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Abstract

After successive rounds of tariff reductions by GATT/WTO members, non-tariff measures (NTMs) have increasingly become the focal point of multilateral trade negotiations. It remains an open question whether the liberalization in tariff rates has subsequently been weakened or even erased by increases in NTMs. Using a product-level global panel of WTO members over the period 1996-2018, this paper systematically examines the empirical relevance of various tariff measures for the imposition of NTMs. I find that bound or applied tariff reductions on their own have not much of an impact on NTM incidence. The relevant trade policy margin for detecting a tariff-NTM nexus is instead tariff overhangs, the difference between WTO members' bound and applied tariff rates. Countries impose more NTMs when their sectoral applied tariffs are close to their respective bound rates, indicating that small tariff overhangs signal limited legal trade policy flexibility.

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Keywords: GATT/WTO, Non-tariff Measures, Tariff Overhangs, Tariffs

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1 Introduction

Tariff reductions of GATT/WTO members over the years have made non-tariff measures (NTMs) increasingly the main focus of multilateral trade negotiations. The question remains to what extent countries' tendency towards lower tariffs truly reflects a general liberalization motif. If governments care strongly enough about protecting certain industries, negotiated tariff reductions might subsequently be weakened or even erased by increases in NTMs. Existing studies on this question offer ambiguous results.[1] Due to data constraints most analyses consider a small number of countries and/or have no panel dimension, which limits the ability to control for confounding factors. Moreover, the theoretical literature offers no clear guidance on the relevant trade policy margin for which a NTM-tariff nexus should be observed.

This paper examines the empirical relevance of various tariff measures for the imposition of NTMs. My analysis uncovers that sectoral tariff overhangs, the difference between bound and applied tariff rates, is the relevant margin to detect a tariff-NTM tradeoff. At the same time, there is little evidence that reductions in applied or bound tariffs significantly contribute to NTM actions. Instead, I find that countries impose more NTMs when their sectoral applied tariffs are close to their respective bound rates. A country's tariff overhang is an indicator of a country's legal trade policy flexibility. If NTMs are primarily used to substitute for tariff protection, then WTO members with small tariff overhangs will feel a stronger urge to use alternative protection instruments to inhibit imports from abroad. Focusing on WTO-notified sanitary and phytosanitary (SPS) measures and technical barriers to trade (TBT) as NTM activity measure, Figure 1 offers preliminary evidence for this channel. Panel a) shows that HS 4-digit products with a zero tariff overhang are about twice as likely to witness NTM actions in the subsequent year than products with a tariff of 10 percent or more. Panel b) presents a similar pattern when considering the average count of new NTM measures across products.

Theoretical backing for the importance of tariff overhangs in determining NTM actions is provided by Beshkar and Bond (2017) who show that higher tariff bindings and contingent protection measures, such as antidumping tariffs, are both means to provide WTO members with desired trade policy flexibility. A similar argument applies to non-tariff measures. Constraining WTO members' trade policy flexibility through tighter tariff overhangs implies that they will seek alternative avenues like NTMs to protect sensitive sectors. In Beshkar and Bond (2017), variations in tariff overhangs

[1] Section 2 reviews this literature in detail.

across sectors naturally emerge due the presence of non-observable time-varying political pressure that countries face. To the extent that NTMs are more difficult to regulate than tariffs, my paper confirms that tariff overhangs and alternative protection measures are indeed substitutes to exploit flexibility in trade agreements.

A major hurdle to examining the nexus between tariffs and NTMs is the lack of detailed and complete sectoral NTM data for many countries and years.[2] I therefore focus in this study on the specific NTM category of SPS and TBT regulations that has been tracked by the WTO since its founding in 1995.[3] A couple of existing studies use subsets of this data to examine the relation between tariffs and NTMs. Beverelli et al. (2019) focus on TBT notifications that subsequently are subject to recorded concerns by other WTO member countries. They find that countries receive more TBT concerns subsequent to applied tariff reductions, in particular in OECD countries. Aisbett and Silberberger (2020) argue instead that tariff reductions lead to more SPS notifications that a country reports to the WTO. However, none of these papers use the full available sample of SPS/TBT activity or juxtapose the impact of different tariff measures.

My paper makes two major contributions relative to previous literature on tariffs and NTMs. First, using a sample of 65 WTO members over the period 1996-2018 at the 4-digit HS level (about 1,200 products), I systematically examine and contrast the impact of different tariff measures on NTM incidence. Second, by focusing simultaneously on SPS and TBT activity, I analyze the tariff-NTM nexus using both (i) self-reported notifications by WTO members and (ii) the subsequently recorded concerns by other countries. I find an inverse link between NTM notifications and tariff overhangs, which is robust to alternative empirical approaches, different subsamples, various NTM determinants suggested in the literature, and extensive fixed effects controls for unobservables.

More broadly, this paper adds to the literature on the determinants of NTM incidence, which emphasizes mostly import competition and political economy factors. Focusing on the US, Ray (1981) presents evidence that NTMs are concentrated in sectors with a comparative disadvantage and away from products with large potential welfare losses for consumers. Trefler (1993) similarly finds that increases in import penetration and private influence groups, in particular businesses,

[2] A notable exception is the NTM Hub created by UNCTAD, which collects and disseminates data on various trade-inhibiting measures besides tariffs. However, this data is not available at an annual frequency for most countries and does not go back as far as the WTO data sources I rely on. For more details, see https://unctad.org/en/Pages/DITC/Trade-Analysis/Non-Tariff-Measures.aspx.

[3] Grübler and Reiter (2020) compile an NTM dataset that combines SPS/TBT notifications to the WTO with information on temporary trade barriers from Bown (2016). I control for the effects of temporary trade barriers below.

are critical drivers of sectoral NTMs in the US. Bagwell and Staiger (1990) note that countries have a greater incentive to implement special protection when import volumes surge, a prediction that is empirically confirmed for the US by Bown and Crowley (2013a). Goldberg and Maggi (1999) emphasize that the positive correlation between import penetration and NTMs is driven by unorganized sectors, whereas the opposite holds for politically organized identify. In the cross-country context, Lee and Swagel (1997) observe NTMs to be more frequent in sectors deemed to be politically important or subject to foreign competition. Mansfield and Busch (1995) in their analysis of cross-national NTM determinants emphasize the importance of political economy factors as well, in particular in the form of economic size and domestic institutions. To control for these channels, the analysis below accounts for various sectoral import and market power measures. Moreover, the estimates are robust to the inclusion of product-country fixed effects.

The next section examines the theoretical linkages between NTMs and tariffs suggested in the literature and the associated empirical evidence. Section 3 discusses the empirical model and the necessary data. Section 4 presents the empirical evidence linking countries' self-reported NTM notifications to different tariff measures, and section 5 considers extensions to the baseline framework. Section 6 focuses on NTM concerns reported by other WTO members. Section 7 concludes.

2 Non-tariff Measures as Trade Policy Instrument

An extensive literature highlights the potential interactions between between tariffs and non-tariff measures. For the purpose of this section, I will use the term non-tariff measures to refer to any barrier that imposes an additional burden to importing a product beyond transportation costs and tariffs. NTMs encompass, but are not limited to, price and quantity controls, monopolistic measures, technical standards, rules of origin, and health regulations. In the empirical analysis below, I apply a more specific definition due to data constraints.

Baldwin (1984) in his review of the early literature argues that the application of NTMs has risen over time as countries have successfully negotiated down tariff rates in successive multilateral trade negotiations. This notion of a substitution effect between tariffs and NTMs is supported by the early empirical literature on the subject. In a cross-country product-level analysis of the NTM-tariff nexus for the US, Japan, the EU and Canada, Ray and Marvel (1984) note that these countries all used NTMs to subsequently undercut the Kennedy Round tariff liberalizations.[4] A number of

[4] This evidence is in line with Ray (1981) and Marvel and Ray (1983) who focus on US NTMs only, which were used

subsequent theoretical papers attempt to explain this phenomenon. Copeland (1990) shows that governments will gravitate towards the usage of NTMs due to loopholes in trade agreements that mostly focus on tariff instruments. These loopholes can arise, for instance, due to uncertainty and asymmetric information (Hungerford 1991). Governments might be particularly inclined to use NTMs after agreeing to multilateral tariff reductions if special interest groups hold some sway over them (Yu 2000 and Limão and Tovar 2011).

Since then, a number of empirical studies have offered further support for a substitution effect between tariffs and NTMs. Focusing on NTM coverage ratios, i.e., the share of products by industry that are protected by an NTM, Broda et al. (2008) note that the US implements greater protection, in the form of higher tariffs or more NTMs, in sectors in which it has more market power.[5] Looking beyond the US and other advanced economies, Kee et al. (2009) estimate ad-valorem equivalents of NTMs for 78 countries at the tariff line level using data available in TRAINS and other sources from the early 2000s. When regressing product-line tariffs on their NTM tariff equivalents, Kee et al. find somewhat mixed results. Whereas tariffs and agricultural support measures are used in a complimentary fashion, other NTMs seem to substitute for border taxes. Their estimates also indicate a stronger substitution effect for developed economies who tend to apply more restrictive NTMs while having lower tariffs.[6]

There is, however, also a large strand of the theoretical trade policy literature that argues tariffs and NTMs are, at best, imperfect substitutes. For instance, Maggi and Rodríguez-Clare (2000) show that whether a tariff or a quota is the optimal trade protection tool for a given sector depends to a large extent on political economy considerations. Anderson and Schmitt (2003) emphasize instead the role of trade costs and the shape of the government's welfare function for the choice of its preferred trade policy instrument.[7] In practice, the choice of the optimal trade policy is, of course, often not as clean-cut as tariffs and NTMs are often applied in tandem. Focusing on a more specific kind of NTM, Falvey and Reed (2002) show that rules of origin can be applied in a complimentary fashion to tariffs to raise the importing country's welfare. Specifically, rules of origin

to offset some of the multilaterally negotiated tariff reductions post World War II. However, one drawback of these early studies is their reliance on NTM indices compiled by the USITC for which no detailed documentation exists.

[5] Broda et al. (2008) find the same to be true when using instead the ad valorem equivalents of NTMs compiled by Kee et al. (2009).

[6] Niu et al. (2020) apply Kee et al.'s approach in a panel context for 3-year averages between 2003 and 2015. They find a substitution effect between NTMs and tariffs but do not differentiate between agricultural support measures and other NTMs.

[7] Additional papers considering this question are Cassing and Hillman (1985), Mayer and Riezman (1987), Hillman and Ursprung (1988), Rosendorff (1996a,b), and Feenstra and Lewis (1991).

allow to actively target the input composition of imports to improve the importer's terms of trade.

In line with this argument, several empirical papers highlight the possibility that countries have an incentive to implement NTMs along with tariffs. Focusing on the trade impacts of US NTMs in manufacturing in 1993, Trefler (1993) notes that tariffs and sectoral NTM coverage ratios are positively correlated across industries. Using data on NTM coverage ratios for 41 advanced and developing countries in 1988, Lee and Swagel (1997) similarly find that NTMs are used in combination with tariffs rather than as substitutes. Focusing on the Colombian trade reforms from 1985 to 1994, Goldberg and Pavcnik (2005) show that tariff reductions went hand in hand with decreases in NTMs. Analyzing the effects of NTMs for 60 countries and 4 sectors, Dean et al. (2009) similarly find a complimentary effect as NTMs are more likely to be applied when tariffs are higher. In the context of China's WTO accession, Imbruno (2016) also provides evidence that NTMs in the form of import licenses were applied in combination with tariff protection.

There is also growing part of the literature that focuses on the relationship between MFN tariffs and temporary protection measures in the form of antidumping (AD) measures, safeguard (SG) tariffs, and countervailing duties (CVD). Although these instruments constitute additional import duties, their application varies substantially from regular MFN tariffs as their level is usually several magnitudes greater. Moreover, AD, SG, and CVD measures can target specific countries and products. Focusing on WTO bound tariffs after the Uruguay Round, Feinberg and Reynolds (2007) find that AD activity increases for products with greater tariff cuts, but only in developing economies. Moore and Zanardi (2011) instead consider changes in MFN applied tariffs over the same period and report a substitution effect between AD measures and tariff reductions, but only for the small subset of emerging economies that most frequently use them. Focusing on product level data for India and the EU, respectively, Bown and Tovar (2011) and Ketterer (2016) also estimate a positive effect of tariff cuts on subsequent AD, SG and CVD activity.

Interestingly, the recent temporary protection literature points out that tariff cuts alone are not necessarily the relevant margin for countries to implement additional protection via NTMs. Focusing on the country level in 13 developing economies, Bown and Crowley (2014) note that the share of sectors where MFN applied tariffs are close their WTO-imposed tariff bound is positively associated with the application of more temporary protection measures.[8] Beshkar and Bond (2016) also provide evidence that safeguard actions are more common in countries with lower tariff overhangs. Finally, focusing on the tariff line level in a sample of 30 WTO member countries over the period

[8] The same measure is not significant in a sample of five advanced economies; see Bown and Crowley (2013b).

1996-2014, Kuenzel (2020) finds strong support for a substitution effect between tariff overhangs and the application of temporary protection, but no effect of tariff cuts (applied or bound) on their own.

There are two major takeaways from the existing literature. First, from a theoretical perspective tariffs and NTM can be either substitutes or complements. We are therefore dealing with an inherently empirical question. Second, the temporary protection literature indicates that identifying any association between regular tariff instruments and NTMs might depend crucially on the exact measurement of the relevant tariff margin. The next section therefore lays out an empirical framework that allows us to examine the NTM-tariff nexus by considering both tariff overhangs and changes in applied and bound tariff rates.

3 Data and Empirical Model

Non-tariff measures can take many forms and shapes. For the purposes of the empirical analysis in this paper, I focus on sanitary and phytosanitary (SPS) measures and technical barriers to trade (TBT). This choice is mostly due to data availability and practicality concerns. Due to data limitations, many of the studies cited in section 2 use cross-section data, which limit the extent of controls that can be included compared to a panel context. While some headway has recently been made to capture a broader set of NTMs over the years, the country and time coverage of SPS and TBT measures is unrivaled. SPS measures capture regulations related to food safety, territorial and human protection against pests and diseases, animal health, and plant protection. TBT regulations focus instead on technical regulations and standards that products have to meet.

3.1 Data

To examine the relationship between non-tariff measures and tariffs, I combine information from three different data sources. Data on non-tariff measures comes from two WTO databases, the SPS and TBT Information Managements Systems (IMS). These WTO databases provides detailed country- and sector-specific information on new regulations (and changes thereof) that exporters have to fulfill in order to move their goods into the country in question. The content in these databases relies on self-reported information by each WTO member as required by the WTO agreements on SPS and TBT measures. One concern for the empirical analysis might be that WTO members underreport the extent of their own regulations. The estimates reported below should therefore be interpreted as a lower bound of the link between tariffs and NTMs. Moreover, any WTO member can officially report concerns regarding specific SPS and TBT measures in the relevant WTO committees if they run counter to WTO commitments or have not been officially notified. Section 6 below provides more details on these NTM concerns and how they relate to the frequency of NTM notifications and tariffs.

WTO members can choose at which level of detail they report their NTM notifications. In the raw data, the most common reporting level is HS 4-digit, followed by HS 6-digit and HS 2-digit.[9] The empirical analysis below therefore focuses on the HS 4-digit level, by aggregating the 6-digit notifications to the 4-digit level and distributing the 2-digit notifications across all affected 4-digit sectors. Appendix A provides a detailed discussion about the construction of the dataset and the sources of all key variables. The third data source is the World Banks' TRAINS database, from which I obtain MFN bound and applied tariff data at the HS 4-digit level. The tariff data is used to construct both the tariff overhang variable and various measures of tariff changes, which will be at the core of the empirical analysis below.

The final sample constitutes the overlap between the NTM notification and tariff data. The dataset includes 65 countries and 919,622 observations at the importer-HS4-year level over the period 1996-2018. The left panel of Table 1 provides an overview of NTM notification counts by country in the full sample, which are further broken down into their respective SPS and TBT composition. NTM activity varies widely across WTO members. The US, Brazil, the EU, Japan and China are the most frequent users of SPS and TBT measures with more than 4,000 NTM notifications each. The least active countries in terms of NTM usage in the sample are Tanzania, Burundi, Belize, Trinidad and Tobago, Mongolia and Barbados with fewer than 50 NTMs each.[10] In the full sample, there are 72,515 NTM notifications at the HS 4-digit level, which are distributed across 50,930 observations, indicating that countries frequently notify multiple NTMs in the same 4-digit HS sector and year. Table 2 provides an overview of the distribution of the non-zero NTM counts. Although the majority of HS 4-digit sectors with a positive NTM count in the sample are subject to only a single new notification in a given year, about a quarter (25.6%) witness two or more new non-tariff measures. The maximum number of NTMs imposed by an importer for a given HS 4-digit sector and year is 26.[11] For 21 countries in the sample, TBT notifications account for the

[9] Over the sample period, 1996-2018, the detailed reporting level breakdown in the raw combined SPS and TBT data is: 2-digit – 11.2%, 4-digit – 48.9%, 6-digit – 40.0%.

[10] Table B5 shows that the results presented below are robust to excluding a wide range of countries from the sample based on their NTM counts

[11] The results presented below are similar when excluding high-count sectors. Detailed estimates are available upon request.

majority of the NTM measures, whereas SPS notifications take the lead for the other 44 countries.

The right panel Table 1 shows the distribution of sectoral tariff overhangs for all 65 countries. The tariff overhang categories were chosen to provide an approximately even four-way split of the sample. Similar to the distribution of NTMs, there is substantial variation in terms of tariff overhang space across the 65 countries. Six countries (China, EU, Hong Kong, Japan, Switzerland, US) have mostly low tariff overhangs, with over 80 percent of their 4-digits HS sectors featuring applied tariff rates at or above the respective bound rate.[12] At the same time, 21 out of 65 countries in the sample have tariff overhangs that exceed 25 percent for over half of their products, among them Colombia, India and Indonesia. Half of the countries in the sample fall between these two extremes, with more than 50 percent of their import sectors featuring tariff overhangs between 0 and 25 percent. The mean sectoral tariff overhang in the sample is 15.12 percent.

In addition to tariff overhangs and NTM counts, the analysis below examines the impact of bound and applied tariff changes on NTMs, which are again computed using the TRAINS data. Most specifications also include different sectoral import and PTA controls. HS 4-digit trade data comes from UN Comtrade, whereas information on bilateral PTAs over time comes from the updated datasets of de Sousa (2012) and Egger and Larch (2008). Table 3 provides detailed summary statistics, definitions and data sources for all variables used in the analysis, which will be discussed in passing below.

3.2 Empirical Model

The variable of interest, NTM counts, varies by importer, year and sector, and the empirical analysis therefore focuses on this level. As the dependent variable is a count measure, see Table 2, the primary estimation approach will rely on Poisson pseudo maximum likelihood (PPML) regressions. Due to the non-linear nature of PPML, the presence of many fixed effects might subject the estimation to the incidental parameters problem (Cameron and Trivedi 2005).[13] To rule out this possibility, I also

[12] Note that tariff overhangs at the HS 4-digit level can be negative for at least three reasons: 1. No bindings are set for certain sub-sectors (which can bias the 4-digit average bound rate), 2. after negotiating new bound rates, WTO members are usually granted phase-in periods during which applied tariffs can exceed the new tariff bindings, and 3. the presence of non-tariff barriers might bias the calculation of tariff overhangs due to the necessary conversion into ad valorem equivalents. To avoid the last issue, I do not consider non-tariff measures in the tariff overhang calculations. The results below are similar when including ad valorem equivalents of non-tariff measures provided in TRAINS; these estimates are available upon request.

[13] Fernández-Val and Weidner (2016) and Weidner and Zylkin (2020) examine the properties of the PPML estimator in settings with many fixed effects. While PPML estimates are consistent even in the small T context, asymptotic confidence intervals might not be correctly centered at the true point estimates.

report below estimates from a linear fixed effects model.

To test whether tariff overhangs are related to the implementation of NTM measures, I estimate the following baseline model:

$$NTM_{ict} = \beta Overhang_{ic,t-1} + \gamma Z_{ic,t-1} + \eta_s + \omega_{ct} + \epsilon_{ict} \tag{1}$$

where NTM_{ict} is a count variable that indicates how many non-tariff measures country c notifies to the relevant WTO committees in the HS 4-digit sector i in year t. The NTM count variable is comprised of the sum of both SPS and TBT measures. The sectoral tariff overhang variable in specification (1) is the difference between the MFN bound and applied tariffs at the 4-digit HS level:

$$Overhang_{ic,t-1} = Tariff^{Bound}_{ic,t-1} - Tariff^{Applied}_{ic,t-1} \quad . \tag{2}$$

If a lower tariff overhang makes protectionist NTM actions more likely, we should observe $\beta < 0$. In this case, a low tariff overhang constraints a country's options to address protectionist pressures by raising its applied tariff. SPS and TBT measures can then offer an escape valve to implement the desired protection level. Conversely, if tariff and non-tariff measures work as complements rather than substitutes, β will be positive or statistically not different from zero.[14]

The empirical model in equation (1) includes one-year lagged values of all independent variables to account for potential information delays.[15] In addition, one might be concerned about potential reverse causality issues when focusing on tariff and NTM notifications from the same period as countries might be more inclined to lower tariffs during periods of increased NTM activity. The vector Z accounts for a number of control variables that could drive NTM incidence and might be correlated with a country's tariff overhang, most importantly applied and bound tariff changes. I discuss these variables in passing below. Vector Z also captures several trade-related measures that are considered to be determinants of tariff overhangs (Beshkar et al. 2015). First, countries with more market power have an incentive to implement more trade-inhibiting NTMs and set higher

[14] I use a continuous tariff overhang measure in equation (1) to capture the full impact of the magnitude of trade policy space on the usage of non-tariff measures. The results presented below are qualitatively similar when grouping tariff overhangs into different binary variables based on size. Table B3 in Appendix B reports results when using two binary variables capturing the tariff overhang magnitude: (i) 0% tariff overhang or less, and (ii) 0 to 25% tariff overhang.

[15] The estimates below are similar when considering a contemporaneous specification. Detailed results are available upon request.

tariffs. To capture this channel, I include in the model a country's sectoral imports in a given year (in logs), log(Imports$_{ict}$), and the sectoral share in world imports (in logs), log(WorldImportShare$_{ict}$). Moreover, countries that receive a greater share of their imports from PTA partners might be less willing to grant multilateral tariff concessions, which could induce a tighter tariff overhang. To account for this possibility, I include the sectoral share of imports from a country's preferential trade agreement partners, PTAImportShare$_{ict}$.

Finally, the empirical model in (1) includes HS 2-digit level fixed effects, η_s, to account for industry-specific regulation patterns. For instance, certain products, e.g., food items, are much more likely to become subject to SPS rules than others. All estimations also include country-year fixed effects, ω_{ct}, to control for country-level NTM patterns, which could be caused by business cycles or other country-specific reasons. Below I examine the sensitivity of the estimates to alternative fixed effects specifications.

4 Results

In this section, I present the baseline estimates of the empirical model in equation (1). Due to the count data nature of SPS and TBT notifications, I first report panel PPML estimates. Subsequently, I also provide OLS results to examine the robustness of the PPML findings. Table 4 shows average marginal effect estimates from PPML regressions of the NTM count measure, which is the sum of SPS and TBT notifications, on the sectoral tariff overhang and additional control variables. Other tariff measures, in particular bound and applied tariff changes, are added subsequently. Standard errors are clustered throughout at the country/2-digit HS level and are reported in parentheses.

4.1 Baseline Results

Column (1) in Table 4 regresses the HS 4-digit NTM count on the sectoral tariff overhang as well as a comprehensive set of country-year and HS 2-digit industry fixed effects. The average marginal effect of the tariff overhang is negative and statistically significant at the one percent level, implying that a greater tariff overhang is associated with fewer notified NTM measures to the WTO. Hence, tariff overhangs and NTMs appear to be substitutes. The estimated marginal effect of .0400 indicates that, on average, an increase in the sectoral tariff overhang from 0 to 25 percent, which corresponds to a switch from the 25th to the 75th percentile in the data, is linked to a decrease in the sectoral NTM count of .01 ($= .25 \times .04$). Given that the unconditional mean of the NTM count variable is .0789, this effect is not only statistically but also economically very significant. Put differently, we can expect a country with a 25 percent tariff overhang across all of its 1,200 HS 4-digit sectors to notify an additional 12 ($= .01 \times 1,200$) NTM measures in a given year compared to a country with zero tariff overhangs across all its product lines. To the extent that SPS and TBT measures are trade facilitating instead of inhibiting, these estimate provide a floor for the impact of tariff overhangs on NTM usage. However, a large literature shows that SPS and TBT measures have mostly trade-inhibiting effects, which supports the notion that these regulations are barriers to trade rather than facilitators of additional imports.[16]

Column (2) accounts for the additional import determinants discussed above: log(Imports), PTAImportShare, and log(WorldImportShare). Three results emerge. First, the tariff overhang impact on NTM notifications remains stable and statistically significant at the one percent level. Second, a greater amount of sectoral imports, log(Imports), has a significant positive impact (at the one percent level) on a country's NTM notifications. This finding indicates that governments tend to implement more import protection when domestic firms face increased competition from abroad. Lastly, the log(WorldImportShare) is linked negatively to the NTM incidence count, an effect that is statistically significant at the one percent level. This result might seem puzzling at first as trade theory predicts an inverse relation between the sectoral world import share and the foreign export supply elasticity that a country faces. We should then expect a country's protection level, e.g., via NTMs, to increase with the world import share. However, part of this market power effect is already picked up by the log(Imports) measure. When excluding the sectoral import variable in specification (3), the log(WorldImportShare) coefficient indeed turns positive, an effect that is again statistically significant at the one percent level.

In specifications (2) and (3), the PTAImportShare variable on its own has no statistically significant impact on NTM notifications. Column (4) in Table 4 examines the impact of the PTA import share further by introducing an interaction of this measure with the tariff overhang. On the one hand, the tariff overhang channel could be less relevant when most imports are sourced from PTA partners for which MFN tariffs do not apply. On the other hand, NTM measures might be an even more attractive policy option when a country faces both a low tariff overhang and substantial imports from PTA partners in a given sector. The interaction coefficient turns out to be negative

[16] Disdier et al. (2012) find that SPS and TBT measures significantly reduce developing countries' agricultural exports to European countries, whereas Bao and Qiu (2012) note a negative impact of TBT notifications on the extensive margin of trade.

and significant at the one percent level, indicating that the latter channel dominates. Countries are more likely to impose NTMs when they both have a lower tariff overhang and a higher PTA import share. Note that column (4) reports composite effects for both the Overhang and PTAImportShare variables, evaluated at the respective sample mean of the other variable. The tariff overhang effect remains negative and significant at the one percent level, even when accounting for its potential dependence on trade shares of preferential partner countries.

Specifications (5) and (6) in Table 4 examine to what extent the tariff overhang impact differs by SPS and TBT measures. Column (5) focuses on the sectoral count of TBT notifications, whereas specification (6) considers the number of SPS notifications. Note that the sample shrinks in both cases compared to the NTM count specifications in columns (1) to (4) because the PPML estimator requires to drop all observations that are perfectly predicted by the included fixed effects. Specifically, the SPS and TBT specifications will omit observations from the full sample in case there is no variation in the dependent variable at the country-year or HS 2-digit fixed effects level. For instance, if a WTO member in a given year only notified TBT but no SPS measures, then the SPS specification in column (6) will drop all observations of that country for the year in question. Two results emerge from the SPS and TBT regressions. First, as in the NTM sample, the overhang coefficient is negative in both cases. Second, the negative effect is only statistically significant (at the five percent level) when focusing on the TBT sample. Hence, TBT notifications seem to be mostly responsible for the earlier detected substitution effect between tariff overhangs and NTM measures.

Finally, column (7) in Table 4 investigates the relationship between NTM notifications and tariff overhangs at the more aggregate HS 2-digit level. The 2-digit codes aggregate the 4-digit information from around 1,200 sectors to 97 industries. Specifically, in the 2-digit specification, the NTM count measure adds up all SPS and TBT notifications that a country submitted to the WTO within a HS 2-digit industry, independent of whether it refers to the 2-digit sector or a 4-digit subsector. Appendix A provides more details on the NTM count variable construction for this case. In column (7), the link between tariff overhangs and NTM notifications is again negative and statistically significant (at the 1 percent level). Thus, even at a more aggregate level, tariff overhangs and NTM measures remain substitutes. The magnitude of the tariff overhang coefficient is larger than in the prior specifications, which is due to the fact that the sectoral prevalence of NTM notifications rises in the 2-digit compared to the 4-digit specifications. Specifically, the mean of the dependent variable is .4330 in the 2-digit sample compared to .0789 in the baseline 4-digit specification in column (2). As before, the log(Import) variable has a significant positive effect on

NTM notifications. However, in contrast to the 4-digit specifications, the log(WorldImportShare) measure is not statistically significant anymore.

To examine the robustness of the fixed effects PPML estimates, Table 5 provides the corresponding results from a standard linear fixed effects model. Columns (8) to (14) replicate the specifications in Table 4. The signs and magnitudes of the marginal effects from the linear model are remarkably similar to the PPML approach. Except for the SPS specification in column (14), which mirrors closely the earlier PPML estimates, there is a significant negative link between tariff overhangs and NTM notifications. Hence, the linear fixed effects model confirms that countries impose more NTM measures on products for which their trade policy flexibility is limited as indicated by a low tariff overhang. The log(Imports) and log(WorldImportShare) variables also retain their signs and statistical significance throughout. One difference that emerges compared to Table 4 is that the PTAImportShare measure now has positive and significant effect in the majority of specifications, indicating that PTAs seem to encourage the application of more NTMs.

As discussed earlier, one weakness of the PPML approach is that it requires to drop all observations for which the included fixed effects perfectly explain the outcome variable. The linear fixed effects model is not subject to this caveat. To ensure that the above results are not driven by this potential sample selection, specification (15) in Table 5 uses all observations for which NTM, tariff overhang and import data could be compiled during 1996 to 2018. This expanded sample adds 267,290 observations compared to the baseline specification in column (9). The coefficient pattern in the enlarged sample is similar to the earlier OLS and PPML results. In fact, the magnitude and the statistical significance of the tariff overhang coefficient even increases compared to the estimate in the baseline specification. Hence, the negative nexus between tariff overhangs and NTM notifications is not driven by the sample selection of the fixed effects PPML model. Given the similarity between the PPML and linear models, I focus on the PPML model going forward. The linear estimates paint a similar picture and are available upon request.

Lastly, I want to address the possibility that the tariff overhang effect is driven by the chosen fixed effects or standard error clustering structure. Table B1 in Appendix B explores the sensitivity of the baseline PPML results (Table 4, column (2)) to changes in these model specifications. The first four columns present results using different, more restrictive fixed effects setups. In all cases, the tariff overhang coefficient remains negative and statistically significant (at least at the five percent level). In fact, the two models with the most extensive fixed effects controls, HS 2-digit×country×year and HS 4-digit×country, respectively, even show substantial increases in the estimated marginal impact of tariff overhangs on NTM measures. Similarly, changing the clustering level to several sensible alternatives in the last four columns of Table B1 leaves the tariff overhang conclusions unchanged as well. Note that Table B1 shows again how different fixed effects structures in the PPML framework lead to vastly varying sample sizes due to the requirement to drop observations whose outcome is perfectly predicted by the included controls. Table B2 therefore re-estimates all specifications from Table B1 using a linear fixed effects model that can include all observations from the full sample regardless of the chosen fixed effects structure. The results in Table B2 mirror closely the estimates from the PPML models in Table B1. The substitution effect between tariff overhangs and NTM notifications is therefore neither driven by the chosen fixed effects structure nor the standard error clustering level.

4.2 Tariffs versus Tariff Overhangs

As reviewed above, there is an extensive literature that examines the linkages between tariffs and the incidence of NTM measures. In the light of the previous results, it is particularly relevant to know whether accounting for actual changes in tariffs affects the estimated link between tariff overhangs and NTM notifications. For instance, if tariff reductions over time have lowered tariff overhangs, then the significant tariff overhang estimates above could be the result of an omitted variable problem. To consider this possibility, Table 6 examines the effect of various tariff change measures on NTM incidence, individually and in combination with tariff overhangs.

In place of the tariff overhang variable, specification (16) in Table 6 includes the lagged 1-year change in the applied MFN tariff rate (at the HS 4-digit level). As indicated by the summary statistics in Table 3, the average change in the 1-year applied tariff is close to zero but there is substantial variation in the sample as indicated by the standard deviation of 3.64%. A similar pattern also holds for the three alternative tariff change measures I introduce in Table 6: 3-year change in applied MFN tariff, 1-year change in bound MFN tariff, and 3-year change in bound MFN tariff. While the coefficient of the 1-year applied tariff change is negative, the effect on NTM notifications is not statistically significant. Column (16) and all other specifications in Table 6 include as controls the same three import measures from before: log(Imports), PTAImportShare, and log(WorldImportShare). The estimated effects of these variables are similar to the earlier results in Table 4. Column (17) explores whether tariff changes unfold their full impact over a longer time horizon instead. However, the 3-year change in the applied MFN tariff turns out to be an equally ineffective determinant of NTM incidence. Columns (18) and (19) replace the changes in the applied tariff with their MFN bound tariff counterparts, but the same results pattern prevails. Neither applied nor bound tariff changes are significantly linked to NTM notifications.

While the different tariff change variables have no individual impact on NTM usage, the question remains whether the tariff overhang retains its effect after controlling for tariff adjustments. Columns (21) to (25) in Table 6 examine this question by introducing the tariff overhang measure alongside each of the four different tariff change measures. In all cases, the marginal effect of the tariff overhang variable remains statistically significant at the one percent level and is comparable to the earlier baseline results in column (2) of Table 4. Moreover, none of the tariff change measures has a statistically significant impact on NTMs even after accounting for tariff overhangs. The "horse" race between different tariff measures in Table 6 allows for two conclusions. First, tariff changes cannot reliably predict future NTMs. Second, a substitution effect exists between tariffs and NTMs, but the relevant trade policy margin is tariff overhangs and not changes in tariffs per se.

5 Extensions

The above results provide evidence that tariff overhangs are inversely linked to the imposition of NTMs. This part implements two extensions of the baseline model. First, I will examine the robustness of this result when controlling for additional determinants of NTMs. Second, I dissect the aggregate tariff overhang effects by considering industry-specific estimates.

5.1 Additional NTM Determinants

One of the most steadfast predictions of the trade policy literature is that countries tend to implements more protection in sectors which feature relatively inelastic import demand and export supply (e.g., Johnson 1953–1954 and Bagwell and Staiger 1990). When these elasticities are low, an increase in trade protection is more likely to improve the terms of trade of the importing country. Bagwell and Staiger (1990) point out that the incentive to impose additional protection, e.g., via NTMs, is particularly high during periods with import surges. Specification (25) in Table 7 therefore introduces as additional NTM determinants the 3-year growth rate of sectoral imports, 'Δlog(Imports), 3 years,' in addition to actual import level in the HS 4-digit sector at hand. The average 3-year import growth rate is close to 20 percent in the sample; see Table 3. However, the estimation results indicate that the import growth variable has no significant impact on NTM notifications. At the same time, the tariff overhang measure retains its negative and highly statistically significant link with the incidence of NTMs.

In addition to accounting for import growth, column (26) in Table 7 introduces the inverse of the sum of the sectoral import and export supply elasticities, '1/[IM + EX Elasticities].' Country-specific import demand and export supply elasticities at the HS 4-digit level come from Nicita et al. (2018). Since low import and export elasticities should reinforce the impact of import growth pressures, I also include the interaction between these two variables. This setup mirrors closely the approach of Bown and Crowley (2013a) who provide evidence in the US context for the 'managed trade' theory by Bagwell and Staiger (1990). Note that column (26) omits the interaction terms and only reports the composite estimates for both 'Δlog(Imports), 3 years' and '1/[IM + EX Elasticities],' evaluated at the respective mean of the other variable. Two results emerge from the modified model in column (26). First, both the import growth and the inverse elasticity measures have no significant impact on NTM notifications. One reason for this finding could be that many countries included in the sample are not large enough to consider terms-of-trade motives when implementing NTM measures. Second, the tariff overhang coefficient effect increases in magnitude relative to the baseline model in column (2) of Table 4 and remains significant at the one percent level.

Much of the literature examining the link between tariffs and NTMs (e.g., Ray 1981 and Trefler 1993) emphasize industry- and country-specific political economy forces as important determinants of trade protection patterns. While the country-year and HS 2-digit fixed effects in the baseline model can account to some extent for these drivers of NTMs, controlling for political economy and other potential product-level determinants is a desirable exercise for robustness purposes.[17] As there is no consistent product-specific data on industry characteristics and political leverage that is available for the wide range of countries in the sample, I rely instead on NTM activity in previous years as proxy for product-specific NTM determinants. Specification (27) in Table 7 adds the variable 'Past NTM Count, 3 years,' which captures the number of NTMs (SPS and TBT) the country notified in the previous three years to the WTO in the respective HS 4-digit code. As expected, past NTM notifications are a positive and statistically significant (at the one percent level) predictor of current NTM actions. Importantly, although slightly lower in magnitude compared to the baseline estimate in column (2) of Table 4, the tariff overhang variable retains its negative coefficient and statistical significance at the one percent level. Hence, even when controlling for potential political economy concerns, there is a significant negative tradeoff between tariff overhangs

[17] Note that the country-year fixed effect also account for any potential macroeconomic determinants of NTMs, such as the business cycle, exchange rates or the unemployment rate.

and NTMs.

As indicated in section 2, there is substantial evidence that temporary protection measures in the form of AD, SG and CVD measures are used to implement trade protection when countries have little maneuvering space to adjust their applied MFN tariffs. Given that these instruments are substitutes for regular tariff protection, we would expect that sectors which are more frequently subject to AD, SG or CVD actions are also more likely to be the target for increased NTM activity.[18] Specification (28) in Table 7 examines this possibility by introducing the binary variable 'Past TP, 3 year,' which takes the value one if at least one temporary protection investigation (AD, SG or CVD) was initiated involving the HS 4-digit product at hand, and zero otherwise. Data on AD, SG and CVD investigations come from Bown (2016). The positive and statistically significant (at the one percent level) estimate of the 'Past TP, 3 year' variable confirms the hypothesis. Products that are more likely to receive protection from AD, SG or CVD measures are also more likely to witness more NTM notifications. Importantly, the tariff overhang coefficient remains negative, statistically significant at the one percent level and similar in magnitude relative to the baseline estimate in column (2) of Table 4.[19]

Finally, specification (29) in Table 7 includes simultaneously all previously introduced NTM determinants. The estimates are line with the prior results in Table 7. Of the additional variables, only 'Past NTM Count, 3 years' and 'Past TP, 3 years' have a statistically significant impact on the incidence of NTMs. At the same time, the highly significant negative link between tariff overhangs and NTM notifications prevails. Importantly, the consistency of the estimated tariff overhang effect when accounting for additional NTM determinants substantially alleviates concerns that the inverse nexus between tariff overhangs and NTMs is based on a spurious correlation. More broadly, the consistency of the link between tariff overhangs and NTMs across the more restrictive fixed effects specifications in Table B1 also provides additional confidence that the results are not subject to omitted variable bias.

5.2 Estimates by Product Groups

The above analysis averages the tariff overhang estimate across all HS 4-digits sectors, independent of the fact that certain products might be more likely to be subject to NTMs than others. For

[18] The literature has not empirically explored why countries would prefer the application of NTMs to temporary protection instruments, and vice versa. While this question is of interest, it is beyond the scope of this paper.

[19] The tariff overhang results are virtually identical when adding the number of past initiated temporary protection investigations, or when including separate AD, CVD and SG controls. Detailed estimates are available upon request.

instance, by their nature, SPS regulations are much more likely to be imposed on agricultural and food products than manufactures. To examine the sectoral sensitivity of the tariff overhang effect, I divide the sample into seven products groups: 1. animal products (HS 1-5) , 2. chemicals (HS 27-40), 3. clothing (HS 41-43, 50-67), 4. foodstuffs (HS 15-24), 5. manufactures (HS 84-97), 6. materials (HS 25-26, 44-49, 68-71, 72-83), and 7. vegetable products (HS 6-14).

The animals, vegetables and foodstuffs categories account for 27,654 of the 50,930 HS 4-digit sectors with NTM notifications in the sample, with respective counts of 8,780, 6,248 and 12,626. That is, agricultural and food related products are responsible for 54.3 percent of all HS 4-digit sectors with NTM measures. The vast majority of these sectors witness new SPS rules (24,074) and a much smaller number are subject to new TBT regulations (5,217).[20] Manufacturing products account for 17.6 percent (or 8,961) of all HS 4-digit sectors with NTM notifications, which are mostly due to products becoming subject to new TBT measures (8,295), whereas SPS notifications (685) only play a small role. The picture is similar for chemicals, which witness 7,999 HS 4-digit sectors with NTM notifications, or 15.7 percent out of the total. We observe again more TBT regulations (5,427) than SPS rules (3,060), but the imbalance is less extreme than in the case of manufacturing industries. A much smaller number of HS 4-digit sectors with NTM notifications are observed for clothing (3,232) and materials (3,084).

To estimate industry-specific tariff overhang effects on NTM notifications, I add to the empirical model in (1) the interactions of the tariff overhang variable with seven industry dummies, D_k:

$$NTM_{ict} = \sum_{k}^{K} \beta_k Overhang_{ic,t-1} \times D_k + \gamma Z_{ic,t-1} + \eta_s + \omega_{ct} + \epsilon_{ict} \tag{3}$$

where β_k captures the effect of tariff overhangs on NTMs in industry k out of the above specified industry set K.

Table 8 presents the industry-specific tariff overhang estimates for three samples of countries: A. all countries, B. OECD countries, and C. non-OECD countries. Note that all specifications account for log(Imports), PTAImportShare and log(WorldImportShare) as well as country-year and HS 2-digit fixed effects. Focusing first on the full-sample results in panel A., two results emerge. First, the industry-specific tariff overhang estimates are negative for all industries. Second, the tariff overhang effect is statistically significant (at least at the 10 percent level) for only four out of

[20] Note that the SPS and TBT notifications do not add up to the total number of NTMs as a given HS 4-digit sector can witness both during a given year.

the seven industries. Most prominently, manufacturing products show the strongest inverse link between tariff overhangs and NTMs. This result is intriguing as, particular in advanced economies, tariff protection is considered to be much lower for manufacturing sectors than agricultural and food related products. The estimated coefficient for manufacturing is about 5-times as large as in the baseline specification in column (2) of Table 4. The statistically significant effects for the animals, foodstuffs and vegetables industries are closer to the aggregate tariff overhang estimate.

Panels B. and C. of Table 8 dissect the industry-specific tariff overhang estimates by OECD and non-OECD countries. In OECD countries, the significant substitution effects between NTMs and tariff overhangs are concentrated in agricultural and food related products. This result is line with the general account in the literature that advanced economies disproportionately protect these sectors while materials and manufactures enjoy much lower protection levels. The opposite picture emerges for non-OECD countries in panel C. Agricultural and food related industries show no statistically significant link between tariff overhangs and NTMs. However, clothing, manufactures and materials industries witness substantial substitution effects between NTM notifications and tariff overhangs. Hence, although we observe an inverse link between tariff overhangs and NTMs in the aggregate, the effect varies substantially by countries' income levels and industries.

6 Non-tariff Measure Concerns

The analysis above focuses on the determinants of NTM notifications by member countries to the relevant WTO committees. However, one could argue that not all NTM notifications are necessarily of a protectionist nature (Beverelli et al. 2019), which could understate the magnitude of any potential substitution effect between tariffs and NTMs. In this section, I therefore use an alternative variable to capture the incidence of NTMs. The SPS and TBT committees of the WTO allow member countries to register concerns about NTMs that other members have implemented or plan to implement. Following the same empirical approach as in equation (1), I swap out the dependent variable to 'NTMconcern_{ict},' which captures the sum of SPS and TBT concerns for HS 4-digit product i in a given year t that have been received by WTO member c. As past NTM notifications are likely to be an important contributor to the frequency of received NTM concerns, I add the frequency of NTM notifications in the sector at hand over the past three years, 'Past NTM Count, 3 years,' to all specifications below. Equation (4) below summarizes these changes:

$$NTMconcern_{ict} = \alpha PastNTMcount_{ict-1} + \beta Overhang_{ic,t-1} + \gamma Z_{ic,t-1} + \eta_s + \omega_{ct} + \epsilon_{ict} \quad . \quad (4)$$

The first column in Table 9 presents the results of a PPML regression of the NTM concern count variable on the number of past NTM notifications. As expected, past NTM notifications are a positive and statistically significant (at the one percent level) determinant of NTM concerns. If a WTO member notifies more NTMs to SPS and TBT committees, it will be on the receiving end of more NTM concerns in the future. Although recent NTM notifications are an important contributor to NTM concerns, there are also plenty of NTM concerns in sectors that were not subject to any NTM notification in the recent past. Specifically, only 38.6 percent of HS 4-digit sectors with positive NTM concern counts had received at least one NTM notification in the previous three years. This fact highlights one potential issue with the NTM concern data with regard to the exact timing of NTM concerns. WTO members can register concerns about NTM notifications independent of when they went into force. Hence, a raised concern could refer to NTMs from several years past, which complicates the interpretation of the NTM concern regressions results. Finally, note that relative to Table 4 the size of the sample shrinks considerably when focusing on NTM concern counts. The reduction in the number of observations to about one third of the earlier analysis is due to the fact that NTM concerns are much rarer than NTM notifications. Therefore, the outcome of a larger number of observations in the PPML regressions is perfectly explained by the included country-year and HS 2-digit fixed effects, which leads to more observations being dropped in the NTM concern case.

Specification (33) in Table 9 adds the tariff overhang variable as an additional regressor. Moreover, the specification accounts for log(Imports), PTAImportShare and log(WorldImportShare), which are potentially correlated with a country's sectoral tariff overhang. Whereas the estimate for the 'Past NTM Count, 3 years' remains positive and statistically significant at the one percent level, the tariff overhang coefficient is not statistically different from zero. That is, tariff overhangs have no direct impact on the reporting frequency of NTM concerns. A similar result emerges in specifications (34) and (35), which replace the tariff overhang with the 1-year and 3-year change in the applied MFN tariff, respectively. Both measures have no significant effect on NTM concerns. The picture changes somewhat in columns (36) and (37) when the applied tariff changes are swapped out for their bound tariff counterparts. Both the 1-year and 3-year change in the MFN bound tariff have a negative effect on reported NTM concerns. That is, a reduction in the bound tariff raises the number of NTM concerns leveled against a WTO member. However, the effect is only statistically significant at the 10 percent level in either case.

More broadly, the picture that emerges in Table 9 indicates that past NTM notifications are the most important determinant of NTM concerns. Whereas tariff overhangs have no direct effect on the number of reported NTM concerns, the measure has at least an indirect impact through its highly significant inverse link with NTM notifications. With regard to applied tariff changes, there is neither a significant impact on NTM notifications nor NTM concerns. For bound tariff changes, the picture diverges slightly between their impact on NTM notifications and NTM concerns. While there is no significant link to the former, bound tariff reductions are significantly linked to increases in NTM concerns. However, to put this result in perspective, bound tariff changes are very small in the sample. On average, the 1- and 3-year change in bound tariffs is about -.2% each (see Table 3). The economic significance of this result is therefore not as relevant as one might think at first. Overall, tariff overhangs through their impact on NTM notifications appear as a more important, although indirect, driver of NTM concerns.

7 Concluding Remarks

Non-tariff measures have increasingly become the major focus of multilateral trade negotiations. It remains a crucial question whether and how the existing tariff structure in countries affects their tendency to implement NTMs. The theoretical literature lays out different channels suggesting that NTMs can either be applied in tandem with or in place of tariffs. Determining the relation between tariffs and NTMs is therefore an inherently empirical question. However, existing empirical studies offer mixed results, which are often based on cross-sectional data and limited country coverage due to the lack of comprehensive NTM data. Importantly, there is also no consensus on the relevant trade policy margin for which a NTM-tariff nexus should be detected.

In this paper, I examine the empirical significance of various tariff measures for the incidence of NTMs. The main part of my analysis focuses on SPS and TBT notifications of WTO members, which have the advantage of being available at the product-year level for a wide range of countries over a long time frame. Whereas applied and bound tariff reductions have previously been emphasized as NTM determinants, I find little support for this notion. Instead, I identify sectoral tariff overhangs, the difference between WTO bound and applied tariff rates, as the key trade policy measure for detecting a significant tradeoff between tariffs and NTMs. Smaller tariff overhangs constrain the trade policy flexibility of WTO members and therefore increase NTM actions. This finding is consistent with the theoretical framework of Beshkar and Bond (2017) who emphasize tariff overhangs as the key driver of a country's likelihood to use alternative protection instruments.

More broadly, the results in this paper suggest that focusing on reductions in bound or applied tariffs might overstate the actually realized trade liberalization of past GATT/WTO negotiation rounds. Less trade policy flexibility in the form of lower tariff overhangs will lead to the increased usage of other protectionist instruments, such as NTMs. To avoid this protectionist backsliding, there are several countermeasures that could be taken. First, in order to distinguish between legitimate and illicit uses of NTMs, every GATT/WTO member needs to transparently report all domestic rules and regulations that could affect trade. Official WTO trade policy reviews frequently point out deficits to that effect. Second, while member countries can report SPS/TBT concerns to the relevant WTO committees, only the dispute settlement mechanism can adjudicate disagreements between members countries. Returning the WTO's dispute settlement body to full working order, including timely appeal and implementation decisions, should therefore top the agenda for WTO members in the near future.

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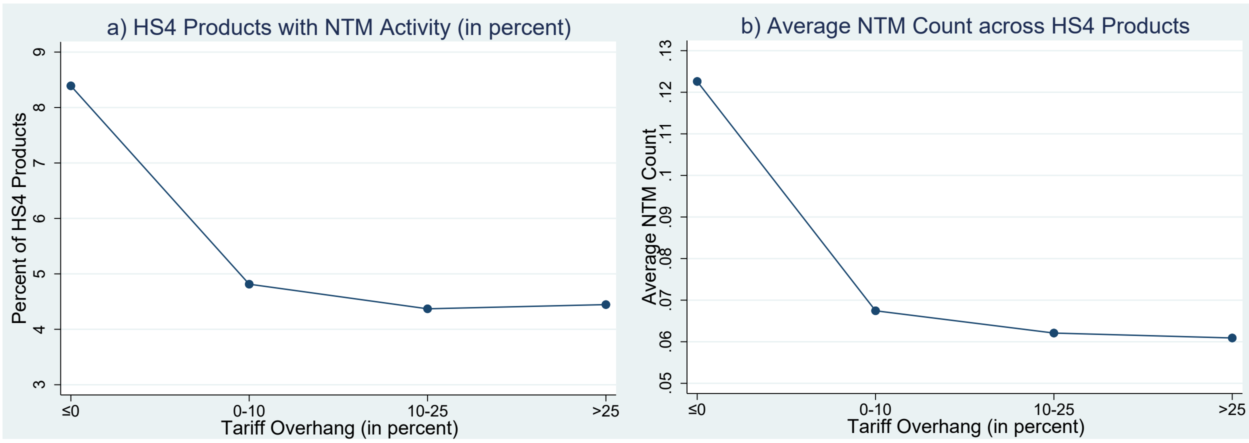
Figure 1: NTM Incidence across 4-digit HS Sectors, by Tariff Overhang



Notes: Author's own calculations based on data for the baseline sample from the SPS/TBT IMS and TRAINS databases. Both panels divide the baseline sample into four tariff overhang bins that contain about the same number of observations. Panel a) shows the share (in percent) of 4-digit HS sectors that are subject to a new NTM in the subsequent year, sorted by tariff overhang categories. Panel b) reports the average of the NTM Count variable in the subsequent year, sorted by tariff overhang categories.

Table 1: Non-tariff Measures and Tariff Overhang Distribution by Country, HS 4-digit, 1996–2018

Country	Observations	NTM Count	TBT Count	SPS Count	Share of Sectors by Tariff Overhang			
					$\leq 0\%$	$0-10\%$	$10-25\%$	$>25\%$
Albania	13,306	304	39	265	0.410	0.558	0.032	0.000
Argentina	27,856	901	168	733	0.051	0.116	0.616	0.217
Armenia	5,991	354	147	207	0.346	0.410	0.244	0.000
Australia	27,566	1,642	579	1,063	0.262	0.518	0.199	0.021
Bahrain	13,492	461	50	411	0.014	0.008	0.077	0.901
Barbados	988	7	1	6	0.000	0.000	0.000	1.000
Belize	2,928	30	8	22	0.015	0.002	0.011	0.972
Bolivia	11,074	233	183	50	0.031	0.001	0.064	0.904
Brazil	27,319	7,200	4,219	2,981	0.057	0.127	0.625	0.191
Burundi	755	32	8	24	0.295	0.101	0.045	0.559
Canada	28,926	1,916	658	1,258	0.467	0.520	0.012	0.001
Chile	27,360	1,671	40	1,631	0.043	0.002	0.944	0.011
China	19,341	4,258	3,125	1,133	0.824	0.172	0.003	0.001
Colombia	24,513	2,746	1,185	1,561	0.016	0.006	0.419	0.559
Costa Rica	20,694	1,952	904	1,048	0.019	0.022	0.069	0.890
Cote d'Ivoire	783	112	16	96	0.575	0.286	0.135	0.004
Dominican Republic	10,362	205	26	179	0.008	0.031	0.422	0.539
Ecuador	15,649	3,773	3,346	427	0.198	0.168	0.624	0.011
Egypt, Arab Rep.	16,584	815	459	356	0.093	0.204	0.438	0.265
El Salvador	25,045	885	222	663	0.019	0.009	0.328	0.644
European Union	28,662	5,194	987	4,207	0.906	0.093	0.000	0.000
Guatemala	19,602	1,196	32	1,164	0.009	0.007	0.179	0.806
Honduras	14,449	339	23	316	0.010	0.036	0.411	0.543
Hong Kong, China	15,005	239	89	150	1.000	0.000	0.000	0.000
India	12,273	692	27	665	0.108	0.081	0.295	0.516
Indonesia	22,187	1,034	548	486	0.024	0.019	0.206	0.751
Israel	15,732	1,909	1,898	11	0.140	0.619	0.136	0.105
Japan	28,883	4,540	2,415	2,125	0.924	0.074	0.003	0.000
Jordan	14,871	147	20	127	0.368	0.439	0.184	0.010
Kenya	2,046	131	97	34	0.009	0.004	0.012	0.975
Korea, Rep.	28,344	2,085	233	1,852	0.363	0.539	0.081	0.018
Kuwait	7,982	240	146	94	0.006	0.001	0.003	0.991
Kyrgyz Republic	1,880	162	132	30	0.481	0.444	0.076	0.000
Malawi	991	79	22	57	0.004	0.003	0.050	0.942
Malaysia	19,045	661	532	129	0.172	0.549	0.238	0.041
Mali	373	195	2	193	0.475	0.110	0.019	0.397
Mexico	25,515	1,841	517	1,324	0.038	0.043	0.541	0.378
Moldova	5,259	358	326	32	0.598	0.327	0.074	0.002
Mongolia	1,887	19	17	2	0.013	0.171	0.816	0.000
Morocco	12,843	603	2	601	0.128	0.081	0.244	0.547
New Zealand	26,027	1,542	270	1,272	0.401	0.290	0.296	0.013
Nicaragua	17,433	582	171	411	0.008	0.003	0.138	0.850
Norway	13,407	94	9	85	0.592	0.380	0.027	0.000
Oman	13,611	338	10	328	0.141	0.288	0.551	0.019
Panama	10,927	253	3	250	0.091	0.215	0.541	0.154
Paraguay	14,415	113	57	56	0.046	0.035	0.572	0.347
Peru	22,393	2,313	1,065	1,248	0.025	0.016	0.682	0.276
Philippines	17,021	1,148	19	1,129	0.057	0.138	0.545	0.260
Qatar	10,180	122	9	113	0.119	0.183	0.692	0.006
Saudi Arabia	6,098	358	62	296	0.064	0.654	0.281	0.001
Singapore	20,219	452	198	254	0.183	0.262	0.555	0.000

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Country	Observations	NTM Count	TBT Count	SPS Count	Share of Sectors by Tariff Overhang			
					$\leq 0\%$	$0-10\%$	$10-25\%$	$>25\%$
South Africa	25,230	1,575	1,340	235	0.277	0.269	0.375	0.079
Sri Lanka	5,366	149	5	144	0.064	0.262	0.419	0.255
Switzerland	6,204	268	46	222	1.000	0.000	0.000	0.000
Tanzania	692	37	35	2	0.000	0.000	0.000	1.000
Thailand	12,265	1,131	793	338	0.221	0.109	0.503	0.167
Trinidad and Tobago	5,479	20	5	15	0.018	0.011	0.057	0.913
Turkey	7,806	440	121	319	0.180	0.349	0.294	0.177
Uganda	910	316	301	15	0.010	0.001	0.047	0.942
Ukraine	12,793	1,140	344	796	0.609	0.371	0.020	0.000
United Arab Emirates	10,747	384	9	375	0.123	0.195	0.679	0.004
United States	28,262	7,620	3,921	3,699	0.941	0.058	0.001	0.000
Uruguay	16,346	81	6	75	0.047	0.100	0.595	0.258
Venezuela	4,710	238	130	108	0.001	0.020	0.631	0.348
Vietnam	12,720	640	63	577	0.568	0.403	0.026	0.004

Table 2: Non-zero Non-tariff Measure Count Distribution

NTM Count	1	2	3	4	5	6-10	11-26	Total
Observations	37,902	9,193	2,006	881	334	527	87	50,930

Table 3: Summary Statistics

Variable	Mean	Std. Dev.	Obs.	Definition	Data Source
ΔAppliedTariff, 1 year	0.0001	0.0364	849,550	1-year change in HS 4-digit applied tariff (in ad valorem terms)	WITS database
ΔAppliedTariff, 3 years	-0.0041	0.0666	815,368	3-year change in HS 4-digit applied tariff (in ad valorem terms)	WITS database
ΔBoundTariff, 1 year	-0.0022	0.0211	842,411	1-year change in HS 4-digit bound tariff (in ad valorem terms)	WITS database
ΔBoundTariff, 3 years	-0.0020	0.0220	777,073	3-year change in HS 4-digit bound tariff (in ad valorem terms)	WITS database
1/[IM + EX Elasticities]	0.1665	0.2208	597,119	HS 4-digit level inverse of sum of import demand and export supply elasticities	Nicita et al. (2018)
log(Imports)	0.1926	1.0793	871,535	log of sectoral imports (in $1,000s)	UN Comtrade
Δlog(Imports), 3 years	0.1962	1.0793	871,535	3-year change in log(Imports)	UN Comtrade
log(WorldImportShare)	-10.2318	2.6452	919,622	Log of sectoral world import share	UN Comtrade
NTM Concern Count	0.0388	0.2698	319,886	Number of submitted concerns regarding SPS and TBT measures in HS 4-digit sector	TTBD database
NTM Notification Count	0.0789	0.4127	919,622	Number of SPS and TBT notifications in HS 4-digit sector	WTO SPS & TBT IMS databases
Past NTM Count, 3 years	0.2008	0.8660	919,622	Number of SPS and TBT notifications in HS 4-digit sector in previous 3 years	WTO SPS & TBT IMS databases
Overhang	0.1512	0.1784	919,622	MFN bound tariff − MFN applied tariff (in ad valorem terms)	WITS database
PTAImportShare	0.3127	0.3573	919,622	Share of sectoral imports from PTA partners	UN Comtrade, de Sousa (2012) & Larch and Egger (2008)
SPS Count	0.0596	0.3356	672,926	Number of SPS notifications in HS 4-digit sector	WTO SPS IMS database
TBT Count	0.0605	0.3693	536,146	Number of TBT notifications in HS 4-digit sector	WTO TBT IMS database
Past TP, 3 years	0.0569	0.2317	761,567	Temporary protection investigation (AD, CVD, SG, CSG) in HS 4-digit sector in previous 3 years: 1 (yes), 0 (no)	TTBD database

Table 4: Non-tariff Measures and Tariff Overhangs – PPML Results (Average Marginal Effects)

Dependent Variable:	4-digit	4-digit	4-digit	4-digit	4-digit	4-digit	2-digit
Non-tariff Measure	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Notification Count	NTM	NTM	NTM	NTM	TBT	SPS	NTM
Overhang_{t-1}	-0.0400***	-0.0386***	-0.0399***	-0.0365***	-0.0270**	-0.0135	-0.3218***
	(0.0132)	(0.0130)	(0.0131)	(0.0127)	(0.0125)	(0.0092)	(0.1168)
$\log(\text{Imports})_{t-1}$		0.0108***		0.0108***	0.0104***	0.0063***	0.1354**
		(0.0006)		(0.0006)	(0.0007)	(0.0004)	(0.0584)
$\text{PTAImportShare}_{t-1}$		0.0027	0.0051	0.0041	0.0087*	-0.0012	0.0278
		(0.0037)	(0.0036)	(0.0037)	(0.0047)	(0.0024)	(0.0525)
$\log(\text{WorldImportShare})_{t-1}$		-0.0074***	0.0036***	-0.0074***	-0.0075***	-0.0044***	-0.0906
		(0.0008)	(0.0005)	(0.0008)	(0.0010)	(0.0005)	(0.0585)
Overhang_{t-1}				-0.0388***			
$\times\text{PTAImportShare}_{t-1}$				(0.0145)			
Observations	919,622	919,622	919,622	919,622	536,146	672,926	79,369
Pseudo R2	0.361	0.367	0.362	0.367	0.299	0.473	0.479
Country-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2-digit HS FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The table presents average marginal effects from PPML regressions. Clustered standard errors at the country/2-digit HS level are in parentheses. ***, ** and * indicate 1 percent, 5 percent and 10 percent significance levels, respectively. Specification (4) reports the respective composite effects for Overhang_{t-1} and $\text{PTAImportShare}_{t-1}$, taking into account the interaction between both variables.

Table 5: Non-tariff Measures and Tariff Overhangs – Linear Fixed Effects Model Results

Dependent Variable:	4-digit	4-digit	4-digit	4-digit	4-digit	4-digit	2-digit	4-digit
Non-tariff Measure	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Notification Count	NTM	NTM	NTM	NTM	TBT	SPS	NTM	NTM
Overhang_{t-1}	-0.0411***	-0.0367**	-0.0406***	-0.0355**	-0.0313**	-0.0061	-0.2890**	-0.0506***
	(0.0154)	(0.0154)	(0.0154)	(0.0153)	(0.0141)	(0.0142)	(0.1327)	(0.0116)
$\log(\text{Imports})_{t-1}$		0.0101***		0.0101***	0.0100***	0.0054***	0.1514***	0.0079***
		(0.0006)		(0.0006)	(0.0008)	(0.0004)	(0.0329)	(0.0005)
$\text{PTAImportShare}_{t-1}$		0.0122**	0.0139***	0.0140**	0.0089**	0.0061	0.0359	0.0089**
		(0.0052)	(0.0053)	(0.0056)	(0.0039)	(0.0056)	(0.0732)	(0.0043)
$\log(\text{WorldImportShare})_{t-1}$		-0.0076***	0.0025***	-0.0076***	-0.0081***	-0.0033***	-0.1466***	-0.0062***
		(0.0008)	(0.0006)	(0.0008)	(0.0009)	(0.0007)	(0.0329)	(0.0006)
Overhang_{t-1}				-0.0745***				
$\times\text{PTAImportShare}_{t-1}$				(0.0253)				
Observations	919,622	919,622	919,622	919,622	536,146	672,926	79,369	1,186,912
R2	0.1539	0.1555	0.1541	0.1556	0.0930	0.2065	0.1784	0.1423
Country-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2-digit HS FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The table presents linear fixed effects model regression results. Clustered standard errors at the country/2-digit HS level are in parentheses. ***, ** and * indicate 1 percent, 5 percent and 10 percent significance levels, respectively. Specification (11) reports the respective composite effects for Overhang_{t-1} and $\text{PTAImportShare}_{t-1}$, taking into account the interaction between both variables.

Table 6: Non-tariff Measures and Tariff Changes – PPML Results (Average Marginal Effects)

Dependent Variable: Non-tariff Measure Notification Count	4-digit (16) NTM	4-digit (17) NTM	4-digit (18) NTM	4-digit (19) NTM	4-digit (21) NTM	4-digit (22) NTM	4-digit (23) NTM	4-digit (24) NTM
Overhang_{t-1}					-0.0394***	-0.0424***	-0.0413***	-0.0420***
					(0.0130)	(0.0139)	(0.0132)	(0.0138)
$\Delta\text{AppliedTariff}_{t-1}$, 1 year	-0.0067				-0.0151			
	(0.0170)				(0.0176)			
$\Delta\text{AppliedTariff}_{t-1}$, 3 years		-0.0007				-0.0045		
		(0.0065)				(0.0099)		
$\Delta\text{BoundTariff}_{t-1}$, 1 year			0.0066				0.0270	
			(0.0312)				(0.0331)	
$\Delta\text{BoundTariff}_{t-1}$, 3 years				-0.0118				0.0016
				(0.0281)				(0.0281)
$\log(\text{Imports})_{t-1}$	0.0109***	0.0114***	0.0110***	0.0114***	0.0109***	0.0114***	0.0110***	0.0114***
	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0006)
$\text{PTAImportShare}_{t-1}$	0.0028	0.0016	0.0029	0.0005	0.0029	0.0016	0.0030	0.0005
	(0.0040)	(0.0042)	(0.0040)	(0.0042)	(0.0039)	(0.0041)	(0.0039)	(0.0041)
$\log(\text{WorldImportShare})_{t-1}$	-0.0073***	-0.0077***	-0.0073***	-0.0077***	-0.0073***	-0.0077***	-0.0073***	-0.0077***
	(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0008)
Observations	849,550	815,368	842,411	777,073	849,550	815,368	842,411	777,073
Pseudo R2	0.366	0.364	0.365	0.365	0.366	0.364	0.366	0.366
Country-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2-digit HS FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The table presents average marginal effects from PPML regressions. Clustered standard errors at the country/2-digit HS level are in parentheses. ***, ** and * indicate 1 percent, 5 percent and 10 percent significance levels, respectively.

Table 7: Non-tariff Measures and Tariff Overhangs – Additional Determinants (PPML Results – Average Marginal Effects)

Dependent Variable: Non-tariff Measure Notification Count	4-digit (25) NTM	4-digit (26) NTM	4-digit (27) NTM	4-digit (28) NTM	4-digit (29) NTM
Overhang_{t-1}	-0.0411***	-0.0543***	-0.0316***	-0.0416***	-0.0447***
	(0.0134)	(0.0174)	(0.0115)	(0.0131)	(0.0152)
$\Delta\log(\text{Imports})_{t-1}$, 3 years	-0.0008	0.0001			0.0013
	(0.0006)	(0.0011)			(0.0011)
1/[IM + EX Elasticities]		0.0031			0.0040
		(0.0030)			(0.0029)
Past NTM Count_{t-1}, 3 years			0.0100***		0.0105***
			(0.0006)		(0.0009)
Past TP_{t-1}, 3 years				0.0122***	0.0083**
				(0.0040)	(0.0040)
$\log(\text{Imports})_{t-1}$	0.0113***	0.0126***	0.0090***	0.0095***	0.0098***
	(0.0006)	(0.0007)	(0.0005)	(0.0005)	(0.0006)
$\text{PTAImportShare}_{t-1}$	0.0019	0.0015	-0.0012	0.0026	-0.0046
	(0.0039)	(0.0052)	(0.0035)	(0.0036)	(0.0045)
$\log(\text{WorldImportShare})_{t-1}$	-0.0075***	-0.0090***	-0.0064***	-0.0067***	-0.0076***
	(0.0008)	(0.0012)	(0.0007)	(0.0008)	(0.0011)
Observations	871,535	597,119	919,622	761,567	502,594
Pseudo R2	0.363	0.355	0.383	0.367	0.375
Country-year FE	Yes	Yes	Yes	Yes	Yes
2-digit HS FE	Yes	Yes	Yes	Yes	Yes

Notes: The table presents average marginal effects from PPML regressions. Clustered standard errors at the country/2-digit HS level are in parentheses. ***, ** and * indicate 1 percent, 5 percent and 10 percent significance levels, respectively.

Table 8: Non-tariff Measures and Tariff Overhangs – PPML Estimates by Industry

Dependent Variable: Non-tariff Measure Notification Count	Industry						
	Animals	Chemicals	Clothing	Foodstuffs	Manufactures	Materials	Vegetables
A. All Countries							
Overhang	-0.0272*	-0.0226	-0.0801	-0.0359**	-0.1986***	-0.0503	-0.0299*
	(0.0158)	(0.0334)	(0.0502)	(0.0174)	(0.0481)	(0.0489)	(0.0167)
B. OECD Countries							
Overhang	-0.1098**	-0.0223	-0.0723	-0.1096*	-0.2198	-0.1557	-0.1647***
	(0.0547)	(0.1214)	(0.1831)	(0.0631)	(0.1457)	(0.1742)	(0.0567)
C. Non-OECD Countries							
Overhang	-0.0081	0.0253	-0.1538***	-0.0238	-0.1847***	-0.0960**	0.0121
	(0.0140)	(0.0274)	(0.0462)	(0.0151)	(0.0473)	(0.0429)	(0.0145)

Notes: The table presents average marginal effects from a PPML model regression of equation (3). Each specification includes country-year and 2-digit HS fixed effects as well as controls for $\log(\text{Imports})_{t-1}$, $\text{PTAImportShare}_{t-1}$ and $\log(\text{WorldImportShare})_{t-1}$. Clustered standard errors at the country/2-digit HS level are in parentheses. ***, ** and * indicate 1 percent, 5 percent and 10 percent significance levels, respectively.

Table 9: Non-tariff Measure Concerns and Tariff Overhangs – PPML Results

Dependent Variable: Non-tariff Measure Concern Count	4-digit (32) NTM	4-digit (33) NTM	4-digit (34) NTM	4-digit (35) NTM	4-digit (36) NTM	4-digit (37) NTM
Past NTM Count$_{t-1}$, 3 years	0.0026***	0.0024***	0.0016**	0.0017**	0.0017***	0.0018***
	(0.0007)	(0.0007)	(0.0006)	(0.0007)	(0.0006)	(0.0007)
Overhang$_{t-1}$		0.0011				
		(0.0069)				
ΔAppliedTariff$_{t-1}$, 1 year			-0.0020			
			(0.0093)			
ΔAppliedTariff$_{t-1}$, 3 years				0.0051		
				(0.0215)		
ΔBoundTariff$_{t-1}$, 1 year					-0.0404*	
					(0.0241)	
ΔBoundTariff$_{t-1}$, 3 years						-0.0501*
						(0.0261)
log(Imports)$_{t-1}$		0.0033***	0.0032***	0.0034***	0.0033***	0.0035***
		(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0005)
PTAImportShare$_{t-1}$		0.0025	0.0039	0.0034	0.0038	0.0059**
		(0.0025)	(0.0025)	(0.0027)	(0.0026)	(0.0028)
log(WorldImportShare)$_{t-1}$		-0.0028***	-0.0026***	-0.0025***	-0.0027***	-0.0027***
		(0.0006)	(0.0007)	(0.0007)	(0.0007)	(0.0007)
Observations	319,886	319,886	303,379	276,970	297,267	252,947
Pseudo R2	0.360	0.362	0.363	0.352	0.361	0.351
Country-year FE	Yes	Yes	Yes	Yes	Yes	Yes
2-digit HS FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The table presents average marginal effects from PPML regressions. Clustered standard errors at the country/2-digit HS level are in parentheses. ***, ** and * indicate 1 percent, 5 percent and 10 percent significance levels, respectively.

Appendix A: Data

Sample Composition: The baseline sample consists of the overlap between the tariff information in the World Bank's TRAINS database and the WTO's SPS and TBT Information Managements Systems (IMS) at the HS 4-digit level. The former can be accessed through the WITS system: http://wits.worldbank.org/wits/. The SPS and TBT data is available at http://spsims.wto.org/ and http://tbtims.wto.org/, respectively. When their MFN tariff data is available, WTO members are included in the sample if they notified at least one SPS and TBT notification during the period 1996-2018. The start of the sample period is determined by the fact that consistent bound and applied MFN tariff data at the HS 4-digit level are not available before 1995. The baseline specification in Table 4 also requires import data (in logs) at the HS 4-digit level. Hence, sectors with missing or zero imports are dropped from the analysis. The sample also excludes the two percent of sectors with the largest tariff overhangs to minimize the impact of outliers, which limits the data to HS 4-digit sectors with tariff overhangs of 120 percent or less.

NTM Notification Count: The NTM variable, NTM_{ict} in equation (1), is a count measure that adds up the number of SPS and TBT notifications to the WTO by member country c in HS 4-digit sector i and year t. WTO members can choose to report their SPS/TBT notifications at any HS level. As indicated in footnote 9, the most frequent notification level is HS 4-digit. The empirical analysis is therefore conducted at this level, implying that HS 6-digit notifications are aggregated up to the HS 4-digit level. For instance, if in a given year a country notifies one SPS measure in HS040610 (fresh cheese) and one TBT measure in HS040610 (grated or powdered cheese), the NTM_{ict} measure takes the value two in the HS 4-digit sector 0406 (cheese and curd). HS 2-digit notifications are instead distributed among the underlying HS 4-digit sectors. For instance, if a country notifies an SPS measure for HS01 (live animals), NTM_{ict} increases its count by one for all HS 4-digit sectors within HS01. Notifications without HS information, e.g., because they apply at a more general level, are not considered in the analysis.

In specification (7) in Table 4, I compile the NTM count variable instead at the HS 2-digit level. For instance, if in a given year a country notifies one SPS measure in HS040610 (fresh cheese), one TBT measure in HS040610 (grated or powdered cheese) and one SPS measure pertaining to HS04 (dairy produce), the NTM_{ict} measure at the HS 2-digit level (HS04) takes the value three.

NTM Concern Count: The NTM concern measure, $NTMconcern_{ict}$ in equation (4), is a count variable that adds up the number of concerns that countries submit to the WTO pertaining to member c's SPS and TBT measures in HS 4-digit sector i and year t. Following the procedure for the NTM notification variable described above, HS 6-digit concerns are aggregated up to the HS 4-digit level and HS 2-digit concerns are distributed among the underlying HS 4-digit sectors.

Tariff Overhangs: To obtain the baseline HS 4-digit tariff overhang measure, $Overhang_{ic,t-1}$ in equation (1), I proceed in two steps. I first obtain from the TRAINS database for each WTO member (if available) the simple averaged bound and MFN applied tariff data at the HS 4-digit level (based on the combined HS nomenclature). The tariff data excludes non-tariff measures; see footnote 12. I then construct the sectoral tariff overhangs by subtracting the MFN applied tariff from the bound tariff. The corresponding tariff overhang measures at the HS 2-digit level are calculated using simple averages of the bound and applied MFN tariff rates at this aggregation level instead.

Appendix B: Additional Results

Table B1: Fixed Effects and Clustering Sensitivity – PPML Results (Average Marginal Effects)

Dependent Variable: Non-tariff Measure Notification Count	4-digit (B1) NTM	4-digit (B2) NTM	4-digit (B3) NTM	4-digit (B4) NTM	4-digit (B5) NTM	4-digit (B6) NTM	4-digit (B7) NTM	4-digit (B8) NTM
Overhang_{t-1}	-0.0282**	-0.1002**	-0.0371***	-0.2815***	-0.0386***	-0.0386***	-0.0386***	-0.0386***
	(0.0138)	(0.0408)	(0.0130)	(0.0703)	(0.0143)	(0.0073)	(0.0125)	(0.0127)
$\log(\text{Imports})_{t-1}$	0.0206***	0.0720***	0.0073**	0.1419***	0.0108***	0.0108***	0.0108***	0.0108***
	(0.0009)	(0.0033)	(0.0029)	(0.0094)	(0.0011)	(0.0003)	(0.0010)	(0.0006)
$\text{PTAImportShare}_{t-1}$	0.0047	0.0342**	-0.0005	-0.0509***	0.0027	0.0027	0.0027	0.0027
	(0.0045)	(0.0153)	(0.0039)	(0.0146)	(0.0051)	(0.0024)	(0.0041)	(0.0039)
$\log(\text{WorldImportShare})_{t-1}$	-0.0166***	-0.0562***	-0.0044	-0.1341***	-0.0074***	-0.0074***	-0.0074***	-0.0074***
	(0.0010)	(0.0035)	(0.0029)	(0.0093)	(0.0011)	(0.0004)	(0.0009)	(0.0007)
Observations	488,419	137,556	916,225	310,025	919,622	919,622	919,622	919,622
Pseudo R2	0.376	0.356	0.384	0.216	0.367	0.367	0.367	0.367
Fixed effects	HS2 x c + ct	HS2 x ct	HS4 + ct	HS4 x c	HS2 + ct	HS2 + ct	HS2 + ct	HS2 + ct
Clustering level	HS2 x c	HS2 x c	HS2 x c	HS2 x c	HS2 + ct	HS2 x ct	HS4 + ct	HS4 x c

Notes: The table presents average marginal effects from PPML regressions. ***, ** and * indicate 1 percent, 5 percent and 10 percent significance levels, respectively.

Table B2: Fixed Effects and Clustering Sensitivity – Linear Fixed Effects Model Results

Dependent Variable: Non-tariff Measure Notification Count	4-digit (B9) NTM	4-digit (B10) NTM	4-digit (B11) NTM	4-digit (B12) NTM	4-digit (B13) NTM	4-digit (B14) NTM	4-digit (B15) NTM	4-digit (B16) NTM
Overhang_{t-1}	-0.0249**	-0.0168**	-0.0356**	-0.1465***	-0.0367*	-0.0367***	-0.0367***	-0.0367***
	(0.0105)	(0.0085)	(0.0158)	(0.0375)	(0.0207)	(0.0096)	(0.0085)	(0.0085)
$\log(\text{Imports})_{t-1}$	0.0101***	0.0098***	0.0118***	0.0406***	0.0101***	0.0101***	0.0101***	0.0101***
	(0.0006)	(0.0006)	(0.0020)	(0.0037)	(0.0015)	(0.0003)	(0.0005)	(0.0005)
$\text{PTAImportShare}_{t-1}$	0.0008	0.0053**	0.0093*	-0.0202***	0.0122**	0.0122***	0.0122***	0.0122***
	(0.0032)	(0.0024)	(0.0054)	(0.0047)	(0.0055)	(0.0026)	(0.0030)	(0.0030)
$\log(\text{WorldImportShare})_{t-1}$	-0.0073***	-0.0070***	-0.0109***	-0.0388***	-0.0076***	-0.0076***	-0.0076***	-0.0076***
	(0.0006)	(0.0005)	(0.0020)	(0.0036)	(0.0015)	(0.0004)	(0.0006)	(0.0006)
Observations	919,622	919,622	919,622	919,622	919,622	919,622	919,622	919,622
R2	0.2618	0.6273	0.1669	0.3048	0.1555	0.1555	0.1555	0.1555
Fixed effects	HS2 x c + ct	HS2 x ct	HS4 + ct	HS4 x c	HS2 + ct	HS2 + ct	HS2 + ct	HS2 + ct
Clustering level	HS2 x c	HS2 x c	HS2 x c	HS2 x c	HS2 + ct	HS2 x ct	HS4 + ct	HS4 x c

Notes: The table presents linear fixed effects model regression results. ***, ** and * indicate 1 percent, 5 percent and 10 percent significance levels, respectively.

Table B3: Tariff Overhang Bins – PPML Results (Average Marginal Effects)

Dependent Variable: Non-tariff Measure Notification Count	4-digit (B17) NTM	4-digit (B18) NTM	4-digit (B19) NTM	4-digit (B20) NTM	4-digit (B21) TBT	4-digit (B22) SPS	2-digit (B23) NTM
Overhang_{t-1}: $\leq 0\%$ (1:Yes, 0:No)	0.0110**	0.0134**	0.0126**	0.0128**	0.0133**	0.0031	0.1355***
	(0.0054)	(0.0053)	(0.0054)	(0.0053)	(0.0067)	(0.0031)	(0.0497)
Overhang_{t-1}: 0%to25% (1:Yes, 0:No)	0.0110**	0.0104**	0.0111**	0.0097**	0.0117**	-0.0022	0.1332***
	(0.0043)	(0.0043)	(0.0043)	(0.0043)	(0.0058)	(0.0026)	(0.0396)
$\log(\text{Imports})_{t-1}$		0.0108***		0.0108***	0.0104***	0.0063***	0.1331**
		(0.0006)		(0.0006)	(0.0007)	(0.0004)	(0.0583)
$\text{PTAImportShare}_{t-1}$		0.0028	0.0053	0.0037	0.0091*	-0.0014	0.0400
		(0.0037)	(0.0036)	(0.0037)	(0.0047)	(0.0024)	(0.0516)
$\log(\text{WorldImportShare})_{t-1}$		-0.0073***	0.0036***	-0.0073***	-0.0075***	-0.0043***	-0.0887
		(0.0007)	(0.0005)	(0.0007)	(0.0009)	(0.0006)	(0.0585)
Overhang_{t-1}: ≤ 0 $\times\text{PTAImportShare}_{t-1}$				0.0130*			
				(0.0068)			
Overhang_{t-1}: 0%to25% $\times\text{PTAImportShare}_{t-1}$				0.0060			
				(0.0061)			
Observations	919,622	919,622	919,622	919,622	536,146	672,926	79,369
Pseudo R2	0.361	0.366	0.362	0.366	0.299	0.473	0.479
Country-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2-digit HS FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The table presents average marginal effects from PPML regressions. Clustered standard errors at the country/2-digit HS level are in parentheses. ***, ** and * indicate 1 percent, 5 percent and 10 percent significance levels, respectively. Specification (B20) reports the respective composite effects for Overhang_{t-1}: $\leq 0\%$, Overhang_{t-1}: 0%to25% and $\text{PTAImportShare}_{t-1}$, taking into account the interactions between the former two variables and $\text{PTAImportShare}_{t-1}$.

Table B4: Non-tariff Measures and Tariff Overhangs – Without HS 2-digit NTM Notifications (PPML Results – Average Marginal Effects)

Dependent Variable: Non-tariff Measure Notification Count	4-digit (B24) NTM	4-digit (B25) NTM	4-digit (B26) NTM	4-digit (B27) NTM	4-digit (B28) TBT	4-digit (B29) SPS
Overhang_{t-1}	-0.0320***	-0.0291***	-0.0322***	-0.0279***	-0.0270**	-0.0135
	(0.0077)	(0.0073)	(0.0077)	(0.0071)	(0.0125)	(0.0092)
$\log(\text{Imports})_{t-1}$		0.0119***		0.0119***	0.0104***	0.0063***
		(0.0006)		(0.0006)	(0.0007)	(0.0004)
$\text{PTAImportShare}_{t-1}$		0.0055**	0.0082***	0.0063***	0.0087*	-0.0012
		(0.0024)	(0.0022)	(0.0024)	(0.0047)	(0.0024)
$\log(\text{WorldImportShare})_{t-1}$		-0.0084***	0.0035***	-0.0084***	-0.0075***	-0.0044***
		(0.0007)	(0.0004)	(0.0007)	(0.0010)	(0.0005)
$\text{Overhang}_{t-1} \times \text{PTAImportShare}_{t-1}$				-0.0188**		
				(0.0093)		
Observations	887,418	887,418	887,418	887,418	536,146	672,926
Pseudo R2	0.306	0.332	0.309	0.332	0.299	0.473
Country-year FE	Yes	Yes	Yes	Yes	Yes	Yes
2-digit HS FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The table presents average marginal effects from PPML regressions. Clustered standard errors at the country/2-digit HS level are in parentheses. ***, ** and * indicate 1 percent, 5 percent and 10 percent significance levels, respectively. Specification (B27) reports the respective composite effects for Overhang_{t-1} and $\text{PTAImportShare}_{t-1}$, taking into account the interaction between both variables.

Table B5: Non-tariff Measures and Outlier Sensitivity – PPML and Linear Fixed Effects Model Results

	PPML Model				Linear Fixed Effects Model			
Sample Restriction	NTM>250	NTM>500	NTM>1000	NTM<2000	NTM>250	NTM>500	NTM>1000	NTM<2000
Dependent Variable:	4-digit	4-digit	4-digit	4-digit	4-digit	4-digit	4-digit	4-digit
Non-tariff Measure	(B30)	(B31)	(B32)	(B33)	(B34)	(B35)	(B36)	(B37)
Notification Count	NTM	NTM	NTM	NTM	NTM	NTM	NTM	NTM
Overhang$_{t-1}$	-0.0477***	-0.0578***	-0.0929***	-0.0203**	-0.0373**	-0.0567***	-0.1258***	-0.0294**
	(0.0157)	(0.0185)	(0.0243)	(0.0098)	(0.0185)	(0.0212)	(0.0300)	(0.0143)
log(Imports)$_{t-1}$	0.0121***	0.0136***	0.0164***	0.0063***	0.0113***	0.0125***	0.0152***	0.0056***
	(0.0006)	(0.0008)	(0.0010)	(0.0004)	(0.0007)	(0.0008)	(0.0010)	(0.0004)
PTAImportShare$_{t-1}$	0.0032	0.0033	0.0049	0.0072***	0.0151**	0.0159**	0.0255***	0.0028
	(0.0043)	(0.0051)	(0.0065)	(0.0026)	(0.0061)	(0.0070)	(0.0091)	(0.0033)
log(WorldImportShare)$_{t-1}$	-0.0084***	-0.0102***	-0.0119***	-0.0040***	-0.0080***	-0.0082***	-0.0094***	-0.0036***
	(0.0009)	(0.0010)	(0.0013)	(0.0005)	(0.0009)	(0.0011)	(0.0014)	(0.0005)
Observations	777,102	648,083	504,284	679,748	777,102	648,083	504,284	679,748
R2 (Pseudo R2)	0.355	0.344	0.329	0.356	0.1647	0.1695	0.1740	0.1313
Country-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2-digit HS FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The table presents average marginal effects from PPML and linear fixed effects model regressions. Clustered standard errors at the country/2-digit HS level are in parentheses. ***, ** and * indicate 1 percent, 5 percent and 10 percent significance levels, respectively.