

# Factors of Korea-China Product Trade According to GVC Changes: Focused on FTA

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## Abstract

**Purpose** – The purpose of this study is to analyze the determinants of commodity trade in Korea and China and to examine the implications of China's GVC shift from export to domestic market on its impact on Korea's trade.

**Design/methodology** – This study selected 30 major trading partner countries. The dependent variable is the trade volume, and the independent variables are general economic factors such as gross domestic product (GDP), GDP per capita, distance, and FTA.

**Findings** – The trade pattern of Korea's commodities shows that GDP has a positive relationship with trade, import, and export. Distance has a significant negative relationship with total trade, import, and export. FTA is significant for import but it is not significant for total trade and export. The trade pattern of China's commodities shows that GDP has a significant positive relationship with total trade, import, and export. Distance has a negative relationship with trade, import, and export. GDP per capita is not significant for total trade and import, but it is significant for export. FTA is significant for total trade and export, but it is not significant for import.

**Originality/value** – Existing papers were studied mainly in certain industrial sectors such as agriculture, manufacturing, automobile industry and steel industry. This paper attempts to collect vast amounts of data about the 30 countries of Korea and China respectively and analyzes by Random Effect Model dividing the goods (0 to 9) in units of SITC (Rev. 4). The major contribution is that the decision factors affecting commodity trade can be analyzed in SITC units (0-9) to obtain analysis results that are subdivided by product group and organized by product.

**Keywords:** China FTA, GVC (Global Value Chain), Korea-China FTA, Korea FTA

**JEL Classifications:** F01, F10, F14

## 1. Introduction

The two countries, Korea and China, established diplomatic relations since 1992 and have developed rapidly through multilateral cooperation such as trade, investment, and human exchange for the past 27 years. Korea-China commodity trade increased 38 times from \$6.4 billion in 1992 to \$243.4 billion in 2019, achieving explosive growth exceeding the world trade rate (by 4.2 times) during the same period. In other words, China, Korea's fifth-largest trading

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partner in 1992, has continued to maintain its largest trading partner since rising to the top in 2004.

Korea-China trade volume and proportion continued to grow, and Korea's trade surplus with China continued to increase. With the change of "Global Value Chain" (hereinafter referred to as GVC) in the protectionist mood, China has been transformed into a domestic-oriented economic structure. In this regard, it has been argued that in the case of Korea, the free trade zone could promote Korean companies to better access the Chinese domestic market. The increase in trade and investment between Korea and China has been centered on processing trade according to China's investment-led growth policy, but China's industrial structure has recently begun to change. As the economic growth trend is rapidly shifting toward consumption and services, changes in the trade structure between the two countries are showing signs of transformation.

In addition, South Korea's investment in China and vice versa fell 46.3 percent and 32.3 percent, respectively, during the first half of 2017 due to political conflicts, including China's opposition to the deployment of Terminal High Altitude Area Defense (THAAD). However, to enter China's fast-growing domestic market, increasing the proportion of exports of consumer goods and development of products based on field surveys is essential. Therefore, Korean companies need to come up with a new strategy to advance into China.

This study aims to analyze the factors affecting the Korea-China FTA and the amount of trade that has been made so far to create a new strategy following China's GVC changes. Therefore, in order to analyze the factors influencing the trade value of Korea and China, 30 countries were selected for each of the major trading partners of Korea and China by gravity model using dependent variable(trade amount), independent variables(GDP, per capita income, distance, FTA dummy) for 2007-2015.

The contribution of this study collects vast amounts of data based on 30 countries of Korea and China(Korea's main partner: China, USA, Hong Kong SAR, Viet Nam, Japan, Singapore, India, Mexico, Malaysia, Australia, Philippines, United Kingdom, Indonesia, Thailand, Germany, Turkey, Canada, Russian Federation, Brazil, Netherlands, Norway, Italy, Poland, France, Belgium, Spain, Chile, Peru, New Zealand, Colombia; China's main partner: USA, Hong Kong SAR, Japan, Rep. of Korea, Germany, Viet Nam, India, Netherlands, United Kingdom, Singapore, Malaysia, Russian Federation, Australia, Thailand, Mexico, Indonesia, United Arab Emirates, Philippines, Canada, Italy, France, Brazil, Pakistan, Turkey, Chile, Saudi Arabia, New Zealand, Peru, Iceland, Switzerland) respectively and analyzes through Random Effect Model dividing the goods (0 to 9) in units of SITC (Rev. 4). The major contribution is that the decision factors affecting commodity trade can be analyzed in SITC units (0-9) to obtain analysis results that are subdivided by product group and organized into product.

In addition, this study also aims to present implications for the impact of China's GVC fluctuation, which has been converted from export to domestic market, on Korea's trade.

## 2. Literature Review

### 2.1. Previous Studies of the Related Korea-China FTA

Kang Jun-Gu, Kim Tae-Jin and Shim Seung-Jin (2017) focused on service trade using the WIOT proposed by WIOD, and proposed the policy implications by analyzing the effects of the transition as well as the creation of the value-added trade. Kim Gyu-Jeong and Kim Min-Ho (2016) suggested that Korea-China FTA seems to have impact on explosive increase in

trade volume between Korea and China and is necessary to set up a detailed export strategy for each of the five strategic industries of Jeollabuk-do. In this regard, we analyzed the competitiveness and linkage among the five major industries of Jeonbuk using the Trade Specialization Index (TSI) and Trade Association Index (GL). Kong Su-Jin (2015) considered the relationship between bilateral and trilateral agreements, taking into account the possibility that complex bilateral agreements would coexist in the context of the Korea-China-Japan trilateral agreement. To this end, the contents of each agreement were examined and was reviewed the basic structure of the bilateral and trilateral investment agreements of the three countries in Northeast Asia.

Baik Il (2015) combined the Marxist warnings on the expansion of non-discriminatory trade with the competition and risk of trade expansion during the FTA period. He also concentrated on the characteristics of international trade between the two countries and achieving mutually beneficial growth through the number of cases is impossible. Seo Chang-Bae (2016) thought this may be an opportunity factor for opening up a new consumer market of 1.4 billion population and \$10 trillion in the Korea-China FTA, but it can be a threat factor considering China's competitiveness is rising sharply.

Lee Hack-Chun and Ko Zoon-Ki (2013) reviewed the status of trade remedies, and the status and environment of trade between Korea, China and Japan, and lastly the FTA policies among the three countries. Based on this, Korea-China-Japan trade liberalization, the FTA benefit, and the ultimate promotion plan of the three countries will be developed in the future. Zhou Kun (2009) analyzed the anticipated effects carefully to promote long-term win-win strategies and to open up vulnerable industries in stages. Duan Pei-Pei (2009) presented the short-term effect and the long-term economic impact of the Korea-China FTA. Also, political and diplomatic influences are presented. Yeo Taek-Dong and Choi Eui-Hyun (2012) suggest that the effects of the Korea-China FTA on the region are different depending on the detailed industrial characteristics of the region. Kim Dae-Jeong (2015) argued that the expansion of trade with China had a ripple effect of economic growth (1.5% ~ 2.1%). An Ni (2019) investigated the export effect of China's agricultural products on the Korea - China FTA, and in order to strengthen the bilateral agricultural and international competitiveness of both agricultural products, both countries will need to cooperate with each other. Chang Eun-Gap (2019) empirically analyzed the case study method and found the financial characteristics of individual companies' relation to the stock price. Yu Min-Gyan (2019) investigated and utilized primary data such as basic statistical data of China and Korea and analyzed secondary data such as research reports and monographs of related research institutes. Based on related articles and data analysis, this paper analyzed the current status of start-ups by Chinese college student at the present stage and the effect Korea-China FTA has on the start-up. Liang Yu-Jie (2019) studied a comparative analysis of the online trading industry and related trade between the two countries in terms of industry scale, payment methods, logistics, customs clearance, and legal & policy aspects. Combined with the signing of the Korea-China FTA agreement, the change of trade dependence after the signing of the agreement was calculated as well as the impact of the agreement on online transactions between the two countries. Li Yue-Xin (2019) analyzed quantitative analysis of the effects of the Korea-China FTA on Chinese agricultural exports by conducting the trade gravity model based on qualitative analysis. Lim Byung-Ho (2019) aimed to analyze the economic effects of FTA by introducing the concept of value-added export and evaluate the influence toward GVC countries. The outcome of FTA was analyzed concerning the increase of exports and value-added exports in regions where GVC is deepened, such as East Asia, and the possibility of its ripple effects that will spread across multiple countries.

This paper intends to concentrate on the effects of the Korea-China FTA on commodity

trading. In particular, we will select 30 major countries that have already concluded FTAs between Korea and China, and analyze the effect of the FTA with the gravity model. The empirical analysis results draw implications for Korea and China's product trade.

## 2.2. Previous Studies of the Related GVC

GVC is a division of labor between countries, and international division of labor is carried out in stages of production and sales of goods beyond the production of final goods within one country. GVC is divided into seven stages such as R&D, design, procurement, manufacturing, logistics, marketing, and services, which are necessary to complete production and sales, as the unit for trade transitioned from goods to tasks (Oh Dong-Yoon, 2018). Previous studies related to GVC are as follows.

KOTRA (2015) drew implications for Korean companies' participation in GVC through an understanding of the recent mega FTA, which is the flow of the recent trade agreement, as well as expanding the production network with GVC.

Park Jung-Soo et al. (2019) identified major domestic service sectors that can cooperate with each other based on the analysis of the trade structure between Korea and China, and develops industrial cooperation plans between the two countries for their overseas expansion in various fields through a qualitative method. KOTRA (2017) confirmed the expansion of Southeast Asia while the quantitative expansion of China's trade continued. Considering that many Korean companies have established local production systems in China, it is necessary to use the expansion of China's exports to Southeast Asia as an opportunity to expand exports of Chinese-made Korean companies' products to Southeast Asia. KDI (2018) attempted to explore ways to develop cooperation between Korea and developing countries using GVC, which has been attracting attention as a major means to support sustainable development in developing countries.

KITA (2020) explained that emerging countries' trade dependence on advanced countries fell from 66% in 2000 to 52% in 2017. As the industrial structure of emerging countries has advanced, dependence on imports and exports to advanced countries has declined in almost all stages of processing, including consumer goods, capital goods, and intermediate goods, and transactions between emerging countries have become more active.

Kang Nae-young and Kang Seong-Eun (2020) said that the global value chain has slowed since 2011. This is because the vertical division of labor between advanced and emerging countries has weakened as emerging countries, which used to function as global production plants, grew rapidly and increased the self-sufficiency rate of intermediate goods. GVC participation rates of advanced and new countries have remained at 59% and 48%, respectively, since 2011. However, the service industry's position in the global value chain is growing. They explained that it is necessary to enhance the competitiveness of export products not only to increase the value of the service industry, but also to promote the convergence between service and manufacturing industries, focusing on the service industry related to the manufacturing industry. Cho Jae-Han and Kim In-Cheol (2020) is concerned about the global economic downturn and domestic economic shock due to Covid-19, and believes it is necessary to understand the changes in the global value chain and to take effective mid to long term countermeasures in order to minimize threats and find opportunities. In response to the reorganization of the global supply chain, expanding the attraction of domestic and foreign corporate investment is suggested, as well as focusing on structural innovation and quality improvement of foreign economic policy goals and capabilities, and linking export companies' digital capabilities and investment policies.

Existing papers have been mainly studied in specific industries such as agriculture,

manufacturing, automotive industry and steel industry. This paper collects a vast amount of data on 30 countries in Korea and China and analyzed products (0 ~ 9) in a Random Effect Model divided by STIC (Rev. 4) units. In addition, this study attempted to establish a new strategy along with the change of GVC in China by deriving factors that affect the Korea-China.

### 3. Methodology

#### 3.1. Research Method

In order to achieve the purpose of the study, we analyzed the effect of the Korea-China FTA on the future trade effects of goods export and imports in Korea and China. Related data were collected from sites such as KITA, Uncomtrade and UNCTAD. Data from the Uncomtrade site was used to collect data from 2007 to 2015 of both countries and used panel data analysis. The econometric analysis using panel data means that both the time series analysis and the cross-sectional area analysis are carried out simultaneously.

Since both time series data and cross-sectional data can be used, there is an advantage that the estimation error occurring in the time series process and the estimation error occurring in the data of the regional unit can be controlled. In addition, the panel model has the greatest significance to overcome the limitations of missing variables that are not included as independent variables even though they have a significant effect on dependent variables.

The major advantages and disadvantages of panel analysis are as follows.

First, dynamic relationships can be estimated because objects are repeatedly observed. Second, the unobserved heterogeneity of groups can be considered in the model. Third, it can mitigate efficient estimator and multicollinearity problems by providing various information and variable volatility. On the other hand, the disadvantages of panel analysis are as follows. First, there are difficulties in collecting data. Second, there may be a correlation between panel groups. Third, there is a disadvantage that the length of the time variable is short when the individual is a panel group.

In addition, STIC (REV. 4) was divided into 10 categories (0 ~ 9) to analyze the trade, export and import.

#### 3.2. Research Model

In this study, data collected during the nine years (2007-2015) were used for 30 countries respectively among the major trading countries from Korea and China. Dependent variable uses the trade volume of imports and exports between Korea and China. As the independent variables uses the GDP, population, distance, and FTA dummy variables. The model used in this study is (1).

$$\ln TR_{ijt} = \beta_0 + \beta_1 \ln(GDP_{it} \times GDP_{jt}) + \beta_2 \ln(PGDP_{it} \times PGDP_{jt}) + \beta_3 \ln DIST_{ij} + \beta_4 FTA_t + \varepsilon_{ijt} \quad (\text{Equation 1})$$

$TR_{ijt}$  = Commodity value of export and import between Korea(China)(i) and trading partner(j) at time (t)

$GDP_{it} \times GDP_{jt}$

= Multiplication of GDP between Korea (China) and trading partner(j) at time (t)

$PGDP_{it} \times PGDP_{jt}$  = Multiplication of GDP per capita between Korea(China) and trading partner(j) at time (t)

$DIST_{ij}$  = Distance between Korea(China) and trading partner(j)

$FTA_t =$  Whether to conclude an FTA between Korea(China)and trading partner(j) at time (t)

Korea's or China's import and export patterns can be analyzed if commodity value of import (Equation (2)) and commodity value of export (Equation (3)) are substituted instead of commodity value of export and import as dependent variables.

$$\ln IM_{ijt} = \beta_0 + \beta_1 \ln(GDP_{it} \times GDP_{jt}) + \beta_2 \ln(PGDP_{it} \times PGDP_{jt}) + \beta_3 \ln DIST_{ij} + \beta_4 FTA_t + \varepsilon_{ijt} \text{ (Equation 2)}$$

$IM_{ijt}$

= Commodity value of import between Korea(China)(i)and trading partner(j) at time (t)

$$\ln EX_{ijt} = \beta_0 + \beta_1 \ln(GDP_{it} \times GDP_{jt}) + \beta_2 \ln(PGDP_{it} \times PGDP_{jt}) + \beta_3 \ln DIST_{ij} + \beta_4 FTA_t + \varepsilon_{ijt} \text{ (Equation 3)}$$

$TR_{ijt}$

= Commodity value of export between Korea(China)(i)and trading partner(j) at time (t)

The independent variables used in the study are the variables used in many previous studies as shown in Table 1. The previous study using gravity models included cultural and other variables such as language and race, but this study was excluded because it was aimed at analyzing product trade patterns and understanding the effects of FTAs.

**Table 1.** Independent Variables of Antecedent Research

Variables	Researcher
GDP	Choi Bong-Ho (2005), Ham Shee-Chang (1997), Nam Ki-Chan, Nam Hyung-Sik, and Kang Dal-Won (2013) Park Ho, Jang Hyun-Mi, Kim Sang-Youl (2016), Park Jae-Jin (2005),
GDP per capita	Choi Bong-Ho (2005), Kang Bong-Kyung (2009), Nam Ki-Chan, Nam Hyung-Sik, and Kang Dal-Won (2013), Park Ho, Jang Hyun-Mi, Kim Sang-Youl (2016), Park Young-Gl, Yi Chae-Deug (2010)
Distant	Choi Bong-Ho (2005), Ham Shee-Chang (1997), Kang Bong-Kyung (2009), Nam Ki-Chan, Nam Hyung-Sik, and Kang Dal-Won (2013), Park Ho, Jang Hyun-Mi, Kim Sang-Youl (2016), Park Jae-Jin (2005),
FTA	Kang Bong-Kyung (2009), Park Ho, Jang Hyun-Mi, Kim Sang-Youl (2016), Park Young-Gl, Yi Chae-Deug (2010)

Table 2 shows the definitions of variables used in the study and the data provided in the UN statistics on commodity value in export and import as sources. As an independent variable, the gross domestic product of both countries used the UN statistics ([www.uncomtrade.org](http://www.uncomtrade.org)). Distance used the data provided at [http://www.cepii.fr/CEPII/en/bdd\\_modele/bdd\\_modele.asp](http://www.cepii.fr/CEPII/en/bdd_modele/bdd_modele.asp), and population used UNCTAD. In addition, the dummy variable, FTA, was assigned 1 for signed and 0 for non-signed.

**Table 2.** Definitions and Sources of Variables

Variables	Description	Source
TR(EX, IM)	Commodity value of trade (export, import)	UNCOMTRADE
GDP	GDP of both countries	UNCTAD
PGDP	GDP per capita of both countries	UNCTAD
DIST	Distance	CEPII
FTA	Whether FTA is signed	Ministry of Foreign Affairs and Trade

As for the independent variables used in the study, GDP indicates the size of the economy and the market size of the country. The increased GDP in both countries means that economies of scale have comparative advantage due to increased productivity. GDP per capita is the total annual production of real GDP divided by the total population, which is the size of the overall production and expenditure of a country. It is an indicator of individual income and expenditure and is a variable that can determine whether trade size is influenced by income level. Therefore, as the GDP per capita of both countries increases, it is expected to have a positive effect on the trade volume of commodities between two countries. Distance is a measure based on the physical distance between the administrative capitals of two countries. Increased distance can be regarded as a typical trade cost, which means an increase in transport cost and time required to quantitatively measure. Therefore, as the distance between two countries increases, it is expected to have a negative impact on the amount of trade in commodities between them.

If the coefficients of the FTA dummy variables and economic integration variables show positive values, this implies expansion of trade through the effect of trade creation. When shown negative values, this implies reduction of trade through the effect of trade conversion. The effect of trade creation is to move the production factors such as capital and labor and to allocate resources efficiently by eliminating tariffs and non-tariff barriers through FTAs or customs unions. This signify the expansion effect of trade as economies of scale occur. On the other hand, the trade-off effect is the negative effect of the removal of trade barriers, which means that commodities imported from foreign countries with low cost of ownership are imported from countries with higher production costs. Therefore, the conclusion of an FTA is expected to have a positive effect on trade volume.

## 4. Analysis

### 4.1. Korea-China Commodity Trade Status

Trade in goods between Korea and China increased 38 times from \$6.4 billion in 1992 to \$243.4 billion in 2019, achieving explosive growth exceeding the world trade increase (4.2 times) during the same period. Over the past 27 years, as the industrial relations between Korea and China have developed cooperatively, the dependence on commodity trade between the two countries has sharply increased. As China's share of trade in Korea exploded from 4% in 1992 to 23.4% in 2016, China's trade rankings remained fifth place in 1992 and maintained its first place from 2004 to 2019. In China trade, Korea's share also increased from 4.2% in 1993 to 6.8% in 2016, and as of 2019, Korea became China's fourth largest exporter and one largest importer. In particular, the ranking of Korea in imports from China rose from

4th in 1998 to 1st in 2013, surpassing Japan, and remains first place until 2019 as shown in Table 3.

**Table 3.** Changes in Trade in Commodity between Korea and China

Division		1992	2004	2016	2019
China's position in Korea's trade	Trade	5 <sup>th</sup>	1 <sup>st</sup>	1 <sup>st</sup>	1 <sup>st</sup>
	Export	6 <sup>th</sup>	1 <sup>st</sup>	1 <sup>st</sup>	1 <sup>st</sup>
	Import	5 <sup>th</sup>	2 <sup>nd</sup>	1 <sup>st</sup>	1 <sup>st</sup>
Korea's position in China's trade	Trade	1998	2004	2016	2019
	Export	4 <sup>th</sup>	4 <sup>th</sup>	4 <sup>th</sup>	3 <sup>rd</sup>
	Import	4 <sup>th</sup>	3 <sup>rd</sup>	1 <sup>st</sup>	1 <sup>st</sup>

**Source:** Korea International Trade Association (2020).

In the early days of diplomatic relations, we can see recent quick shift from simple light industry and heavy chemical-oriented items to high value-added items related to information and communication technology (ICT). In 1992, Korea exported steel products and textile products to China and imported vegetable materials (feeds) and crude oil. As shown in Table 4, “inter-industry” trade which was originally the main focus recently changed to “intra-industry” trade forms such as semiconductors and displays as the two countries’ industries advanced.

The following are the top 10 export items that have led Korea’s exports for 10 years. As of 2019, the nation’s major export items were semiconductors, automobiles, petroleum products, displays, synthetic resins, ships, steel plates, wireless communication devices and plastic products. There has been little change in the nation’s top 10 export items over the past 10 years, and only slight change in the ranking. The top 10 export items accounted for 56.1% of the total exports (542.33 billion dollars), and the top five export items accounted for 40.7%.

A previous study on trade between Korea and China, Gyunggi Future Development Institute (2008) divided trade structure into China export structure and import structure and analyzed the characteristics of recent changes in the Korean economy in a comprehensive manner. Jeon Kwang-Myung and Noh Won-Jung (2008) examined the patterns and causes of change in the trade structure between Korea and China in terms of the development of the industries of both countries, analyzed the impact of these structural changes on Korea’s future imports and exports, and sought policy implications and countermeasures. The Korea International Trade Association (2011) analyzed the status of linkage between Korean-Chinese cities and regions in the industry and logistics sector, and analyzed the difficulties of major regional companies in both Korea and China. Han Sang-Wan and Cho Gyu-Rim (2014) analyzed the structural causes of sluggish exports to China and found ways to respond to the risk of China, which is threatened by the stable growth of the Korean economy, through future export channels. Yang Pyung-Seop (2014) assessed the 2014 economic cooperation between Korea and China as a focus on trade and investment in Korea-China economic relations and presented the direction of cooperation between Korea and China. Lee Bu-Hyeong and Chun Yong-Chan (2016) tried to analyze the phenomenon of mutual economic dependence between Korea and China and present policy directions on the future direction of economic exchanges between the two countries. Yang Pyung-Seop and Park Min-Sook (2017) analyzed the changes and causes of Korea’s trade balance with China and presented countermeasures. Nam Soo-Jung et al. (2018) presented detailed cooperation plans for major areas in full consideration of changes in internal and external conditions surrounding the two



Table 4. Changes in the Proportion of Korea's Top Ten Import and Export Items (Unit: %)

Ranking	Export					Import						
	1992	2000	2019	1992	2000	2019	1992	2000	2019			
1	semiconductor	17.3	semiconductor	15.1	semiconductor	8.9	crude oil	14.0	crude oil	15.7	crude oil	11.7
2	car	7.9	computer	8.5	clothing	8.5	semiconductor	9.3	semiconductor	12.4	semiconductor	6.6
3	Petroleum products	7.5	car	7.7	Marine Offshore Structures and Components	5.4	Natural gas	4.1	computer	4.9	Aircraft and parts	3.2
4	Automotive Parts	4.2	Petroleum products	5.3	Video equipment	4.8	Petroleum products	3.5	Petroleum products	3.1	Petroleum products	2.7
5	Flat panel display and sensor	3.8	Marine Offshore Structures and Components	4.9	Artificial long fiber fabric	4.4	Coal	2.8	Natural gas	2.4	Prime mover and pump	2.4
6	Synthetic resin	3.7	Wireless communication device	4.6	furniture	4.2	Wireless communication device	2.7	Semiconductor manufacturing equipment	2.3	Wood	2.2
7	Marine Offshore Structures and Components	3.7	Synthetic resin	2.9	Steel sheet	4.1	car	2.4	Gold, silver and platinum	1.7	Textile and chemical machinery	2.1
8	Steel sheet	3.4	Steel sheet	2.8	computer	3.9	computer	2.3	Wired communication equipment	1.6	computer	2.0
9	Wireless communication device	2.6	clothing	2.7	car	3.7	Fine Chemical Raw Materials	2.3	Steel sheet	1.5	Measurement Control Analyzer	2.0
10	Plastic products	1.9	Video equipment	2.1	Sound equipment	3.2	clothing	2.2	Fine Chemical Raw Materials	1.4	Coal	2.0

Note: MTI 3 digits.

Source: Korea International Trade Association (2020).

economies. Lee Chan - Woo (2018) analyzed the changes of the trade in value added between Korea and China, using the World input and output Database (WIOD) of 2005, 2010 and 2014. After joining the \$1 trillion trade club for the first time in 2011, Korea achieved \$1 trillion in trade for seven years, excluding years from 2015 to 2016. Certain items such as semiconductors and automobiles contributed to the country's rise to become an export powerhouse.

#### 4.2. Basic Statistics of Variables

In order to identify the characteristics of the variables used in the analysis before the empirical analysis, the basic statistics of the variables in the model Table 5 and Table 6 shows that there is a correlation between independent variables and confirmed on the matter of multiple collinearity between independent variables in Table 7. In addition, the dispersion expansion index of each independent variable was smaller than 10, indicating that there was no multi-collinearity problem.

**Table 5.** Basic Statistics of Variables

Type	N	Average	S.D	Min. Value	Max. Value
$GDPX_KGDP$	270	2.268	3.843	8.691	2.499
$GDP_{it}X_{pck}GDP$	270	649.306	556.097	19.749	2728.371
$DIST_i$	270	8142.973	4.516	955.651	18375.180

**Table 6.** Correlations

Div.	C	GDP	pcGDP	DIST	FTA
C	1.000				
GDP	0.523***	1.000			
pcGDP	0.032	0.341***	1.000		
DIST	- 0.658***	- 0.079	0.243***	1.000	
FTA	0.112*	- 0.081	- 0.090	- 0.140**	1.000

Note: \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.001$ .

**Table 7.** VIF between Independence Variables

Div.	VIF	Tolerance
GDP	1.0484	0.9538
PcGDP	1.0475	0.9547
DIST	1.0317	0.9693
FTA	1.0298	0.9710

#### 4.3. Results

Table 8 summarizes the results of the fixed effects and random effects models with dependent variables for Korea's trade, import, and export products. The trade patterns of Korean commodities show that trade, import, and export between Korea and its trade partners is in proportion to the market size of Korea and its trade partners.

The trade pattern of Korean commodities shows that GDP has a positive relationship with total trade, import, and export which is significant at the 1% level. GDP per capita of Korea

and its trade partners has a negative relationship with trade, import, and export which is not significant. Distance has a negative relationship with trade, import, and export which is significant at the 1% level. The FTA was derived as a significant variable in import, but as an insignificant variable in total trade and export.

**Table 8.** Korean Commodity Analysis Results

Division	Trade		Import		Export	
	Fixed Effect	Random Effect	Fixed Effect	Random Effect	Fixed Effect	Random Effect
C	-9.886 (-1.254)	14.165 (4.774)	-8.083 (-0.683)	11.146 (2.809)	-26.889 (-2.302)	13.946 (4.256)
GDP	1.197*** (3.198)	0.471*** (5.023)	1.067* (1.899)	0.485*** (3.865)	1.977 (3.564)	0.504*** (4.845)
PcGDP	-0.857** (-2.061)	-0.047 (-0.455)	-0.729 (-1.168)	-0.064 (-0.457)	-1.731 (-2.809)	-0.099 (-0.862)
DIST	-	-1.001*** (-5.154)	-	-0.809*** (-3.141)	-	-1.119*** (-5.330)
FTA	0.008*** (0.263)	0.027 (0.902)	0.160*** (3.334)	0.172*** (3.809)	-0.070 (-1.473)	-0.030 (-0.676)
Obs.	270	270	270	270	270	270
Adj. R2	0.984	0.456	0.973	0.337	0.970	0.301
F-stat.	521.503***	57.323***	298.890***	35.201***	272.058	29.973***
H-M $\chi^2(3)$		4.559		4.025		7.356*

Notes: 1. \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.001$ .

2. Figures in parenthesis are t-statistics.

Table 9 showed the results of Korea's trade by item. Item 6 (Manufactured goods classified chiefly by material) is affected by GDP, GDP per capita, distance, and FTA. Item 5 (Chemicals and related products) and item 7 (Machinery and transport equipment) are affected by GDP, distance and FTA, except GDP per capita. All items were affected by GDP excluding number 3 (Mineral fuels, lubricants and related materials) and number 9 (Commodities and transactions not classified elsewhere in the SITC). GDP per capita affects only item 5 (chemicals and related products), while the remaining items have no effect. The distance affected all items except item 0 (food and live animals), item 4 (Animal and vegetable oils, fats and waxes). FTA affected only the items 0 (food and live animals), 3 (mineral fuels, lubricants and related materials), 5 (chemicals and related products), 6 (Manufactured goods classified chiefly by material) and 7 (machinery and transportation equipment).

Looking at the Korean import by item in Table 10, import volume was influenced by GDP, excluding item 9 (Commodities and transactions not classified elsewhere in the SITC). GDP per capita affects only item 7 (machinery and transport equipment) and not all items. The distances affected only items 3, 5, 6, 7, 8, and 9, and FTA affected only items 0, 5, 6, 7 and 8. Item 7 (machinery and transport equipment) was wholly influenced by four variables (GDP, GDP per person, distance, FTA). Items 5 (chemicals and related products), 6 (Manufactured goods classified chiefly by material), and 8 (Miscellaneous manufactured articles) were affected by three variables except GDP per capita.

Table 9. Korea's Trade Analysis Result by Item (Random Effect Model)

Item.	0	1	2	3	4	5	6	7	8	9
Commodity	Food and live animals (0)	Beverages and tobacco (1)	Crude materials, inedible, except fuels (2)	Mineral fuels, lubricants and related materials (3)	Animal and vegetable oils, fats and waxes (4)	Chemicals and related products (5)	Manufactured goods chiefly by material (6)	Machinery and transport equipment (7)	Miscellaneous manufactured articles (8)	Commodities and transactions not classified elsewhere in the SITC(9)
GDP	0.704*** (4.672)	0.982*** (4.360)	0.680*** (3.603)	0.403 (1.318)	0.537* (1.918)	0.592*** (6.502)	0.426*** (4.428)	0.426*** (4.049)	0.702*** (5.278)	-0.079 (-0.259)
P<GDP	-0.179 (-1.070)	0.157 (0.631)	-0.275 (-1.311)	0.095 (0.282)	-0.138 (-0.444)	-0.159 (-1.575)	-0.214** (-2.006)	0.032 (0.271)	-0.178 (-1.205)	0.316 (0.938)
DIST	-0.556* (-1.782)	-1.132** (-2.558)	-0.146 (-0.370)	-1.723*** (-2.965)	-0.768 (-1.393)	-1.170*** (-6.337)	-1.059*** (-5.373)	-1.148*** (-5.389)	-1.405*** (-5.247)	-2.833*** (-4.838)
FTA	0.254*** (5.210)	0.256 (1.981)	0.157*** (2.824)	0.406* (1.748)	0.105 (0.654)	0.292*** (7.842)	0.122*** (3.465)	-0.030*** (-0.676)	0.049 (0.828)	0.071 (0.331)

Notes: 1. \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.001$ .

2. Figures in parenthesis are t-statistics.

Table 10. Korea's Import Analysis Result by Item (Random Effect Model)

Div.	0	1	2	3	4	5	6	7	8	9
Commodity	Food and live animals (0)	Beverages and tobacco (1)	Crude materials, inedible, except fuels (2)	Mineral fuels, lubricants and related materials (3)	Animal and vegetable oils, fats and waxes (4)	Chemicals and related products (5)	Manufactured goods chiefly by material (6)	Machinery and transport equipment (7)	Miscellaneous manufactured articles (8)	Commodities and transactions not classified elsewhere in the SITC(9)
GDP	0.710*** (4.487)	1.143*** (3.786)	0.671*** (2.885)	0.826** (2.124)	0.530* (1.783)	0.643*** (4.486)	0.449*** (3.218)	0.409** (2.218)	0.560*** (3.434)	0.275 (0.586)
P<GDP	-0.255 (-1.454)	0.145 (0.433)	-0.304 (-1.180)	-0.320 (-0.750)	-0.246 (-0.749)	0.117 (0.741)	-0.287* (-1.857)	0.213* (1.045)	-0.062 (-0.342)	0.743 (1.443)
DIST	-0.183 (-0.564)	-0.552 (-0.932)	0.045 (0.093)	-1.547** (-2.150)	-0.420 (-0.728)	-1.065*** (-3.789)	-0.818*** (-2.923)	-2.360*** (-6.410)	-1.827*** (-5.560)	-2.763*** (-3.218)
FTA	0.314*** (5.630)	0.335* (1.950)	0.079 (1.110)	0.372 (1.042)	0.125 (0.660)	0.140*** (3.002)	0.140*** (2.199)	0.253*** (2.865)	0.229*** (3.199)	1.153** (2.302)

Notes: 1. \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.001$ .

2. Figures in parenthesis are t-statistics.

Looking at the results of Korea's export by item in Table 11, 4 variables (GDP, GDP per capita, distance, FTA) influenced item 5 (chemical products and related products) and item 6 (Manufactured goods classified chiefly by material). All items were affected by all three variables except GDP per capita excluding item 2 (Crude materials, inedible, except fuels) and item 7 (machinery and transport equipment). Item 8 (Miscellaneous manufactured articles) were affected by all three variables except the FTA dummy variable. In case of Korea's exports, all items were affected by distance.

Table 12 summarizes the results of the random effects model with dependent variables for China's trade, import, and export products. The trade pattern of Chinese commodities shows that GDP has a positive relationship with trade, import, and export which is significant at the 1% level. The trade pattern of China's commodities shows that total trade, import, and export are in proportion to the market size rather than people's income patterns. Distance has a negative relationship with trade, import, and export. GDP per capita is significant for export but is not significant for total trade, indicating that trade patterns based on market size are more visible than trade patterns based on income levels. FTA was a significant variable for trade and export, but was not significant for import.

As for the results of China's trade products by item in Table 13, in case of item 6 (Manufactured goods classified chiefly by material) for trade was affected 4 variables (GDP, GDP per capita, distance, FTA). Item 5 (chemicals and related products) was affected GDP, GDP per capita, distance. Item 3 (Mineral fuels, lubricants and related materials) was affected excluding GDP per capita. GDP has positive effect on trade for all items except item 4 (Animal and vegetable oils, fats and waxes) and item 9 (Commodities and transactions not classified elsewhere in the SITC).

Looking at China's imports by item in Table 14, item 0 (food and live animals) was affected by three variables (GDP per person, distance, and FTA), excluding GDP. Item 3 (Mineral fuels, lubricants and related materials) was affected by three variables (GDP, distance, FTA), excluding GDP per capita. Item 6 (Manufactured goods classified chiefly by material) was affected by three variables (GDP, GDP per capita, FTA) except for distance.

Looking at China's exports by item in Table 15, item 5 (chemicals and related products) was affected by all variables (GDP, GDP per capita, distance, FTA). Item 2 (Crude materials, inedible, except fuels), No. 3 (Mineral fuels, lubricants and related materials), No. 6 (Manufactured goods classified chiefly by material), No. 7 (machinery and transportation equipment) were affected by 3 Variables (GDP, GDP per capita, distance) except for FTA. In the case of distance, all items were affected.

## 5. Conclusion and Implications

This study analyzed the FTA and the trade status between Korea and China, and also, the trade volume changes resulting from it. We examined the implications of China's GVC shift from export to domestic market and its impact on Korea's trade.

### 5.1. Conclusion

The main findings of this study are as follows. First, as a result of the analysis of Korea's trade (import and export commodity), the dependent variables are classified as the random effect model. As the GDP is influenced by trade, import and export and its trade patterns of Korean commodities are in proportion to the market size rather than the national income pattern. In the case of export, the distance is proportional to the assumption of the gravity

Table 11. Korea's Export Analysis Result by Item (Random Effect Model)

Div.	0	1	2	3	4	5	6	7	8	9
Commodity	Food and live animals (0)	Beverages and tobacco (1)	Crude materials, except fuels (2)	Mineral fuels, lubricants and related materials (3)	Animal and vegetable oils, fats and waxes (4)	Chemicals and related products (5)	Manufactured goods classified chiefly by material (6)	Machinery and transport equipment (7)	Miscellaneous manufactured articles (8)	Commodities and transactions not classified elsewhere in the SITC(9)
GDP	0.690*** (7.989)	1.190*** (7.133)	0.386 (1.560)	0.690*** (7.989)	1.190*** (7.133)	0.386 (1.560)	0.690*** (7.989)	1.190*** (7.133)	0.386 (1.560)	0.690*** (7.989)
PcGDP	-2.008*** (-5.276)	-2.133*** (-5.070)	-2.462*** (-3.159)	-2.008*** (-5.276)	-2.133*** (-5.070)	-2.462*** (-3.159)	-2.008*** (-5.276)	-2.133*** (-5.070)	-2.462*** (-3.159)	-2.008*** (-5.276)
FTA	0.136* (1.722)	0.326* (1.764)	0.248 (1.015)	0.136* (1.722)	0.326* (1.764)	0.248 (1.015)	0.136* (1.722)	0.326* (1.764)	0.248 (1.015)	0.136* (1.722)

Notes: 1. \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.001$ .

2. Figures in parenthesis are t-statistics.

Table 12. China's Commodity Analysis Results

Division	Trade			Import			Export		
	Fixed Effect	Random Effect	Random Effect	Fixed Effect	Random Effect	Random Effect	Fixed Effect	Random Effect	Random Effect
C	-53.712 (-3.469)	10.850 (2.391)	12.005 (0.527)	10.235 (1.933)	-109.088 (-7.600)	5.607 (1.212)	-109.088 (-7.600)	5.607 (1.212)	5.607 (1.212)
GDP	2.870 (4.602)	0.537*** (3.589)	0.183 (0.199)	0.450** (2.571)	5.073*** (8.774)	0.779*** (5.115)	5.073*** (8.774)	0.779*** (5.115)	0.779*** (5.115)
PcGDP	-2.678*** (-4.087)	-0.227 (-1.447)	0.149 (0.154)	-0.132 (-0.717)	-4.989*** (-8.212)	-0.477*** (-2.984)	-4.989*** (-8.212)	-0.477*** (-2.984)	-0.477*** (-2.984)
DIST	-	-0.761*** (-2.970)	-	-0.557* (-1.882)	-	-0.928*** (-3.533)	-	-0.928*** (-3.533)	-0.928*** (-3.533)
FTA	0.088 (1.412)	0.122** (2.005)	0.143 (1.556)	0.136 (1.521)	0.038 (0.662)	0.103* (1.825)	0.038 (0.662)	0.103* (1.825)	0.103* (1.825)
Obs.	216	216	214	214	216	216	216	216	216
Adj. R2	0.984	0.740	0.967	0.967	0.990	0.737	0.990	0.737	0.737
F-stat.	507.718***	153.622***	242.904***	79.571***	802.791***	151.602**	802.791***	151.602**	151.602**
H-M $\chi^2$ (3)		20.850***		0.130		70.190***		70.190***	70.190***

Notes: 1. \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.001$ .

2. Figures in parenthesis are t-statistics.

Table 13. China's Trade Analysis Result by Item (Random Effect Model)

Div.	0	1	2	3	4	5	6	7	8	9
Commodity	Food and live animals (0)	Beverages and tobacco (1)	Crude materials, inedible, except fuels (2)	Mineral fuels, lubricants and related materials (3)	Animal and vegetable oils, fats and waxes (4)	Chemicals and related products (5)	Manufactured goods classified chiefly by material (6)	Machinery and transport equipment (7)	Miscellaneous manufactured articles (8)	Commodities and transactions not classified elsewhere in the SITC(9)
GDP	0.320* (1.917)	0.289 (1.037)	0.451** (2.493)	0.473* (1.673)	0.102 (0.315)	0.702*** (4.777)	0.611*** (4.328)	0.581*** (3.043)	0.666*** (3.528)	0.391 (0.760)
PcGDP	0.138 (0.790)	0.255 (0.872)	-0.203 (-1.069)	-0.187 (-0.632)	0.259 (0.764)	-0.388** (-2.510)	-0.338** (-2.281)	-0.321 (-1.117)	-0.222 (-0.472)	-0.252 (-0.472)
DIST	-0.753*** (-2.687)	-0.462 (-0.991)	0.291 (0.963)	-1.617*** (-3.454)	-0.262 (-0.487)	-1.029*** (-4.118)	-0.752*** (-3.158)	-1.183*** (-3.602)	-0.883*** (-2.753)	-2.080** (-2.512)
FTA	0.173 (1.644)	0.172 (0.892)	0.124 (0.962)	-0.591** (-2.321)	-0.247 (-1.001)	0.109 (1.568)	0.227*** (2.888)	0.121 (1.622)	0.047 (0.522)	-0.136 (-0.185)

Notes: 1. \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.001$ .

2. Figures in parenthesis are t-statistics.

Table 14. China's Import Analysis Result by Item (Random Effect Model)

Div.	0	1	2	3	4	5	6	7	8	9
Commodity	Food and live animals (0)	Beverages and tobacco (1)	Crude materials, inedible, except fuels (2)	Mineral fuels, lubricants and related materials (3)	Animal and vegetable oils, fats and waxes (4)	Chemicals and related products (5)	Manufactured goods classified chiefly by material (6)	Machinery and transport equipment (7)	Miscellaneous manufactured articles (8)	Commodities and transactions not classified elsewhere in the SITC(9)
GDP	0.505** (2.501)	0.444 (1.130)	0.477** (2.519)	0.717* (1.672)	0.384 (0.988)	0.406* (1.764)	0.567*** (2.665)	0.582 (1.538)	0.900*** (3.164)	0.596 (0.891)
PcGDP	0.165 (0.778)	0.487 (1.181)	-0.212 (-1.065)	-0.093 (-0.210)	0.067 (0.165)	-0.135 (-0.560)	-0.390* (-1.744)	-0.413 (-1.039)	-0.456 (-1.525)	0.126 (0.182)
DIST	0.043 (0.127)	0.357 (0.545)	0.439 (1.383)	-1.970*** (-2.870)	0.352 (0.549)	-1.125*** (-2.867)	-0.524 (-1.473)	-1.983*** (-3.090)	-2.102*** (-4.326)	-3.097*** (-2.765)
FTA	0.052 (0.348)	0.056 (0.179)	0.100 (0.770)	-1.328** (-2.055)	-0.166 (-0.435)	0.080 (0.776)	0.610*** (4.087)	0.324 (1.728)	-0.127 (-1.025)	-0.636 (-0.623)

Notes: 1. \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.001$ .

2. Figures in parenthesis are t-statistics.

Table 15. China's Export Analysis Result by Item (Random Effect Model)

Div.	0	1	2	3	4	5	6	7	8	9
Commodity	Food and live animals (0)	Beverages and tobacco (1)	Crude materials, inedible, except fuels (2)	Mineral fuels, lubricants and related materials (3)	Animal and vegetable oils, fats and waxes (4)	Chemicals and related products (5)	Manufactured goods classified chiefly by material (6)	Machinery and transport equipment (7)	Miscellaneous manufactured articles (8)	Commodities and transactions not classified elsewhere in the SITC(9)
GDP	0.565*** 2.833	0.082 (0.355)	0.558*** (3.733)	0.380** (2.103)	0.120 (0.509)	0.812*** (6.912)	0.625*** (5.054)	0.645*** (3.832)	0.660*** (3.535)	-0.352 (-1.037)
PcGDP	-0.226 -1.079	0.257 (1.068)	-0.352** (-2.244)	-0.387** (-2.050)	0.465* (1.898)	-0.474*** (-3.839)	-0.317** (-2.441)	-0.377** (-2.134)	-0.219 (-1.116)	-0.530 (-1.556)
DIST	-1.460*** -4.298	-1.650*** (-4.369)	-1.175*** (-4.691)	-1.782*** (-6.027)	-1.458*** (-3.832)	-0.977*** (-4.902)	-0.951*** (-4.585)	-0.958*** (-3.317)	-0.755** (-2.385)	-1.753*** (-3.402)
FTA	0.155* 1.743	0.172 (0.704)	0.138 (1.415)	0.273 (1.343)	-1.123*** (-3.450)	0.079** (1.388)	0.069 (0.871)	0.100 (1.489)	0.074 (0.804)	-0.094 (-0.146)

Notes: 1. \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.001$ .

2. Figures in parenthesis are t-statistics.



model, but the distance is not significant for import. The reason for this is that most of the imported commodities are essential iron ore, crude oil, etc., which are irrelevant to the distance as raw materials. The FTA was a significant variable in import, but was not a significant variable in total trades and export. The reason for this result is the imbalance between imports and exports. This shows that import is increasing after the conclusion of the FTA, and needs countermeasures to solve the international imbalance.

Second, as a result of the analysis, GDP is highly influenced by China's trade, import, and export products. The trade pattern of Chinese commodity shows that trade, imports, and exports is in proportion to the market size rather than the national income pattern. The distance has a negative effect in trade, import and export of China's commodities like the assumption of gravity models. GDP per capita is not significant for trade indicating that trade patterns based on market size are more visible than trade patterns based on income levels, but the case of exports is significant. The FTA was a significant variable in trades, exports, and the elimination of tariffs and non-tariff barriers through FTA will enable the efficient transfer of resources and production factors such as capital and labor.

## 5.2. Implications and limitation

The increase in trade and investment between Korea and China has been centered on processing trade according to China's investment-led growth policy, but China's industrial structure has recently begun to change. As the trend of economic growth moved rapidly to consumption and services, changes in the trade structure between the two countries are visible. In this regard, the meaning of the Korea-China FTA and the change in GVC in the process of transition from export to domestic demand in China have the following implications for Korean companies.

First, the FTA between Korea and China could promote greater access to China's domestic market. In China, the successful conclusion of the Korea-China FTA has a positive impact on China's "Belt and Road Initiative (BRI)" policy. In addition, China's current economic development face a number of problems, including regional economic development imbalances, slowing economic growth, shrinking export markets and environmental issues. Korea-China FTA can provide China with favorable factors such as Korea's technology, funds, market and development experience, which helps speed up China's economic changes and industrial upgrades.

Second, a strategy is needed to target the Chinese domestic market of Korean exporters. With the government's support for contactless marketing using measures to boost consumption in China, not only consumer goods but also intermediate goods companies such as materials, parts and equipment need strategic methods to communicate with local buyers online.

Third, expansion of its global partnership business is evident from automobile and shipbuilding equipment to aviation, home appliances, machinery and semiconductors in preparation for the reorganization of GVC. It is also necessary to expand the support for export of intermediate goods by identifying alternative demands following the transition to the Chinese supply chain.

Fourth, Korea can expand the opening of follow-up investment service trade in China's already signed FTA. Looking at the mutual relationship between liberalization of product trade and service trade, it showed the characteristics of "product priority" before 2006, but the characteristics of the expansion and development of products and services since 2008. The major conclusion of the Korea-China FTA service sector was that China promised to liberalize services and investment in a negative list manner for the first time.

This study has the following limitations although it derives meaningful implications above. Unit value is only available until 2015 and was not able to analyze after the conclusion of Korea-China FTA. For this reason, panel data of this paper was limited to nine years from 2007 to 2015. Because of the lack of data, the explanatory variables in the gravity model only considered general macroeconomic factors such as GDP, per capita income, etc. For the analysis of the Korea-China FTA, analyzing by long-term data collection is necessary for which this is an issue that needs to be studied in the future.

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