

# **Do Technical Regulations affect the Economies of Trading Partners? Evidence from South Korea**

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*The use of technical regulations as technical barriers to trade (TBT) is widespread and has become an important issue in international trade. Specifically, there has been considerable discussion of whether technical regulations promote or restrict trade. Due to the theoretical complexity and the scarcity of data, the literature considers TBT one of the most difficult measures to quantify. In this paper, we construct a TBT notification database for 30 World Trade Organization (WTO) members for 2002–2010 and a model based on gravity theory. Using G2SLS, our results indicate that technical regulations had a negative impact on Korean exports. Specifically, our empirical analysis implies that the technical regulations reduce the trade in agricultural goods, but promote the trade in manufacturing goods.*

**JEL codes:** F13; F17

**Keywords:** Technical Regulations; TBT Notification; Industrial Classification; Economic Effect

## **I. Introduction**

With the rapid reduction in traditional trade barriers, such as tariffs and quotas, institutional factors such as technical regulations have proliferated and increased their impact on international trade. Recently, technical barriers to trade (TBT) have been widely utilized by governments to protect the environment, consumer interests, and national security, and some may act as non-tariff measures (NTMs).

As one of the most popular measures in TBT, technical regulations are used widely for a variety of reasons. First, World Trade Organization (WTO) members are authorized by the WTO TBT/Sanitary and Phytosanitary (SPS) Measures Agreement to enact technical regulations to protect the health of humans, animals, and plants, provided that the enforced measures are not disguised protectionism (Bao and Qiu, 2010). Furthermore, as trade liberalization becomes more complex, it has become difficult to use traditional measures to protect domestic industries.

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*“...The Secretariat shall, when it receives notifications in accordance with the provisions of this Agreement, circulate copies of the notifications to all Members and interested international standardizing and conformity assessment bodies, and draw the attention of developing country Members to any notifications relating to products of particular interest to them.”*  
(Article 10.6 of WTO/TBT Agreements)

Unlike tariffs and other non-tariff barriers (NTBs), the impact of TBT on trade can be both positive and negative. On the one hand, TBT can promote trade by giving consumers in importing countries confidence in the quality, safety, and other health-related concerns of the imported products. On the other hand, the governments of importing countries can use TBT to reduce imports, even if the imports are safe and meet any imposed standards. However, the understanding and quantification method related to the technical regulation may differ because of cultural, geographic, environmental, and systematic differences between countries.

Given the proliferation of TBT and their theoretical complexity, the Organization for Economic Cooperation and Development (OECD) (2001) suggested that more empirical research examine TBT with the view that quantitative analysis is an important step in international trade and can help inform governments when preparing more efficient regulations (Bao and Qiu, 2010). However, due to their theoretical complexity, and scarcity of data, TBT are considered one of the most difficult NTBs to quantify (Deardoff and Stern, 1997). Some attempts have been made in this direction, but there is still no preferred quantification strategy and consensus on “whether such restrictions tend to reduce trade by virtue of raising compliance costs or expand trade by increasing consumer confidence in the safety and quality of imported goods” (Maskus and Wilson, 1999)

Therefore, this study analyzed how technical regulations imposed by importing countries affected trading partners’ economies during the period between 2002 and 2010. To this end, we first needed to understand the implementation of technical regulations under the WTO/TBT Agreement and the development of TBT Notifications.

Then, we used the extended gravity model to estimate the impact of technical regulations on international trade. The results indicated that the impact of technical regulations on agricultural and manufactured goods imports differs. Consequently, Korea, which is highly export-oriented, must improve its understanding of TBT and develop policy strategy targeting different industries.

## **II. Literature Review**

So far, the domestic and international literature on TBT has focused on the definition, characteristics, and international trends. Typical research on TBT issues can be found in Swann, Temple and Shurmer (1996), who use counts of voluntary national and international standards recognized by the UK and Germany as indicators of standards over the period 1985–1991. Their research indicated that shared standards influence exports positively, but have little influence on imports; while unilateral standards have a positive influence on imports, but a negative influence on exports.

Moenius (2004, 2006) examined the trade effects of country-specific and bilaterally shared standards over the period 1985–1995. Both papers used counts of binding standards in a given industry as a measure of standard stringency. Moenius (2004) focused on 12 OECD countries and found that, at the aggregate level, bilaterally shared, country-specific standards implemented by the importing or

exporting countries are both trade promoting, on average; at the industry level, however, the importer-specific standards have a negative trade effect on non-manufacturing sectors. Moenius (2006) confirmed that bilateral standards in the European Union (EU) have very strong trade-promoting effects on the trade between EU and non-EU members, but harmonization decreases the internal trade within the EU.

Otsuki, Wilson, and Sewadeh (2001) used the gravity model to estimate the impact of the new EU aflatoxin standards on food imports from Africa. The study suggested that the implementation of the new standard would have a negative impact on African exports of cereals, dried fruits, and nuts to Europe.

Chen, Otsuki, and Wilson (2006) drew on the World Bank Technical Barriers to Trade Survey database of 619 firms in 16 developing countries to examine how meeting foreign standards affects firms' export performance, reflected in export propensity and market diversification. The results indicated that standards and technical regulations in developed countries do affect a firm's propensity to export in developing countries.

Bao and Qiu (2010) constructed a TBT database from 1998–2006 to examine the influence of TBT imposed by China on the country's imports. When using the frequency index, they found that TBT are trade restrictive. However, when using the coverage ratio, the negative effects of TBT were not significant, based on the entire period.

Some scholars have used questionnaires to explore the effects of technical regulations on industry. Fliess and Schonfeld (2006) presented findings from a survey conducted in 2005/2006 of conformity assessment bodies (CABs) and exporting companies from the OECD. The survey was conceived to gather primary data from key players in the field on perceptions of conformity assessment (CA) barriers and identify trends in CA practices, including the use of tools aimed at removing barriers and facilitating international trade.

Overall, the literature indicates that TBT imposed by WTO members have a negative impact on international trade. Furthermore, the technical regulations in developed countries do affect exports, as well as the propensity of firms in developing countries.

Compared with empirical analysis, most of the Korean literature focuses on theoretical explanations. Park (2009) analyzed CA activity and international trends in Korea in connection with product tests and inspection and certification procedures to recognize the importance of technology regulation through notification report trend analysis based on the WTO/TBT Agreement. They found that standard policy and technology regulation countermeasures improve quality, productivity, and cost reduction in industry.

Han (2009) evaluated the current technical regulation system in Korea and determined the orientation of the technical regulation policy. The study analyzed the importance of technical regulations as TBT and explored the current technical regulation system in Korea.

Park (2010) explored the impact of the transparency measures of WTO member countries on Korean Trade based on gravity theory with a proxy variable of the number of country-specific standards notifications to the Secretariat. The empirical analysis indicated that the transparency measures of WTO member countries have a positive impact on Korean trade. Regression models of the analysis of Korean exports and imports also showed that such measures led to a non-price competitive advantage rather than a competitive disadvantage, which is similar to existing studies.

Ha (2010) analyzed the features of TBT in free trade agreements (FTAs) and suggested that, to strengthen specific industries, government should support certain policies, such as those involving

technical regulations, standards, and conformity assessment. The paper reviewed several major FTA TBT agreements, developed a framework to estimate the scale of TBT on a theoretical basis, and examined the economic impact on Korea and China using an International Input-out Model.

### **III. Technical Regulations under the WTO/TBT Agreement**

#### **1. Understanding Technical Regulations and TBT Notifications**

The WTO/TBT Agreement tries to ensure that regulations, standards, testing, and certification procedures do not create unnecessary obstacles, while providing members with the right to implement measures to achieve legitimate policy objectives, such as those concerned with protecting human health and safety or the environment. The scope of application of the TBT Agreement, and the types of agreement measures are applied to a 'limited class of measures'. However, the two types of measure to which the TBT Agreement applies are defined in Annex 1 of the TBT Agreement. In Annex 1.1, a technical regulation is defined as:

*"[a] document which lays down product characteristics or their related processes and production methods, including the applicable administrative provisions, with which compliance is mandatory. It may also include or deal exclusively with terminology, symbols, packaging, marking or labeling requirements as they apply to a product, process or production method."*<sup>3</sup>

The TBT Agreement requires WTO members to provide other members with the opportunity to participate in the development of mandatory standards-related measures, which helps to ensure that these measures do not become unnecessary obstacles to trade.<sup>4</sup> In particular, the TBT Agreement requires each member to publish advance notice that it proposes to adopt a technical regulation or conformity assessment procedure.<sup>5</sup> It also requires each WTO member to notify the WTO of proposed technical regulations and conformity assessment procedures so that other WTO members may comment on them in writing. WTO members are required, without discrimination, to consider these written comments, plus the results of any requested discussion of those comments when finalizing their measures.<sup>6</sup> In 2010 alone, WTO members notified the WTO of 1,419 new or amended technical regulations and conformity assessment procedures.

Table 1 and Figure 1 show the increase in notifications from 1995 to 2010.<sup>7</sup> Analyzing the TBT

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<sup>3</sup> TBT Agreement, supra note 426, Annex 1, Para. 1.

<sup>4</sup> Depending on the domestic processes of the WTO member, interested parties may participate directly in that member's process for developing new standards-related measures, such as by submitting written comments to the member, or indirectly by working with their own governments to submit comments.

<sup>5</sup> Typically, members do this by publishing a notice in an official journal of national circulation or on a government website that they propose to adopt a technical regulation or conformity assessment procedure, or by publishing the full text of the draft measure.

<sup>6</sup> The obligations described in this paragraph apply to measures that have a significant effect on trade and are not based on relevant international standards, guides, or recommendations, or in circumstances where relevant international standards, guides, or recommendations do not exist. In many instances, however, members, including the United States, notify the WTO of proposed technical regulations and conformity assessment procedures, regardless of whether they are based on relevant international standards.

<sup>7</sup> WTO Members must notify others of new measures, as well as addenda and corrigenda to previously notified measures.

notifications that have been reported to the WTO, the number of new technical regulations in member countries has increased steadily. In particular, the TBT notifications have increased drastically since 2005, and peaked in 2010.

Comparing the numbers of TBT Notifications from both developed and developing countries from 1995 to 2010, the proportions of TBT notifications were similar, i.e., 48 and 52%, respectively. The proportion of TBT notifications by developed countries decreased from 72% in 1995 to 25.6% in 2010, while the proportion of TBT notifications by developing countries increased dramatically from 27.9% in 1995 to 74.4% in 2010.

[Table 1] Number of TBT Notifications to the WTO (1995–2010)

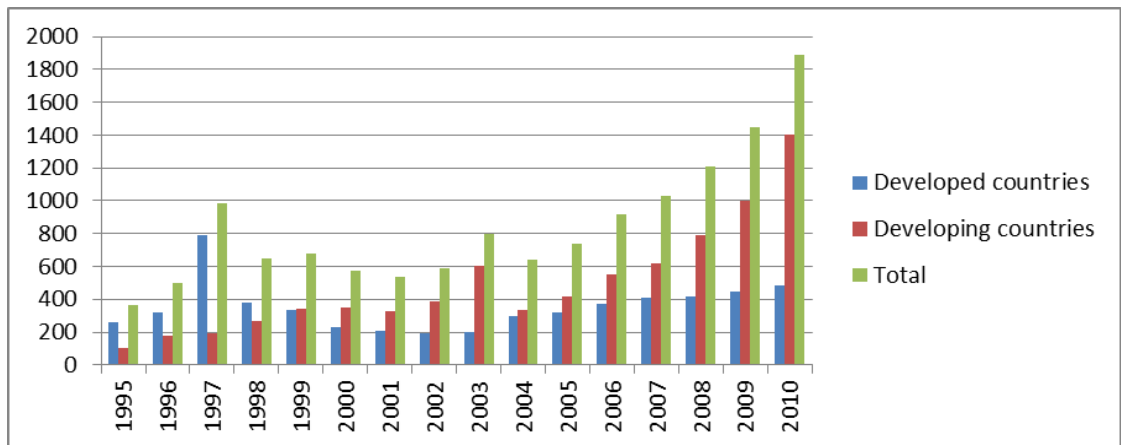
(Units: %)

	1995	1998	2001	2004	2007	2009	2010
<b>Total</b>	365	648	538	638	1030	1490	1889
<b>Developed Countries</b>	263 (72.1)	377 (58.2)	210 (39.0)	300 (47.0)	409 (39.7)	475 (31.9)	483 (25.6)
<b>Developing Countries</b>	102 (27.9)	271 (41.8)	328 (61.0)	338 (53.0)	621 (60.3)	1015 (68.1)	1406 (74.4)

Source: Annual Review of the Implementation and Operation of the TBT Agreement

[Figure 1] Annual Review of TBT Notifications to the WTO (1995-2010)

(Units: %)



Source: Annual Review of the Implementation and Operation of the TBT Agreement

Table 2 ranks the number of TBT notifications by objective from 1995 to 2010. According to the WTO/TBT Agreement, the top ranking TBT notifications were for the “Protection of human health or safety” (43.7%), “Prevention of deceptive practices and consumer protection” (13.1%), and “Protection

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An addendum alerts WTO Members that substantive or technical changes have been made to a measure that has been notified previously. A corrigendum conveys editorial or administrative corrections to a previous notification.

of the environment” (8.7%).

Figure 2 shows the objectives of TBT notifications by different countries. The top three TBT notifications in developed countries were “Protection of human health or safety”, “Protection of the environment”, and “Prevention of deceptive practices and consumer protection”, which reflected the idea that the focus of technical regulation in developed countries is on the innovation of new technologies. In developing countries, the main objective was “Prevention of deceptive practices and consumer protection”, indicating that, rather than investing in technical regulations, developing countries are focused more on introducing and following technology from other countries.

[Table 2] Ranking of TBT notifications by objective (1995–2010)

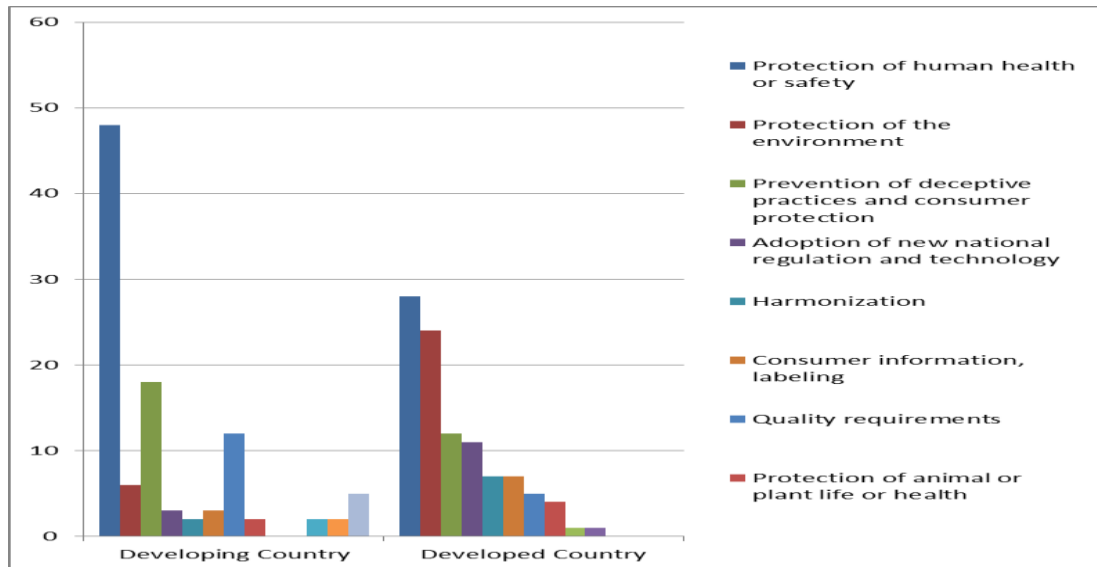
(Units: %)

<b>Objective</b>	<b>Rank</b>
Protection of human health or safety	6610 (43.9%)
Prevention of deceptive practices and consumer protection	1978 (13.1%)
Protection of the environment	1311 (8.7%)
Adoption of new national regulations and technology	1212 (8.1%)
Quality requirements	1168 (7.8%)
Harmonization	683 (4.5%)
Consumer information, labeling	558 (3.7%)
Improvement and elimination of trade barriers	302 (2.0%)
Protection of animal or plant life or health	255 (1.7%)
Trade facilitation	166 (1.1%)
Cost saving and productivity improvement	118 (0.8%)
National security requirement	67 (0.4%)
Not specified	119 (0.8%)
Other	496 (3.3%)

Source: Annual Review of the Implementation and Operation of the TBT Agreement

[Figure 2] The objective of TBT notification by country (1995-2010)

(Units: %)



Source: Annual Review of the Implementation and Operation of the TBT Agreement

## 2. Understanding Technical Regulations by Industry

Table 3 summarizes the TBT notifications to the WTO in 2010 by industry. There were 1889 TBT notifications and the industries ranked in the following order: medical (478, 25.3%), electrical equipment (247, 13.1%), chemicals/ceramics (163, 8.6%), and agriculture (138, 7.3%); all were related to the protection of human health and safety. By contrast, the bottom ranking TBT notifications focused mainly on general machinery and the environment.

[Table 3] Ranking of TBT notifications by industry (1995–2010)

(Units: %)

Industry	TBT notifications
Medical	478 (25.3%)
Electrical equipment	247 (13.1%)
Chemicals/ceramics	163 (8.6%)
Agricultural	138 (7.3%)
Necessities	129 (7%)
Energy logistics	125 (6.8%)
General machinery	100 (5.3%)
Environment	38 (2%)
Standard systems	38 (2%)
Conformity assessment	25 (1.3%)
Other	408 (21.6%)
Total	1889 (100%)

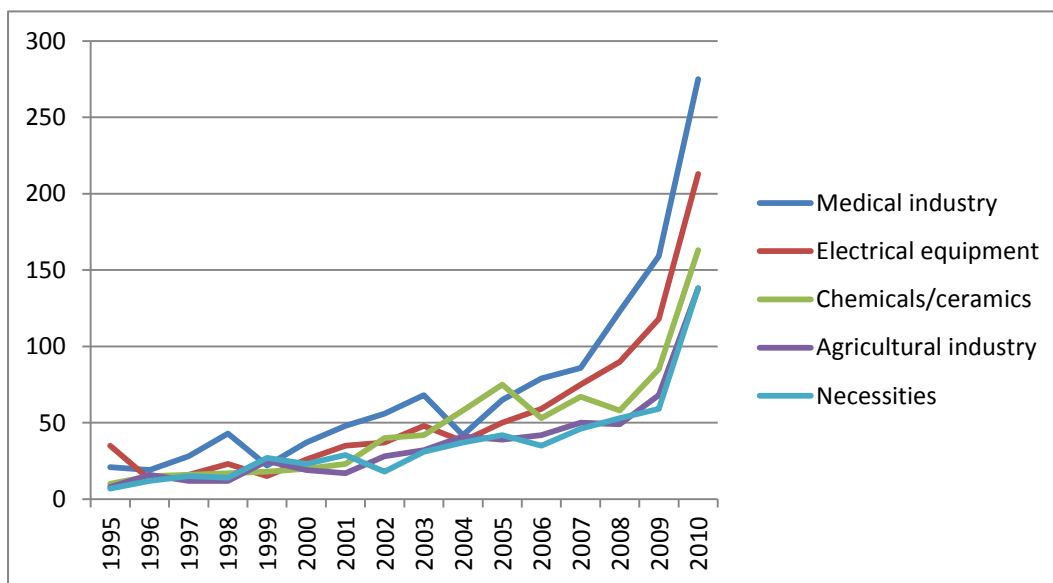
Source: Annual Review of the Implementation and Operation of the TBT Agreement

Theoretically, the economic effects of technical regulations can differ based on industry. According to Table 3, the impact of technical regulations on trade mainly affects technology-intensive industries, which indicates that the more complicated the technology in an industry, the greater the possibility of technical regulations becoming trade barriers.

Figure 3 plots the top five ranking TBT notifications by industry from 1995 to 2010, for the medical, electrical equipment, chemicals/ceramics, agricultural, and necessities industries. The number of TBT notifications in the five industries was similar from 1995 to 2001 and increased slowly after that. Specifically, the number of TBT notifications in the medical and electrical equipment industries increased dramatically after 2007.

[Figure 3] Annual review of TBT notifications by industry (1995-2010)

(Units: %)



Source: Annual Review of the Implementation and Operation of the TBT Agreement

#### IV. Model, Methodology and Quantification of Technical Regulations

Following the literature, we use the gravity model to study a country's trade. In particular, we introduce our constructed TBT variable to examine how TBT influences a country's exports. As in most gravity models, we include gross domestic product (GDP), distance, and population as independent variables.

We use the GDP per capita of an importing country as a proxy for its supply capacity. The round-trip distance between the importing countries and Korea captures the transportation costs. In addition to the usual gravity model variables, we introduce our key variable, the TBT notification measure.

Our basic regression model is as follows:

$$\ln Y_{kit} =$$



$$b_0 + b_1 \ln \text{PERGDP}_{it} + b_2 \ln \text{DIS}_{ki} + b_3 \ln \text{POP}_{it} + b_4 \ln \text{TBT}_{it} + b_5 \ln \text{ROE}_{it} + \mu_{it} \quad (1)$$

Where  $\text{DIS}_{ki}$  is the distance between country  $i$  and Korea; and for country  $i$  in year  $t$ ,  $Y_{kit}$  is the value of Korean exports to that country,  $\text{PERGDP}_{it}$  is the GDP per capita of the importing country,  $\text{POP}_{it}$  is the population;  $\text{TBT}_{it}$  is the number of TBT notifications to the WTO; and  $\text{ROE}_{it}$  is the exchange rate.

In our sample, Korea is the only exporting country, whereas there are 30 importing countries/economies (Annex 1). The time span covers 2002–2010. With these 30 importers and 9 years for HS 2-digit level products, we have a panel of about 270 observations.

In this study, we use 2000 constant US dollars to express all the dependent and explanatory variables. The values of Korean exports to the 30 individual importers were gathered from the Korea International Trade Association (<http://stat.kita.net>).

The GDP per capita of the importing country, denoted PERGDP, is used as the mass factor in the model. This factor captures the purchasing power and market size of the importing country, the demand side effect of the commodity. This mass factor should have a positive effect on Korean export of the commodity under study. Data for the PERGDP of the importing country are selected from the World Development Indicators (WDI) database, and are in 2000 constant US dollars.

The round-trip distance between Korea and the importing country, denoted DIS, is used as a resistance factor in the model. In this study, this is the geographic distance between the capital cities of the two countries and the data are from CEPII (<http://www.Cepii.fr/anglaisgraph/bdd/distances.htm>).

The population of the importing country, denoted POP, should have a positive effect on Korean exports of the commodity. The population data for the importing country are from the WDI.

The number of TBT notifications to the WTO, denoted TBT, is used as another resistance factor in the model. According to Otsuki et al. (2001) and Essaji (2008), the impact of TBT on international trade is negative under empirical analysis. The number of TBT notifications to the WTO imposed by importing countries on each commodity is taken from the TBT Information Management System.

Finally, the exchange rate of country  $i$ , denoted ROE, is used as another resistance factor to investigate the effect of TBT.

## **V. Regression Results and Explanations**

### **1. All Products**

Table 4 shows the coefficients of the trade control measure variables and the other variables. There were no high correlations among the explanatory variables.

[Table 4] Correlations between the explanatory variables

	<i>PERGDP</i>	<i>DIS</i>	<i>POP</i>	<i>TBT</i>	<i>ROE</i>
<i>PERGDP</i>	1.000				
<i>DIS</i>	-0.0406	1.000			
<i>POP</i>	-0.1767	-0.3018	1.000		
<i>TBT</i>	0.0548	-0.2271	0.4758	1.000	
<i>ROE</i>	-0.3856	0.0873	-0.0941	-0.1870	1.000

To conduct the econometric regression analysis, we applied the Generalized 2 Step Least Squares (G2SLS) model, which was documented in Parks (1967) and Kmenta (1997). This model assumes an autoregressive error structure of the first order AR(1), along with contemporaneous correlation among cross-sections. The STATA System (Version 11.0) was used to estimate the gravity models. First, we ran the regressions based on the entire sample period and we also controlled for the fixed year effect.

The regression results based on all of the HS 2 products are reported in Table 5. According to the results, all estimates were significant. Most of the explanatory variables in the standard gravity model have the expected signs. Specifically, the *PERGDP* of an importing country has a positive effect on Korean exports (a 1% increase in the *PERGDP* of the importing country increases Korean exports to that country by 1.61%), which implies that a larger market size and greater purchasing power in the importing countries increases the demand for Korean commodities. The distance between the importing country and Korea had a negative effect on trade between the two countries (a 1% increase in the distance reduced Korean exports to that country by 0.95%). In addition, the population of the importing country had a positive effect on trade, as predicted.

[Table 5] Regression results from 1995–2010

Explanatory Variables	Dependent Variable		
	Random Effects	HT	G2SLS
$\ln(\text{PERGDP})$	1.58 (0.36)***	1.65 (0.40)***	1.61 (0.54)**
$\ln(\text{DIS})$	-0.81 (0.52)**	-0.93 (0.52)**	-0.95 (0.57)***
$\ln(\text{POP})$	0.77 (0.26)***	0.85 (0.28)***	0.87 (0.28)**
$\ln(\text{TBT})$	-0.21 (0.48)*	-0.23 (0.51)*	-0.25 (0.56)*
$\ln(\text{ROE})$	-0.04 (0.19)**	-0.03 (0.20)*	-0.01 (0.20)*
Constant	-8.75 (9.62)**	-8.39 (8.91)**	-8.11 (8.93)*
$\overline{R^2}$	0.57	0.63	0.64

<b>Obs</b>	270
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Note: \*, \*\*, and \*\*\* stand for significant at 10%, 5%, and 1%, respectively

Turning to the impact of the number of TBT notifications, in all models, the variable TBT was negative and significant. The regression coefficients show that a 1% increase in the number of TBT notifications, which means tighter standards, will decrease the value of Korean exports by 0.21%.

## **2. Agriculture vs. manufacturing products**

Trade barriers, especially TBT measures, may have different effects on a country's exports depending on the nature of the products. To observe this, we examined the interactions of the individual terms of trade measures with the product classification dummy at the HS 2-digit level: agriculture (indicating that product K is an agricultural product: HS 01-24) or manufacture (indicating that product K is a manufacturing product: HS 25-97).

Table 6 reports the results after adding the agriculture (manufacturing) dummy to each of the TBT notification measures in terms of G2SLS. Since the standard gravity model variables (GDP, DIS, and POP) show the same pattern in Table 6, we focus mainly on the TBT notification measures. Generally, we infer that the impact of TBT on agricultural products differs from that on manufacturing products. Based on the results in Table 6, TBT has contradictory effects on agricultural and manufacturing imports.

On comparing columns 1, 2, 4, and 11 of Table 6, we find that TBT has the expected significant negative impact on agricultural exports; in addition, there is a negative effect for the electronics industry (HS 85) and chemicals/ceramics (HS 29-40). This indicates that agriculture and electronics imports are more responsive to changes in TBT notifications.

Conversely, considering columns 3, 6–10, and 12, we find that TBT has a positive impact on exports in manufacturing. For columns 10 and 12, the impact is significantly positive, indicating that the more complex the industry is, the more techniques it obtained.

Overall, although TBT have a significant negative impact on agricultural exports, they had a significant positive impact on some manufacturing exports. As a result, TBT are trade restricting for agriculture goods, but trade promoting for manufacturing goods.

## **VI. Conclusion and Policy Implications**

This study analyzed the impact of TBT on international trade to suggest government policies for strengthening the related industries. The paper contributes to the literature of empirical studies on the effects of TBT on international trade, analyzing how TBT and other variables affected Korean trade from 2002–2010. Using G2SLS, we found that TBT have a negative impact on Korean exports. Furthermore, the TBT notification variable was trade reducing for agricultural goods, but trade promoting for manufacturing goods.

This study should help our understanding of the impact of TBT on international trade and suggest how the Korean government could nurture the related industries in order to efficiently respond to TBT issues. The collaboration of policy actors, such as conformity assessment companies, research institutes,

and government, is crucial for strengthening the negotiation strategy related to TBT as well as for supporting government policy on human resource development, the rapid gathering and analysis of worldwide TBT information, and coordination of the actors needing to be reinforced.

[Table 6] Regression results by industry (HS 2-digit)

	Agricultural industry		Manufacturing industry										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
	Primary commodity (01–10)	Primary commodity processing (11–24)	Mineral processing (25–28)	Chemical products (29–40)	Family products (41–43)	Paper/ wood (44–49)	Clothing/ textiles (50–67)	Non–metallic minerals (68–71)	Metal products (72–83)	General machinery (84)	Electrical machinery (85)	Transport equipment (87)	Other manufactured goods (86,88–97)
$\ln(PERGDP)$	0.40 (0.52)**	0.63 (0.50)**	0.69 (0.79)**	0.56 (0.75)**	0.46 (0.64)**	0.71 (0.62)**	1.02 (0.53)**	0.82 (0.71)**	0.96 (0.69)**	0.53 (0.72)**	0.46 (0.76)**	0.82 (0.75)**	0.66 (0.51)**
$\ln(DIS)$	-0.72 (0.60)	-0.69 (0.80)	-1.05 (0.75)	-0.82 (0.77)*	-0.69 (0.65)*	-0.75 (0.72)*	-0.93 (0.70)**	-0.92 (0.63)	-0.47 (0.59)	1.05 (0.75)	-1.59 (0.69)**	-0.93 (0.79)	-1.00 (0.85)
$\ln(POP)$	0.88 (0.13)**	0.93 (0.25)**	1.85 (0.23)**	0.96 (0.27)**	0.58 (0.19)**	0.63 (0.20)**	0.91 (0.24)**	1.05 (0.22)**	1.13 (0.23)**	0.61 (0.26)**	0.53 (0.21)**	0.86 (0.20)**	0.62 (0.28)**
$\ln(TBT)$	-0.14 (0.05)**	-0.08 (0.10)*	0.08 (0.03)**	-0.11 (0.05)*	-0.04 (0.04)	0.02 (0.03)	0.01 (0.06)	0.01 (0.06)*	0.05 (0.06)*	0.13 (0.07)**	-0.21 (0.04)**	0.06 (0.07)**	0.01 (0.09)**
$\ln(ROE)$	-0.02 (0.01)	-0.03 (0.02)	-0.01 (0.01)	-0.04 (0.02)	-0.02 (0.01)	-0.02 (0.03)	-0.03 (0.02)	-0.05 (0.08)	-0.02 (0.06)	-0.03 (0.02)	-0.05 (0.04)	-0.02 (0.01)	-0.01 (0.01)
Constant	-8.27 (6.51)	-9.25 (9.28)	9.73 (10.34)	15.28 (9.27)	13.64 (8.05)	15.21 (8.46)	10.85 (7.23)	16.39 (0.29)	13.92(1.56)	10.88 (8.06)	18.56 (7.78)**	16.23 (7.02)	7.58 (9.96)
$\overline{R^2}$	0.50	0.43	0.64	0.59	0.68	0.62	0.73	0.78	0.62	0.58	0.59	0.49	0.60
Obs	270												

Note: \*, \*\*, and \*\*\* stand for significant at 10%, 5%, and 1%, respectively

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## Appendix

### Top 30 ranking of TBT notifications by countries/regions (2002–2010)

Country	2002	2003	2004	2005	2006	2007	2008	2009	2010
China	12	28	23	112	64	90	185	201	62
USA	14	26	38	72	64	101	106	71	172
Israel	8	20	18	52	22	42	62	135	103
EU	17	21	30	22	40	35	67	61	57
Brazil	45	52	26	37	32	35	50	39	77
Japan	33	45	22	26	35	45	52	33	27
Kenya	0	0	6	12	62	31	14	69	68
Canada	28	23	12	38	37	34	33	39	45
Korea	19	15	16	19	29	37	33	57	49
Bahrain	0	0	1	3	5	21	49	41	34
Tailand	21	21	13	22	28	37	31	82	34
Qatar	0	0	0	4	10	20	41	78	60
Saudi Arabia	0	0	0	5	8	13	23	90	89
Romania	0	0	5	9	10	25	46	57	54
Argentina	40	44	2	27	11	23	14	13	4
El Salvador	35	40	15	20	24	11	13	14	10
Mexico	40	26	3	9	9	12	33	19	43
Columbia	8	9	4	11	12	22	19	16	25
Oman	0	0	1	4	5	15	28	21	22
The South Africa	7	8	10	12	7	12	20	28	10
Costa Rica	5	8	8	12	24	12	13	14	5
Philippine	16	2	1	8	30	18	7	9	20
France	7	12	3	15	8	13	20	13	13
Swiss	8	6	3	13	21	15	13	12	10
Chile	8	3	4	9	8	10	16	21	42
Taiwan	5	5	3	12	15	11	12	12	17
Armenia	1	1	9	14	23	15	8	8	8
Slovenia	7	2	5	9	13	12	17	7	0
Sweden	17	8	5	19	15	14	5	5	5
Ecuador	0	0	2	6	9	18	4	20	10

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