

# **New Trade Restrictive Measures and Exports: Evidence from South Korea**

**Hea-Jung Hyun and Yong Joon Jang**

The world economy recently witnessed a surge in trade remedies and non-tariff measures (NTMs) as new trade-restrictive measures. This study attempts to provide empirical evidence on the effects of new trade-restrictive measures, such as anti-dumping, countervailing measures, technical barriers to trade, and sanitary and phytosanitary measures on trade. By using the Korean product-level export data and the new NTM data, we find that new trade-restrictive measures in trade can depend on the affected sectors and imposing countries. Exports can be adversely affected by new trade-restrictive measures in their concentrated sectors taken by importing developed countries. We also find the threatening effects of trade remedy before this investigation. However, new trade-restrictive measures imposed by importing developing countries can have positive impact on trade, particularly an increase in consumers' trust in product quality and decrease in asymmetric information. Results imply that the government of an exporting party should enhance trade policies by considering the heterogeneous effects of new trade-restrictive measures across industries and trading partners.

*Keywords:* New Trade Restrictions, Non-tariff Measures (NTMs), Trade Remedy, Technical Barriers to Trade (TBT), Sanitary and Phytosanitary Measures (SPS)

*JEL Classification:* F13, F14, F15

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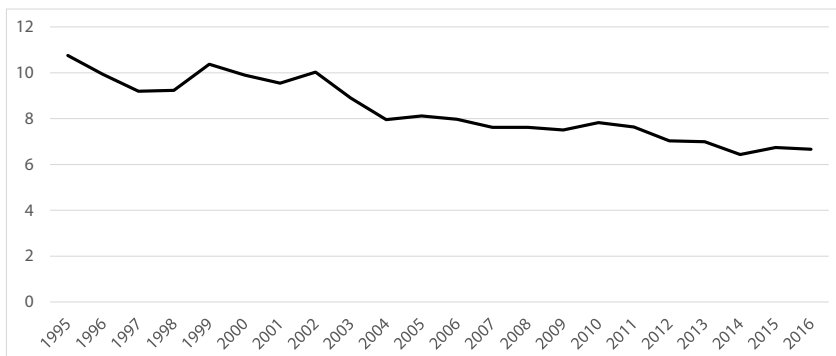
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## I. Introduction

The average world tariff rate has steadily declined (Figure 1) since the establishment of the World Trade Organization (WTO) in 1995. This decline is due to multilateral negotiations and rapid increase in free trade agreements (FTAs) among WTO member countries. However, each country was induced to protect domestic import competing sectors during the recession in the late 2000s. For FTA member countries, tariff may not be an effective trade policy because trading parties need to renegotiate on or renegotiate FTAs to raise tariff again. This renegotiation is relatively complex and costly. Thus, member countries began to increase tariffs using the system of trade remedy (TR) to circumvent this process and to raise protectionist measure after the global economic downturn in 2008. Moreover, member countries adopted non-tariff measures (NTMs), such as technical barriers to trade (TBT) and sanitary and phytosanitary measures (SPS). WTO (2012a) and the United Nations Conference on Trade and Development (UNCTAD 2012) called these measures “new trade-restrictive measures,” which affected 0.9% of global imports (Chung *et al.* 2012). Pascal Lamy, former director general of WTO, explained that new trade-restrictive measures are considered a long-term strategy to protect infant industries and not a short-term remedy for the global financial crisis (WTO 2012b). Exports, particularly from developing countries to developed countries, suffered during the crisis (Lee 2009).

Figure 2 shows the world trends of trade remedies and technical measures, such as TBT and SPS. Both measures have increased since the 2008 global financial crisis. UNCTAD (2012) classified protective measures into three types, namely, tariff measures, trade remedies, and NTMs, in its Trade Analysis Information System (TRAINS). Trade remedies simply consist of three measures: anti-dumping, countervailing duties, and safeguard (GATT Articles 6 and 19).

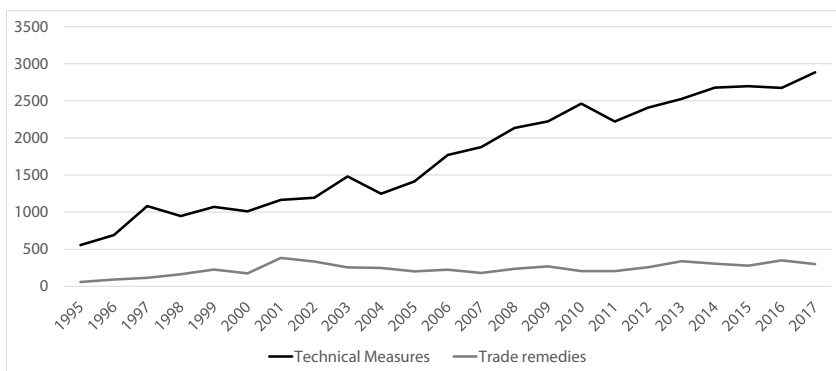
However, the classification of NTMs can be complicated, depending on various research objectives. UNCTAD (2012) established the international classification of NTMs into technical, non-technical, and export-related measures. Governments mandatorily impose technical regulations, standards, and conformity assessment procedures on certain products to enhance human security, improve health, provide product information, and protect the environment in TBT and SPS. Moreover, TBT and SPS can be taken in international trade because



Note: The value represents the simple average of the MFN applied tariff rate for manufacturing.

Source: World Bank, World Integrated Trade Solution

**FIGURE 1**  
ANNUAL AVERAGE TARIFF RATE IN THE WORLD (%)



Note: The value represents the number of WTO notifications.

**FIGURE 2**  
ANNUAL NUMBER OF TECHNICAL MEASURES AND TRADE REMEDIES

each trading party has its own established legitimacy for adopting technical measures. These measures have different norms, depending on the social, cultural, and geographical backgrounds. TBT mainly deals with the external elements of products, such as label, registration, and production process. By contrast, SPS deals with internal elements, such as additives, pesticide residue, and toxins. Recently, more than half of NTMs are technical measures, thereby implying the increasing

importance of TBT and SPS in international trade (Gourdon and Nicita 2013).

Trade remedies and technical measures burden exporters with costs for defense, certification, and technological development despite their legitimacy. An increasing number of studies have been conducted on the impact of these new trade-restrictive measures (Arita *et al.* 2015; Choi *et al.* 2015; Sun *et al.* 2014; Jang *et al.* 2011; Bao and Qiu 2012). Arita *et al.* (2015) investigate the effects of selected SPS and TBT on agricultural trade between the US and the European Union (EU) and find that the estimated ad valorem tariff equivalents of NTMs are considerably higher than existing tariffs. Bao and Qiu (2012) use the TBT notifications in 1995-2008 and find a decrease and increase in the extensive and intensive margins of exports. However, these studies have individually dealt with each measure and did not analyze these measures simultaneously. The majority of the previous studies also used the data from the WTO Integrated Trade Intelligence Portal (I-TIP) to determine the number of notifications for trade remedies and technical measures. However, only 43% of the entire notifications are recorded as a harmonized system (HS) code in the WTO I-TIP data set (Ghodsi *et al.* 2017). Thus, a sectoral investigation with the WTO I-TIP data set can generate sample selection bias owing to missing information.

The current study attempts to consider trade remedy and technical measures in one model and empirically examine how new trade-restrictive measures affect Korean exports between 1996 and 2015 by using a new data set. We use the recently constructed wiiw (Vienna Institute for International Economic Studies) NTM Database for trade remedies and the technical measures recorded at HS 6-digit level unlike previous literature. The wiiw NTM Database<sup>1</sup> substantially reduces the percentage of missing HS code from 57% to 25%. This study is the first to use the wiiw NTM Database to resolve bias from the missing information in the WTO I-TIP data set.

The remainder of this paper is organized as follows. Section II investigates the trends of trade remedies and technical measures for

<sup>1</sup> The wiiw NTM data set provides the missing values by taking the HS code matching procedure through various sources, such as the International Classification Standards, product description, and Temporary Trade Barriers Database.

Korean exports by year, country, sector, and type. Section III provides the theoretical background and econometric specifications on the basis of the literature review. Section IV shows the empirical results. Section V draws the conclusions and presents the policy implications.

## **II. Trends of New Trade-Restrictive Measures for Korean Exports<sup>2</sup>**

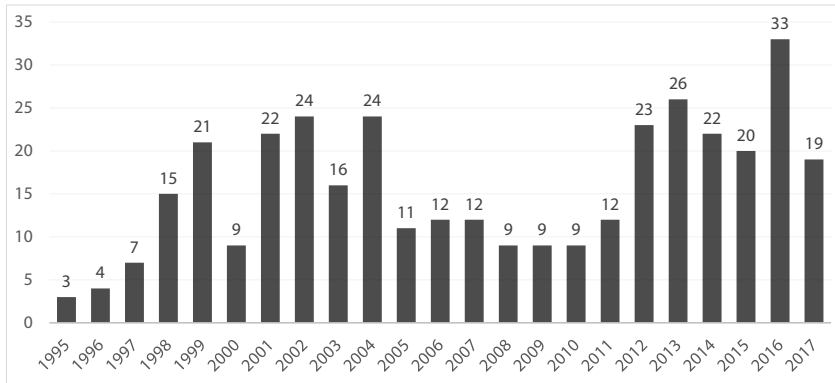
### *A. Trade Remedies*

A total of 5,589 cases of trade remedies were initiated between 1995 and 2017 from the reports of WTO I-TIP. A total of 362 cases among these cases were levied on Korean exports: 342 cases of anti-dumping, 20 cases of countervailing duties, and no case of safeguard. Moreover, 68.8% (=  $(249/362) \times 100$ ) of initiations of trade remedies were continued. Thus, the majority of trade remedies imposed on Korean exports are anti-dumping measures with high feasibility. Figure 3 shows the number of initiating trade remedies on Korean exports between 1995 and 2017. This number increased after 1998, decreased in the early and mid-2000s, and increased again in 2008. A total of 33 cases are recorded in 2016, which was the highest level in the entire sample period. New trade-restrictive measures have been recently converted (beyond their original legitimacy) as a long-term strategy to protect domestic industries, particularly during an economic downturn. Figure 3 shows that trade remedies levied on Korean exports were no exception.

A total of 24 countries initiated trade remedies on Korean exports in the sample period, including India (59 cases, most number of cases), the US (56), China (36), Australia (27), Brazil (21), and EU (18). The Korean exports has 28 sectors: steel products (122, highest value), organic chemical products (52), and plastic products (41).

Appendix Figure 1 in the Appendix shows the annual number of initiating countries and initiated sectors of trade remedies on Korean exports. Both numbers substantially increased in the late 1990s, early 2000s and 2010s. These numbers show similar trends with those in

<sup>2</sup> In this section, we used the WTO I-TIP data set for the majority of the analyses. However, the wiiw NTM data set for the sectoral analyses was avoided for sample selection bias.



Note: The value represents the number of WTO notifications.

Source: WTO I-TIP (Integrated Trade Intelligence Portal)

**FIGURE 3**

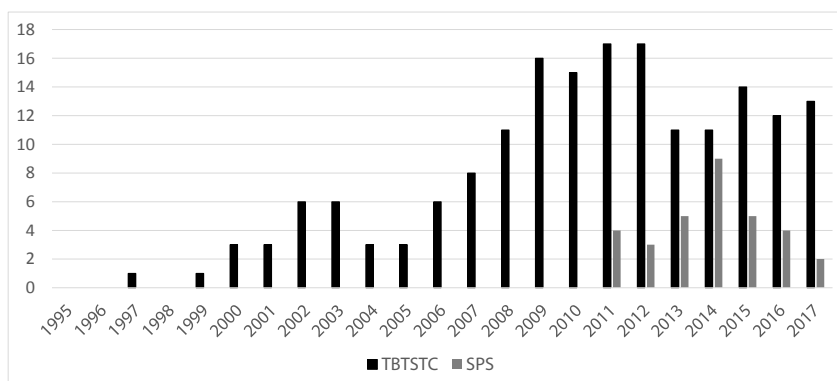
ANNUAL NUMBER OF INITIATIONS OF TRADE REMEDIES FOR KOREAN EXPORTS

Figure 3. This increase in trade remedies on Korean exports resulted from new initiators and frequent imposition of importers, such as India and the US. The initiation of trade remedies on plastic, rubber, steel, and chemicals also contributed to increase in the number of cases. We find volume and variety matter to consequently increase in trade remedies on Korean exports.

### *B. Technical Measures*

According to the principle of National Treatment (GATT Article 3 and WTO TBT Agreement Article 2.1), TBT imposed by WTO members should not target other member countries. Accordingly, TBT should be equally applied across countries, which is different from trade remedies and SPS. The latter can be imposed on specific trading partners. Thus, we alternatively consider TBT specific trade concerns (STC), in which TBT is specifically against Korean exports. Regular meetings of the WTO TBT committee are held thrice a year, in which a WTO member can voice a concern about TBTs imposed by other members. These concerns are counted as the number of TBT STCs.

Figure 4 displays TBT STCs raised by the Korean government and SPSs against Korean exports. The Korean government raised 59 cases of TBT STCs during the sample period. Moreover, the government



Note: The value represents the number of WTO notifications.

Source: WTO Integrated Trade Intelligence Portal

**FIGURE 4**

ANNUAL NUMBER OF TBT STCs AND SPSs FOR KOREAN EXPORTS

discussed 13 cases in 2017. The number of TBT STCs from Korea has increased significantly since the late 2000s. Many TBT concerns raised by South Korea are unsolved and deferred to the next meetings.

The Korean government raised 18 concerns to Chinese TBTs followed by the EU (13), the US (6), and India (5). The majority of the TBT STCs are for electric and electronic products (59.19%), which is the major export-oriented industry for Korea, toys and gaming machines (7.97%), other vehicles (7.44%), machinery (5.04%), and steel products (4.54%). WTO members seemingly adopted TBTs on Korean exports to protect their domestic industries beyond legitimacy, along with trade remedies (Jang and Nam 2010).

WTO members adopted 32 measures against Korean exports in the sample period for SPS. Measures increased between 2011 and 2014 but declined thereafter. The US have the highest value with (6) measures followed by Australia (4), Taiwan (4), Peru (4), and the Philippines (3). The list of these countries is also similar with the case of trade remedies. The majority of SPSs were adopted on live animals and vegetable products (HS 01-10) and processed foods (HS 11-24) by fundamental feature: fruits and nuts (10), meats (8), trees and plants (8), live animals (6), and dairy products (4).

Appendix Figure 2 in the Appendix shows the annual number of countries raised by Korea's TBT STCs or adopted SPSs for Korean

exports. Both numbers substantially increased in the late 2000s, thereby showing similar trends with Figure 4. These increases in technical measures for Korean exports seemingly arise from new initiators and frequently imposing countries. We conclude that volume and variety matter to the increase in technical measures for Korean exports.<sup>3</sup>

### III. Econometric Specifications

#### A. Theoretical Background

We empirically examine the impact of trade remedies, such as TBT and SPS, on Korean exports. The majority of the related studies conducted have analyzed the effects of “unilateral” NTMs imposed by an importing country on “bilateral” trade. For this case, the trade diversion effect was hardly detected because NTMs were equally applied to all WTO member countries under the “most favored nation” principle. Meanwhile, we investigate the impact of specific trade-restrictive measures, such as antidumping, countervailing measure, TBT STCs, and bilateral SPSs, imposed by importing countries on Korean exports.

Trade remedies are generally believed to have negative impact on exports through an increase in tariff (Sun *et al.* 2014). However, the trade effects of TBT and SPS can vary on the basis of measurement, objective, affected industry, and characteristics of the imposing countries. If NTMs, such as TBT and SPS, are obstacles to trade, then they become non-tariff “barriers” (Ghodsi *et al.* 2017). However, the effects are not necessarily negative because technical measures originally improve health, sanitation, quality of products, and protection of environment.

Exporting firms should incur compliance costs to develop products that satisfy new standards and regulations or acquire the required certificates for production. These costs can increase the export price, thereby emphasizing the trade restrictive effects (Maskus *et al.* 2000). By contrast, standards and certificates that reinforce quarantine can shape consumption patterns and enhance consumer trust on product

<sup>3</sup> We also found that countries adopted technical measures on new sectors, such as electronics and food, when the number increased for Korean exports from the wiiw NTMs data set. We did not report the relevant figure for brevity.



quality, which is called trade promotion effects (Thilmany and Barrett 1997).

The net effects of technical measures on trade are ambiguous because they can be determined by relative forces between trade restrictive effects and trade promotion effects, depending on the nature of country and industries (Fugazza 2008). Therefore, the effects of TBT and SPS on exports are empirical questions (Jang *et al.* 2011).

### B. Empirical Model

This study's empirical model relies on the gravity model. Bilateral trade volume among countries increases as economic size enlarges and distance between two countries decreases in the standard gravity model (Krugman *et al.* 2012). We employ the augmented gravity model, in which the standard gravity model incorporates tariff, TBT, and SPS. The equation of the baseline model is as follows:

$$EX_{ijkt} = \beta_0 Y_{i,t}^{\beta_1} Y_{j,t}^{\beta_2} D_{i,j}^{\beta_3}, \quad (1)$$

where the dependent variable  $EX_{ijkt}$  is the export volume of industry  $k$  from country  $i$  to country  $j$  in year  $t$ , the explanatory variable is the real GDP of country  $i$  in year  $t$ ,  $Y_{j,t}$  is the real GDP of country  $j$  in year  $t$ , and  $D_{i,j}$  is the distance between country  $i$  and country  $j$ . Given that South Korea is the only exporting country included in this study,<sup>4</sup>  $Y_{i,t}$  is controlled by year dummies and consequently excluded from the equation. The reason is that the exporter GDP is fixed each year and subsumed in year dummies. Additional explanatory variables, such as free trade agreement (FTA), tariff, and other trade-restrictive measures are included. Moreover, we take a log transformation to derive the augmented gravity model as follows:

$$\begin{aligned} \ln EX_{ijkt} = & \ln \beta_0 + \beta_1 \ln Y_{jt} + \beta_2 \ln D_{ij} + \beta_3 \ln(\tau_{jkt} + 1) + \beta_4 FTA_{ijt} \\ & + \beta_5 TR_{ijkt} + \beta_6 TBTstc_{ijkt} + \beta_7 SPS_{ijkt} + \gamma_k + \delta_j + \phi_t + \varepsilon_{ijkt} \end{aligned} \quad (2)$$

where  $\tau$  and FTA are the MFN ad valorem equivalent tariff and a dummy variable representing the existence of FTA between two

<sup>4</sup> Gravity framework remains applicable because this case is special case, in which the number of exporting country is fixed as one instead of many.

trading parties, respectively;  $TR_{ijkt}$  is the level of anti-dumping and countervailing duties against imposed subsidy by country  $j$  on exports from South Korea at product  $k$  in year  $t$ , and  $TBTstc_{ijkt}$  is a specific trade concern raised by Korea against TBT imposed on product  $k$  in year  $t$ . Analysis of the reports on the global TBTs may underestimate their trade effects on a specific exporting country because TBTs are equally applied on all trading partners (Disdier *et al.* 2008). The WTO TBT notifications also merely represent the adoption of new technical regulations rather than barriers to other trade partners. Hence, difficulty will ensue in distinguishing the trade restrictive and trade promotion effects with the WTO TBT's notification. Meanwhile, TBT STCs can have a more substantial impact on trade than global TBT notifications because exporting countries raise concern on TBTs, particularly when the significant amount of products are exported and negatively affected. We use bilateral SPSs, which only obtain products exported from South Korea and few other countries, rather than from all exporting countries.

We include the product dummy  $\gamma_k$ , importing country dummy  $\delta_j$ , and year dummy  $\phi_t$  in Equation (2) to control for product characteristics, an importing country's attribute and macroeconomic shocks (Chen and Novy 2011). Estimates can be biased if an unobserved trade barrier is omitted and a multilateral resistance is not considered (Anderson and van Wincoop 2004). Feenstra (2003) shows that bias can be resolved by including exporter and importer dummy variables. However, a multilateral resistance term is time-varying in the panel gravity framework. The problem of biased estimates will remain if an unobserved trade barrier is omitted. Baier and Bergstrand (2007) includes the dummies for country and time pair effects ( $it$ ,  $jt$ ) to resolve this problem. In case country and country-time pair dummies are included simultaneously, several variables are excluded from the analysis owing to multicollinearity. Therefore, we consider only the country dummy variables in the baseline model and include the importer-year pair dummy variables for the robustness check. Given that South Korea is the only exporting country in our model, only importing countries are considered country dummies.

Previous studies have used a random effect or a fixed effect model as an empirical strategy to estimate Equation (2). Thus, zero trade flows decreased. However, zero trade may contain important information on a firm's decision not to export relevant to the high fixed costs of trade.

Thus, an exclusion of zero trade flows may cause inconsistency in the estimates from selection bias. In addition, estimates can be biased if a heteroscedasticity problem exists in the log-linearized model, such as Equation (2). This study uses the Poisson pseudo maximum likelihood estimation (PPML) developed by Santos Silva and Tenreyro (2006) to resolve these econometric problems. The transformed Equation (2) using PPML is as follows:

$$\begin{aligned} E(EX_{ijkt} | Y_{jt}, D_{ij}, \tau_{ijkt}, TBTstc_{ijkt}, SPS_{ijkt}, \gamma_k, \phi_t) \\ = \exp(\beta_0 + \beta_1 \ln Y_{jt} + \beta_2 \ln D_{ij} + \beta_3 \ln(\tau_{ijkt} + 1) + \beta_4 FTA_{ijt} \\ + \beta_5 TR_{ijkt} + \beta_6 TBTstc_{ijkt} + \beta_7 SPS_{ijkt} + \gamma_k + \delta_j + \phi_t). \end{aligned} \quad (3)$$

Lagging variables of new trade-restrictive measures are opt for one to three years. Moreover, the lead variable by one year is included to resolve a potential endogeneity problem between these variables and export volume. Anti-dumping or countervailing measures are likely to be taken on products in increasing imports or are expected to. We investigate the impact of new trade-restrictive measures on exports in the previous year because the export volume can shrink because of an importing country's investigation on unfair trade. This investigation is called investigation effects or threatening effects (Prusa 1992; Staiger and Wolak 1994; Sun *et al.* 2014).

### C. Measurement and Data

#### a) Measurement of Trade-Restrictive Measures

An inventory method quantifies the level of new trade-restrictive measures. We use the frequency index and coverage ratio similar to Fugazza (2008) to construct a product-level variable. The frequency index is computed as the ratio of products, in which a measure is applied to the total number of products within an industry as follows:

$$FI_{jk} = \left[ \frac{\sum D_{jl} M_{jl}}{\sum M_{jl}} \right] \times 100,$$

where  $D_{jl}$  is 1 if the importing country  $j$  imposes a trade-restrictive measure on product  $l$  imported from South Korea more than once or 0 if otherwise. Product  $l$  is classified at HS-6 digit within industry  $k$  at HS-2 digit.  $M_{jl}$  obtains 1 if country  $j$  imports product  $l$  from Korea and 0

otherwise.

The coverage ratio is measured as the percentage share of the import volume affected by trade-restrictive measures among the total import volume in industry  $k$ . It is computed as follows:

$$CR_{jk} = \left[ \frac{\sum D_{jl} V_{jl}}{\sum V_{jl}} \right] \times 100,$$

where  $V_{jl}$  is the volume of product  $l$  imported from South Korea to country  $j$  and  $\sum V_{jl}$  is the total volume of imports in industry  $k$  from South Korea to country  $j$ .  $\sum D_{jl} V_{jl}$  is the volume of total products to which a trade-restrictive measure is applied. The coverage ratio closely measures the level of trade-restrictive measures to reality by placing weight on the basis of trade volume, compared with the frequency index, in which trade volume is not considered. However, a potential endogeneity issue can exist for the coverage ratio if the volume of import  $V_{jl}$  is affected by the policy dummy variable  $D_{jl}$  (Choi *et al.* 2015).

#### b) Data

Trade remedies and technical measures are collected from the wiiw NTM Database, which covered 106 importing countries with 96 products at HS-2 digits between 1996 and 2015. The wiiw NTM Database was compiled as a research project called Productivity, Non-tariff Measures and Openness funded by the European Commission (Ghodsai *et al.* 2017). This data set substantially reduced the omitted HS code in the WTO I-TIP notification by matching WTO I-TIP with various sources of data and increasing the share of matched HS code from 43% to 75%. The summary table of NTMs are as follows.

The mean of each frequency index in Table 1 is extremely low compared with the 40-60% of the average TBT frequency index and 12-60% of the average SPS frequency index in Choi *et al.* (2015) and Cho *et al.* (2017), respectively. However, this result is no longer surprising because previous studies have used unilateral TBTs and SPSs. Thus, the numbers are considerably higher than those of TBT STCs and bilateral SPS used in this research.

We use the United Nations International Trade Statistics Database and MFN ad valorem tariff rate is extracted from the WTO Tariff Analysis Online. The annual real GDPs of each importing countries are collected from the WDI World Development Indicator database. Distance

**TABLE 1**  
SUMMARY STATISTICS OF NEW TRADE-RESTRICTIVE MEASURES

Variable	Index	Observations	Mean	Std.	Min	Max
<i>TR</i>	FI	109,948	0.80	8.3	0	100
	CR	109,948	1.00	9.2	0	100
<i>TBT STC</i>	FI	109,948	1.30	10.9	0	100
	CR	109,948	1.50	11.6	0	100
<i>SPS</i>	FI	109,948	0.01	0.9	0	100
	CR	109,948	0.01	1.0	0	100

**TABLE 2**  
SUMMARY STATISTICS OF EXPLANATORY VARIABLES

Variable	Observations	Mean	Std.	Min	Max
<i>EX</i>	138,677	38711.21	497455.7	0	5.25E+07
$\ln(\tau+1)$	138,677	0.089	0.105	0	2.950735
$\ln Y$	138,677	20.927	1.970	14.661	25.83497
$\ln D$	138,677	8.976	0.535	6.858	9.881444
<i>FTA</i>	138,677	0.134	0.341	0	1

among South Korea and importing countries are from the Center d'Etudes Prospectives et d'Informations Internationales. The WTO regional trade agreements database provide information on whether a country has FTA with Korea. Table 2 summarizes the statistics of the explanatory variables.

## IV. Empirical Results

### A. Baseline Results

Table 3 and 4 show the empirical results for all industries. Table 3 reports the results using the frequency index, while Table 4 shows those with the coverage ratio. The effects of the MFN tariff on Korean exports are negative in all model specifications. This result is robust across different time lags and types of the trade-restrictive measure. Exports from Korea increase as the real GDP of importing countries increases.

**TABLE 3**  
BASELINE RESULTS: ALL INDUSTRIES (FI)

Variable	Frequency Index				
	$t+1$	$t$	$t-1$	$t-2$	$t-3$
$\ln(t+1)$	-2.989*** (0.500)	-3.064*** (0.467)	-3.205*** (0.534)	-3.242*** (0.557)	-3.286*** (0.576)
$\ln Y$	0.580*** (0.0663)	0.506*** (0.0586)	0.603*** (0.0678)	0.648*** (0.0766)	0.672*** (0.0822)
$\ln D$	-1.837*** (0.112)	-0.543*** (0.0711)	-1.933*** (0.117)	-1.902*** (0.119)	-1.951*** (0.123)
<i>FTA</i>	-0.00805 (0.0650)	0.0202 (0.0591)	0.0368 (0.0609)	0.0681 (0.0607)	0.0787 (0.0609)
<i>TR</i>	0.242** (0.109)	0.216 (0.117)	0.171 (0.122)	0.143 (0.129)	0.124 (0.129)
<i>TBT STC</i>	0.0713 (0.0720)	0.104 (0.0747)	0.0614 (0.0798)	0.0356 (0.0855)	0.0262 (0.0948)
<i>SPS</i>	-2.410** (0.971)	1.047 (1.018)	-2.775*** (0.605)	-2.919*** (0.725)	-2.746*** (0.865)
Year FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes
Observation	94,035	106,091	93,241	87,526	81,792
R-squared	0.776	0.771	0.775	0.776	0.777
Log likelihood	-2.16e+09	-2.46e+09	-2.28e+09	-2.19e+09	-2.08e+09

Notes: 1) Robust standard errors in parentheses. 2) \*\*, \*\*\* are statistically significant at 5% and 1%, respectively.

Moreover, the distance between importer and South Korea decreases. These results are relatively similar to previous gravity literature, while the FTA dummy is positive but statistically insignificant.

The statistical significance of trade remedy (TR) varies depending on the time lag. The effects of TR is statistically insignificant at time  $t$  and afterwards (see Table 3). Meanwhile, TR has a positive impact on Korean exports for the previous year of dumping investigation. TR is also statistically significant at the 5% level. Table 4 confirms these results because TR is measured using the coverage ratio.

Table 3 reports that the TBT STC measured from the frequency index has no significant impact on Korean exports. This result is consistent across different time lags and coverage ratio for TBT STC, similar

**TABLE 4**  
BASELINE RESULTS: ALL INDUSTRIES (CR)

Variable	Coverage Ratio				
	$t+1$	$t$	$t-1$	$t-2$	$t-3$
$\ln(t+1)$	-2.998*** (0.501)	-3.067*** (0.468)	-3.209*** (0.535)	-3.248*** (0.558)	-3.294*** (0.578)
$\ln Y$	0.580*** (0.0663)	0.506*** (0.0586)	0.602*** (0.0676)	0.647*** (0.0764)	0.673*** (0.0822)
$\ln D$	-1.839*** (0.112)	-0.543*** (0.0712)	-1.933*** (0.117)	-1.901*** (0.119)	-1.953*** (0.123)
<i>FTA</i>	-0.00880 (0.0649)	0.0191 (0.0590)	0.0366 (0.0607)	0.0686 (0.0606)	0.0788 (0.0609)
<i>TR</i>	0.219** (0.0957)	0.195 (0.101)	0.157 (0.105)	0.121 (0.113)	0.0989 (0.114)
<i>TBT STC</i>	0.0767 (0.0687)	0.107 (0.0713)	0.0711 (0.0760)	0.0461 (0.0815)	0.0263 (0.0906)
<i>SPS</i>	-1.472 (1.323)	-0.0517 (0.798)	-1.999*** (0.202)	-1.933*** (0.198)	-1.864*** (0.201)
Year FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes
Observation	94,035	106,091	93,241	87,526	81,792
R-squared	0.776	0.771	0.776	0.776	0.777
Log likelihood	-2.16e+09	-2.46e+09	-2.28e+09	-2.19e+09	-2.08e+09

Notes: 1) Robust standard errors in parentheses. 2) \*\*, \*\*\* are statistically significant at 5% and 1%, respectively.

with Jang *et al.* (2011) and Choi *et al.* (2015). The net effect may be insignificant because of the opposite forces among the trade restrictive and promotion effects<sup>5</sup> for supply and demand, respectively.

The contemporaneous effects of SPS on Korean exports is insignificant. However, the effects are negative and statistically significant in other time lags. SPS does not affect export before it starts and in year  $t$  in columns 6 to 10 with the coverage ratio. However, SPS has adverse effects after one to three years. SPS reduces exports from South Korea during the time lag. This result is similar to Choi

<sup>5</sup> Using China's HS-8 digit product-level data, Hu and Lin (2016) show that product standards can improve product quality.

**TABLE 5**  
ROBUSTNESS CHECK: BAIER AND BERGSTRAND (2007)

Variable	Frequency Index				
	$t + 1$	$t$	$t - 1$	$t - 2$	$t - 3$
$\ln(t + 1)$	-1.463*** (0.547)	-1.532*** (0.514)	-1.652*** (0.576)	-1.802*** (0.599)	-1.879*** (0.627)
TR	0.200 (0.116)	0.195 (0.123)	0.195 (0.129)	0.207 (0.133)	0.231 (0.132)
TBT STC	0.0426 (0.0718)	0.0816 (0.0735)	0.0532 (0.0776)	0.0434 (0.0825)	0.0534 (0.0893)
SPS	-2.899 (1.755)	0.847 (0.947)	-2.711*** (0.600)	-2.889*** (0.713)	-2.840*** (0.943)
Year FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes
Observation	97,399	109,948	96,624	90,657	84,670
R-squared	0.779	0.775	0.778	0.780	0.781
Log likelihood	-2.1e + 09	-2.4e + 09	-2.2e + 09	-2.2e + 09	-2.1e + 09

Notes: 1) Robust standard errors in parentheses. 2) \*\*, \*\*\* are statistically significant at 5% and 1%, respectively.

*et al.* (2015), which suggests that SPS is generally concentrated on agricultural products with low product differentiation and low trade promotion effects for demand. The current research paper confirms this idea.

Table 5 displays the empirical results with varying times of multilateral resistance country-year dummy, which is similar to Baier and Bergstrand (2007).<sup>6</sup> The results show that TR and TBT STC do not significantly affect Korean exports. The statistical significance of TR disappears after controlling for potential endogeneity through the country-year fixed effects. SPS significantly reduces exports after it is imposed (see Tables 5 and 6). No evidence supports the negative impact of trade remedies or TBT STCs in the analyses of all industries. Meanwhile, SPS has a significant adverse effect on trade. This result may be relevant to the distribution of skewed trade-restrictive measures

<sup>6</sup> We omitted the results with the coverage ratio because they are relatively similar to those with the frequency ratio.



in a few industries. Accordingly, we examine trade-restrictive measures on trade by subsamples of industries.

### *B. Subsample of Industries*

This subsection analyzes the top six industries in which trade remedy or TBT STCs are substantially imposed from 1996 to 2015. The subsample of industries comprises HS-72 (iron and steel), 73 (iron or steel articles), 39 (plastic and articles thereof), 85 (electrical machinery, equipment, and parts thereof), 28 (organic and inorganic compounds of precious metals), and 55 (man-made staple fibers). SPS is excluded because it has not been obtained in these industries. Table 6 provides the empirical results the key variables of the new trade-restrictive measures. TR substantially reduced the exports of South Korea in all time lags from these six industries where anti-dumping is concentrated. TR has a negative impact on exports from South Korea in the previous year before the dumping investigation. Moreover, TR can reduce exports after the investigation in the other columns. A 1% point increase in the frequency index of TR can reduce Korean exports by 0.32% to 0.36%.<sup>7</sup>

By contrast, TBT STC has significant positive effects on trade. Trade promotion is affected through an increase of consumer trust in product quality. This increase outweighs trade restrictive effects because of an increase in production costs. These six products exported by South Korea are featured with high technology and quality (IMF 2014). The increase of consumer trust caused by TBT is considerably prevalent in products with high technology (Hallak 2006). Jang *et al.* (2011) show that TBT increases Korean exports in industries with comparative advantage.

We analyze the effects of trade-restrictive measures for the top six industries in which TBT STCs are generally concentrated. The subsample includes HS-85 (electrical machinery, equipment, and parts thereof), 95 (toys, games, and parts and accessories of sports

<sup>7</sup> By taking natural logarithm, equation (3) is transformed to log-linear model, as dependent variable, export is in the form of log and explanatory variable, NTM is in level. Assuming the coefficient of the effect of TR on exports is denoted as  $b$ , this effect can be calculated as  $100(\exp(b) - 1)\%$ . However, for PPML analysis, both frequency index and coverage ratio are divided by 100, increase in 1 unit of TR implies increase in 100% point. Thus, the effect of TR is  $(\exp(b) - 1)\%$  from increase in 1% point of TR.

**TABLE 6**  
TRADE REMEDY: TOP SIX INDUSTRIES

Variable	Frequency Index				
	$t+1$	$t$	$t-1$	$t-2$	$t-3$
<i>TR</i>	-0.570** (0.232)	-0.560** (0.226)	-0.693*** (0.215)	-0.783*** (0.211)	-0.827*** (0.207)
<i>TBT STC</i>	0.565*** (0.0569)	0.618*** (0.0546)	0.607*** (0.0540)	0.571*** (0.0623)	0.537*** (0.0636)
Year FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes
Observation	8,903	9,941	8,866	8,373	7,875
R-squared	0.666	0.672	0.663	0.629	0.597
Log likelihood	-1.180e+09	-1.340e+09	-1.270e+09	-1.270e+09	-1.250e+09

Notes: 1) Robust standard errors in parentheses. 2) \*\*, \*\*\* are statistically significant at 5% and 1%, respectively.

**TABLE 7**  
TBT STC: TOP SIX INDUSTRIES

Variable	Frequency Index				
	$t+1$	$t$	$t-1$	$t-2$	$t-3$
<i>TR</i>	-0.110 (0.0942)	-0.154 (0.0970)	-0.241** (0.0969)	-0.355*** (0.0956)	-0.395*** (0.0946)
<i>TBT STC</i>	0.207** (0.0808)	0.227*** (0.0843)	0.176 (0.0914)	0.150 (0.0987)	0.127 (0.109)
Year FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes
Observation	8,882	9,950	8,871	8,397	7,912
R-squared	0.882	0.871	0.872	0.871	0.870
Log likelihood	-4.82e+08	-5.59e+08	-5.16e+08	-4.95e+08	-4.76e+08

Notes: 1) Robust standard errors in parentheses. 2) \*\*, \*\*\* are statistically significant at 5% and 1%, respectively.

thereof), 87 (vehicles besides railway or tramway rolling stock, parts and accessories thereof), 84 (nuclear reactors, boilers, machinery, mechanical appliances and parts thereof), 72 (iron and steel), and 92 (musical instruments, parts, and accessories of such articles). The

**TABLE 8**  
SPS: TOP FIVE INDUSTRIES

Variable	Frequency Index				
	$t + 1$	$t$	$t - 1$	$t - 2$	$t - 3$
<i>TR</i>	0.581 (0.381)	0.383 (0.367)	0.167 (0.394)	0.0808 (0.429)	-0.140 (0.449)
<i>TBT STC</i>	-0.425 (0.430)	-0.184 (0.452)	-0.154 (0.468)	-0.343 (0.485)	-0.349 (0.454)
<i>SPS</i>	-1.733** (0.829)	-2.116*** (0.769)	-2.345*** (0.400)	-2.623*** (0.554)	-2.385*** (0.670)
Year FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes
Observation	1,277	1,540	1,261	1,171	1,065
R-squared	0.621	0.606	0.585	0.575	0.578
Log likelihood	-2.692e + 06	-3.065e + 06	-2.733e + 06	-2.530e + 06	-2.188e + 06

Notes: 1) Robust standard errors in parentheses. 2) \*\*, \*\*\* are statistically significant at 5% and 1%, respectively.

effects of SPS are excluded from the regression because there are no cases of SPS in these industries. Table 7 shows that TR reduced trade before the investigation, similar to Table 6. TBT STC increased trade on the previous year and after its implementation. The statistical significance of the impact of TBT STC disappears one to three years after it was imposed. The significant positive effects of TBT STC dissipate because the costs of conformity increase and competitors enter the market. Meanwhile, the effects can be positive through the increase of consumer trust in product quality at the early stage of implementation.

Table 8 reports the results using the top five industries in which SPS is generally imposed. These industries are HS-08 (edible fruit and nuts, peels of citrus fruit or melons), 06 (trees and other living plants, bulbs, roots, cut flowers, and ornamental foliage), 01 (live animals), 07 (edible vegetables, certain roots, and tubers), and 02 (edible meat and offal). These industries are classified as agricultural products. All columns show that TR does not significantly affect exports of agricultural products. The effects of TBT STC in these industries are negative and insignificant in all specifications. Meanwhile, bilateral SPS reduces

Korean exports in all time lags. The significant negative impact of SPS before it was imposed may be caused by the conscious self-selection of exporters (Lopez 2013).

### C. *Subsample of Countries*

This section explores whether the effects of new trade-restrictive measures differ across destination countries. Moreover, these countries are dependent on its level of development. Tables 9 and 10 show the results for OECD member importing countries and non-OECD member countries, respectively. Table 9 shows how imposed TR by OECD member countries significantly reduced exports from Korea in all time lags, including threatening effects before the dumping investigation. The increase in the frequency index for TR by 1% point reduced Korean exports to OECD member countries by 0.17% to 0.36% in all columns.

TBT STC and TR have adverse effects on trade when importing countries are OECD members. The estimation coefficients show that Korean exports decrease by 0.32% to 0.36% as the frequency index of TBT STC increases by 1% point. This result is consistent with Jang *et al.* (2011), which find the evidence of trade restrictive effects of TBTs obtained by developed countries. Regulations and standards on technology in advanced countries are higher than those in developing countries. Developed countries' technological standards negatively affect exports from developing countries (Maskus *et al.* 2000). Regulation on high technology may incur high costs of conformity, thereby increasing trade barriers (Jang 2018).

SPS reduces trade in the previous year and after its implementation. However, the statistical significance disappears after two to three years of imposition. The reason for these negative effects of SPS is similar to the case of TBT STC. The increase in conformity costs caused by high standards on food ingredients by developed countries can increase trade barriers against exports from developing countries (Thilmany and Barrett 1997; Xiong and Beghin 2014).

Table 10 provides the effects of the new trade-restrictive measures imposed by OECD non-member countries on trade. TR investigated by OECD non-members significantly increased Korean exports in all periods compared with the case of OECD member countries. TBT STC also has positive impact on Korean exports for all time lags at the 1% significance level. These results suggest that the effects of new trade-

**TABLE 9**  
OECD MEMBER IMPORTING COUNTRIES

Variable	Frequency Index				
	$t + 1$	$t$	$t - 1$	$t - 2$	$t - 3$
<i>TR</i>	-0.187*** (0.0676)	-0.255*** (0.0665)	-0.339*** (0.0666)	-0.422*** (0.0632)	-0.447*** (0.0616)
<i>TBT STC</i>	-0.384*** (0.101)	-0.407*** (0.102)	-0.414*** (0.105)	-0.424*** (0.108)	-0.441*** (0.112)
<i>SPS</i>	-2.942*** (0.898)	0.776 (1.186)	-4.575** (2.305)	-5.093 (3.421)	-5.161 (4.580)
Year FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes
Observation	38,482	41,055	38,338	36,412	34,188
R-squared	0.803	0.795	0.800	0.803	0.808
Log likelihood	-8.980e + 08	-1.000e + 09	-9.480e + 08	-9.150e + 08	-8.420e + 08

Notes: 1) Robust standard errors in parentheses. 2) \*\*, \*\*\* are statistically significant at 5% and 1%, respectively.

restrictive measures can differ depending on the importing country and industries. A product quality of Korean exports is relatively higher than those of other developing countries (IMF 2014). TBTs obtained by non-OECD countries may not significantly increase the conformity costs of Korean exporting firms. TBT can instead raise the conformity costs to other competing developing countries and build entry barriers to these countries. South Korea can take advantage of this effect (Bao and Chen 2013). Meanwhile, the impact of SPS is not significant.<sup>8</sup> The insignificant effects of TR and TBT STC for the entire sample of all industries and countries may be due to the offset of the aforementioned opposing forces.

<sup>8</sup> SPS in other time lags, except contemporaneous year, are excluded from the analysis. It is because most of SPS imposed on Korean exports is obtained by OECD member importing countries.

**TABLE 10**  
OECD NON-MEMBER IMPORTING COUNTRIES

Variable	Frequency Index				
	$t + 1$	$t$	$t - 1$	$t - 2$	$t - 3$
<i>TR</i>	0.659*** (0.136)	0.653*** (0.130)	0.587*** (0.133)	0.582*** (0.134)	0.578*** (0.134)
<i>TBT STC</i>	0.373*** (0.0909)	0.429*** (0.0894)	0.381*** (0.0947)	0.378*** (0.0994)	0.452*** (0.103)
<i>SPS</i>		-2.529 (1.466)			
Year FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes
Observation	55,553	65,036	54,903	51,114	47,604
R-squared	0.838	0.839	0.848	0.852	0.859
Log likelihood	-1.060e + 09	-1.240e + 09	-1.120e + 09	-1.080e + 09	-1.040e + 09

Notes: 1) Robust standard errors in parentheses. 2) \*\*, \*\*\* are statistically significant at 5% and 1%, respectively.

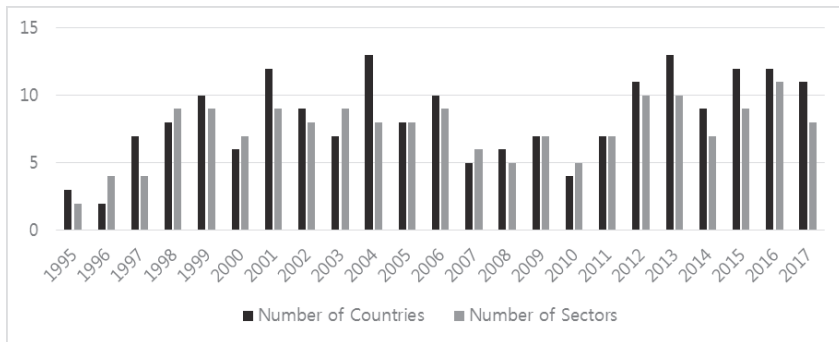
## V. Conclusion

This study introduces “new trade-restrictive measures,” such as TR, TBT, and SPS. Moreover, this research reports these measures’ trends against Korean exports and provides empirical evidence of the different effects on trade, depending on type of measures, industry, and imposing country. New trade-restrictive measures can substantially reduce Korean exports of products, in which measures are concentrated and obtained by developed countries. Anti-dumping and countervailing duties can have negative impact on exports through threatening effects and decreasing price competitiveness. TBT and SPS do not need to be trade restrictive if trade promotion effect exists from upgrading product quality, alleviating asymmetric information, and increasing consumer trust. However, TBT and SPS by developed countries can increase the trade barrier because the level of technology and product quality of Korea is relatively low compared to these countries. Thus, the costs of conformity can increase.

Government needs to enhance trade policies by considering the nature of industries, trading partners and to strengthen international

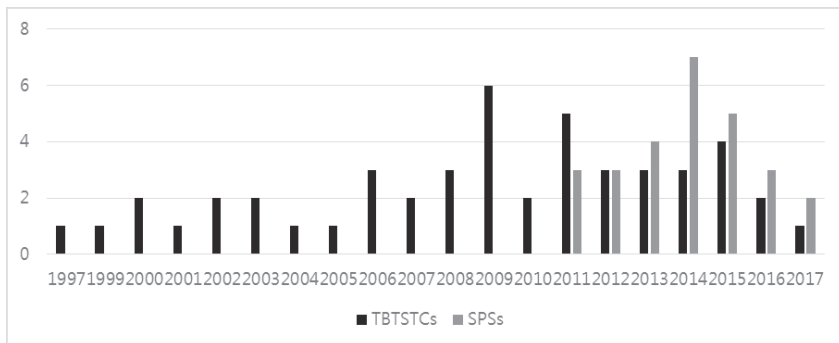
regulatory cooperation, such as a mutual recognition agreement to reduce the adverse effects of new trade-restrictive measures imposed by importing countries (Jang 2018). Meanwhile, government and exporters should focus on improving product quality and market environment rather than stop overseas shipments. Given the trade promotion effects of new trade-restrictive measures in some subsamples, TR, TBT, and SPS can be “barriers” or “springboards,” depending on how actively and flexibly the government and the firms cope with these measures.

**Appendix**



Source: WTO I-TIP (Integrated Trade Intelligence Portal)

**APPENDIX FIGURE 1**  
ANNUAL NUMBERS OF INITIATING COUNTRIES AND INITIATED SECTORS OF TRADE REMEDIES ON KOREAN EXPORTS



Source: WTO I-TIP (Integrated Trade Intelligence Portal)

**APPENDIX FIGURE 2**  
ANNUAL NUMBERS OF COUNTRIES FOR TBTSTCs AND SPSs FOR KOREA

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