Staff Working Paper ERSD-2014-18 **Date: 29 October 2014**

World Trade Organization
Economic Research and Statistics Division

Trade Policy Substitution:

Theory and Evidence from Specific Trade Concerns

Cosimo Beverelli
(Economic Research Division, WTO)

Mauro Boffa
(GSEM, University of Geneva)

Alexander Keck
(Economic Research Division, WTO)

Manuscript date: 29 October 2014

Trade Policy Substitution:

Theory and Evidence from Specific Trade Concerns*

Cosimo Beverelli† Mauro Boffa‡ Alexander Keck†

Abstract

We investigate to what extent the probability that a Specific Trade Concern (STC) is raised in the WTO against a Member in a given sector is affected by past reductions in applied tariffs. Employing an identification strategy based on 'new measures', we find evidence of a substitution of non-tariff measures for tariffs both in the sample of TBT and in the sample of SPS concerns. While in the SPS sample this result holds both among developed and developing economies, in the TBT sample such 'trade policy substitution' only occurs when the country maintaining the measure at issue is economically developed. These results are consistent with our theoretical model, which predicts policy substitution between tariffs and standards in economies where meeting such standards is relatively less costly and in sectors where meeting such standards is relatively more important from the perspective of producers.

Keywords: Import, International Trade Agreements, Non Tariff, Tariff, WTO

JEL Classification: F13, F14, F15

*This is a working paper, and hence it represents research in progress. The opinions expressed in this paper should be attributed to its authors. They are not meant to represent the positions or opinions of the WTO and its Members and are without prejudice to Members' rights and obligations under the WTO. Any errors are attributable to the authors. Without implicating them, we thank Marc Bacchetta, Marcelo Olarreaga, Lorenzo Rotunno and participants at the Fifth Research Workshop on International Trade (Villars, 6-7 February 2014) and at the Trade Agreements Workshop (KU Leuven, 14-15 March 2014) for valuable comments and suggestions.

†Economic Research Division, World Trade Organization. Rue de Lausanne 154, CH-1211, Geneva, Switzerland. E-mail: cosimo.beverelli@wto.org (corresponding author); alexander.keck@wto.org.

‡GSEM, University of Geneva. Bd. du Pont d'Arve 40, CH-1211 Geneva, Switzerland. E-mail: mauro.boffa@unige.ch.

1 Introduction

Through successive waves of liberalization, tariffs have steadily dropped over the years both in industrial and developing countries (WTO, 2007; Milner, 2013; Bown, 2014). Having constrained this traditional instrument of import protection, countries may be inclined to pursue trade policy objectives through non-tariff measures (NTMs). Unlike tariffs, such measures may have a dual purpose: NTMs may be designed or administered in ways that intentionally restrict trade even if their declared purpose is to serve a public policy goal (WTO, 2012). For example, a technical product requirement may be introduced to prevent the importation and marketing of products considered unsafe for consumption, but it may also be targeted at undoing some of the impact of opening up to trade on the domestic industry. The use of NTMs to replace, at least in part, former levels of tariff protection can be defined as 'trade policy substitution'.

We develop a model that can explain the occurrence of policy substitution when tariffs come down, but also allows for the possibility of policy complementarity, whereby NTMs would be positively correlated with tariffs. In the baseline version of the model, NTMs such as product standards unambiguously increase the firm's marginal production costs. Whether a domestic firm prefers standards to be tightened or loosened after tariff reductions depends on the cost advantage in meeting the standard *vis-à-vis* foreign producers. Policy substitution, i.e. the tightening of standards, is likely to occur when domestic firms find it relatively less costly to meet the standard than foreign firms, and vice versa for the case of policy complementarity. At the aggregate level, therefore, policy substitution is expected to occur in more advanced economies (where meeting product standards is relatively less costly) and policy complementarity in less advanced economies (where meeting product standards is relatively more costly).

When we relax the assumption that product standards only represent a cost for the firms adopting them, and allow for the possibility that firms' productivity may increase with the standard, results depend on the *net* cost advantage, i.e. the relative cost-benefit of domestic versus foreign firms in meeting the standard. Under this scenario, policy substitution can result in all cases in which the benefits related to adopting the standard are high enough to warrant the costs. At the aggregate level, therefore, policy substitution is expected to occur in sectors where product standards are relatively more important.

In the empirical application of our model, we seek to determine to what extent the probability of applying

NTMs is related to tariff reductions. To measure NTMs, we use the information embedded in Specific Trade Concerns (STCs) raised in two WTO committees – the Committee on Technical Barriers to Trade (TBT) and the Committee on Sanitary and Phytosanitary Measures (SPS).[1] STCs may be brought by any WTO member considering to be negatively affected by an SPS/TBT measure imposed by a WTO trading partner. They are 'soft law' mechanisms to deal with NTMs, as they are based on diplomatic relations, rather than adjudication.

Unlike other data on NTMs that has been used to address the question of trade policy substitution and that may include trade-enhancing policies – such as frequency counts of product standards – STCs identify actual trade restrictions in specific sectors. Moreover, they refer to measures of general application – as opposed to bilateral measures such as anti-dumping investigations.

To address the issue of causality, we employ an identification strategy based on pre-determined (lagged) cuts in sectoral applied tariffs *and* on the exclusive use of STCs relating to 'new measures'. The intuition is that if a new TBT or SPS measure is introduced after a tariff is liberalized, it is less likely (indeed, quite unlikely) to affect tariff liberalization itself compared to a pre-existing measure. To address the issues of confounding biases and of nuisance parameters, we control for a multitude of factors that are likely to affect the use of NTMs and add country-sector fixed effects with year dummies in a conditional logit specification.

Our contribution to the literature is fourfold. First, we build a simple model of trade policy substitution that lends itself to empirical testing with existing data. Second, we examine the empirical evidence of trade policy substitution at a fairly disaggregated sectoral level (HS four digit headings), using more suitable information on NTMs than previous studies. Third, we exploit the fact that TBT and SPS measures are subject to different WTO disciplines and affect a different range of sectors to show that TBT and SPS measures are subject to different policy dynamics. Finally, we demonstrate that the likelihood of trade policy substitution differs between groups of countries, in function of their level of development and – to a lesser extent – the degree of sectoral tariff commitments (as measured by the so-called 'water' in the tariffs, i.e. the difference between applied and bound rates).

[1]The TBT Committee deals with technical regulations, standards and conformity assessment procedures, for instance in relation to testing and certification requirements. The SPS Committee focuses on measures regarding food safety and animal and plant health. Both committees normally meet three times per year at the WTO headquarters in Geneva.

The paper is structured as follows. In Section 2 we give an overview of the existing theoretical and empirical literature on trade policy substitution, identify shortcomings in the methodologies and data employed and explain how we intend to address these concerns. Section 3 presents the theoretical model from which we derive testable hypotheses regarding policy substitution between applied tariffs and product standards. Section 4 describes in detail the information contained in the TBT and SPS databases on STCs. In Section 5 we explain our empirical strategy. Section 6 discusses descriptive statistics for the variables used in the regression analysis. Our econometric findings (in terms of both statistical and economic significance) are discussed in Section 7. Section 8 concludes and discusses some implications of our results for multilateral trade co-operation.

2 Literature

Trade liberalization lowers tariff protection afforded to import-competing sectors and increases their incentive to lobby the government for the restoration of previous levels of protection through other means (Copeland, 1990; Yu, 2000; Bagwell and Staiger, 2001; Ederington, 2001; Anderson and Schmitt, 2003; Bajona and Ederington, 2012). In this context, it has been claimed that there is a 'Law of Constant Protection', applying more strongly in historically protected sectors (Bhagwati, 1988). Conversely, Bagwell et al. (2002) argue that market access concessions made in the context of GATT/WTO negotiations may lead to a 'race to the bottom' or 'regulatory chill'.[2] The intuition is that lower (higher) standards in the home country imply tougher (softer) competition faced by foreign exporters in their own domestic market and, thus, entail a lower (higher) export price – which constitutes a terms-of-trade loss (gain) for the foreign country – and diminished (increased) access to the market where standards have been manipulated.[3]

Essaji (2010) provides a model that is able to explain both possible outcomes – policy substitution and complementarity – emphasizing the importance of taking into account the marginal effectiveness of one

[2]These two terms refer, respectively, to the lowering and to the freezing of standards in import-competing industries due to increased competitive pressure from abroad – despite the role that these standards may play in addressing relevant market failures.

[3]In a recent study, Staiger and Sykes (2011) show that for an international trade agreement to yield the first-best outcome, countries need to commit not only on tariffs but also on domestic taxes and regulatory policies. In the absence of commitments on NTMs, there could be inefficient changes, e.g., in domestic standards following the conclusion of the agreement. See also Staiger (2012) for a related discussion. Note that, following this literature, we adopt a similarly broad definition of 'standards', as explained in WTO (2012, p. 38).

measure for different levels of another. In his model, a standard is justified by the existence of a negative consumption externality and increases costs more for the foreign than for the domestic firm. For the specific set-up of an international Cournot duopoly, Essaji (2010) highlights that the standard will be tightened following tariff liberalization if this increases the government's payoffs at lower levels of tariff protection. Whether this is the case depends on the government's objective function. If the government only cares about consumer surplus and profits of domestic firms, it will respond to tariff cuts by relaxing the standard (policy complementarity). Conversely, the standard will be increased if the government is also concerned with tariff revenue and with the negative consumption externality (policy substitution).[4] Essaji's model underscores the fact that the proliferation of NTMs after tariff liberalization may reflect a growing awareness of consumption externalities. However, the model also entails the counterintuitive result that "a government that is overwhelmingly protectionist, i.e., only concerned with the Domestic firm's profits, will be motivated to lower standards [...] in the wake of tariff reduction" (Essaji, 2010, p. 14). This result is at odds with the considerable body of literature that has studied the use of standards for purely protectionist reasons (see for instance Fischer and Serra, 2000; Sturm, 2006; Abel-Koch, 2013).

As noted in Section 1, the apparent substitution of NTMs for tariffs may indeed be motivated by an increased demand for regulation, as more potentially unsafe products become available, but it may also reflect a form of protection that is not openly discriminatory. The theoretical model we present shows how the importance of these considerations may vary across countries and sectors. Across countries, we expect trade policy substitution to prevail in advanced economies, relative to less advanced ones. Although we use a different approach (based on relative cost considerations), this prediction is similar to the one formulated by Bagwell and Staiger (2014). They argue that a degree of trade policy substitution in developed countries may be attributed to 'globalization fatigue' – the fact that existing tariffs were globally efficient when they were negotiated, but may be considered too low in a world that has changed tremendously in terms of the economic size and relative trade shares of countries participating in international trade. Given the political and practical difficulties of renegotiating tariff commitments, Bagwell and Staiger (2014) hold that trade policy substitution in developed countries could be seen as a second-best policy to 'make room' for negotiations with developing

[4]The intuition for policy complementarity is that at the margin the tariff reduction exacerbates the (negative) impact of the standard on consumer surplus and firms' profits. Conversely, a lower tariff enhances the standard's role in mitigating the negative consumption externality and does not imply major losses in tariff revenues, which may lead to policy substitution.

countries. If this is true, *ceteris paribus*, we would expect the probability of trade policy substitution to be higher in developed compared to developing countries, following episodes of tariff reductions.

Across sectors, we expect trade policy substitution to be more likely in sectors where product standards are relatively more important, in the sense that they yield relatively large benefits to the firms adopting them, owing, for instance, to the pre-eminence of health concerns by final consumers in that sector. To the best of our knowledge, this point has not been made previously in the literature.

As theory does not make a unique prediction, the link between the imposition of NTMs and tariff liberalization remains an empirical question. Existing empirical approaches generally are of an *ad hoc* nature and not based on an explicit theory of policy substitution. One strand of the literature uses formal statistical methods to analyze whether constraints imposed by international trade agreements on countries' ability to set tariffs may induce them to replace tariffs with NTMs. Examining the period of trade reforms in Colombia between 1985 and 1994 in the context of GATT negotiations leading to the establishment of the WTO, Goldberg and Pavcnik (2005) find that tariffs and NTMs were positively correlated, i.e. tariffs that were reduced were not simply replaced by NTMs. Analyzing data for a cross-section of 91 countries having implemented the results of the Uruguay Round of trade negotiations in the early 2000s, Kee at al. (2009) find instead that the average ad-valorem equivalent (AVE) of NTMs increases with GDP per capita, while the overall level of protection, mainly driven by average tariffs, decreases when countries grow richer, suggesting that tariffs and NTMs may be substitutes. The authors also find a negative correlation of tariffs and AVEs of NTMs at the tariff line level. In the same vein, Broda et al. (2008) show for the United States that NTMs were higher in those import-competing sectors where it had a greater ability to affect foreign export prices, after GATT/WTO commitments constrained the use of tariffs to influence its terms-of-trade. In a recent study on Turkey, Limão and Tovar (2011) exploit the variation in tariff constraints under the WTO and under the Turkey-European Union PTA. This approach allows the authors to establish a causal impact of the required tariff changes on the use of NTMs, providing evidence of policy substitution. Limão and Tovar (2011) also find that the likelihood and restrictiveness of Turkish NTMs increases with the stringency of tariff commitments made.

A common challenge in all of these studies is the definition and measurement of NTMs. The data used often comprises a vast array of policies, including trade-enhancing measures, and suffers from well-known

deficiencies, such as inconsistent data collection across years, use of coverage/frequency ratios as a measure of trade protection or, where AVEs are calculated, potentially misleading estimates of their stringency.[5]

Another strand of the empirical literature analyzes possible substitution effects between tariffs and a particular class of restrictive NTMs – anti-dumping (AD) measures. Evaluating data for 24 countries (17 developing and 7 developed countries) during the period from 1996 to 2003, Feinberg and Reynolds (2007) find that reductions in bound tariffs in the context of the Uruguay Round have a small positive effect on AD. When only considering AD activities by developing countries, Feinberg and Reynolds (2007) find a much larger positive effect of lower tariff bindings both for the likelihood of using AD and for the number of AD petitions filed by a country. It is not clear, however, to what extent this result provides evidence of policy substitution. The authors focus on reductions in bound tariffs, which in many instances, notably for developing countries, did not lead to actual reductions in Most-Favoured Nation (MFN) applied rates, but only to a narrowing of the 'water' in the tariff. Moreover, to their own surprise, Feinberg and Reynolds (2007) find that tariff commitments by developed countries, even though 'biting' into applied rates, are associated with less frequent AD activity.[6] The authors conjecture that this result may reflect a move towards alternative means of protection, such as TBT and SPS measures, i.e. policy substitution proper. It may also be due to a host of other omitted variables, such as an increased orientation towards services and FDI in these countries, that would reduce their interest in AD (Feinberg and Reynolds, 2007). Given these limitations, Moore and Zanardi (2011) conduct a similar study, focusing on applied rather than bound rates and controlling for additional factors that may affect AD initiations. Examining tariff cuts and AD initiations in 35 countries (29 developing and 6 developed) over the period from 1991 to 2002, the authors also dispose of a larger set of importing and exporting countries, a longer time span, more disaggregated sectoral information and a more complete AD database. Overall, Moore and Zanardi (2011) find that reductions in applied rates do not lead to a higher probability of AD petitions. But for a small group of developing countries that have become heavy users of AD, they obtain a statistically significant impact of trade liberalization on the probability of AD filings. For

[5] For an extensive overview of available sources of information on NTMs and an in-depth discussion of the challenges faced in using the data in trade analysis, see WTO (2012). For an illustration of the pitfalls in AVE estimations of different kinds of NTMs see, specifically, the case studies provided in Whalley (2005). Beghin et al. (2014) estimate that almost 40% of the product lines affected by NTMs according to the NTM global database (Kee et al., 2009) are actually subject to trade-facilitating measures.

[6] Applying the same methodology as Feinberg and Reynolds (2007), specifically to AD investigations by the EU at a more disaggregate product level, Ketterer (2014) finds, however, a small positive impact of bound tariff concessions on AD.

this sub-sample, a one standard deviation increase in tariff liberalization is related to a 25 per cent higher probability of AD. Bown and Tovar (2011) obtain similar results for trade reforms undertaken by India in the 1990s. According to the authors, in India the probability of launching a trade remedy investigation is 50 per cent higher for a one standard deviation increase in trade liberalization.

From this literature, it is difficult to draw a general conclusion as to the occurence of trade policy substitution. At most, the existing literature has established, for a limited number of cases, the increased use of AD – a bilateral, time-bound and transaction-based measure in excess of MFN tariffs – when the general level of import protection represented by MFN tariffs has been reduced. Owing to their exporter-specific nature, AD measures have often led to increases in imports from third countries (which – as shown by Brenton (2001) – may also have supported the initial AD petitions), and, hence, can hardly be seen as a policy substitute for a general reduction in import protection. Adopting the methodology by Moore and Zanardi (2011), Aisbett and Pearson (2012) try to address this problem by using SPS measures notified to the WTO as a proxy for NTMs. However, their analysis reverts to the use of bound tariffs and suffers from the common shortcoming that notification information does not only include trade-restricting practices (WTO, 2012). In their most conservative (and econometrically most rigourous) estimation, the authors find evidence of policy substitution. Namely, they obtain a negative correlation between changes in bound tariffs and the probability of new SPS notifications at the country-HS2 sector level.

Building in particular on the econometric methodology by Moore and Zanardi (2011), we refine existing identification strategies of policy substitution, including by employing measures of actual import protection and of general application.

3 Theoretical model

Our model uses the basic set-up of Gulati and Roy (2008). Let 'Home' be a small open economy with perfectly competitive markets. There are two goods, 1 and 2. Good 2 is the numéraire. Good 1 is produced with labor (l) and capital (k). As in Battigalli and Maggi (2003), labor is perfectly mobile between sectors but capital is specific to each sector. The import price of good 1 is normalized to 1; however, the domestic producer price for this good need not be equal to 1. We suppose that a costly standard $\sigma \in [0, \Sigma]$ is imposed

on the production of good 1.[7] The overall domestic production function after the standardization process is:

$$y_1 = \frac{1}{1+\chi(\sigma)} f(k,l) \tag{3.1}$$

The production function $f(\cdot)$ is twice differentiable, homogeneous of degree one, and concave in its arguments. Given that the import price of good 1 is normalized to 1, the function $\chi(\sigma)$ is readily interpreted as the *net* cost of meeting the standard σ. We assume that $\chi(\sigma) \equiv \frac{\phi(\sigma)}{\psi(\sigma)}$. The numerator is interpreted as the cost of meeting the standard σ. As in Gulati and Roy (2008), this function is increasing and strictly convex ($\phi_\sigma > 0$, $\phi_{\sigma\sigma} > 0$), with $\phi(0) = 0$.[8] The denominator, $\psi(\sigma)$, captures the benefit accruing to the producer that meets a standard σ. There are various channels through which meeting a (costly) standard can be beneficial.[9] We highlight two. First, the firm may benefit from an increase in the quality of its products that can be perceived by consumers (may they be final consumers, wholesalers, retailers or downstream firms). Second, the firm may benefit from a reduction in per-unit inspection costs related to delivering the good to the consumer.[10] The function $\psi(\cdot)$ is assumed to be increasing and strictly concave ($\psi_\sigma > 0$, $\psi_{\sigma\sigma} < 0$), with $\psi(0) = 0$.[11] Furthermore, we assume that the domestic industry does not export.

Domestic demand for good 1 is the sum of domestic production and imports m_1, which are expressed as follows:

$$m_1 = \frac{m_r}{1+\chi^*(\sigma)} \tag{3.2}$$

In equation (3.2), the numerator m_r refers to the 'raw' form (i.e. not yet fulfilling the standard) of imports of good 1. The denominator is equal to the price of the 'raw' form of good 1 (equal to 1), plus the net cost

[7] As extensively argued in WTO (2012), there are several possible reasons for the imposition of a 'behind-the border' non-tariff measure, such as a product standard. A standard might correct for a market failure, it might be imposed as a beggar-thy-neighbour policy, it might respond to equity concerns or it might address political economy considerations. While the Gulati and Roy (2008) model explicitely models the standard as a policy to correct for a market failure (namely, a pollution externality generated by the consumption of good 1), we do not need to specify the rationale for the standard in this context.

[8] From now on, the argument in the subscript will indicate a partial derivative. So, for instance, $\phi_\sigma \equiv \partial\phi(\sigma)/\partial\sigma$ and $\phi_{\sigma\sigma} \equiv \partial^2\phi(\sigma)/\partial\sigma^2$.

[9] See, for instance, German Institute for Standardization (DIN) (2000), where in Part A ('Benefits for business') at least eight different rationales are given why meeting a standard may be beneficial to firms. Besides the benefits we highlight in the text, related to quality competition and signalling and to certification-related cost reductions, the study also discusses, for example, the role of standards in realizing network economies or in knowledge transmission.

[10] Once the fixed cost of certifying that a product meets a given standard is paid and certification is obtained, the need for inspection of individual items, and hence the related inspection costs, are reduced.

[11] The concavity of $\psi(\cdot)$ is consistent with economic logic (decreasing marginal benefits). In other words, concavity ensures that the firm does not obtain increasing returns to scale from adopting the standard. The assumptions on $\phi(\cdot)$ and $\psi(\cdot)$, together, imply that $\chi(\cdot)$ is continuous and twice differentiable, with $\chi(0) = (\phi_\sigma/\psi_\sigma)|_{\sigma=0} = 0$.

borne by exporters in meeting the standard σ, $\chi^*(\sigma) \equiv \frac{\phi^*(\sigma)}{\psi^*(\sigma)}$.[12]

With positive imports, subject to a specific import tariff τ (and the standardization process by foreign suppliers), the effective consumer price for one unit of the imported good is:[13]

$$p^* = 1 + \chi^*(\sigma) + \tau \tag{3.3}$$

Consumers buy the domestically produced good only if the consumer price of the domestically produced good is no greater than that of the imported good. Therefore, (3.3) is also the effective consumer price for one unit of the domestically-produced good. By selling at this price, domestic producers of good 1 get an effective producer price equal to:

$$p = \frac{1 + \chi^*(\sigma) + \tau}{1 + \chi(\sigma)} \tag{3.4}$$

Given profit maximization and equation (3.4), the profit function of domestic producers, $\pi(p)$, can be written as $\pi(p) = \pi(\sigma, \tau)$. In the initial situation, the standard is set as σ_0 and the tariff at τ_0. The profit function is therefore $\pi(p_0) = \pi(\sigma_0, \tau_0)$.

To evaluate the incentives for producers to lobby for policy substitution, consider a new situation in which the tariff falls to $\tau_1 < \tau_0$.[14] The standard that makes domestic producers indifferent between the initial and the new situation, which we define as σ_1, is implicitly defined by the following condition:

$$\pi(p(\sigma_1, \tau_1)) = \pi(p(\sigma_0, \tau_0)) \tag{3.5}$$

which states that profits are unchanged between the initial situation with a standard σ_0 and a tariff τ_0 and the new situation with a standard σ_1 and a tariff τ_1. This condition is satisfied when $p(\sigma_1, \tau_1) = p(\sigma_0, \tau_0)$.

[12] Unlike Gulati and Roy (2008), we assume that foreign exporters need to meet the same standard σ, rather than a foreign-specific standard σ^*, to be able to export good 1 to the home market. The function $\phi^*(\cdot)$ is, like $\phi(\cdot)$, increasing and strictly convex ($\phi^*_\sigma > 0$, $\phi^*_{\sigma\sigma} > 0$), with $\phi^*(0) = 0$. And ψ^* is increasing and strictly concave ($\psi^*_\sigma > 0$, $\psi^*_{\sigma\sigma} < 0$), with $\psi^*(0) = 0$. Therefore, $\chi^*(\cdot)$ is continuous and twice differentiable, with $\chi^*(0) = (\phi^*_\sigma/\psi^*_\sigma)|_{\sigma=0} = 0$.

[13] Note that exporters are willing to sell to Home only if the price they could receive for one unit of good 1 (equal to 1) equals the revenue from selling the good after meeting the standard and after paying the import tariff. Thus $1 = p^* \left[\frac{1}{1+\chi^*(\sigma)+\tau}\right]$. Equation (3.3) follows directly from this expression.

[14] We do not model, in this context, the determination of tariffs. The basic intuition we exploit is that – in a political economy setting (such as 'protection for sale') applied to the baseline model with costly standards – domestic producers lobbying for protection might accept tariff reductions only if product standards are adjusted to restore their competitive advantage *vis-à-vis* foreign exporters.

Setting, for simplicity, $\tau_1 = 0$, redefining $\tau_0 \equiv \tau$ and $\sigma_1 \equiv \sigma$ and using (3.4), the iso-profit condition becomes:

$$\frac{1+\chi^*(\sigma_0)+\tau}{1+\chi(\sigma_0)} = \frac{1+\chi^*(\sigma)}{1+\chi(\sigma)} \tag{3.6}$$

Solving equation (3.6) for τ and totally differentiating, we obtain:

$$\frac{d\sigma}{d\tau} = -\omega \frac{[1+\chi(\sigma)]^2}{\chi^*_\sigma [1+\chi(\sigma)] - \chi_\sigma [1+\chi^*(\sigma)]} \tag{3.7}$$

where $\omega \equiv \frac{1}{1+\chi(\sigma_0)} > 0$.[15] Clearly, the sign of (3.7) depends on the sign of the expression $\chi^*_\sigma [1+\phi(\sigma)] - \chi_\sigma [1+\phi^*(\sigma)]$. If this expression is positive, $d\sigma/d\tau < 0$, implying that the standard and the tariff are negatively related (policy substitution). If this expression is negative, $d\sigma/d\tau > 0$, implying that the standard and the tariff are positively related (policy complementarity).

We now consider two cases separately: standards that only represent a cost and standards that are both costly and beneficial to producers.

3.1 Costly standards

To begin with, we assume that the standard only entails a cost for producers, as in Gulati and Roy (2008). Normalizing $\psi(\sigma) = \psi^*(\sigma) = 1 \ \forall \ \sigma$, the $\chi(\cdot)$ function reduces to $\phi(\cdot)$ and the $\chi^*(\cdot)$ function reduces to $\phi^*(\cdot)$. Equation (3.7) becomes:

$$\frac{d\sigma}{d\tau} = -\lambda \frac{[1+\phi(\sigma)]^2}{\phi^*_\sigma [1+\phi(\sigma)] - \phi_\sigma [1+\phi^*(\sigma)]} \tag{3.8}$$

where $\lambda \equiv \frac{1}{1+\phi(\sigma_0)} > 0$. Intuition is further improved by making the following proportionality assumption: $\phi^*(\sigma) \propto \phi(\sigma)$. Specifically, we let:

$$\phi^*(\sigma) = \kappa\phi(\sigma) \qquad\qquad \kappa > 0 \text{ and } \kappa \neq 1 \tag{3.9}$$

Since, by assumption, the $\phi(\cdot)$ functions are continuous and always convex in their domain, it is also the case that $\phi^*_\sigma \propto \phi_\sigma$. In particular, using (3.9), $\phi^*_\sigma = \kappa\phi_\sigma$. With these proportionality conditions, equation (3.8) is

[15] To derive (3.7), we have assumed that σ_0 is exogenously given, so that $d\sigma_0 = 0$.

rewritten as:

$$\frac{d\sigma}{d\tau} = -\lambda \frac{\left[1+\phi(\sigma)\right]^2}{\phi_\sigma} \frac{1}{\kappa - 1} \tag{3.10}$$

Like in Gulati and Roy (2008), we now define 'cost advantage' in meeting the standard.

Definition 1. The domestic industry has a cost advantage in meeting the standard σ relative to foreign exporters if $\phi^*_\sigma/\phi_\sigma \equiv \kappa > 1$. The domestic industry has a cost disadvantage in meeting the standard σ relative to foreign exporters if $\phi^*_\sigma/\phi_\sigma \equiv \kappa < 1$.

Since $\lambda > 0$ and $\phi_\sigma > 0$, the sign of the relationship in (3.10) only depends on the cost advantage parameter κ. If the domestic industry has a cost advantage ($\kappa > 1$), the standard will be negatively related to the tariff (policy substitution). If, conversely, the domestic industry has a cost disadvantage ($\kappa < 1$), the standard will be positively related to the tariff (policy complementarity).

The intuition behind this result is simple. If domestic producers find it relatively less costly than foreign producers to meet a given standard, they will want the standard to be tightened after tariff liberalization to restore their competitive advantage *vis-à-vis* foreign exporters. Conversely, if they find it relatively more costly than foreign producers to meet a given standard, they will resist a tightening of the standard after tariff liberalization in order not to see their competitive position *vis-à-vis* foreign exporters being further eroded.

3.2 Costly, but beneficial, standards

In our second scenario, where standards entail both costs and benefits for producers, the functions $\psi(\cdot)$ do not simplify to a constant. Impose the proportionality assumption (3.9) for the $\phi(\cdot)$ functions and the following proportionality assumption for the $\psi(\cdot)$ functions:

$$\frac{\psi^*(\sigma)}{\psi(\sigma)} = \frac{\psi^*_\sigma}{\psi_\sigma} = \delta \qquad\qquad \delta > 0 \text{ and } \delta \neq k \tag{3.11}$$

where the first equality in (3.11) stems from the fact that, by assumption, the $\psi(\cdot)$ functions are continuous and always concave in their domain.

Using the proportionality conditions, we can rewrite equation (3.7) as:

$$\frac{d\sigma}{d\tau} = -\omega \frac{\left[1+\chi(\sigma)\right]^2}{\chi_\sigma} \frac{1}{\frac{\kappa}{\delta}-1} \tag{3.12}$$

The sign of this expression depends both on the sign of χ_σ and on whether $\kappa \gtrless \delta$. The sign of χ_σ is, in principle, ambiguous, as it depends on whether $\phi_\sigma \psi(\sigma) \gtrless \psi_\sigma \phi(\sigma)$. In the following, we present an illustration in which χ_σ is positive, i.e. the reasonable scenario where for higher levels of the standard, net costs increase. We can therefore focus on the economically meaningful term $\frac{\kappa}{\delta} - 1$.

3.2.1 Illustration

With little loss of generality, let the $\phi(\cdot)$ and $\psi(\cdot)$ functions take the following functional forms:

$$\phi(\sigma) = \sigma^\theta \qquad \theta > 1 \tag{3.13}$$

$$\psi(\sigma) = \sigma^\gamma \qquad 0 < \gamma < 1 \tag{3.14}$$

In this case, $\chi_\sigma = \sigma^{\theta-(1+\gamma)}(\theta-\gamma) > 0$. The sign of $d\sigma/d\tau$ in (3.12) will only depend on whether $\kappa \gtrless \delta$. We can now define 'net cost advantage' in meeting the standard.

Definition 2. The domestic industry has a net cost advantage in meeting the standard σ relative to foreign exporters if $\phi^*_\sigma/\phi_\sigma = \kappa > \delta = \psi^*_\sigma/\psi_\sigma$. The domestic industry has a net cost disadvantage at meeting the standard σ relative to foreign exporters if $\phi^*_\sigma/\phi_\sigma = \kappa < \delta = \psi^*_\sigma/\psi_\sigma$.

In the presence of a net cost advantage in meeting the standard, domestic producers will want the standard to be tightened after tariff liberalization to restore their competitive advantage *vis-à-vis* foreign exporters. Conversely, if the relative net costs of domestic producers exceed those of foreign producers, the former will oppose a tightening of the standard in order not to see their competitive position *vis-à-vis* foreign exporters being further eroded. The interesting implication of this scenario is that domestic producers can benefit from a standard even if $\kappa < 1$ (i.e. if they suffer from a pure cost disadvantage) as long as $\delta > \kappa$ (i.e. the marginal cost disadvantage is more than compensated for by the marginal benefit advantage relative to

foreign producers).[16] Therefore – assuming that domestic producers succeed in lobbying the government to implement their preferred policy mix – we can expect policy substitution, rather than policy complementarity, to occur when the benefits from adopting a standard are sufficiently large for domestic producers, even if fulfilling the standard may be more costly than for producers abroad.

In the empirical application of the model, we will use the level of a country's economic development (in the baseline estimations, OECD membership) as a proxy measure for 'cost advantage'. This is a realistic assumption, which is widely supported by the data on product standards compliance costs collected by the World Bank for a range of countries at different levels of development.[17] Furthermore, on the benefit side, it could be argued that product standards used in the SPS domain may be of particular importance, as compared to the universe of TBT measures. The reason for this is that SPS measures *exclusively* deal with the policy objectives of life and health protection set forth in Article 2.1 of the SPS Agreement. In the *EC – Asbestos* case, the WTO Appellate Body recognized these objectives as being "both vital and important in the highest degree".[18] By contrast, life and health considerations also feature in Article 2.2 of the TBT Agreement, but only as one of several possible objectives contained in a list that, in addition, is characterized as being non-exhaustive.[19]

Before discussing our empirical strategy to test the implications of the model, we present in the next section detailed information contained in the STC datasets, which we use to construct the main dependent variable of our study.

4 Specific Trade Concerns

Specific Trade Concerns are raised, orally or in written form, by individual WTO members in the TBT or SPS committees and refer to trade problems in relation to specific TBT or SPS measures maintained by

[16] See for instance Anderson et al. (2004) showing different marginal benefits for EU and US farmers in relation to certain standards, as a function of average farm sizes.

[17] See Wilson and Otsuki (2004) for a detailed description of the World Bank's Technical Barriers to Trade Database. Using this data, Maskus et al. (2005) present descriptive statistics and econometric evidence in line with our assumption that 'cost advantage' can be proxied by the level of economic development.

[18] WTO (2001a), para. 172. In fact, in the *Korea–Beef* case, the WTO Appellate Body had already ruled that "[t]he more vital or important those common interests or values are, the easier it would be to accept as 'necessary' a measure designed as an enforcement instrument" (WTO, 2001b, para. 162).

[19] See also Swinnen and Vandemoortele (2009) for a political-economy model explaining differences in standard-setting for different types of risk.

other countries. The WTO's Information Management System (IMS) contains information about STCs. For each concern, it reports the maintaining country, the HS product codes affected by the measure and the date of initiation.[20] We consider STCs raised between 1996 and 2011 (included). Table A-1 provides a full list of countries involved as maintaining countries in SPS and/or TBT STCs.

Table 1 collects information on the number of concerns, the number of maintaining countries and the number of HS headings and chapters covered, both for TBT and SPS concerns.

< Table 1 about here >

In the area of TBT, 327 STCs were raised between 1996 and 2011. Out of these, we were able to identify HS codes for 291 concerns. In the area of SPS, we were able to identify HS codes for 269 out of the 326 STCs raised over the period under analysis. An HS code could not be assigned in cases in which: i) there was no information on the members maintaining the measure (indicated as 'certain members' in the original data); or ii) the contested measure was too broad in scope. An example of a concern with no information on maintaining members is SPS concern number 124, raised by the US on 'notifications [by unspecified countries] related to avian influenza'. An example of a concern that is too broad in scope for our analysis is SPS concern number 117, raised by Argentina, Canada and the US *vis-à-vis* the EU, on 'traceability and labelling of [products that contain or comprise] genetically modified organisms and food and feed [products produced from genetically modified organisms]'.

As mentioned in Section 1 and further discussed in Section 5, our identification strategy relies on the use of STCs based on new measures. For each TBT and SPS concern with information on HS codes, we have recorded the date of introduction of the underlying measure by the maintaining country, whenever available. In cases in which an STC refers to a notified measure, we have checked the notification by the maintaining country. In all other cases, we have looked for information on the date of introduction of the measure in the STC description in the WTO's IMS. If such information was not available, we have searched for it in the domestic legislation of the maintaining country. In cases of uncertainty, we have consulted WTO experts who regularly attend and service TBT and SPS Committee meetings.

[20] For the purposes of this study, we have engaged in substantial re-coding of the SPS dataset, to ensure consistency. The final dataset, with consistent HS-4 coding across SPS concerns, is available upon request. A consistently-coded TBT dataset was already publicly available (see `http://www.wto.org/english/res_e/publications_e/wtr12_dataset_e.htm`). For TBT, we simply extended the dataset to include the STCs raised in the second half of 2011.

Table 1 shows the resulting classification of STC-related measures. In the table, 'new measures' refer to measures introduced by country i during the year of the STC initiation (t), or the year before ($t-1$); 'old measures' refer to measured introduced by country i in year $s < t-1$. To remain on the conservative side, we have decided to code as 'uncertain' – and to drop in the econometric estimations – not only STCs for which we could not find any information on the year of introduction of the related measure, but also STCs that we strongly suspected to be based on a new measures, but for which we could not find definitive evidence in support of this presumption. In the TBT sample, 258 STCs refer to new measures, accounting for 88.7% of the 269 STCs potentially usable in the estimations. In the SPS sample, 185 STCs out of 269, that is 68.8%, are based on new measures.

Overall, 40 WTO members (10 OECD, 30 non-OECD) were involved at least once as maintaining country in a TBT concern. This roughly amounts to 29% of WTO members (considering an overall average membership of 140 between 1996 and 2011). The number of members involved as maintaining country in an SPS concern is 59 (15 OECD, 44 non-OECD), which roughly amounts to 40% of WTO members.[21]

There are 82 HS chapters (HS 2-digit codes) covered by at least one TBT concern, out of 99 chapters contained in the HS classification. In terms of HS headings (HS 4-digit codes), 919 are covered out of the 1241 headings under the HS system. The corresponding figures for SPS are quite different. SPS STCs cover less HS chapters (33) and HS headings (219) than TBT STCs. This is not surprising, because, as discussed below, SPS measures cover almost exclusively a subset of animal and vegetable products and foodstuffs. In contrast, the almost ubiquitous nature of technical regulations and product standards covered by the WTO's TBT Agreement explains the wide sectoral coverage of TBT STCs.

The last two rows of Table 1 report that the average number of HS headings covered by a TBT STC is 34.1, while the median is equal to 4. That is, labelling HS 4-digit codes as 'sectors', one half of the TBT concerns cover less than 4 sectors, the other half covers more than 4 sectors. Each SPS concern, instead, covers a limited number of HS headings (7.8) on average. The median (5) is however higher than in the case of TBT STCs. This indicates that for TBT the mean is inflated by a few STCs covering a very large number of HS headings.

[21] We do not report the number of raising countries because our unit of observation is a combination HS heading-maintaining country in a given year. Also, in this study, the European Union counts as a single country.

Figure 1 clearly shows that TBT measures can be found across a wide array of sectors, while SPS measures cover almost exclusively a small subset of sectors. As the figure indicates, SPS concerns are concentrated in HS sectors 01-05 ('Animal & Animal Products'), 06-15 ('Vegetable Products') and 16-24 ('Foodstuffs'), while TBT concerns are much less concentrated and also cover sectors such as HS 28-38 ('Chemicals & Allied Industries'), 39-40 ('Plastics / Rubbers'), 50-67 ('Textiles and Footwear') and 84-85 'Machinery / Electrical').

< Figure 1 about here >

The evolution of the number of TBT and SPS concerns over time is shown in Figure 2.[22] In SPS, there is a wide fluctuation in the number of STC initiations. The peaks of 1997-8, 2001-3 and 2005 roughly correspond to the outbreakes of the avian influenza, the foot-and-mouth (FMD) disease and the bovine spongiform encephalopathy (BSE, or 'mad cow disease'), respectively.[23]

For TBT concerns, there seem to be three distinct trends. A period of low activity between 1996 and 2001; a spike in 2002, followed by a declining trend until 2004; and an increasing number of STCs since 2005 (with the only exception being the year 2010). The absence of pronounced peaks in the case of TBT may be explained by the fact that, contrary to SPS measures, the demand for technical regulations and product standards is more or less steady rather than subject to sudden 'crisis'-related surges.

< Figure 2 about here >

The evolution of TBT and SPS concerns is disaggregated by country group in the left and right panels of Figure 3, respectively. It can be seen that the trends identified for TBT concerns – and the peaks in SPS STCs – are not systematically driven by a particular group of countries.

< Figure 3 about here >

[22] The figure includes all raised concerns, not only the ones for which an HS code could be identified or the subset of STCs based on new measures. Exclusion of STCs without HS codes or of STCs that are not based on new measures would make no relevant difference.

[23] Even during these episodes, the nature of concerns varied widely, with several STCs covering issues such as pesticide maximum residue level (MRL) in food products, just to mention one.

5 Empirical strategy

In this section, we provide empirical evidence of the central prediction of our model linking the probability of observing trade policy substitution to country and sector attributes that define a relative net cost advantage in meeting a standard. To that end, we estimate the determinants of the probability that a maintaining country's TBT or SPS measure is subject to a Specific Trade Concern (STC). We establish our dependent response as a Bernoulli random variable taking a value of 1 if in a given year t an STC against country i was raised by *any* other country.

There are two main reasons why we do not exploit the bilateral dimension of STCs. First, a country may engage in 'bandwagoning' – raising a concern just because other members have decided to raise it, despite not being directly affected by the measure. Alternatively, it may free-ride on other countries' initiative to raise a concern, even if it is directly affected by the measure. Yet another possibility is that a country's capacity to raise concerns is constrained (owing, for instance, to the small size of its delegation to the WTO), and therefore it only focuses on the most sensitive issues. Such types of behaviour are naturally difficult to detect and to measure without making potentially large errors. In the raw data, there are several concerns involving 'supporting' countries, beyond the maintaining and the raising ones. It would be unclear whether to include them or not in a bilateral dataset.[24] Reading through the minutes of the meetings in the TBT and SPS committees, it is also apparent that the order of interventions matters. A concern against country i may be recorded with, say, Japan as raising country and, say, Canada as supporting country just because the delegate of Japan was given the floor before the delegate from Canada.[25]

The second reason why we decided to forego the bilateral variation of STCs is that TBT and SPS measures are, in principle, non-discriminatory. This is a basic obligation of the TBT and SPS Agreements (respectively, Article 2.3 and Article 2.1), and, for the question of policy substitution, it is also safe to presume that the origin of imports does not actually matter.

For a subset of SPS concerns, another piece of information exists that we choose not to employ. The raw

[24] A possible rule of thumb would be to include only those supporting' countries that send a written communication to the relevant committee. But why, then, should STCs that are only raised orally be included?

[25] It is impossible to ascertain whether Japan and Canada were both 'sufficiently' concerned about country i's measure to have acted by themselves (in which case each delegate would have raised a concern, independently of the order of interventions), or whether only Japan was concerned with country i's measure to begin with, while Canada learnt about it during the meeting and supported Japan's claim (in which case Canada would not have raised a concern, had the order of interventions been Canada, then Japan).

data indicates whether an STC is resolved and, if this is the case, the date of resolution. In principle, even for concerns that are not reported as resolved (including TBT ones), an arbitrary rule of thumb could be used to assign a resolution date.[26] Our interest is, however, not in the duration of STCs, but in their initiation. To initiate a concern, a raising country must overcome a fixed political cost and the opportunity cost of putting resources on the case. This is an indication that the measure at issue is, or has the potential to be, trade-restrictive. The duration of a concern, even if it was perfectly measured, would not provide any additional information on the relationship between pre-determined sectoral tariffs cuts in a given sector and the imposition of NTMs.[27]

The predictions of our theoretical model are given by equation (3.12). On the basis of this, we postulate the following econometric specification to determine the effects of past sectoral tariff cuts on STC initiations, controlling for other factors that could potentially affect such initiations:

$$\Pr\left[y_{ikt} = 1 \,|\mathbf{x}_{ikt}, \beta, \alpha_{ik}\right] = \Lambda(\alpha_{ik} + \mathbf{x}'_{ikt}\beta) \tag{5.1}$$

In equation (5.1), i indexes maintaining countries (importers); k indexes HS headings (4 digit sectors); t indexes years. $\Lambda(\cdot)$ is the logistic cdf with $\Lambda(z) = e^z/(1+e^z)$; α_{ik} are country-sector fixed effects. As described in Table 2, the left-hand side variable is an initiation dummy variable. It takes value one if there was an initiation in country-sector ik in year t, and value zero in all years $s \neq t$. Explanatory variables (also described in Table 2) are in the vector $\mathbf{x}_{ikt}$.

For estimation, we employ a conditional logit model. Given the way the dependent variable is constructed, this is a natural modeling strategy. It uses only information on ik's for which there is at least one STC inititation over the sample period, and discards all country-sector combinations in which there is no STC initiation.[28] The conditional logit is also the most conservative regression model that can be used with the data at hand, because it allows for identification within country-sectors over time, controlling for common

[26] A possible rule of thumb would be: if a concern is raised in year t, possibly re-raised any number of times until year $t+j$ and never raised again, consider it resolved in year $t+j+2$.

[27] Since TBT and SPS committees typically meet three times a year, it is possible that an STC is raised and resolved the same year. Since we focus on initiation, this is not a serious issue for our estimation strategy. For the SPS dataset, we have, however, conducted robustness analysis excluding concerns that are reported as resolved in the same year as, or one year after, their inititation (see Section 7.2 for details). The estimation results are unaffected.

[28] It turns out that for each ik there is at most one initiation between 1996 and 2011, both in the SPS and in the TBT datasets. Therefore, we do not have to worry about multiple initiations.

shocks related to business cycle fluctuations with year dummies.[29]

The main explanatory variable of interest is the tariff percentage change of maintaining country i in sector k. It is computed as the percentage *decrease* between $t-2$ and $t-1$. Although we cannot exclude *a priori* the possibility that tariff cuts are affected by the imposition of NTMs, which may in turn become subject to an STC, an identification strategy based on new measures (see Section 4) and lagged tariff cuts goes a long way in addressing concerns related to reverse causality. When compared to pre-existing NTMs, or to NTMs imposed in the wake of tariff cuts, NTMs imposed after one or two years are significantly less likely to affect the tariff cut itself. This is especially so when considering measures of general application and focused on consumer protection such as TBT or SPS measures, as compared, for instance, with anti-dumping measures that are specifically targeted at producers in a particular sector and trading partner. The reason is that the TBT and SPS measures subject to STCs need not be determined by the same political-economy processes (e.g., lobbying by import-competing firms) that affect the determination of tariffs.[30]

An additional advantage of using only those STCs that are based on new measures is that we can be more confident in the interpretation of our results. We rule out instances in which an STC is raised because a pre-existing NTM, which was not the binding constraint for foreign exporters under the initial tariff, becomes binding (in an economic, not legal sense) after the tariff cut.

The tariff used in this study is the minimum between the effectively applied rate (defined in WITS as the lowest available tariff, equal to the preferential tariff if it exists) and the MFN tariff. We compute tariffs in this way because any tariff reduction can, in principle, lead to policy substitution. Since most preferential tariff rates are fixed at zero (Keck and Lendle, 2012) and therefore cannot be reduced further, we believe that our approach is more conservative than an approach that uses MFN tariffs only.[31] As explained in Section 2, we do not use bound tariffs because policy substitution (in the sense of replacing one instrument of actual trade protection with another) can happen in the absence of reductions in bound rates, as countries are free

[29] We do not perform regressions with country-year fixed effects and sector dummies. There are two reasons why it would be incorrect to use variation within country-years across sectors. The first reason is econometric. This would be equivalent to dropping altogether those years in which countries did not experience any concerns and would therefore compromise the time series dimension of the data. The second reason is economic. Trade policy is, to a very large extent, sector-specific. Therefore, it would be hard to justify to consider the effects of tariff cuts in one sector on the probability that an NTM is imposed in another sector.

[30] Conversely, anti-dumping duties follow the same political-economy process as tariff formation. Establishing a direction of causality is therefore harder in studies using anti-dumping measures than in our case.

[31] In Section 7.2, we show that the main results (notably, policy substitution in developed countries in the TBT sample) are unaffected, if not strenghtened, when the analysis is conducted only with MFN tariffs.

to reduce applied tariffs at any time (and have indeed done so on many occasions).

We estimate our regressions separately for TBT and SPS to test for the expected differences in policy dynamics outlined in Section 3. If TBT and SPS measures are effectively used as policy tools to substitute for tariffs, the tariff percentage decrease will positively affect the probability that a concern is raised against country i in sector k. We control for a set of trade-related and macroeconomic variables that may affect the probability that an STC is brought against country i in sector k.

Trade-related control variables include:

- Tariff level, computed as the unweighted applied tariff in sector k in $t-2$. This variable can control for systematic differences across sectors, deriving, for instance from lobbying activity. As explained by Moore and Zanardi (2011), sectors with higher tariffs may be the ones that do not need other forms of protection (in the form of non-tariff barriers). In this case, the sign on this coefficient would be negative. Alternatively, one might argue that such sectors may be considered to be particularly 'sensitive' and, hence, will be protected with both tariffs and non-tariff barriers. In that case, the sign of the coefficient would be positive.

- Percentage change in imports of product k between $t-2$ and $t-1$. Since an increase in imports could lead to more demand for protection by the import-competing sector, we expect this variable to positively affect the probability that a concern is raised.

- Import share of product k in country i imports in $t-1$. If anything, the sign of this variable should be positive, assuming that the demand for protection by import-competing firms is especially intense in sectors with larger import shares.[32]

- World tariff change, measured as the percentage decrease in world average applied tariff in sector k between $t-2$ and $t-1$. If the world average tariff in a sector decreases, other countries might be engaging in policy substitution, applying non-tariff measures. This, in turn could induce country i to apply non-tariff measures as a form of retaliation. If anything, we therefore expect a positive sign on

[32]This is a 'protection-for-sale'-based argument, but it is not necessarily a strong prediction. According to Baldwin and Robert-Nicoud (2008), several rounds of reciprocal tariff cuts are likely to reduce the size and political influence of import-competing sectors, a process leading to large import shares and low levels of protection.

this variable.

Macroeconomic control variables include:

- The growth rate of GDP between $t-2$ and $t-1$, which controls for swings in the business cycle. Under the expectation that an economic upturn reduces protectionist pressure, this variable should negatively affect the probability that a concern is raised. On the other hand, faster economic growth could also increase regulatory demand from consumers, which would imply a positive coefficient.

- The level of GDP per capita in $t-1$, a measure of economic development that we introduce to control for regulatory capacity. Countries with higher GDP per capita may have higher capacity to design and implement standards and technical regulations that may act as non-tariff barriers. This would lead to a positive coefficient. However, higher regulatory capacity could also imply more transparency, which could reduce the likelihood that the importing country gets involved as a maintaining member in an STC.[33] This would lead to a negative coefficient.

- The annual inflation rate in country i in $t-1$. Higher inflation is an indicator of the economy approaching, or even exceeding potential output. The increased demand for factors of production should alleviate the pressure for trade policy intervention, and hence be reflected in an odds ratio less than one.

- The real effective exchange rate of country i in $t-1$. This is an inverse measure of the overall competitiveness at the country-level. Whether reductions in competitiveness trigger a protectionist response is in principle ambiguous. An appreciation of the real exchange rate due, fron instance, to Dutch Disease effects (Corden and Neary, 1982) could induce protectionist demands by the lagging tradeable sector(s). However, whether such demands will be taken into account by policymakers and, if so, by means of which policy instrument, is unclear. We therefore have no strong prior on the sign on this variable.

- The average current account (as percentage of GDP) between $t-2$ and $t-1$. This variable reflects, to a great extent, the trade balance of a country. A positive overall trade balance may be the result of

[33] The lack of regulatory transparency is a relevant driver of STCs. A substantial number of them are raised to seek clarification on existing measures, especially in SPS.

several positive bilateral trade balances. The initiation of an STC by country j *vis-à-vis* country i may be triggered by a large bilateral trade deficit. If this is so, the expected sign of this variable is positive.

A major implication of the theoretical model of Section 3 is that a country's level of economic development should affect the substitutability/complementarity relationship between tariffs and standards. If the benefits from adopting standards are not too large relative to the costs, policy substitution should occur in more developed economies (where meeting product standards is relatively less costly), whereas policy complementarity should occur in less developed economies (where meeting product standards is relatively more costly). To test this prediction, we add an interaction term to the empirical specification (5.1), equal to the product of the tariff percentage change and an OECD dummy, which, as noted in table 2, is equal to 1 if the maintaining country was an OECD member in $t-2$ (and therefore also in t).[34] If significant, the coefficient on this interaction term should be positive.

Although the theoretical model is silent on political economy aspects, we conjecture that the incidence of trade policy substitution should also vary across sectors depending on the 'policy space' available to countries to increase tariffs again at any time, without renegotiation or violation of international commitments. Reductions in applied tariffs may be less politically costly, and they may be associated with lower degrees of trade policy substitution, in sectors with 'deep' water.[35] We therefore add an interaction term to the empirical specification (5.1), equal to the product of the tariff percentage change and a tariff water dummy variable. As noted in Table 2, this variable is equal to 1 in ik observations in which the tariff water in $t-2$ is less than its median. We prefer to use the tariff water dummy, rather than the level of the tariff water, for three main reasons. First, since the dummy is based on the median, it suffers less from the relatively poor quality of data on bound tariffs. Second, computing and properly interpreting tariff water can be challenging and likely to induce severe errors.[36] Finally, using a dummy makes it easier to compare results with the

[34] OECD membership status and entry dates are indicated in Table A-1.

[35] In a recent paper, Kuenzel (2013) constructs a political-economy model showing that a lower tariff overhang (i.e. less water) increases the probability that a country breaches its obligations under a trade agreement in the event of a favourable productivity shock for its trading partner. The same logic could apply to our set-up. Foletti et al. (2011) argue that not all the difference between the bound and the applied tariff is effective policy space, notably because the bound tariff may be higher than the prohibitive one. However, they show that on average only around 31% of the tariff water is 'smoke' that does not represent truly available policy space. The other 69% does.

[36] Using theoretically sound measures of tariff water, Foletti et al. (2011) estimate that the world's tariff water is 11%, with significant variations across countries (with high-income countries having a level of tariff water equal to 7%, middle-income countries 16% and low-income countries 36%) and across sectors (tariff water is around 27% in agriculture and around 9% in manufacturing). In our analysis, Table 3 indicates that the median of tariff water, used to define the water dummy, is equal to 11.6% in the TBT sample and to 21.7% in the SPS sample. With HS4 data varying across years, it is not possible

OECD interaction term. If significant, the coefficient on the interaction term between tariff reductions and the tariff water dummy should be positive.

< Table 2 about here >

6 Data and descriptive statistics

In this section, we present the data on the explanatory variables and related descriptive statistics, starting from the main variable of interest, namely tariffs. Tariff data are from the UNCTAD Trade Analysis and Information System (TRAINS) database. As argued in Section 5 above, we use the minimum between the effectively applied and the MFN tariff. Even with two duty types, there are several notorious gaps in data coverage. We partially address such gaps by making the following two assumptions:

i) if $\tau_{ik,t}$ is missing, but $\tau_{ik,t-1}$ and $\tau_{ik,t+1}$ are both non-missing and equal to each other (say, they are both equal to a value x), we replace $\tau_{ik,t}$ with this value x;

ii) we fill all gaps between two non-missing observations within each ik with linear interpolation.

Assumption i) is harmless and is made without apology. Assumption ii) could be considered somewhat more problematic. However, we believe this not to be a major concern, for two reasons. First, most of the gaps are only two or three years long. It does not appear to be too harmful to linearly interpolate between, say, the tariff level applied by country i in sector k in 2000 and the level applied in 2002 if information for 2001 is missing. Second, as described by Hoda (2001), tariff cuts negotiated in the Uruguay Round were implemented in a linear fashion, namely in five equal annual installments for industrial products and six equal annual installments for agriculture. For our purposes, the linear cuts are relevant where a cut in bound rates also implied a cut in applied rates.

We drop the first percentile of the percentage tariff change variable. This allows us to get rid of instances of extreme tariff increases that would bias the results. Consequently, as shown in Table 3, the variable ranges

to compute theoretically sound measures of tariff water. This is because time series information is not available for import demand elasticities. Even if such elasticities were available across years, we would need to aggregate them from HS6 to HS4, re-introducing some type of aggregation bias. Note, in any event, that the levels of tariff water that we report in Table 3 are broadly in line with the results of Foletti et al. (2011).

between -1.25 (125% tariff increase) and 1 (the tariff is reduced to zero) in the TBT sample and between -1.36 and 1 in the SPS sample.

< Table 3 about here >

The data show that there has been a clear reduction in tariffs in sectors affected by TBT and SPS concerns (see Figure 4). Between 1996 and 2011, the average, unweighted tariff applied by countries involved in TBT (SPS) concerns in sectors affected by such concerns fell from 13% (11%) to 5% (for both).[37]

< Figure 4 about here >

The average applied tariffs in TBT and SPS sectors are consistently higher in non-OECD that in OECD countries, as shown in Figure 5. However, and more importantly, the figure also shows that tariff reductions have occurred in *both* groups of countries between 1996 and 2011, and these reductions have been sizeable. In particular, for the group of OECD countries included in our sample, the average applied tariffs went down from 7.3 to 2.3% in TBT sectors, and from 7.8 to 2.1% in SPS sectors. Likewise, for the group of non-OECD countries included in our sample, the average applied tariffs went down from 15.2 to 6.2% in TBT sectors, and from 12.4 to 6.2% in SPS sectors. The size of the reduction in applied tariffs is larger in OECD countries (68% reduction in TBT sectors and 73% reduction in SPS sectors over the sample period) than in non-OECD countries (59% reduction in TBT sectors and 50% reduction in SPS sectors), but both groups have certainly made substantial cuts.

< Figure 5 about here >

Data on the other explanatory variables are from a variety of sources. Trade data are from UNCTAD TRAINS. Data on real effective exchange rates are from a database recently published by Bruegel (Darvas, 2012). All other macroeconomic variables are taken from the World Bank World Development Indicators (WDI) database. Table 3 provides summary statistics for all variables used in the TBT and SPS samples.

[37] Figure 4 also shows the evolution of the average tariff applied in all goods-sectors (HS chapters 01-97) by countries involved in TBT and in SPS concerns. It is apparent that the average tariff in TBT- and SPS-sectors did not decline faster or slower than in the rest of the economy, but rather followed a very similar trend, particularly after 2004.

7 Results

Tables 4 and 5 present the results for the TBT and the SPS sample, respectively. As indicated in the footnotes to each table, we use year dummies and country-sector (HS headings) fixed effects in all regressions. The standard errors are clustered accordingly by country-sector. The results are presented in terms of odds ratios, namely the change in the odds of the outcome (the probability that it takes a value of 1 relative to the probability that it takes a value of 0) for a one-unit increase in the predictor. An odds ratio greater than one means that the predictor increases the odds, less than one that it decreases the odds and, if it is one, or not significantly different from one, that it has no observed impact.

Both in tables 4 and 5, column (1) gives the results of a regression that only includes the tariff percentage change as explanatory variable. Columns (2) and (3) respectively add the trade-related and the macroeconomic controls discussed in Section 5. Columns (4) and (5) replicate the regressions of columns (1) and (3), respectively, adding an interaction term between the tariff change and the OECD-membership dummy. Columns (6) and (7) repeat the exercise of the two previous columns, using the tariff water interaction instead of the OECD interaction.

< Tables 4 and 5 about here >

We start with the TBT regressions of Table 4. The results of columns (1)-(3) indicate, for the whole sample, a positive and statistically significant effect of tariff reductions by country i in sector k on the probability that a TBT concern is filed against country i in sector k. Therefore, there is evidence of policy substitution on average in the TBT sample. The coefficient on the OECD interaction terms in columns (4) and (5) are largely above one and statistically significant. As we will further explain in Section 7.1 below, this implies that applied tariff cuts are associated with an increase in the probability of a TBT concern in the sample of OECD countries, and with a decrease in this probability in the sample of non-OECD countries. That is, the evidence of policy substitution obtained for the whole sample is driven by OECD countries. Conversely, in non-OECD countries there is evidence of policy complementarity. This fundamental difference across countries as a function of their level of development is in line with the first main hypothesis derived from our theoretical model, which predicts policy substitution (complementarity) in economies where meeting product

standards is relatively less (more) costly.

There are other possible explanations for our finding of policy substitution in OECD countries and policy complementarity in non-OECD countries in the TBT sample. An intriguing possibility is that developed countries may experience Bagwell and Staiger's (2014) 'globalization fatigue' (see Section 2). Developing countries, on the other hand, may be willing to reduce their overall level of protection to better integrate into global value chains. This may not only involve tariff liberalization (especially on intermediate products), but also the lifting of behind-the-border measures affecting trade.[38]

The results of columns (6) and (7) of Table 4 also indicate a difference between country-sector observations with shallow and deep tariff water. The coefficient on the tariff water interaction term is distinctly above 1. This implies policy substitution when tariff water is shallow, and policy complementarity when tariff water is deep. In part, this result is owed to the fact that OECD countries have relatively shallow tariff water, and we should, therefore, expect the results on shallow vs. deep tariff water to be in line with those on OECD vs. non-OECD countries. It should be kept in mind, however, that the correlation between the OECD dummy and the tariff water dummy is not very high (0.31 in the TBT sample). Hence, for TBT, there is *prima facie* evidence in support of our conjecture that reductions in applied tariffs in sectors with more policy space may reduce some of the political pressure for policy substitution.

All of the coefficients on the trade-related and macroeconomic control variables for which we have clear-cut predictions (set forth in Section 5) have the correct sign and are statistically significant. For the four variables for which we dit not have strong priors, the following results are obtained in the TBT sample. The tariff level has an odds ratio of less than one, indicating a negative effect of high sectoral tariffs on the probability that a TBT concern is raised. This is consistent with the insight that sufficiently high tariffs shield a sector from competition from abroad, leaving producers in less of a need for other forms of protection. An odds ratio below unity on GDP growth seems to suggest that slower economic growth may increase the demand for regulatory intervention to deliver a momentary respite to domestic producers. A higher level of GDP per capita is associated with a higher probability of facing a TBT STC, in line with the interpretation that rich countries regulate more given their higher level of regulatory capacity. The odds ratio associated with the

[38]See WTO (2014) for an analysis of the trade and trade-related policies that are conducive to integrating into regional or global value chains. See specifically Baldwin (2010) for an account of tariff liberalization as a means to join international production networks.

real effective exchange rate is less than one. This is consistent with the idea that sectors that are hurt by real exchange rate appreciation either become small enough for policymakers not to pay much attention to their demands for restoring their competitiveness, or they seek policy interventions other than TBT.

Consider now the results from the SPS sample, shown in Table 5. In all specifications, the coefficient on the main variable of interest, tariff percentage change, is significant and above one. Tariff reductions by country i in sector k are therefore associated with an increase in the probability that an SPS concern is filed against country i in sector k. This is evidence of policy substitution for the whole sample. The coefficients on the interaction terms in columns (5) and (7) (the specifications with all controls) are not statistically significant, indicating that there is policy substitution in both groups of countries (OECD and non-OECD) and in observations in sectors with shallow and deep tariff water. This result strongly supports the second main prediction of our theoretical model, postulating that policy substitution occurs even in high-cost countries if the benefits for producers from adopting product standards are sufficiently large. As we have explained extensively in Section 3, with SPS measures being exclusively about the primordial objectives of life and health protection, such benefits arguably are particularly prevalent in this area.

In the regressions of Table 5, the coefficients on the trade-related variables are generally not statistically significant. The main exception is a coefficient larger than one associated with the import share variables in columns (1)-(6). This is in line with our theoretical prediction. In columns (2) and (3), the coefficient associated with the tariff level variable is less than one and statistically significant. As in the case of TBT, higher sectoral tariffs reduce the need to obtain other forms of protection. Concerning the macroeconomic control variables, the signs of the variables for which expectations were ambiguous are opposite to what they are in the TBT regressions. This is another indiciation of the different regulatory dynamics across sectors where SPS, rather than TBT measures prevail. The coefficient on GDP per capita is less than one. In the SPS sample, therefore, higher regulatory capacity reduces the probability of being targeted by an STC. An intuitive explanation is that such capacity is also associated with more transparency and, in particular, with easier access to the scientific evidence that – unlike in the area of TBT – is explicitly required by Article 2.2 of the SPS Agreement as a justification for higher standards. A coefficient above one on GDP growth implies that for SPS an upswing in the business cycle may be associated with a higher demand for regulation

from consumers. The coefficient on the real effective exchange rate is also larger than one, which may point to some political pressure for regulation in response to a loss in competitiveness from producers that are concentrated in the few sectors affected by SPS measures (see Figure 1).

7.1 Economic significance

The odds ratios reported in Tables 4 and 5 indicate whether a given variable has a positive or negative effect on the probability that a concern is filed against country i in sector k. However, when discussing interaction terms in logistic regressions, Ai and Norton (2003) point out that odds ratios alone are not informative. Marginal effects could even be of opposite signs for given values of the interacted variables. To show that this is not the case for our estimations, we have computed marginal effects in the form of semi-elasticities. Table 6 presents the results for the whole sample. The results in column (1), which refer to TBT concerns, are calculated using the specification in column (3) of Table 4, while the results in column (2), which refer to SPS concerns, are calculated using the specification in column (3) of Table 5. The marginal effects are always positive, confirming the odds-ratios for the whole sample from tables 4 and 5 for any level of tariff liberalization.

< Table 6 about here >

In light of the results of columns (4)-(5) and (6)-(7) of Table 4, we have disaggregated the marginal effects for TBT concerns by country group (OECD vs. non-OECD) and by tariff water group (shallow vs. deep). The results are in Table 7. The table clearly shows that policy substitution holds only in the OECD group of countries, while policy complementarity holds in the non-OECD group. Moreover, the results indicate policy substitution (complementarity) in country-sector observations with shallow (deep) tariff water. Consider first columns (1) and (2). The estimated semi-elasticity when the tariff percentage reduction is equal to zero (first row) implies that reducing the tariff by 0.1% increases the probability of an STC initiation by 1.4%, relative to no change in tariff, for OECD countries. In the case of full tariff reduction, the probability of facing a concern rises (roughly) by 0.7% in OECD countries. For non-OECD countries, tariff reductions are associated with a decrease in the probability of TBT concerns, which is larger the larger the tariff reduction. The estimated semi-elasticity when the tariff percentage reduction is equal to zero implies that reducing

the tariff by 0.1% reduces the probability of an STC initiation by 2.3% relative to no change in tariff. In the case of full tariff liberalization, the probability of facing a concern falls (roughly) by 3.7%. A graphical representation of these heterogenous marginal effects across groups of countries for TBT concerns is given in panel (i) of Figure 6.

< Table 7 and Figure 6 about here >

Consider now columns (3) and (4). The estimated semi-elasticity when the tariff percentage reduction is equal to zero (first row) implies that reducing the tariff by 0.1% increases the probability of an STC initiation by 3.6%, relative to no change in tariff, when tariff water is shallow. In the case of full tariff liberalization, the probability of facing a concern rises (roughly) by 2.8-3.5% for shallow tariff water. Conversely, in the case of deep tariff water, tariff reductions are associated with a decrease in the probability of TBT concerns. In particular, reducing the tariff by 0.1% reduces the probability of an STC initiation by 2.6-2.8% relative to no change in tariff. A graphical representation of these heterogenous marginal effects for TBT concerns is given in panel (ii) of Figure 6.

7.2 Robustness

In this section, we show that the main result validating our theoretical model – policy substitution (complementarity) in developed (developing) countries in TBT – is robust across several different estimations. We further show that the result of policy substitution holding in both groups of countries in SPS is also robust to such different estimations. Conversely, the result on the tariff water dummy in the TBT sample, which does not rest on equally solid theoretical foundations, is not as robust.

A first robustness check that we have performed is the adoption of a linear probability model (LPM), using the same sample of regressions in tables 4 and 5. There are two main flaws in the LPM (Baum, 2013). The first one, which is widely recognized, is that its fitted values are not constrained to lie in the unit interval. The second, less recognized flaw, is that the error ε cannot be independent of any regressors, unless the matrix of explanatory variables X consists of a single binary regressor.[39] This violates the basic OLS orthogonality assumption. The LPM results presented in Table 8 are, therefore, to be taken with a grain of

[39]This arises because for any given X, ε must equal either $1 - X\beta$ or $-X\beta$ (β being the vector of coefficients associated with X). Clearly, these vectors are functions of all elements of X.

salt. Nonetheless, they are qualitatively the same as the baseline results, with policy substitution holding throughout in the SPS sample and holding only for OECD countries and for observations with shallow tariff water in the TBT sample.[40]

< Table 8 about here >

The second, and in our view most important, robustness check concerns the measurement of tariffs. In the baseline regressions, we have used the minimum between the effectively applied and the MFN tariff. By doing this, we may have included tariff cuts that only apply preferentially. We have re-estimated model (5.1), including the OECD and tariff water interactions, using only MFN tariffs. The results are in columns (1) and (2) of tables 9 and 10 for TBT and SPS, respectively. The main result of policy substitution in OECD countries, and policy complementarity in non-OECD countries in the TBT sample is confirmed and becomes even more economically significant. This can be visualized in panel (i) of Figure 7, where we plot the semi-elasticities estimated from column (1) of Table 9. Compared with the semi-elasticites represented in panel (i) of Figure 6, they are larger for OECD countries. The result of policy substitution in both groups of countries in the SPS sample is also confirmed (the odds ratio being largely above one in the first row of columns (1) and (2) of Table 10). In the TBT sample, the tariff water interaction loses statistical significance (see column (2) of Table 9 and the graphical representation of the interaction in panel (i) of Figure 8). Therefore, the evidence of policy substitution in TBT as a function of the water in the tariff is not robust to measuring tariffs as MFN.

< Tables 9 and 10 and Figures 7 and 8 about here >

A third robustness check concerns WTO membership. In both the TBT and the SPS samples, there are countries that acceded to the WTO after its creation in 1995. As indicated in Table A-1, these countries are Ecuador, Moldova, Saudia Arabia (TBT sample); Albania, Armenia, Jordan, Oman, Panama, the United Arab Emirates (SPS sample); China, Croatia, Qatar, Ukraine and Viet Nam (both samples). Following Aisbett and Pearson (2012), we exclude these countries from the sample. Columns (3) and (4) of tables

[40]The only difference between the results of Table 8 and the baseline results based on the conditional logit approach is that the LPM approach yields an odds ratio less than one for the whole sample in the TBT regressions of columns (1) and (2). This result from LPM is not only at odds with the first row of table 4, but also with the results we have obtained from all the conditional logit estimations of other robustness checks (results available upon request). Therefore, we can safely ignore it.

9 and 10 show results with WTO members as of 1995 only. The baseline results are not affected, as also graphically represented in panels (ii) of figures 7 and 8.

The two next robustness checks concern country groups. In the main regressions, we have used OECD membership to indicate whether a country is developed. Not every OECD country is, however, a 'high-income economy' (using the World Bank's definition). And there are several high-income economies that do not belong to the OECD. Moreover, some OECD countries are considered as 'developing' in the WTO. Developing country status in the WTO brings certain rights. There are for example provisions in some WTO Agreements which provide developing countries with longer transition periods before full implementation of the agreement. To address possible concerns related to country groupings, we have re-estimated the regressions of tables 4 and 5 using, instead of OECD membership, high income economy status and WTO-developing country status.[41] The regression results, reported in columns (5) and (6) of tables 9 and 10, are qualitatively similar to, and quantitatively larger than, the corresponding results of column (5) of tables 4 and 5. This can be clearly seen by confronting panel (i) of Figure 6 with panels (iii) and (iv) of Figure 7. Therefore we conclude that the results are robust to these alternative groupings of countries.

A final robustness check exclusively concerns the SPS sample. As mentioned in Section 5, for SPS concerns the date of resolution (if there has been one) is available. Some concerns were short-lived. They were reported as raised in year t and solved in year t or $t+1$.[42] The results of the SPS regressions that exclude STCs raised in year t and solved in year t or $t+1$ are shown in Table 11. These results are very similar to the baseline results of Table 5.

< Table 11 about here >

[41] High income economy status is a dummy variable equal to 1 if country i's GNI per capita, calculated using the World Bank Atlas method, is equal to or above the threshold set by the World Bank in year t (the data on thresholds is available at `https://datahelpdesk.worldbank.org/knowledgebase/articles/378833-how-are-the-income-group-thresholds-determined`). WTO-developing country status is a dummy equal to 1 for every country listed in Table A-1, with the exception of Australia, Canada, European Union (EU), Iceland, Japan, New Zealand, Norway, Switzerland and the United States. Czech Republic (EU entry in 2004), Hungary (2004), Poland (2004), Romania (2007), Slovak Republic (2004) and Slovenia (2004) only appear in the dataset until the year before their respective EU entry and are considered developing.

[42] Out of the 185 SPS concerns related to new measures, 64 have a reported date of resoution. Out of these, 4 were reported as solved in the same year in which they were raised. Thirteen concerns were reported as solved in the following year after being raised.

8 Conclusions

As tariffs have continued to come down over the years, increased attention in international policy circles has been given to NTMs. Specifically, the question to what extent governments use NTMs to restore previous levels of tariff protection has been raised. This paper has studied such 'trade policy substitution' from both a theoretical and empirical angle. We have shown that policy substitution is expected to occur when domestic producers have a *net* cost advantage in meeting a regulatory standard. This includes situations where compliance is less costly for producers abroad, but the benefits from adopting the standard are sufficiently large for domestic producers. Unlike existing approaches in the literature, our model can explain the occurrence of policy substitution both for reasons of import protection and in response to a genuine increase in the demand for regulation. This implies that the likelihood of policy substitution varies across countries and sectors where different conditions and policy objectives may prevail. Two main predictions emerge. First, we expect policy substitution to be more prevalent in advanced economies, where meeting a standard is comparatively less costly than in developing ones. Second, policy substitution is more likely to occur in sectors where the benefits from adopting a standard are important and possibly large enough to warrant the costs of compliance, even if these are comparatively high.

We have tested empirically these predictions using data on Specific Trade Concerns (STCs) raised in the WTO TBT and SPS Committees. This type of information is more suitable to address questions of policy substitution than the data used in previous empirical studies. In particular, STCs reflect actual trade problems in relation to NTMs compared to other NTM data sources that suffer from a multitude of well-documented conceptual and methodological shortcomings. Notably, STC data is preferable to information on anti-dumping duties, which is ill-suited to test for the replacement of generally applicable MFN tariffs through other means, due to the peculiar nature and design of such measures.

We have used a conditional logit model to estimate the effect of past tariffs cuts on the likelihood that an STC is brought against a country that puts in place a TBT or SPS measure, controlling for other relevant factors and conditioning on country-sector fixed effects. To address the issue of causality, we have employed an identification strategy that has made exlusive use of STCs related to 'new measures'. Consistently with the predictions of our model that policy substitution is more likely to occur when the costs of meeting

a product standard are relatively low, we have produced clear and robust evidence of policy substitution in advanced economies, both in the TBT and in the SPS samples. Our finding can also be interpreted as providing empirical support for the oft-quoted argument by Bagwell and Staiger (2014) that developed countries suffer from 'globalization fatigue', having bound their tariffs at relatively low rates. We have also found some evidence of policy substitution being more likely in sectors where 'tariff water' is shallow, i.e. where 'policy space' is limited, as highlighted elsewhere in the literature. However, this result, which is outside the predictions of our own model, is not confirmed in regressions that use MFN tariffs only.

While the occurrence of policy substitution is limited to advanced economies in the TBT sample, for SPS we have provided clear and robust evidence of policy substitution across all country groups and across sectors with shallow and deep tariff water. With SPS measures being exclusively about the primordial objectives of life and health protection, this result confirms the prediction from our model that policy substitution is more likely to occur when the benefits for producers from adopting product standards are large, even in a high-cost environment.

All these findings are remarkably stable using MFN tariffs only, various samples, country group definitions, and different estimation techniques.

In terms of magnitude, we have estimated the potential for policy substitution to be sizeable. For TBT, the probability of facing an STC in the whole sample rises by between 0.5 and 0.6%, depending on the level of tariff reduction. These averages mask significant heterogeneity across groups of countries. In OECD countries, the probability of facing an STC rises by between 0.7 and 1.4%. In non-OECD countries, the same probability shrinks by between 2.3 and 3.7%. In SPS, the probability of facing an STC in the whole sample rises by between 1.6 and 2.3%, without any significant difference across country groups. All the estimated semi-elasticities lie between quite narrow bands across different robustness checks.

Our paper has confirmed the significant scope for trade policy substitution in a world where the use of traditional means of protection, notably tariffs, becomes more limited. However, it is difficult – and beyond the scope of this paper – to make a clear distinction between those instances in which the increased use of NTMs such as standards reflects a legitimate policy response to evolving consumer concerns, as opposed to well-hidden protectionist motives. The shortage of economic analysis on this issue strongly contrasts with

the prominence of its discussion among lawyers. Robert Hudec, one of the most distinguished scholars in the field of international economic law, has famously argued in favour of applying a so-called 'aims-and-effects' test in certain trade disputes (Hudec, 1998). In the *Japan – Alcoholic Beverages II* case, the WTO Appellate Body, while criticizing the aims-and-effects test applied by the Panel, still conceded that "[A]lthough it is true that the aim of a measure may not be easily ascertained, nevertheless its protective application can most often be discerned from the design, the architecture, and the revealing structure of a measure" (WTO, 1996, p. 29). Given the importance of this question for international trade cooperation, more can be done to help analyze policy rationales from an economic point of view. Future work could seek to entangle the relative contribution that certain measures make to consumer protection vs. producer protection. As noted by Abel-Koch (2013), firm heterogeneity in productivity and size leads to different preferences regarding NTMs over tariffs, as the former entail an important fixed cost component. This suggests that the analysis could go beyond a sectoral dimension (as highlighted in the 'protection for sale' literature), and be conducted at the level of firms.

References

Abel-Koch, J., 2013, "Endogenous Trade Policy with Heterogeneous Firms," Discussion paper No. 1306, Johannes Gutenberg University Mainz.

Ai, C., and E. C. Norton, 2003, "Interaction terms in logit and probit models," *Economics Letters*, 80, 123–129.

Aisbett, E., and L. M. Pearson, 2012, "Environmental and Health Protections, or new Protectionism? Determinants of SPS Notifications by WTO Members," Crawford School Working Paper No. 12-13, Australian National University.

Anderson, K., R. Damania, and L. A. Jackson, 2004, "Trade, Standards, and the Political Economy of Genetically Modified Food," CEPR Discussion Paper No. 4526.

Anderson, S. P., and N. Schmitt, 2003, "Nontariff Barriers and Trade Liberalization," *Economic Inquiry*, 41, 80–97.

Bagwell, K., P. C. Mavroidis, and R. W. Staiger, 2002, "It's a Question of Market Access," *American Journal of International Law*, 96, 56–76.

Bagwell, K., and R. W. Staiger, 2001, "Domestic Policies, National Sovereignty and International Economic Institutions," *Quarterly Journal of Economics*, 116, 519–562.

Bagwell, K., and R. W. Staiger, 2014, "Can the Doha Round be a Development Round? Setting a Place at the Table," in Robert C. Feenstra, and Alan M. Taylor (ed.), *Globalization in an Age of Crisis: Multilateral Economic Cooperation in the Twenty-First Century*, University of Chicago Press.

Bajona, C., and J. Ederington, 2012, "Domestic Policies, Hidden Protection, and the GATT/WTO," available at `http://ssrn.com/abstract=2140943`.

Baldwin, R. E., 2010, "Unilateral Tariff Liberalisation," *The International Economy*, 14, 10–43.

Baldwin, R. E., and F. Robert-Nicoud, 2008, "A Simple Model of the Juggernaut Effect of Trade Liberalisation," Discussion Paper No. 845, Centre for Economic Performance (CEP), London School of Economics.

Battigalli, P., and G. Maggi, 2003, "International agreements on product standard: an incomplete contracting theory," NBER Working Paper No. 9533.

Baum, C. F., 2013, "Implementing new econometric tools in Stata," Mexican Stata Users' Group Meetings 2013 09, Stata Users Group. Available at `http://www.stata.com/meeting/mexico13/abstracts/materials/mex13_baum.pdf`.

Beghin, J., A.-C. Disdier, and S. Marette, 2014, "Trade Restrictiveness Indices in Presence of Externalities: An Application to Non-Tariff Measures," CESifo Working Paper No. 4968.

Bhagwati, J., 1988, *Protectionism*, MIT Press, Cambridge, MA.

Bown, C. P., 2014, "Trade policy instruments over time," World Bank Policy Research Working Paper No. 6757.

Bown, C. P., and P. Tovar, 2011, "Trade liberalization, antidumping, and safeguards: Evidence from India's tariff reform," *Journal of Development Economics*, 96, 115–125.

Brenton, P., 2001, "Anti-dumping policies in the EU and trade diversion," *European Journal of Political Economy*, 17, 593–607.

Broda, C., N. Limão, and D. E. Weinstein, 2008, "Optimal Tariffs and Market Power: The Evidence," *American Economic Review*, 98, 2032–65.

Copeland, B. R., 1990, "Strategic Interaction among Nations: Negotiable and Non-Negotiable Trade Barriers," *Canadian Journal of Economics*, 23, 84–108.

Corden, W. M., and J. P. Neary, 1982, "Booming Sector and De-Industrialisation in a Small Open Economy," *The Economic Journal*, 92, 825–848.

Darvas, Z., 2012, "Real effective exchange rates for 178 countries: a new database," Bruegel, Brussels.

Ederington, J., 2001, "International Coordination of Trade and Domestic Policies," *American Economic Review*, 91, 1580–1593.

Essaji, A., 2010, "Trade Liberalization, Standards and Protection," *The B.E. Journal of Economic Analysis & Policy*, 10, 1–21.

Feinberg, R. M., and K. Reynolds, 2007, "Tariff Liberalization and Increased Administrative Protection: Is There a Quid Pro Quo?," *World Economy*, 30, 948–961.

Fischer, R., and P. Serra, 2000, "Standards and Protection," *Journal of International Economics*, 52, 377–400.

Foletti, L., M. Fugazza, A. Nicita, and M. Olarreaga, 2011, "Smoke in the (Tariff) Water," *The World Economy*, 34, 248–264.

German Institute for Standardization (DIN), 2000, *Economic Benefits of Standardization*, Beuth Verlag, Berlin.

Goldberg, P. K., and N. Pavcnik, 2005, "Trade, wages, and the political economy of trade protection: evidence from the Colombian trade reforms," *Journal of International Economics*, 66, 75–105.

Gulati, S., and D. Roy, 2008, "National Treatment and the Optimal Regulation of Environmental Externalities," *Canadian Journal of Economics*, 41, 1445–1471.

Hoda, A., 2001, *Tariff Negotiations and Renegotiations under the GATT and the WTO: Procedures and Practices*, Cambridge University Press and World Trade Organization, Cambridge (UK) and Geneva.

Hudec, R. E., 1998, "GATT/WTO Constraints on National Regulation: Requiem for an "Aim and Effects" Test," *The International Lawyer*, 32, 619–649.

Keck, A., and A. Lendle, 2012, "New Evidence on Preference Utilization," Staff Working Paper ERSD-2012-12, World Trade Organization, Geneva.

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

Ketterer, T. D., 2014, "EU Antidumping and Tariff Cuts: Trade Policy Substitution?," GEP Research Paper No. 2014/05, University of Nottingham.

Kuenzel, D. J., 2013, "WTO Dispute Determinants," Job Market Paper, University of Washington. Available at http://econ.washington.edu/files/2013/12/kuenzel_jmpaper.pdf.

Limão, N., and P. Tovar, 2011, "Policy choice: Theory and evidence from commitment via international trade agreements," *Journal of International Economics*, 85, 186–205.

Maskus, K., T. Otsuki, and J. S. Wilson, 2005, "The Cost of Compliance with Product Standards for Firms in Developing Countries: An Econometric Study," World Bank Policy Research Working Paper No. 3590.

Milner, C., 2013, "Declining Protection in Developing Countries: Fact or Fiction?," *The World Economy*, 36, 689–700.

Moore, M. O., and M. Zanardi, 2011, "Trade Liberalization and Antidumping: Is There a Substitution Effect?," *Review of Development Economics*, 15, 601–619.

Staiger, R. W., 2012, "Non-tariff Measures and the WTO," Staff Working Paper ERSD-2012-01, World Trade Organization, Geneva.

Staiger, R. W., and A. O. Sykes, 2011, "International Trade, National Treatment, and Domestic Regulation," *The Journal of Legal Studies*, 40, 149 – 203.

Sturm, D., 2006, "Product Standards, Trade Disputes, and Protectionism," *Canadian Journal of Economics*, 39, 564–581.

Swinnen, J. F. M., and T. Vandemoortele, 2009, "Are food safety standards different from other food standards? A political economy perspective," *European Review of Agricultural Economics*, 36, 507–523.

Whalley, J., 2005, "Pitfalls in the Use of Ad Valorem Equivalent Representations of the Trade Impacts of Domestic Policies," CESifo Working Paper No. 1480.

Wilson, J. S., and T. Otsuki, 2004, "Standards and Technical Regulations and Firms in Developing Countries: New Evidence from a World Bank Technical Barriers to Trade Survey," available at http://siteresources.worldbank.org/INTRANETTRADE/Resources/Topics/Services/TBT_Data_Description.pdf.

World Trade Organization (WTO), 1996, "Japan – Taxes on Alcoholic Beverages (*Japan – Alcoholic Beverages II*)," Panel and Appellate Body Reports, WT/DS8/R, WT/DS10/R, WT/DS11/R and WT/DS8/AB/R, WT/DS10/AB/R, and WT/DS11/AB/R, adopted on 1 November, World Trade Organization, Geneva.

World Trade Organization (WTO), 2001a, "European Communities – Measures Affecting Asbestos and Asbestos-Containing Products (*EC – Asbestos*)," Panel and Appellate Body Reports, WT/DS135/R and WT/DS135/AB/R, adopted on 5 April, World Trade Organization, Geneva.

World Trade Organization (WTO), 2001b, "Korea – Measures Affecting Imports of Fresh, Chilled and Frozen Beef (*Korea – Beef*)," Panel and Appellate Body Reports, WT/DS161/R and WT/DS169/R, and WT/DS161/AB/R and WT/DS169/AB/R, adopted on 10 January, World Trade Organization, Geneva.

World Trade Organization (WTO), 2007, *World Trade Report 2007. Six decades of multilateral trade cooperation: What have we learnt?*, World Trade Organization, Geneva.

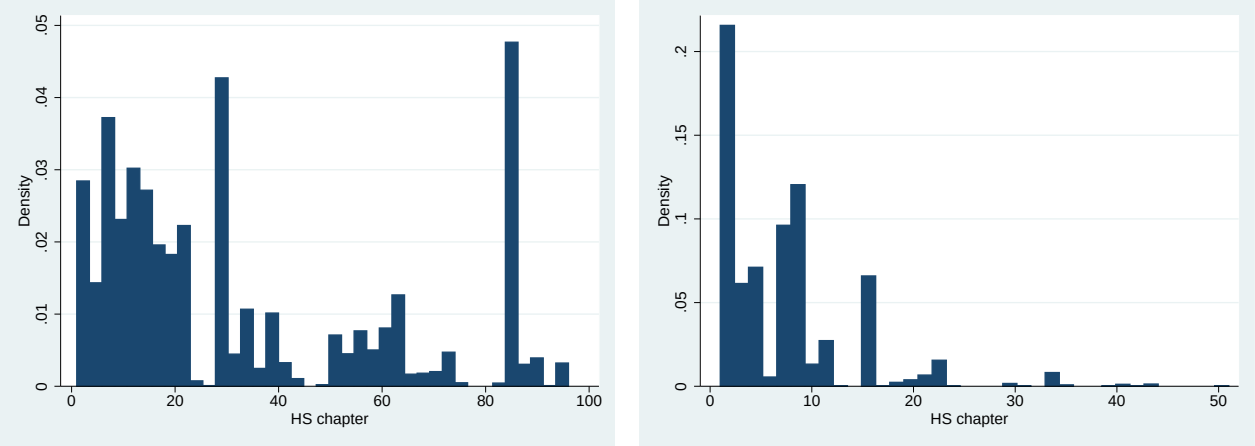
World Trade Organization (WTO), 2012, *World Trade Report 2012. Trade and public policies: A closer look at non-tariff measures in the 21st century*, World Trade Organization, Geneva.

World Trade Organization (WTO), 2014, *World Trade Report 2014. Trade and development: recent trends and the role of the WTO*, World Trade Organization, Geneva.

Yu, Z., 2000, "A model of substitution of non-tariff barriers for tariffs," *Canadian Journal of Economics*, 33, 1069–1090.

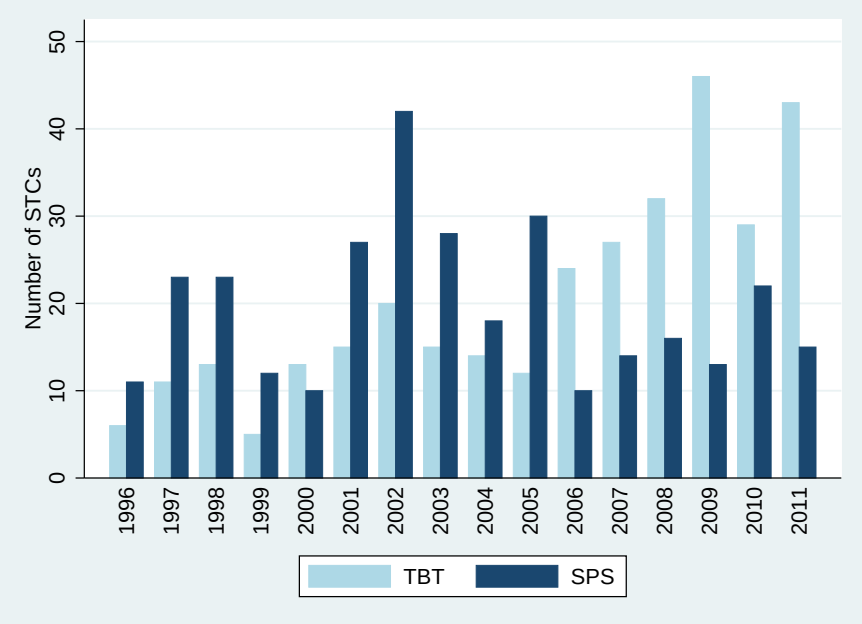
Figures

Figure 1: Sectoral distribution of TBT concerns (left panel) and of SPS concerns (right panel)



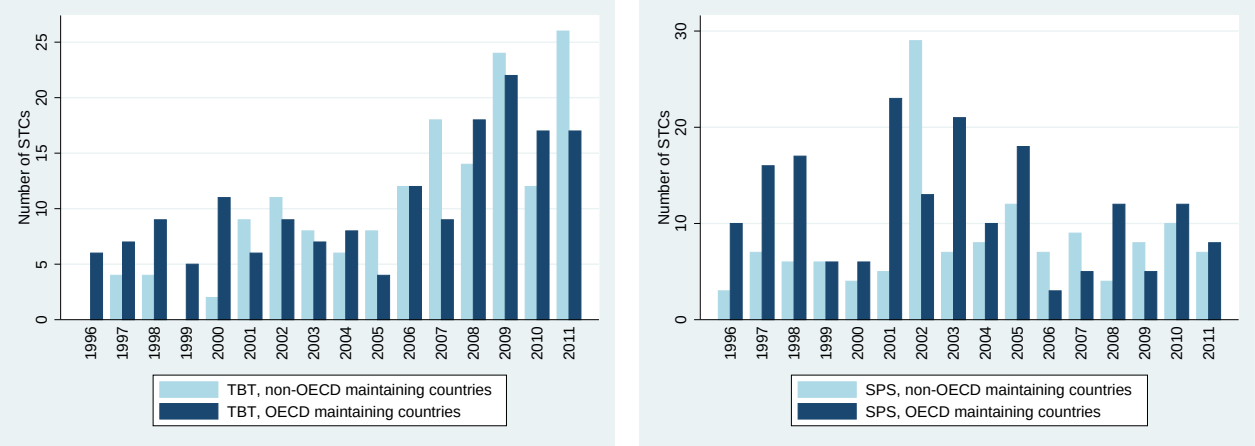
Source: Authors' calculations based on WTO Information Management System

Figure 2: Evolution of Specific Trade Concerns (STCs), 1996-2011



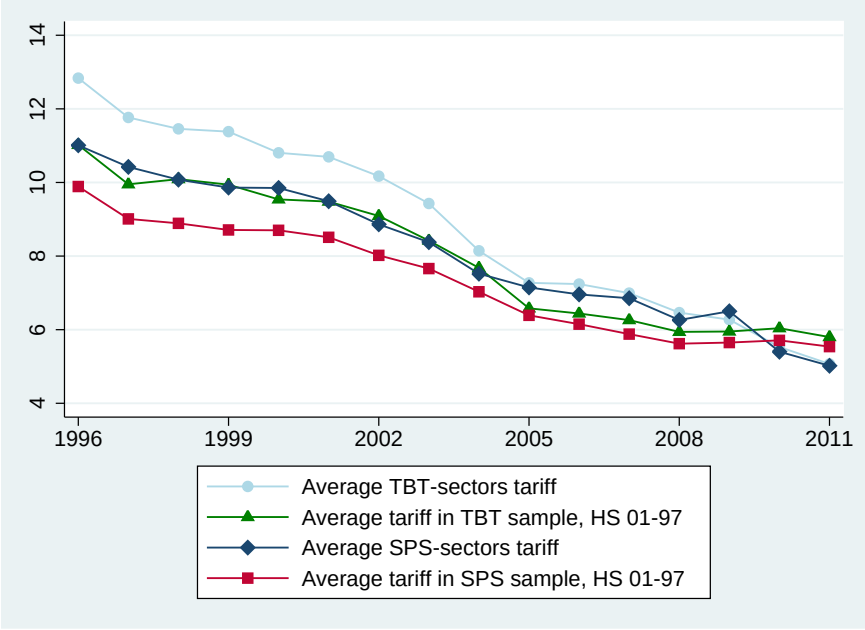
Source: Authors' calculations based on WTO Information Management System

Figure 3: Evolution of TBT and SPS concerns, OECD vs. non-OECD, 1996-2011



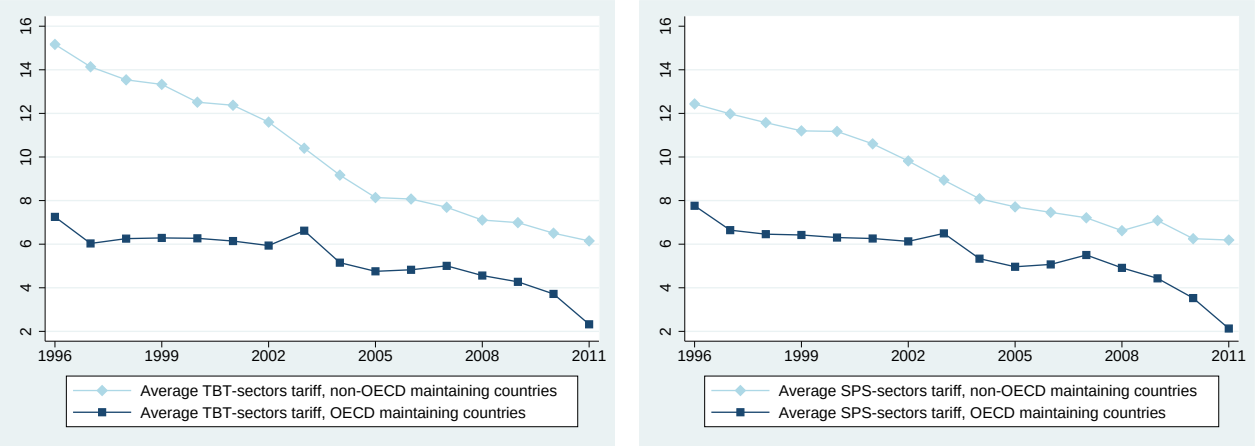
Source: Authors' calculations based on WTO Information Management System

Figure 4: Evolution of tariffs in TBT-, SPS- and all goods-sectors, 1996-2011 (%)



Source: Authors' calculations based on UNCTAD TRAINS
Note: Countries in TBT and SPS samples listed in Table A-1

Figure 5: Evolution of tariffs in SPS- and TBT-sectors, OECD vs. non-OECD, 1996-2011 (%)

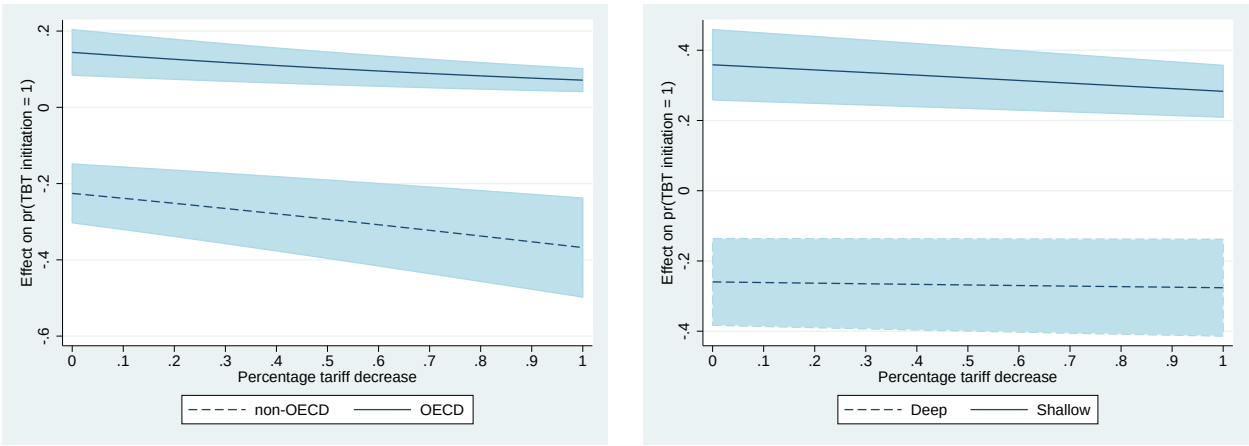


Source: Authors' calculations based on UNCTAD TRAINS

Figure 6: TBT, interaction effects

(i) OECD dummy

(ii) Water dummy



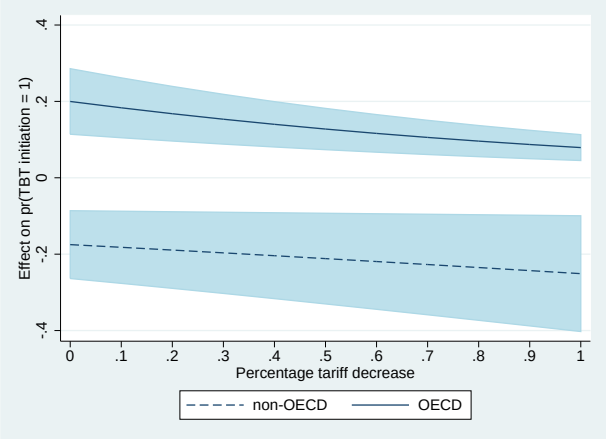
90 % confidence intervals based on Delta method

Panel (i): Semi-elasticities from columns (1) and (2) of Table 7

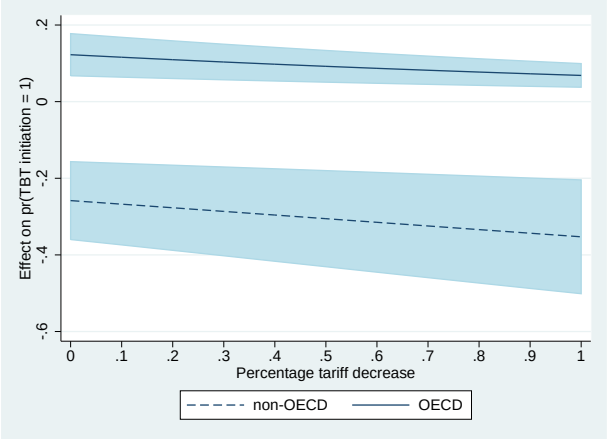
Panel (i): Semi-elasticities from columns (3) and (4) of Table 7

Figure 7: TBT, OECD interaction effects, robustness checks

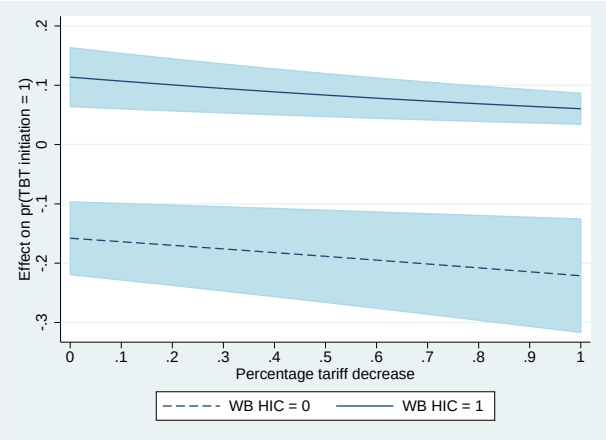
(i) MFN tariffs only



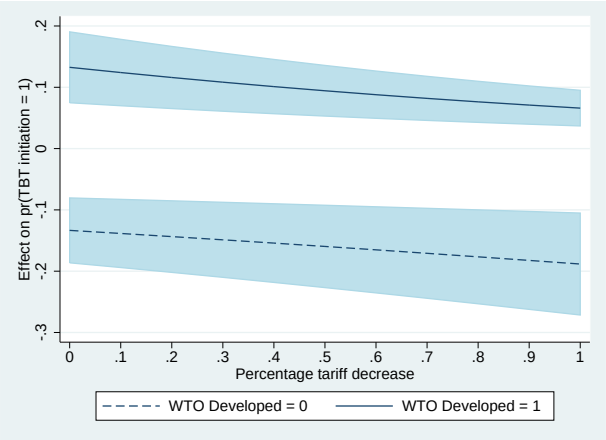
(ii) WTO members as of 1995



(iii) WB HIC



(iv) WTO developed



90 % confidence intervals based on Delta method

Panel (i): Semi-elasticities based on estimations in column (1) of Table 9

Panel (ii): Semi-elasticities based on estimations in column (3) of Table 9

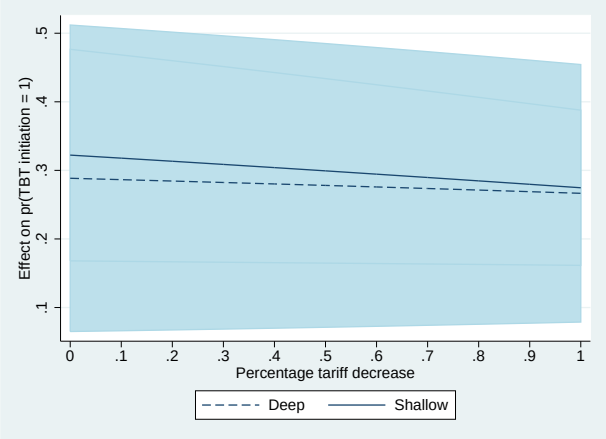
Panel (iii): Semi-elasticities based on estimations in column (5) of Table 9

Panel (iv): Semi-elasticities based on estimations in column (6) of Table 9

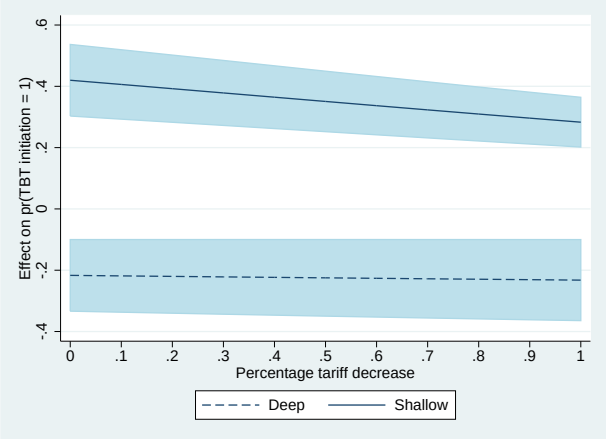
Semi-elasticities at means assuming the fixed effects to be zero

Figure 8: TBT, water dummy interaction effects, robustness checks

(i) MFN tariffs only



(ii) WTO members as of 1995



90 % confidence intervals based on Delta method
Panel (i): Semi-elasticities based on estimations in column (2) of Table 9
Panel (ii): Semi-elasticities based on estimations in column (4) of Table 9
Semi-elasticities at means assuming the fixed effects to be zero

Tables

Table 1: STCs: Sample outlook

	TBT	SPS
Sample period	1996-2011	1996-2011
Number of STCs	327	326
STCs with acquainted HS codes		
New measures	258	185
Old measures	17	70
Uncertain	16	14
Total	291	269
Number of maintaining countries		
OECD	10	15
non-OECD	30	44
Total	40	59
Distinct HS chapters covered	82	34
Distinct HS headings covered	919	211
Average HS headings covered by STC	34	8
Median HS headings covered by STC	4	5

Source: Authors' calculations based on WTO Information Management System

Table 2: Variables list

Variable	Description
TBT initiation (ikt)	Dummy equal to 1 if TBT STC is initiated against i in sector k in t
SPS initiation (ikt)	Dummy equal to 1 if SPS STC is initiated against i in sector k in t
Tariff % change (ikt)	Percentage tariff decrease between $t-2$ and $t-1$
Tariff level (ikt)	Unweighted applied tariff in $t-2$
Import share (ikt)	Import share of sector k of country i imports in $t-1$
Import % change (ikt)	Percentage change in imports between $t-2$ and $t-1$
World tariff % change (kt)	Percentage decrease in world average applied tariff in sector k between $t-2$ and $t-1$
GDP per capita (it)	Per capita Gross Domestic Product in $t-1$
GDP growth (it)	Gross Domestic Product growth between $t-2$ and $t-1$
Exchange rate (it)	Real effective exchange rate of country i in $t-1$
Inflation (it)	Annual inflation rate in country i in $t-1$
Current account (it)	Average current account (as % of GDP) between $t-2$ and $t-1$
OECD (it)	Dummy equal to 1 if country i is an OECD country in $t-2$
Water dummy (ikt)	Dummy equal to 1 if tariff water* in $t-2$ < median

i is an STC maintaining country; k is an HS 4-digit heading; t is time (year)

* Tariff water (ikt) defined as difference between bound and applied tariff

Table 3: Summary statistics

	Mean	Median	Std	Min	Max
TBT sample					
Tariff % change	0.03	0.01	0.26	−1.25	1.00
Tariff level	12.92	7.50	22.27	0.01	672.51
Import % change	2.68	0.06	358.24	−1.00	78849.93
Import share	0.07	0.01	0.29	<0.01	10.05
World tariff % change	0.04	0.05	0.21	−4.56	0.84
GDP growth	4.21	4.05	3.92	−14.80	18.29
GDP per capita	16.12	8.63	14.40	0.40	70.57
Inflation	5.18	2.92	8.75	−1.71	99.88
Exchange rate	101.51	99.84	20.95	60.43	234.61
Current account	0.51	0.22	4.85	−16.30	28.54
Tariff water	11.57	3.25	28.56	−672.51	1608.60
SPS sample					
Tariff % change	0.04	0.00	0.29	−1.36	1.00
Tariff level	17.67	10.00	29.07	0.01	583.54
Import % change	2.71	0.05	88.01	−1.00	7380.97
Import share	0.05	0.01	0.12	<0.01	2.45
World tariff % change	0.01	0.04	0.27	−4.56	0.82
GDP growth	3.59	3.92	4.54	−14.80	18.29
GDP per capita	13.88	5.48	14.59	0.40	70.57
Inflation	9.04	3.95	14.23	−1.71	99.88
Exchange rate	102.84	100.00	22.41	60.43	234.61
Current account	0.93	0.53	5.39	−18.05	32.86
Tariff water	21.74	15.48	38.25	−258.25	867.58

Statistics computed from estimation samples (column (3) of Table 4 for TBT and of Table 5 for SPS)

Table 4: TBT: conditional logit estimation results (odds ratios)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Tariff % change	1.249***	1.206***	1.335***	0.690***	0.457***	0.978	0.719***
	(0.064)	(0.065)	(0.076)	(0.051)	(0.043)	(0.075)	(0.068)
Tariff level		0.990***	0.989***		0.991***		0.992**
		(0.003)	(0.003)		(0.003)		(0.003)
Import % change		1.000***	1.000***		1.000***		1.000***
		(<0.0001)	(<0.0001)		(<0.0001)		(<0.0001)
Import share		1.352	1.759***		1.788***		2.026***
		(0.365)	(0.305)		(0.314)		(0.385)
World tariff % change		1.148*	1.232**		1.209**		1.263**
		(0.092)	(0.104)		(0.103)		(0.117)
GDP growth			0.930***		0.929***		0.923***
			(0.006)		(0.006)		(0.007)
GDP per capita			1.022***		1.020***		1.060***
			(0.006)		(0.006)		(0.007)
Inflation			0.992***		0.989***		1.000
			(0.003)		(0.003)		(0.004)
Exchange rate			0.998**		0.997***		0.996***
			(0.001)		(0.001)		(0.001)
Current account			1.082***		1.079***		1.067***
			(0.006)		(0.006)		(0.005)
OECD # Tariff % change				2.717***	4.906***		
				(0.270)	(0.564)		
Water dummy						1.177**	0.686***
						(0.086)	(0.080)
Water dummy # Tariff % change						1.575***	2.430***
						(0.161)	(0.291)
Number of observations	77461	52332	49277	77461	49277	63207	41800
Pseudo-R squared	0.146	0.136	0.150	0.149	0.157	0.124	0.139

Estimated odds ratios

All regressions contain year dummies and country-sector (HS headings) fixed effects

Clustered standard errors (cluster: country-sector) in parentheses

OECD dummy omitted because of collinearity

* p<0.10, ** p<0.05, *** p<0.01

Table 5: SPS: conditional logit estimation results (odds ratios)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Tariff % change	1.422***	1.636***	1.785***	2.047***	2.261***	2.212***	2.453***
	(0.162)	(0.209)	(0.244)	(0.349)	(0.476)	(0.399)	(0.526)
Tariff level		0.992**	0.995*		0.996		1.003
		(0.003)	(0.003)		(0.003)		(0.004)
Import % change		0.999	0.998		0.998		0.997
		(0.001)	(0.002)		(0.002)		(0.002)
Import share		2.900*	2.771*		2.761*		1.233
		(1.800)	(1.696)		(1.680)		(0.864)
World tariff % change		0.842	0.863		0.865		0.960
		(0.101)	(0.109)		(0.110)		(0.179)
GDP growth			1.055***		1.055***		1.022*
			(0.012)		(0.012)		(0.013)
GDP per capita			0.920***		0.921***		0.971**
			(0.013)		(0.013)		(0.014)
Inflation			0.998		0.998		0.986***
			(0.004)		(0.004)		(0.005)
Exchange rate			1.016***		1.017***		1.011***
			(0.002)		(0.002)		(0.003)
Current account			1.060***		1.060***		1.078***
			(0.012)		(0.012)		(0.015)
OECD # Tariff % change				0.469***	0.632*		
				(0.107)	(0.173)		
Water dummy						0.717*	0.756
						(0.144)	(0.221)
Water dummy # Tariff % change						0.500***	0.525**
						(0.133)	(0.157)
Number of observations	14656	9817	9309	14656	9309	11010	7766
Pseudo-R squared	0.126	0.165	0.184	0.128	0.184	0.134	0.175

Estimated odds ratios

All regressions contain year dummies and country-sector (HS headings) fixed effects

Clustered standard errors (cluster: country-sector) in parentheses

OECD dummy omitted because of collinearity

* p<0.10, ** p<0.05, *** p<0.01

Table 6: TBT and SPS marginal effects, whole sample

	TBT	SPS
	(1)	(2)
Tariff % reduction		
0.00	0.060***	0.235***
	(0.017)	(0.070)
0.10	0.058***	0.227***
	(0.016)	(0.067)
0.20	0.057***	0.219***
	(0.016)	(0.064)
0.30	0.056***	0.211***
	(0.015)	(0.061)
0.40	0.054***	0.204***
	(0.015)	(0.058)
0.50	0.053***	0.196***
	(0.014)	(0.055)
0.60	0.052***	0.189***
	(0.014)	(0.053)
0.70	0.051***	0.181***
	(0.013)	(0.050)
0.80	0.049***	0.174***
	(0.013)	(0.048)
0.90	0.048***	0.167***
	(0.012)	(0.046)
1.00	0.047***	0.160***
	(0.012)	(0.043)
Observations	49277	9309

Semi-elasticities at means assuming the fixed effects to be zero
Semi-elasticities in column (1) calculated from column (3) of Table 4
Semi-elasticities in column (2) calculated from column (3) of Table 5
Delta method standard errors between parenthesis
* p<0.10, ** p<0.05, *** p<0.01

Table 7: TBT marginal effects, OECD vs. non-OECD and shallow vs. deep tariff water

	OECD	non-OECD	Shallow water	Deep water
	(1)	(2)	(3)	(4)
Tariff % reduction				
0.00	0.144***	−0.226***	0.359***	−0.260***
	(0.036)	(0.047)	(0.061)	(0.075)
0.10	0.135***	−0.239***	0.351***	−0.261***
	(0.034)	(0.050)	(0.059)	(0.076)
0.20	0.126***	−0.252***	0.344***	−0.263***
	(0.032)	(0.053)	(0.058)	(0.077)
0.30	0.118***	−0.265***	0.337***	−0.265***
	(0.030)	(0.056)	(0.056)	(0.078)
0.40	0.110***	−0.279***	0.329***	−0.267***
	(0.028)	(0.059)	(0.055)	(0.079)
0.50	0.102***	−0.293***	0.322***	−0.268***
	(0.026)	(0.062)	(0.053)	(0.080)
0.60	0.095***	−0.308***	0.314***	−0.270***
	(0.024)	(0.066)	(0.051)	(0.081)
0.70	0.089***	−0.323***	0.306***	−0.272***
	(0.023)	(0.069)	(0.050)	(0.081)
0.80	0.083***	−0.337***	0.299***	−0.273***
	(0.021)	(0.072)	(0.048)	(0.082)
0.90	0.077***	−0.353***	0.291***	−0.275***
	(0.020)	(0.076)	(0.046)	(0.083)
1.00	0.071***	−0.368***	0.283***	−0.276***
	(0.018)	(0.079)	(0.045)	(0.084)
Observations	49277	49277	41800	41800

Semi-elasticities at means assuming the fixed effects to be zero

Semi-elasticities in columns (1)-(2) calculated from column (5) of Table 4

Semi-elasticities in columns (3)-(4) calculated from column (7) of Table 4

Delta method standard errors between parenthesis

* p<0.10, ** p<0.05, *** p<0.01

Table 8: TBT and SPS: Linear probability model

	TBT		SPS	
	(1)	(2)	(3)	(4)
Tariff % change	0.949***	0.971***	1.070***	1.079***
	(0.007)	(0.008)	(0.019)	(0.017)
Tariff level	1.000	1.000	1.000	1.000
	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)
Import % change	1.000***	1.000***	1.000**	1.000**
	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)
Import share	1.039***	1.063***	1.060	1.006
	(0.014)	(0.014)	(0.047)	(0.045)
World tariff % change	1.019***	1.027***	0.985	0.993
	(0.006)	(0.008)	(0.010)	(0.013)
GDP growth	0.994***	0.991***	1.003***	1.000
	(0.001)	(0.001)	(0.001)	(0.001)
GDP per capita	1.002***	1.005***	0.993***	0.998*
	(0.001)	(0.001)	(0.001)	(0.001)
Inflation	1.000	1.001	1.000	0.999***
	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)
Exchange rate	1.000**	1.000***	1.001***	1.001***
	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)
Current account	1.008***	1.008***	1.004***	1.006***
	(<0.0001)	(0.001)	(0.001)	(0.001)
OECD	0.995		0.771***	
	(0.010)		(0.057)	
OECD # Tariff % change	1.129***		0.967	
	(0.011)		(0.022)	
Water dummy		0.972***		0.971
		(0.008)		(0.019)
Water dummy # Tariff % change		1.088***		0.956*
		(0.012)		(0.024)
Number of observations	56759	48890	10546	9257
Adjusted-R squared	0.076	0.069	0.098	0.086

Estimated odds ratios

TBT and SPS regressions respectively based on the samples of columns (5) and (7) of Tables 4 and 5

All regressions contain year dummies and country-HS headings fixed effects

Clustered standard errors (cluster: country-sector) in parentheses

* p<0.10, ** p<0.05, *** p<0.01

Table 9: TBT, conditional logit estimation results (odds ratios), robustness checks

	MFN tariffs only		WTO members as of 1995		WB HIC	WTO Developed
	(1)	(2)	(3)	(4)	(5)	(6)
Tariff % change	0.564***	1.429**	0.539***	0.746***	0.591***	0.604***
	(0.082)	(0.241)	(0.058)	(0.071)	(0.054)	(0.052)
Tariff level	0.985***	0.987***	0.997	0.997	0.991***	0.991***
	(0.003)	(0.004)	(0.002)	(0.002)	(0.003)	(0.003)
Import % change	1.000***	1.000***	1.000***	1.000***	1.000***	1.000***
	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)
Import share	1.788***	2.012***	2.683***	2.471***	1.775***	1.781***
	(0.307)	(0.361)	(0.567)	(0.523)	(0.310)	(0.311)
World tariff % change	1.162	1.211*	1.225**	1.270**	1.205**	1.203**
	(0.121)	(0.137)	(0.114)	(0.130)	(0.102)	(0.102)
GDP growth	0.920***	0.918***	0.868***	0.867***	0.928***	0.928***
	(0.006)	(0.007)	(0.007)	(0.007)	(0.006)	(0.006)
GDP per capita	1.020***	1.054***	1.036***	1.050***	1.021***	1.021***
	(0.006)	(0.007)	(0.007)	(0.007)	(0.006)	(0.006)
Inflation	0.992***	1.001	0.991**	1.000	0.990***	0.990***
	(0.003)	(0.004)	(0.003)	(0.004)	(0.003)	(0.003)
Exchange rate	0.998***	0.996***	0.997***	0.999	0.998***	0.998***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Current account	1.077***	1.062***	1.013*	1.009	1.079***	1.080***
	(0.005)	(0.005)	(0.008)	(0.008)	(0.006)	(0.006)
OECD # Tariff % change	5.111***		3.644***			3.663***
	(0.989)		(0.464)			(0.410)
HIC # Tariff % change					3.465***	
					(0.389)	
WTO Dev # Tariff % change						3.663***
						(0.410)
Water dummy		0.644***		0.585***		
		(0.087)		(0.069)		
Water dummy # Tariff % change		1.107		2.826***		
		(0.230)		(0.355)		
Number of observations	50152	42767	39247	36464	49277	49277
Pseudo-R squared	0.154	0.139	0.176	0.172	0.154	0.155

Estimated odds ratios

All regressions contain year dummies and country-sector (HS headings) fixed effects

Clustered standard errors (cluster: country-sector) in parentheses

OECD dummy omitted because of collinearity

* p<0.10, ** p<0.05, *** p<0.01

Table 10: SPS, conditional logit estimation results (odds ratios), robustness checks

	MFN tariffs only		WTO members as of 1995		WB HIC	WTO Developed
	(1)	(2)	(3)	(4)	(5)	(6)
Tariff % change	2.122**	1.809*	3.600***	2.993***	2.429***	2.308***
	(0.659)	(0.567)	(0.882)	(0.644)	(0.487)	(0.441)
Tariff level	0.995*	1.004	0.999	1.003	0.996	0.996
	(0.003)	(0.004)	(0.003)	(0.004)	(0.003)	(0.003)
Import % change	0.997	0.997	0.997	0.997	0.998	0.998
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Import share	2.690*	1.385	1.502	1.133	2.792*	2.741*
	(1.483)	(0.889)	(1.033)	(0.862)	(1.718)	(1.672)
World tariff % change	1.063	1.452	0.914	0.964	0.864	0.867
	(0.194)	(0.359)	(0.123)	(0.204)	(0.110)	(0.110)
GDP growth	1.056***	1.024**	0.989	1.010	1.055***	1.056***
	(0.012)	(0.012)	(0.011)	(0.013)	(0.012)	(0.012)
GDP per capita	0.922***	0.969**	0.940***	0.969**	0.921***	0.921***
	(0.013)	(0.013)	(0.014)	(0.014)	(0.013)	(0.013)
Inflation	1.001	0.985***	0.998	0.990**	0.999	0.999
	(0.004)	(0.005)	(0.004)	(0.005)	(0.004)	(0.004)
Exchange rate	1.018***	1.012***	1.016***	1.013***	1.017***	1.017***
	(0.002)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)
Current account	1.064***	1.084***	1.083***	1.084***	1.060***	1.060***
	(0.012)	(0.015)	(0.017)	(0.018)	(0.012)	(0.012)
OECD # Tariff % change	0.805		0.380***			0.548**
	(0.352)		(0.115)			(0.146)
HIC # Tariff % change					0.518**	
					(0.138)	
WTO Dev # Tariff % change						0.548**
						(0.146)
Water dummy		1.062		1.106		
		(0.364)		(0.355)		
Water dummy # Tariff % change		0.836		0.577*		
		(0.376)		(0.181)		
Number of observations	9519	7983	7790	7079	9309	9309
Pseudo-R squared	0.184	0.174	0.188	0.201	0.185	0.185

Estimated odds ratios

All regressions contain year dummies and country-sector (HS headings) fixed effects

Clustered standard errors (cluster: country-sector) in parentheses

OECD dummy omitted because of collinearity

* p<0.10, ** p<0.05, *** p<0.01

Table 11: SPS, conditional logit estimation results (odds ratios), excluding STCs raised in year t and resolved in year t or $t+1$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Tariff % change	1.252**	1.330**	1.466***	2.105***	2.072***	1.610***	2.150***
	(0.139)	(0.162)	(0.190)	(0.384)	(0.463)	(0.274)	(0.425)
Tariff level		0.997	0.999		0.999		1.002
		(0.002)	(0.002)		(0.002)		(0.003)
Import % change		0.999	0.998		0.998		0.997
		(0.001)	(0.002)		(0.002)		(0.002)
Import share		1.009	0.992		0.991		0.719
		(0.582)	(0.588)		(0.587)		(0.479)
World tariff % change		0.897	0.930		0.931		0.928
		(0.105)	(0.113)		(0.112)		(0.156)
GDP growth			1.009		1.008		1.019*
			(0.009)		(0.009)		(0.011)
GDP per capita			0.927***		0.928***		0.958***
			(0.012)		(0.012)		(0.013)
Inflation			1.009**		1.009**		1.004
			(0.004)		(0.004)		(0.004)
Exchange rate			1.017***		1.017***		1.014***
			(0.002)		(0.002)		(0.002)
Current account			1.051***		1.051***		1.049***
			(0.013)		(0.013)		(0.015)
OECD # Tariff % change				0.404***	0.572**		
				(0.092)	(0.153)		
Water dummy						0.599***	0.751
						(0.114)	(0.206)
Water dummy # Tariff % change						0.729	0.634*
						(0.177)	(0.170)
Number of observations	14726	10257	9670	14726	9670	12019	8467
Pseudo-R squared	0.090	0.135	0.146	0.093	0.147	0.111	0.153

Estimated odds ratios

All regressions contain year dummies and country-sector (HS headings) fixed effects

Clustered standard errors (cluster: country-sector) in parentheses

OECD dummy omitted because of collinearity

* p<0.10, ** p<0.05, *** p<0.01

Table A-1: List of countries

Country	Dataset	WTO entry	OECD entry	Country	Dataset	WTO entry	OECD entry
Albania	SPS	2000		Argentina	SPS and TBT	1995	
Armenia	SPS	2003		Australia	SPS and TBT	1995	1971
Barbados	SPS	1995		Bahrain, Kingdom of	SPS and TBT	1995	
Bolivia, Plurinational State of	SPS	1995		Brazil	SPS and TBT	1995	
Costa Rica	SPS	1995		Canada	SPS and TBT	1995	1961
Cuba	SPS	1995		Chile	SPS and TBT	1995	2010
Czech Republic	SPS	1995	1995	China	SPS and TBT	2001	
Dominican Republic	SPS	1995		Chinese Taipei	SPS and TBT	1995	
Gabon	SPS	1995		Colombia	SPS and TBT	1995	
Guatemala	SPS	1995		Croatia	SPS and TBT	2000	
Honduras	SPS	1995		Egypt	SPS and TBT	1995	
Hungary	SPS	1995	1996	El Salvador	SPS and TBT	1995	
Iceland	SPS	1995	1961	European Union	SPS and TBT	1995	1961*
Jordan	SPS	2000		India	SPS and TBT	1995	
Norway	SPS	1995	1961	Indonesia	SPS and TBT	1995	
Oman	SPS	2000		Israel	SPS and TBT	1995	2010
Panama	SPS	1997		Japan	SPS and TBT	1995	1964
Poland	SPS	1995	1996	Korea, Republic of	SPS and TBT	1995	1996
Romania	SPS	1995		Kuwait, the State of	SPS and TBT	1995	
Senegal	SPS	1995		Malaysia	SPS and TBT	1995	
Singapore	SPS	1995		Mexico	SPS and TBT	1995	1994
Slovak Republic	SPS	1995	2000	New Zealand	SPS and TBT	1995	1973
Slovenia	SPS	1995	2010	Philippines	SPS and TBT	1995	
Suriname	SPS	1995		Qatar	SPS and TBT	1996	
Trinidad and Tobago	SPS	1995		South Africa	SPS and TBT	1995	
United Arab Emirates	SPS	1996		Switzerland	SPS and TBT	1995	1961
Ecuador	TBT	1996		Thailand	SPS and TBT	1995	
Hong Kong, China	TBT	1995		Turkey	SPS and TBT	1995	1961
Kenya	TBT	1995		Ukraine	SPS and TBT	2008	
Moldova, Republic of	TBT	2001		United States of America	SPS and TBT	1995	1961
Peru	TBT	1995		Uruguay	SPS and TBT	1995	
Saudi Arabia, Kingdom of	TBT	2005		Venezuela, Bolivarian Republic of	SPS and TBT	1995	
Tunisia	TBT	1995		Viet Nam	SPS and TBT	2007	

* OECD entry in 1961 for every current EU member not elsewhere included in the table, with the exception of Italy (1962)