KDI Journal of Economic Policy 2023, 45(3):1-24
http://dx.doi.org/10.23895/kdijep.2023.45.3.1

The Peace Effects of Inter-Korean Trade and the Political-Economic Separation: Analysis of the Reciprocal Effects of Inter-Korean Relations and Inter-Korean Trade†

By KYOOCHUL KIM*

This paper empirically examines the relationship between inter-Korean trade and inter-Korean relations over the past three decades. It asks two questions: (1) Does inter-Korean trade contribute to improved inter-Korean relations and peace on the Korean Peninsula? (2) Does improved inter-Korean relations lead to increased inter-Korean trade? The study employs a time-series causal relationship analysis methodology to answer these questions. The findings show that during the progressive government's reign, inter-Korean trade was not impacted by inter-Korean relations. This is due to the implementation of a political-economic separation policy towards North Korea. Moreover, the increase in general trade and processing on commission did enhance inter-Korean relations, reflecting the "inclusive policy" aimed at achieving peace on the Korean Peninsula through inter-Korean trade. In contrast, during the conservative government's reign, inter-Korean relations had a direct impact on inter-Korean trade, with deteriorating relations leading to a significant decrease in trade. This was due to the implementation of North Korea policies that were linked to politics and the economy.

Key Word: Inter-Korean Trade, Inter-Korean Relations, GDELT, Peace Effect, Political-Economic Separation
JEL Code: F51, P33

I. Introduction

In 1989, South Korea and North Korea established the initial trade relationship, which has since been followed by various trade and economic cooperation

* Fellow, Korea Development Institute (E-mail: kyoochul@kdi.re.kr)
* Received: 2023. 3. 20
* Referee Process Started: 2023. 3. 27
* Referee Reports Completed: 2023. 4. 24
† This paper is an extension of Kim (2022). I thank two anonymous referees and Editor for their valuable suggestions. All remaining errors are mine.

projects, resulting in a substantial increase in economic exchanges[1] between the two countries. However, inter-Korean trade came to a halt in 2016 due to the deterioration of inter-Korean relations caused by North Korea's military provocations, leading to a significant decrease in trade and the suspension of the Kaesong Industrial Complex following North Korea's nuclear test. As of 2023, the security situation surrounding the Korean Peninsula, including North Korea's missile provocations and the strategic competition between the United States and China, suggests that inter-Korean relations will be difficult to improve. Nevertheless, given the quickly changing atmosphere in the region after North Korea expressed its willingness to participate in the Pyeongchang Olympics in its 2018 New Year's address, there is still a possibility that inter-Korean relations could change rapidly. Therefore, it is imperative to consider past experiences before resuming inter-Korean economic exchanges in case inter-Korean relations improve again.

Upon reflecting on the past 30 years of inter-Korean trade, there have been divergent views concerning the matter. Progressive political groups endorse the "peace economy theory," which posits that increased economic exchanges between North and South Korea enhance inter-Korean relations, motivating North Korea to desist from provocations while improving its relations with South Korea by attaining economic benefits through trade. Therefore, regardless of North Korea's military provocations or political situations, proponents of the "separation of politics-economy" principle advocate for continuous inter-Korean economic cooperation. Conversely, there are those who argue that inter-Korean trade should be halted if the security situation on the Korean Peninsula deteriorates due to a North Korean nuclear test or ICBM launch. The May 24 measures and the suspension of the Kaesong Industrial Complex during the conservative Lee Myung-Bak and Park Geun-Hye governments, respectively, serve as examples of this stance. Those holding this position are apprehensive that foreign currency derived from workers' wages at the Kaesong Industrial Complex or inter-Korean trade may be diverted to North Korea's missile and nuclear development funds. Consequently, opposing views on inter-Korean economic cooperation and trade persist to this day.

Up to this point, discussions surrounding inter-Korean trade have been primarily reliant on anecdotal evidence and incomplete examples. In order to address this issue, it is necessary to conduct a rigorous and objective analysis of empirical data to verify the hypothesis of inter-Korean economic cooperation prior to resuming inter-Korean trade and economic cooperation. This article seeks to accomplish this by examining the prevailing attitudes towards inter-Korean trade through a comprehensive empirical analysis of inter-Korean relations and trade spanning the last 30 years. The study's research questions are summarized below.

Hypothesis 1. Peace Effect

Can inter-Korean trade be regarded as a factor contributing to the improvement of

[1]Economic exchange generally involves trade and investment between countries. The South Korean government uses the phrase "economic exchange and cooperation," where exchange refers to trade and cooperation refers to investment. In this paper, economic exchanges are limited to trade according to the definition of the South Korean government. Moreover, we limit our analysis to trade as there is no reliable data on investment between the two Koreas.

inter-Korean relations and, consequently, to the establishment of peace on the Korean Peninsula? Alternatively, can a positive correlation be established between the increase in economic exchanges (trade) between the two Koreas and the enhancement of inter-Korean relations?

Hypothesis 2. Political-economic separation

Did inter-Korean relations have an impact on inter-Korean trade? Alternatively, has the continuity of inter-Korean trade been unaffected by inter-Korean relations? Alternatively, did a decline or contraction of inter-Korean trade occur in the event of any deterioration in inter-Korean relations?

The first hypothesis postulates the influence of inter-Korean trade on the state of inter-Korean relations, while the second hypothesis examines the effects of inter-Korean relations on inter-Korean trade. This study assumes that there exists a reciprocal relationship between inter-Korean trade and inter-Korean relations. To examine the qualitative perceptions or conditions of inter-Korean relations empirically, it is necessary to quantify these factors. Therefore, this study objectively quantified inter-Korean relations using internationally recognized standards for assessing relationships between countries. Additionally, inter-Korean trade was segmented into commercial and non-commercial types of trade, and the interplay between inter-Korean relations and inter-Korean trade was analyzed while accounting for differences in trade characteristics.

This study differs from prior studies in its approach to quantifying the qualitative characteristics of inter-Korean relations. Unlike previous research, which relied on hand-categorized and digitized event data from daily newspapers, this study utilizes a new dataset consisting of Google's search engine data to index recent inter-Korean relations. This provides a more comprehensive and objective analysis, as the data instances are accumulated through machine learning with minimal human intervention. Furthermore, this study addresses the limitation of prior research, which was primarily limited to the mid-2000s and lacked an analysis of later periods. By using Google's search engine data, this study offers a more comprehensive and up-to-date examination of inter-Korean relations.

In addition, prior research has analyzed inter-Korean trade by categorizing it broadly, positing total trade, commercial trade, and non-commercial trade categories, among others. However, this study went a step further and delved deeper into the analysis by dividing inter-Korean trade into more refined categories, including division and group levels, to determine if there were any differences or similarities in the effects on inter-Korean relations for each type of trade.

This study is organized as follows. In Chapter II, we conduct a review of existing studies on the topic, including those that analyze inter-Korean trade and its effects on inter-Korean relations. In Chapter III, the data to be used in this study is introduced. This includes a brief review of existing data on international events as well as the introduction of new data that will be used to measure inter-Korean relations. The section also provides a brief overview of inter-Korean trade data. Chapter IV presents the methodology and results of the time-series analysis, which will interpret the relationship between inter-Korean trade and inter-Korean relations,

including differences that take into account the period of the Korean government's administration and the nature of trade. Finally, Chapter V summarizes the key findings and conclusions and provides corresponding implications.

II. Literature Review

The esteemed German philosopher Immanuel Kant posited that promoting economic exchanges between nations is a crucial step in securing "eternal peace." He believed that countries that are economically interdependent will work to resolve disputes in order to safeguard their mutual interests. This debate on the relationship between trade, disputes and cooperation between nations continues to be a significant matter of discussion in international relations even today. Political and economic theorists including David Ricardo, Vladimir Lenin, John Maynard Keynes and Albert O. Hirschman have all explored the correlations between trade and political variables. Correlations between trade and political variables were initially explored in an empirical manner by Polachek (1978), and since then, a multitude of related studies have been conducted.

The relationship between trade and conflict between nations is reciprocal. Both trade and national relations impact each other. It is widely accepted that positive national relations lead to increased trade and investment. In addition, disputes between nations result in a decline of economic exchanges. This has been substantiated by numerous studies. However, the impact of trade on peace and conflicts between nations is still being debated. Proponents of liberalism contend that mutual economic dependence through trade and investment fosters incentives for conflict reduction and peace preservation, thereby improving national relations.[2] Conversely, some studies suggest that despite increased economic ties, national relations may deteriorate if economic dependence becomes too severe.[3] Hence, the relationship between trade and national relations is complex and influenced by various variables depending on the specific context and country characteristics.

Lee (2006) conducted a pioneering empirical analysis to investigate the relationship between inter-Korean trade and inter-Korean relations. The study aimed to test the "peace economic theory," which suggests that economic benefits from inter-Korean trade could ease tensions and strengthen peace between the two Koreas. It utilized the Korea Peace Index (KOPI), jointly developed by Hanyang University and JoongAng Ilbo, as a measure of inter-Korean relations and found it challenging to arrive at a definitive conclusion pertaining to the causal relationship between inter-Korean trade and peace on the Korean Peninsula. The analysis indicated that prior to October of 2002, North Korea's trade surplus had a significant impact on inter-Korean relations, but this relationship weakened following the second North Korean nuclear crisis during that month.

Lee (2010) expanded his research with the aim of reaffirming his hypothesis that inter-Korean economic cooperation positively impacts inter-Korean relations. To quantify these relations, the study utilized both the Korea Peace Index and Harvard

[2]Hegre, Oneal, and Russett (2010), Oneal and Russett (1997), Reuveny and Kang (1996).
[3]Barbieri (1996), Gasiorowski (1986), Martin, Mayer, and Thoenig (2008).

University's 1990-2004 international relations event data.[4] The study period from January of 1998 to December of 2004, a slightly wider range compared to the previous study. This study analyzed the impact of trade among North Korea, China, Japan, and the U.S. on North Korea's external behavior. The results showed that only trade with the U.S. had a significant impact on North Korea's behavior, while trade with other countries did not. Based on these findings, Lee (2010) suggested that trade with the U.S. may be perceived as a political and diplomatic signal, affecting North Korea's external behavior. Ultimately, Lee (2006) and Lee (2010) suggested that inter-Korean trade has no significant impact on inter-Korean relations, North Korean actions, or peace on the Korean Peninsula.

Ju and Kim (2006) conducted a comprehensive study to assess the evolution of inter-Korean relations from 1989 to 2005. The study took into account several key factors while dividing commercial transactions into those related to general trade, processing on commission, Mt. Geumgang tourism, and the Kaesong Industrial Complex. The researchers relied on data from the Chosun Ilbo and Yonhap News Agency, as well as the Ministry of Unification, to compute an index of inter-Korean relations, by carefully observing and recording instances of cooperation and disputes between the two Koreas. The results showed that inter-Korean relations improved with an increase in general trade, whereas trade in the form of commission processing had no significant impact on inter-Korean relations.

Kim and Lee (2013) conducted an analysis of inter-Korean trade and conflict relations spanning the period from January of 2000 to December of 2012. The data for the disputes was collected independently, utilizing the COPDAB (Conflict and Peace Data Bank) methodology. This study not only analyzed inter-Korean trade but also its impact on inter-Korean relations by considering North Korea-China trade and South Korea-China trade as relevant variables. The results of the analysis confirmed the relationship between inter-Korean trade and inter-Korean conflict and further validated the liberal theory of peace through trade in the context of inter-Korean relations.

Previous studies of inter-Korean relations and trade are limited as they only examine data up to the early 2010s. Since then, there have been significant changes in the relationship between North Korea and South Korea. The 5.24 measures in 2010 caused a complete cutoff of inter-Korean exchanges, excluding the Kaesong Industrial Complex. The suspension of inter-Korean trade in 2016, excluding humanitarian aid, was a result of North Korea's nuclear test and the subsequent closure of the Kaesong Industrial Complex. North Korea's continued nuclear tests and missile launches have internationalized the Korean Peninsula and led to a significant decrease in non-commercial transactions due to UN Security Council sanctions. To ensure accurate analysis methods and data, it is necessary to expand the analysis period and conduct a comprehensive analysis of inter-Korean relations and trade. This study aims to fulfill this need by presenting an extended examination of inter-Korean relations and trade.

[4]https://dataverse.harvard.edu/dataset.xhtml?persistentId=hdl:1902.1/FYXLAWZRIA

III. Data

A. *Inter-Korean Relations*

Event data techniques are widely employed to quantify interactions, such as cooperation and conflict, between countries. This approach involves observing events that take place between countries and converting them into numerical data using standardized methods. Event data encompasses the date of occurrence, the country responsible for the action (actor), the country that is the target of the event, and the event itself. The development of event data techniques took place during the Cold War period and was designed to examine the issues of conflict and cooperation between the United States and the Soviet Union scientifically. Notable studies that pioneered the use of event data techniques include Azar's Conflict and Peace Data Bank (COPDAB), McClelland's World Event/Interaction Survey (WEIS) project, and CAMEO (Conflict and Mediation Event Observations).

The ongoing efforts to collate events between countries as data have resulted in the availability of a representative database called GDELT (Global Database of Events, Language and Tone). This study utilizes GDELT, which is supported by the National Science Foundation (NSF). The database provides a substantial amount of information through its webpage,[5] facilitated by the use of software known as Textual Analysis by Augmented Replacement Instructions (TABARI). This software automatically converts text from news media sources into data.

This study utilizes the GDELT 1.0 Event Database,[6] a comprehensive resource that provides information on the origin and target countries, the behavior (classified according to the Goldstein Scale), and the location of events dating back to 1979 and up to the present day. The data is sourced from media articles collected by Google, in over 100 languages, and it reflects the tone of each article. The tone is determined through a numerical value that distinguishes the positive or negative nature of the actions between countries portrayed in the article. A positive score of an article is calculated using the proportion of words with positive emotional connotations, while a negative score is the proportion of words with a negative emotional meaning. These values are then combined to form an emotional index (AvgTone). Inter-country behaviors are classified based on the CAMEO code system, which modifies the Goldstein Scale system used in WEIS.

The GDELT dataset offers insights into the actions and behavior of countries, enabling the differentiation of South Korea's stance towards North Korea and vice versa. With the use of Google's data and cutting-edge technology, the world's largest database is constructed with a strong emphasis on objectivity as the information is generated through computer algorithms, minimizing human interference. This comprehensive dataset dates back to 1979 and continues to be updated daily, making it a valuable resource for time-series analysis and historical trends.

GDELT event data has been widely utilized in various fields and disciplines. Yuan

[5]https://www.gdeltproject.org/.

[6]Additionally, the GDELT 2.0 Event Database has been continuously updated every quarter hour since February 18, 2015. However, for the purpose of this study, which focuses on the variables of inter-Korean relations prior to 2015, the GDELT 1.0 Event Database will be utilized.

et al. (2020) leveraged this data to examine the interplay between cooperation and conflict among the United States, Russia, and China. Similarly, Voukelatou *et al*. (2020) utilized GDELT data to compute peace indices for individual countries. Furthermore, Alamro *et al*. (2019) employed this data to forecast the stock market index of Saudi Arabia, while Consoli *et al*. (2020) conducted an analysis of the Italian government bond market utilizing GDELT data. These examples demonstrate the versatility of GDELT data, which has found applications not only in the realm of international politics but also in economic and financial research.

Recently, South Korean researchers have been exploring the use of data to analyze inter-Korean and international relations. Park (2021) conducted an analysis of Korea-Japan trade disputes and Korea-China trade conflicts using GDELT. Son (2020) also used GDELT to examine changes in Korea-Japan relations over the course of 20 years and reported that the data effectively reflected these changes. Lee (2022) leveraged GDELT to analyze the impact of U.S.-China conflicts on Korea-China relations. Yi and Lim (2021) further analyzed the interplay between cooperation and conflict between South and North Korea using GDELT.

In this study, we examine the inter-Korean relationship as depicted through GDELT data. The time series covered in this analysis ranges from January of 1990 to December of 2021 and the daily GDELT data was consolidated on a monthly basis. GDELT data features two key indicators of the relationship between the two countries: the Goldstein Scale, which quantifies the level of cooperation and conflict, and the average tone (AvgTone) of media articles about events. The Goldstein Scale, which classifies events based on long-term academic and systematic standards, is utilized to express the value of inter-Korean relations in this study. On the other hand, the AvgTone index reflects the tone of the news coverage rather than the actual inter-Korean relationship, as it represents the positive or negative view of each article being analyzed.[7]

The Goldstein Scale is utilized to measure the nature of relationships between two entities, with negative values indicating a conflictual relationship and positive values indicating a cooperative one. In this research, the level of inter-Korean relations was calculated by taking the average of the Goldstein Scale values of events that took place during a given month. This average value represents the overall level of cooperation or conflict between North and South Korea, considering both nations' interactions with each other.

The trend of inter-Korean relations index is depicted in Figure 1, displaying crucial events that took place during each presidential term and their impacts on inter-Korean relations. It is evident that inter-Korean relations experienced a steep decline in response to major North Korean provocations and inter-Korean conflicts such as the missile launches, nuclear tests, and the sinking of the ROKS Cheonan. Conversely, inter-Korean relations experienced a significant surge when inter-Korean dialogue or cooperation was initiated. Therefore, the inter-Korean relations index presented in this paper aligns with the commonly accepted view of inter-Korean relations.

After examining the general perception, we will delve into the accuracy of the

[7]Park (2021) and Lee (2022) conducted research on the average tone of inter-country relationships, focusing on variables that can gauge the emotional reactions of individuals to specific events.

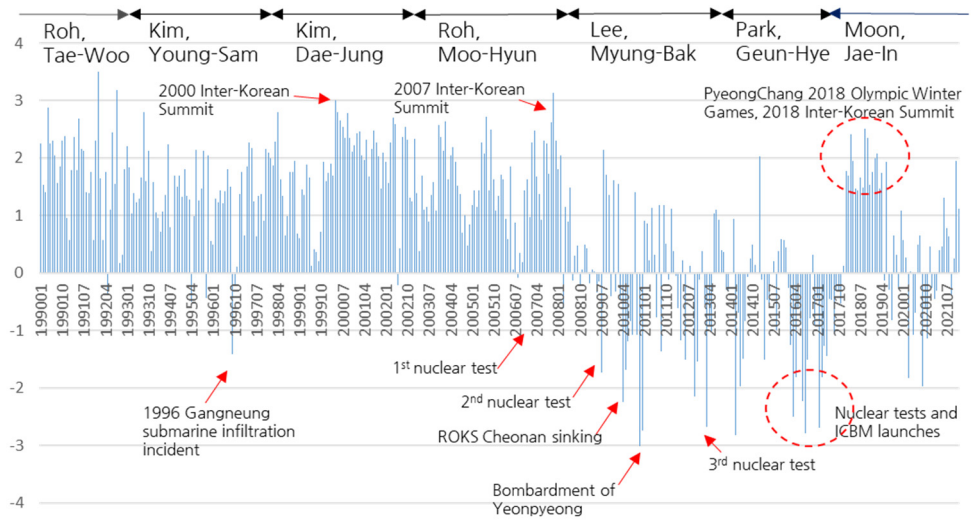

FIGURE 1. INDEX OF THE TREND OF INTER-KOREAN RELATIONS BY GDELT

inter-Korean relations figures estimated by GDELT by comparing them with indices that quantify the state of inter-Korean relations. The first index to be analyzed is the Korea Peace Index (KOPI) developed by the Asia-Pacific Research Center at Hanyang University and JoongAng Ilbo, using the COPDAB method. This index was created using the manual classification of inter-Korean relations events reported in Korean media articles, including Yonhap news. As shown in Figure 2, the trends of the Korean Peace Index (KOPI) and the inter-Korean relations index estimated by GDELT appear to be following a similar direction. In fact, a high correlation of 0.72 was discovered between the two indices.

The second index of inter-Korean relations is the Index of Geopolitical Risk from North Korea, developed by Jung *et al*. (2021). This index is a compilation of crucial events in inter-Korean relations, including military tensions, sanctions, inter-Korean dialogue and agreements, and economic cooperation, sourced from prominent

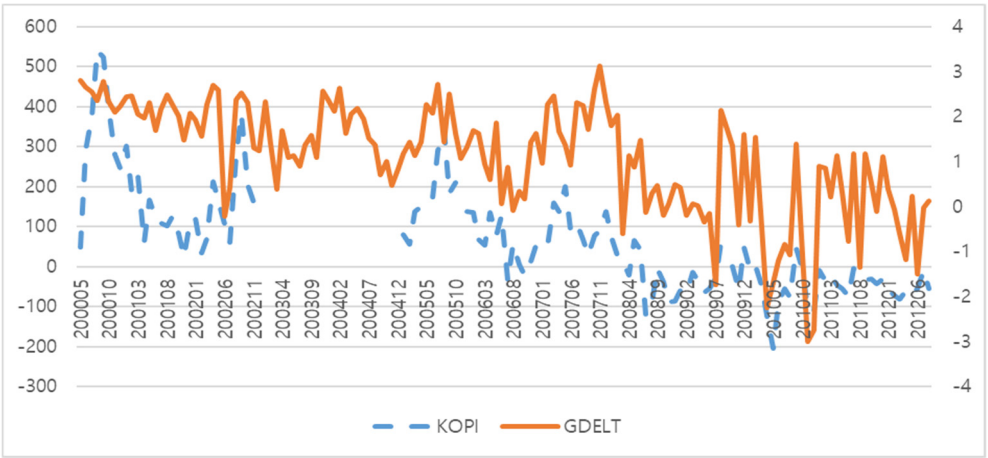

FIGURE 2. INTER-KOREAN RELATIONS ESTIMATED BY KOPI AND GDELT

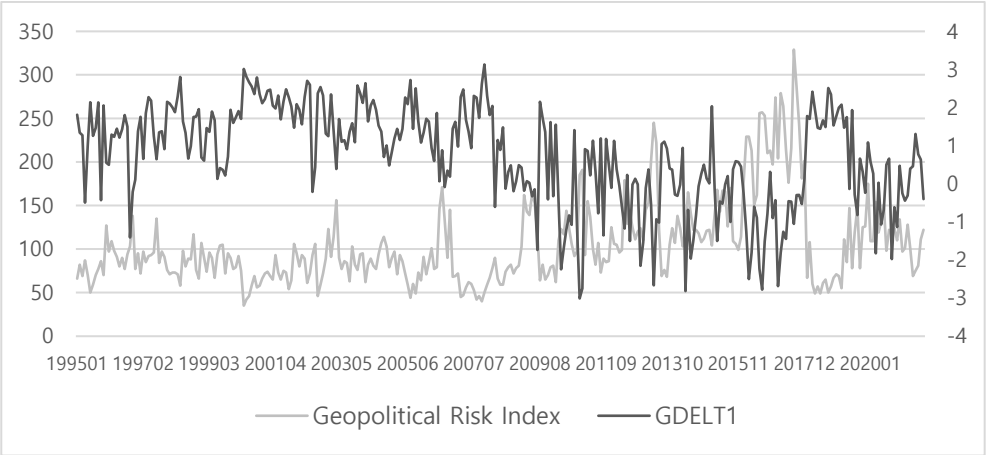

FIGURE 3. GEOPOLITICAL RISK INDEX AND GDELT

Korean media outlets. The data is quantified and covers a time frame of January of 1995 to September of 2021, with data compiled monthly. The trends of the geopolitical risk index and the GDELT inter-Korean relations index are depicted in Figure 3. An inverse relationship between the two indices can be seen, with the higher value of the geopolitical risk index indicating a higher level of risk or uncertainty in inter-Korean relations. The two indices appear as mirror images, and the correlation coefficient of -0.73 suggests a strong inverse relationship between the two. Consequently, the inter-Korean relations index, as depicted in GDELT, was discovered to be in consonance with the inter-Korean relations computed in prior studies as well as with general perceptions.

B. *Inter-Korean Trade*

The data on economic exchanges between South and North Korea was sourced from Inter-Korean trade data. The Inter-Korean Exchange and Cooperation System[8] offers access to Inter-Korean trade statistics, which can be downloaded for usage. The Inter-Korean trade information is updated on a monthly basis and can be sorted according to as many as ten units of HS code, providing a comprehensive classification of products. Additionally, Inter-Korean trade is differentiated between commercial and non-commercial transactions, as further outlined in Table 1.

To gain a comprehensive understanding of the impact of inter-Korean relations on inter-Korean trade, it is crucial to analyze the diversity of transactions by categorizing them based on the type and direction of flow. To achieve this, we need to delve into the intricacies of classifying inter-Korean trade and distinguish between imports and exports.

Figure 4 illustrates the annual scope of inter-Korean trade, which has been segregated into non-commercial and commercial transactions. Over a period of 33 years, from 1989 to 2021, the total inter-Korean trade volume amounted to $24.86 billion, with commercial transactions accounting for 88.9% ($22.1 billion) and non-

[8]https://www.tongtong.go.kr/unikoreaWeb/ui/pblc/guidance/dta/PGDDTDtaBbsNrstkrTradeStatsGuidance.do

TABLE 1—INTER-KOREAN TRADE CLASSIFICATION BY TYPE

Section	Division	Group
Commercial transactions	Trade	General trade
		Processing on commission
	Economic cooperation projects	Kaesong Industrial Complex
		Mt. Geumgang Tourism
		Other economic cooperation projects
	Light industry projects	Light industry projects
	Cooperation projects before 2004	Cooperation projects before 2004
Non-commercial transactions	Assistance to North Korea	Privately funded
		Government-funded
		Assistance to North Korea before 2004
	Socio-cultural projects	Socio-cultural projects
	Light water reactor projects	Light water reactor construction
		KEDO heavy oil
	Energy assistance	Energy assistance

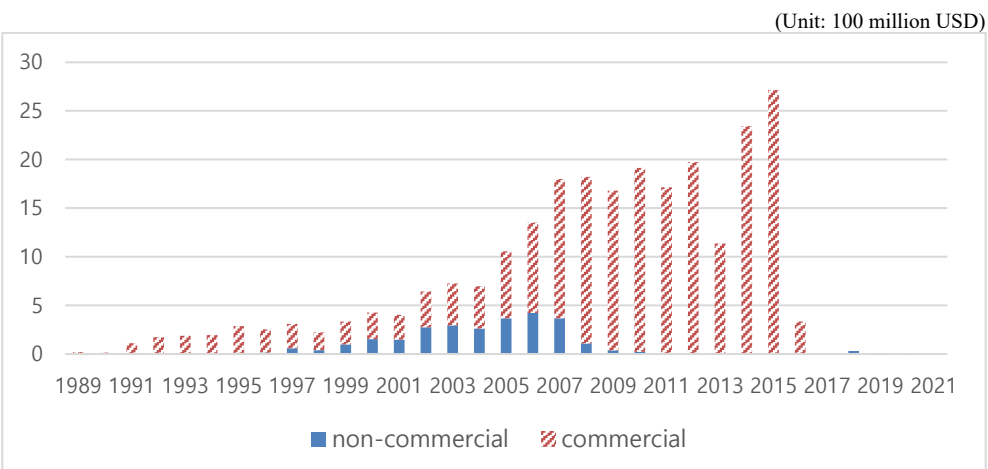

FIGURE 4. INTER-KOREAN TRADE: NON-COMMERCIAL AND COMMERCIAL TRANSACTIONS

commercial transactions constituting 11.1% ($2.76 billion). The initiation of commercial transactions took place in 1989 and ceased in 2016, while non-commercial transactions commenced in 1995 and continued until 2021. The suspension of commercial inter-Korean trade was a result of the closure of the Kaesong Industrial Complex and sanctions imposed on North Korea, while non-commercial trade was initiated with the assistance to North Korea during North Korea's economic crisis in the mid-1990s, continuing until 2021. The inter-Korean trade volume witnessed a significant rise in the mid-2000s, reaching a level of at least $2.7 billion in 2015. However, after North Korea's fourth nuclear test in 2016 and the subsequent closure of the Kaesong Industrial Complex, the trade volume experienced a significant decline, with only minor non-commercial transactions

maintained since 2017.

Examining the non-commercial transactions between North and South Korea reveals that South Korea is the predominant exporter, accounting for 99.4% of all non-commercial transactions. This suggests that the non-commercial transactions are a one-sided effort on South Korea's part to provide assistance. During the presidencies of Kim Dae-Jung (1998 to 2003) and Roh Moo-Hyun (2003 to 2008), 89% of all non-commercial transactions took place. This period coincided with North Korea's period of severe hardship, including widespread starvation, following an economic crisis. As a result, the international community, including South Korea, delivered numerous humanitarian aid shipments to North Korea. The main items exported through non-commercial transactions were fertilizers, grains, mineral fuels, and medical supplies.

Regarding commercial transactions, the import-export ratio between North and South Korea is recorded as 57:43, demonstrating a bi-directional trade pattern, unlike non-commercial transactions. Unlike the latter, which are predominantly executed by South Korea, South Korea's imports from North Korea surpass its exports. When examining commercial inter-Korean trade based on the division level, it is observed that 67.5% of the transactions fall under the category of economic cooperation projects, while 31.9% are classified as trade. The largest contributor to the economic cooperation projects category is the Kaesong Industrial Complex project, accounting for 64.7% of such transactions, followed by the Mt. Geumgang Tourism project at 2.3% and other economic cooperation projects at 0.4%. With regard to general trade, 17.8% of commercial transactions are accounted for, with processing on commission making up 14.1%. This highlights the significant role that the Kaesong Industrial Complex project, general trade, and processing on commission play in commercial transactions between the two Koreas.

The key features of inter-Korean trade can be summarized as follows: non-commercial transactions started later than commercial transactions and have remained small in scale. Unlike commercial transactions, where imports and exports between North Korea and South Korea are balanced, non-commercial transactions are mostly carried out by South Korea, making it appear as unilateral support. Commercial transactions also vary by type, with the Kaesong Industrial Complex project and processing on commission being the most common. These types of trade involve raw materials being exported to North Korea, where intermediate and final products are manufactured using North Korean labor, before being imported back into South Korea. This has resulted in a two-way trade form with similar levels of exports and imports. On the other hand, most general trade imports from North Korea are of the one-way type. North Korea lacks the purchasing power to buy South Korean products, thus resulting in a small scale of South Korean exports. Imports from North Korea to South Korea are primary products, such as fish, minerals, sand, and vegetables, all of which are traded due to their comparative advantage. Hence, general trade between the two Koreas is economically motivated, just like regular trade with other countries.

In conclusion, to assess the interplay between inter-Korean trade and inter-Korean relations accurately, it is recommended to analyze trade characteristics and imports and exports separately rather than treating inter-Korean trade as a homogeneous entity.

IV. Empirical Analysis

In this section, we conduct an empirical analysis of the relationship between the two aforementioned variables through the use of the inter-Korean relations index calculated by GDELT and inter-Korean trade data. To account for fluctuations in trade amounts, we use logarithmic transformation after adding a constant of 1. This correction was necessary to prevent errors that may arise when taking the logarithm of zero at the monthly level.

Inter-Korean trade has fluctuated primarily due to military and security tensions between North and South Korea. These tensions had a direct impact on the suspension and resumption of inter-Korean trade and economic cooperation projects. The study analyzed the timing and end points of each type of inter-Korean trade, taking into consideration only the periods during which actual trade was conducted. The analysis periods varied according to the trade type. For commercial transactions, the analysis was limited to the period up to March of 2016. Regarding the division level, the analysis period was up to May of 2010 for general trade and March of 2016 for economic cooperation projects. This was necessary due to the complete suspension of inter-Korean trade, excluding the Kaesong Industrial Complex, after the Korean government's May 24 measures in 2010. The Mt. Geumgang tourism project was virtually suspended following the tourist shooting incident in July of 2008; thus, the time point was set as the analysis period. Non-commercial transactions, which began in 1995, have continued to the present due to the existence of humanitarian support, regardless of sanctions. As a result, the research period for assistance to North Korea was up to December of 2021. Lastly, the relationship between inter-Korean relations was examined by dividing the imports and exports of inter-Korean trade according to the type of trade.

In order to examine the relationship between the inter-Korean relations index and the inter-Korean trade data, it is imperative to confirm the stationarity of the time-series variables. This requires conducting a unit root test on the variables. The ADF (augmented Dickey-Fuller) test is utilized to determine the unit root of the time-series variables. The results of the ADF test for both inter-Korean relations and inter-Korean trade are presented in Appendix 1. The inter-Korean relations variable is found to exhibit stationary characteristics. However, the inter-Korean trade variables are observed to either exhibit stationary or non-stationary time series characteristics depending on the trade type and period.

The Granger causality test is commonly utilized to analyze relationships between time-series variables. This test determines the significance of an independent variable in predicting the dependent variable in the present, distinct from a general causal relationship. In situations where it is challenging to establish an experimental group and a control group in the analysis of time-series variables, the Granger causality test is predominantly utilized due to such practical limitations of the data. This study will assess the relationship between inter-Korean relations and inter-Korean trade through the application of the Granger causality test.

When the integration order between time-series variables is consistent, a general regression analysis is utilized to determine if the past value of the independent variable has an impact on the current value of the dependent variable. However, if

the integration order between the independent and dependent variables is not equivalent, such as when analyzing the relationship between I(0) and I(1), the possibility of a spurious correlation can arise. Regardless of the timing, inter-Korean relations variables are considered I(0), while inter-Korean trade variables can be either I(0) or I(1) depending on the timing and form. As such, a methodology that takes this into account must be employed when analyzing the relationship between the two. Toda and Yamamoto (1995) developed a methodology that verifies causal relationships between variables with different integration orders, considering the aforementioned issue. This methodology can be used to verify causal relationships regardless of whether the time series is stationary or non-stationary. Consequently, here the methodology developed by Toda and Yamamoto (1995) is applied to assess the causal relationship between inter-Korean relations and inter-Korean trade.

The control variable was employed under the assumption that inter-Korean relations and trade would exhibit a linear trend and be impacted by the political orientation of the South Korean government. Notably, the imposition of independent sanctions by South Korea against North Korea in the form of the May 24 measures in 2010 and the UN Security Council's sanctions against North Korea between 2016 and 2017 have significantly altered the nature of inter-Korean trade. As a result, following these pivotal events, they were subsequently categorized and managed as dummy variables.

The null hypothesis to be evaluated through Granger causality is that the coefficients of past values of X (independent variables) are all zero with regard to determining the current value of Y (dependent variable). The outcomes of the Granger causality test simply indicate whether the coefficients are rejected (the historical values of the independent variable do not contribute to predicting the current value of the dependent variable) and whether it is necessary separately to determine the direction of influence, whether positive (+) or negative (-).

The correlation between inter-Korean relations and inter-Korean trade is widely acknowledged to be positive. Improved inter-Korean relations are likely to result in a rise in inter-Korean trade, whereas a decline in inter-Korean relations may lead to a decrease in inter-Korean trade. Upon conducting a thorough examination of the regression analysis coefficients, it was found that there were no instances where the inter-Korean relationships had a detrimental impact on inter-Korean trade, which was in line with the expected outcomes. In the accompanying tables, the symbol '⇨' signifies that there is a positive causal relationship between inter-Korean relations and the type of trade. Conversely, the symbol '⇦' indicates that inter-Korean trade has a positive impact on inter-Korean relations.

Table 2[9] provides a summary of the causal relations observed in various types of inter-Korean trade. The noteworthy finding is that inter-Korean relations exert a significant influence on trade, while the reverse is not observed in any form of trade. The unilateral impact of inter-Korean relations on trade remains consistent across both commercial and non-commercial transactions, serving as the criteria for segmentation. Furthermore, inter-Korean relations exhibit a unilateral effect on trade across most trade forms. Specifically, an improvement in inter-Korean relations

[9]Appendix Table A2 provides a summary of the Granger causality test statistics and significance pertaining to the various trade types and governments.

TABLE 2—GRANGER CAUSALITY RESULT 1: WHOLE PERIOD

	Total amount	Export	Import
Total transaction	⇨	⇨	⇨
1. Commercial transaction	⇨	X	⇨
1.1. Trade	X	X	X
1.1.1. General trade	X	X	X
1.1.2. Processing on commission	X	X	X
1.2. Economic cooperation projects	X	X	⇨
1.2.1. Kaesong Industrial Complex	⇨	⇨	X
1.2.2. Mt. Geumgang Tourism	X	X	-
2. Non-commercial transaction	⇨	⇨	-
2.1. Assistance to North Korea	⇨	⇨	-

leads to an overall increase in inter-Korean trade, including both commercial and non-commercial transactions. Conversely, in the event of the deterioration of inter-Korean relations, a causal link exists whereby the volume of trade diminishes.

First, we examine the impact of inter-Korean relations on commercial trade. Specifically, the imports in general trade and processing on commission trade, both subcategories of trade, experience a positive impact from inter-Korean relations. This signifies that improved inter-Korean relations result in a rise in South Korea's general trade and processing of commission trade. Conversely, when inter-Korean relations weaken, the value of these types of trade decreases. However, for the Kaesong Industrial Complex, which is a subcategory of economic cooperation projects, inter-Korean relations have a positive impact on exports but not imports. Moreover, inter-Korean trade associated with the Mt. Geumgang tourism project does not exhibit a correlation with inter-Korean relations. This raises the question of why the import and export of inter-Korean trade are affected differently by the type of trade. The import volume of general trade and processing on commission trade exceeds that of exports, and it is sensitive to the influence of inter-Korean relations because it represents a means of acquiring foreign currency for North Korea. Conversely, in the context of the Kaesong Industrial Complex trade, imports are associated with the volume of exports and thus inter-Korean relations may have a more direct impact on exports. Mt. Geumgang tourism trade is a form of trade aimed at promoting tourism rather than commercial trade. Accordingly, the effect of inter-Korean relations on it may be limited.

An impact of inter-Korean relations on commercial transactions, particularly imports, was observed. The subclass of commercial transactions, i.e., general trade, remained unaffected by inter-Korean relations, while trade projects related to economic cooperation were affected. Subcategories of trade, such as general trade and processing on commission, were either unaffected or impacted by inter-Korean relations. In the specific case of the Kaesong Industrial Complex project, exports were influenced by inter-Korean relations, whereas imports were not found to be related to such relations. It has been established that inter-Korean trade conducted under the tourism project at Mt. Geumgang was not influenced by inter-Korean relations. Non-commercial forms of trade, such as assistance to North Korea, were found to be unilaterally affected by inter-Korean relations. To elaborate, an improvement in inter-Korean relations leads to an increase in South Korea's support

TABLE 3—GRANGER CAUSALITY RESULT 2: PROGRESSIVE GOVERNMENT

	Total amount	Export	Import
Total transaction	X	X	X
1. Commercial transaction	X	X	X
1.1. Trade	X	X	X
1.1.1. General trade	⇦	X	⇦
1.1.2. Processing on commission	⇦	X	X
1.2. Economic cooperation projects	X	X	X
1.2.1. Kaesong Industrial Complex	X	X	X
1.2.2. Mt. Geumgang Tourism	X	X	-
2. Non-commercial transaction	⇨	⇨	-
2.1. Assistance to North Korea	⇨	⇨	-

for North Korea, while deterioration of these relations results in a decrease in such support.

The study aims to determine the variation in the reciprocal impact of inter-Korean relations and inter-Korean trade based on the political orientation of the South Korean government. The analysis is conducted by dividing the periods of South Korean governance into conservative and progressive eras. The period from March of 1998 to February of 2008, characterized by the presidencies of Kim Dae-Jung and Roh Moo-Hyun, is considered here as a progressive government era, while the presidencies of Lee Myung-Bak and Park Geun-Hye from March of 2008 to February of 2017, is considered as a conservative government era.

Table 3 encapsulates the relationship between inter-Korean relations and inter-Korean trade during the era of progressive governments in South Korea. During these progressive governments, the effects of general trade and processing on commission are found to be positive. Specifically, as the volume of South Korean imports from North Korea (or North Korean exports to South Korea) increased, it had a positive impact on the relationship between the two nations. The Kaesong Industrial Complex and Mt. Geumgang tourism projects, on the other hand, were not found to have a direct impact on inter-Korean relations. Non-commercial transactions, such as assistance to North Korea, were solely dependent on the state of inter-Korean relations.

The interplay between inter-Korean relations and inter-Korean trade during the era of progressive governments can be analyzed as follows. First, the observation that inter-Korean relations did not hinder trade in terms of commercial dealings highlights the adherence to the principle of separating politics from business at the time. The progressive governments stressed the need for establishing stable inter-Korean relations and emphasized that inter-Korean trade should persist regardless of political circumstances or developments on the Korean Peninsula. In fact, the Kim Dae-Jung government upheld this principle of separation even during military provocations such as the North Korea's submarine infiltration incident in 1998 and the Battle of Yeonpyeong in 1999.[10] The positive impact of general trade and processing on commission on inter-Korean relations can be attributed to what is termed the "peace effect." The influx of general trade into Korea was found to have

[10]Ministry of Unification North Korean Information Portal, "Principle of Political-Economic Separation" (https://nkinfo.unikorea.go.kr/nkp/term/viewKnwldgDicary.do?pageIndex=15&dicaryId=43&searchCnd=0&searchWrd=).

TABLE 4—GRANGER CAUSALITY RESULT 3: CONSERVATIVE GOVERNMENT

	Total amount	Export	Import
Total transaction	⇨	⇨	⇨
1. Commercial transaction	⇨	⇨	⇨
1.1. Trade	X	-	X
1.1.1. General trade	⇨	-	⇨
1.1.2. Processing on commission	X	-	X
1.2. Economic cooperation projects	⇨	⇨	⇨
1.2.1. Kaesong Industrial Complex	⇨	⇨	⇨
1.2.2. Mt. Geumgang Tourism	⇨	⇨	-
2. Non-commercial transaction	X	⇨	-
2.1. Assistance to North Korea	X	⇨	-

a positive impact on the relationship between North and South Korea. The export of general trade products to the South was a major source of foreign currency for North Korea. Thus, it can be deduced that North Korea was mindful of its relationship with South Korea, considering that an increase in exports to South Korea led to an increase in foreign currency income. This phenomenon aligns with the goals of the "Sunshine policy," which aimed to enhance North Korea's economic ties with South Korea and promote inter-Korean trade, ultimately leading to an improvement in North Korea's behavior and the overall relationship between the two nations.

Table 4 provides a comprehensive overview of inter-Korean relations and inter-Korean trade during the period from March of 2008 to February of 2017, when conservative governments led by Presidents Lee Myung-Bak and Park Geun-Hye were in power.[11] It has been established that the state of inter-Korean relations has a one-way impact on inter-Korean trade. Specifically, inter-Korean relations exerted an influence on inter-Korean trade, but inter-Korean trade did not affect inter-Korean relations. The direction of this impact was found to be positive. In other words, inter-Korean relations impacted inter-Korean trade in a positive manner. This correlation becomes particularly noteworthy when considering the tense inter-Korean relations during the presidencies of Lee Myung-Bak and Park Geun-Hye, which led to a decrease in the magnitude of inter-Korean trade. The unilateral impact of inter-Korean relations on inter-Korean trade serves as a demonstration of the interplay between politics and business. In contrast to the rules of a progressive government, inter-Korean economic exchanges during the conservative government were directly influenced by inter-Korean relations and events such as South Korea's 5.24 sanctions and the suspension of the Kaesong Industrial Complex project following North Korea's nuclear test.

The empirical analysis of inter-Korean relations and trade has revealed the following insights. During the progressive government era, commercial transactions remained unaffected or had a minimal impact on inter-Korean relations. This reflects the implementation of South Korea's policy toward North Korea of separating politics and business, with a focus on proceeding with inter-Korean trade. The analysis of trade types also showed that improvements in inter-Korean relations were

[11]As a result of the implementation of measures on May 24, 2010, the export of ordinary trade and commission processing trade was discontinued during that year. The limited time- series data was not adequate to include this type of trade in the analysis.

correlated with an increase in general trade, likely due to the "inclusive policy" aimed at promoting peace and stability through inter-Korean trade. In contrast, during the era of conservative governments, the strained inter-Korean relations had a unilateral impact on inter-Korean trade, resulting in a decline in transactions overall, both commercial transactions and non-commercial transactions (assistance to North Korea). This was due to North Korea's political and military provocations, which prompted the suspension of economic exchanges between North and South Korea.[12]

The dynamics of non-commercial transactions, such as assistance to North Korea, are influenced solely by inter-Korean relations regardless of the government's tendencies. A correlation was observed between improvements of inter-Korean relations and increased levels of South Korean assistance to North Korea, as well as declines in assistance when relations worsen. This pattern was evident under both conservative and progressive governments. This suggests that incidents such as North Korea's military provocations that deteriorate inter-Korean relations may impact the South Korean public's sentiment towards North Korea, thereby altering the stance of civic groups or governments that provide aid to North Korea.

This paper's empirical analysis is distinct from previous analyses that examined the correlation between inter-Korean trade and the inter-Korean relations. By extending the time frame to include the period since 2010, during which significant incidents took place that affected inter-Korean relations, it becomes evident that the conservative and progressive governments exhibit discernible differences. This study makes a contribution by analyzing inter-Korean trade at a detailed level, specifically focusing on exports and imports. Finally, an inter-Korean relations index that is objectively measured was introduced with the aim of proposing the potential for broader future research in related areas.

V. Conclusion

Currently, inter-Korean relations are in a strained state, but we should prepare for the resumption of inter-Korean trade due to the improvement of inter-Korean relations in the future. To this end, first it is necessary to reconfirm the existing perception of inter-Korean trade in the past. It is necessary to evaluate whether inter-Korean trade actually had a peace effect that improved inter-Korean relations and whether the principle of political-economic separation of inter-Korean trade was in fact well implemented using objective data and a proper methodology.

There exists a divergence of opinions concerning the peace-enhancing effects of inter-Korean trade on the Korean Peninsula and the furtherance of peace through this medium. Those who support the peace effect of inter-Korean trade assert that economic exchanges between South and North Korea should persist irrespective of

[12]The text revealed that the deteriorated inter-Korean relations led to a disruption or reduction in inter-Korean trade. Conversely, if the relations between North and South Korea improve, will inter-Korean trade increase? If inter-Korean relations improve and become politically stable, it is also undeniable that there will be a possibility of increased economic activity by South Korean companies investing in North Korea. Moreover, the approval of new investments and an improved investment climate due to improved inter-Korean relations will have a positive impact on trade. Hence, it is believed that an improvement in inter-Korean relations may have a positive impact on inter-Korean trade. We thanks to the reviewer for providing the clues about hint on this.

political circumstances, emphasizing the separation of politics and economics. Conversely, others advocate for the continuation or severance of economic exchanges in accordance with North Korea's actions.

This study presents an empirical analysis of the reciprocal effects between inter-Korean relations and inter-Korean trade data spanning three decades. The research findings suggest that the contribution of inter-Korean trade to peace on the Korean Peninsula remains inconclusive. The analysis revealed that inter-Korean trade had limited impact on inter-Korean relations. However, this conclusion varied based on the Korean government's stance. When a progressive government was in power, a positive effect on inter-Korean relations was observed through an increase in certain imports from North Korea. Nonetheless, the overall impact of inter-Korean trade on inter-Korean relations remained insignificant. This indicates that the potential for inter-Korean economic cooperation to foster peace was evident at a specific juncture but not in a general sense. An investigation into the correlation between the fluctuations in inter-Korean relations and their impacts on inter-Korean trade revealed that when a progressive government held power, the principle of separating politics and business was upheld. However, when a conservative government was in office, it was established that the ups and downs of inter-Korean relations did indeed affect inter-Korean trade.

In light of the recent economic decline in North Korea resulting from sanctions and the COVID-19 pandemic, calls for humanitarian aid have once again arisen. Regardless of the political and military circumstances, it is imperative that aid be provided to North Korea. According to this study, which analyzed empirical data, past assistance to North Korea was influenced by inter-Korean relations. Instead, aid was directly impacted by North Korea's actions towards South Korea, regardless of government tendencies. In other words, it is uncertain if aid to North Korea can continue, even if North Korea engages in military provocations such as nuclear tests or missile launches in the future. The study also found that non-commercial transactions such as assistance to North Korea are affected by inter-Korean relations, even during the pursuit of an "inclusive policy" by a progressive government.

This study has made the following contributions. First, the study provides an empirical analysis of the relationship between inter-Korean trade using objective and comprehensive data (GDELT). Unlike previous studies that utilized an inter-Korean relations index that was subjective and limited in scope, this study utilizes GDELT to augment these limitations. While this is not the first study to analyze inter-Korean relations through GDELT, the study is unique in its application of GDELT in that it empirically verifies the relationship with inter-Korean trade. The data employed in this study has the potential to be used in a range of future research topics, including the relationships between South Korea and its neighboring countries, such as Japan, China, the United States, and Russia, among others. Secondly, the study investigates the structural changes in the relationship between inter-Korean relations and inter-Korean trade since 2010. The correlation between changes in inter-Korean relations and inter-Korean trade was examined, and the heterogeneity of mutual influence was analyzed comprehensively according to government propensities and trade types. However, the study acknowledges that limitations in the data prevent a thorough analysis of the exact causal relationship between inter-Korean relations and inter-Korean trade.

APPENDIX

TABLE A1—STATIONARY TIME-SERIES VARIABLES (ADF TEST RESULT)

(1) Whole Period: Jan, 1991~Dec, 2021

	level		difference		Stationary
	No Trend	Trend	No Trend	Trend	
Inter-Korean relations	-3.170**	-3.925**	-10.667***	-10.657***	I(0)
Total transaction	-1.859	-2.499	-12.519***	-12.571***	I(1)
Total transaction , import	-0.933	-1.792	-7.565***	-7.680***	I(1)
Total transaction, export	-1.787	-2.465	-7.950***	-8.082***	I(1)
Commercial transaction	-3.777***	-4.480***	-10.272***	-10.327***	I(0)
Commercial transaction, import	-4.613***	-5.236***	-12.862***	-12.901***	I(0)
Commercial transaction, export	-3.348**	-4.499***	-6.575***	-6.745***	I(0)
Trade	-3.387**	-3.965***	-4.181***	-4.342***	I(0)
Trade, import	-3.639***	-3.919**	-4.608***	-4.771***	I(0)
Trade, export	-5.009***	-4.612***	-4.842***	-5.561***	I(0)
General trade	-3.978***	-4.255***	-4.520***	-4.492***	I(0)
General trade, import	-4.386***	-4.527***	-11.479***	-11.518***	I(0)
General trade, export	-3.448***	-3.363*	-7.669***	-7.798***	I(0)
Processing on commission	-4.144***	-8.691***	-4.217***	-4.010***	I(0)
Processing on commission, import	-4.762***	-7.872***	-4.494***	-4.648***	I(0)
Processing on commission, export	-8.919***	-12.327***	-3.089**	-3.470**	I(0)
Economic cooperation projects	-4.158***	-4.633***	-9.022***	-9.200***	I(0)
Economic cooperation projects, import	-3.872***	-3.159*	-5.971***	-6.370***	I(0)
Economic cooperation projects, export	-4.537***	-4.907***	-7.708***	-7.912***	I(0)
Kaesong Industrial Complex	-5.895***	-5.956***	-7.202***	-7.479***	I(0)
Kaesong Industrial Complex, import	-4.440***	-4.597***	-7.787***	-7.975***	I(0)
Kaesong Industrial Complex, export	-5.985***	-5.942***	-7.873***	-8.051***	I(0)
Mt. Geumgang Tourism	-5.330***	-5.780***	-9.833***	-9.980***	I(0)
Mt. Geumgang Tourism, export	-4.888***	-5.506***	-9.718***	-9.850***	I(0)
Non-commercial transaction	-1.908	-3.004	-9.048***	-9.060***	I(1)
Non-commercial transaction, export	-1.332	-2.577	-6.628***	-6.688***	I(1)
Assistance to North Korea	-2.49	-3.294*	-9.178***	-9.282***	I(1)
Assistance to North Korea, export	-2.543	-3.344*	-9.167***	-9.263***	I(1)

Note: 1) *, **, and *** indicate significant at the significance levels of 10%, 5%, and 1%, respectively; 2) The order is selected by AIC (Akaike's information criterion).

TABLE A1—STATIONARY TIME-SERIES VARIABLES (ADF TEST RESULT) (CONT'D)

(2) Progressive Government: Mar, 1998~Feb, 2008

	level		difference		Stationary
	No Trend	Trend	No Trend	Trend	
Inter-Korean relations	-4.988***	-4.968***	-11.369***	-11.326***	I(0)
Total transaction	-1.935	-5.992***	-8.541***	-8.486***	I(0)
Total transaction , import	-1.558	-5.415***	-7.439***	-7.390***	I(0)
Total transaction, export	-3.608***	-6.304**	-11.076***	-11.056***	I(0)
Commercial transaction	0.882	-1.786	-6.274***	-6.475***	I(1)
Commercial transaction, import	-1.564	-5.425***	-7.471***	-7.423***	I(0)
Commercial transaction, export	0.197	-0.883	-4.953***	-4.968***	I(1)
Trade	0.319	-2.891	-5.781***	-5.784***	I(1)
Trade, import	0.271	-3.732**	-6.183***	-6.237***	I(0)
Trade, export	-0.345	-1.654	-5.044***	-5.019***	I(1)
General trade	-0.24	-3.481**	-4.607***	-4.597***	I(0)
General trade, import	-1.668	-5.283***	-7.586***	-7.528***	I(0)
General trade, export	-3.253**	-3.242*	-7.158***	-7.129***	I(0)
Processing on commission	0.328	-1.765	-4.468***	-4.473***	I(1)
Processing on commission, import	0.742	-2.036	-5.738***	-5.809***	I(1)
Processing on commission, export	-0.04	-1.593	-6.226***	-6.213***	I(1)
Economic cooperation projects	-4.585***	-5.722***	-8.597***	-8.643***	I(0)
Economic cooperation projects, import	-6.781***	-4.928***	-2.216	-4.213***	I(0)
Economic cooperation projects, export	-4.700***	-5.761***	-8.490***	-8.541***	I(0)
Kaesong Industrial Complex	-2.269	-4.553***	-4.599***	-3.887**	I(0)
Kaesong Industrial Complex, import	-4.638***	-3.236**	-3.398**	-4.532***	I(0)
Kaesong Industrial Complex, export	-1.987	-3.223**	-5.702***	-4.997***	I(0)
Mt. Geumgang Tourism	-6.860***	-7.356***	-8.510***	-8.570***	I(0)
Mt. Geumgang Tourism, export	-6.796***	-7.234***	-8.413***	-8.479***	I(0)
Non-commercial transaction	-5.222***	-6.247***	-12.171***	-12.188***	I(0)
Non-commercial transaction, export	-5.223***	-6.245***	-12.162***	-12.178***	I(0)
Assistance to North Korea	-6.024***	-7.513***	-10.662***	-10.798***	I(0)
Assistance to North Korea, export	-6.024***	-7.513***	-10.662***	-10.798***	I(0)

Note: 1) *, **, and *** indicate significant at the significance levels of 10%, 5%, and 1%, respectively; 2) The order is selected by AIC (Akaike's information criterion).

TABLE A1—STATIONARY TIME-SERIES VARIABLES (ADF TEST RESULT) (CONT'D)

(3) Conservative Government: Mar, 2008~Feb, 2017

	level		difference		Stationary
	No Trend	Trend	No Trend	Trend	
Inter-Korean relations	-5.671***	-6.147***	-9.898***	-9.849***	I(0)
Total transaction	-1.111	-1.889	-6.477***	-6.618***	I(1)
Total transaction , import	-1.002	-1.801	-7.850***	-7.952***	I(1)
Total transaction, export	-1.848	-2.413	-3.752***	-3.858**	I(1)
Commercial transaction	-0.893	-1.691	-7.009***	-7.113***	I(1)
Commercial transaction, import	-1.003	-1.801	-7.850***	-7.952***	I(1)
Commercial transaction, export	-1.332	-2.085	-6.446***	-6.551***	I(1)
Trade	-0.986	-2.23	-7.429***	-7.394***	I(1)
Trade, import	-1.036	-2.386	-7.375***	-7.340***	I(1)
Trade, export	-2.326	-3.522**	-8.561***	-9.106***	I(1)
General trade	-1.153	-2.431	-3.008**	-2.992	I(1)
General trade, import	-1.144	-2.43	-3.024**	-3.007	I(1)
General trade, export	-0.407	-1.709	-3.994***	-4.178***	I(1)
Processing on commission	-1.173	-1.232	-3.650***	-3.689**	I(1)
Processing on commission, import	-1.184	-1.274	-3.865***	-3.902**	I(1)
Processing on commission, export	-2.563	-3.540**	-8.549***	-9.086***	I(1)
Economic cooperation projects	-1.001	-1.706	-7.482***	-7.587***	I(1)
Economic cooperation projects, import	-1.284	-1.93	-8.246***	-8.348***	I(1)
Economic cooperation projects, export	-1.358	-2.056	-6.437***	-6.547***	I(1)
Kaesong Industrial Complex	-0.989	-1.691	-7.425***	-7.535***	I(1)
Kaesong Industrial Complex, import	-1.265	-1.91	-8.203***	-8.309***	I(1)
Kaesong Industrial Complex, export	-1.362	-2.055	-6.432***	-6.550***	I(1)
Mt. Geumgang Tourism	-2.027	-2.058	-6.030***	-6.165***	I(1)
Mt. Geumgang Tourism, export	-2.344	-3.036	-7.644***	-7.675***	I(1)
Non-commercial transaction	-3.673***	-5.633***	-11.509***	-11.459***	I(0)
Non-commercial transaction, export	-3.597***	-5.244***	-10.629***	-10.581***	I(0)
Assistance to North Korea	-1.685	-3.943**	-4.900***	-4.876***	I(0)
Assistance to North Korea, export	-1.79	-3.778**	-4.966***	-4.940***	I(0)

Note: 1) *, **, and *** indicate significant at the significance levels of 10%, 5%, and 1%, respectively; 2) The order is selected by AIC (Akaike's information criterion).

TABLE A2—RESULTS OF A GRANGER CAUSALITY TEST OF INTER-KOREAN RELATIONS AND INTER-KOREAN TRADE

	Whole period		Progressive gov		Conservative gov	
	←	→	←	→	←	→
Total transaction	0.905	10.496**	1.322	0.347	0.037	4.905**
Total transaction , import	2.122	6.292	6.9228*	4.564	0.062	7.084***
Total transaction, export	4.303	17.81***	1.998	0.496	0.021	3.9115**
Commercial transaction	0.503	6.7315***	0.980	0.002	0.172	8.041***
Commercial transaction, import	0.744	6.5805**	6.8059*	4.505	0.062	7.101**
Commercial transaction, export	4.029	2.321	0.053	0.434	1.179	6.4097**
Trade	17.280	9.355	13.739	29.455***	0.0006	2.6324
Trade, import	0.001	0.347	6.179	7.6516*	0.012	2.7798*
Trade, export	30.18***	13.021	0.735	0.679	-	-
General trade	8.6983**	1.234	12.668***	2.022	0.322	6.6269**
General trade, import	7.9984**	2.930	9.2362**	4.553	0.318	6.6643**
General trade, export	0.840	0.173	4.7629*	0.046	-	-
Processing on commission	8.781	10.655	24.812**	15.389	7.169	5.3331
Processing on commission, import	10.949	12.345	19.529*	26.151***	8.415	4.9613
Processing on commission, export	4.592	13.378	12.412	10.966	-	-
Economic cooperation projects	0.045	2.131	1.148	3.6847*	0.314	6.6417**
Economic cooperation projects, import	0.970	6.2433**	0.605	3.093	0.10871	6.413**
Economic cooperation projects, export	3.4708*	0.865	1.159	3.7302*	1.338	6.2844**
Kaesong Industrial Complex	1.542	7.719**	0.575	0.859	0.54326	5.9618**
Kaesong Industrial Complex, import	0.758	3.0618*	0.896	1.981	0.22434	5.8772**
Kaesong Industrial Complex, export	1.599	7.8682***	0.400	1.703	1.366	6.356**
Mt. Geumgang Tourism	2.200	2.249	0.694	1.537	-	-
Mt. Geumgang Tourism, export	2.489	2.497	0.892	1.821	-	-
Non-commercial transaction	2.792	26.141***	1.158	4.4463**	0.20675	1.9374
Non-commercial transaction, export	2.884	29.43***	1.151	4.4527**	0.45076	4.3885**
Assistance to North Korea	4.292	16.422**	2.248	11.069***	0.50999	1.9053
Assistance to North Korea, export	4.606	19.141***	2.249	11.07***	0.74351	4.0886**

Note: *, **, and *** indicate significant at the significance levels of 10%, 5%, and 1%, respectively.

References

Alamro, R., A. McCarren, A. Al-Rasheed. 2019. "Predicting Saudi Stock Market Index by Incorporating GDELT using Multivariate Time Series Modelling," in A. Alfaries, H. Mengash, A. Yasar, E. Shakshuki (eds.), *Advances in Data Science, Cyber Security and IT Applications*, Communications in Computer and Information Science, Vol. 1097. Springer, Cham.

Barbieri, K. 1996. "Economic interdependence: A path to peace or a source of interstate conflict?" *Journal of Peace Research*, 33(1): 29-49.

Consoli, S., L. T. Pezzoli, and E. Tosetti. 2020. "Using the GDELT Dataset to Analyse the Italian Sovereign Bond Market," International Conference on Machine Learning, Optimization, and Data Science. Springer, Cham.

Gasiorowski, Mark J. 1986. "Economic interdependence and international conflict: Some cross-national evidence," *International Studies Quarterly*, 30(1): 23-38.

The Gdelt Project (https://www.gdeltproject.org/, accessed Oct. 5. 2022)

Harvard Dataverse (https://dataverse.harvard.edu/dataset.xhtml?persistentId=hdl:1902.1/FYXLAWZRIA, accessed Oct. 5. 2022).

Hegre, Håvard, John R. Oneal, and Bruce Russett. 2010. "Trade does promote peace: New simultaneous estimates of the reciprocal effects of trade and conflict," *Journal of Peace Research*, 47(6): 763-774.

Ju, Sungwhan, Jinsoo Kim. 2006. "The Effect of Trade on the Conflicts between South and North Korea-based on the Liberal Theory," *International Area Studies Review*, 10(3): 496-516 (in Korean).

Jung, Seungho, Jongmin Lee, and Seohyun Lee. 2021. "The Impact of Geopolitical Risk on Stock Returns: Evidence from Inter-Korea Geopolitics," Bank of Korea Working Papers, 2021-10.

Kim, Jinsoo, Hansung Lee. 2013. "An Analysis of the Relation between Economic Trade of South-North Korea, North Korea-China, and South Korea-China and South-North Korean Conflicts," *The Journal of Eurasian Studies*, 10(3): 77-97 (in Korean).

Kim, Kyoochul. 2022. "Analysis of Mutual Influence between Inter-Korean Trade and Inter-Korean Relations," in Suk Lee (ed.) *Future North Korea Policies and Inter-Korean Economic Cooperation*, Chapter 4, Research Monograph 2022-06, KDI (in Korean).

Lee, Heejeong Jasmine. 2022. "Analysis of US-China Conflict and Korea-China Relations (2011-2020): Time series analysis using the GDELT big data," *The Journal of Chinese Studies*, 99: 135-158 (in Korean).

Lee, Suk. 2006. "External Dependency of North Korean Economy and Influence of South Korean Economy," Research Series 06-04, Korea Institute for National Unification (in Korean).

Lee, Suk. 2010. *Economic Consequence of Unification Policy: Empirical Evidence and Its Implications*, Policy Study 2010-14, Korea Development Institute (in Korean).

Martin, Philippe, Thierry Mayer, and Mathias Thoenig. 2008. "Make trade not war?" *The Review of Economic Studies*, 75(3): 865-900.

Ministry of Unification North Korean Information Portal. "Principle of Political-Economic Separation" (https://nkinfo.unikorea.go.kr/nkp/term/viewKnwldgDicary.do?pageIndex=15&dicaryId=43&searchCnd=0&searchWrd=, accessed Oct. 5. 2022)

Oneal, John R. and Bruce M. Russett. 1997. "The classical liberals were right: Democracy, interdependence, and conflict, 1950-1985," *International studies quarterly*, 41(2): 267-293.

Park, Sung Jun. 2021. "International Conflicts and Trade Dispute in Northeast Asia," *National Future Strategic Insight*, 13, National Assembly Futures Institute (in Korean).

Polachek, Solomon. 1978. "Dyadic Dispute: An Economic Perspective," *The Papers of the Peace Science Society*, 28: 67-80.

Reuveny, Rafael and Heejoon Kang. 1996. "International trade, political conflict/cooperation, and Granger causality," *American Journal of Political Science*, 40(3): 943-970.

Son, Jung Wook. 2020. "An analysis on peaceful relationships between South Korea and Japan, using big data," Research Series 48, Jeju Peace Institute (in Korean).

The Inter-Korean Exchange and Cooperation System (https://www.tongtong.go.kr/unikoreaWeb/ui/pblc/guidance/dta/PGDDTDtaBbsNrstkrTradeStatsGuidance.do, accessed Oct. 5. 2022)

Toda, Hiro Y. and Taku Yamamoto. 1995. "Statistical inference in vector autoregressions with possibly integrated processes," *Journal of econometrics*, 66(1-2): 225-250.

Voukelatou, Vasiliki *et al*. 2020. "Estimating countries' peace index through the lens of the world news as monitored by GDELT," 2020 IEEE 7th international conference on data science and advanced analytics (DSAA). IEEE, 2020.

Yi, Seong-Woo and Jae Hyoung Lim. 2021. "Dynamics of Inter-Korean Cooperation and Dispute: 2000~2020," *Depute Resolution Studies Review*, 19(2): 67-99 (in Korean).

Yuan, Lihua *et al.* 2020. "The cooperative and conflictual interactions between the United States, Russia, and China: A quantitative analysis of event data," *Journal of Geographical Sciences*, 30(10): 1702-1720.

LITERATURE IN KOREAN

김규철. 2022.「남북교역과 남북관계의 상호 영향 분석: 남북교역의 평화효과와 정경분리 원칙」, 이석 편,『새로운 대북정책과 남북경협의 모색』, 제4장, 연구보고서 2022-06, 한국개발연구원.

김진수·이한성. 2013.「남북·북중·한중간의 교역확대와 남북한분쟁과의 관계분석」,『유라시아연구』, 10(3): 77-97.

박성준. 2021.「동북아 지역의 국제 갈등 양상과 무역분쟁: GDELT를 중심으로」,『국가미래전략 Insight』, 13, 국회미래연구원.

손정욱. 2020.「빅 데이터로 살펴본 국가 간 평화관계 분석: 1998년부터 2019년까지 한일관계 사례를 중심으로」,『2019 동아시아지역 평화인식조사』, 제주평화연구원.

이석. 2006.『북한경제의 대외의존성과 한국경제의 영향력』, 연구보고서, 통일연구원.

이석. 2010.『대북정책의 경제적 성과: 실증적 평가와 시사점』, 정책연구시리즈 2010-14, 한국개발연구원.

이성우·임재형. 2021.「남북한간의 상호협력과 갈등의 역학: 2000~2020」,『분쟁해결연구』, 19(2): 67-99.

이희정. 2022.「미중갈등과 한중관계 분석(2011-2020): GDELT 빅데이터 기반 시계열 분석」,『중국학연구』, 99:135-158.

주성환·김진수. 2006.「남북한 간 교역이 분쟁에 미치는 효과-자유주의 이론을 중심으로」,『국제지역연구』, 10(3): 496-516.