Impact of Sanitary and Phytosanitary Measures and Technical Barriers on International Trade

Kang, Jong Woo and Ramizo, Dorothea

Asian Development Bank

July 2017

Impact of Sanitary and Phytosanitary Measures and Technical Barriers on International Trade

Jong Woo Kang[1]
Dorothea M. Ramizo[2]

February 28, 2017

Abstract

In principle, sanitary and phytosanitary (SPS) measures aim to protect the health of humans, plants and animals, while technical barriers to trade (TBT) ensure product quality and safety. However, governments may overshoot the requirements of health and consumer safety and use SPS and TBT to shield domestic producers from fair competition. Potential abuses of both measures as protectionist tools not only constrain international trade but also consumers' welfare by restricting the choices of goods available to them. Our analysis shows that in general the measures seem to be positive for trade after controlling for other factors. However, the impacts are mainly driven by exports from advanced economies. Less developed countries do not gain as much when implementing the measures or are disadvantaged in exporting goods, particularly when importers are advanced economies. Within South countries, developing Asia are more adversely affected by SPS while non-Asian developing country exports are afflicted more by TBT. SPS in particular is damaging intraregional agricultural trade among Asian countries, which calls for policy makers to act more proactively in resolving nontariff hurdles in the region.

Keywords: agriculture, protectionism, sanitary and phytosanitary measures, technical barriers to trade

JEL Classification: F13, F14, F15

[1] Corresponding author. Principal Economist, Economic Research and Cooperation Department, Asian Development Bank. jkang@adb.org
[2] Economic Research and Cooperation Department, Asian Development Bank. dramizo.consultant@adb.org

1. Introduction

Trade protectionism is on the rise. While it is gaining traction in advanced economies, protectionism may soon spillover to developing economies once they feel its pinch as trading partners. Although spiraling domino effect of rising protectionism and self-centric nationalism is something that collective wisdom tells us we need to rigorously fend off, the harsh reality is that trade protection measures are poised to be strengthened. This does not bode well for the prospects of international trade, which is already ailing and will be hurt further by the recent decline in economic growth around the world.

Connections between rising protectionism and the global trade slowdown since 2012, which started in the aftermath of the global financial crisis, are still uncertain. A clearer picture requires more thorough analysis of the real impact of protection measures on trade flows. Use of import tariffs, the most obvious form of trade impediment, has declined drastically in the past few decades, while the use of nontariff measures (NTMs) such as technical barriers to trade (TBT) and sanitary and phytosanitary (SPS) have increased, along with trade remedies such as anti-dumping duties, countervailing duties and safeguards.

Trade remedies and SPS and TBT measures share common features in that they are legitimate trade protection measures allowed under the World Trade Organization (WTO) regime. One stark difference is that while trade remedies are intended to restore level-playing field after considering the impact of trade on an economy (ex-post), SPS and TBT measures are implemented to ensure the quality and standard of imported goods before they are consumed (ex-ante). Legitimate as these motivations are, such measures can depress trade flows if they are excessive, and could be even more detrimental to the welfare of people if driven by the vested interests of domestic businesses or imposed to suit nationalistic self-interest.

In principle, SPS and TBT measures aim to protect the health of humans, plants and animals. However, governments may overshoot the minimum requirements to protect the lives or health of their consumers and use such measures to shield domestic producers from fair competition against exports, even as WTO rules prohibit members from applying them for the purposes of

protectionism. Trade restrictive SPS and TBT measures, like other forms of protectionism, do not only hurt foreign producers and exporters by driving up costs but also domestic consumers and importers, who fail to benefit from cheaper imported products in greater variety.

Despite the rising significance of SPS and TBT measures as expounded above, their impact on trade is little known. Economic theory provides no straightforward insights on how these measures affect international flows of goods. Instead, literature proposes that the impact of SPS and TBT measures on trade varies and does not necessarily restrict trade. To illustrate, Thilmany and Barrett (1997) distinguish between informative and non-informative regulatory measures. The former reveals information on product quality or safety while the latter do not. On one hand, both informative and non-informative measures increase producer surplus because they protect domestic firms against foreign competitors. On the other hand, while informative measures are expected to increase consumer surplus, non-informative trade barriers have the opposite effect. Therefore, evaluating the diverse effects of SPS and TBT measures remains an empirical issue.

The purpose of this paper is to determine the trade impact of SPS and TBT measures and whether or not the impact of these measures is similar for all exporting economies. We control for tariffs imposed by importing countries so as to separate the impact of SPS and TBT from that of tariffs. To capture the effect of SPS and TBT, a simple dummy variable equals to one if the importing country notifies at least one barrier at the six-digit level of the Harmonized System of Classification (hereafter referred to as HS). The rest of the paper is structured as follows: the next section provides a background on SPS and TBT measures including review of related empirical literature, trends, and regulatory frameworks on SPS and TBT while the third section describes the data, the econometric model, and provides the results while the last section concludes.

2. Background

This section discusses the regulatory measures that are classified under SPS and TBT and illustrate using examples from related empirical literature how these measures may positively or negatively impact trade. Furthermore, although SPS and TBT measures are domestic regulations which are left to the discretion of countries and are not subject to international control, these

measures may have to conform to international standards such as WTO agreements. This section presents an overview of the existing regulatory framework on SPS and TBT measures and outlines existing trends.

2.1. SPS Measures

An important goal for all governments is to guarantee the safety of food for consumers and to prevent or limit the spread of pests, the outbreak of disease among plants and animals, and other health risks from residues (of pesticides or veterinary drugs), contaminants (heavy metals), toxins or disease-causing organisms in foods, beverages, or feedstuffs. Policies with these objectives are generally referred to as sanitary (human and animal health) and phytosanitary (plant health) measures. The scope of SPS covers all relevant laws, decrees, regulations, requirements, and procedures.

SPS measures are classified into eight major requirements. Six requirements pertain to technical regulations, one requirement deals with conformity assessments, while another covers all other requirements. [3] SPS-related conformity assessment covers verification that a given SPS requirement has been met. This could be achieved by inspection (for example sampling and testing) and approval procedures including verification, assurance of conformity, and accreditation.[4] SPS measures primarily cover the domestic production of food and plant and animal health, but to the extent that they are also applied to imported products, SPS may cause harm to foreign trade. Nevertheless, the findings produce mixed results.

[3] SPS technical regulations take the following forms: (i) prohibition and/or restriction of the final products to be imported (for example import bans on dairy products from countries with poor sanitary conditions), (ii) tolerance limits for residues and restricted use of substances such as food and feed additives used for coloring, preservation, and sweeteners, (iv) labelling, marking and packaging requirements like specifying the storage conditions, or alerting to potentially dangerous ingredients such as allergens, (iv) hygienic requirements involving microbiological criteria of the final product (such as that liquid eggs should be pasteurized or otherwise treated to destroy salmonella microorganisms), or hygienic practices during production (such as milking equipment should be cleaned daily with a specified detergent), and other hygienic requirements; (v) post-harvest treatment such as irradiation and fumigation; and (vi) other requirements on production or post-production processes, for example requirements on how plants should be grown or how animals should be raised or caught (UNCTAD 2013).

[4] Examples of this requirement include tests on imported fruit samples to check against the maximum residues of pesticides, quarantine requirement such as the quarantine of plants to terminate or restrict the spread of harmful organisms, and traceability requirements such as in meat products, where information must be disclosed about the slaughter house , as well as food–processing factory (UNCTAD 2013).

Otsuki, Wilson and Sewadeh (2001a) investigate the impact of a particular SPS measure on food, the maximum aflatoxin level imposed on imports of cereals and fruits, nuts, and vegetables by EU members from 9 sub-Saharan African (SSA) countries over 1989-1998. The study shows that a more stringent requirement of 10% deduction of maximum allowable level of aflatoxin in European countries reduces exports of cereals from SSA countries by 11% and by 4.3% for fruits, nuts and vegetables. Another study by the same authors on the impact of aflatoxin on groundnut oil and groundnuts for oil seeds using the same sample of countries show that imposing higher standards such as 10% decrease in the ceiling of permissible level of aflatoxin in European economies will reduce SSA exports of edible groundnuts by 11% while stricter aflatoxin standard appears not to affect trade in groundnuts for oilseed Otsuki, Wilson and Sewadeh (2001b).

Crivelli and Gröschl (2012) find that conformity assessment-related SPS reduce the likelihood of firms' market entry while measures covering product characteristics boost trade. Hence, while conditional on market entry, markets which implement SPS tend to have higher export volumes. Crivelli and Gröschl (2012) attribute the negative impact of SPS on the probability that conformity assessment-related SPS will be particularly burdensome and costly, while SPS technical regulations on product characteristics explain most of the positive effects of SPS on trade volumes.

The positive effect of SPS regulation may be explained by the information content of these measures, which signals quality and safety, benefits consumers, and outweighs the costs to the producers. This means that SPS technical regulations on product characteristics bolster consumer trust in imported products, thereby stimulating trade for exporters that successfully cover the fixed cost of market entry (Crivelli and Gröschl 2012).

The WTO's Sanitary and Phytosanitary Agreement is binding on all WTO members and came into force with the organization's establishment on 1 January 1995. The agreement defines the rules that WTO members are required to comply, and covers all SPS which may, directly or indirectly, affect international trade. While any WTO member is free to implement SPS to protect the life and health of its human population, plants and animals, WTO rules require that

these measures are transparent, based on international standards, and scientifically proven, proportionate to the potential risk involved, and equally applicable to domestic and foreign products so as to prevent discrimination. The guidelines aim to engender predictable and sustainable trade.

The SPS agreement requires a WTO member who proposes a new regulation or wants to amend an existing one to notify the WTO Secretariat, which disseminates the notification to other WTO member governments. Governments are required to submit notification of a new regulation ahead of its implementation so that trading partners have an opportunity to raise concerns. This process may be forgone in case of a health and safety emergency, provided that the WTO Secretariat is immediately notified.

Based on this notification system, 14,123 SPS measures have been notified to the WTO as of August 2016. Figure 1 in the Appendix section shows the increasing number of notifications to the WTO and the number of notifying countries since 1995 for SPS measures. SPS measures are either multilateral (cover all WTO members) or bilateral (targeted to a particular economy or group of economies). An average of 46 WTO countries notified the WTO about imposing SPS measures from 1995–2015; 30% of these countries were Asian. Moreover, Asia imposed the highest number of SPS measures (4,297) followed by North America (4,001) (Figure 2). Asia is the region most affected by bilateral SPS (282), followed by Latin America and the Carribean (276) (Figure 3).

Product groups subject to large numbers of SPS include: (i) live animals and products, (ii) vegetable products, (iii) prepared foodstuff, beverages, spirits, and vinegar, (iv) tobacco, and products of the chemical and allied industries, and (v) animal and vegetable fats, oils and waxes. The SPS agreement created a committee on Sanitary and Phytosanitary Measures (the "SPS Committee") to provide for the exchange of information about food safety or plant and animal measures that affect trade, and to ensure the implementation of the SPS agreement. The SPS Committee, like other WTO committees, is open to all WTO member countries. Meanwhile, for trade disputes involving SPS, the usual WTO settlement procedures are resorted to. Evidence of the increasing number of SPS is supported by the complaint-based information in the Specific

Trade Concerns Database (Figures 4). A recent example of an Asia-related concern raised in the SPS Committee is the restriction that the PRC placed on imports of bovine products and genetic materials from the European Union from 2012 following concerns about the Schmallenberg virus, a disease infecting sheep, cattle, and goats in Europe. The European Union raised concerns about the legitimacy of the restrictions.

2.2.TBT Measures

Governments have tightened existing rules or have implemented new policies in response to consumer demands for greater product safety and stricter environmental protection. Countries have adopted increasing numbers of mandatory technical regulations and voluntary standards. These regulations and standards, also known as TBTs, define either the specific characteristics of a product (such as shape, size, or design and performance) or they can pertain to the process and methods used in its production (WTO 2012).

TBT are classified by eight key areas of regulation and procedures. Six areas are related to technical regulations which include requirements for products and processes. One area focuses on conformity assessment procedures, while another covers TBT that are not specified elsewhere.[5]

TBT-related conformity assessment procedures ensure that a given TBT requirement has been met. Examples of this include requirements on: (i) product registration requirement in the importing country (for example only registered medicines may be imported), (ii) testing requirement (for example testing on a sample of imported motor vehicle); (iii) certification requirement for example requirement of certificate of conformity for electric products) (iv) inspection: for example when clothing imports are examined for size and materials used before

[5] TBT technical regulations include the following: (i) prohibition and/or restriction of imports for objectives set out in the TBT agreement such as for importers of sensitive products like firearms and explosives who may be required to register in the importing country, (ii) tolerance limits for residues and restricted use of substances (for example, the lead content permitted in consumer paints), (iii) labelling, marking and packaging requirements (e.g. appliances carrying label indicating its size, weight and electricity consumption level); (iv) production or post-production requirements such as the use of environment friendly equipment, (v) product identity requirements (for example that a product must contain a minimum of 30% cocoa to be considered “chocolate”), and (vi) product-quality or performance requirements, for example that furniture or fixture must resist a certain temperature (UNCTAD 2013).

entry is allowed, and (v) traceability information: such as on the origin of materials and parts, processing history, and distribution and location of products after delivery (UNCTAD 2013).

These types of regulation have serious implications for international trade because exporters attempting to gain market access for their goods are compelled to determine, learn, and meet the requirements and to upgrade their products or processes if they fail to meet standards and regulations. They are also required to show proof of compliance with regulations or standards. The fixed costs of completing these requirements are burdensome, if not prohibitive, and pose a barrier for small and medium enterprises looking to export their products. Moreover, complying with varying regulations and standards across countries is both costly and complicated as exporting to different markets involves different processes, which reduces economies of scale. In line with this, empirical evidence shows that internationally harmonized standards have trade enhancing effect while standards inconsistent with international norms achieve the opposite.

Portugal-Perez, Reyes and Wilson (2009) studied the impact of product standards on exports of electronic and related products of 131 countries to the EU over 1990-2006 using two count variables: (1) the number of EU standards internationally harmonized with the International Electrotechnical Commission and (2) the number that are not. Internationally-harmonized European standards increase exports of electronic products to the EU while European standards inconsistent with international norms have lower impact on exports to the EU and even negatively affect some electronic products. Czubala, Shepherd, and Wilson (2009) examine the impact of product standards on 47 SSA economies' exports of textile and clothing to the EU from 1995 to 2003 using two count variables depicting the number of EU standards harmonized with ISO standards and the number that are not. They find that non-harmonized standards negatively impact SSA exports of textile and clothing to the EU while EU standards that are consistent with ISO standards have less trade depressing effect.

In principle, TBTs have valid policy goals such as the protection and promotion of public health and safety. However, when these requirements go beyond what is needed to reach policy objectives, or if they are implemented to protect domestic products, they serve as trade barriers

and create distortions in international trade. Hence, TBTs are considered one of the most significant and commonly imposed nontariff measures (WTO 2012).

Like the SPS agreement, the Agreement on Technical Barriers to Trade (the "TBT agreement") entered into force with the creation of the WTO. The goal of the agreement, which is binding on all WTO members, is to prevent regulations, standards, testing, and certification procedures from creating unnecessary obstacles to trade. To this end, the agreement contains provisions that specifically address the preparation, adoption, and application of regulations that affect trade in goods by promoting the use of international standards and avoidance of unnecessary barriers to trade (WTO 2014).

The TBT agreement requires WTO members to notify other members, through the WTO Secretariat, of proposed measures that may affect other members' trade and that are not based on relevant international standards. As of August 2016, 21,399 TBT measures have been notified to the WTO. Figure 5 shows the increasing number of TBT notifications to the WTO and the number of notifying countries since 1995. During the same period, an average of 59 WTO countries notified the WTO about imposing TBT, and a quarter of them were Asian.

All TBT measures in the WTO notification database are multilateral. Asia imposed the highest number of TBT (4,948) followed by Europe (2,337) (Figure 6). Product groups subject to large numbers of TBT include: (i) machinery and electrical equipment, (ii) prepared foodstuffs like beverages, spirits, vinegar, and tobacco; (iii) products of the chemical and allied industries, (iv) resins, plastics and articles; rubber and articles, and (v) vegetable products. The TBT Committee provides an opportunity for WTO members to discuss concerns that may arise from the exchanges of information required by TBT agreement's notification requirement and transparency provisions. WTO members have an opportunity to raise specific trade concerns in the TBT Committee, an open multilateral forum composed mostly of technical experts. Discussions of specific trade concerns allow WTO members to better understand the purpose behind their trading partners' regulations, and to have a chance to obtain clarification. However, if trade concerns cannot be addressed by the committee, WTO members may resort to the formal

WTO dispute settlement process (WTO 2014). Evidence of rising number of TBT is supported by complaint-based information in the Specific Trade Concerns Database (Figure 7).

Recent Asia-related examples of specific trade concerns on TBTs raised in the WTO include the Republic of Korea raising concerns about PRC's regulation of the registration of infant and follow-up formula; Indonesia's concerns about Russia's implementation plan related to excise taxes for palm oil and soda products; and the United States raising concerns about Indonesia's law on halal product assurance and Thailand's controls on marketing on foods for infants and young children.

Empirical literature discussed in this section shows that while several studies have attempted to determine the impact of SPS and TBT measures on trade they do so using only particular SPS or TBT measure or product specific trade flows. Meanwhile, some studies which employ overall trade flows focus only on the impact of NTMs in general and not on SPS and TBT in particular. Lastly, other research works have investigated the combined impact of SPS and TBT measures on specific product groups and overall trade flows without considering their possible separate and distinct effect on trade. Fontagne, Mayer and Zignano (2005) investigate the impact of NTMs on overall trade flows by classifying NTMs into four variables according to (1) direct impact on prices (e.g. minimum import pricing, trigger prices, and variable levies), (2) quantity restrictions (e.g. quotas and prohibitions), (3) quality restrictions (e.g. health, safety, or technical regulations), and (4) existence of retaliatory threats (e.g. antidumping and countervailing duty investigations). Each NTM variable is set equal to 1 if at least one of the tariff lines underlying HS6 category is imposed with an NTM, and 0 otherwise. This information is then used to create a frequency index on the share of tariff lines under HS6 category imposed with an NTM. The authors find that price NTMs appear to have larger impact on trade flows, while quantity NTMs show positive but insignificant coefficient. In sum, trade depressing impact of NTMs is 3.2%. Hoekman and Nicita (2008) used the World Bank NTM restrictiveness index as a proxy for NTM and introduced it in the gravity model. Results show that a 10% reduction in NTM restrictiveness increases import volume by 1.8%.

Fontagne, Mimouni, and Pasteels (2005) estimate the impact of SPS and TBT measures including tariff across countries and all products. Their study covers all notifying countries and SPS and TBT notifications up to 2001. The results are consistent with previous findings: negative impact of SPS and TBT measures are observed on agricultural products particularly fresh and processed foods while these measures appear to show insignificant or even positive impacts on majority of manufactured goods.

Employing cross-section data of 183 exporters and 154 importers of agricultural and food products for 2004, Disidier, Fontagne and Mimouni (2008) use 3 SPS and TBT variables to capture the impact of regulations on agricultural trade: (1) a dummy equals to 1 if the importing country notifies either at least 1 SPS or TBT measure at HS4 category; (2) a frequency ratio; and (3) an advalorem equivalent of SPS and TBT measures calculated by Kee, Nicita, and Olarreaga (2009). The authors conclude that SPS and TBT measures implemented by OECD economies have negative impact on their imports of agricultural products from developing countries but have neutral effect on trade among OECD members. Moreover, exports to European Union economies are more negatively influenced by SPS and TBTs than exports to OECD economies. This finding suggests that the impact of SPS and TBT measures is not uniform across countries but may vary according to different export groups.

While both immediately preceding studies include bilateral tariff to allow distinction between impact of tariffs and SPS and TBT measures on trade, neither study considers the possible separate and distinct impact of SPS and TBT measures, respectively on trade given that previous studies show these measures may either negatively or positively impact trade depending on products considered.

This study distinguishes itself from the existing literature by examining both the combined and separate impact of SPS and TBT measures on: (1) trade on all product groups; (2) trade on two major product groups (agriculture and non-agriculture); (3) all economies in the sample; and (4) different export groups.

3. Model Specification and Data

3.1. Model Specification

Following Disdier et al. (2008), which measured the impact of SPS and TBT on trade in the agriculture sector, we estimate the gravity equation model using a set of fixed effects for importer, exporter and sector to control for various types of country and sector-specific factors that may affect trade flows and mitigate potential endogeneity problems.

To measure transport costs, bilateral distance between both partners (*d*) are used. These distances are obtained from the CEPII database. A dummy variable "contiguity" (*contig*) is also included, which equals one if both countries share a border. Bilateral trade can also be enhanced by countries' cultural proximity. We therefore control for this by introducing two dummy variables, which are equal to one if both countries share a common official or primary language (*comlang_off*) or if both partners have had colonial ties (*col*). These data are also derived from CEPII database.

The next step is to introduce tariff barriers in the gravity equation to distinguish the impact of nontariff barriers on trade from that of tariffs. For this, we include a bilateral tariff (*tar*) data at the four-digit level of the HS classification extracted from WITS. It incorporates not only the applied tariff but also specific duties, tariff quotas, and anti-dumping duties. All these barriers are converted into an ad valorem equivalent tariff and summarized in one measure.

Our objective in this paper is to evaluate the trade impact of measures notified by importing countries under the SPS and TBT agreements. The last step is therefore to specify these measures. A dummy variable (*NTM*), which corresponds to the four-digit level of the HS classification, is considered to be equal to one if the importing country notifies at least either one SPS or TBT at the six-digit level under the four-digit level of the HS classification.

For models estimated to determine the possible separate and distinct effects of SPS and TBT respectively on trade, the dummy variable *NTM* is considered to be equal to one if the importing

country notifies at least one SPS (TBT) at the six-digit level under the four-digit level of the HS classification.

For our dependent variable, we choose bilateral import data of country *j* (*importer*) from country *i* (*exporter*). The source is the UNCOMTRADE database. In our sample, notifications and tariff data are taken from 2012 to 2014. To address the problem that the error term is likely to exhibit correlation patterns for a given country-pair, we cluster the robust standard errors at the country-pair and four-digit product code. This model specification is analogous to the approach taken by Disdier et al. (2008).

After taking logs, the estimated basic specification using the pooled OLS and panel regression method takes the form:

$$(1)\ \ln x_{ijt}^{hs_4} = \mu_i fe_i^{hs} + \alpha_j fe_j^{hs} + \delta_1 \ln GDP_{it} + \delta_2 \ln GDP_{jt} + \delta_3 \ln d_{ij} + \delta_4 \text{contig}_{ij} + \delta_5 \text{comlang\_off}_{ij} + \delta_6 \text{col}_{ij} + \delta_7 tar_{ijt}^{hs_4} + \delta_8 NTM_{ijt}^{hs_4} + \varepsilon_{ij}^{hs_4}$$

where fe^{hs} = importer or exporter fixed effects interacted with either two-digit or four-digit sector depending on technical and degree of freedom constraints.

To investigate the impact of SPS and TBT on exports of high, middle, and low-income countries, we estimate the following equation using the pooled OLS and panel regression method:

$$(2)\ \ln x_{ijt}^{hs_4} = \mu_i fe_i^{hs} + \alpha_j fe_j^{hs} + \delta_1 \ln GDP_{it} + \delta_2 \ln GDP_{jt} + \delta_3 \ln d_{ij} + \delta_4 \text{contig}_{ij} + \delta_5 \text{comlang}_{\text{off}_{ij}} + \delta_6 \text{col}_{ij} + \delta_7 tar_{ijt}^{hs4} + \delta_8 NTM_{ijt}^{hs_4} + \delta_9 D_{2i} + \delta_{10} NTM_{ijt}^{hs_4} D_{2i} + \varepsilon_{ij}^{hs_4}$$

where D_{2i} = 1 if exporting country is low or medium income, 0 if a high-income country.[6]

[6] Low, medium and high-income country groupings are based on World Bank income groups (see Appendix 1 for list of countries).

Furthermore, to analyze the effect of SPS and TBT on the exports of OECD and Asian countries, we estimate the following equation using the same methods:

$$(3)\ \ln x_{ijt}^{hs_4} = \mu_i fe_i^{hs} + \alpha_j fe_j^{hs} + \delta_1 \ln GDP_{it} + \delta_2 \ln GDP_{jt} + \delta_3 \ln d_{ij} + \delta_4 \text{contig}_{ij} + \delta_5 \text{comlang}_{\text{off}_{ij}} + \delta_6 \text{col}_{ij} + \delta_7 tar_{ijt}^{hs4} + \delta_8 NTM_{ijt}^{hs4} + \delta_9 D_{3i} + \delta_{10} NTM_{ijt}^{hs4} D_{3i} + \varepsilon_{ij}^{hs_4}$$

where $D_{3i} = 1$ if exporting country is Asia, 2 if non-Asia or non-OECD, 0 if OECD.

3.2. Data

As previously discussed, SPS and TBT agreements require WTO members to notify the WTO Secretariat on the measures they impose. These notifications are collected, complemented by information based on national sources and analyzed by the United Nations Conference on Trade and Development (UNCTAD) available through the World Bank's World Integrated Trade Solution (WITS). For countries with no SPS and TBT data available under WITS, we gather data from WTO's online database, Integrated Trade Intelligence Portal (I-TIP). Using these data, we estimate various econometric models on the trade impact of SPS and TBT. We first merge the HS 4-digit-level information on notifications with trade data of the UNCOMTRADE. Notifications in the econometric model cover 2012 to 2014. Our sample includes 107 importing countries and 154 exporting countries.

An important issue is the aggregation of trade data in the study. For instance, if trade data are aggregated at the two-digit level of the HS product classification system, variance among products goods will not be wide enough. Evaluation at the two-digit level could also result in low variation in SPS and TBT. However, if the trade data under consideration are at the most specific level (for example, six or eight digits), then a problem of reverse causality arises, in which countries with higher trade flows have greater possibility of imposing SPS and TBT to each other's imports. Hence, following Disdier et al. (2008), trade data and SPS and TBT are evaluated at the four-digit level of HS classification.

4. Empirical Results

4.1. Effects of SPS/TBT When Combined

The regression results across all models confirm the expected impact of gravity factors. Both exporter and importer GDPs have significantly positive impacts on trade. The same applies to border contiguity, use of common language, and historical colonial ties. Geographical distance shows highly significant and negative effect on bilateral trade flows. As expected, a bilateral applied tariff rate (weighted average) based on the value of a product reduces trade significantly.

As shown in Table 1 below, SPS or TBT in a sector increase trade in both pooled OLS and panel regressions. According the basic model, SPS and TBT increase average worldwide bilateral trade by 0.15%–0.19%. We further test for any difference in the effect of SPS and TBT on trade across different regional and income groups. For this, we add income group dummies of middle and low-income countries and regional dummies of Asia, non-Asia, non-OECD along with their respective interactions with the SPS and TBT existence dummy.

As shown in columns (3) and (4) below, SPS and TBT are shown to increase exports of middle and low-income countries slightly more than for high-income countries, which could highlight the informative value of the measures for these countries' exports. In the meantime, regional differences are revealed in the regression results under columns (5) and (6). Compared to OECD countries, Asia's exports to world get a boost from the SPS and TBT of importers. On the other hand, SPS and TBT hurt exports of non-Asia, non-OECD countries, as shown by the significant, negative terms of -0.38 (in pooled OLS) and -0.17 (in panel regression).

On average, the SPS and TBT of importers cause a 0.13% reduction in exports of non-Asia, non-OECD countries, according to the pooled OLS regression. According to panel regression, the effect of SPS and TBT for this country group is still positive at 0.01%, but this is significantly lower than the 0.18% increase shown for OECD countries and 0.26% for Asian countries. It is worth noting that in our analysis non-Asia, non-OECD countries constitute the largest sample. with 91 countries in Africa, Middle East, Latin America, and Eastern Europe. Hence, we can infer that the overall positive effect of SPS and TBT on trade flows is driven mainly by the

exports of advanced economies, followed by Asian exports, while the measures hurt most of the developing and least-developed countries in the rest of the world.

In Table 2, we further examine the impact of SPS and TBT on trade flows between different income group pairs. Given limited sample size, we use pooled OLS regression instead of panel regression, but control sector specific fixed effects by including sector specific importer fixed effects along with exporter fixed effects. In columns (1) and (2), we show how the measures affect trade when importers are high-income countries. Overall, SPS and TBT by high-income importers boost exports of high, middle, and low-income countries (the increase for middle and low-income countries being 0.33% higher than that for high-income countries).

The SPS and TBT of high-income importers might carry more informative value through screening procedures and quality assurances. Columns (3) and (4) show the results when importers are low-income countries. Still, the measures imposed by importers boost the exports of high-income and middle and low-income countries, although the increase for middle and low-income countries is much lower than for high-income countries' exports—on average by 0.13% point.

Table 1: Pooled OLS and Panel Regression—Income Group and Region Samples (2012–2014)

Dependent variable: Log(bilateral imports)	(1) Pooled OLS	(2) Panel—Random Effects	(3) Pooled OLS	(4) Panel—Random Effects	(5) Pooled OLS	(6) Panel—Random Effects
Importer	All WTO Member Countries		All WTO Member Countries		All WTO Member Countries	
Exporter	All WTO Member Countries		All WTO Member Countries		All WTO Member Countries	
ln GDP exporter	0.36***	0.52***	0.35***	0.52***	0.35***	0.53***
	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)
ln GDP importer	0.72***	0.57***	0.72***	0.57***	0.74***	0.57***
	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)
ln distance	-0.90***	-0.80***	-0.90***	-0.80***	-0.91***	-0.81***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Contiguity	0.33***	0.68***	0.72***	0.68***	0.72***	0.68***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Common language	0.72***	0.28***	0.33***	0.28***	0.34***	0.28***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Colonial ties	0.72***	0.59***	0.72***	0.59***	0.71***	0.59***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Bilateral applied tariff AVE (weighted average)	-0.01***	-0.01***	-0.01***	-0.01***	-0.01***	-0.01***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
= 1 if at least 1 SPS or TBT at the HS6 level[7]	0.19***	0.15***	0.18***	0.14***	0.27***	0.18***
	(0.01)	(.01)	(0.01)	(0.01)	(0.01)	(0.01)
= 1 if income group of exporting country is low or medium income (0 = high income)			-1.8***	-1.56***		
			(0.05)	(0.10)		
SPS and TBT dummy X middle-income and low-income countries (exporter)			0.03*	0.02		
			(0.02)	(0.01)		
Exporter dummy (= 1 if exporter is Asian country; = 2 if non-Asia and non-OECD; 0 = OECD)						
- Asia					0.67***	1.24***
					(0.10)	(0.07)
- Non-Asia, non-OECD					2.94***	-1.54***
					(0.14)	(0.11)
SPS and TBT dummy X exporter dummy						
- Asia					0.09***	0.08***
					(0.02)	(0.02)
- Non-Asia, non-OECD					-0.38***	-0.17***
					(0.02)	(0.02)
Number of Observations	2,448,182	2,448,182	2,448,182	2,448,182	2,448,182	2,448,182
R-squared	0.39	0.31	0.39	0.30	0.39	0.31

Note: AVE = ad valorem equivalent. Dependent variable: ln (imports). Pooled OLS models have robust standard errors (importing country‑exporting country and sector HS4 clustered) in parentheses. *, **, and *** denote significance at the 1%, 5%, and 10% levels. Pooled OLS models (1), (3), and (5) include exporter, importer, and sector (four-digit level) fixed effects (no interaction). Panel regression (random effects) models (2), (4), and (6) include exporter, importer, and sector (two-digit level) fixed effects (no interaction)

[7] To clarify, four-digit level of the HS classification is considered equal to one if the importing country notifies at least one SPS or TBT measure at the six-digit level which is under the four-digit level of the HS classification.

A similar analysis for the agriculture sector reveals a similar impact between different income country groups (Table 3). A few points are worth noting. First, the boost that agriculture trade gets from SPS and TBT is almost three times larger when importers are high-income countries than when they are low-income countries. Second, when imposed by low-income countries, the positive effect from such measures is significantly lower on imports from middle and low-income countries.

All in all, the impact of SPS and TBT is greater for the agriculture sector than for other sectors. As shown in Appendix 2, 16.3% of the total observations entail SPS and TBT that apply to agricultural products, while 13.9% entail measures across all sectors, given the growing concerns about health issues associated with imports of vegetables, plants, animals, and dairy products.

Table 4 shows the effects of SPS and TBT on trade among different regional groups. Columns (1) and (2) indicate cases where importers are OECD countries while exporters are Asia and non-Asia, non-OECD, taking OECD as base group. Overall, the measures produce a 0.44% increase in trade when importers are OECD countries. However, this overall positive impact seems to obscure the diverse effects on the exports of different regional economies. As indicated in column (3) of Table 4, OECD to OECD trade is boosted by the SPS and TPT of importers, the greatest rise being 0.63%. Asian exports to OECD countries also gain, but 0.13% point less than that for OECD exporters. On the other hand, the positive impact on exports by non-Asia, non-OECD countries is 0.60% point lower than for OECD exports, making the overall positive impact for this country group a minimal 0.03%.

Asia countries' imports gain from SPS and TBT is 0.53% on average, a greater amount than OECD importers have experienced. However, the figure for Asia's imports from Asia is not positively affected by SPS and TBT as much as for imports from OECD countries. On average, the measures increase trade by 0.12%. On the other hand, SPS and TBT quite significantly increase Asia's imports from non-Asia, non-OECD countries. Compared to imports from OECD countries, those from non-Asia, non-OECD countries are 0.78% point higher than imports from OECD countries. While Asian countries' SPS and TBT contribute more to trade flows than those

of OECD countries and non-Asia, non-OECD countries, they do not contribute as much to intraregional trade as those for imports from other regions.

The regression results presented for the agriculture sectors of the country groupings in Table 5 show similar implications, albeit with magnified impacts, analogous to those presented in the results for the high-income and low-income importer cases shown in Table 3. When importers are OECD countries, gains from SPS and TBT on exports from Asia and non-Asia, non-OECD countries are very much subdued, while OECD to OECD trade gets a 1.35% boost. For Asian importers, the positive effect of SPS and TBT on agriculture sector exports from OECD countries is much smaller at 0.27%. While this is significantly increased in the case of agriculture imports from non-Asia, non-OECD—by an additional 0.79% point—SPS and TBT significantly dampen such imports from Asian countries, making the overall impact -0.07%. The measures clearly reduce intraregional agriculture trade in Asia.

Table 2: Pooled OLS: Influence of SPS and TBT—High, Middle, and Low-Income Countries Samples (2012–2014)

Dependent variable: Log(bilateral imports)	(1)	(2)	(3)	(4)
Importer	High Income Countries		Low Income Countries	
Exporter	All WTO Member Countries		All WTO Member Countries	
Bilateral applied tariff AVE (weighted average)	-0.004*** (0.00)	-0.004*** (0.00)	-0.01*** (0.00)	-0.01*** (0.00)
= 1 if at least 1 SPS or TBT at the HS6 level[8]	0.47*** (0.04)	0.35*** (0.04)	0.44*** (0.01)	.48*** (0.02)
= 1 if income group of exporting country is low or medium income (0 = high income)		-1.41*** (0.26)		-1.91*** (0.13)
SPS and TBT dummy X middle-income and low-income countries (exporter)		0.33*** (0.04)		-0.13*** (0.02)
Number of Observations	1,011,343	1,011,343	1,406,483	1,406,483
R-squared	0.36	0.36	0.28	0.27

Note: AVE = ad valorem equivalent. Dependent variable: ln (imports). Robust standard errors (importing country-exporting country and sector HS4 clustered) in parentheses with *, **, and ***denoting significance at the 1%, 5%, and 10% levels. Models (1) to (4) include exporter and sector specific importer fixed effects in all estimations.

Table 3: Pooled OLS: Influence of SPS and TBT—High, Middle, and Low-Income Countries Samples, Agriculture Sector (2012–2014)

Dependent variable: Log(bilateral imports)	(1)	(2)	(3)	(4)
Importer	High Income Countries		Low Income Countries	

[8] To clarify, four-digit level of the HS classification is considered equal to one if the importing country notifies at least one SPS or TBT measure at the six-digit level which is under the four-digit level of the HS classification.

Exporter	All WTO Member Countries		All WTO Member Countries	
Bilateral applied tariff AVE (weighted average)	-0.002*** (0.00)	-0.002*** (0.00)	-0.01*** (0.00)	-0.01*** (0.00)
= 1 if at least 1 SPS or TBT at the HS6 level[7]	1.2*** (0.13)	1.2*** (0.13)	0.37*** (0.03)	0.45*** (0.03)
= 1 if income group of exporting country is low or medium income (0 = high income)		-4.1*** (.75)		-3.68*** (0.36)
SPS and TBT dummy X middle-income or low-income countries (exporter)		0.03 (0.10)		-0.21*** (0.05)
Number of Observations	219,347	219,347	261,313	261,313
R-squared	0.31	0.31	0.23	0.23

Note: AVE = ad valorem equivalent. Dependent variable: ln (imports). Robust standard errors (importing country-exporting country and sector HS4 clustered) in parentheses with *, **, and ***denoting significance at the 1%, 5%, and 10% levels. Models (1) to (4) include exporter and sector specific importer fixed effects in all estimations.

Table 4: Pooled OLS: Influence of SPS and TBT—OECD and Asian Countries Samples (2012–2014)

Dependent variable: Log(bilateral imports)	(1)	(2)	(3)	(4)
Importer	OECD Countries		Asian Countries	
Exporter	All WTO Member Countries		All WTO Member Countries	
Bilateral applied tariff AVE (weighted average)	-0.004*** (.00)	-0.004*** (0.00)	-0.005*** (0.00)	-0.004*** (0.00)
= 1 if at least 1 SPS or TBT at the HS6 level[9]	0.44*** (0.03)	0.63*** (0.04)	0.53*** (0.02)	0.44*** (0.03)
Exporter dummy (base = OECD)				
Asia		-0.12 (0.16)		0.82*** (0.18)
Non-Asia, non-OECD		-3.6*** (0.31)		-0.72** (0.31)
SPS and TBT dummy X exporter dummy				
Asia		-0.13*** (0.04)		-0.32*** (0.06)
Non-Asia, non-OECD		-0.60*** (0.04)		0.78*** (0.06)
Number of Observations	722,738	722,738	703,225	703,225
R-squared	0.36	0.36	0.31	0.31

Note: AVE = ad valorem equivalent. Dependent variable: ln (imports). Robust standard errors (importing country-exporting country and sector HS4 clustered) in parentheses with *, **, and ***denoting significance at the 1%, 5%, and 10% levels. Models (1) to (4) include exporter and sector specific importer fixed effects in all estimations.

Table 5: Pooled OLS: Influence of SPS and TBT—OECD and Asian Countries Samples, Agriculture Sector (2012–2014)

Dependent variable: Log(bilateral imports)	(1)	(2)	(3)	(4)
Importer	OECD Countries		Asian Countries	
Exporter	All WTO Member Countries		All WTO Member Countries	
Bilateral applied tariff AVE (weighted average)	-0.003*** (.00)	-0.003*** (0.00)	-0.001*** (0.00)	-0.001*** (0.00)
= 1 if at least 1 SPS or TBT at the HS6 level[8]	0.90*** (0.13)	1.35*** (0.13)	0.38*** (0.00)	0.27*** (0.06)
Exporter dummy (base = OECD)				

[9] To clarify, four-digit level of the HS classification is considered equal to one if the importing country notifies at least one SPS or TBT measure at the six-digit level which is under the four-digit level of the HS classification.

Asia		0.31		1.03***
		(0.34)		(0.40)
Non-Asia, non-OECD		-3.05***		-2.11*
		(0.80)		(1.1)
SPS and TBT dummy X exporter dummy				
Asia		-0.70***		-0.34***
		(0.11)		(0.12)
Non-Asia, non-OECD		-1.01***		0.79***
		(0.10)		(0.12)
Number of observations	157,006	157,006	146,137	146,137
R-squared	0.32	0.32	0.24	0.25

Note: AVE = ad valorem equivalent. Dependent variable: ln (imports). Robust standard errors (importing country-exporting country and sector HS4 clustered) in parentheses with *, **, and ***denoting significance at the 1%, 5%, and 10% levels. Models (1) to (4) include exporter and sector specific importer fixed effects in all estimations.

4.2. Effects of SPS/TBT When Separately Tested

We further test the effect of SPS and TBT separately. In the regression results presented in the tables in Appendix 2, column (1) indicates the results when a sector faces SPS while column (2) shows the results when a sector faces TBT. Column (3) is the case where the sector faces either SPS or TBT and column (4) is when a sector faces both SPS and TBT. The regression results again confirm the expected impact of gravity factors. As shown below in Table 6 for OLS regressions and Table 7 for panel regressions, SPS does not boost trade while TBT does. This suggests overall the positive impact of SPS/TBT combined is mainly driven by TBT, not by SPS. TBT increase average worldwide bilateral trade by 0.07%–0.10%. We further test for any difference in the effect of SPS and TBT on trade across different regional and income groups. For this, we add income group dummies of middle and low-income countries and regional dummies of Asia, non-Asia, non-OECD along with their respective interactions with the SPS and TBT existence dummy.

As shown Tables 8 and 9, SPS is shown to hurt exports of developing Asian countries significantly while TBT rather boosts their exports. The opposite case is true for the exports by non-Asia, non-OECD developing countries. Their exports are boosted by SPS, but hurt by TBT. This country group suffers from -0.73% lower exports compared to OECD countries due to TBT in import countries. They face similar hurdles when they export to OECD countries as shown in Table 10. As shown in columns (3) and (4) of Table 10, exports by both developing Asian countries and non-Asia, non-OECD developing countries are boosted when OECD importing

countries impose SPS or TBT, or SPS and TBT at the same time in a sector although the overall effects are much more subdued when compared to exports by OECD countries.

Finally, Table 11 shows that Developing Asia's exports of agricultural products are being hurt by SPS while unaffected by TBT. On the other hand, exports by non-Asia and non-OECD developing countries are positively affected by SPS while hurt by TBT. Column (4) of Table 11 shows intraregional trade among developing Asian countries is being hurt by SPS while boosted by TBT. Intraregional trade is reduced by an average of 0.14% due to SPS in the sector. On the other hand, exports by non-Asia, non-OECD developing countries gain from SPS of developing Asian countries and the effect amounts to 0.68 % larger exports due to SPS.

5. Conclusion

SPS and TBT are legitimate trade policy tools and can contribute to ensuring the safety and health of a nation. In principle, the measures aim to protect the health of humans, plants and animals. However, governments may overshoot the minimum requirements to protect the lives or health of their consumers and use the measures to shield domestic producers from fair competition. Therefore, SPS and TBT retain their potential for being abused as protectionism tools. When such motivation is combined with nationalistic tendencies, it may hamper the growth of international trade and hurt consumers' welfare by limiting their choices.

Policy makers should be aware of the need for striking a proper balance between the imperatives of national health security and the free-flow of trade. Even when ensuring health security is a legitimate goal, the implementing tool should be rational, practical, and transparent, not be too burdensome for exporters. Our analysis shows that in general SPS and TBT appear to have a positive impact on trade. However, the positive impacts are mainly driven by exports from advanced economies, with less developed economies gaining less, or being hurt by these measures. This becomes more evident when importing countries are advance countries. Therefore, while SPS and TBT are believed to contribute to North-North trade, South countries appear to a certain extent to be excluded from the gains.

Further, the overall positive impact seems to be driven mainly by TBT while SPS hurts the international trade, which is more pronounced for exports by developing Asian countries, be those to the world or to the region. Given the importance of the measures in the agriculture sector, the analysis showing that they hurt intraregional trade in Asia calls on policy makers in the region to act more proactively in resolving nontariff hurdles across their borders, in particular by focusing on SPS. Stronger regional cooperation built on dialogue in various subregional and regional settings should help achieve this goal.

REFERENCES

CEPII. 2005. "Geographic and Bilateral Distance Database." *Paris: Centre d'Etudes Prospectives et d'Informations Internationales.*

Crivelli, P., and J. Gröschl. 2012. "SPS Measures and Trade: Implementation Matters." *World Trade Organization Staff Working Paper*. ERSD-2012-05.

Czubala W., Shepherd B., and J. Wilson. 2009. "Help or Hindrance? The Impact of Harmonized Standards on African Exports." *Journal of African economies, March, 1 35*.

Disdier, A.C., L. Fontagné, and M. Mimouni. 2008. "The Impact of Regulations on Agricultural Trade: Evidence from the SPS and TBT Agreements." *American Journal of Agricultural Economics*. 90 (2): 336–50.

Feenstra, R. 2004. "Advanced International Trade: Theory and Evidence." Princeton, New Jersey: Princeton University Press.

Fontagné, L., Mayer T. and S. Zignago. 2005. "Trade in the Triad: how easy is the access to large markets?" *Canadian Journal of Economics.* 38(4), 1401-1430.

Fontagné, L., M. Mimouni and J-M. Pasteels. 2005. "Estimating the Impact of Environmental SPS and TBT on International Trade." *Integration and Trade Journal.* 22 :7–37.

Hoekman B. and A. Nicita. 2008. "Trade Policy, Trade Costs and Developing Country Trade." *Policy Research Working Paper, N°4797.*

Kee, H. L., A. Nicita and M. Olarreaga. 2009. "Estimating Trade Restrictiveness Indices." *Economic Journal.* 119, 172-199.

Otsuki, T., J.S. Wilson, and M. Sewadeh. 2001a. "Saving Two in a Billion: A Case Study to Quantify the Trade Effect of European Food Safety Standards in African Exports." *Working paper, The World Bank, Washington*.

Otsuki, T., J. S. Wilson, and M. Sewadeh. 2001b. "What price precaution? European harmonisation of aflatoxin regulations and African groundnut exports." *European Review of Agriculture Economics*. 28(3), 263-284.

Portugal-Perez A., Reyes J-D and J. Wilson. 2009. "Beyond the Information Tecnology Agreement: Harmonization of Standards and Trade in Electronics." *Policy Research Working Paper, N°4916.*

Thilmany, D.D., and C.B. Barrett. 1997. "Regulatory Barriers in an Integrating World Food Market." *Review of Agricultural Economics*. 19 (1): 91–107.

UNCTAD. 2013. "Non-Tariff Measures to Trade: Economic and Policy Issues for Developing Countries." *New York and Geneva: United Nations.*

World Trade Organization. 2012. "Trade and public policies: A closer look at non-tariff measures in the 21st century." *World Trade Report.*

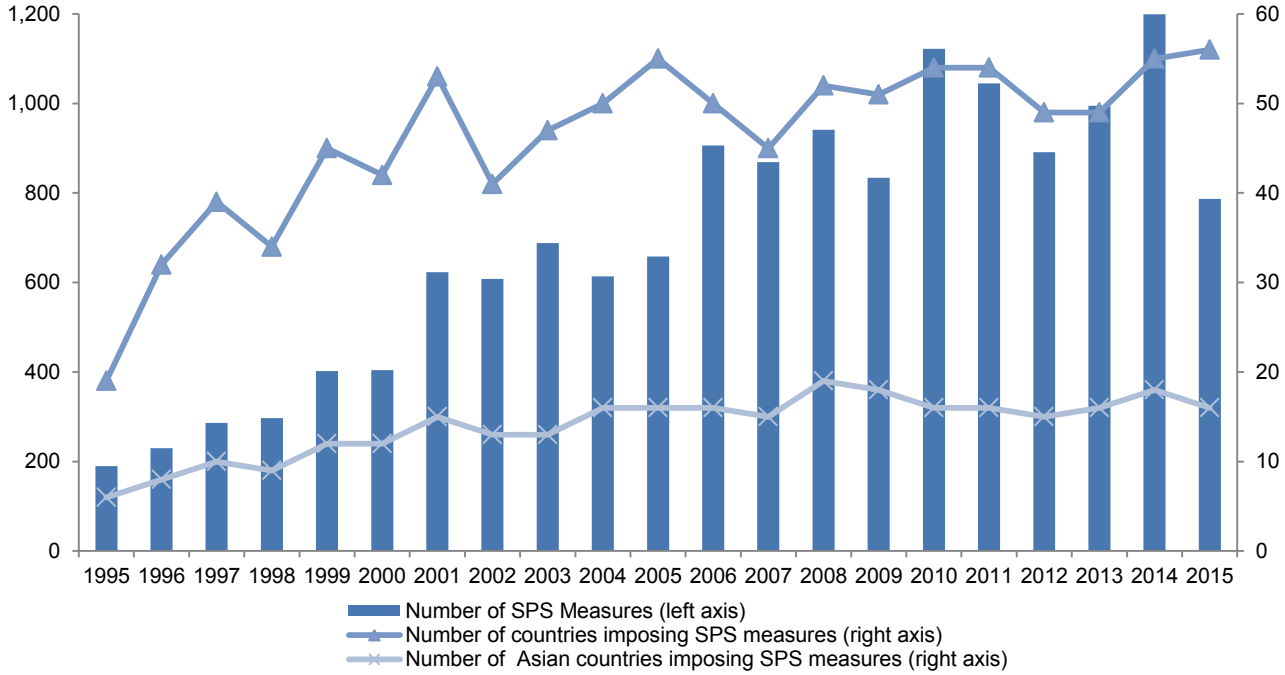
———. 2012. Sanitary and Phytosanitary Measures. *The WTO Agreements Series*.

———. 2014. Technical Barriers to Trade. *The WTO Agreements Series*.

APPENDIXES

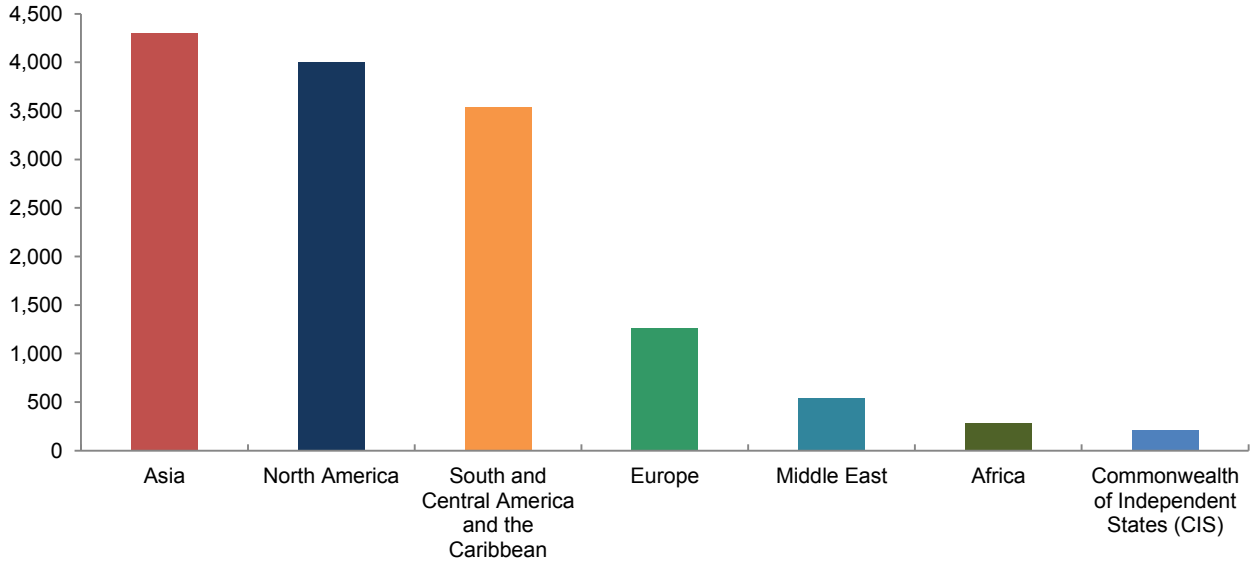
Appendix 1

Figure 1: SPS Measures (1995–2015)



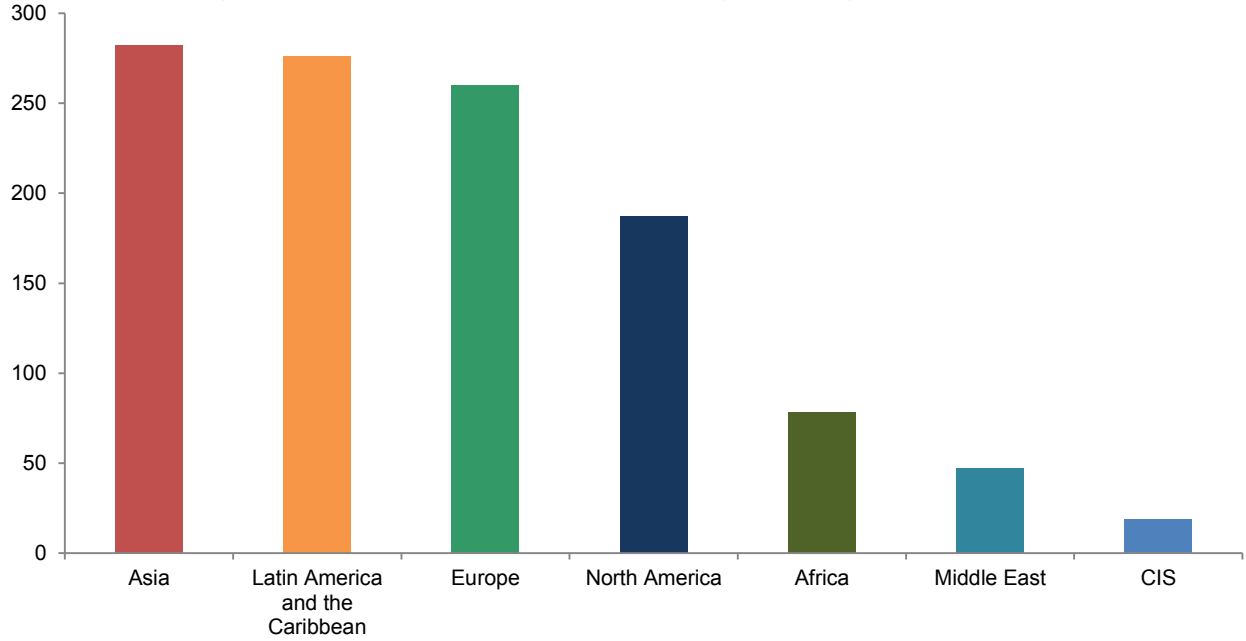
Note: SPS measures include both those initiated but not yet in force, and those in force.
Source: ARIC analyst calculations based on WTO Integrated Trade Intelligence Portal (I-TIP). Data as of August 2016.

Figure 2: SPS Measures Imposed by Region (1995–2015)



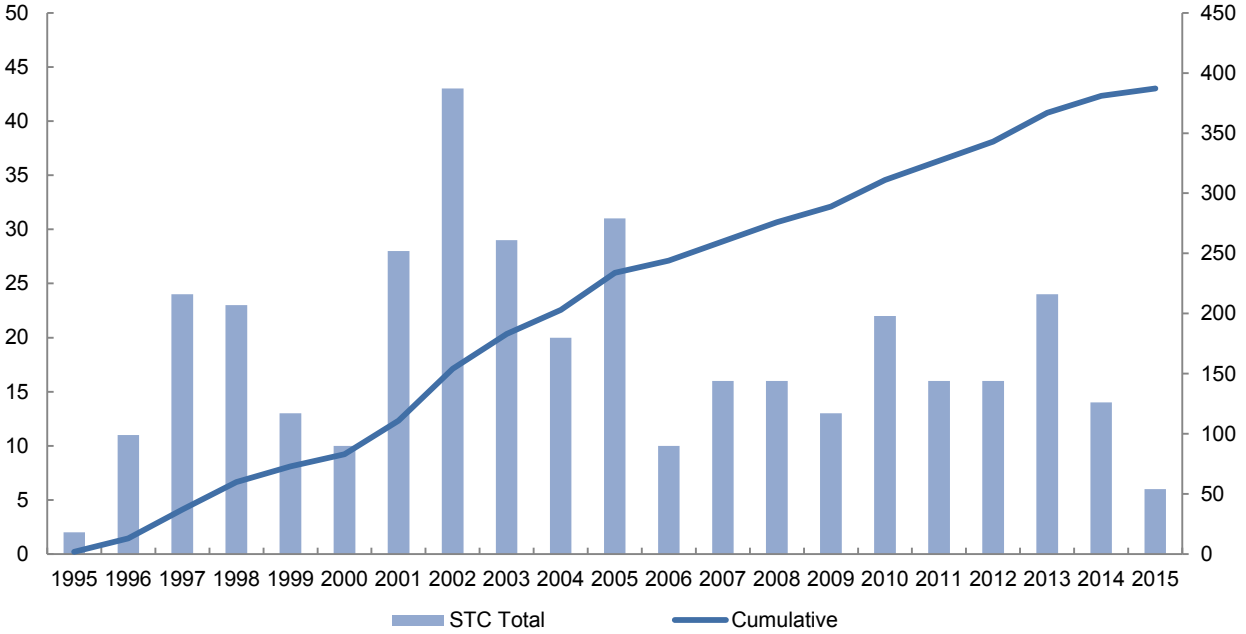
Note: SPS measures include both those initiated but not yet in force, and those in force.
Source: ARIC analyst calculations based on WTO Integrated Trade Intelligence Portal (I-TIP). Data as of August 2016.

Figure 3: Bilateral SPS Measures Affecting Each Region (1995-2015)



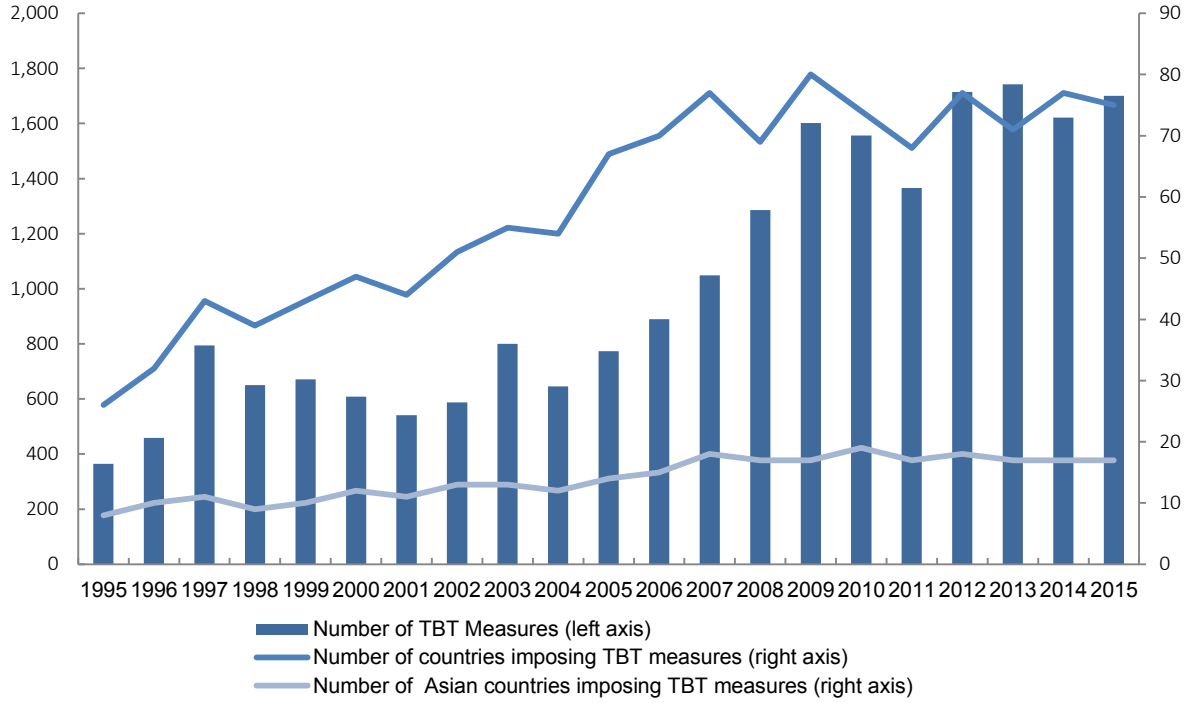
Note: SPS measures include both those initiated but not yet in force, and those in force.
Source: ARIC analyst calculations based on WTO Integrated Trade Intelligence Portal (I-TIP). Data as of August 2016.

Figure 4: SPS-Specific Trade Concerns (1995–2015)



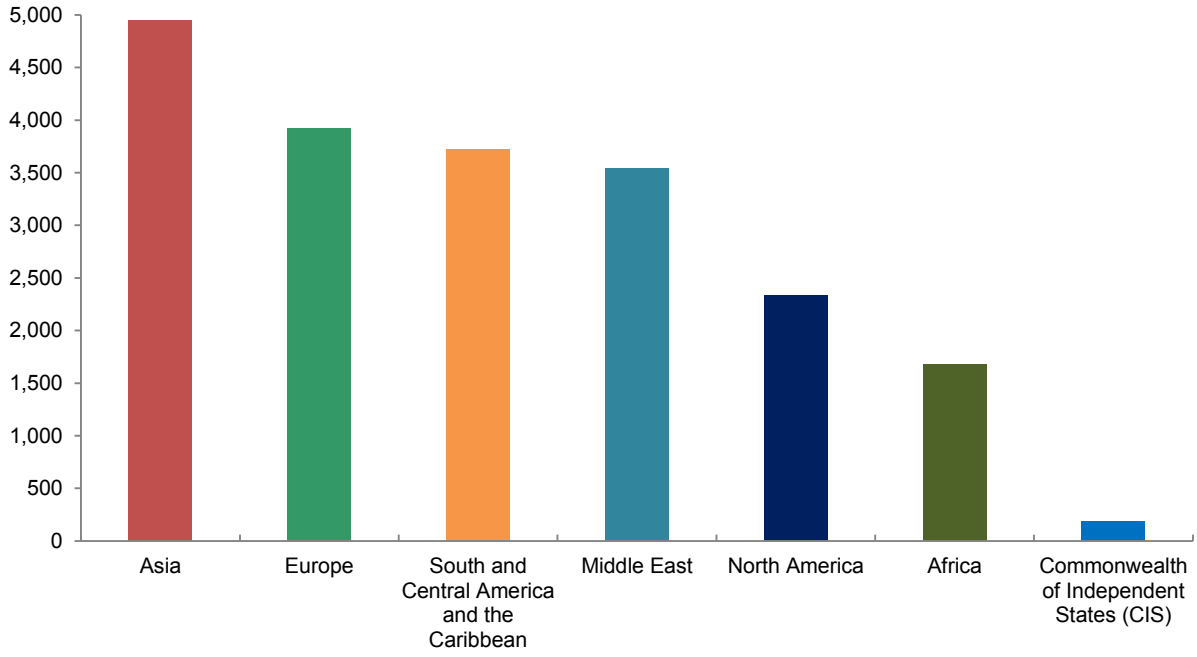
Source: ARIC analyst calculations based on WTO Integrated Trade Intelligence Portal (I-TIP). Data as of August 2016.

Figure 5: TBT Measures (1995–2015)



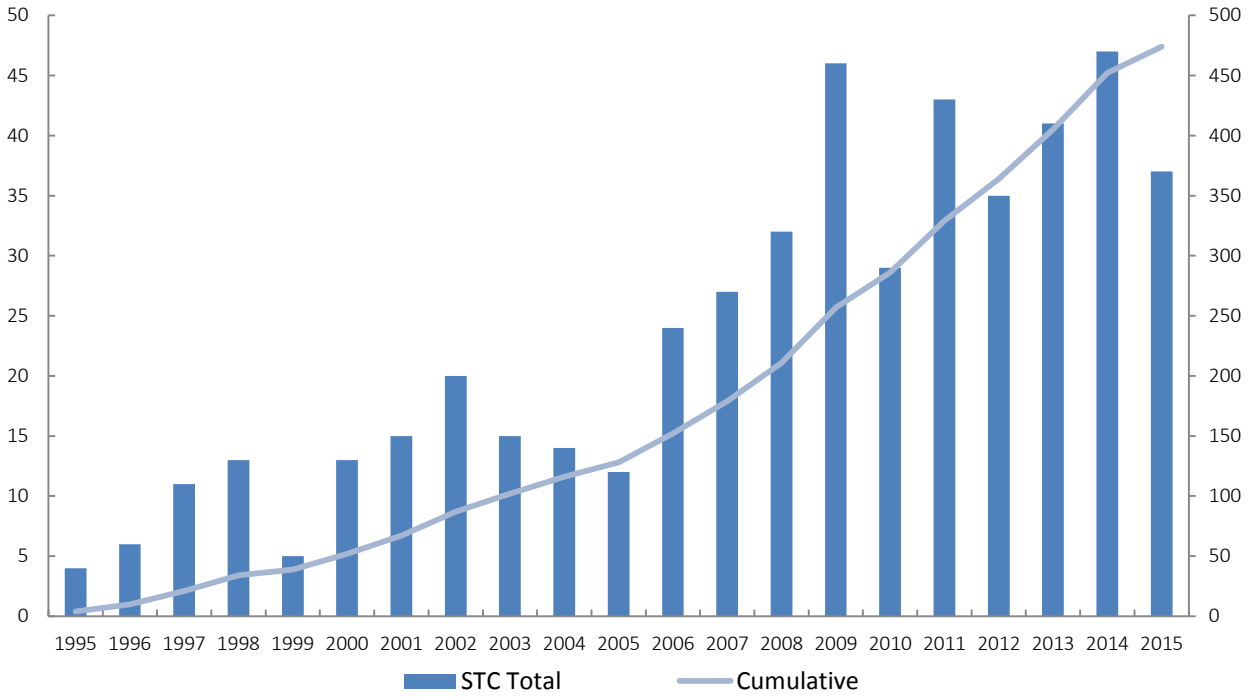
Note: TBT measures include both those initiated but not yet in force, and those in force.
Source: ARIC analyst calculations based on WTO Integrated Trade Intelligence Portal (I-TIP). Data as of August 2016.

Figure 6: TBT Measures Imposed by Region (1995–2015)



Note: TBT measures include both those initiated but not yet in force, and those in force.
Source: ARIC analyst calculations based on WTO Integrated Trade Intelligence Portal (I-TIP). Data as of August 2016.

Figure 7: TBT-Specific Trade Concerns (1995–2015)



Source: ARIC analyst calculations based on WTO Integrated Trade Intelligence Portal (I-TIP). Data as of August 2016.

Appendix 2:

Table 6: Pooled OLS Regression: Impact of SPS and TBT – General Overview (2012-2014)

Dependent variable = ln(imports)	(1) SPS	(2) TBT	(3) SPS or TBT	(4) SPS and TBT
Importer		All WTO Member Countries		
Exporter		All WTO Member Countries		
Bilateral applied tariff AVE (weighted average)	-0.03*** (0.00)	-0.03*** (0.00)	-0.01*** (0.00)	-0.03*** (0.00)
= 1 if at least 1 SPS at the HS6 level	0.02 (0.02)			
=1 if at least 1 TBT at the HS6 level		0.07* (0.04)		
=1 if at least 1 SPS or TBT at the HS6 level			0.14*** (0.01)	
=1 if at least 1 SPS and TBT at the HS6 level				0.04** (0.02)
No. of Obs.	271,280	271,280	2,846,983	271,280
R-squared	0.38	0.38	0.40	0.38

Note: AVE = ad valorem equivalent. Dependent variable: ln (imports). Pooled OLS models have robust standard errors (importing country-exporting country and sector HS4 clustered) in parentheses. *, **, and *** denote significance at the 1%, 5%, and 10% levels. Pooled OLS models (1) - (4) include exporter, importer, and sector (four digit level) fixed effects (no interaction).

Table 7: Panel Regression: Impact of SPS and TBT – General Overview (2012-2014)

Dependent variable = ln(imports)	(1) SPS	(2) TBT	(3) SPS or TBT	(4) SPS and TBT
Bilateral applied tariff AVE (weighted average)	-0.02*** (0.00)	-0.02*** (0.00)	-0.01*** (0.00)	-0.02*** (0.00)
= 1 if at least 1 SPS at the HS6 level	-0.002 (0.02)			
=1 if at least 1 TBT at the HS6 level		0.09*** (0.04)		
=1 if at least 1 SPS or TBT at the HS6 level			0.12*** (0.01)	
=1 if at least 1 SPS and TBT at the HS6 level				0.20*** (0.02)
No. of Obs.	271,280	271,280	2,846,983	271,280
R-squared	0.38	0.38	0.31	0.28

Note: AVE = ad valorem equivalent. Dependent variable: ln (imports). *, **, and *** denote significance at the 1%, 5%, and 10% levels. Based on panel regression model which includes exporter, importer, and sector (four digit level) fixed effects (no interaction).

Table 8: OLS Pooled Regression: Impact of SPS and TBT – Samples Involving OECD and Asian Countries (2012-2014)

Dependent variable = ln(imports)	(1) SPS	(2) TBT	(3) SPS or TBT	(4) SPS and TBT
Importer		All WTO Member Countries		
Exporter		All WTO Member Countries		
Bilateral applied tariff AVE (weighted average)	-0.03*** (0.00)	-0.03*** (0.00)	-0.01*** (0.00)	-0.03*** (0.00)
= 1 if at least 1 SPS at the HS6 level	-0.03 (0.02)			
=1 if at least 1 TBT at the HS6 level		0.33*** (0.04)		
=1 if at least 1 SPS or TBT at the HS6 level			0.13*** (0.01)	
=1 if at least 1 SPS and TBT at the HS6 level				0.05** (0.02)
Exporter dummy (base = OECD)				
Developing Asia	3.5*** (0.67)	3.1*** (0.70)	-2.17*** (0.16)	3.7*** (0.68)
Non-Developing Asia, Non-OECD	4.34*** (0.77)	5.31*** (0.78)	-0.82*** (0.17)	4.7*** (0.78)
(Rest of the world)				
SPS, TBT, SPS or TBT, SPS and TBT dummy X exporter dummy				
Developing Asia	-0.45*** (0.04)	0.14* (0.10)	0.42*** (0.02)	-0.45*** (0.04)
Non-Developing Asia, Non-OECD	0.53*** (0.04)	-1.1*** (.08)	-0.28*** (0.02)	0.26*** (0.04)
No. of Obs.	271,280	271,280	2,846,983	271,280
R-squared	0.39	0.39	0.40	0.39

Note: AVE = ad valorem equivalent. Dependent variable: ln (imports). Based on pooled model which includes exporter, importer, and sector (four digit level) fixed effects (no interaction).*, **, and *** denote significance at the 1%, 5%, and 10% levels.

Table 9: Panel Regression: Impact of SPS and TBT – Samples Involving OECD and Asian Countries (2012-2014)

Dependent variable = ln(imports)	(1) SPS	(2) TBT	(3) SPS or TBT	(4) SPS and TBT
Importer		All WTO Member Countries		
Exporter		All WTO Member Countries		
Bilateral applied tariff AVE (weighted average)	-0.02*** (0.00)	-0.02*** (0.00)	-0.01*** (0.00)	-0.02*** (0.00)
= 1 if at least 1 SPS at the HS6 level	-0.03 (0.02)			
=1 if at least 1 TBT at the HS6 level		0.34*** (0.04)		
=1 if at least 1 SPS or TBT at the HS6 level			0.10*** (0.01)	
=1 if at least 1 SPS and TBT at the HS6 level				0.23*** (0.02)
Exporter dummy (base = OECD)				
Developing Asia	1.3*** (0.48)	0.89* (0.48)	-1.37*** (0.11)	1.61*** (0.48)
Non-Developing Asia, Non-OECD (Rest of the world)	1.82*** (0.57)	2.82*** (0.58)	-0.12 (0.12)	2.43*** (0.58)
SPS, TBT, SPS or TBT, SPS and TBT dummy X exporter dummy				
Developing Asia	-0.50*** (0.04)	0.20*** (0.08)	0.20*** (0.01)	-0.45*** (0.04)
Non-Developing Asia, Non-OECD	0.47*** (0.04)	-1.07*** (0.07)	-.011*** (0.01)	0.17*** (0.04)
No. of Obs.	271,280	271,280	2,846,983	271,280
R-squared	0.38	0.38	0.31	0.28

Note: AVE = ad valorem equivalent. Dependent variable: ln (imports). *, **, and *** denote significance at the 1%, 5%, and 10% levels. Based on panel regression model which includes exporter, importer, and sector (four digit level) fixed effects (no interaction).

Table 10: OLS Pooled Regression: Impact of SPS and TBT – Samples Involving OECD and Asian Countries (OECD Countries as Importer), Agriculture Sector (2012-2014)

Dependent variable = ln(imports)	(1) SPS	(2) TBT	(3) SPS or TBT	(4) SPS and TBT
Importer		OECD Countries		
Exporter		All WTO Member Countries		
Bilateral applied tariff AVE (weighted average)	-0.02*** (.01)	-0.02*** (0.01)	-0.002*** (0.00)	-.02*** (.01)
= 1 if at least 1 SPS at the HS6 level	0.23** (0.12)			
=1 if at least 1 TBT at the HS6 level		1.37*** (0.18)		
=1 if at least 1 SPS or TBT at the HS6 level			0.86*** (0.08)	
=1 if at least 1 SPS and TBT at the HS6 level				0.83*** (0.11)
Exporter dummy (base = OECD)				
Developing Asia	-6.9** (3.14)	-6.84** (3.16)	-1.96*** (0.55)	-6.86** (3.14)
Non-Developing Asia, Non-OECD (Rest of the world)	-5.9* (3.37)	-4.76 (3.38)	-0.59 (0.61)	-5.45 (3.37)
SPS, TBT, SPS or TBT, SPS and TBT dummy X exporter dummy				
Developing Asia	-0.18 (0.19)	-0.39 (0.24)	-0.17* (0.09)	-0.33* (0.18)
Non-Developing Asia, Non-OECD	0.33* (0.18)	-1.36*** (0.22)	-0.64*** (0.08)	-0.46** (0.16)
No. of Obs.	18,028	18,028	170,797	18,028
R-squared	0.24	0.25	0.33	0.24

Note: AVE = ad valorem equivalent. Dependent variable: ln (imports). Based on pooled model which includes exporter, importer, and sector (four digit level) fixed effects (no interaction).*, **, and *** denote significance at the 1%, 5%, and 10% levels.

Table 11: Panel Regression: Impact of SPS and TBT – Samples Involving Agriculture Sector and Developing Asian Countries as Importer), 2012-2014

Dependent variable = Log(bilateral imports)	(1) SPS	(2) TBT	(3) SPS	(4) TBT
Importer	All WTO members		Developing Asia	
Exporter	All WTO members		All WTO members	
Sector	Agriculture		All sectors	
Bilateral applied tariff	-0.02***	-0.02***	-0.06***	-0.06***
AVE (weighted average)	(0.00)	(0.00)	(0.00)	(0.00)
SPS (TBT) dummy	-0.20***	0.67***	-0.37***	0.32***
	(0.04)	(0.07)	(0.02)	(0.00)
Exporter dummy (base = OECD)				
Developing Asia	7.02***	6.55***	2.22	2.44
	(1.06)	(1.07)	(3.33)	(3.33)
Non-Developing	9.68***	10.26	3.51	4.74
Asia, non-OECD	(1.22)	(1.22)	(3.83)	(3.83)
Interaction: SPS (TBT) dummy and exporter dummy				
Developing Asia	-0.39***	0.04	-0.51***	0.42***
	(0.09)	(0.12)	(0.10)	(0.13)
Non-Developing	0.29***	-0.93***	0.31***	-0.41***
Asia, non-OECD	(0.08)	(0.11)	(0.10)	(0.12)
Number of observations	60,151	60,151	19,182	19,182
R-squared	0.16	0.16	0.44	0.44

Note: AVE = ad valorem equivalent. Dependent variable: ln (imports). *, **, and *** denote significance at the 1%, 5%, and 10% levels. Based on panel regression model which includes exporter, importer, and sector (four digit level) fixed effects (no interaction).

Appendix 3: Data statistics (Number of Observations with SPS and TBT)

1. All WTO members

	Frequency	Percent	Cumulative
Observations without SPS and TBT	2,282,852	86.07	86.07
Observations with SPS and TBT	369,350	13.93	100
Total	2,652,202	100	

2. All WTO members (agriculture sector)

	Frequency	Percent	Cumulative
Observations without SPS and TBT	444,449	83.71	83.71
Observations with SPS and TBT	86,515	16.29	100
Total	530,964	100	

3. All WTO members (non-agriculture sectors)

	Frequency	Percent	Cumulative
Observations without SPS and TBT	1,838,403	86.67	86.67
Observations with SPS and TBT	282,835	13.33	100
Total	2,121,238	100	

4. Asia (imports)

	Frequency	Percent	Cumulative
Observations without SPS and TBT	703,102	97.44	97.44
Observations with SPS and TBT	18,442	2.56	100
Total	721,544	100	

5. Asia (imports; agriculture sector)

	Frequency	Percent	Cumulative
Observations without SPS and TBT	145,039	96.99	96.99
Observations with SPS and TBT	4,503	3.01	100
Total	149,542	100	

6. Asia (imports; non-agriculture sectors)

	Frequency	Percent	Cumulative
Observations without SPS and TBT	558,063	97.56	97.56
Observations with SPS and TBT	13,939	2.44	100
Total	572,002	100	