An Empirical Study on the Effects of Export Promotion on Korea-China-Japan Using Logistics Performance Index (LPI)*

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Abstract

Purpose – "Trade Facilitation" aims the easier flow of trade across borders, driven not only by effective customs administration, the efficiency of appropriate authorities, but also by telecommunications, the quality of infrastructures and competent logistics. Facilitating trade will help lower trade development costs as well as improve economic development and enhance economic benefits for emerging economies at a time when imports and exports are sent in and out across borders several times in the form of intermediate and final products. Not only that, globalization is being accelerated, which in turn increases competitiveness and this makes logistics one of the key factors when it comes to international trade. Highly efficient logistics services promote product movement, ensure product safety and delivery speed, and reduce trade costs between countries. The purpose of this study is, by using the LPI indices based on gravity model estimates, to analyze the impact of each LPI component on trade with the 20 biggest exporting countries of Northeast Asian countries—Korea, Japan, and China—which account for 19.05% of global exports.
Design/methodology – Also, this study statistically analyzes the impact of trade on Northeast Asian countries' top 20 exporting countries, using the LPI indices relevant to Trade Facilitation based on the gravity model estimates.
Findings – As a result, it was turned out that the distance, GDP, and the LPI components have relevant impact on the trade exports of all three countries but demonstrated little relation to the demographic perspective.
Originality/value – The study also found we can increase the trade volume by improving three countries' trade partners' LPI indices since Korea, Japan, and China share most of their 20 biggest trade partners.

Keywords: Gravity Model, Logistics Performance Index, Trade Facilitation
JEL Classifications: F10, F15, F17

1. Introduction

The WTO's Trade Facilitation Agreement (TFA) was finalized at the Ninth WTO Ministerial Conference in December 2013, and in November 2014, the General Council adopted the Protocol to formally accept the agreement. After that, member countries of WTO had ratified it domestically. On July 30, 2015, Korea accepted the agreement by depositing an "instrument of acceptance" and became the tenth state in ratifying the Protocol. On February

22, 2017, the TFA entered into force as other member countries such as Rwanda, Oman, Chad, and Jordan followed the step.[1]

When policymakers talk about "Trade Facilitation", they are referring to a specific set of measures that streamline and simplify the technical and legal procedures for products entering or leaving a county to be traded. Trade Facilitation, therefore, covers the full spectrum of border procedures, from the electronic exchange of data about a shipment, to the simplification and harmonization of trade documents, to the possibility to appeal to administrative decisions by border agencies.[2]

In general, "Trade Facilitation" aims the easier flow of trade across borders, driven not only by effective customs administration, the efficiency of appropriate authorities, but also by telecommunications, the quality of infrastructures and competent logistics (Felipe and Kumar, 2010). Facilitating trade will help lower trade development costs as well as improve economic development and enhance economic benefits for emerging economies at a time when imports and exports are sent in and out across borders several times in the form of intermediate and final products. Not only that, globalization is being accelerated, which in turn increases competitiveness and this makes logistics one of the key factors when it comes to international trade. Highly efficient logistics services promote product movement, ensure product safety and delivery speed, and reduce trade costs between countries.

Existing Indicators relevant to Trade Facilitation include OECD Trade Facilitation Indicators (TFI) and World Bank's Logistics Performance Index (LPI). The OECD, considering the similarities, reclassified Trade Facilitation measures of Article 1-12 into 11 indices, which is the basis of Trade Facilitation Agreement. The organization created 12 TFI indicators by adding border governance and a fairness index, which are updated every two years. Meanwhile, the Logistics Performance Index (LPI) measures the efficiency of logistics. It is the weighted average of the country scores on six key dimensions: Efficiency of the clearance process, Quality of trade and transport related infrastructure, Ease of arranging competitively priced international shipments, Competence and quality of logistics services, Ability to track and trace consignments, Timeliness of shipments in reaching destination within the scheduled or expected delivery time.

The purpose of this study is to analyze how each component of the LPI indices affects trade procedures of Northeast Asian countries—Korea, Japan, and China—accounting for 19.05%[3] of global exports and their top 20 trade partners, using gravity model estimates.[4] The study also aims to look at the possibility of the potential of logistics development of traders of Korea, Japan and China by comparing the first LPI data released in 2010 with the latest data of 2018. For this purpose, Chapter II explains previous studies and the definition of Trade Facilitation, LPI and TFI indices. Chapter III introduces the gravity model methodology used to draw significant results of this study. Chapter IV presents the estimated results of the gravity model, explaining the importance of LPI components with regard to the geographic regions, and finally, Chapter V summarizes major points of this study.

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[1] Subject to Article 10.3 of the 「Marrakesh Agreement for the Establishment of the World Trade organization」, the Agreement shall enter into force only when two-thirds of WTO Members (110 countries) ratify, and when a new member joins the Agreement, it is implement at a time when the member ratify the agreement.

[2] http://www.oecd.org/trade/topics/trade-facilitation/

[3] As of 2018, China's trade recorded $ 2.4741 trillion, Japan's $ 732.6 billion, and Korea's $ 601.1 billion, in total of $ 3 trillion 807.9 billion, and global exports in total was $ 19 trillion 522.3 billion.

[4] As of 2018, the top 20 exporting countries for Korea, Japan, and China, each country's decency on exports was 83.86% for Korea, 86.51% for Japan and 75.26% for China.

2. Literature Review & Trade Facilitation

2.1. Literature Review

First, Wilson, Mann and Otsuki (2003/2004) developed detailed Trade Facilitation indices by evaluating the level of Trade Facilitation in each country, by breaking down sectors such as port efficiency, customs environment, regulatory environment, and services infrastructure. They further estimated how much Trade Facility can promote trade, using the gravity equation. The European Commission sees that Trade Facilitation can reduce trade costs by around 2% of the entire amount of world trade (European Commission, 2006).

Trade Facilitation has a great potential to reduce trade costs and its impacts have been quantified by a series of empirical studies based on Novy's methodologies (2013) and have been used to infer trade costs from production and trade patterns between trade partners. Trade Facilitation also explained that 4.5% of fluctuations of trade costs across 11 EU member states during 1999-2003 were due to technical barriers across the region (Chen and Novy, 2009).

Meanwhile, another paper that studied the costs and problems of implementing Trade Facilitation Agreement going through implementation negotiation, analyzed that the costs of establishing and implementing Trade Facilitation Measures will not be particularly huge and the benefits of implementing such measures will be much bigger than the costs. Some measures of TFA, of course, can be expensive when trying to establish at the beginning. However, they may not be expensive once they are operated in practice, while other measures are largely dependent on politics rather than finance (Moïé, 2013). The paper also presents the results of OECD indicators that can assess the impact of specific Trade Facilitation measures on developing countries' trade. The article established 16 Trade Facilitation Indicators (TFIs) corresponding to the key policy areas under the negotiation at the time to assess the impact of resolving some barriers in a country's trade and border procedure issues. The policy areas that have the greatest impact on trade volume and trade costs of importing and exporting goods turned out to be the following: the availability of trade-related data, simplified and harmonized document processes, simplified trade procedures and automated processes. If improvement is made in these areas, trade costs for low income countries can be slashed by 14.5%, 15.5% for middle income countries and 13.2% for upper and middle income countries (Moïé and Sorescu, 2013).

A recent study found that the full implementation of binding and non-binding measures of Trade Facilitation Agreement (TFA) can reduce trade costs by an average of 15% in the Asia-Pacific region. Moreover, the full implementation of binding and non-binding TFA measures, along with other provisions and border-free trade promotion measures (such as promoting digital trade), can reduce trade costs by more than 26%, reducing global trade costs between Asia and the Pacific to $600 billion annually (Duval, Utoktham and Kravchenko, 2018).

Some studies in this literature use econometric results from gravity equations to perform counterfactual analysis. Hoekman and Nicita (2011) simulate the effect of policy convergence by low-income countries to the average of middle-income countries. The percentage increases in exports (imports) of low-income countries that would result from a combined convergence of the Doing Business "cost of trading" indicator and of the LPI score to the average of middle-income countries would be 17% (13.5%). Portugal-Perez and Wilson (2012) simulate the effects of improving Trade Facilitation broadly encompassing physical infrastructure, information and communications technology, border and transport efficiency as well as business and regulatory environment. Their benchmark is an improvement half-way to the level of the top performing nation in the region. The ad valorem tariff-cut

equivalents they estimate are heterogeneous across regions, with investment in physical infrastructure generally resulting in the largest trade gains. Hufbauer et al. (2013) performed a thought experiment in which countries lifted their Trade Facilitation halfway to the region's top performer in each category. They estimated an increase in total merchandise exports of developing countries of $569 billion (9.9%) and an increase in total exports of developed countries of $475 billion (4.5%).

Jesus Felipe and Utsav Kumar examine the relationship between bilateral trade flows and Trade Facilitation (TF) as well as estimate the gains in trade from improvements in Trade Facilitation in the Central Asian countries. Their results show that there are significant gains in trade by improving Trade Facilitation in Central Asian countries. These gains in trade vary from 28% in the case of Azerbaijan to as much as 63% in the case of Tajikistan. Furthermore, intra-regional trade increases by 100%. Overall, though exports increase more than imports, most of the gains in total trade come from imports. They found that the greatest increase in total trade comes from the improvement of infrastructure, followed by logistics and the efficiency of customs and other border agencies (Felipe and Kumar, 2010).

The WTO Trade Facilitation Agreement (TFA) provides significant opportunities in reducing trade costs by enhancing the speed and efficiency of border procedures and also the involvement of the global value chain that determines today's global trade. In 2015, the OECD predicted that the Trade Facilitation Indicators (TFIs) (hereafter referred to as TFIs) could reduce worldwide trade costs by anywhere from 12.5% to 17.5% by implementing the TFA. Trade costs can be reduced further by 1.4 to 3.9 percentage points for the countries that will make the full implementation. In particular, low income countries are estimated to have the biggest chance to cut trade costs.

The potential cost reduction from a "full" implementation of the TFA is 16.5% of total costs for low income countries (LICs), 17.4% for lower middle income countries (LMICs), 14.6% for upper middle income countries (UMICs) and 11.8% for OECD countries, based on analysis using the TFIs (OECD, 2018). If countries limit themselves to the mandatory provisions of the Agreement, the potential reduction reaches 12.6% for LICs, 13.7% for LMICs, 12.8% for UMICs and 10.4% for OECD countries.

A higher level of ambition in implementing the best endeavours provisions of the TFA would generate very substantial benefits of 3.9, 3.7, 1.8 and 1.4 percentage points more than if countries only implemented mandatory provisions. The opportunity costs are particularly high for the low and lower middle income country groups, as many upper middle and high income countries are already implementing measures that are formulated on a "best endeavours" basis.

**Fig. 1.** Overall Potential Trade Costs Reductions by Income Group
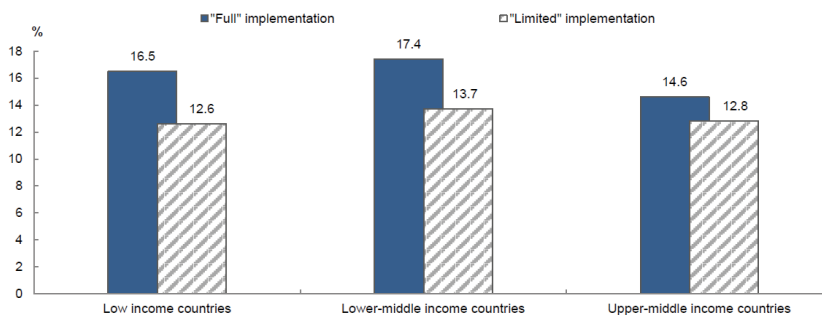
Source: OECD (2018).

Improvements in the area of formalities (simplification of trade documents; streamlining of border procedures; and automation of the border process) appear to have the greatest impact on trade costs, generating cost savings of 2.8% to 4.2% depending on the level of development. Other policy areas that have an important potential for cost reductions are the availability of trade-related information and the possibility to request advance rulings.

For low income countries, the measures with the highest possibility to contribute to the reduction of trade costs are: harmonizing and simplifying trade documents (4.2%); automating trade and customs processes (3.6%); ensuring the availability of trade-related information (2.8%) and streamlining border procedures (2.8%).

For lower middle income countries, streamlining border procedures are estimated to have the greatest impact (3.9%), while harmonizing and simplifying trade documents and auto-mating trade and customs procedures would reduce costs by 3.5% and 2.9%, respectively.

Fig. 2. Potential Trade Costs Reductions for the "Top Four" Sets of Measures
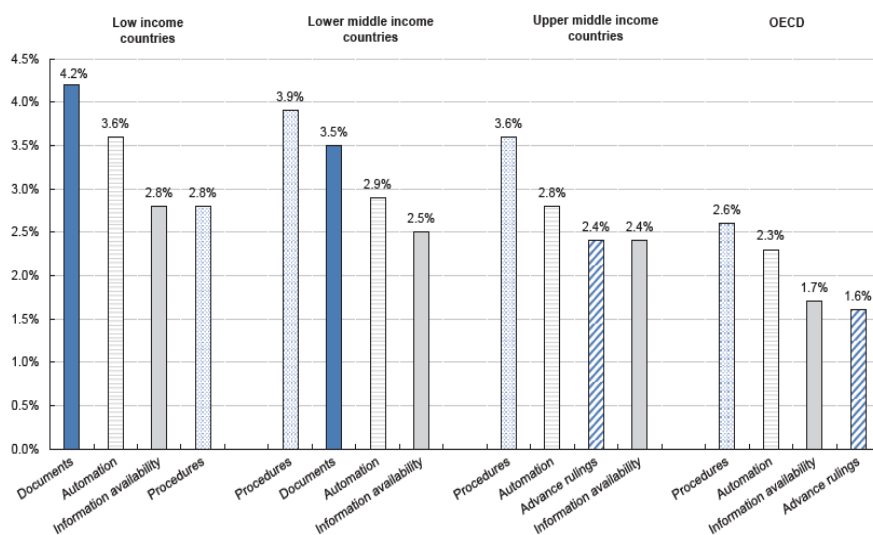
Source: OECD (2018).

The study by Luisa Martí, Rosa Puertas & Leandro García analyses the impact that each of these components has on trade in emerging economies, using a gravity model. Furthermore, the study also attempts to detect possible advances in logistics in developing countries, which are grouped into five regions (Africa, South America, Far East, Middle East and Eastern Europe) by comparing the first LPI data published in 2007 with the most recent one, released in 2012. The results obtained reveal that improvements in any of the components of the LPI can lead to significant growth in a country's trade flows. Specifically, LPI components are becoming increasingly important for international trade in many countries in Africa, South America and Eastern Europe (Martí, Puertas and García, 2014).

Previous studies did not analyze the LPI indices for a year, nor did they take LPI data since 2010 into account in their studies. This study, however, will analyze the detailed six items to figure out how the LPI indices affect the 20 biggest trading partners of Northeast Asian countries—Korea, Japan, and China.

2.2. The Concept of Trade Facilitation

Under the WTO system, tariffs, which have long been considered as traditional barriers to trade, have been considerably lowered, but still there remain other obstacles such as individual customs procedures of traders, complicated customs clearance systems including the submission of documents, and the lack of transparency. The costs incurred by the delay in moving goods at the border, complicated and unnecessary requirements for documents, and the lack of automation of trade procedures set by a government are estimated to be higher than actual customs costs (Choi Bo-Young et al., 2015).

The WTO states that Trade Facilitation is about simplifying, modernizing and harmonizing the import and export processes of moving goods across borders.[5] The TFA covers measures for expediting the movement of goods, release and clearance of goods, including goods in transit. It also covers provisions on effective measures to boost cooperation between customs and others appropriate authorities when it comes to trade facilitation efforts and customs compliance issues. Trade Facilitation, in the World Customs Organization (WCO) context, means raising effectiveness of Trade Facilitation by establishing standards and reducing trade costs by simplifying customs procedures, accelerating the movement of goods including those in transit, and shipping out process (WCO, 2011).

The OECD defines Trade Facilitation as simplification and harmonization of a set of activities, practices and formats related to the collection and submission, delivery and process of data required for the movement of goods in the global trade. According to UN / CEFACT (United Nations Centre for Trade Facilitation and Electronic Business), Trade Facilitation involves making procedures and the flow of relevant information required for all the processes from initial transport of goods from exporters to importers to the final payment to be done in a simple, standard, and harmonized manner.

Table 1. The Concept of Trade Facilitation

Division	Concept to use
WTO	Simplification and harmonization of international trade procedures for customs clearance and border movement of goods
APEC	Simplify all procedures and administrative obstacles related to trade, including customs administration, standards and technical regulations, the movement of entrepreneurs, and e-commerce
UNCTAD	Increase trade efficiency through trade infrastructure and standardization such as harmonization of laws and regulations, simplification of procedures and documents, transportation, information and communication systems
OECD	Simplification and harmonization of activities, conventions and formats related to the collection, submission, transmission and processing of data required for the movement of goods in international trade.
Comprehensive concept	All actions and activities that can expand trade by reducing or increasing transaction costs by eliminating, simplifying, harmonizing and automating unnecessary or complex procedures, practices and infrastructure in relation to trade.

Source: Choi Bo-Young et al. (2015).

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[5] Trade facilitation—the simplification, modernization and harmonization of export and import processes—has therefore emerged as an important issue for the world trading system.

Although there is no single definition of Trade Facilitation, the combined concept of the very term suggested by each organization, we can define Trade Facilitation as "all measures to promote trade by boosting efficiency and reducing trade costs by eliminating, simplifying, harmonizing and automating unnecessary or complicated procedures, practices and infra-structures related to trade". In other words, "simplifying and standardizing customs related procedures and systems to reduce trade costs." (The Ministry of Government Legislation, 2015).

2.3. Measurement Tools for Trade Facilitation

2.3.1. OECD Trade Facilitation Indicators

The OECD provides Trade Facilitation Indicators (TFIs) across 152 countries with different geographical regions and levels of development. The updated TFIs offer the most current assessment of the potential impact of the WTO TFA implementation, using ESCAP-World Bank Trade Cost Database. These indicators allow nations to identify strengths and weaknesses in Trade Facilitation, to prioritize areas of actions, and to put technical assistance and capacity building at the top priority. The updated OECD TFI helps countries monitor progress since 2012 and compare indicators with other countries or groups of countries of interest. With web tools, countries can also compare their relative performances in terms of 11 Trade Facilitation indices, identify key tools to drive achievement for a selective country with a specific index, and simulate the effects of the potential consequences following after upcoming policy reform.

The OECD Trade Facilitation Indicators is a package of 156 questionnaires: 21 from Information Availability, 8 from Involvement of the Trade Community, 11 from Advance Rulings, 13 from Appeal Procedures, 14 from Fees and Charges, 9 from Formalities–Documents, 13 from Formalities–Automation, 34 from Formalities– Procedures, 11 from Internal Co-operation, and 9 from Governance and Impartiality.

The OECD first figured out areas where actions must be taken by governments to improve global trade flows by cutting down trade costs and streamlining border procedures to maximize the profit in the end. As part of the effort, it has created TFIs and with these indicators, countries can evaluate potential impact of any improvement measures. The estimates based on TFIs serve as a basis for governments to prioritize Trade Facilitation measures and to focus more on technical assistance and capacity building efforts for developing countries.

The TFIs take values from 0 to 2, where 2 designate the best performance that can be achieved. The values are calculated based on TFA database. Comparing Korea, Japan and China's TFIs, Korea recorded the highest, at 19.986. For Japan, the overall score is high at 18.908, but slightly lower in terms of internal border cooperation and information availability. In the case of China, the overall score was 14.919, the lowest score, and even scored below 1, especially for institutional cooperation inside and outside the border.

2.3.2. World Bank's Logistics Performance Index (LPI)

The Logistics Performance Index (LPI) is a tool to help countries identify their perfor-mance on trade logistics. It is a weighted average of six components: Customs, Infrastructure, International shipments, Logistics quality and competence, Tracking and tracing, Timeliness. Since three years of term between 2007 and 2010, the World Bank now releases LPI scores every two years, and the latest one is the LPI 2018.

The LPI is built on the basis of a worldwide survey carried out on companies responsible

for the transport of goods and for the facilitation of trade globally. Specifically, it was developed with the assistance of over 800 professionals involved from different areas of the sector's lines of activity. Each respondent to the survey was asked for data pertaining to the eight countries they most traded with at the international level. In total over 5000 assessments were obtained for each country (Martí, Puertas and García, 2014).

Table 2. Detailed Variables in LPI

Type of variable	Description
Customs	The efficiency of customs and border management clearance
Infrastructure	The quality of trade and transport infrastructure
International shipments	The ease of arranging competitively priced shipments
Logistics competence	The competence and quality of logistics services—trucking, forwarding, and customs brokerage
Tracking and tracing	The ability to track and trace consignments
Timeliness	The frequency with which shipments reach consignees within scheduled or expected delivery times

Source: World Bank (n.d.).

The definition of the six indicators of the international LPI follows;

First, Customs: measures the efficiency and effectiveness of customs procedure (speed, simplicity, and predictability of customs agencies). All of this is configured through a series of administrative tasks that allow the existing legislation on international trade to be implemented and taxes on the import/export of goods and services to be collected.

Second, Infrastructure: measures the quality of a country's transport and telecommunications infrastructure. It is related to the procedure used for moving the goods to the final consumer, and is not totally controlled by companies due to external factors. However, it is important to measure how organizations cope with the available facilities, being either an advantage or an obstacle that prevents them from being competitive.

Third, International shipments: measures the easiness of arranging competitively priced shipments.

Fourth, Quality of logistics services and competence: measures the competence and quality of logistics services. It shows how certain parties within the organizational structure behave, representing the quality of service to the customer and optimizing the relationship between organizations and consumers.

Five, Tracking and tracing: measures the ability to track and trace consignments. It is important to identify the exact location and the route of each consignment up to its delivery to the end customer. All parties in the good's supply chain are involved in this component, and consequently traceability is the result of the activity of the sector as a whole.

Six, Timeliness: measures the frequency with which shipments reach consignees within scheduled or expected delivery times. This is an important factor for consideration, because with the existing high level of competition, failure to comply with delivery schedules is unacceptable. This has influenced the need for increasingly sophisticated computerization processes.

When we look at the LPI scores of major countries in 2018, Germany topped the list with 4.2, followed by Sweden, recording 4.05, and Belgium with 4.04, Austria with 4.03, Japan with 4.03, and Korea and China recorded 3.61, ranking 25th and 26th, respectively. The annual LPI scores of the top 20 exporting countries of Korea, Japan and China are listed below.

In particular, Japan, the UAE, Vietnam, Indonesia and the Russian Federation have significantly improved their LPI scores, though partially, in 2018 compared to 2010, resulted in higher scores and rankings. In contrast, Canada, Taiwan, Malaysia, Turkey, Brazil, and the Philippines saw a gradual decrease in scores and rankings.

Table 3. LPI Score and Ranking by Year

Country	2018		2016		2014		2012		2010	
	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score
Germany	1	4.20	1	4.23	1	4.12	4	4.03	1	4.11
Japan	5	4.03	12	3.97	10	3.91	8	3.93	7	3.97
Netherlands	6	4.02	4	4.19	2	4.05	5	4.02	4	4.07
Singapore	7	4.00	5	4.14	5	4.00	1	4.13	2	4.09
United Kingdom	9	3.99	8	4.07	4	4.01	10	3.90	8	3.95
United Arab Emirates	11	3.96	13	3.94	27	3.54	17	3.78	24	3.63
Hong Kong, China	12	3.92	9	4.07	15	3.83	2	4.12	13	3.88
United States	14	3.89	10	3.99	9	3.92	9	3.93	15	3.86
Australia	18	3.75	19	3.79	16	3.81	18	3.73	18	3.84
Canada	20	3.73	14	3.93	12	3.86	14	3.85	14	3.87
Korea, Rep.	25	3.61	24	3.72	21	3.67	21	3.70	23	3.64
China	26	3.61	27	3.66	28	3.53	26	3.52	27	3.49
Taiwan	27	3.60	25	3.70	19	3.72	19	3.71	20	3.71
Thailand	32	3.41	45	3.26	35	3.43	38	3.18	35	3.29
Vietnam	39	3.27	64	2.98	48	3.15	53	3.00	53	2.96
Malaysia	41	3.22	32	3.43	25	3.59	29	3.49	29	3.44
India	44	3.18	35	3.42	54	3.08	46	3.08	47	3.12
Indonesia	46	3.15	63	2.98	53	3.08	59	2.94	75	2.76
Turkey	47	3.15	34	3.42	30	3.50	27	3.51	39	3.22
Mexico	51	3.05	54	3.11	50	3.13	47	3.06	50	3.05
Brazil	56	2.99	55	3.09	65	2.94	45	3.13	41	3.20
Philippines	60	2.90	71	2.86	57	3.00	52	3.02	44	3.14
Russian Federation	75	2.76	99	2.57	90	2.69	95	2.68	94	2.61

Source : World Bank (n.d.).

3. The Model of the Study

3.1. Hypothesis of the Analytical Model

The most appropriate method of studying the impact of logistics on trade flows derives from the gravity model. Conventionally, this method includes transportation costs, which are usually measured in distance. Recently, logistical performance has become increasingly important as a facilitator of trade. In these days, many components are considered to be deciding factors of trade flows, ranging from infrastructure to customs and border man-

agement, (both of which are public sector related) to goods and transportation services, to shipping costs and shipping services, to the role of skilled workers, to the capacity and development of the private sector, such as the integration of logistics chains and the IT sector. The recent study (Martí, Puertas and García, 2014) illustrates bilateral trade, using the basic ideas of the gravity equation.

The basic idea behind a gravity equation is that bilateral trade is explained by the following three factors: Factors related to the potential of a country to export goods and services, factors that explain how prone a country is to import goods and services, and other forces that attract bilateral trade. In its simplest form, a gravity model considers bilateral trade flows to be dependent positively on the volume of income in both economies (exporter/importer) and negatively on the distance between them, in line with Newtonian gravitational attraction.

The purpose of this study is to analyze the impact on trade for Northeast Asian countries (Korea, Japan and China)'s top 20 exporting partners, using the LPI indices related to Trade Facilitation based on the gravity model. The study also compares the first LPI data released in 2010 with the LPI data released in 2012, 2014, 2016, and 2018 every two years, to see how the changes take place in exports affected the LPI indices of trading partners of Korea, Japan and China, with the help of the gravity model.

The hypotheses about trade, considering the characteristics of each country and of two years of period, after extracting the LPI indices and the influential factors mentioned above as independent variables are explained in detail below.

H1: The larger the economy will have a positive impact on exports.
H2: The farther the geographical distance will have a negative impact on the bilateral trade. In contrast, the closer the geographic distance will have a positive impact on the bilateral trade.
H3: The larger the population, the greater the demand in the import market and will have a positive effect on exports.
H4: The LPI indices improve through Trade Facilitation will have a positive impact on exports as customs administration, infrastructure, and punctuality improve.

3.2. Designing the Analysis Model and Variables

The gravity model is one of the most representative empirical models used in the analysis of trade flows between countries. To use this model, we will take various components into consideration: GDP, the LPI indices, the distance between trading partners' capitals, and population of the 20 biggest exporting partners (as of 2018) of Korea, Japan, and China from 2010 to 2018 every two years.

Most of the 20 biggest trading partners of Northeast Asian countries overlap. Still, there are some countries do not overlap: Turkey, the Netherlands and the UAE. First, Korea's top 20 trading partners are China, the United States, Vietnam, Hong Kong, Japan, Taiwan, India, the Philippines, Singapore, Mexico, Australia, Germany, Malaysia, Indonesia, Thailand, Russia, the United Kingdom, Turkey, Canada and Brazil. Next, Japan's are China, the United States, Korea, Taiwan, Hong Kong, Thailand, Singapore, Germany, Australia, Vietnam, Indonesia, Malaysia, United Kingdom, Netherlands, Mexico, Philippines, India, Canada, United Arab Emirates, and Russia. Finally, China's are the United States, Hong Kong, Japan, Korea, Vietnam, Germany, India, the Netherlands, the United Kingdom, Singapore, Taiwan, Russia, Australia, Malaysia, Mexico, Indonesia, Thailand, Canada, the Philippines and Brazil. (Countries are listed in order of the amount of exports)

The gravity model used in this study for each area analyzed is structured as follows:

$$\log(X_{ij}) = \beta_0 + \beta_1 \log(D_{ij}) + \beta_2 \log(Y_i) + \beta_3 \log(Y_j) + \beta_4 \log(P_i)$$
$$+ \beta_5 \log(P_j) + \beta_6 \log(LPI_i) + \beta_7 \log(LPI_i) + \beta_A W \tag{1}$$

Xij: quantity exported by country i to country j
Dij: distance between country i and country j
Yi: GDP of country i
Yj: GDP of country j
Pi: population of country i
Pj: population of country j
LPIi: Logistics Performance Index for country i
LPIj: Logistics Performance Index for country j
W: dummy variables (Whether the country of export is an OECD country)

Since the above regression takes a log-linear model, β stands for elasticity. Therefore, a 1% change in explanatory variables measure the percent change (elasticity) that brings to Korea's exports.

According to equation (1), exports depend on economic, geographic and demographic variables together with logistics variables. This approach is based on the hypothesis that the variables included in the model have a significant impact on trade and hypotheses and signs are coherent with an economic theory.

The distance variable is an approximate indication of trading costs, which is not without its problems, as it assumes that transport costs are independent of the medium used and that capital cities are a good approximation of the economic centers of a country. The effect of distance between countries ($\beta1$) should be negative, because proximity promotes a growth in trade.

Theoretically, the GDP coefficients of both the exporter ($\beta2$) and the importer ($\beta3$) will be positive. That is because the larger the economy, the more exports and imports can be expected. Furthermore, the population coefficient for the exporting country ($\beta4$) could be either positive or negative, depending on whether the most populated country exports less due to absorbing domestic production, or exports more due to the predominating technological and logistics variables associated with the level of economic development.

In accordance with the objective of this research, we include the exporter and importer LPI in the gravity model. Both variables have coefficients ($\beta6$ and $\beta7$) that represent the importance of Trade Facilitation in export flows. Consequently, a positive sign is expected in both cases. Finally, among the series of dummy variables, if the exporting country belongs to the OECD, presented as 1, and if not, presented as 0.

The study also focuses on analyzing the importance of each LPI component in trade flows. The fact that the six components of the LPI are markedly correlated means that it is not feasible to estimate one single equation including all the components, as doing so would lead to multicollinearity and erroneous results. Therefore, regressions similar to equation 1 have been estimated, including each index component separately.

It was initially expected that the LPI components will display a significant and positive coefficient, such that higher values of these variables favor international trade. Comparing the results of the estimation allows us to see which component had the greatest impact on trade flows and identify changes undergone over the period (The year 2010, 2012, 2014, 2016, 2018).

3.3. Empirical Analysis Data and Methodology

For the 20 biggest exporting partners of Korea, Japan, and China, we used KITA's trade

statistics and extracted data for 2018, 2014, 2012, and 2010 on the two years basis. This is because the LPI indices are published every two years. Other indicators—GDP, population, the LPI indices of trading partner—came from World Bank data. For distance variables, we referred to the data, offered by GlobeFeed, which shows the distance between capitals of trading partners.

Table 4. List of Variables Used in the Study

Variable	Description	Source
X_{ij}	quantity exported by country i to country j	KITA
D_{ij}	distance between country i and country j	WorldBank
Y_i	GDP of country i	WorldBank
Y_j	GDP of country j	WorldBank
P_i	population of country i	WorldBank
P_j	population of country j	WorldBank
LPI_i	Logistics Performance Index for country i	WorldBank
LPI_j	Logistics Performance Index for country j	WorldBank
W	dummy variables(OECD country 1, Non OECD 0)	OECD

4. Analysis of the Results

In statistics, a correlation analysis can analyze if two numeric variables are linearly related. The statistical relationship, dependence or association, is considered between the two variables. Here, the strength of the relationship between the relative movements of two variables is calculated using the correlation coefficient. The correlation coefficient, however, does not explain causality though it identifies the degree of association. The causal relationship between the two variables can be determined using the regression analysis as the regression analysis identifies causal directions, the degree of causality, and mathematical models. ± 0.8 to 1 means the correlation is very strong, ± 0.6 to 0.8 means strong, ± 0.4 to 0.6 means moderate, ± 0.2 to 0.4 means weak, and ± 0 to 0.2 means there is very little correlation.

Table 5. Correlation Analysis between Korea and Variables

	y	dist	gdp	pop	lpi
y	1	-.306**	.686**	.634**	.170
dist	-.306**	1	.148	-.167	-.070
gdp	.686**	.148	1	.401**	.292**
pop	.634**	-.167	.401**	1	-.165
lpi	.170	-.070	.292**	-.165	1

The correlation analysis of distance, GDP, population, and the LPI indices of the 20 biggest exporting countries of Korea shows that GDP (r = 0.686 **) has the highest correlation and the population (r =0.634 **) also seems to be significant. The correlation of distance (-0.306 **) shows a significant inverse correlation with decreasing export volumes as distance increases in the negative direction. On the other hand, the LPI (r = 0.170) indices do not show a significant correlation with Korea's exports.

Table 6. Correlation Analysis between China and Variables

	y	dist	gdp	pop	lpi
y	1	-.022	.730**	.048	.375**
dist	-.022	1	.322**	-.003	-.020
gdp	.730**	.322**	1	.191	.264**
pop	.048	-.003	.191	1	-.288**
lpi	.375**	-.020	.264**	-.288**	1

The correlation between distance, GDP, population and the LPI indices of China's top 20 trading economies shows the highest correlation with GDP (r = 0.730 **) and significant correlation with LPI (r = 0.375 **). The distance (-0.022) shows a negative correlation, but it does not have significant results. The population (r = 0.048) also does not show any significant correlation with China's exports. In the case of Korea and Japan, there is a significant correlation between export and population, but not in China. China's population is about 1.4 billion, 28 times higher than Korea's, but only 4 times higher in terms of exports.

Table 7. Correlation Analysis between Japan and Variables

	y	dist	gdp	pop	lpi
y	1	-.190	.853**	.462**	.224*
dist	-.190	1	.251*	-.192	.208*
gdp	.853**	.251*	1	.427**	.214*
pop	.462**	-.192	.427**	1	-.209*
lpi	.224*	.208*	.214*	-.209*	1

In the correlation analysis of distance, GDP, population, and the LPI indices of Japan's top 20 trading countries, GDP (r = 0.853 **) shows the highest correlation, and the population (r = 0.462 **) also reveals to be significant. The distance (-0.190) shows a negative correlation but does not lead to a significant result. The LPI (r = 0.224 *) indices have no significant correlation with Korea's exports.

Table 8. Analysis of Export Quantity in Korea

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Constant	21.737***	12.882***	18.429***	20.035***	12.688***	13.107***	12.448***
	(0.783)	(1.401)	(1.171)	(1.082)	(1.434)	(1.544)	(1.501)
Dist	-0.633***	-0.741***	-0.637***	-0.652***	-0.736***	-0.616***	-0.716***
	(0.101)	(0.083)	(0.096)	(0.099)	(0.084)	(0.086)	(0.091)
Gdp		0.345***			0.332***		0.280**
		(0.050)			(0.052)		(0.101)
Pop			0.180**			0.279***	0.057
			(0.051)			(0.051)	(0.093)
Lpi				1.344**	0.388	2.567***	0.786
				(0.567)	(0.499)	(0.542)	(0.825)
F	42.294***	20.535***	14.767***	13.210***	37.134***	12.843	27.749***
Adj R^2	0.305	0.0538	0.380	0.338	0.536	0.497	0.532

Note: ( ) indicates standard error, significant at *: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$.

The analysis of Korea's exports used the gravity model based on distance. In Model 1, the distance (−0.633 **) has a significant impact on exports, and in Model 2, both distance (-0.741 ***) and GDP (0.345 ***) are significant. In Model 3, the distance (-0.637 ***) and the population (0.180 ***) show a significant impact. In Model 4, the distance (-0.652 ***) and the LPI indices (1.344 **) show the significant results. In Model 5, the distance (-0.736 ***), GDP (0.332 ***), and the LPI indices (0.388) are significant, while the LPI indices have no significant influence. In Model 6, the distance (-0.616 **), the population (0.279 ***), and the LPI indices (2.567 ***) turned out to have significant results. In Model 7, the distance (-0.716 ***), and GDP (0.280 **) do not have a significant effect, while the population (0.057) and the LPI indices (0.786) do not.

Table 9. Analysis of Export Quantity in China

	Model1	Model2	Model3	Model4	Model5	Model6	Model7
Constant	19.666***	10.069***	19.533***	16.228***	9.198***	11.136***	9.683***
	(0.866)	(1.491)	(1.270)	(0.989)	(1.382)	(1.573)	(1.456)
Dist	-0.220***	-0.512***	-0.223*	-0.212*	-0.459***	-0.290**	-0.481***
	(0.102)	(0.092)	(0.105)	(0.090)	(0.085)	(0.086)	(0.087)
Gdp		0.436***			0.365***		0.442***
		(0.060)			(0.057)		(0.094)
Pop			0.009			0.237***	-0.092
			(0.061)			(0.059)	(0.088
Lpi				2.682***	1.901***	3.863***	1.274***
				(0.492)	(0.432)	(0.545)	(0.737)
F	4.646*	30.119***	2.310	17.849***	30.325***	19.039***	23.043***
adj R^2	0.036*	0.370	0.026	0.254	0.471	0.353	0.471

Note: ( ) Indicates standard error, significant at *: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$.

The analysis of China's exports used the gravity model based on distance. In Model 1, the distance (−0.220 **) has a significant impact on exports and in Model 2, both the distance (-0.512 ***) and GDP (0.436 ***) are significant. In Model 3, the distance (-0.223 *) has a significant impact, but the population (0.009) is not significant. In Model 4, the distance (-0.212 ***) and the LPI indices (2.682 **) indicate that they are significant. In Model 5, the distance (-0.459 ***), GDP (0.365 ***), and the LPI indices (1.901 **) are correlated, which means that the distance, GDP, and the LPI indices are all significant. In Model 6, the distance (-0.290 **), the population (0.237 ***) and the LPI indices (3.863 ***) all lead to significant results. In Model 7, the distance (-0.481 ***), GDP (0.442 ***), and the LPI indices (1.274 ***) have a significant impact, but the population (-0.092) hasn't.

The analysis of Japanese exports used the gravity model based on the distance. In Model 1, the distance (−0.630 ***) has a significant impact on exports, while in Model 2, both the distance (-0.851 ***) and GDP (0.437 ***) are significant. In Model 3, the distance (-0.622 ***) has a significant effect, while the population (0.109 *) hasn't. Model 4 also shows significant correlation with the distance (-0.688 ***) and the LPI indices (2.668 **). As for Model 5, the distance (-0.875 ***), GDP (0.397 ***), and LPI indices (2.027 **) are relevant and the distance, GDP, and LPI indices are significant. For Model 6, the distance (-0.703 **), the population (0.286 ***), and LPI indices (4.250 ***) are significant. In Model 7, the distance

(-0.891 ***), GDP (0.435 ***), and LPI indices (1.748 ***) have a significant effect, while the population (-0.039) hasn't.

Table 10. Analysis of Export Quantity in Japan

	Model1	Model2	Mode3	Model4	Model5	Model6	Model7
Constant	26.802***	16.627***	24.785***	23.940***	15.383***	16.932***	15.533***
	(1.039)	(1.352)	(1.382)	(1.086)	(1.226)	(1.397)	(1.261)
Dist	-0.630***	-0.851***	-0.622***	-0.688***	-0.875***	-0.703***	-0.891***
	(0.121)	(0.092)	(0.119)	(0.109)	(0.082)	(0.091)	(0.087)
Gdp		0.437***			0.397***		0.435***
		(0.048)			(0.043)		(0.082)
Pop			0.109*			0.286***	-0.039
			(0.050)			(0.043)	(0.072)
Lpi				2.668***	2.027***	4.250***	1.748**
				(0.525)	(0.391)	(0.499)	(0.645)
F	27.163***	66.667***	16.436***	29.928***	65.211***	43.152***	48.625***
adj R^2	0.209	0.570	0.238	0.369	0.661	0.561	0.658

Note: ( ) Indicates standard error, significant at *: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$.

5. Conclusion

In recent years, global trade is being swayed by non-tariff barriers such as customs clearance, administrative processes, technical regulations, inspections and certifications rather than tariffs itself. The WTO's Trade Facilitation Agreement (TFA) was concluded at the Ninth Ministerial Conference in February 2013, and in November 2014, the revised Protocol was adopted to include the protocol officially in the WTO agreements. After that, the WTO obtained the two-thirds acceptance of the Agreement as majority of member countries completed domestic procedures to accept the protocol and the TFA entered into force on 22 February 2017.

Among the existing indicators relevant to Trade Facilitation, OECD Trade Facilitation Indicators (TFIs) and the World Bank's Logistics Performance Index (LPI) are the most common. The OECD and the World Bank have designed and indexed the scores reflecting the content of the TFA. This study statistically analyzes the impact on trade for the 20 biggest exporting partners of Korea, Japan, and China by using the LPI indices related to Trade Facilitation based on the gravity model.

The statistical analysis of Korea's exports mostly showed significant results. In Model 7, the distance and GDP were significantly affected, but the population and the LPI indices were not. In addition, in the statistical analysis of China's exports, Model 3 showed that the distance has a significant effect, but the population does not. In Model 7, a significant impact was seen in relation with the distance, GDP, and the LPI indices, but not with the population. Finally, statistical analysis on Japanese exports yielded the same results as that of China. In Model 3, the distance had a significant impact, but not with population. In Model 7, the distance, GDP, and the LPI indices had significant impacts, but not with population. Thus, in three countries, the distance, GDP, and the LPI indices have a significant impact on exports but in a

geographic point of view, there seems to be a very little impact.

The focus of this research is on the fact that the trade volume can be increased by improving the LPI indices under the situation where most of trading partners of Korea, Japan, and China overlaps. In particular, if countries rank above 41th in the LPI scores, such as India, Taiwan, the Philippines, Malaysia, and Indonesia, are able to improve their LPI scores, then trade flows are highly likely to increase. What is needed to improve the LPI scores of these countries is as follows: First, the improvement of customs and infrastructures depends on how strong a government's commitment to the public policy is. Second, global shipment, logistics service capacity, traceability and timeliness are areas that the private sector often engages in, thereby, the private sector should take a better approach to the market with improved market flow predictions.

When it comes to the future direction of improving the LPI, it seems better to take two track approaches. First is the short-term approach. In the short-term, improving customs efficiency seems easier and cheaper than establishing infrastructure. Likewise, improving customs clearance efficiency may provide faster results. Infrastructure, however, is very important, especially for neutral countries. Establishing infrastructure will support the volume of trade in and out of the region, reducing transaction time, and allowing countries within the region to trade more with each other as well as far-distance countries. In addition, companies should reduce unnecessary customs delays by selecting AEO (Authorized Economic Operator)companies that integrate complex customs procedures from entry to customs clearance into AEO.

In addition, the government authorities must improve their institutional environment and policy transparency. This can be achieved by upgrading institutional environment, improving the transparency of the policy, and creating a fair, efficient and transparent institutional environment. Such changes can play an important role in the development of a nation's external trade. Not only that, countries should actively be engaged in creating a IT-friendly trade environment. This is because the dependency on trade services and commodities trade through electronic commerce is increasingly growing in this modern economy. And it is necessary to take advantage of the Mutual Recognition Agreement (MRA), in which conformity assessment procedures or certifications between countries are equivalent to those performed in their own countries. This will reduce the cost of testing and certification required for import and export, and shorten the testing and certification period, thereby securing competitiveness in import and export.

References

Beverelli, C., N. Simon and T. Robert (2015), "Export Diversification Effects of the WTO Trade Facilitation Agreement", *World Development*, 76, 293-310.

Choi Bo-Young, Jeong-Gon Kim, Ho-Gyeong Bang, Min-Sung Kim, Bo-Ram Lee and Ju-Mi Lee (2015), *Study on Strategic Plan for Establishing Master Plan of Trade Facilitation*, Sejong, Korea: Korea Institute for International Economic Policy.

Duval, Y., C. Utoktham and A. Kravchenko (2018), *Impact of Implementation of Digital Trade Facilitation on Trade Costs* (ARTNeT Working Paper Series, No. 174), Bangkok: ESCAP.

Elliott, D. and C. Bonsignori (2019), "The Influence of Customs Capabilities and Express Delivery on Trade Flows", *Journal of Air Transport Management*, 74, 54-71.

Maciejewski, M. and K. Wach (2019), "What Determines Export Structure in the EU Countries? The Use of Gravity Model in International Trade based on the Panel Data for the Years 1995-2015", *Journal of International Studies*, 12(1), 151-167.

Messerlin, P. and J. Zarrouk (2000), *Trade Facilitation: Technical Regulations and Customs Procedures*,

Hoboken, NJ: Blackwell Publishers, 577-593.

Moïisée, E. (2013), *The Costs and Challenges of Implementing Trade Facilitation Measures* (OECD Trade Policy Papers, No. 157), Paris: OECD.

Moïisée, E. and S. Sorescu (2013), *The Potential Impact of Trade Facilitation on Developing Countries' Trade* (OECD Trade Policy Papers , No. 144), Paris: OECD.

Felipe, J. and U. Kumar (2010), *The Role of Trade Facilitation in Central Asia: A Gravity Model* (Levy Economics Institute of Bard College Working Paper, No. 628), New York, NY: Bard College, 1-42.

Grübler, J., O. Reiter and R. Stehrer (2019), "The EU-Japan EPA: A Case for Non-tariff Measures", *CESifo Forum* , 20(2), 17-25.

Ramasamy, B. and M. C. H. Yeung (2019), "China's One Belt One Road Initiative: The Impact of Trade Facilitation versus Physical Infrastructure on Exports", *The World Economy,* 42(6), 1673-1694.

Sakyi, D., J. Villaverde, A. Maza and I. Bonuedi (2017), "The Effects of Trade and Trade Facilitation on Economic Growth in Africa", *African Development Review*, 29(2), 350-361.

Shon, Jeong-Soo (2019) "A Study on the Trade Patterns of Korea, China and Japan in the ASEAN Market", *Journal of International Trade & Commerce*, 15(4), 191-211.

OECD (2018), *Implementation of the WTO Trade Facilitation Agreement: The Potential Impact on Trade Costs* (OECD Database), Paris: Author. Available from https://issuu.com/oecd.publishing/docs/implementation_of_the_wto_trade_fac

Seo, Jin-Kyo, Soo-Hyun Oh, Ji-Hyun Park, Min-Sung Kim and Chang-Soo Lee (2013), *Economic Effect Analysis and Policy Responses of Early Harvest Package for DDA Negotiations* (Research Report 13-06), Seoul: Korea Institute for International Economic Policy.

Seo, Jin-Kyo, Min-Sung Kim, Baek-Hoon Song and Chang-Soo Lee (2014), *Analysis of the Development Direction of Post-Bali DDA Negotiations and Korea's Negotiation Measures* (Research Report 14-06), Seoul: Korea Institute for International Economic Policy.