Retaliatory Use of Public Standards in Trade

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Selected paper prepared for presentation at the 2019 Summer Symposium: Trading for Good – Agricultural Trade in the Context of Climate Change Adaptation and Mitigation: Synergies, Obstacles and Possible Solutions, co-organized by the International Agricultural Trade Research Consortium (IATRC) and the European Commission Joint Research Center (EU-JRC), June 23-25, 2019 in Seville, Spain.

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March 18, 2019

Abstract

This research investigates the extent to which countries use public standards as a means of political retaliation in the international policy arena. We construct a dataset that matches the adoption of public standards between 1996–2015 with annual, bilateral trade flows and the initiation of antidumping and countervailing duty (ADCV) proceedings. Our results indicate that—over the period of analysis—public standards were frequently used for retaliatory purposes. The imposition of a public standard or the instigation of an ADCV proceeding by one country against another country increased the probability that the target country would adopt a standard of its own. Retaliation commonly occurred outside the product group of the original measure. At the 2-digit product level, we find that about 4,000 bilateral trade flows were subject to retaliatory standards. Under reasonable assumptions, this equates to trade losses in the range of $30–$40 billion per year. However, implications may not be exclusively trade destructive. Retaliation may also have induced the withdrawal of non-tariff barriers in partner countries.

Keywords: non-tariff barriers, public standards, political retaliation, trade protectionism, trade wars

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". . . trade wars are good, and easy to win."

Donald Trump (March 2, 2018).

1 Introduction

Recent months have seen a resurgence in politicians' willingness to engage in overt trade wars (Culbertson, 2018; Partington, 2018). Tariff wars, in which one country raises tariffs in response to tariff hikes in another country, are a well-documented and classic example of this type of retaliatory behavior (Kennan and Riezman, 1988). Public backlash made tariff wars rare in the era of free-trade politics (Economist, 2018). Yet, incentives for protectionism and retaliation persisted. In this paper, we ask whether—between 1996–2015—politicians satisfied the proclivities for retaliation through more subtle, non-tariff mechanisms. Specifically, we investigate the manner and extent to which countries used public standards as a means of political retaliation.

The WTO categorizes public standards that impact trade under two agreements: the *Agreement on the Application of Sanitary and Phytosanitary Measures* (referred to hereinafter as the SPS Agreement) and the *Agreement on Technical Barriers to Trade* (referred to hereinafter as the TBT Agreement). These agreements provide exceptions from rules barring non-tariff barriers (NTBs) for regulatory measures that satisfy conditions on justification and scope of use. SPS measures must be implemented on the basis of animal, plant, and human health protection, whereas the TBT Agreement covers technical regulations, standards, and procedures that are related to products or processes and production methods (Ahn, 2002). Under the SPS and TBT Agreements, countries are required to notify the WTO whenever they adopt a new (or change or withdraw an existing) SPS or TBT requirement affecting trade.[1]

When used legitimately, public standards serve to correct market failures (Fischer and Serra, 2000; Marette and Beghin, 2010; Swinnen and Vandemoortele, 2011). However, imposing or enforcing SPS and TBT measures alters the terms of trade and can result in substantial losses to the targeted export industry (Anders and Caswell, 2009; Disdier, Fontagné and Mimouni, 2008; Fontagné et al.,

[1] The U.S. ban on imports of citrus seeds from certain countries (instituted in 2009) to protect the U.S. citrus industry against citrus greening disease is an example of an SPS measure. Maximum tolerance levels for automobile emissions to control air pollution is an example of a TBT measure.

2015). These trade effects may incentivize politicians to use standards for illegitimate purposes, such as domestic protectionism or geopolitical suasion (Aisbett and Pearson, 2012; Baylis, Martens and Nogueira, 2009; Baylis, Nogueira and Pace, 2012; Besedina and Coupe, 2015).

In this paper, we study the use of SPS and TBT measures as an instrument for political retaliation. In light of the retreat from tariff wars in the modern era of free trade politics, this "tit-for-tat" phenomenon may have occurred in the adoption and use of non-tariff measures. Did countries targeted with an NTB respond with an NTB of their own? Some anecdotal evidence already exists in the literature to suggest that they did. For instance, de Almeida, da Cruz Vieira and da Silva (2012) present evidence that Brazil retaliated against SPS or TBT measures issued by the U.S., EU, and Japan. Bridges (2012) documents that Argentina, when hit with WTO dispute settlement proceedings initiated by the U.S. in 2012, responded by initiating SPS complaints against the U.S.

To the authors' knowledge, this is the first paper to econometrically investigate retaliation in the use of NTBs. We construct a dataset that matches the adoption of SPS and TBT measures notified to the WTO between 1996–2015 with annual, bilateral trade flows and the initiation of antidumping and countervailing duty (ADCV) proceedings at the two-digit product level. We present evidence that public standards falling under the SPS and TBT Agreements were frequently used for retaliatory purposes. The imposition of a public standard or the instigation of ADCV proceedings by one country against another country increased the probability that the target country would adopt a standard of its own. Retaliation commonly occurred outside the product group of the original measure. Our results indicate that—over the period of analysis—approximately 4,000 bilateral trade flows were subject to retaliatory standards. Under reasonable assumptions, this equates to trade losses in the range of $30–$40 billion per year. However, implications may not be exclusively trade destructive. We also present evidence that retaliation may have induced the withdrawal of NTBs in partner countries.

The remainder of the paper is structured as follows. In Section 2, we present a brief review of related literature. Section 3 provides an overview of the SPS and TBT Agreements and the adoption of the public standards over time. In Section 4, we discuss the methodology used to analyze the presence of retaliation in the use of SPS and TBT measures and provide a description of our data.

Section 5 presents results. In Section 6, we extend the model to investigate whether retaliation induced the withdrawal of NTBs in partner countries. Section 7 concludes.

2 Related literature

A large body of work examines the impact of public standards on international trade (Achterbosch et al., 2009; Beestermöller, Disdier and Fontagne, 2016; Beghin and Melatos, 2012; Crivelli and Gröschl, 2016; Disdier, Fontagné and Mimouni, 2008; Fontagné et al., 2015; Vigani, Raimondi and Olper, 2009; Wei, Huang and Yang, 2012; Wieck, Schlüter and Britz, 2012). Trade impacts of SPS measures depend *inter alia* on the country- and product-scope of the standard. Fontagné et al. (2015) and Crivelli and Gröschl (2016), for example, find that SPS measures that apply globally (i.e., notifications that apply to all trade partners) have a much greater effect on imports than bilateral SPS measures (i.e., notifications against a specific trade partner). Technical requirements reduce trade with firms in exporting countries unable to comply or for which costs of compliance are prohibitive (Disdier, Fontagné and Mimouni, 2008). However, standards that convey information about the product profile can also facilitate trade for firms that are able to comply with the requirements (Bao and Qiu, 2010, 2012).

Empirical literature on the political economy of the SPS and TBT measures remains in its infancy. Baylis, Martens and Nogueira (2009) show that the application of public standards in the U.S. is subject to lobbying expenditure. Baylis, Nogueira and Pace (2012) present evidence that tariff reductions are associated with an increase in border rejections in the EU. Grundke and Moser (2014) compare U.S. import refusals with national unemployment data and find that import refusals are consistent with protectionistic reactions to fluctuations in the business cycle. Aisbett and Pearson (2012) and Boza and Muñoz (2017) show that the inverse relationship between tariff reductions and NTBs holds with respect to SPS and TBT regulations.

Few papers examine retaliatory aspects of public standards. de Almeida, da Cruz Vieira and da Silva (2012) is most relevant for our purposes. The authors use a bargaining model to investigate whether Brazilian SPS and TBT measures instituted against the U.S., EU, and Japan are instituted for purposes of retaliation or cooperation. Their findings are mixed—results for some countries suggest retaliatory motives while others suggest cooperation.

3 The SPS and TBT Agreements

The SPS and TBT Agreements govern different types of regulations, and the relevant rules governing their use depend on the scope of the regulation and the mechanism of action. SPS measures must be implemented on the basis of animal, plant, and human health protection. The SPS Agreement permits discrimination among member-countries with respect to SPS obligations, so long as the discrimination is not "arbitrary and unjustified". Discrimination is allowed because member-countries differ with respect to pest and disease profiles and food safety conditions. Accordingly, SPS measures vary in obligations for compliance and product- and country-scope. Measures sometimes target only a specific country or set of countries, but may be heavily restrictive, such as mandating long quarantine periods or outright bans on products from disease-endemic areas.[2]

In contrast, the TBT Agreement covers technical regulations, standards, and procedures that are related to products or processes and production methods (Ahn, 2002). Such instruments are required to satisfy the principles of non-discrimination, including conformance with most-favored nation (MFN) and national treatment obligations. In other words, TBT standards directed at a given product imported from one member-country must apply equally to similar products sourced from domestic producers and all other member-countries. Though the country-scope of TBT standards may be broad, they are less trade restrictive than many SPS measures in the sense that—if a product can be shown to satisfy the standard—the issuing country must accept its import.

As a legal matter, the SPS Agreement takes precedence over the TBT Agreement. If a measure could be defined as either a TBT or an SPS standard, the measure is subject to the SPS Agreement, even if it is implemented in the form of a technical regulation or standard (WTO, 1998). However, legal scholars note the issue of "forum shopping" in which countries choose to couch technical

[2]SPS measures are broadly defined to include "all relevant laws, decrees, regulations, requirements and procedures including, *inter alia*, end-product criteria; processes and production methods; testing, inspection, certification and approval procedures; quarantine treatments including relevant requirements associated with the transport of animals or plants, or with the materials necessary for their survival during transport; provisions on relevant statistical methods, sampling procedures and methods of risk assessment; and packaging and labeling requirements directly related to food safety" (Ahn, 2002).

standards on the basis of animal, plant, and human health, or cast measures that traditionally would fall under the SPS Agreement as TBTs, depending on whether the rules of the TBT or SPS Agreement are more desirable in the specific context (Ahn, 2002; Downes, 2015; Filipović, 2014; Haugen, 2015). A country's decision to institute a public standard likely depends, *inter alia*, on the risk profile of the imported product, local enforcement capacity, the historical relationship with countries potentially affected by the standard, the current political climate, and the country's proclivity towards domestic protectionism.

The WTO maintains repositories, known respectively as the SPS Information Management System (SPS-IMS) and the TBT Information Management System (TBT-IMS), containing all past SPS and TBT notifications. We use two decades of data from the SPS-IMS and TBT-IMS databases, running from 1996–2015, on the adoption of public standards in WTO member-countries. SPS measures are disaggregated by reporter, target country, and product. We distinguish between measures taken against specific countries (i.e., "targeted measures") and measures that are applied to all trading partners (i.e., "global measures"). TBT measures can be regarded as global because they must satisfy principles of non-discrimination and may not target specific countries or country groups. Global use of SPS and TBT standards over time is summarized in the Appendix.

For purposes of the analysis, we treat the European Union (EU) as a single country. So, for example, a measure taken against Belgium counts as a notification against the EU. Sub-national restrictions are treated in the same way. A measure directed at Uttar Pradesh or Odisha is treated as a notification against India as a whole.

Table 1 reports the total number of SPS and TBT measures adopted over the period of analysis. Adoption of standards is further disaggregated by year in Figure 1. In the mid-to-late 1990s, TBT standards were more widely used than SPS, probably because policymakers were more familiar with TBT instruments at the time.[3] Usage of both TBT and SPS has grown over time. The turn of the century saw a spike in the popularity of SPS standards, driven primarily by increased use of targeted measures.

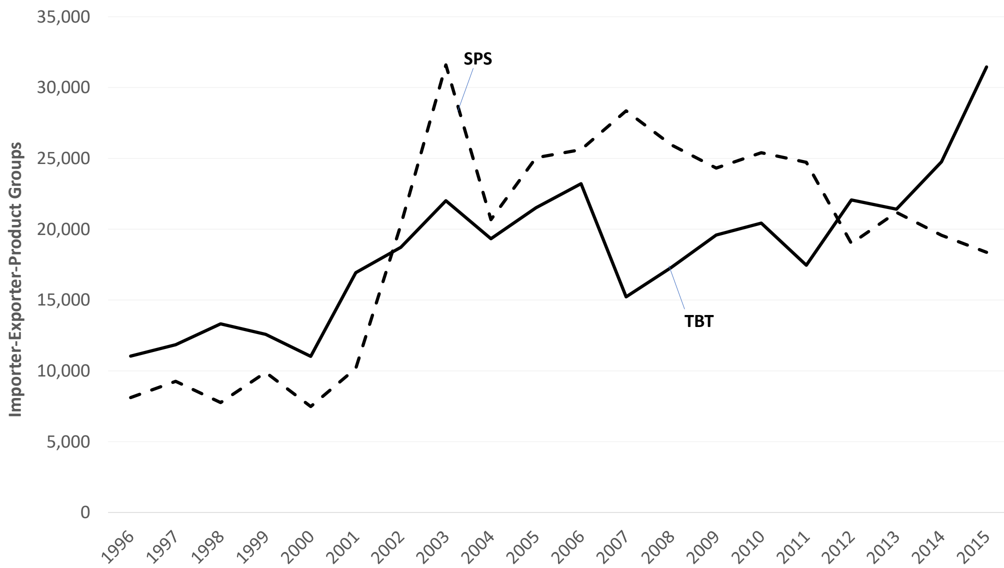
Table 2 disaggregates SPS and TBT use by sector. SPS and TBT standards are present in

[3]The SPS Agreement was implemented in January 1995, whereas the TBT Agreement had been in existence since the last 1970s.

Table 1: Use of Public Standards and Affected Importer-Exporter-Product (IEP) Groups

	Total Measures	IEP Groups Affected
Global TBT	26,102	382,801
Global SPS (SPS^G)	8,288	374,346
Targeted SPS (SPS^D)	14,006	6,595

Figure 1: SPS and TBT Measures Initiated, by year



all sectors. However, in practice, SPS measures tend to be used more frequently for agricultural products while TBT standards tend to apply more frequently to industrial products. Approximately 90% of all IEP groups affected by SPS fall within food and animal sectors (i.e., HS codes 01–24). This is not surprising. Food and animal products have a high-risk profile relative to other products, both with respect to human health, through food safety threats like pesticide residues and mycotoxins, and plant and animal health, through pest and disease vectors. In industrial sectors, the ratio of SPS and TBT use is reversed. In textiles, for example, over 25,000 IEP groups are affected by TBT standards, compared to the 3,180 IEP groups subject to SPS measures.

Figure 2 shows the geographic distribution of SPS and TBT measures. Panels (a) and (b) of the Figure show the number of IEP groups against which the country has issued SPS measures (in Panel a) and TBT standards (in Panel b). Panels (c) and (d) of the Figure show the number of IEP groups that are subject to SPS measures (in Panel c) and TBT standards (in Panel d) that have been issued abroad. As one would expect if the adoption of standards is motivated—at least

Table 2: Public Standards by Sector, 1996–2015

HS Codes	Product Group	SPS	TBT
		(Affected IEP Groups)	
01–05	Animals and Animal Products	102,114	13,995
06–15	Vegetable products	117,268	29,727
16–24	Foodstuffs	79,920	43,690
25–27	Mineral Products	4,553	11,509
28–38	Chemicals and Allied Industries	36,940	42,321
39–40	Plastic/Rubbers	10,562	23,952
41–43	Raw Hides, Skins, Leather, & Furs	3,631	3,421
44–49	Wood & Wood Products	12,494	9,644
50–63	Textiles	3,180	25,765
64–67	Footwear/Headgear	304	5,614
68–71	Stone/Glass	1,538	15,687
72–83	Metals	2,075	34,215
84–85	Machinery/electrical	1,931	60,807
86–89	Transportation	1,179	23,058
90–97	Miscellaneous	3,252	39,396
	Total	**380,941**	**382,801**

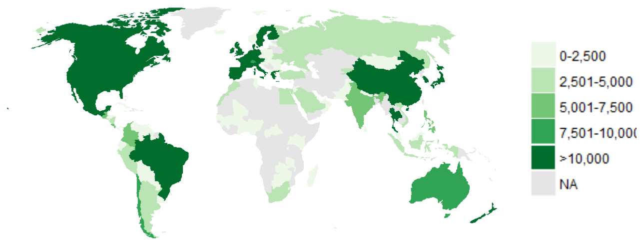
partially—by protection of domestic industry, large importers are the primary users of SPS and TBT measures. The U.S., EU, and China, for example, are the top three importers across almost all product categories over this period. Referring to Panels (a) and (b) of Figure 2, these countries also represent the predominant share of SPS and TBT users.

Turning to Panels (c) and (d) of Figure 2, the EU, China, Canada, and the U.S. face the highest number of IEP groups subject to SPS and TBT standards. These are also some of the world's largest exporters, by value. Brazil—a large exporter of food and animal products—is a common target and frequent user of SPS. Although some African and Central Asian countries are large exporters, especially of agricultural products, these regions are generally infrequent users and targets of public standards according to Figure 2.

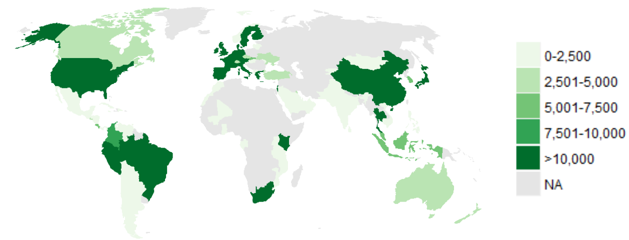
4 Methdology

To investigate whether countries used public standards for retaliatory purposes, we construct a linear probability model of a country's decision to adopt a public standard against another country. We construct a dataset with annual observations on importer- and exporter-use of SPS and TBT

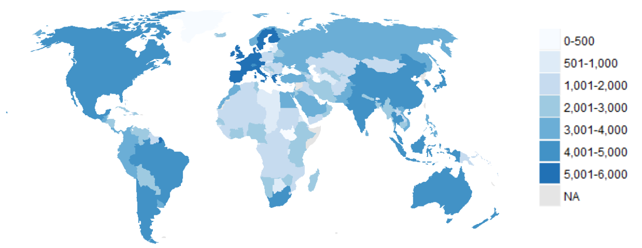
Figure 2: Geographic Distribution of Public Standards



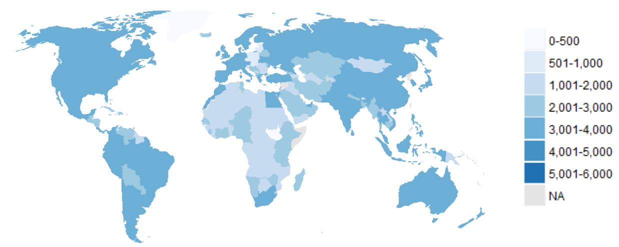
(a) SPS User Country



(b) TBT User Country



(c) SPS Affected Country



(d) TBT Affected Country

In Panels (a) and (b), shading corresponds to the number of IEP groups against which standards have been issued by the user country. In Panels (c) and (d), shading corresponds to the number of IEP groups within the affected country against which standards have been taken.

standards, bilateral importer-exporter-product (IEP) trade flows, use of other trade barriers, and country characteristics to empirically model the adoption decision. We are primarily interested to determine whether the decision of an importing country i to initiate an SPS or TBT regulation on product p from country e depends on whether country e has previously initiated a trade barrier affecting country i. We estimate the following equations at the IEP level via ordinary least squares (OLS):

$$\text{SPS}_{iept} = \alpha^S + \beta^S_S \text{SPS}_{eip,t-1} + \beta^S_T \text{TBT}_{eip,t-1} + \beta^S_{ADCV} \text{ADCV}_{eip,t-1} + \beta^S_m X + \theta^S Z + \epsilon^S_{eipt} \quad (1)$$

$$\text{TBT}_{iept} = \alpha^T + \beta^T_S \text{SPS}_{eip,t-1} + \beta^T_T \text{TBT}_{eip,t-1} + \beta^T_{ADCV} \text{ADCV}_{eip,t-1} + \beta^T_m X + \theta^T Z + \epsilon^T_{eipt} \quad (2)$$

where vector X contains control variables, including log of GDP for both the importer and the exporter and the log of value of trade for product p between the importer and exporter. Vector Z contains various fixed effects, including year dummies and importer-exporter-product fixed effects. These variables account for any exporter- or importer-specific differences across countries and any time-invariant differences in the relationship between individual importers and exporters (e.g., colonial ties, distance, and language barriers). The variation used in estimating equations (1) and (2) is time variation at the importer-exporter-product level. The final term, ϵ, is the residual, which we have clustered at the importer-exporter level and assumed to satisfy the usual *i.i.d.* properties. Coefficients α, β_S, β_T, β_{ADCV}, β_m, and θ in both equations are the parameters to be estimated.

We consider two specifications for variables related to adoption of public standards. In the first specification, SPS and TBT variables are specified as the number of notifications between countries i and e for product p in year t. In the second specification, such variables are defined as binary variables equal to one if a standard was adopted at time t, and zero otherwise. There are pros and cons of both specifications. On one hand, specification one, in which standards variables are continuous, makes use of all available information. On the other hand, this information creates the potential for noise in the estimation process. To see this, consider two scenarios regarding the use of SPS measures. First, consider a scenario in which a country issues an SPS measure against all live animals from a given country. This measure would be counted as a single notification in the first specification. Alternatively, consider a scenario in which a country issues two SPS measures: one against imports of zoo elephants and one against imports of hamsters. When standards variables are treated continuously, as in the first specification, this scenario counts as two SPS standards. Clearly, the scope and effect of the measure in the first scenario is larger than the measure in the second scenario; yet, the second scenario is treated as a higher barrier to trade.

We note that our binary specifications violate standard OLS assumptions regarding continuity of the dependent variable. If the model is unconstrained, this can lead to negative probabilities or probabilities exceeding one. In spite of this issue, we use OLS as opposed to other commonly used models, such as probit and logit, for the following reasons. First, to ensure our estimates are robust to cross-sectional differences in the probability a country will implement an SPS measure, we limit our analysis to within-variation at the importer-exporter-product level. Probit fixed-effects models are inconsistent due to the incidental parameters problem. The logistic fixed-effects model does not suffer from the incidental parameters problem, but it drops from the estimation all groups that have no SPS (or TBT) measures over the sample period. For example, if there were no notifications for "live animals" from Singapore to Germany from 1996–2015, these observations are dropped. For our sample, this is a non-trivial loss in sample size. For the SPS specification, for example, around 90% of our sample is dropped using logistic fixed effects. In our case, this is likely to bias our estimates. For instance, suppose a country never issues an SPS or a TBT notification. This country is never retaliating for any SPS or TBT measures taken against them. However, since the country has no variation in the dependent variable, it is dropped from the sample used for the estimation. Thus, as the logit estimation drop countries that never retaliate, this is likely to upward bias the level of retaliation in the logit model.[4]

Note that observations are aggregated at the two-digit level of the harmonized tariff classification system (HS code).[5] The aggregation decision is purely a matter of convenience—data are reported at the two-digit level by the WTO. This high-level of aggregation is unlikely to lead to incorrect inference in the current context: we are interested merely in understanding whether retaliation occurs, and, if so, how frequently it is motivated by domestic protectionism (demonstrated by retaliation within the same sector) and/or by geopolitical suasion (evidenced by retaliation outside the sector of the original trade barrier). Aggregation allows us to avoid or reduce many compounding intra-sector issues, like cross-product trade diversion or the presence of standards that are motivated by domestic protectionism, but that fall under a slightly different tariff line from the original trade barrier at, say, the 4- or 6-digit HS level.

One concern in attributing correlation in the adoption of public standards across countries to retaliation is the spread of transboundary risks to plant, animal, and human health. Some product risks, such as pesticide and pharmaceutical residues or other contaminants in excess of maximum tolerance thresholds may pose legitimate safety risks, but such risks are confined to the

[4] In addition, Beck (2011) discussed the difference in an OLS model and a logit FE model when a large proportion of the sample is dropped in the logit estimation due to lack of in-group variation of the dependent variable. He finds that the logit FE model tends to over-estimate the marginal effect, and OLS provides a less-biased estimate than the logit model.

[5] UN Comtrade is divided into different levels based on the aggregation of product codes. For instance, the two-digit code 08 is trade in fruit, the 4-digit level 0805 is trade in citrus, and the 6-digit level 080550 is trade of lemons or limes.

non-conforming products. Other risks, such as pests and infectious diseases, may originate in one location and spread regionally or even globally. These latter risks could lead to an upward bias in the coefficients measuring retaliation. For instance, consider a hypothetical situation in which the U.S. adopts an SPS measure on against citrus from Brazil after citrus greening is identified in Brazilian orchards. If the disease later spreads to the U.S., Brazil may respond with an SPS measure against citrus from the U.S. in order to bolster disease eradication efforts in Brazil. This situation is legitimate but would be identified as retaliation in our model. The issue is diminished by looking across HS 2-Digit product groups for SPS standards.

In the citrus greening example above, a legitimate response would likely be confined to HS codes related to citrus imports. Implementation by Brazil of an SPS measure against the U.S. for another product, say live animals, would be evidence of retaliation. As a result, we perform a robustness check where we incorporate right-hand side variables for both SPS measures taken in the same product code and for products outside the scope of the original measure. That is, if an importer responds with an SPS measure directed at a product category other than citrus, the motivation is likely retaliation rather than a legitimate concern, such as disease control.

4.1 Final Dataset

We merge the SPS and TBT data with annual observations on the value of trade (in US$) for the corresponding IEP trade flow, obtained from UN comtrade. We also include controls for GDP for both importer and importer, obtained from the World Bank. In the analysis that follows, these control variables are specified in natural logarithmic form. Because the sample includes zero trade flows, the log of trade value is transformed as $\log(value + 1)$. We include imposition of trade barriers in addition to public standards with a variable on whether the exporter has filed an antidumping or countervailing duty (ADCV) proceeding against the importer for the product of interest. Information on timing, and country- and product-scope of ADCV proceedings is obtained from the Global Antidumping and Global Countervailing Duty Databases maintained by the World Bank.[6]

[6] We note that the United Nations Conference on Trade and Developments Trade Analysis and Information Systems (TRAINS) database and the WTO Integrated Database (IDB) and Consolidated Tariff Schedules (CTS) database contain limited information on bound and applied tariff rates at the IEP level. We elect not

Table 3: Summary Statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
			(continuous)				*(indicator)*		
Non-Tariff Barriers[(a)]									
SPS Variables:									
SPS_{iep}	16,597,280	0.023	0.154	0	21	0.022	0.148	0	1
SPS^{D}_{iep}	16,597,280	0.000	0.022	0	21	0.000	0.020	0	1
SPS^{G}_{iep}	16,597,280	0.023	0.152	0	3	0.022	0.147	0	1
$SPS_{ie,\ p}$	16,597,280	2.204	4.640	0	81	0.337	0.473	0	1
W_{iep}	16,597,280	0.000	0.021	0	2	0.000	0.021	0	1
TBT Variables:									
TBT_{iep}	16,597,280	0.023	0.150	0	1	0.023	0.150	0	1
$TBT_{ie,\ p}$	16,597,280	1.715	5.073	0	53	0.197	0.398	0	1
ADCV Variables:									
$ADCV_{iep}$	16,597,280	0.000	0.014	0	1				
$ADCV_{ie,\ p}$	16,597,280	0.007	0.1424	0	12	0.004	0.059	0	1

Variable	Obs.	Mean	Std. Dev.	Min	Max
Additional Variables					
Log($Value_{iep}$)	16,597,280	4.150	5.787	0	26.140
Log(GDP_i)	16,597,280	24.625	2.399	16.969	30.504
Log(GDP_e)	16,597,280	24.969	2.397	16.969	30.504

[(a)]By construction, *ei* public standards variables (unreported in this table) are equivalent in mean, std. dev., min, and max to *ie* public standards variables reported here.

The final dataset contains data on all IEP groups for which at least one non-zero trade flow occurred between 1996–2015. Summary statistics are reported in Table 3. The panel contains 183 exporters, 171 importers and 99 product groups and a total of 16,597,280 observations. The sample includes 26,102 TBT standards and 22,294 SPS standards. Of the SPS measures taken, 8,288 are global and 14,006 are targeted. TBT and SPS standards apply to a total of 382,801 and 380,941 IEP groups, respectively. Additional details about the country- and product-coverage of the SPS and TBT standards used in the sample can be found in the Appendix.

to use this data for three reasons. First, the data are not updated on an annual basis and updates are not done systematically across IEP groups. Second, tariff information is available only for a small portion of IEP groups in our sample, primarily in high- and middle-income countries. Thus, inclusion of tariff information creates a significant risk with respect to selection bias. Finally, we do not believe exclusion of tariff data is problematic for the validity of the analysis. Because our primary results in Section 5.1 include fixed effects at the IEP level, variation in tariff rates is likely to be minimal within the unit of observation and is absorbed in the individual year effects.

Variable W represents SPS measures that have been withdrawn in group iep at time t. Global measures (denoted with superscript G) and out-of-product group variables (denoted with subscript p) affect a larger number of IEP groups, and thus occur more frequently and have higher means, than targeted (denoted with superscript D) and in-product-group variables. Because no IEP trade flows experience more than one ADCV case in a given period, the maximum value for $ADCV_{iep}$ is one, and the variable is identical in continuous and indicator form.

5 Results

Results of estimating equations (1) and (2) are discussed in Section 5.1. In Section 5.2, we disaggregate our definition of SPS measures and expand the set of products against which the importer is allowed to respond.

5.1 Retaliation and Trade Protection

Primary results are presented in Table 4. Columns (1) and (2) report results for retaliation via SPS for the continuous and dummy specifications, respectively. Columns (3) and (4) report results for retaliation via TBT. In Columns (4) and (5), we report results for specifications in which SPS and TBT standards are treated as homogenous, and the dependent variable is the sum of SPS and TBT. Note that for the dummy specification (Column 5), the dependent variable is still binary. A value of one signifies that in time t, there was at least one notification under *either* the SPS or TBT Agreement. Across all specifications (Columns 1 through 5), coefficients on importer GDP and the value of bilateral trade are positive and statistically significant, signifying that an increase in a country's "mass" or the value of trade increased the probability that the country will implement a public standard. These findings are consistent with previous research on protectionism and trade (Aisbett and Pearson, 2012; Baldwin, 1989; Baylis, Nogueira and Pace, 2012). Table 4 also shows strong evidence of retaliation.

Turning first to Columns (1) and (2), imposition of an SPS standard by the exporter affecting the importer increased the probability that the importer would implement an SPS measure that affected the exporter. The coefficient on SPS_{eip} is 0.0081 (statistically significant at 99%) in the

Table 4: Tit-for-tat use of Public Standards

VARIABLES	(1) SPS_{iep} Continuous	(2) SPS_{iep} Binary	(3) TBT_{iep} Continuous	(4) TBT_{iep} Binary	(5) $(SPS+TBT)_{iep}$ Continuous	(6) $(SPS+TBT)_{iep}$ Binary
SPS_{eip} (L1)	0.0081***	0.0071***	-0.0005	-0.0006*	0.0075***	0.0057***
	(0.0008)	(0.0007)	(0.0004)	(0.0004)	(0.0009)	(0.0008)
TBT_{eip} (L1)	-0.0009**	-0.0009**	0.0015**	0.0015**	0.0006	0.0007
	(0.0004)	(0.0004)	(0.0006)	(0.0006)	(0.0007)	(0.0007)
$ADCV_{eip}$ (L1)	0.0080*	0.0063	0.0064	0.0064	0.0144**	0.0093
	(0.0046)	(0.0045)	(0.0053)	(0.0053)	(0.0072)	(0.0064)
Ln Value$_{iep}$ (L1)	0.0001**	0.0000*	0.0001***	0.0001***	0.0001***	0.0001***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Ln GDP$_i$	0.0257***	0.0240***	0.0160***	0.0160***	0.0417***	0.0356***
	(0.0017)	(0.0016)	(0.0011)	(0.0011)	(0.0025)	(0.0023)
Ln GDP$_e$	0.0017	0.0018*	0.0007	0.0007	0.0023	0.0026
	(0.0011)	(0.0010)	(0.0013)	(0.0013)	(0.0019)	(0.0018)
Year Effects	Yes	Yes	Yes	Yes	Yes	Yes
IEP Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	15,639,065	15,639,065	15,639,065	15,639,065	15,639,065	15,639,065
R-squared	0.37	0.36	0.28	0.28	0.36	0.35

Standard errors clustered at the importer-exporter level.
***p<0.01, ** p<0.05, * p<0.1

continuous specification and 0.0071 (statistically significant at 99%) in the binary specification.

In the continuous specification (Column 1), the imposition of antidumping or countervailing duty proceedings by the exporter against the importer increased the probability that the importer will respond with an SPS measure by 0.0080 (statistically significant at 90%). The ADCV coefficient in the more-conservative binary specification is 0.0063 but is not statistically significant. The ADCV coefficient is positive across all specifications and is also statistically significant at 95% in Column (4) when SPS and TBT are treated jointly (coefficient 0.0144).

Turning to Columns (3) and (4), similar to the tit-for-tat findings for SPS, the imposition of a TBT measure by an exporter that affected an importer increased the probability that the importer would institute a TBT measure that affected the exporter. The coefficient on TBT_{eip} in Columns (3) and (4) is 0.0015. The coefficient is statistically significant with 95% confidence in both Columns.

Comparing across Columns (1) through (4), there appears to be an inverse relationship between imposition of an SPS (TBT) by the exporter and the imposition of a TBT (SPS) by the importer. For example, in both Columns (1) and (2), the imposition of a TBT measure by the exporter *reduces* the likelihood of importer response via SPS by 0.0009. In both specifications, this result is statistically significant at 95% confidence. Similarly, in Columns (3) and (4), imposition of an SPS measure reduced the probability of the implementation of a TBT standard by the importer by 0.0005 and 0.0006, respectively, though the result is only significant in the binary specification (Column 4). The specific economic or political mechanism is ambiguous here. One possible explanation relates to the "forum shopping" issue discussed in Section 3: When hit with a TBT (SPS) standard by the exporter, the importer re-cast an existing TBT (SPS) standard as an SPS (TBT) standard to suit the purposes of retaliation.

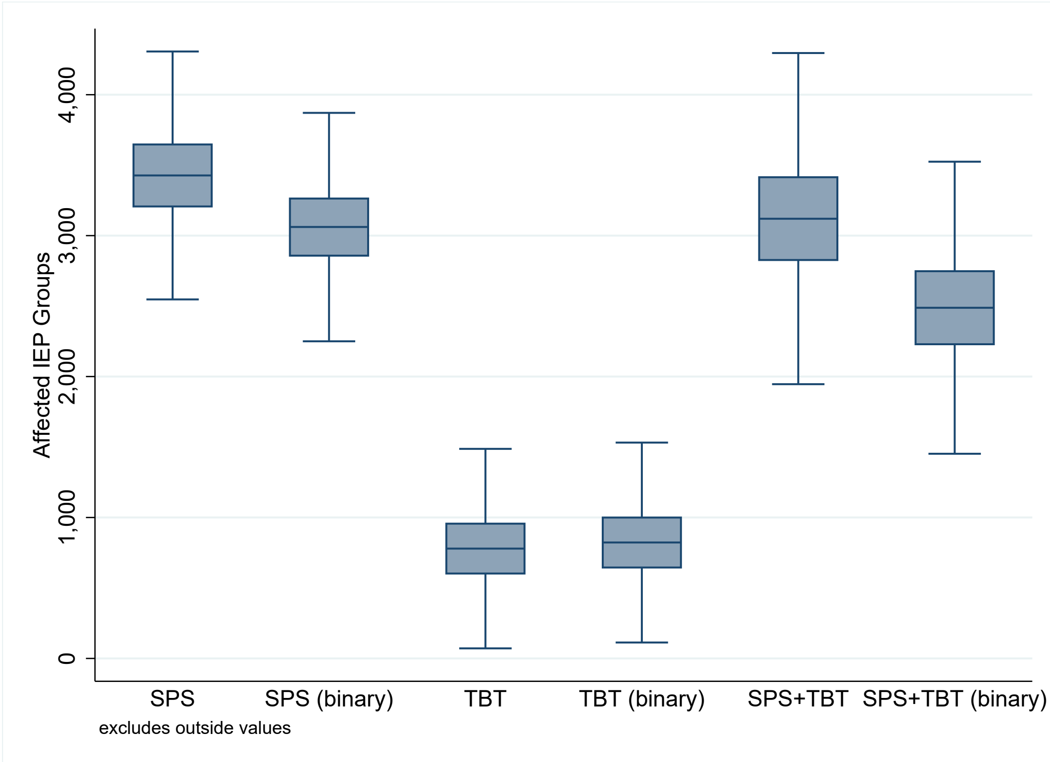
The results in Table 4 provide evidence regarding the *statistical* significance of retaliatory use of SPS and TBT measures. However, relative to total number of IEP flows in the sample, imposition of a public standard remained a low probability event. The small coefficients in Table 4 provide little evidence of the *economic* significance of the findings. We derive the predicted number of retaliatory SPS and TBT standards ($\hat{\Lambda}^S_{iep}$ and $\hat{\Lambda}^T_{iep}$) implemented over the sample horizon as follows:

$$\hat{\Lambda}^l_{iep} = \sum_t \left(\frac{\hat{\beta}^T_S}{|\hat{\beta}^T_S|} \hat{\beta}^T_S \text{SPS}_{eip,t} + \frac{\hat{\beta}^T_T}{|\hat{\beta}^T_T|} \hat{\beta}^T_T \text{TBT}_{eip,t} + \frac{\hat{\beta}^T_{ADCV}}{|\hat{\beta}^T_{ADCV}|} \hat{\beta}^T_{ADCV} \text{ADCV}_{eip,t} \right), \forall l \in \{SPS, TBT\} \tag{3}$$

where all parameters ($\hat{\beta}$) correspond to the point estimates of coefficients from equations (1) and (2), expressed as a positive magnitude. We generate confidence intervals around these predictions using the Bayesian Bootstrap method with 1 million draws from the posterior distribution of each estimated parameter (Rubin, 1981). The box-and-whisker plots in Figure 4 show the predicted range of IEP groups affected by retaliatory standards for each specification in Table 4.

As shown in Figure 4, SPS measures appear to have been used more frequently for retaliatory purposes than TBT standards. Our median estimates for the number of IEP groups affected by retaliatory SPS measures is 3,427 for the continuous specification and 3,061 for the binary specification. In contrast, the median estimate for retaliatory TBT standards is 779 IEP groups for the continuous specification and 823 for the binary specification. The associated trade costs were likely substantial. As a back-of-the-envelope calculation, if retaliatory standards reduced trade in

Figure 3: Estimated Frequency of Within-Product Retaliation



the affected IEP group by only 1%, the associated trade loss was approximately $2 billion per year. If—as some previous literature suggests (Disdier, Fontagné and Mimouni, 2008)—SPS and TBT measure reduced trade by around 15%, the associated trade loss was $36.2 billion per year.

5.2 Disaggregating Avenues for Retaliation

Analysis in the previous section is limited to retaliation within the same product category. Notwithstanding the issue of transboundary risks discussed in Section 4, this approach likely underestimates the extent of retaliation for at least two reasons. First, if some instances of retaliation were effected to punish the instigating country (as opposed to protecting the domestic industry), one would expect the retaliating country to target industries of economic and strategic importance to the instigator, whether or not they fall into the same product code as the original standard. Second, even if standards within the same product code could have effected the necessary punishment, such obvious retaliation could have exposed to the retaliating country to dispute settlement mechanisms.

In this section, we allow countries to retaliate over a broader scope of products. We also disaggregate our definition of SPS measures. We consider four specifications for the dependent variable: (1) total SPS measures initiated (denoted *All*), (2) global SPS measures instituted against all trade partners (denoted *Global*), (3) SPS measures that target a specific trade partner (denoted $Targeted$), and (4) total TBT measures (all of which apply globally). For simplicity and clarity of findings, we limit the analysis to the binary definition of these variables. As shown in Table 4, binary specifications are generally more conservative than their continuous counterpart. All results are robust to the continuous definition.

Table 5 reports results. Column (1) shows the results for a specification where the dependent variable includes all SPS measures. Columns (2) and (3) show results for specifications where the dependent variable is limited, respectively, to global and targeted SPS measures. Column (4) reports results for TBT measures.

Column (1) shows that importers responded with SPS measures against both global and targeted measures taken by the exporter. This propensity towards retaliation was broad in product scope. First, considering the response to targeted SPS measures, the coefficients on variables SPS_{eip}^{T} and $SPS_{ei\ p}^{T}$ are positive and significant. Instigation of a targeted SPS measure by an exporting country increased the probability of retaliation in the same product group by the importer the following year by 0.0510. Results also hold out-of-product group; instigation of a targeted SPS measure by an exporter increased the probability the importer would retaliate against a different HS code by 0.004. Thus, the results are robust to potential legitimate motivations associated with responding within the same product code.

Not surprisingly, global SPS measures elicited a smaller retaliatory response from trade partners, though the in-product result remains significant. Within the same HS code, a global SPS measure taken by an exporter in time $t-1$ increased the probability of retaliation by the importer by 0.0065 (significant at 99%). Out-of-product group results were insignificant. These results are expected. When a country issued an SPS measure against all trading partners, those affected included many countries that were not major traders of the targeted product. The economic impact of the standard—and thus the incentive to retaliate—was small in these countries.

As with the results in Section 5.1, these findings constitute strong evidence regarding the *presence* of retaliation in the use of SPS measures. Columns (2) and (3) show *how* countries retaliate. When

Table 5: Multiple Avenues of Retaliation

VARIABLES	(1) SPS All	(2) SPS Global	(3) SPS Targeted	(4) TBT All
SPS^{T}_{eip} (L1)	0.0510***	0.0475***	0.0098***	0.0010
	(0.0068)	(0.0069)	(0.0030)	(0.0034)
$SPS^{T}_{ei,\ p}$ (L1)	0.0040***	0.0037***	0.0005**	0.0061***
	(0.0010)	(0.0010)	(0.0002)	(0.0016)
SPS^{G}_{eip} (L1)	0.0065***	0.0061***	0.0007***	-0.0005
	(0.0007)	(0.0007)	(0.0001)	(0.0004)
$SPS^{G}_{ei,\ p}$ (L1)	-0.0002	-0.0002	0.0000	-0.0007*
	(0.0003)	(0.0003)	(0.0000)	(0.0004)
TBT_{eip} (L1)	-0.0008**	-0.0007**	-0.0001*	0.0019***
	(0.0003)	(0.0003)	(0.0001)	(0.0005)
$TBT_{ei,\ p}$ (L1)	-0.0005	-0.0007*	0.0003***	-0.0014***
	(0.0004)	(0.0004)	(0.0000)	(0.0005)
$ADCV_{eip}$ (L1)	0.0050	0.0052	0.0001	0.0064
	(0.0043)	(0.0044)	(0.0007)	(0.0051)
$ADCV_{ei,\ p}$ (L1)	0.0044	0.0043	0.0004	-0.0001
	(0.0038)	(0.0037)	(0.0006)	(0.0036)
Ln Value$_{iep}$ (L1)	0.0000*	0.0000	0.0000	0.0001***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Ln GDP$_i$	0.0239***	0.0243***	-0.0004***	0.0160***
	(0.0016)	(0.0016)	(0.0001)	(0.0011)
Ln GDP$_e$	0.0019*	0.0018*	0.0002	0.0010
	(0.0010)	(0.0010)	(0.0001)	(0.0013)
Observations	15,639,065	15,639,065	15,639,065	15,639,065
R-squared	0.3647	0.3626	0.1452	0.2837

Standard errors clustered at the importer-exporter level.
*** p<0.01, ** p<0.05, * p<0.1

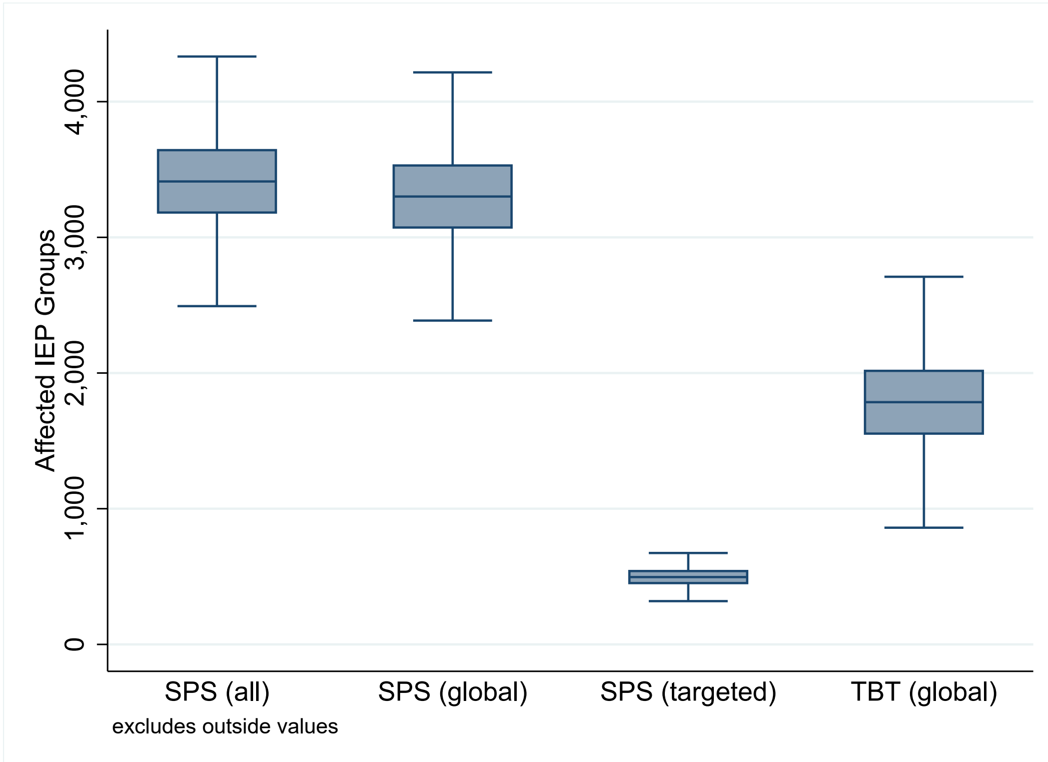
the dependent variable is limited to global measures in Column (2), findings are consistent with the aggregate measure of SPS notifications. This is primarily a matter of construction. Because global measures affected a much larger share of IEP groups than targeted measures (Table 1), variables $SPS_i^{All}ep$ and SPS_{iep}^G are similar.

When the dependent variable is limited to targeted notifications (Column 3), the magnitude of results decreases significantly compared to Columns (1) and (2). When an exporter issued a targeted SPS measure, the probability of retaliation by the importer via a targeted measure issued against the exporter increased by only 0.0098. Results are also smaller for out-of-product group variables and when the exporter issues a global measure. The probability of retaliation against a global SPS measure via a targeted standard within the same product group was only 0.0007.

Consistent with the SPS variables and the results in Table 4, Column (4) shows that importers faced with a TBT measure taken by an exporter commonly responded with a TBT standard of their own (Coefficient 0.0014). SPS-to-TBT and TBT-to-SPS relationships are complex. TBT standards implemented by the exporter *reduced* use of global SPS measures by the importer (Columns 1 and 2). Importer use of TBT measures in response to SPS measures implemented by the exporter appears to occur primarily out-of-product group. Targeted SPS measures induced a positive and statistically significant response with respect to TBT use (coefficient 0.0061) while Global SPS measures induced a negative, statistically significant response (coefficient -0.0008).

We deduce the economic significance of these estimates using the same approach as described in equation (3) in Section 5.1. Results are summarized by the box-and-whisker plots in Figure 4. The predicted number of IEP groups affected by retaliatory SPS measures (Global + Targeted) is 3,412, similar to the results from Section 5.1. As expected, most of these retaliatory standards were instituted globally. Our estimates suggest that approximately 3,300 IEP groups were affected by retaliatory SPS measures instituted globally, compared to approximately 500 retaliatory SPS measures that were targeted. Consistent with Section 5.1, our results suggest TBT standards were used less frequently for retaliation than are SPS measures. However, our disaggregated specification identifies slightly more frequent retaliatory use of TBT standards than do the aggregated results (1,785 affected IEP groups compared to ≈800 in Section 5.1).

Figure 4: Estimated Frequency of Intra- and Extra-Product Retaliation



6 Extension: Withdrawal of SPS Measures

At first glance, our results in Section 5 may appear to indicate a domino effect with respect to the retaliatory use of public standards in trade. If countries faced with an NTB perpetually responded with NTBs of their own, regulatory barriers would have increased and, ultimately, clogged the global trade system. In this section we ask one final question: could retaliation have led to freer trade by inducing other countries to withdraw their own NTBs? Our findings indicate that—at least in some limited circumstances—retaliation did serve as a lever for trade liberalization.

In addition to information on adoption of standards, the WTO SPS-IMS system also provides information on when member countries withdraw SPS measures.[7] We re-run the linear probability model described in equation (1) from Section 5.1, but substitute as the dependent variable $W_{iep,t}$, which measures whether, in time t, the importing country (i) *withdrew* an SPS measure in product category p that applies to exporter e. As in Section 5.1, the primary variables of interest are

[7] Note that the WTO TBT-IMS database does not provide corresponding information on the withdrawal of TBT standards.

defined, alternatively, as continuous and binary. In addition to the explanatory variables described in equation (1), we include two additional control variables: $SPS_{iep,t-1}$ and $SPS_{iep,t-2}$. Inclusion of these variables ensures that the importing country had adopted an SPS standard within the last two years that could be withdrawn.

Table 6: Retaliation as a Lever for Trade Liberalization

VARIABLES	(1) SPS Withdrawal Continuous	(2) SPS Withdrawal Binary
SPS_{eip} (L1)	0.0002*	0.0002*
	(0.0001)	(0.0001)
TBT_{eip} (L1)	-0.0001*	-0.0001
	(0.0001)	(0.0001)
ADCV_{eip} (L1)	-0.0004	-0.0001
	(0.0007)	(0.0006)
SPS_{iep} (L1)	0.0079***	0.0072***
	(0.0006)	(0.0006)
SPS_{iep} (L2)	0.0053***	0.0032***
	(0.0005)	(0.0003)
Ln Value_{iep} (L1)	-0.0000***	-0.0000***
	(0.0000)	(0.0000)
Ln GDP_i	-0.0011***	-0.0010***
	(0.0001)	(0.0001)
Ln GDP_e	-0.0000	0.0000
	(0.0001)	(0.0001)
Year Effects	Yes	Yes
IEP Effects	Yes	Yes
Observations	14,695,811	14,695,811
R-squared	0.08	0.07

Standard errors clustered at the importer-exporter level.
*** p<0.01, ** p<0.05, * p<0.1

Estimation results are presented in Table 6. Coefficients on variables measuring own use of SPS measures ($SPS_{iep,t-1}$ and $SPS_{iep,t-2}$) are positive and statistically significant at 99%. This is not surprising. Countries needed a standard in place in order to withdraw the standard. By comparing the coefficients for the one-year lag and the two-year lag variable, we see that countries were more likely to withdraw standards that had recently been adopted. The coefficients on $SPS_{iep,t-1}$ are

0.0079 and 0.0072 in Columns (1) and (2), respectively. In comparison, corresponding coefficients on $SPS_{iep,t-2}$ are smaller: 0.0053 and 0.0032.

Coefficients on variable SPS_{eip}—which measure the importer's response to the imposition of an SPS measure by the exporter—are positive and statistically significant (at 90% confidence) in both specifications. This is evidence that imposition of a public standard by an exporter could force the importer to withdraw its own standard. The coefficient on importer GDP is negative and statistically significant at 99% confidence, suggesting that more economically powerful countries were less willing to withdraw SPS standards as a result of retaliation.

Finally, the coefficient on trade value is negative and statistically significant at 99% confidence in both specifications. This finding constitutes further evidence of protectionism in the use of SPS standards. Importers were less likely to withdraw SPS standards for larger trade flows.

7 Conclusion

This research investigates the extent to which countries used public standards as a means of political retaliation between 1996–2015. We match data on the adoption of public standards under the WTO SPS and TBT Agreements with annual, bilateral trade flows and the initiation of ADCV proceedings. We estimate a linear probability model to determine whether the decision of an importing country to initiate an SPS or TBT regulation against an exporter depended on whether the exporter had previously initiated a trade barrier affecting the importer.

Our results indicate that SPS and TBT standards were frequently used for retaliatory purposes over the sample horizon. The imposition of a public standard or the instigation of an ADCV proceeding by one country against another country increased the probability that the target country would adopt its own standard. As many as 4,000 bilateral trade flows at the 2-digit product level were subject to retaliatory standards. Under reasonable assumptions, this equates to trade losses in the range of \$30–\$40 billion per year.

For both SPS and TBT measures, retaliation commonly occurred outside the product group of the original measure. This finding may suggest that retaliation was driven by geopolitical motives rather than protectionism for domestic export industries that faced trade barriers abroad. It could also indicate that countries attempted to obfuscate the true motive of the regulation.

Implications may not be exclusively trade destructive. We extend our model to investigate whether retaliation forced countries to withdraw their own NTBs. To do so, we re-run the linear probability model, substituting the withdrawal of an SPS measure as the dependent variable. Our findings indicate that—at least in some circumstances—retaliation induced the withdrawal of SPS measures.

These fiindings are of significance to current policy debates. In many countries, recent months have seen an increased willingness among politicians to engage in public tariff wars. Such practices result in economic inefficiencies that generate deadweight losses to affected industries (Gros, 1987). This paper documents the use of "under-the-radar" retaliation in the use of public standards between 1996–2015. Though these "standards wars" generate less public outcry than overt tariff wars, they are likely a less economically efficient mechanism—in *ad valorem* equivalent terms—to achieve retaliation. Levied duties increase taxpayer revenues to offset a portion of the deadweight losses to industry caused by a tariff war. Such is not the case in the context of retaliation via NTBs.

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