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Impacts of TBT and SPS Measures on Trade: Evidence from South Korean Exports to RCEP Economies

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<Abstract>

As the Regional Comprehensive Economic Partnership(RCEP) trade deal being negotiated is slated to be finalized no later than 2020, non-tariff measures(NTMs) appear to have become one of the most contentious issues among RCEP's member states in achieving deeper regional integration. This study attempts to analyze the growing trend of technical NTMs, which seem to be adopted as protective trade instruments so that they hinder intra-regional trade in the new protectionist era. The study is conducted from the perspective of South Korea in the context of RCEP. It analyzes the potential impacts of regulatory measures, namely Technical Barriers to Trade(TBT) and Sanitary and Phytosanitary measures(SPS), on trade between South Korea and RCEP's major trading partners. This is an empirical study where a gravity model is used to assess the impacts of TBT and SPS measures imposed by the 10 member states of RCEP on South Korea's primary exports aggregated at the two-digit level of the Harmonized System(HS) from 2007 to 2016. The empirical results are as follows: 1) Consistent with existing studies, the TBT imposed by RCEP's trading partners have a negative impact on South Korea's export values while SPS measures have an insignificant effect on the whole industry. 2) The industry-wise regression results also show the negative impacts of technical regulations on trade in majority of the industries. 3) The SPS measures

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imposed by the RCEP members on South Korea's exports have a positive influence on agricultural commodities, but insignificant impact on manufactured goods. 4) The negative impact of TBT is less significant in high-technology industries.

*Keywords: Technical Barriers to Trade(TBT), Sanitary and Phytosanitary Measures(SPS), Non-Tariff Measures(NTMs), Gravity Model, Regional Comprehensive Economic Partnership(RCEP)

Ⅰ. Introduction

The expansion of trade liberalization under the World Trade Organization (WTO) has led to removal or reduction of restrictions and barriers including tariffs and non-tariff barriers(NTBs) on the exportation and importation of goods and services between states. However, there is also a paradoxically growing trend of protectionism among the states which is threatening the international trading regime and has led to some regulations that constitute other obstacles to trade and require significant legal and policy challenges. Since the global financial crisis of 2008, the use of non-tariff measures(NTMs) as trade policy instruments has gradually accelerated(Cadot et al. 2015; Choi et al. 2015; UNESCAP 2016; WTO 2012b). The border measures such as tariff and quotas, which are the predominant forms of trade restrictions, are currently being replaced by behind-the-border measures, specifically technical barriers to trade(TBT) and sanitary and phytosanitary measures(SPS), whereas the average level of tariffs has fallen. The importance of the TBT and SPS measures is highlighted by Ando and Obashi(2010), who observed that the technical NTMs are more common than the other types of measures in the member countries of the Association of South East Asian Nations(ASEAN). Fugazza(2013) also reported that the technical measures far outweigh other types of trade barrier measures. The UNESCAP has provided evidence of the rise in NTMs as part of protectionist policies in the Asia-Pacific region (UNESCAP 2016, 15).[1] Despite the proliferation of NTMs as a protectionist

1) UNESCAP refers to United Nations Economic and Social Commission for Asia and the

policy instrument, the Regional Comprehensive Economic Partnership(RCEP) members still lack a plan on effectively addressing NTMs.

The main objective of this study is to empirically assess the impacts of technical NTMs, including TBT and SPS, levied by the RCEP member countries. Based on the results, this study aims to devise policy measures in order to enhance economic integration in the Asia-Pacific region. More specifically, our main research questions for the study are as follows: (1) How do the TBT and SPS measures imposed by major RCEP trading partners affect South Korean exports? (2) If the regulatory measures affect South Korean exports, does the degree of effect differ by industry? (3) Is there any correlation between high-technology industries and the effect of TBT measures?

This paper is a key addition to the previous empirical studies on NTMs' impact on trade. For this research, we constructed a TBT database confined to the RCEP region based on the aggregated sectors at the HS-2 digit level, which allows for a comparison of the effects of TBT across industries. While most previous studies divide industries into two broad categories: agricultural and manufacturing, this paper analyzes a larger variety of industrial sectors based on the export values of South Korea and the number of TBT notifications reported by the RCEP member states.[2)]

We apply a gravity model to analyze the effects of TBT and SPS imposed by the RCEP member states on Korean exports on three levels: overall level, sectoral level, and technology level. A more detailed analysis at the product level is also conducted to capture the extent to which the individual industries are impacted. A panel dataset of 61 agricultural and manufactured products in Korea from a 10-year time period is employed for the analysis. The data for TBT and SPS measures across importing countries and industrial sectors from 2007 to 2016 are constructed based on the WTO Integrated Trade Intelligence Portal(I-TIP).

This paper is structured as follows: Section II presents the background of

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Pacific. The report has recorded 1,244 restrictive measures since the 2008 global financial crisis.

2) The term Korea will be used hereafter to refer to South Korea unless otherwise specified.

NTMs with the characteristics of the core subcategories TBT and SPS, and RCEP which is a mega trade deal in the Asia-Pacific region. It also covers the recent trade developments between Korea and its 10 major RCEP trading partners. Section III explains the data used and the estimation model. Section IV presents the estimation results. Finally, Section V concludes with a summary of the main findings with policy implications for effectively addressing the issues related to NTMs in future RCEP negotiations.

II. Background of RCEP and NTMs

1. The Regional Comprehensive Economic Partnership

The RCEP is an ASEAN-led proposal for a free trade agreement(FTA) among ten ASEAN countries and six of ASEAN's FTA partners.[3] This mega-trade pact is expected to be finalized no later than 2020. The documentation regarding the provision of the agreement has been reportedly completed and is at the closing stage of legal reviews. As of 2017, the prospective RCEP member states have a combined population of over 3.4 billion(49% of the world's population) and a cumulative GDP of over $49.5 trillion(approximately 39% of the world's GDP), the combined GDP of China and India making up more than half the amount. Successful RCEP negotiations could lead to what can be considered as the world's most widespread trading bloc.

The trade volume of Korea with 16 RCEP member states recorded $443 billion in 2016, which accounted for 49.13 percent of $902 billion of Korea's total trade volume(KITA). The total export values to RCEP countries amounted to $244 Billion. The top export destinations of Korea's were China, which accounted for 25.12 percent of Korea's total export, followed by Vietnam(6.59%), Japan(4.92%) and Singapore(2.51%) among 16 RCEP countries.

3) 10 ASEAN member states (Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam) and 6 ASEAN FTA partners(Australia, People's Republic of China, India, Japan, Republic of Korea, and New Zealand).

Meanwhile, the top import origins of Korea were China(21.41%), followed by Japan(11.69%), Australia(3.74%), and Indonesia(2.04%).[4)]

2. Non-Tariff Measures

NTMs, which encompass the concept of TBT and SPS measures, are a prominent feature of international trade regulations. They can be broadly defined as policy measures other than ordinary customs tariffs that can affect international trade(UNCTAD 2013).

TBT refers to all forms of trade barriers that hinder free trade of goods and services between the trade partners, by using different standards, technical regulations, and certification procedure(UNCTAD 2013). These regulations stipulate either the specific characteristics of a product—such as its shape, size, or design—or the production and manufacturing processes. The TBT Agreement by the WTO requires each member to publish an advance notice specifying that it proposes to adopt a technical regulation or conformity assessment procedure; this notice helps to ensure that these measures do not become unnecessary obstacles to trade. The TBT is generally introduced in pursuit of a legitimate policy objective such as public health protection and safety. However, they can have a restrictive and distortionary effect on international trade in the form of "disguised" protectionism. TBT can have both demand-enhancing effect and trade-restriction effect(Ganslandt and Marksuen 2001; Bureau et al. 1998; Otski et al. 2001). More specifically, technical measures may enhance a country's demand for imports if they are informative by addressing market imperfection and improving market efficiencies(Thilmany & Barret 1997). On the flip side, technical measures may depress a country's exports increasing compliance costs that do not translate directly into production costs and price(Otski et al. 2001).

It would be every government's priority to ensure public health and safety by preventing the spread of pests and the outbreak of diseases among plants

4) Refer to the Korea International Trae Association(KITA). http://stat.kita.net/stat/kts/ctr/CtrTotalImpExpList.screen (downloaded 15 October 2020)

and animals. Policies with these goals are known as sanitary(human and animal health) and phytosanitary(plant health) measures, or commonly referred to as SPS measures. They can be diverse in nature and include inspection, testing, requirements for specific product treatments, or regulations on the maximum level of pesticide residues in fruit and vegetables(ESCAP 2016). When the measures go beyond the requirement of health protection and are used as a means of protectionism against foreign competition, they may result in restrictions on trade. Similar to the positive function of TBT, however, not all SPS measures are trade restrictive. When SPS measures help streamline information regarding the safety, quality, and specifications of products, they can potentially reduce trade costs. Also, the consumer demand for products with stringent SPS regulations may increase as quality assurance increases consumer confidence as well. The effects of SPS measures can thus be inconclusive, encompassing trade disruption, trade diversion, and trade creation.

The number of newly initiated TBT notifications submitted by WTO member states has increased by almost five times, from 364 in 1995 to 1,778 in 2017. There has been a sharp increase in the notifications since 2008, coinciding with the Global Financial Crisis, which implies the possibility of countries implementing NTMs to protect their domestic economy(Choi 2015). This increase in the number of TBT can also be explained as a response to increasing consumer demands for product safety and greater awareness of environmental protection that encourages governments to tighten domestic technical regulations or introduce new stringent regulations(WTO 2012b). RCEP members accounted for about 18.22% of TBT notifications between 2007 and 2017. The share of TBT notifications by RCEP member states compared to all WTO member states had decreased from 25.44% in 2007 to 12.05% in 2017. However, there had been a big surge in TBT notifications from RCEP member states between 2008 and 2009, their total notifications amounted to 366 in 2009, or 27.02% share of WTO member states, which hints at the possible causal relationship between economic recession and proliferation of TBT measures.

III. Data and Model Specification

This study uses a gravity framework to econometrically assess the potential

impact of technical NTMs like TBT and SPS imposed by 10 major RCEP economies on Korean export values between 2007 and 2016.[5] The assessment is conducted at the two-digit level of the Harmonized System(HS). As shown in Table 1, 96 product groups at the two-digit HS level are classified into 15 broad sectors. Also, these industries are grouped into low-tech and high-tech sectors based on the technology intensity, measured by the ratio of R&D expenditure relative to the value-added and gross production statistics according to the classification given by the Organization for Economic Co-operation and Development(OECD)(Hatzichronoglou 1997).

Table 1. Classification of industrial sectors and technology-intensity

Industry	HS 2-digit	Industrial sector	Technology intensity
1	01 - 10	Primary commodity	Low
2	11 - 24	Primary commodity processing	Low
3	25 - 28	Mineral processing	Low
4	29 - 40	Rubber & Chemical products	High
5	41 - 43	Leather products	Low
6	44 - 49	Paper & Wood	Low
7	50 - 67	Clothing & Textiles	Low
8	68 - 71	Non-metallic minerals	Low
9	72 - 83	Metal products	Low
10	84	General machinery	High
11	85	Electrical machinery	High
12	87	Transport equipment(Road vehicles)	High
13	86, 88 - 89	Other transport equipment (other than road vehicles)	High
14	90 - 91	Precision machinery	High
15	92 - 97	Other manufactures	Low

Note: Classification for industrial sectors according to the Korean Standard Statistical Classification (KSSC). Data on technology-intensity from Hatzichronoglou(1997).[6]

5) Among the entire 16 participating states of RCEP including 10 ASEAN members, Australia, China, India, Japan and New Zealand, annual amount of Korean exports to Brunei, Myanmar, Lao PDR and Cambodia is less than a billion US dollars, and number of SPS/TBT notifications by the states is insignificantly too small as well. Also, India expressed its discontent toward the RCEP deal at the summit in November 2019 and decided to pull out of the RCEP negotiation. Therefore, the aforementioned countries are decisively ruled out for the analysis and the study is targeted at 10 major RCEP economies.

6) Industries are grouped into four categories: high, medium—high, medium—low and low technology in the OECD report, but they are reclassified into two larger categories—high-tech and low-tech sectors for the quantitative analysis in this paper.

The basic regression model covers the complete sample encompassing agricultural and manufacturing industries: HS 01-40 and 68-89. All the sectors are divided into nine specific product groups: HS 01-10, 11-24, 25-28, 29-40, 68-71, 72-83, 84, 85, and 87, to estimate the impact of TBT and SPS measures on trade across industries. Lastly, the TBT variable is interacted with products with high technology intensity to check whether the level of technology is correlated with the trade restrictiveness of TBT.

1. Model Specification

The gravity model of trade is widely used to estimate the determinants of trade(Tinbergen 1962; Anderson 1979, Eaton and Kortum 2002; Anderson and van Wincoop 2003; Helpman et al. 2008). It states that the bilateral trade volumes are proportional to the size of the trading countries' economies measured by GDP or GDP per capita, and other factors that influence trade flows including a country's trade policies, distance, and cultural aspects. Many studies analyzed the impact of NTMs using the gravity model(Bao & Qiu 2010; Bao & Qiu 2012; Cho et al. 2019; Choi et al. 2015; Jang et al., 2011; Moenius 2004; Otsuki et al. 2001).

We specify a gravity model to evaluate the impacts of TBT and SPS on South Korean exports to RCEP countries. For the model specification, we tackle endogeneity issues in the regression in two ways. First, we include country and time specific effects to control for multilateral resistance(Anderson and van Wincoop 2003).[7] Second, we use lagged TBT and SPS variables to correct the potential endogeneity of TBT and SPS measures(Bao and Qiu 2012). Another issue in model specification is zero trade flows. Since trade flow variables such as export, tariffs, TBT and SPS are included in logarithmic form, zero trade values will be excluded from the regressions as missing values, which gives biased estimation results. To avoid

7) Multilateral resistance captures not just bilateral trade resistance, which is the barriers to trade between countries, but also the barriers to trade that each country faces with all its trading partners.

the problem, we do logarithm transformation by adding 1 to the original values.

The first specification of the adjusted gravity structure estimates the general effects of TBT without considering any specific industry. This basic regression model takes the following form:

$$\ln(1+1\ Exp_{jkt}) = \beta_0 + \beta_1 \ln GDP_{jt} + \beta_2 \ln Dist_j + \beta_3\ FTA_{jt} + \beta_4\ TSI_{jkt} + \beta_5\ Tech_k + \beta_6 \ln(1+Tariff_{jkt}) + \beta_7 \ln(1+TBT_{jkt}) + \alpha_j + \tau_t + \varepsilon_{jkt} \quad [1]$$

In equation (1), the dependent variable is Exp_{jkt}, which is the log of Korean export values of the two-digit product k in US dollars to partner country j in year t. The subscript j represents the 10 RCEP member states that import from Korea.[8] The time period, t, covers the years between 2007 and 2016 and k denotes 61 product groups at the HS two-digit level, from HS 01 to 40, and 68 to 89(no data for HS 77), which are classified into 9 aggregated sectors.[9] To reduce the impact of outliers on the data, the natural logs of the entire distribution are taken to normalize the distribution. The typical gravity controls including GDPs of importing countries, distances, and FTA between two countries are introduced as explanatory variables. The GDP of importing country in logs, GDP_{jt}, is used to capture its market size. Thus, the positive sign of GDP can be interpreted as a positive effect on Korean export values. The gravity variable included in the regression FTA_{jt} is a dummy variable that shows whether the bilateral countries are involved in the same regional trade agreement in that year. The variable $Dist_j$ represents the geographical distance in km between Korea and importer j's capital in logs. The distance between two countries captures the

8) Korea's major RCEP trading partners are Australia, China, Indonesia, Japan, Malaysia, New Zealand, Philippines, Singapore, Thailand, and Vietnam.

9) We initially targeted the full 2-digit HS codes list; however, the number of TBT and SPS notifications related to HS 41-43(Leather products), HS 44-49(Paper/Wood), and HS 50-67(Clothing/Textiles) was found to be insignificantly too small. Therefore, the aforementioned HS codes are decisively ruled out for the analysis.

transportation costs. TSI_{jkt} is the trade specialization index(TSI), ranging between -1 and +1, which shows the competitiveness of the 10 importing countries' traded goods compared to that of Korea.[10] A positive value of TSI implies that Korea's importing trading partners are more specialized or have a comparative advantage in producing good k while a negative value implies a comparative disadvantage in trading good k and, thus, an increase in Korean exports to the importing countries. $Tech_k$ is a dummy variable with a value of 1 if the given product group belongs to a high-technology sector and a value of 0 if it belongs to a low-technology sector.

One of the key variables, $Tariff_{jkt}$ is the change in the log of importer's MFN tariff applied to the industry k in year t. The import tariffs are used to measure any potential effect the tariffs may have. An increase in tariff levels may lead to a reduction in exports from the target country. TBT_{jkt} and SPS_{jkt} represent the log of numbers of TBT notifications reported by country j. TBT_{jkt} and SPS_{jkt} respectively represent the importing country j's introduction of TBT and SPS applied to product groups k at the HS two-digit level in year t. It should be noted that choosing different proxies for TBT and SPS may lead to different estimates of the effects of technical measures on trade as they do not have any direct measurements. To measure the intensity of technical restrictiveness, this study employs the number of TBT and SPS notifications that provide information on imposing countries, affected partners, dates of initiation, objectives, and the affected products according to the HS codes interpreted by the WTO.

In this model specification, three regional dummies for 10 importing countries α_j[11] and year dummy τ_t are introduced to control for multilateral

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10) The calculation of TSI_{jkt} is based on the share of commodity group k in the exports of a country and the share of commodity group k in imports of its trading partner, $TSI_{jkt}=(EX_{ijkt}-IM_{ijkt})/(EX_{ijkt}+IM_{ijkt})$, where EX_{ijkt} and IM_{ijkt} are respectively exports and imports of good i by country j and the value of trade specialization index lies between -1 and +1.

11) 10 RCEP member states are divided into three regions to reflect the specific characteristics of each importing country: (*i*) Region 1: ASEAN, (*ii*) Region 2: East Asia, and (*iii*) Region 3: Oceania.

resistance. Regions 2 and 3 are dummy variables for ASEAN and East Asian regions in the data set while a dummy variable for Region 1, Oceania region, is excluded to avoid perfect collinearity. Likewise, τ_t is a dummy variable for the period 2007 to 2016 excluding the year 2007 as a reference year. ε_{jkt} is an error term.

In addition to the equation [1], the impacts of TBT and SPS measures adopted by RCEP trading partners on Korean exports are estimated across different industries in equations [2] and [3]. Equation [2] estimates the effects of TBT measures on different industries while equation [3] evaluates the effect of SPS measures. To consider industry-specific characteristics, an interaction term between the number of TBT notifications and high-tech dummy variable is included in equation [4].

$$\ln(1+1\ Exp_{jkt}) = \beta_0 + \beta_1 \ln GDP_{jt} + \beta_2 \ln Dist_j + \beta_3\ TSI_{jkt} + \beta_4 \ln(1+Tariff_{jkt}) + \beta_5 \ln(1+TBT_{jkt}) + \alpha_j + \tau_t + \varepsilon_{jkt} \quad [2]$$

$$\ln(1+1\ Exp_{jkt}) = \beta_0 + \beta_1 \ln GDP_{jt} + \beta_2 \ln Dist_j + \beta_3\ TSI_{jkt} + \beta_4 \ln(1+Tariff_{jkt}) + \beta_5 \ln(1+SPS_{jkt}) + \alpha_j + \tau_t + \varepsilon_{jkt} \quad [3]$$

$$\ln(1+1\ Exp_{jkt}) = \beta_0 + \beta_1 \ln GDP_{jt} + \beta_2 \ln Dist_j + \beta_3\ FTA_{jt} + \beta_4\ TSI_{jkt} + \beta_5\ Tech_k + \beta_6 \ln(1+Tariff_{jkt}) + \beta_7 \ln(1+TBT_{jkt}) + \beta_8\ Tech_k \times \ln(1+TBT_{jkt}) + \alpha_j + \tau_t + \varepsilon_{jkt} \quad [4]$$

2. Data Description

An unbalanced panel data set of 6,100 observations is constructed for 61 product groups of 10 importing partners with a time span of 10 years. The value of Korean exports to 10 RCEP member countries for industrial sectors aggregated at the HS two-digit level in US dollars is obtained from the United Nation's Commodity Trade Statistics Database(UNCOMTRADE). The

current year GDPs of each importing country in US dollars are taken from the World Development Indicators(WDI). The data for the distance between the capital of Korea and those of individual importing countries are obtained from the Centre d'Etudes Prospectives et d'Informations Internationales in Franc(CEPII). Import tariffs imposed on Korea's export markets for each product group are compiled from the WTO Tariff Analysis Online(WTO TAO). The TSI between Korea and its 10 trading partners is calculated for each aggregated industrial sector using bilateral trade values extracted from the UNCOMTRADE data. The information on the conclusion of FTAs between Korea and given RCEP member countries is obtained from Korea Customs Service FTA Portal System. Finally, TBT and SPS datasets for 10 RCEP member countries are constructed across industries covering 24 agricultural products and 37 manufactured product groups. As a proxy for stringency of TBT and SPS, the number of TBT and SPS notifications to the WTO reported by 10 countries for 61 product groups is compiled based on the WTO Integrated-Trade Intelligence Portal(I-TIP). The detailed information on variables used in the regression model is listed in Table 2. Table 3 presents the sample statistics for the variables.

Table 2. Explanation on each variable used for regressions

Variable	Unit	Description	Predicted sign	Data source
Dependent variable				
Exp_{jkt}	US$	The value of Korean exports in the industry k to 10 RCEP individual countries j in year t.		UNCOMTRADE
Explanatory variables				
GDP_{jt}	current US$	The gross domestic production level of 10 RCEP importing countries j in year t.	(+)	World Development Indicators (WDI)
$Dist_j$	km	The geographical distance between Korea and 10 RCEP importing countries j capitals.	(-)	CEPII

Variable	Unit	Description	Predicted sign	Data source
$Tariff_{jkt}$	%	The MFN tariffs on industry k by 10 RCEP importing countries j.	(-)	WTO Tariff Analysis Online (WTO TAO)
TSI_{jkt}	-1 ~ + 1	Author's calculations based on Korean exports and imports from RCEP countries using data from UN Comtrade.	(-)	Author's calculation from UNCOMTRADE
FTA_{jt}	0 or 1	A binary variable that equals 1 if Korea has free trade agreement in force with importing countries j, and 0 otherwise.	(+)	Korea Customs Service FTA Portal System
$Tech_k$	0 or 1	A binary variable with a value of 1 for the products that belong to high-technology intensity, and 0 for the products that belong to low-technology intensity.	(+)	OECD
TBT_{jkt}	number	The number of TBT imposed by importing countries j on each product imported from Korea in year t.	(-) / (+)	WTO I-TIP
SPS_{jkt}	number	The number of SPSs imposed by importing countries j on product k imported from Korea in year t.	(-) / (+)	WTO I-TIP

Table 3. Sample statistics

Variable	Mean	Standard deviation	Min	Max
Exp_{jkt} (US$ million)	311.96	1,918.99	0	52,661.06
GDP_{jt} (US$ 100 million)	18,023.10	27,628.34	774.14	11,190.92
$Dist_j$ (km)	4,388.89	2,826.40	955.65	10,293.84
$Tariff_{jkt}$ (%)	0.06	0.09	0	1.09
TSI_{jkt}	-0.02	0.73	-1.00	1.00
FTA_{jt}	0.67	0.47	0	1.00
TBT_{jkt}	0.16	1.00	0	27
SPS_{jkt}	0.04	0.40	0	14.00

IV. Estimation Results

1. General Results for the Whole Industries

This study uses the pooled ordinary least squares(POLS) for empirical analysis based on the gravity model set in the previous section. Table 4 reports the estimation results for all product groups(HS 01.40, 68.89) as the benchmark model specified in the equation [1]. The estimation examines the effects of two predominant technical measures, TBT and SPS, on Korean exports by its trading partners in the RCEP.

Table 4 presents the results for the impact of TBT on trade while Table 5 indicates the results for the impact of SPS on trade.

Table 4. Regression results for all industries(HS 01.40, 68.89): TBT

	TBT		
HS 01–40, 68–89	[1]	[2]	[3]
ln(gdp_jt)	0.226** (0.108)	0.293*** (0.112)	0.324*** (0.118)
ln(dist_j)	-2.023*** (0.318)	-2.132*** (0.334)	-2.303*** (0.350)
ln(1+tariff_jkt)	-4.126*** (1.277)	-5.136*** (1.354)	-5.741*** (1.436)
tsi_jkt	-1.187*** (0.107)	-1.172*** (0.112)	-1.166*** (0.118)
fta_jt	1.011*** (0.162)	0.930*** (0.172)	0.862*** (0.184)
tech_k	1.837*** (0.168)	1.801*** (0.177)	1.777*** (0.188)
ln(1+tbt_jkt)	-0.849*** (0.207)		
ln(1+tbt_jkt-1)		-0.925*** (0.215)	
ln(1+tbt_jkt-2)			-0.911*** (0.226)
Year FE	Yes	Yes	Yes
Region FE	Yes	Yes	Yes
N	5,958	5,350	4,742
R-squared	0.202	0.202	0.201

Notes: Dependent variable is the log value Korean exports of 2-digit products to 10 RCEP importing countries. Robust standard errors in parenthesis.
Statistical significance: * p<0.1, ** p<0.05, *** p<0.01.

The regression results for the samples(Tables 4 and 5) are all statistically significant and have the expected signs. The coefficient estimates for GDP of importing countries is positive and statistically significant at the 1% and 5% level. The gravity control variable, *distance* between Korea and the 10 RCEP trading partners, is also statistically significant at the 1% level. The effect of FTA is positive and highly significant, which proves that the FTAs promote bilateral trade between Korea and its FTA partners through the "trade creation" effect. Thus, the results confirm that Korean exports increase when the trading partners have a higher income, are located closer to each other geographically, and when two countries have signed FTAs.

Also, the coefficient for *Tech* is positively significant at the 1% level, implying that the export value of high technology Korean products is likely to be higher than that of low technology products. The negative value of *TSI* suggests that South Korea's importing trading partners have less specialization or a relative comparative disadvantage in producing and trading goods and this may result in increase in Korean exports to the 10 RCEP trading partners by 1.166~1.187%. The coefficient for the *Tariff* applied to each product from each country is shown to be negative and statistically significant at the 1% level, which implies that a 1% increase in import tariff levels may result in a decline in Korean exports by 4.126~5.741%.

Consistent with the findings of most of the previous studies showing trade restrictions caused by TBT measures, the estimated coefficient for the key variable TBT is also negative and highly significant at the 1% level. Therefore, a 1% increase in TBT notifications will reduce Korean exports by 0.849%. This result confirms the theoretical predictions that the imposition of TBT measures by importing countries has negative effects on Korean export values. The sign and significance of the TBT variable effect also shows its robustness in lagged variables. Meanwhile, the estimates for the number of SPS notifications on Korean exports are found to be statistically insignificant for the sample as a whole(see Table 5)

Table 5. Regression results for all industries(HS 01.40, 68.89): SPS

	SPS		
HS 01–40, 68–89	[1]	[2]	[3]
ln(gdp_jt)	0.236**	0.301***	0.327***
	(0.108)	(0.112)	(0.118)
ln(dist_j)	-2.064***	-2.200***	-2.347***
	(0.320)	(0.335)	(0.350)
ln(1+tariff_jkt)	-4.737***	-5.860***	-6.571***
	(1.292)	(1.372)	(1.453)
tsi_jkt	-1.187***	-1.175***	-1.164***
	(0.107)	(0.112)	(0.118)
fta_jt	0.946***	0.843***	0.761***
	(0.164)	(0.174)	(0.186)
tech_k	1.741***	1.692***	1.651***
	(0.169)	(0.178)	(0.189)
ln(1+sps_jkt)	0.176		
	(0.289)		
ln(1+sps_jkt-1)		0.036	
		(0.316)	
ln(1+sps_jkt-2)			-0.253
			(0.380)
Year FE	Yes	Yes	Yes
Region FE	Yes	Yes	Yes
N	5,958	5,350	4,742
R-squared	0.198	0.198	0.197

2. Results Across Different Industries

Table 6 displays the effects of TBT by 10 RCEP importing countries on the primary Korean product groups that account for a high share of the TBT notifications. To ascertain if the effects of TBT measures differ based on the type of industry, all industries(HS 01-40, 68-89) were divided into nine specific sub-sectors—primary commodity(HS 01-10), primary commodity processing(HS 11-24), mineral processing(HS 25-28), chemical(HS 29-40), non-metallic minerals(HS 68-71) and metal products(HS 72-83), general machinery(HS 84), electrical machinery(HS 85), and transport equipment(HS 87). As seen in the regression results, the direction and the significance of

effects of TBT vary considerably across product groups.

Table 6. Regression results of TBT for specific sectors

	Agricultural industry		Manufacturing industry						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Primary commodity (01 - 10)	Primary commodity processing (11 - 24)	Mineral processing (25 - 28)	Chemical products (29 - 40)	Non-metallic minerals (68 - 71)	Metal products (72 - 83)	General machinery (84)	Electrical machinery (85)	Transport equipment (87)
ln(gdp_jt)	0.569*** (0.156)	0.540*** (0.106)	2.055*** (0.285)	0.967*** (0.121)	0.902*** (0.156)	1.194*** (0.162)	1.934*** (0.517)	0.878 (0.641)	0.047 (0.431)
ln(dist_j)	-2.518*** (0.295)	-2.139*** (0.230)	0.429 (0.520)	-1.622*** (0.214)	-1.562*** (0.280)	-1.576*** (0.300)	-1.617*** (0.725)	-3.447 (2.483)	-5.677*** (2.053)
ln(1+tar_jkt)	-4.801*** (1.715)	-3.883*** (1.985)	-6.610*** (1.958)	-3.345*** (1.983)	-9.646 (1.707)	-7.841 (1.898)	-8.755*** (1.632)	-6.691*** (1.465)	-6.542*** (1.914)
tsi_jkt	-1.377*** (0.195)	-1.649*** (0.203)	-4.191*** (0.493)	-1.164*** (0.269)	0.067 (0.431)	0.462 (0.284)	-0.116 (1.549)	-4.575*** (1.914)	-9.289*** (1.076)
ln(1+tbt_jkt)	-0.375 (0.436)	-1.501*** (0.449)	-0.455 (0.765)	-1.115*** (0.473)	-2.434*** (0.755)	-1.658*** (0.574)	-3.440*** (1.113)	-3.389*** (0.920)	-0.156 (0.886)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	980	1,352	392	1,176	392	1,078	100	98	98
R-squared	0.299	0.226	0.257	0.133	0.168	0.136	0.226	0.508	0.712

Notes: Dependent variable is the log value Korean exports of 2-digit products to 10 RCEP importing countries. Robust standard errors are in parenthesis. Statistical significance: *p<0.1, **p<0.05, ***p<0.01.

As expected, TBT has a negative impact on Korean exports in most industries. This result confirms that the imposition of TBT by major RCEP trading partners acts as a barrier for Korean exports. Specifically, the differences in technical regulations and standards across importing countries may impose a compliance cost on exporting countries. The negative effects of TBT are more prominent in general machinery(HS 84) and electrical machinery(HS 85) related industries.

As shown by the regression results of SPS measures on trade in Table 7, the coefficients for SPS notifications reported by importing countries have a positive impact on trade of agricultural products including fresh and

processed food, HS 01-24, but a statistically insignificant impact on the manufacturing industry. The positive effect of SPS measures may be explained by the fact that the positive "information costs," which represent quality and safety of products, outweigh the negative "compliance costs" that may be borne by exporters(Moenius 2004). From this perspective, SPS notifications may help reduce exporters' adaption costs in the foreign markets by providing detailed market information on consumers' preferences to the exporters(Bao & Chen 2013).

Table 7. Regression results of SPS for specific sectors

	Agricultural industry		Manufacturing industry						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Primary commodity (01 - 10)	Primary commodity processing	Mineral processing (25 - 28)	Chemical products (29 - 40)	Non-metallic minerals (68 - 71)	Metal products (72 - 83)	General machinery (84)	Electrical machinery (85)	Transport equipment (87)
ln(gdp_jt)	0.636*** (0.160)	0.574*** (0.110)	2.017*** (0.272)	0.884*** (0.116)	0.818*** (0.154)	1.151*** (0.161)	1.200*** (0.380)	1.672*** (0.775)	0.052 (0.424)
ln(dist_j)	-2.455*** (0.297)	-2.052*** (0.236)	0.458 (0.518)	-1.451*** (0.203)	-1.275*** (0.266)	-1.383*** (0.290)	-1.237* (0.692)	-6.606** (2.660)	-5.745*** (2.009)
ln(1+tar_jkt)	-4.651*** (1.650)	-4.329*** (1.047)	-6.789*** (1.136)	-3.736*** (1.988)	-2.686*** (1.990)	6.222 (1.771)	-5.513 (1.367)	-6.020*** (1.007)	-6.996*** (1.808)
tsi_jkt	-1.417*** (0.196)	-1.645*** (0.203)	-4.175*** (0.492)	-1.117*** (0.268)	-0.194 (0.435)	0.498* (0.283)	-2.019 (1.646)	-20.062*** (4.784)	-9.313*** (1.808)
ln(1+sps_jkt)	1.279*** (0.386)	1.781*** (0.467)	0.395 (0.939)	1.433 (0.364)	5.384 (1.383)	(dropped)	1.754 (3.480)	(dropped)	(dropped)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	980	1,352	392	1,176	392	1,078	98	98	98
R-squared	0.304	0.221	0.256	0.127	0.133		0.087	0.381	0.712

Notes: Dependent variable is the log value Korean exports of 2-digit products to 10 RCEP importing countries. Robust standard errors are in parentheses. Statistical significance *p<0.1, **p<0.05, ***p<0.01

3. Results for TBT Effects on Products with High-Technology

Table 8 shows the estimation results for the effect of TBT imposed on products with high level of technology. Column (1) exhibits the result for all

sample sectors regardless of the level of technology of each commodity. Column (2) includes only the sectors with high technology. Interestingly, the effects of TBT on exports turned out to be positive in the case of high-technology products. Column (3) presents the regression results for the sample with the high-technology dummy variable and its interaction with the TBT variable. The coefficient for interaction term $\ln(1+tbt\_jkt) * tech\_k$ would help in determining whether the impact of TBT on sectors with high-tech intensity and low-tech intensity is different.

Table 8. Regression results for TBT effects on high-tech industries

	TBT	
ln(gdp_jt)	0.226** (0.108)	0.233** (0.122)
ln(dist_j)	-2.023*** (0.318)	-2.069*** (0.382)
ln(1+tariff_jkt)	-4.126*** (1.277)	-4.290*** (1.046)
tsi_jkt	-1.187*** (0.107)	-1.183*** (0.105)
fta_jt	1.011*** (0.162)	0.993*** (0.167)
tech_k	1.837*** (0.168)	1.687*** (0.169)
ln(1+tbt_jkt)	-0.849*** (0.207)	-0.369*** (0.092
ln(1+tbt_jkt)* tech_k		0.292*** (0.102)
Year FE	Yes	Yes
Region FE	Yes	Yes
N	5,958	5,958
R-squared	0.202	0.201

Notes: Dependent variable is the log value Korean exports of 2-digit products to 10 RCEP importing countries. Robust standard errors are in parentheses. Statistical significance * p<0.1, ** p<0.05, *** p<0.01

Each coefficient for *hightech_k* and *ln(1+tbt_jkt)* represents the direct effect of exported products with high level of technology and the number of TBT notifications reported by importing countries on Korean exports, respectively. The interaction term of these two variables shows the indirect effect of both TBT and high technology sector products exported from Korea to RCEP economies. Overall, the result implies that the positive effect of TBT on sectors with high technology offsets the negative effect of TBT on exports. Hence, exporters with high technology are likely to gain higher profit from importers' imposition of TBT. In other words, the value of high-technology products exported by Korea is less likely to be impacted by the adverse effects caused by the introduction of TBT measures. One explanation for this result is the fact that the countries included in the sample are mostly developing countries whose capacity to meet the developed countries' technical regulations is low. Their level of technology is also relatively low compared to that of Korea whose main exports have a large portion of high-technology products such as semiconductors, computers, motor vehicles, ships and petrochemicals.

V. Conclusion and Policy Implications

While a large number of multilateral and regional trade agreements in recent years have sought to make substantial tariff reductions, NTMs have been adopted in a new protectionist wave. Accordingly, there has been a lot of discussion on the effects of TBT and SPS on international trade. This study analyzes the technical measures imposed by Korea's top 10 export destinations among the RCEP member states on Korea's major exportations.

The gravity model results provide four significant points. First, the RCEP member states' imposition of TBT reduces Korean exports to RCEP economies in general. This confirms the negative impact of TBT on trade. On the other hand, the overall trade effects of SPS measures are statistically insignificant. Second, the extent of TBT effects on trade varies depending on the

characteristics of each industry while the TBT measures have negative impacts on trade in majority of the manufactured products. Third, contrary to the results of TBT, the trade effects of SPS measures implemented by importing countries are found to promote Korean exports in the agricultural sectors. Such results imply that not all NTMs serve as barriers. This result supports the argument that stringent SPS regulations increase consumer confidence and lead to higher demand for the products. Lastly, when industry-specific characteristics are taken into consideration, the negative effects of TBT become less prominent in sectors with high level of technology. This implies that Korea is relatively competent at the high-tech export industries compared to other countries participating in the RCEP negotiation. Korea needs to compete with developing countries in the RCEP region in terms of export share. Armed with strong price competitiveness, developing countries have an upper hand in the export race. However, considering how Korea's high-technology industries are less vulnerable to the negative impact of TBT, Korean exporters are urged to focus on improving its competitiveness in exports that require high level of technology.

The empirical results have important policy implications for the regulatory reform process of governments. Compared to traditional trade policies like tariffs, NTMs are specifically designed to ensure public health, safety, and welfare of consumers. However, NTMs are a double-edged sword as they also serve as a protectionist measure. Due to their double-edged nature, blindly eliminating TBT may prevent the intentional use of TBT as a protectionist measure, but at the same time rather hurt the domestic interests of a nation. The elimination of TBT is not an optimal policy option; a more reasonable suggestion would be the "soft-harmonization" that eliminates duplicate testing requirements across RCEP member states and removes trade-hindering regulations at the national level.

At the regional level, two challenges persist. First of all, as the RCEP member states are mostly composed of developing countries, an increase in their income level is likely to expand the number of informed consumers who demand higher regulatory standards. Consequently, the number of NTMs will show an upward movement. To effectively address NTMs at the regional

level, the experience and guidelines issued by ASEAN in this regard can be utilized to ensure that NTMs are effectively tackled. Secondly, despite the well-known trade restrictions aspect of NTMs, RCEP economies lack a mechanism to discuss and cooperate on NTM issues. Therefore, communication channels to achieve harmonization of standards, mutual recognition of conformity assessment, and policy transparency are necessary. As one of ways to simplify SPS and TBT procedures, countries may enter into mutual recognition arrangements(MRAs) of conformance procedures to avoid repeated and unnecessary laboratory testing and certifications.

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국문요약

기술장벽과 위생 및 식물위생조치가 무역에 미치는 영향에 관한 연구: RCEP 국가에 대한 한국의 수출을 중심으로

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현재 논의 중인 RCEP 무역협정에 대한 최종 타결이 2020년으로 예정됨에 따라, 보다 심도 있는 지역 통합을 추진하려고 하는 RCEP 회원국들 사이에서 비관세장벽(NTM)은 가장 논쟁이 될 만한 사안 중 하나로 인식된다. 글로벌 금융위기 이후 각국은 국내 산업을 보호하기 위한 보호무역의 수단으로 관세 대신 비관세조치를 도입하는 경향을 보이고 있다. 이러한 배경에서 본 논문은 주요 RCEP 참여국의 비관세조치가 한국의 수출에 미친 영향을 분석하기 위해 한국과 주요 RCEP 참여국의 역내 무역 현황을 파악하고, 비관세장벽 중 기술적 조치로서 널리 사용되고 있는 TBT와 SPS가 무역에 미치는 효과를 이론적으로 살펴보고 실증적으로 분석하였다. TBT와 SPS가 무역 및 소비자 효용에 미치는 경제적 효과를 생산자와 소비자 관점으로 구분하여 이론적으로 살펴보았으며, 한국의 주요 교역국인 10개의 RCEP 참여국이 최근 10년 동안 (2007-2016) 도입해 온 기술적 조치인 TBT와 SPS의 국가별·산업별 WTO통보문 수를 이용하여 한국의 수출에 미치는 영향을 실증적으로 분석하였다. 본 연구의 주요 실증분석 결과는 다음과 같다. 첫째, 기존 실증연구와 같이 전체 산업에 대한 RCEP 회원국의 TBT 도입은 한국의 수출에 부정적인 영향을 미치는 것으로 나타났으나 SPS의 영향은 유의하지 않게 나타났다. 둘째, TBT 영향은 산업별로 각각 다르게 나타났으며 특히 고기술집약산업인 일반기계 및 전기/전자 산업에서는 부정적인 영향이 다른 산업에 비해 더욱 크게 나타났다. 셋째, TBT와 달리 SPS는 농업 분야에서 한국의 수출을 촉진하는 것으로 분석되었다. 마지막으로 고기술집약산업과 TBT의 교차항을 고려한 결과, 고기술집약산업들은 저기술집약산업들에 비해 TBT가 무역에 미치는 부정적인 효과가 상대적으로 적어지는 것으로 나타났다. 이러한 결과는 RCEP 교역국들이 주로 개도국으로 구성된 바, 한국은 상대 교역국들에 비해 상대적으로 기술수준이 높은 것으로 해석된다.

주제어: 비관세장벽, 무역기술장벽, 식품동식물검역규제, 중력 모형, 역내포괄적 경제동반자협정

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