95.4%), the EU (87.10%), and the United States (84.4%), as well as agreements with low FTA utilization rates such as New Zealand (42.8%), Vietnam (44.5%), ASEAN (54.1%), and China (64.9%). By industry, the utilization rate of machinery (85.4%) was high, but the export utilization rates of miscellaneous products (46.7%), textiles (50.3%), and agricultural, and forestry and fishery products (64.6%) were below average.

The low utilization of FTAs is largely due to the role of Rules of Origin. Estevadeordal & Suominen (2004) is a representative study that introduced and empirically analyzed the concept of the strictness index of the rules of origin, and it explained that the strictness of the rules of origin is a major factor hindering free trade. Kala (2005) found that the more stringent the rules of origin, the higher the production cost, which reduces consumer surplus. More difficult rules of origin consequently result in lower FTA utilization rates (Mitsuyo and Shujiro, 2018). Further, a number of researchers have shown that rules of origin play a major role in increasing trade costs in FTAs (Koskinen, 1983; Hayakawa, 2011; Carrière and de Melo, 2004; Cadot et al., 2005).

The rule of origin was introduced as a measure to prevent trade deflection from non-FTA countries, and it is premised on the assumption that value-added occurs in a exporting country over a certain level. Specifically, there are various standards, such as changes in tariff item number, the occurrence of specific process, regional value contents, etc., but the common point is that the value added of the FTA country should be considered. If an FTA has been concluded but the actual value added generated within that country is low, it is highly likely that the rules of origin cannot be met, which will lead to non-fulfillment of the FTA.

Another point to note is that the change in the global value chain will lead to strengthened regional value standards. The United States withdrew from the NAFTA agreement and entered into the new USMCA agreement in July 2020. The biggest issue is that by strengthening the rules of origin in the region related to automobiles and parts, it is intended to create value added in the region as well as minimize the use of foreign intermediate materials. This has the same meaning as near shoring, which has been newly proposed along with the crisis of the existing global supply chain system during COVID-19.

Making an assessment based on domestic added value allows for the impact of the FTA to be properly evaluated, and it is expected to affect future exports according to changes in the global value chain. In this study, in contrast to the existing methods used to evaluate the impact of FTAs, a new FTA analysis methodology is developed that considers the value added that has been generated in the region, and the differences between this method and the existing methods will be highlighted. In addition, the effect of strengthening RVC(Regional Value Contents) on the economic effect of FTA is estimated by assuming a scenario of strengthening FTA rules of origin according to the changes in the existing global supply chain.

2. Literature Review

2.1. Impact Analysis of FTA

There is no consensus methodology for analyzing the impact of FTA. However, the economic effects of trade liberalization can be summarized as (i) tariff reduction, (ii) markdown, (iii) trade creation, and (iv) production expansion (Hertel et al., 2001; Kawasaki, 2003; Calvo Pardo et al., 2009; Plumer et al., 2011). In recent studies, although the scope of research has extended from the effect of Foreign Direct Investment (FDI) to spillover (Thangavelu and Findlay, 2011; Thangavelu and Narjoko, 2014; Duong et al., 2020), the effect of trade liberalization on trade of goods has mainly been examined in terms of tariff reduction.

The most direct effect of the FTA is the trade impact according to tariff liberalization (Haveman and Thursby, 1999; Harwit, 2001; Rena, 2011). Tariff cuts reduce the price of export products, and they in turn increase the demand for those products. The CGE (Computable General Equilibrium) model is widely used to analyze the explained impact of FTA (Cheong, 2005; Ando and Urata, 2007; Kitwiwattanacha et al., 2010). Econometric models are also used to analyze the effect of a specific industry or product (Francois et al., 2005; Urata and Okabe, 2010; Kahouli and Makouf, 2015).

The econometric method typically estimates the price elasticity of imports by HS code, and the elasticity calculates the volume of trade creation or diversion depending on the markdown (Plumer et al., 2011; Sato, 2017). The trade creation results from an increase in demand while the diversion is caused by replacing the origin through efficiency variation (Kahouli and Maktouf, 2015).

Another impact of a FTA is that it increases productivity according to changes in the industrial structure (Badinger, 2008; Lileva, 2008; De Loecker and Van Biesbroeck, 2016; Jongwanich and Kohpaiboon, 2020). Through a FTA, regional trade growth and investment can be simultaneously increased, and the increase in foreign direct investment (FDI) in turn increases the productivity of domestic manufacturing. Increasing productivity improves the competitiveness in an economy, which can also lead to an increase in exports to member countries as well as the rest of the world.

2.2. Korea's FTA Impact Assessment Model and Problems

Korea's FTA impact assessments are conducted by a relevant research institute for each industry. Each research institute uses its own analysis methods and models because each analysis model has its own strengths and weaknesses and in response to the need to ensure the independence of the research. KIEP (Korea Institute for International Economic Policy), KIET (Korea Institute for Industrial Economics & Trade), KREI (Korea Rural Economic Institute), and KMI (Korea Maritime Institute) assess the impact of FTAs using CGE (Computable General Equilibrium), PEM (Partial Equilibrium), KASMO (Korea Agricultural Simulation Model), and EDM (Equilibrium Displacement Model), respectively (Han et al., 2015a). These models have differences between static analysis and dynamic analysis, differences in the precision of the equations used, and differences between micro-analysis and macro-analysis. These differences affect the accuracy of the analysis results. The reason why the analysis models for each institute are different is mainly because of the characteristics of the products to be analyzed and the availability of data. KIEP and KIET mainly analyze industrial products, while KREI and KMI analyze agricultural products and marine products,

respectively. In the case of KREI-KASMO, the direct and indirect impact of changes in imports of certain items under FTAs on the supply and demand of other items is analyzed using price elasticity values and substitution elasticity values for each item. However, there is a limitation in that inter-industry labor and capital movement were not reflected because the macro-level impact was not designed.

According to Article 9 of "the Trade Treaty Enforcement Procedure and Implementation Act", the economic feasibility of the trade treaty must be analyzed and reviewed prior to the initiation of trade negotiations. In addition, in accordance with Article 11 of the same Act, the impact of the trade treaty on domestic related industries must be evaluated after agreement with the negotiating partner. For trade treaties that have been in force for less than 10 years, the implementation status, including the economic effects as well as the effects and improvement plan of domestic measures for the damaged industries, should be evaluated. Therefore, economic impact assessments must be made before and after establishing trade treaties such as FTAs.

The pre-impact assessment is the basis for judging the economic feasibility of the FTA, as well as the basis for determining the amount of financial input necessary to promote domestic support measures for industries that are expected to be damaged by the implementation of the FTA. For example, the Korea-U.S. FTA was expected to damage agriculture and fisheries, so in June 2007, the "Domestic Support Measures for the Korea-U.S. FTA" was established, and KRW 20.4 trillion was invested over the subsequent 10 years (2008-2017) to improve the structure of agriculture and strengthen competitiveness (Jeong et al., 2013).

In the pre- and post-impact assessment, the effects of FTA in various fields such as export and import, investment, welfare, production, employment, and service trade are estimated. For example, Table 1 lists the effects of exports and imports in the fifth years of the Korea-US FTA and the Korea-EU FTA. The growth rates of exports and imports according to the FTA effect are estimated by sector, and the scales of export and import growth are accordingly converted. In the fifth year of the Korea-US FTA, it was estimated that the total exports increased by about $3,162-6,629 million annually due to the FTA effect. In the fifth year of the Korea-EU FTA, it was estimated that total exports increased by an annual average of $2,721 million.

Table 1. The effects of exports and imports in the fifth year of the Korea-US FTA and Korea-EU FTA (Estimated).

		Growth amount (Million $)			Annual Growth rate (%)		
		Agriculture Fisheries	Mining	Manufacturing	Agriculture Fisheries	Mining	Manufacturing
Korea-US	Export	87.9-90.2	2.3	3,070- 6,539	19.6-20.1	112.9	6.5-13.9
	Import	643-647	-	1,400- 2,012	11.4	-	4.5-6.4
Korea-EU	Export	99.4	0.1	2,622	67.1	0.5	5.1
	Import	909	4.7	3,729	55	4.3	11.5

Note: The "Increase rate" is based on the average annual import amount to the United States before the FTA enters into force (2007-2011), and the "Increase amount" is the value obtained by converting the growth rate into an amount. The year of implementation of the Korea-EU FTA means from July of each year to June of the following year.

Source: Bae et al. (2016, 2018).

However, the FTA effect is overestimated by various causes, because all the effects of tariff reduction resulting from the implementation of the FTA are applied to the analysis model. Even for items with reduced tariffs, exports or imports may not increase due to non-tariff factors. In particular, if the rules of origin are not satisfied, the benefits of tariff reduction of the FTA cannot be obtained by exporters.

When comparing the estimated FTA export effect of agricultural products (including livestock and forestry products) with the actual annual average growth rate of agricultural exports, the FTA effect was overestimated. According to the post-impact assessment of the fifth year of the Korea-US FTA, the FTA export effect of agricultural products was estimated to increase by 19.6-20.1% annually; however, in reality, the exports of agricultural products to the U.S. only increased 13.0% annually compared to the rate before the FTA's establishment. The gap between the 2012-2020 average export value and the post-impact assessment results is widened. This is because of the limitations of the post-impact assessment, which assumes that all tariff reductions due to the FTA will be reflected in trade. In other words, in actual trade, various macro-environmental change factors, including rules of origin, have an impact in addition to tariff factors. In the fifth year of the Korea-US FTA, the utilization rate of preferential tariffs when exporting Korean agricultural products to the United States was only 48.7% (Ji, 2017).

In case of the EU's post-impact assessment, the annual average growth rate of agricultural exports after FTA was 67.1%, but actual exports of agricultural products to the EU increased only 5.1% annually compared to before the FTA entered into force. In the 10th year of the Korea-EU FTA, the utilization rate of preferential tariffs when exporting Korean agricultural products to the EU was still only 63.9% (Kim, 2021).

Table 2. The average annual growth rate of agricultural exports and imports after the Korea-U.S. and Korea-EU FTA entered into force. (Unit: million $, %)

		Before	After		Annual growth rate	
Korea-US		2007-2011(A)	2020(B)	2012-2020(C)	B/A	C/A
FTA	Export	402	1,206	731	13.0	6.9
	Import	5,936	8,860	7,701	4.6	2.9
Korea-EU		2006-2010(A)	2020(B)	2011-2020(C)	B/A	C/A
FTA	Export	198	327	352	5.1	5.9
	Import	2,111	4,904	3,910	8.8	6.4

Source: Ministry of Trade, Industry and Energy (2021), Kim et al. (2021).

Of course, there may be discrepancies caused by differences in analysis models, analysis targets, and scenario assumptions between the pre- and post-impact evaluation results (Han, 2015a). In addition, an analysis target may include all items, or it may only selectively include items with lower tariff rates and specific item groups. In addition, the scenario assumptions may be simplified or further specified based on the rules of origin as well as animal and plant quarantine, etc. In fact, in the pre-impact assessment of the Korea-U.S. FTA by Choi (2011), it was estimated that agricultural production decreased by an annual average of KRW 814.7 billion over 15 years. In the post-impact assessment of Han (2015b), the average annual decrease in agricultural production was only estimated to be KRW 184.8 billion.

2.3. Re-Evaluation of FTA Economic Effects

There are various limitations when evaluating the impact of FTA using current methodologies, and several researchers have noted these restrictions (Koopman et al., 2014; Borin and Mancini, 2015). One of these limitations is that gross exports are not directly connected to real GDP and job increase, but that the value added created in a country could contribute to its growth (Stehrer, 2012). For example, if gross exports increase by 10% through the FTA, domestic production does not increase by 10%, and the import of foreign products indispensably follows. Therefore, although it is necessary to consider the amount of domestic value added, it is not appropriately measured when estimating the effects of FTA due to issues with data collection and immature methodology.

However, since the publication of the World Input-Output Table (WIOT), it has become feasible to estimate the domestic value-added in trade (Wang, Wei and Zhu, 2013). With the release of the global IOT, various analysis methodologies to divide gross exports are being developed (Timmer et al., 2015; Ke and Tang, 2016; Antràs, 2020). Although WIOT mainly provides major the IO of developed countries, estimating the detailed exports, which are divided into four categories, could provide substantial implications for those countries as well as the countries are linked with them. It is also possible to identify policy gaps by evaluating the current position of a country in the environment of global value chains.

Studies examining the relation between the rule of origin in FTAs and the value added in trade are also being conducted. The rules of origin of FTAs include the minimum share of the domestic value added to obtain preferential tariffs on each HS code. Although the rules of origin could also be divided into 'Change in Tariff Heading' and 'Specific Process Standards', certain industries quantify the value-added ratio as rules of origin.

Recently, as the stability of GVC has become important, FTAs are demanding high shares of value added in trade between those countries. Specifically, the USMCA introduced high intra-regional value-added standards in the automobile sector. The ratio of the intra-regional value of the engine and transmission is expected to increase up to 75% in the long-term, which could incur substantial trade diversion from other third countries. Therefore, the rules of origin could have a significant impact on the trade structure of the automobile sector in the United States (Han et al., 2020).

Table 3. Content Requirement of NAFTA and USMCA for Vehicles

	Calculation method	NAFTA Content Requirements	USMCA Content Requirements
Passenger Vehicles	Net Cost		75%
Core parts	Net Cost		75%
	Transaction value	62.5% for passenger vehicles and light trucks, 60% for heavy trucks	85%
Principal parts	Net Cost		70%
	Transaction value		80%
Complementary parts	Net Cost		65%
	Transaction value		75%

Source: NAFTA and USMCA legal text.

In estimating the economic effect of FTAs, this study aims to estimate the change in trade based on RVC level. To this end, the concept of 'value-added exports'—which means value added in total exports (Koopman et al, 2014) and is based on the GTAP-VA model (Antimiani and Fusacchia, 2018) applied to general equilibrium analysis—is used in the development of a new model by applying the 'regional value-added criterion'. Based on the country's value added included in total exports, the model decides whether or not the FTA tariff rate is applied, and preferential FTA tariffs are only applied to products that meet the ROO (Rules of Origin).

This study explores whether the tariff reduction agreed upon in the FTA would be fully reflected in the importing price. In other words, the conclusion of an FTA does not necessarily mean the total reduction or elimination of tariffs. Every FTA agreement has rules of origin to prevent trade deflection, and tariff reductions are only applied when the criterion is met. However, the current FTA research methodology does not take this into account, and all products 'shipped' from the exporting country is considered to be FTA qualified, which consequently overestimates the effect of trade.

To correct the estimation errors, tariff reduction should be applied based on domestic value added. By including this, the FTA qualification would be determined by the value-added ratio generated in the exporting country. The changes in the market price were affected by the tariff reduction changes variable, which is dependent on domestic added value.

The advantage of this model is that it could accurately estimate the economic effect of the FTA by using value-added exports as a criterion for using the FTA. The concept that enough value-added from an exporting country is a necessary condition to meet the rules of origin was introduced into the CGE model for the first time. By correcting errors in overestimation, this model could become a standard for FTA pre-evaluation in sectors where budget level is dependent on economic results, such as the agriculture, livestock and fishery.

The model proposed in this study has a theoretical contribution that the FTA effect is estimated based on the value-added trade produced by the partner, which is not considered in the previous researches that only consider the total trade. Although researches are actively being conducted to divide total trade into value-added trade, there are not many studies modeling it. In this regard, this study is differentiated from previous studies in that it targets value-added produced by partners.

3. Research Model

3.1. Model

The method of estimating the FTA effect differs depending on the subject and purpose, but the General Equilibrium Model is used to estimate the FTA effects. Hertel et al. (2007), Ando (2009), Cheong et al. (2007), Lim et al. (2019), and other researchers have estimated the effect of FTAs to date. Although the detailed model setting and scenarios differ, analyses of the effect of FTA using the CGE model commonly show that reducing tariff rates lowers import prices, thus causing the imports to increase by consuming more imported goods with lower prices than domestic goods. The existing CGE model considers inter-industry feedback. This overcomes the limitations of the analysis model that considers only specific industries such as agriculture and manufacturing. However, the existing CGE model still provides unsegmented results such as the total export effect. Accordingly, a model was developed in

which total exports were subdivided into domestic value-added and foreign value-added according to the production stage (GTAP-VA). This can be summarized in the following equation.

$$PMS_{i,r,s} = PCIF_{i,r,s}\, TMS_{i,r,s} \tag{1}$$

The market price (pms: domestic price for good i supplied from r to region s) is dependent on two variables: the import price (pcif) and the tariff rate (tm, tms). Here, the conclusion of an FTA will affect the reduction of tariffs, and the market price (pms) will decrease according to this ratio.

$$PIM_{i,s}QMS_{i,s} = \sum_r PMS_{i,r,s}\, QXS_{i,r,s} \tag{2}$$

$$VIMS_{i,r,s} = PMS_{i,r,s}QXS_{i,r,s} \tag{3}$$

The decrease in the price of goods i imported into country s increases the quantity of exports (QXS) of country r. Here, the export volume from country r is determined not only by the PMS, but also by the total price (PIM) and quantity (QMS) in the import market of a country. After all, the final imports of country s (VIMS: imports of i from r to s valued at domestic mkt prices) are determined by the import price (PIM) and quantity (QMS). In the CGE model, the differentiated export volume for each product is determined by the Armington elasticity, which is expressed as follows.

$$qxs_{i,r,s} = qim_{i,s} - \mathrm{ESUBM}_i * [pms_{i,r,s} - pim_{i,s}]; \tag{4}$$

In this model, the importing price change is dependent on the tariff change rate(tmso), which is derived from ratio between RVC and ROO (6). RVC refers to the ratio of domestic value added included in total exports. Thus, in this study, when referring to value added for FTAs, the term RVC is more appropriate than DVA (Domestic Value Added). Products with RVC exceeding ROO are eligible to preferential FTA tariffs, but they are otherwise not subject to FTA.

$$PMS_{i,r,s} = PCIF_{i,r,s}TMSO_{i,r,s} \tag{5}$$

$$TMSO_{i,r,s} = \frac{RVC_{i,r,s}}{ROO_{i,r,s}} TMS_{i,r,s}\,, \text{where } RVC_{i,r,s} \le ROO_{i,r,s} \tag{6}$$

For example, if the RVC of product i with an ROO of 50% is 55%, the tariff concession in the agreement is wholly applied to product i. However, RVC 45% product, which has a lower domestic value added than ROO, has only 90% applied of the tariff reduction. (RVC = 45%/50%)

RVC only includes 'direct' domestic value added (dirDVA), which was suggested by Antimiani and Fusacchia (2018), and it does not include 'indirect' domestic value added (indirDVA) of which value-added come from other industry. (7)

$$RVC_{i,r,s} = \frac{dirDVA_{i,r,s}}{EX_{i,r,s}}, \text{ where } DVA_{i,r,s} = dirDVA_{i,r,s} + idirDVA_{i,r,s} \tag{7}$$

The distinction between 'dirDVA' and 'indirDVA' is to split the value-added generated in the exporting sector from other non-exporting sectors. The value-added of the exporting sector is naturally included as the RVC of the exporting sectors, but value-added other than the exporting sector would be incorporated into through intermediate goods transaction. (8). In this study, considering the characteristics of trade in agricultural, livestock and fishery sectors, that intermediate trades are not as frequent as manufacturing sectors and it is difficult to present supporting documents related to origin, so only dirDVA is calculated to FTA applications.

$$\sum_j DVA = \sum_{\mathrm{j}} VSH * LOC_{jj}^{ss} * VXE + \sum_i \sum_{\mathrm{j}\neq\mathrm{i}} VSH * LOC_{ij}^{ss} * VXE \quad (8)$$

3.2. Scenarios

This study analyzes the economic effects of the Korea-US, Korea-EU, and Korea-China FTAs, which are Korea's FTAs with its major trading partners. In addition, assuming a FTA scenario of nearshoring, we analyze how the effect of the FTA would change if the same regional value ratio (75%) as that of the USMCA were required in the Korea's FTA.

Reinforcement of rules of origin is simulated in such a way that the level of ROO decreases the proportion of actual tariff reduction. For example, 100% tariff concessions could be applied under ROO agreements requiring 50% of goods with an RVC of 55%, but in ROO requiring 75%, only 73.3% (55%/75%) of tariff elimination would be applied in simulation.

Scenario 1 adopts the ordinary FTA analysis methodology and assumes total tariff elimination according to the tariff reduction schedule. In Scenario 2, the level of RVC of each industry is considered, and the FTA effect is differentially determined by the level of value added in the exporting country. In Scenario 3, it is assumed that the extent of tariff cuts is further reduced as the rules of origin are strengthened, which means that the rules of origin under the Korea's FTA are strengthened. This can be summarized as follows.

Table 4. Analysis Scenarios

	Tariff Reduction Ratio	Requirement for preferential tariff application	ROO requirement
Scenario 1	Kor-US FTA: 99% Kor-EU FTA: 99% Kor-CN FTA: 25%* - Agriculture: 10%	No	-
Scenario 2		RVC exceeds ROO criterion	30% ~ 50%(Agr 99%)
Scenario 3		RVC exceeds ROO criterion	75%(Agr 99%)

Note: FTA entering into force year considered: Kor-US(2012), Kor-EU(2011), Kor-CN(2015).

We should refer to the product specific rules of origin from FTA agreement text in order to define ROO. RVC rules are presented by HS6 digit products, and not all products are applied by RVC rules. Products with RVC rules are aggregated in 8 sectors (Table 5.) and ROO level is averaged, so as to represent each sector's overall level.

The following is a summary of ROO by industry in the Korea-US, Korea-EU, and Korea-China FTAs. The criterion levels differ between each FTA agreement; the higher the requirement, the more difficult it is to meet the qualifications, and vice versa. Excluding the service and agriculture sector, the value-added criterion ranges from 30% to 50%, and the

ROO in EU is relatively higher than those in the US and China. In the case of the agricultural sector, products must be grown and raised in the exporting country (known as wholly obtained criterion), so the rule of origin could be quantified as 99%.

Table 5. Rules of Origin Criterion: Regional Value Contents (unit: %)

Sector	Korea-US	Korea-EU	Korea-China
Agriculture, Meat, Fisheries, Food	99.0	99.0	99.0
Chemical, rubber, plastic	30.0	55.6	40.0
Metal products	45.0	53.4	40.0
Motor vehicles and parts	54.2	52.6	48.8
Transport equipment	45.5	57.1	49.7
Electronic equipment	39.2	54.2	40.6
Machinery and equipment	46.7	53.1	41.8
Other Manufactures	44.3	55.4	40.0
Service	0.0	0.0	0.0

Source: Author's Calculation based on each agreement.

4. Result and Discussion

The results of the analysis are described in three stages: first, the analysis of the relationship between FTA possibility and GVCs by country is presented; second, the re-evaluation of FTAs considering RVC is described; and finally the possibility of reinforced RVCs impact on trade is discussed.

4.1. Regional Value Contents and GVC index

Since each country has a different input structure of intermediate goods, labor costs, and capital input used in the production of its export goods, the domestic value added included in its exports differs as well. In general, RVC tends to be high in service and primary commodities such as agriculture and fisheries, while it tends to be low in industries where a GVC production mechanism is actively working. Excluding agriculture and services, Korea showed the lowest RVC in chemical products (24.1%) and the highest RVC in other manufacturing industries (41.1%). It was analyzed that the RVC values of the US and the EU were relatively high, particularly in chemical products (US 34.5%, EU 35.5%), machinery and equipment (US 47.6%, EU 40.8%), and other manufacturing industries (USA, 60.5%). China was found to have a structure similar to that of Korea, but the RVC difference in agriculture was relatively larger (Korea 47.4%, China 64.4%).

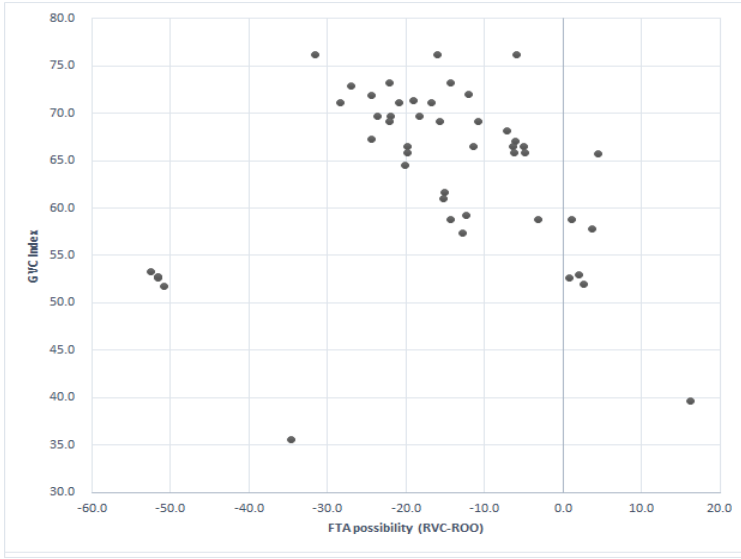
ROO is a requirement for FTA utilization, and RVC actually generates regional value added. Thus, the difference between the two values (RVC-ROO) could be an indicator of the possibility of using FTA. In addition, the GVC Index represents how much an industry is involved with the global value chain (Lim, et al, 2021). Fig. 1 shows that the FTA possibility and the GVC Index show a negative (-) correlation. If the RVC is insufficient, the input of foreign added value would increase, consequently resulting in an intensified GVC Index, which means a low possibility of FTA.

Table 6. RVC(Regional Value Contents) in exports by countries (unit: %)

Sector	Korea	USA	EU	China
Agriculture, Meat, Fisheries, Food	47.4	48.2	46.6	64.4
Chemical, rubber, plastic	24.1	34.5	35.5	35.1
Metal products	33.6	47.1	38.4	34
Motor vehicles and parts	30.6	27.3	28.2	29.7
Transport equipment	28.8	48.1	32.7	27.6
Electronic equipment	34.4	32.1	39	28.6
Machinery and equipment	31	47.6	40.8	27.5
Other Manufactures	41.1	60.5	42.7	43.7
Service	74.2	87.7	85	67

Source: Author's Calculation based on Domestic Value Added

Fig. 1. FTA possibility and GVC index in Korea's FTA with US, EU and China (unit: %)



Source: Author's description.

Similarly, when the possibility of FTA is large, the GVC index has a low value because RVC for FTA utilization is sufficiently high. In other words, if the ROO is high, the exporter will give up on the FTA and attempt to increase the input of foreign added value instead of aiming to increase the RVC to utilize the FTA. In trade with the three countries, it is unlikely that the FTA will be used as a driving force to improve RVC.

In Fig 1. the agricultural, forestry and fishery products clustered on the left side are industries with low FTA possibility, and they are thus supposed to use a high input of foreign added value (high GVC index), but their GVC indices are relatively low due to the primary industry characteristic. The agricultural, forestry, and fishery sectors to which the 'wholly obtained criterion' is applied would only be FTA qualified if the product is 'wholly' produced in the exporting country, so the use of foreign value added is inevitably restricted below a minimal level (mostly not allowed at all).

4.2. Re-Evaluation Results by FTA Possibility

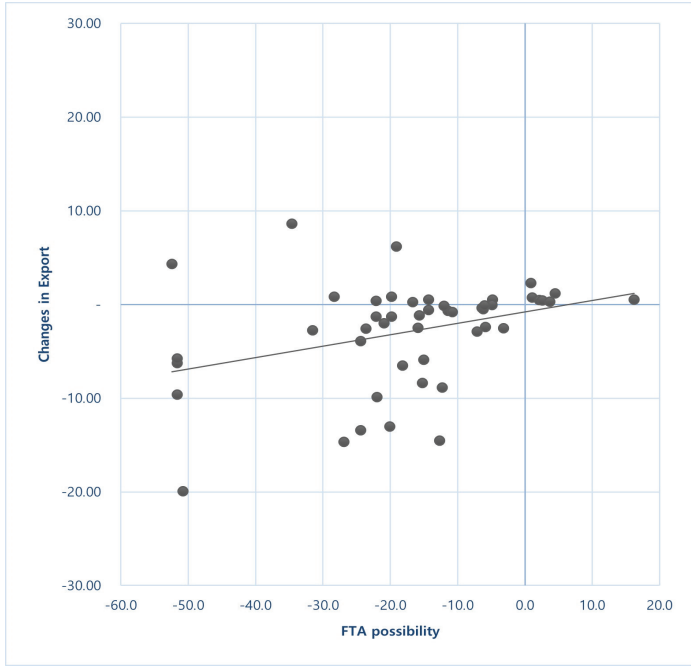
Table 7. presents the analysis results from the viewpoint of RVC when the FTAs with US, EU, and China took effect. In the case of the ordinary FTA analysis method (S1), Korea's total exports increased with the Korea-US FTA (5.52%), the Korea-EU FTA (2.91%), and the Korea-China FTA (6.57%). However, when using the RVC method (S2), the growth rates of exports to Korea-US (4.39%), Korea-EU (1.20%), and Korea-China (5.19%) were lower than that of S1. The difference in the growth rate between the two scenarios for Korea's imports is greater than the corresponding difference for exports. In the Korea-US FTA and the Korea-EU FTA, the import growth rate decreased, whereas it slightly increased in the Korea-China FTA. It is estimated that the effect of the Korea-China FTA, which does not have a high level of openness, is a result of trade diversion caused by the decrease in the effect of the Korea-US and Korea-EU FTAs.

Table 7. Increase rate in Korea's export to FTA partners

	S1 (%)			S2 (%)			Changes (%p)		
	US	**EU**	**China**	**US**	**EU**	**China**	**US**	**EU**	**China**
Export	5.52	2.91	6.57	4.39	1.20	5.19	-1.12	-1.71	-1.38
Import	23.05	25.75	1.84	18.72	16.72	2.19	-4.33	-9.03	0.35

Source: Author's Calculation.

Fig. 2. FTA possibility and its impact on export changes (unit: %)

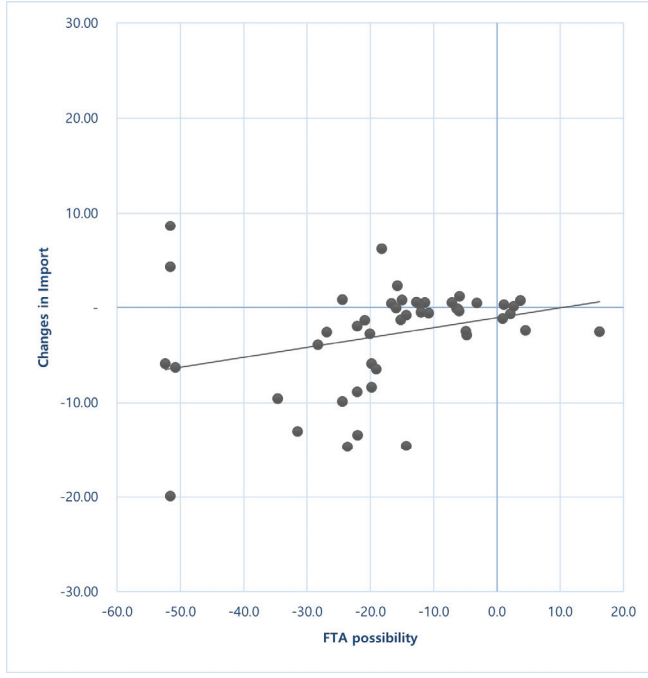


Source: Author's description.

The possibility of FTAs by industry also have influenced the export growth rate. Looking at the Fig. 2, it can be seen that the higher the FTA possibility value, that is, the absolute value (S2-S1) of the changes in exports decreases as a more relaxed regional value ratio is required. Industries with high domestic added value have no problem in meeting the rules of origin, so the use of FTAs is facilitated. The Fig. 3, which demonstrate relation between import changes and FTA possibility, explains that products with high FTA possibility show small changes in import. However, in the case of the agriculture, forestry and fishery industry, the ROO requirements are the highest, since the export growth rate is relatively low compared to other industries.

As can be seen above, the actual FTA export effect varies substantially depending on whether the ROO set in the FTA agreement are considered. In particular, in the case of the Korea-EU FTA, which showed the highest level of ROO, the differences in the effects of the FTA between methodologies indicates that the effect of the rule of origin is the most distinctive among FTAs.

Fig. 3. FTA possibility and its impact on import changes (unit: %)



Source: Author's description.

4.3. Higher Rules of Origin and Effects on Trade

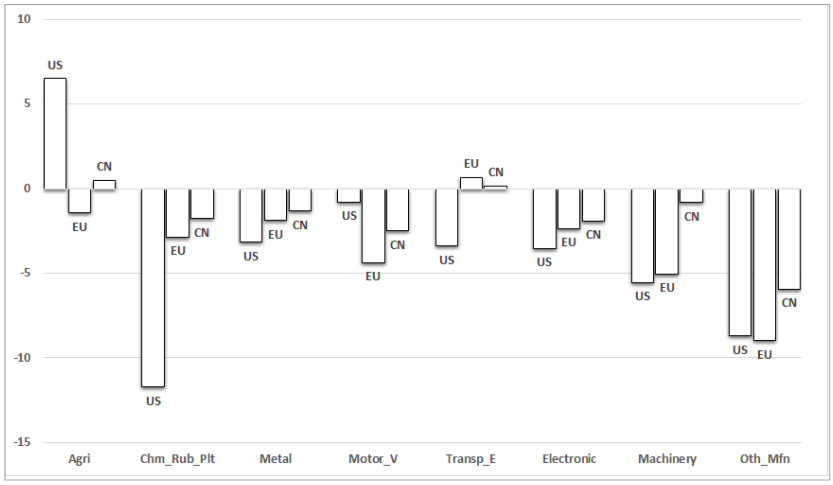
The reinforcement of FTA ROO from global value chains reduces the possibility of FTAs, and exports are thus expected to decrease. FTA partners may demand an increase in the level

of RVC in order to stabilize their supply chain, which would cause a decrease in FTA utilization and exports. In the case of industries where most of the value added is created domestically, the strengthening of ROO will not impose much negative effects on exports. However, in industries in which GVCs have been formulated in multinational countries, the effect of changes in ROO requirement will have a significant effect on international trade.

Changes in total trade by FTA agreement are estimated from setting the rules of origin reinforcement scenario. As shown in Fig. 4, most of the sectors except for agriculture show a significant decrease in trade, and chemical products (Chm_Rub_Pit) as well as other manufacturing sectors (Oth_Mfn) are expected to show the largest decreases in trade. In most industries, the decrease in trade between Korea and the US was the largest, but the automobile (Motor_V) and other manufacturing (Oth_Mfn) industries showed the largest decrease in trade between Korea and the EU. Between Korea and China, due to the fixed GVC structure, the change in ROO does not have as large an impact on trade than it does with the US or the EU.

However, trade in the agricultural sector of the Korea-US FTA was found to be increased, which is the result of setting the S2 and S3 ROO to be the same (99%). The negative effects in other sectors would consequently seem to make the effect of tariff reduction in agriculture sectors even larger than before. In particular, Korea's MFN (most favorite nation) import tariff rate against the US (143.67%), compared to those against the EU (7.76%) and China (4.48%), appear to make the FTA effect bigger.

Fig. 4. Influence of strengthened RVC in Kore's trade with FTA partners (unit: %)



Source: Author's description.

5. Conclusion

In analyzing the effects of an FTA, this paper suggests a new analysis methodology under the assumption that tariff cuts are applied proportionately by the RVC as well as based on whether ROO are met or not, unlike the current methodology in which tariff cuts are applied

uniformly. Further, the possibility of strengthening ROO and its impact on FTA was estimated in order to preemptively forecast the negative ripple effect on international trade in the future.

Complete tariff elimination assumption regardless of ROO was acceptable in the early 2000s when the world average tariff rates were higher than they currently are. However, this is no longer realistic in the 2020s, which is represented by the US-China trade conflict, global supply chain crisis, and strengthening economic regionalism. From the political and economic point of view, the demand for securing a stable supply chain is expected to demand an improvement in ROO in each FTA agreement implementation committee. In preparation for this, the Korea government needs to recognize the importance of value added in the region and improve its position as a leading FTA country by securing a stable supply chain.

Appendix / Appendices

A1. Korea's Export changes by FTA Re-Evaluation [Unit: %]

	S1			S2			S3		
Industry	**USA**	**EU**	**China**	**USA**	**EU**	**China**	**USA**	**EU**	**China**
Food	11.83	11.28	19.81	4.83	4.86	8.30	7.86	7.53	12.55
Chemical	14.12	5.54	6.98	11.36	2.65	4.33	4.53	1.92	2.32
Metal	3.36	-2.75	5.13	2.68	-1.96	4.73	1.53	-1.23	2.28
MotorVehicle	4.90	26.61	18.35	2.20	14.11	10.65	1.75	9.86	6.88
TransportEqp	-0.95	-2.76	4.09	-0.69	-1.95	2.00	-0.43	-1.20	1.40
Electronics	-0.01	2.96	5.79	0.52	1.64	5.28	-0.05	1.29	2.56
Machinery	3.26	-1.88	3.84	2.05	-1.51	2.98	1.25	-0.89	1.45
OthMfn	52.00	-3.63	14.88	48.11	-3.12	15.72	26.75	-1.31	8.70
Service	-2.69	-2.78	-2.88	-2.05	-2.13	-2.17	-1.21	-1.27	-1.33
Total	5.52	2.91	6.57	4.39	1.20	5.19	2.26	1.02	2.73

A2. Korea's Import changes by FTA Re-Evaluation [Unit: %]

	S1			S2			S3		
Industry	**USA**	**EU**	**China**	**USA**	**EU**	**China**	**USA**	**EU**	**China**
Food	56.17	-7.28	-6.43	25.06	-3.27	1.64	33.45	-5.05	1.36
Chemical	34.28	41.85	2.58	35.88	23.35	2.52	14.48	18.09	1.24
Metal	14.92	23.03	0.69	15.48	15.77	0.59	9.33	11.10	0.05
MotorVehicle	37.91	38.41	-10.51	17.67	19.84	-4.96	12.73	13.57	-3.57
TransportEqp	11.65	5.94	-0.51	12.13	1.80	-1.82	7.57	1.85	-1.13
Electronics	20.62	36.98	0.41	17.16	25.47	0.26	8.23	18.27	-0.07
Machinery	28.75	43.55	-5.23	31.68	30.82	-5.79	18.84	21.70	-4.27
OthMfn	29.51	95.40	14.34	30.17	66.96	14.68	24.09	46.15	7.94
Service	1.95	2.13	2.28	1.41	1.58	1.66	0.87	0.99	1.05
Total	23.05	25.75	1.84	18.72	16.72	2.19	12.54	11.80	1.01

A3. Korea's import tariff reduction

Industry	KOR	USA	EU27	CHN	ROW
Agriculture, Fishery	-	14.37	4.82	4.97	4.64
Chemical	-	6.06	6.91	1.57	4.08
Metal	-	2.27	3.13	0.42	1.22
MotorVehicle	-	7.89	7.91	0.41	6.57
TransportEqp	-	1.83	1.19	0.42	1.84
Electronics	-	2.68	4.04	0.53	1.86
Machinery	-	4.72	5.95	0.95	4.37
OthMfn	-	3.04	7.04	1.70	2.18

A4. USA's import tariff reduction

Industry	KOR	USA	EU27	CHN	ROW
Agriculture, Fishery	0.43	-	0.27	0.25	0.14
Chemical	2.19	-	1.31	2.84	0.67
Metal	0.87	-	1.07	1.93	0.32
MotorVehicle	1.09	-	1.00	0.82	0.32
TransportEqp	0.27	-	0.14	2.64	0.23
Electronics	0.35	-	0.79	0.59	0.25
Machinery	0.82	-	0.78	0.48	0.38
OthMfn	4.66	-	2.43	6.80	1.05

A5. EU27's import tariff reduction

Industry	KOR	USA	EU27	CHN	ROW
Agriculture, Fishery	0.34	0.78	0.01	0.79	0.50
Chemical	0.84	1.93	0.00	3.53	0.44
Metal	0.02	1.77	0.00	2.21	0.34
MotorVehicle	4.40	6.89	0.00	3.97	1.71
TransportEqp	0.02	1.33	0.00	1.56	1.18
Electronics	0.67	0.98	0.00	1.30	0.59
Machinery	0.19	1.13	0.00	1.13	0.35
OthMfn	0.05	0.77	0.00	7.22	0.37

A6. China's import tariff reduction

Industry	KOR	USA	EU27	CHN	ROW
Agriculture, Fishery	1.82	0.45	1.11	-	0.67
Chemical	1.24	5.70	5.67	-	4.31
Metal	1.15	2.30	3.62	-	1.83
MotorVehicle	3.35	19.71	17.42	-	14.99
TransportEqp	0.87	2.65	2.80	-	4.26
Electronics	1.11	2.55	4.42	-	3.15
Machinery	0.95	4.29	5.60	-	3.91
OthMfn	1.89	2.24	5.43	-	0.51

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