Specific Trade Concerns and Technical Barriers to Trade: evidence from a new database

Malo Beguin[†]

October 25, 2022

JEL Classification — F13; P48

Keywords — Specific Trade Concerns, Technical Trade Barriers, Gravity, WTO

Acknowledgements — Computational resources have been provided by the supercomputing facilities of the Université catholique de Louvain (CISM/UCL) and the Consortium des Équipements de Calcul Intensif en Fédération Wallonie Bruxelles (CÉCI) funded by the Fond de la Recherche Scientifique de Belgique (F.R.S.-FNRS) under convention 2.5020.11 and by the Walloon Region.

Abstract

Increasingly present at the WTO, Specific Trade Concerns (STCs) on Technical Barriers to Trade (TBTs) are assumed to signal the most stringent TBTs in terms of trade costs. Lacking information in the only available WTO STC database, the previous literature relies on the assumption that the raised dates at the WTO effectively proxy the trade shock. Building an updated WTO STC database, we examine two potential endogeneity issues when using raised dates. First, a third of all STCs are raised a long time before or after the TBT is in force. Second, a TBT reducing trade increases the willingness to complain at the WTO and complaints impact trade in return. As a result, it creates a bias when using only raised dates to measure the trade shock of a TBT STC. We create a 1:1 match of STCs with respective TBTs which includes notification and enforcement dates. Then, we also examine the role of timings when complaining at the WTO. Complaining before or after the in force date is not equivalent and discards the initial hypothesis that STC are the most restrictive TBTs. In line with Ghodsi et al. (2017), we show that TBT STCs increase trade levels at the mean. Also, raised dates are accurate to measure TBT impacts on trade in the manufacturing sector, but not in agriculture and in many specific industries inside the manufacturing, mining and energy, and services

[†]LFIN/LIDAM, UCLouvain, Belgium; email: malo.beguin@uclouvain.be

broad sectors. Finally, we find that agriculture is only impacted by STCs when raised before the respective TBT enter into force. It confirms the need to reassess the use of TBT STC in the literature.

I. Introduction

For two decades, the level of tariffs has decreased and the number of non-tariff measures (NTMs) in trade agreements has increased. Their impact on trade is not as straightforward as for tariffs. The reason is that NTMs are more complex and more heterogeneous than tariffs. Indeed, there are sixteen categories among NTMs going from non-technical measures which are trade-related (e.g. subsidies, quotas, anti-dumping, pre-shipment inspection, etc.) to technical measures which are product-related (e.g. technical requirements and conformity assessments). Because they cover most NTMs, researchers have shown high interest in product-related sanitary and phytosanitary measures (SPSs) and technical barriers to trade (TBTs)[1]. Also, TBTs cover all types of industries contrarily to SPSs. Both NTMs came into effect in 1995 after the Uruguay Round negotiations. In the SPS and TBT agreements, the intention of SPSs and TBTs is to protect consumers and the environment, to prevent protectionism and to help industrial standardization, giving technical boundaries for specific products[2]. TBTs and SPSs often applies to a product in one or several industries at once. Thus, it it sometimes impacts a whole sector. It can improve trade (e.g. bringing a better information and increasing trust among partners) or hurt trade (e.g. increasing the compliance cost for both exporters and domestic firms and the administrative burden, such as new environmental and production process requirements)[3].

In both cases, a SPS or TBT must be notified at the WTO in early stage in order to allow other WTO members to comment. After the commenting period, some amendments can be made. Then, the NTM is adopted, published, and at least six months later, the it enters into force. While there might be some effects due to anticipations, the new TBT or SPS is effective only from this enforcement period.

[1]There are currently roughly 45.000 TBTs notified compared to 30.000 SPSs (measures for the period 1995-2022). See WTO website for more information.

[2]Annex A.1. (wto, 2022a) is clear on SPSs which are "any measures applied (...) to protect human or animal life or health". In the same vein, article 2.2 of TBT agreement recognizes that TBTs "ensure the quality of its exports, or for the protection of human, animal or plant life or health, of the environment, or for the prevention of deceptive practices (...)".

[3]For TBT, the initial intention was to “prevent protectionism” and to allow also each member to “enact product regulations for approved (legitimate) public policy purposes”. Legitimate public policy purposes is defined in the TBT Agreement (wto, 2022b) in Article 2.2. (but not exclusive). It also includes technical harmonization, and quality standards.

Even when focusing on SPSs and TBTs, it is difficult to grasp the direction and size of their impacts on trade[4]. In a meta-analysis on the TBT and SPS literatures for the agri-food sector, Santeramo and Lamonaca (2019) give more insights on the reasons why the literature finds such heterogeneous results. TBTs and SPSs calls for different objectives of implementation in different industries and, thus, different effects of TBTs are expected. To avoid a dilution effect of insignificant and non-constraining TBTs, a part of the NTM literature has focused on specific trade concerns (STCs).

Table 1: Stated concerns for TBTs raised at the WTO

Concerns	**Number of STCs raised**	**Proportion in all STCs**
Further Information	395	17,75
Unnecessary barrier to trade	364	16,36
Transparency	342	15,37
Other issues raised	289	12,99
International standards	242	10,88
Rationale, legitimacy	225	10,11
Discrimination	178	8,00
Time to adapt, "reasonable interval"	127	5,71
Non-product related & procedural meas.	42	1,89
Special and differential treatment	17	0,76
Technical assistance	4	0,18

Source: Author's calculations on the NTC database for 2000-2021 period, WTO.
Notes: Each STC can have more than one objective. The total number of STCs raised in this database is 725.

Specific trade concerns (STCs) are brought at the WTO to complain on a SPS or a TBT at any moment from the notification until after the entry into force. Those complaints are called SPS STCs and TBT STCs. According to WTO's official data, there have been 725 TBT STCs raised between 1995 and 2021[5]. In the STC literature, it is assumed that a concern is raised because a TBT or SPS measure is impeding trade and STCs signal the most restrictive ones (Beghin et al., 2015; Disdier et al., 2020; Fontagné and Orefice, 2018; Fontagné et al., 2015; Kamal and Zaki, 2018; Orefice, 2017; Singh and Chanda, 2021)[6]. However, as it is shown in table 1 which gives the reasons of complaints against TBTs, any WTO member, on its own or with

[4]The variety of SPSs and TBTs might explain why some authors find positive effects of on trade (De Frahan and Vancauteren, 2006; Fernandes et al., 2021) while other find the opposite (Bao and Qiu, 2012; Shepherd, 2007).

[5]For more information, see WTO's TBT and SPS committee website.

[6]The literature distinguishes among two definition for restrictive TBT. A loose definition of restrictiveness considers that the presence of STC is enough (as used in the recent literature (Herghelegiu, 2018)). For a stricter definition of restrictiveness, the STC must not have been withdrawn and should be in-force before

other members, can submit a STC to address several issues linked to trade barriers or not. For example, "further information" is rather linked to a lack of translation or notification of a given TBT [7]. Once a STC has been raised, it can be raised again by the same countries or by new ones in the next meetings. The different dates of complaints are recorded as such: the "first raised date" is for the first concern raised against a specific TBT or SPS, the "last raised date" is the last raised date which is the last one recorded at the WTO. There might be several raised dates in this interval. The concern is resolved when there is no new raised date for at least two years.

One famous case is the one of Indian tyres in the 133rd TBT STC raised at the WTO. On March 2006, the European Union raised a first STC against India on a newly notified tire regulation aimed at setting a new public certification system to secure tires against warm roads conditions. While its primary objective is consumer safety, the European Union, joined later on by the United States, Japan, and a series of other developed countries, are concerned that it discriminates against foreign tire producers. For example, this new regulation obliges every producers to pass through a new certification system which cost nearly 35 cents per tire for foreign producers, while only 0.5 cents for the local ones. Against those concerns, India adopted the new regulation in 2010 and the concerns are still ongoing at the WTO until now, hoping for a change in the regulation. In total, the concern has been raised 37 times at the WTO against this Indian TBT.

The STC literature mainly proves its initial intuition that TBT STC measures slow down trade. However, they do so using firm-level databases with exports or imports from one specific country and with the old WTO STC database which does not include initiation and in force dates and stops in 2012. Fontagné and Orefice (2018) study the impact of TBT STCs on different margins of trade using firm-level data from French exporters. The proxy for trade impact is the interval [t-1;t+1] around all the raised dates (not the in force dates since it is not available in the old WTO STC database). They show that export participation drops even more for multi-destination firms and for sectors composed of similar firms in terms of size. A TBT is taken as an additional cost burden and many firms will divert trade towards a destination with no restrictive TBTs. Kamal and Zaki (2018) find similar results using the same database on TBT STCs with Egyptian firms. Their proxy for TBT STC impact on trade is the interval [t-1;t+1] around the first raised date. They also find that TBTs change the firms' product diversification heterogeneously across industries, increasing the diversity of agricultural goods while having mixed effects on non-agricultural products. Finally, another interesting work on intermediate Indian firms from Singh and Chanda (2021) show that TBT STCs are significantly decreasing imports for OECD countries only. It suggests that stricter TBTs are lessening the access of non-OECD countries to high-quality inputs. They find that TBTs lead importers to decrease their markups more than non-importers (concerning intermediate inputs producers) with no significant impact on prices.

---

the last raised concern (Singh and Chanda, 2021).

[7] For specific examples, the official complaints meetings are recorded and available in a written report for each recorded minute.

Another pan of the literature show that TBT STCs act as substitutes for tariffs. Again, the old WTO STC database is used and the proxy for trade impact is not the in force date but the interval [t-1;t+1] around all the raised dates. Herghelegiu (2018) finds that only TBTs raised as STCs are substitutes for tariffs. Orefice (2017) makes a distinction between sectors to study if TBT STCs (manufacture) and SPS STCs (agriculture) are substitute for tariffs and find stronger and more significant results in manufacturing (table 4) but he does not compare those sectors and do not study them within TBT STCs. He also adds details concerning the level of development of trade partners. Countries with similar development complain more after a tariff reduction than pairs with different level of development (developed - developing country pairs). In their work,Beverelli et al. (2019) show that TBT STCs are replacing tariffs only in developed economies.

Finally, a sector-level study from Ghodsi et al. (2017) investigates the trade impact of each NTM. They look inside manufacturing sector into different industries (hs2 level) and find also heterogeneity while often negatively impacting trade. They find opposite and heterogeneous results specifically when comparing TBT STCs across industries. Interestingly, TBT STCs impact positively trade at the mean but negatively at the median, suggesting that big exporters benefit from TBT STCs contrarily to most other firms.

As shown above, the literature highlights the importance of taking sectors and countries into account when measuring the impact of STCs. For that reason, we focus on TBT STCs. TBTs are a better choice to study the heterogeneous impact across industries because TBTs are more diversified in all sectors compared to SPSs which are mostly present in agriculture (Ghodsi et al., 2017).

We contribute to the present literature in three ways: in terms of data in order to contribute later in terms of methodology, and in terms of results.

First, due to an old and incomplete database on STCs, the literature was stuck with the use of raised dates at the WTO to study the trade impacts of TBTs. We built an updated STC database going until 2021 compared to 2012 previously. The initial STC database is now extended with a TBT's notification (i.e. initiation date) and enforcement dates. In other words, we create a 1:1 match of STCs and respective TBTs. It allows to study whether the coefficients for STC raised dates significantly differ from the ones for TBT initiation and in-force dates, both in terms of significance and sign. It also allows us to control for all timings between dates observed at the WTO, which might signal distinct realities behind a complaint at the WTO (see figure **??**).

As it is explained by Fontagné and Orefice (2018), the dummy TBT reflects "the existence at time t of an ongoing (unresolved) TBT (. . .) turns to zero when the TBT concern is solved" (p.650). However, they also make the case that they only observe raised dates (at the WTO), which, as they say, assumes that "a STC is raised the same year of the underlying TBT measures"(p.650). Thus, the literature relies on the assumption that the raised dates at the WTO effectively signal the trade shocks brought by TBTs. Using raised dates brings up two potential issues. Using the updated STC database, we solve both using directly the interval [t-1; t+1] around the in-force date (i.e. the year before, the same year or the year after) which is the date that previous researchers were aiming at in the previous literature but not able to use[8]

A first endogeneity issue is that a STC raised date might be misleading because it can occur a long time before or after the TBT trade shock. It could bias the estimation. Out of the 555 STCs for which we have the information on the in-force date, 30.6% are raised at least two years before or after the in-force date. It drops to 12.4% for STCs raised at least 4 years before or after the in-force date but it remains non-negligible and a potential source of measurement error[9].

A second issue is that, as mentioned by Ghodsi et al. (2017), raised dates might bring endogeneity because a TBT affecting trade negatively increases the reasons to complain at the WTO and complaints might impact trade positively (negatively) in return, as if hope (fear) for change could boost (hinder) trade. Using only STCs might be biased in the positive (negative) direction. Knowing the timings between in-force dates, initiation dates, and raised dates, we can control this potential simultaneity bias (see figure **??**). We examine whether raised dates effectively measure the impact of TBTs and give a representative picture of TBTs impact on trade. Then, we control the different timings separately. We keep only the STCs raised before (during, and after) the in-force date: 51.7% (24.3%, and 24% respectively) out of the ones for which we know the in-force dates.

Finally, we contribute in terms of results. Like the literature, we find that TBT STCs lead to more significant and stronger results than simple TBT notifications to the WTO (Herghelegiu, 2018; Shepotylo, 2016). We show that signs and magnitudes of our estimates are very heterogeneous with a refined sectoral disaggregation. This is in line with the previous literature (Ghodsi et al., 2017; Orefice, 2017). Unexpectedly, but like Ghodsi et al. (2017), most sectoral exports are positively impacted by TBT STCs, with very significant results (i.e. with a p-value below the 1% level). Also, considering that a bias is the distance with the in force date estimation (which is the benchmark), raised dates are accurate to measure TBT impacts on trade in the manufacturing sector, but not in agriculture and in many specific industries inside the manufacturing, mining and energy, and services broad sectors. Finally, we find that agriculture is only impacted by STCs when raised before the respective TBT enter into force. Finally, selecting the timing impacts the results, showing different realities among TBT STCs. We also address the potential discriminatory issue brought by TBTs. TBTs can be set up in order to favor domestic industries. However, they are supposed to be

[8]Fontagné and Orefice (2018) do acknowledge the fact that the "in force" date is the one that needs to be studied when saying "a STC is raised the same year of the underlying TBT measures" (p.650).

[9]In their study, Beverelli et al. (2019) show that 88.7% of STCs (among 291 STCs with information on the initiation date and on the hs4 products linked to the TBT) were introduced the year of initiation of the corresponding TBT or the year before. In our own calculation with the updated STC database, it drops to 72.7% out of 578 STCs with information on the initiation date and on the hs4 products. While it reveals a majority of new STCs, as it is called by Beverelli et al. (2019), it does not consider the in-force date, neither does it dig into the case of "old" STCs (the STCs raised at least two years before or after the in-force or initiation dates).

non-discriminatory according to the WTO rules. Following the work from Yotov et al. (2016), we include internal trade flows[10] to measure the potential discrimination. We add an interaction between the TBT variable and a variable equal to one for intra-national trade observations. We find that discrimination is present for some sectors, in majority favouring the foreign exporters.

The remaining of the paper presents the construction of our database with stylized facts about TBTs in several industries and the relevance of TBT STCs as an object of study (section 2). Then, we continue with the methodology (section 3) and the results (section 4). Section 5 concludes.

II. Construction of a merged database of STCs and gravity data

In order to measure the impact of TBT on trade, we merge data from 5 different databases: bilateral export flows from the ITPD-E database, the updated STC database, the WIIW dataset, the Dynamic Gravity Dataset, and TRAINS bilateral tariffs. After the merging, we are left with 178 countries and 131 industries for the period 2000-2016[11]. The database considers importer-sector and exporter-sector pairs for which at least one TBT STC occurs. Thus, we discard countries and industries non-linked to a TBT STC. Unless a complaint is filed against a specific member of the European Union, we aggregate European countries into the EU in terms of trade flows. Indeed, the EU complains as a whole and most concerns from non-EU countries are against the EU as a unique entity.

To measure the impact of TBT on trade, we use the ITPD-E database. It is made for disaggregated gravity estimations and has the advantage of including domestic trade. Also, it gives better gravity estimates than other similar databases such as WIOD because it does not estimate the missing data but is built from reported administrative data (Borchert et al., 2021). ITPD-E aggregates ISIC industries into 170 sectors (agriculture, mining and energy, manufacturing, and service) and it gives a cleaned dataset of bilateral trade (exports), as explained by Borchert et al. (2021). The database gives the most precise data at the sectoral level of aggregation and the theoretical gravity framework allows to measure the impact on trade at the world level or at the industrial level in the same way.

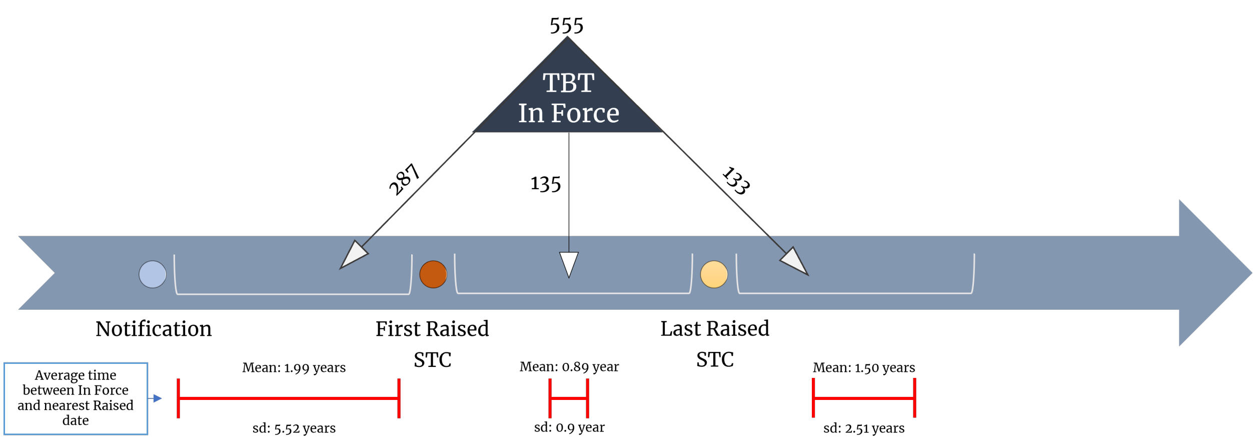
TBT STC data comes from the updated STC database for information on raised dates and from the I-Tip NTM database for information on the initiation and in-force dates. The updated STC database records 725 concerns raised in the TBT committee between 1995 until 2021. It is an updated and augmented version

[10]The goods bought and sold in the same country.

[11]The 2000-2016 period is shorter than the 1995-2021 period provided by the STC dababase. Some information from NTC is still of importance for the years after 2016, such as raised dates, which signal that the STC is not resolved. Also, it still gives the best time span compared to the most similar database, WIOD. ITPD-E is more precise in terms of number of industries (131 after matching versus 56), countries (164 exporters, 178 exporters after matching versus 16 economies, knowing we count European Union as one country), and year coverage (2000 until 2016 versus 2014).

of the STC database which stopped in mid 2011. It fills a gap in the literature which was limited to use STC raised dates to measure the impact of In Force date TBT STCs. We know the objectives, the issues raised, the HS2017 4 digits codes[12], the first raised date and all subsequently raised ones, the complaining and the maintaining country(ies). Figure **??** shows the distribution of STC by HS line. We match the STC unique codes (i.e.: the identifiers available on the TBT IMS website) with the notification codes also available in the I-Tip NTM database. We filled manually some missing dates using the online TBT IMS database[13] and recorded meetings minutes. Having the initiation, in-force, and raised dates allows us to find several information on the duration of the STC issue and how a sector reacts through time. It characterizes the timing of in-force and initiation dates regarding complaining dates. We observe three types of timings which might alter the estimation of TBT STCs impact on trade, as shown in figure 1. While a TBT STC has an initiation date before a first and last raised date, the in force date might occur at any point before, between, or after raised dates. This means that countries complain either after the TBT is hurting trade or before, anticipating the trade shock.

Figure 1: In Force date distribution timeline



In Force dates arrive at different moment through the TBT STC life. Below the timeline is the distance (mean and standard deviation) of In Force date from the nearest raised date, for each of the three In Force date position in the timeline.

To control the impact of TBT STCs on trade, we complete our database with other important explanatory variables: tariffs, other NTMs, and gravity variables, which estimate the trade cost. The tariffs come from the UNCTAD Trade Analysis Information System (TRAINS) through the WITS portal. TRAINS contains information on tariffs for over 160 countries. Also, missing years are replaced by the nearest year available[14].

[12]We compute the corresponding ITPDE code which are at the ISIC 3.1 level using the correspondence table provided by Borchert et al. (2021) and a correspondence table which we build for HS2017 4 digits codes.

[13]Here is the website of the online TBT IMS database.

[14]We check the box "earlier year wins ties" to avoid missing observations.

Tariffs are Ad Valorem Equivalent weighted average of effectively applied rates (AHS) and take the UNCTAD 2 method for AVEs, which uses HS-6 digits imports statistics of all OECD countries and keeps the margin of preference in the preferential tariff. AHS rates with UNCTAD 2 method work as follows: tariff statistics are weighted by import values[15]. The effectively applied tariff takes either the lowest available preferential tariff if available, or the MFN applied tariff. One reason for using AHS rates instead of simple average MFN tariffs is that it varies by partner and through time. This allows to take tariffs into account with a simple PPML approach with several fixed effects[16].

I also control our estimation with other NTMs potentially affecting trade and correlated with TBT STCs. I add information on other NTMs from WIIW. The WIIW NTM database is an augmented WTO's Integrated Trade Intelligence Portal (I-TIP) database which provides more HS 6-digit codes (missing codes dropped by 55% to 22.3%) and more details on the NTM types. While one could wonder why we did not use WIIW directly to measure TBT STCs, this database lacks coherence on TBT STCs because two distinct variables account for their presence and are not equivalent[17]. Also, it is not updated with the most recent STC data and does not give any information about the types of TBT STCs. Compared to the WIIW database, our update of the STC database almost triples the number of observations hit by a TBT STCs [18].

The Dynamic Gravity Dataset provides demographics, country characteristics such as distance, colonial ties, GDP or preferential agreements, etc (Gurevich and Herman, 2018). One version of this dataset is made to fit the ITPD-E database in the same time span (2000-2016). Thus, it is a natural choice compared with the CEPII Gravity database. The Dynamic Gravity Dataset includes data for the European Union as a whole and updates its composition through time. However, for the concern of our analysis, we study the EU with the 15 first members since it allows to avoid jumps in trade when integrating new members. As a result, we create a country "EU-15" based on both Dynamic Gravity Dataset and ITPD-E data which is like the previous Dynamic Gravity Dataset in terms of fixed variables and a sum of the 15 countries by year for time-varying variables.

[15]This is subject to caveats: extreme values bias the results. Indeed, a very high tariff likely implies small imports and thus it has a low weight. This might lead to prohibitive tariffs having the same weight as zero-tariffs. However, taking the simple average tariff (i.e.: not weighted) would also bring some issues: some goods with very high import levels will have the same impact in terms of tariff than a good with very low import level if they have both the same tariff level.

[16]It would not have been feasible with MFN tariffs which are country specific.

[17]STC is a dummy equal to one if STC is present, NTM gives the NTM type, including TBT STC. All TBT STCs should have $STC = 1$, it is not the case.

[18]It increases from 35.686 observations at the sectoral level which are hit by a TBT STC in WIIW data to 99.302. The TBT STCs in the STC database cover all the ones from WIIW.

III. Empirical strategy with gravity for sector level estimation

We test the impact of TBT STCs on trade flows using the gravity framework with two econometric models: Ordinary Least Squares (OLS) and Poisson Pseudo Maximum Likelihood method (PPML) proposed by Silva and Tenreyro (2006). Theory and empirics strongly support the gravity framework[19]. For both models, we control for the internal trade as suggested by Yotov et al. (2016).

a. Theoretical grounds

Theoretically, TBTs impact trade through the bilateral trade frictions present in the standard gravity equation derived by Yotov et al. (2016):

$$X^k_{ij,t} = \frac{Y^k_{i,t} E^k_{j,t}}{Y^k_t} \left(\frac{t^k_{ij,t}}{\Pi^k_{i,t} P^k_{j,t}} \right)^{1-\sigma^k} \tag{1}$$

where: i and j are the exporting and importing countries respectively, k is the industry, and t is the year. $X^k_{ij,t}$ is the nominal export (in levels) from i to j in industry k at time t, Y is the production at price factory and E is the expenditure in the importing country. t denotes the bilateral trade frictions between i and j in industry k at time t. It includes the NTMs, the TBTs and TBT STCs. Π is the outward and P is the inward multilateral resistance of Anderson and Van Wincoop (2003). σ^k is the elasticity of substitution between the varieties in k. Since we use industry level estimates, the above gravity model implies that the TBT STCs are industry specific, and that the fixed effects are of the country-industry-year dimension.

Following Silva and Tenreyro (2006), PPML panel fixed effects give the preferred estimates when using a gravity model. It partly answers an endogeneity issue since it controls for country-pair-time fixed effects and studies the within country-pair dimension. The PPML method avoids the strong heteroscedasticity present with OLS estimates and it considers zero trade flows, contrarily to OLS. We control for pair fixed effects as Yotov et al. (2016) recommend it. However, it discards all time invariant estimates such as distance, common ethnicity, colony, language, and contiguity. Thus, we also show the results without pair fixed effects. Finally, we present OLS as a robustness check. It is not the best estimation method. While OLS is the classical model used in the gravity literature, it has been proven to be biased compared to PPML.

b. Empirical methodology to measure the impact of TBT STCs depending on four dates

Our model tests if a STC in a sector affects the export from i to j at time t. We ask whether exports hit by a STC differ significantly from exports not hit by a STC for a sector. We test the impact of the choice of proxy

[19] A broad class of trade models converges to the gravity framework, as Arkolakis et al. (2012) showed it.

for the TBT STC with four dates: initiation, in-force, first raised, and the period between the first raised and last raised dates. In order to compare our results, we perform four regressions, one for each date of interest.

While we regress our empirical equation for all sectors at once first, we also regress it for broad sectors and then for all sectors separately. Broad sectors are grouping several industries from ITPD-E given our selection of 131 industries. Agriculture contains 16 industries, Mining and Energy contains 3 industries, Manufacturing contains 110 industries and Services contains 2 industries. We estimate at the sector level to obtain more exploitable results in terms of policies. It avoids complex interpretation. Separate estimations for each sector also allows the FE to vary with the elasticity of substitution[20].

We study the following gravity equations:

$$\begin{aligned} X^k_{ij,t} = d^k_{ij} \times \exp\Big[&\beta^k_5 TAR_{ij,t} + \beta^k_6 NTM_{ij,t} + \beta^k_7 TBT^{STC}_{ij,t} \\ &+ \beta^k_8 TBT^{STC}_{intrai,t} + \sum_i \beta^k_{9,i} SMCTRY_{ij} + \pi^k_{i,t} + \chi^k_{j,t}\Big] \times \varepsilon^k_{ij,t} \end{aligned} \tag{2}$$

with

$$d^k_{ij} = \exp\left[\beta^k_1 DIST_{ij} + \beta^k_2 CNTG_{ij} + \beta^k_3 LANG_{ij} + \beta^k_4 CLNY_{ij}\right]$$

and

$$\begin{aligned} X^k_{ij,t} = \exp\Big[&\beta^k_5 TAR_{ij,t} + \beta^k_6 NTM_{ij,t} + \beta^k_7 TBT^{STC}_{ij,t} \\ &+ \beta^k_8 TBT^{STC}_{intrai,t} + \mu_{ij,t} + \pi^k_{i,t} + \chi^k_{j,t}\Big] \times \varepsilon^k_{ij,t} \end{aligned} \tag{3}$$

where $X^k_{ij,t}$ denotes the trade flow, $NTM_{ij,t} = TBT_{ij,t} + nonTBT_{ij,t}$ with TBT being all non STCs and $nonTBT$ being all the other NTMs. $SMCTRY$ denotes the dummy equal to 1 when the exporter is the importer. It brings in the internal trade dimension to the model. TBT^{STC} signals the presence of a TBT STC in the measured industry. It is equal to 1 when the trade year is in the $[t-1; t+1]$ interval of the TBT STC date of interest[21]. The dates of interest are the initiation date, the in-force date, the first raised date, or the period between the first raised date and the last raised date. NTM is a dummy equal to 1 around the NTM in-force date period (in $[t-1; t+1]$). It controls for all NTMs other than TBT^{STC}. d_{ij}

[20] It considerably facilitates the interpretation of the results because it does not force to have an estimation of the elasticity of substitution to estimate the trade costs (for example with the Ad Valorem Equivalent)

[21] To measure the impact of TBTs on trade flows, we choose to use dummy variables because they assume the stringency of the TBTs (Santeramo and Lamonaca, 2019). The interval $[t-1; t+1]$ accounts for the time to adapt and the potential bias coming from the aggregation of dates from day-format to year-format. Dolabella (2020) and Herghelegiu (2018) recommend using lag values.

are the bilateral trade costs. Finally, TBT^{STC}_{intra} is the interaction between $SMCTRY$ and TBT^{STC}[22]. $\mu_{ij,t}$, $\pi^k_{i,t}$, and $\chi^k_{j,t}$ are country pair, importer-year and exporter-year fixed effects, respectively. They account for the multilateral resistance terms in the theoretical model of gravity from Anderson and Van Wincoop (2003) and give much more explanatory power than without them (higher R-squared) as well as discard most endogeneity. However, pair FEs also eliminate all the variables varying in the same dimension as the FEs (which are collinear). Specification (2) (without pair FEs) will present our main results because (1) we want to estimate the variables in d^k_{ij} and (2) we want to avoid losing explanatory power of $TBT^{STC}_{ij,t}$. First, d^k_{ij} vary in the ij dimension like the country pair FEs. Second, $TBT^{STC}_{ij,t}$ varies very little each year t, only three year around the date of interest (initiation, in force, raised dates). In addition, TBTs are policies which are mostly applying in specific sectors for a long time period. Adding pair FEs discards most of the effects measured in by $TBT^{STC}_{ij,t}$[23].

Our reason to implement internal trade is to identify the potential discrimination between domestic and foreign producers. We expect a TBT leads to a higher compliance cost for both exporters and domestic firms. We can measure whether the exporters' compliance cost is lower or higher by looking at significant changes in trade volumes after introducing a TBT STC (knowing we assume TBT STCs select significant TBTs). If the estimate of TBT^{STC}_{intra} on the exported quantities is negative (positive), then exporters are better (worse off) than domestic producers in terms of profits[24].

We expect the TBT^{STC} estimates (β_7) to be negative or positive, depending on the sector. If we follow the literature, the total sector estimation could give positive results according to Ghodsi et al. (2017) because some sectors with higher trade levels show strong positive impacts, moving the total effect in the positive area even though TBT STCs potentially affect negatively a majority of sectors. Intuitively, it is more obvious to think of TBT STCs as hitting negatively trade flows. Indeed, it makes sense to think that a negative trade shock would cause a complaint issued at the WTO. However, a positive TBT might also be brought to the WTO TBT committee if the reasons of complain are for clarity reasons more than trade barriers reasons. It is also possible that countries invoke trade barriers at the WTO only to add political pressure on the maintaining member.

We can estimate the effect of TBT STCs on trade as being the difference between sectoral trade with and without TBT STCs as in Dolabella (2020) (see its equation 1, 2, 3 and annex 1). The coefficients β_7 for

[22]While for typical policy variables it creates a variation across FE dimensions and allows to estimates the standard gravity variables, our TBT^{STC} already varies through time and we do not need this interaction to estimate its impact on trade with a standard PPML framework.

[23]$TBT^{STC}_{ij,t}$ varies also according to the sector k. For robustness check, we also test specification (3) and the case with country pair sector FEs in the appendix.

[24]A similar analysis can be done with price: if the consequent increase of the import price is lower (higher) than the one of the domestic price, then exporters are better (worse off) than domestic producers in terms of profits. However, we do not observe price in the ITPDE database.

the TBT^{STC} variable give the expected decrease or increase of log export quantities when there is a TBT STC (the extensive margins). A simple operation gives the percentage change in exports.

$$\Delta T = (e^{\beta_7^k} - 1) * 100 \tag{4}$$

IV. Results

a. Our results for standard gravity estimates

Figure 2: Set of NTMs and its subsets

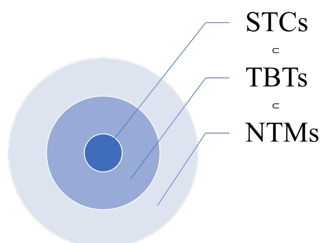


Table 5 gives us the baseline results without any TBT STC covariate, comparing different included FEs. The idea here is to first look at TBTs as the subset included into NTMs without accounting for STCs (the baseline) and then look at STCs as the subset of TBTs itself subset of NTMs (see figure 2 above).

Let us look at standard gravity estimates, which accounts for the trade cost, in column (1) to convince the reader of the strength of our results for TBT STC dates in the next paragraph. Column (1) does not include pair fixed effects in order to be able to estimate those gravity variables. As noted by Borchert et al. (2021), the ITPD-E gives very strong estimates for distance, contiguity, language, and colony variables. The signs and size are the same as in the literature. Colonial ties is the only variable which gives non-significant results. It is caused by the fact that most countries complaining and getting complains are OECD countries which do not have colonial ties, as showed in figure 3. Tariff is a standard gravity covariate when testing the impact of a NTM. The impact of tariff is an elasticity: an increase of one percent of tariff is decreasing trade by 1.788%. Concerning the "TBTs without STCs", "Other NTMs than TBTs" and "NTMs including TBTs" variables[25], we find the following results: in column (1), "TBTs without STCs" decrease exports by

[25] In column (1), those variables are respectively written as follows: TBTs w/o STCs for "TBTs without STCs" accounts for all TBTs except TBT STCs, NTMs w/ TBTs for "Other NTMs than TBTs" accounts for all NTMs except TBTs and TBT STCs.

***23.9%[26]. This is expected: most TBTs hurt trade because of the time and cost to adapt. Other non-TBTs NTMs increase exports by ***34%. There are many NTMs and while some are intuitively more likely to hinder trade, on average, it favors it.

Our baseline results are robusts when we include more restrictive pair FEs. Column (2) control for country pair fixed effects and gives lower estimates. The literature on the gravity framework (Yotov et al., 2016) advises the use of country pair fixed effects because it discards the potential endogeneity created by omitted variables [27]. Significance levels and signs are similar in column (2) compared with column (1). Column (3) controls for country-pair sector FE. However, with country-pair sector FE, we do not observe much since only time variability is remaining and most independent variables in our regression do not vary a lot through time. Similarly, we include country pair FEs for robustness check for two reasons. First, they erase all variability between country pair, which only leaves us with variability through time and sectors. It is interesting but for our variable of interest, TBT STC, it is not the most suitable. Indeed, there is only a low variability of TBT STC through time. Once a TBT is set on, it does not change. Similarly for raised dates. Thus, we would be left with the variability through sectors. However, an important part of TBT STCs are fixed across pair countries dimension and we want to capture the whole impact before checking only for the part of TBT STC which vary across pair countries.

Let us now look at the gravity variables in table 7 which looks at broad sectors and compares OLS and PPML. OLS and PPML show quite different results because of the high number of zero trade flows, in conformity with the work from Silva and Tenreyro (2006). Tariffs are a bit reduced for agriculture and manufacturing compared with all sectors results. However, a 1% change in tariff increases trade by 7.489% in the mining and energy broad sector and by 40.506% in services. This is unexpected but remember that only few industries in those sectors are included in the analysis (only the ones with at least one STC). Also, tariffs on gas, petrol, electricity, telecommunication service or other business services are too broad sectors to study a tariff impact. For example, in the energy sector, a green tariff hits the most polluting source of energy while it favours the other one. The low elasticity of demand of energy goods and the presence of substitutes might explain a positive impact of a tariff. Consequently, studying disaggregated sectors in the rest of the paper is important to dig deeper into this interpretation.

b. The effects of TBT STC dates on export

We now show our main findings concerning the impact of TBT STC dates on trade. We first present our results for all sectors. Then, we propose disaggregated estimates for broad sectors and, finally, we discuss a sample of sector-specific results.

[26]For the readability, stars on the left-hand side of an estimate are denoting significance levels: * p <0.10, ** p <.05, *** p <.01.

[27]For example, bilateral policies other than the one we wish to study.

b.1 The effects for all sectors and broad sectors

Taking all sectors in table 8, the mean effect of TBT STCs in an industry is to increase exports. More precisely, this is true whatever the date used to measure the impact of a TBT STC and with our without pair FEs[28]. The only difference when using or not pair FEs is the significance level. It is significant at the 1% level for the In Force date, at the 10% level for the raised dates when using either first raised date or the interval between the first and the last raised dates, as used in the literature. The initiation date is not significant when taking country pair FE into account. If we look at the specification without pair FE, this trend is significant at the 1% level for all dates and robust across OLS & PPML, even though different in size (see also table 7.

Looking at table 7 column (1) for all sectors, the presence of a TBT STC is increasing exports by ***153.45% around the in-force date with OLS and ***38.54% with PPML. The impact with PPML is less strong because of the zero trade flows, which are considered contrarily to the OLS case, which has the tendency to over-estimate the dependant variables.

While it is expected that the mean impact of NTMs without STCs is negative, as well as TBTs without STCs, we did not expect to find a positive impact of TBT STCs on trade. It makes sense to think that a negative shock pushes countries to complain at the WTO. Thus, we could at least have expected a negative sign for the initiation date (INIT). But our results are the mean results for all sectors or for broad sectors, it does not take into account specific industries nor specific countries complaining which could observe negative results for them. As a matter of fact, when we look at specific industries, the impact is negative (see table 11). The reason for negative results in work like Fontagné and Orefice (2018) is rather linked to their specific case focused on French exporters. As we have found looking only at European exporters, the TBT STC at In Force date is negatively impacting trade flows (see table 12). A positive effect in our main results might be driven by big exporters which are not hurt by new regulation since they are already the ones leading new regulations. In a way, one could think that they lobby to make new TBTs that favour their competitive position. Thus, a new TBT is advantaging big exporter enough to find a mean positive result even though most small and medium size exporters are worse off with a new TBT. This could be the case because they must adapt to the new regulation but also because they face fiercer competition from big exporters. While we do not verify this intuition which would ask for a firm-level dataset, this is what is found in the literature which uses one-country firm level data (Fontagné and Orefice, 2018; Fontagné et al., 2015). Also, as explained in the introduction, our results are similar to Ghodsi et al. (2017) who find a mean positive impact but a median negative impact. It comforts us in the interesting idea that big exporters benefit from new TBTs, especially when they cost more in terms of adaptation costs and time (and therefore lead to a complaint).

What is the role of STCs in this case? Complaints against the WTO could be raised by competitors,

[28] The results for equation 3 are in table 8 column (2) which includes country pair FE.

maybe small and medium firms which do not have the power to lobby for a TBT in their favor but can ask for STCs to be raised. It would mean that raising a concern has a role to re-equilibrate unequal TBTs impact among firms of different size. However, we need to control for the different timing (see figure **??**). A new STC would increase even further the positive impact of those TBTs when raised after the in force date as initially disadvantaged companies would get better terms after a complaint. On the other hand, when the concern is raised before the in force date, most of the positive impact would be in the raised dates rather than the in force date which would no longer necessarily give significant results because the costs and time of adaptation would have already been anticipated.

For all sectors pooled, we confirm the positive trend of TBT STCs on trade. When looking at columns (B) to (E) of table **??**, we find a positive impact for almost all broad sectors and dates. For example, in columns (1), around the initiation date, the exports increase by **26.49% in the agricultural sector, by 15.14% in the mining and energy sector (but not significant), by ***21.16% in the manufacturing sector, and by ***245.9% in the services sector. Only the mining and energy sector is not significantly affected by TBT STCs with the PPML approach. For the other sectors, it is always significant with the PPML approach.

Table 2: Summary results of bias when using raised dates by sector (PPML) **with Pair FEs**, 1995 - 2021

Dep. Var. Sector	(1) Agriculture	(2) Mining and Energy	(3) Manufacturing	(4) Services
INFORCE	0.212***	0.307**	0.050	-1.53***
FRAISED	0.048	0.016***	0.034	0.240***
Sign of the bias	Strong Underestimation	Strong Underestimation	Not significant	Strong Overestimation

Notes: Here is the summary of estimates for all 131 sectors from ITPD-E which have been hit in at least one period and in one exporting country. We have performed two regressions to get each of two dates (INFORCE is the TBT dummy at the in-force date and FRAISED is the TBT dummy for first raised dates). All other information is available in table 7. Standard errors in parentheses * p <0.10, ** p <.05, *** p <.01. See text for further details.

Let us now turn to the difference in results across dates. In tables 2 and 3, we look at a summary of the potential bias between in-force dates and first raised dates which is a proxy used in the literature to measure the impact of TBT STCs. In column (3) using PPML and country pair FE, the in-force dates does not impact trade, there is not a major concern in terms of bias[29]. However, it is not the case for agriculture (column 1) and mining and energy (column 2). There is an important difference between in-force and first raised dates.

[29]However, we recall that there is an issue using country pair FEs, since all TBT STCs apply once to all countries. Thus, it is fixed when looking only at this bilateral trade dimension. The estimates give us only the variability across sectors and through time and discard an important part of variability across pair of countries. This table 2 is a robustness check.

Table 3: Summary results of bias when using raised dates by sector (PPML) **without Pair FEs**, 1995 - 2021

Dep. Var. Sector	(1) Agriculture	(2) Mining and Energy	(3) Manufacturing	(4) Services
INFORCE	0.481***	0.205	0.223***	-2.829***
FRAISED	0.333***	-0.020	0.246***	1.287***
Sign of the bias	Underestimation	Insignificant Effect	Slight Overestimation	Very Strong Overestimation

Notes: Here is the summary of estimates for all 131 sectors from ITPD-E which have been hit in at least one period and in one exporting country. We have performed two regressions to get each of two dates (INFORCE is the TBT dummy at the in-force date and FRAISED is the TBT dummy for first raised dates). All other information is available in table 7. Standard errors in parentheses * p <0.10, ** p <.05, *** p <.01. See text for further details.

Finally, looking at Services in column (4), the proxy using first raised dates is strongly overestimating the impact of TBT on trade flows and has the wrong signs. This is robust through specifications.

Using table 8, similar information is available concerning other potential proxies for TBT. In columns (A) , (B), (C), the in-force dates are always increasing trade more importantly than the initiation dates[30]. Looking at comparable TBT implementation dates which accounts for one moment in time (i.e. initiation and in force), we observe a monotonic increase from initiation to in force. It partly confirms what we assumed: the in-force date is the "peek" of the impact on trade. Concerning the other dates, raised dates impact trade more than the initiation dates when significant. It is to note that the interval between first and last raised dates is significantly impacting trade in the manufacturing sector, but not in agriculture. This would mean that the STC process works in the manufacturing sector but not in agriculture.

The only exception to the positive trend is for the in force date in the services sector for both OLS and PPML. It is also an exception to the predominant weight of in-force date over the other dates. The impact in the services sector (column 1 of (E)), which contains only two industries (telecommunications and other business services)[31], is quite important. The presence of an active TBT STC (in t-1, t, and t+1) decreases export by ***94% around the in-force date. However, around the first raised dates, the export increases by ***323.34% on average. Taking all the intervals between first and last raised dates, the increase is of ***262.19%.

Lastly, we also add controls for a potential discrimination bias towards domestic industries (the variables $*\_INTRA$, one for each date). Looking at columns (1) or (2), signs are switching, showing the importance of not adding pair FEs when measuring discrimination. Indeed, part of the bilaterally-fixed TBT STCs are discarded when using those pair FEs and changes the signs. We show mostly counter-intuitive results. We

[30] In column (D), the manufacturing estimates are not significant.

[31] Both industries were subject to seven STCs each throughout our database.

expected TBT STCs to impact advantageously domestic firms since a new TBT is likely to be adapted to protect domestic firms and to be acknowledged earlier by local industries compared to foreign firms. It is the case when looking at country pair FE results (2), but not anymore when discarding them. For most of our significant results (most at the 1% level), we find that positive TBT STC estimates are higher for the domestic sectors. For example, taking column (A - 1), in force and first raised dates impact significantly and in a negative way domestic firms compared to foreign sectors. An interesting fact is that, in this case, it is the robust around the in force dates when taking pair FEs. At the mean, domestic firms are disadvantaged by new TBTs but are less after a first complain at the WTO. While the size of discrimination is not large, it is unexpected. A cause for a positive discrimination towards foreign sectors is potentially caused by the unequal distribution of firms towards export. The international trade exports in the local country accounts only for exporters. They are more likely to adapt than local producers when there is a new TBT because foreign exporters are more productive and larger (Chaney, 2008). Note that it is not the case for agriculture which is a sector which is known for domestic firm protection.

b.2 The effects for a sample of sectors

In order to show that there is an important heterogeneity across industries and that results in the literature can be found with more disaggregated data, we show here the results for a set of industries.

Table 11 presents the results for the industry-level gravity estimates for a sample of sectors. Our selection criteria are: 1) at least one sector per broad sectors, and 2) sectors with either a low or a high number of STCs (based on table 4).

In four sectors belonging to the 10th decile of the distribution of sectors given the number of STCs (see figure 6), the results are already heterogeneous. Two of them belong to the food sectors: “34 - Processing/preserving of meat” and “48 - Wines” are not hit similarly by the different dates studied. The in-force date hits positively and significantly Wines but negatively Processing/preserving of the meat sector. TBTs affect positively the “87 - Soap and cosmetic” sector when looking at raised dates, while “88 - Other chemical products” not significantly impacted. In conclusion, TBTs impact very heterogeneously the "largest" sectors in terms of STCs.

We now look at sectors which are less often hit by a STC. “30 - Mining of iron ores” sector (first decile) is negatively impacted by the raised dates (trade drops by 84.2%) but positively by the in force date. Another interesting case is the “151 - Sports goods” sector. Trade is impacts first positively with initiation, in force and first raised dates but then it becomes negative after the last concern. Finally, in the “162 - Telecom, computer, and information services “ sector, the impact is positive and significant at after several dates of concerns, but it was strongly negative at the in force date. Again, it illustrates the heterogeneity across sectors and the importance of controlling for the timing to interpret our results in the best conditions.

c. Robustness across three timings among TBT STCs

So far, we provided evidence that the impact of TBTs on trade is heterogeneous and largely depends on sectors. We showed that the in-force dates affect trade slightly more than first raised dates. We also find unexpected results in terms of sign, almost all dates show positive effects on exports.

We test the importance of timings on our results. Possada et al. (2020) explains that "STC raised at the draft stage of notification are less likely to end up to a formal dispute" (p.412). We expect a greater positive trade impact of TBT STC when inforce is after last raised.

Let us consider three timings (as in figure 4): 1) when the in-force date is before the first raised date at the WTO; 2) when the in-force date is between the first and last raised date; 3) when the in-force date is after the last raised date. We expect that a greater positive impact would be present in the third timing, while less significant. Countries have the time to adapt before the TBT enters into force and mostly complain to prevent a negative impact. However, a negative impact is expected for the first timing since countries are more likely to complain for a negative shock after a TBT is set.

We apply our model in equation 1 keeping TBT^{STC} for one timing at a time. Then we compare our results for the three timings and the first specification with all timings included. In the end, it is as if we were limiting the restrictiveness criteria invoked by the literature by discarding some STCs depending on the timing of their raised dates regarding the in-force date.

We now compare our results for each timing in table 9. When looking at all sectors together, our results are robust with table 7 and are relatively similar for the in-force dates. In both tables, our conclusion remains unchanged concerning the slight negative bias of first raised dates compared with in-force dates. In timing 2, the initiation dates and the interval of raised dates improved upward while it is the reverse for the two other dates. It makes sense that the interval of raised dates is more impacting in this timing since it only includes multiple raised dates STCs.

Perhaps our more stringent results are the one for agriculture. In the agriculture sector, we do not find significant results for the agriculture in timing 1 and 2. In timing 3, when the in-force dates are after the last raised dates, estimates for in-force dates are very large and very significant (***1090.55% increase in exports) while the other dates are not significantly impacting trade. This result explains the aggregate finding that in-force dates always supplement the other dates when taking all sectors and all timings. It would be interesting to investigate this further but it means that previous results in the literature on agricultural goods are strongly biased by taking all timings at once and by using raised dates as a proxy for the time of the trade shock.

In the mining & energy, we also find heterogeneous results across timings. In timing 1, only the raised dates are significant but strongly negative. We do not find significant results for the second timing and the third timing also show significant and negative estimates for the initiation dates.

In the manufacturing, compared to table 7, all dates are improved when keeping only timing two.

Concerning the third timing, all dates (at the 1% level of significance) are impacting more trade than the in-force dates, which are not significant.

Finally, the services sector gives similar results for all timings and at all dates except for the in-force dates which is more negative when the in-force date is after the first raised date.

To summarize, all sectors together, raised dates are less biased when taking only the STCs with in-force dates after the raised dates. There are important differences across timings for each sector separately. It should be considered when measuring the impact of TBT STCs.

V. Conclusion

To expose the potential endogeneity present in the literature on TBT studying Specific Trade Concerns at the WTO, we updated an old Specific Trade Concerns database by matching it with their respective TBT notifications on the initiation and enforcement dates. We implemented this database in the ITPD-E database to study disaggregated impacts at the sectoral level.

While the literature uses the raised dates to measure the effect of TBTs on trade flows, they might bring biased results because i) raised dates inadequately proxy the trade shock occurring at the in-force date and ii) industries might react to a complaint defending them at the WTO. In order to identify those two issues, we used the gravity model with a PPML approach, and we distinguish between timings because the in-force dates happen either before, during, or after a STC is raised. Making the distinction in timings allows us to identify whether industries react positively to a complaint defending them at the WTO and to discuss the quality of STCs as proxies for stringent TBTs (as some argue in the literature).

First, without distinction in terms of timings, we find that there is downward bias with first raised dates and the interval between first and last raised dates, taking all sectors together. It is heterogeneous and more stringent when looking at specific broad sectors. The bias is more biased downward in the agriculture sector, and strongly biased upward in the services sector. However, there is no significant impact in the manufacturing sector, except when we look at the whole interval between first and last raised dates. This heterogeneity is even more present with narrow sectors.

Second, adding the distinction in timings, we find that the bias is more important, all sectors together, when taking only STCs with in-force dates after the raised dates. Moreover, there is a non-negligible effect of timing when taking broad sectors separately, especially for the agriculture sector which shows strong positive and significant results only with the in-force date and when enforced after the raised dates.

Using a dummy variable controlling for internal trade flows, we find that there is a slight positive discrimination brought by TBTs towards foreign exporters around the in-force date. The discrimination becomes in favor of domestic firms around the raised dates. While it is very significant (p-value less than 1%) in broad sectors, it is negligible in terms of size in most of them. A large impact is visible only for the services sector, which also showed opposite results given the dates we studied.

To our knowledge, we are the first to consider different dates than raised dates to measure the impact of TBT STCs. Our updated version of the STC database invites for further research on the cause of heterogeneous impacts of TBT STCs on trade flows.

References

(2022a). Agreement on sanitary and phytosanitary measures, uruguay round agreement.

(2022b). Agreement on technical barriers to trade, uruguay round agreement.

Anderson, J. E. and Van Wincoop, E. (2003). Gravity with gravitas: A solution to the border puzzle. *American economic review*, 93(1):170–192.

Arkolakis, C., Costinot, A., and Rodríguez-Clare, A. (2012). New trade models, same old gains? *American Economic Review*, 102(1):94–130.

Bao, X. and Qiu, L. D. (2012). How do technical barriers to trade influence trade? *Review of International Economics*, 20(4):691–706.

Beghin, J. C., Maertens, M., and Swinnen, J. (2015). Nontariff measures and standards in trade and global value chains. *Annu. Rev. Resour. Econ.*, 7(1):425–450.

Beverelli, C., Boffa, M., and Keck, A. (2019). Trade policy substitution: theory and evidence. *Review of world economics*, 155(4):755–783.

Borchert, I., Larch, M., Shikher, S., and Yotov, Y. (2021). The international trade and production database for estimation (itpd-e). *International Economics*, 166:140–166.

Chaney, T. (2008). Distorted gravity: the intensive and extensive margins of international trade. *American Economic Review*, 98(4):1707–21.

De Frahan, B. H. and Vancauteren, M. (2006). Harmonisation of food regulations and trade in the single market: evidence from disaggregated data. *European Review of Agricultural Economics*, 33(3):337–360.

Disdier, A.-C., Fugazza, M., et al. (2020). *A practical guide to the economic analysis of non-tariff measures*. United Nations.

Dolabella, M. (2020). Bilateral effects of non-tariff measures on international trade: Volume-based panel estimates. Technical report.

Fernandes, A. M., Lefebvre, K. J.-R., and Rocha, N. (2021). Heterogeneous impacts of sps and tbt regulations: Firm-level evidence from deep trade agreements. Technical report, The World Bank.

Fontagné, L. and Orefice, G. (2018). Let's try next door: Technical barriers to trade and multi-destination firms. *European Economic Review*, 101:643–663.

Fontagné, L., Orefice, G., Piermartini, R., and Rocha, N. (2015). Product standards and margins of trade: Firm-level evidence. *Journal of international economics*, 97(1):29–44.

Ghodsi, M., Grübler, J., Reiter, O., and Stehrer, R. (2017). The evolution of non-tariff measures and their diverse effects on trade. Technical report, wiiw Research Report.

Gurevich, T. and Herman, P. (2018). The dynamic gravity dataset: 1948-2016. *US International Trade Commission, Office of Economics Working Paper*.

Herghelegiu, C. (2018). The political economy of non-tariff measures. *The World Economy*, 41(1):262–286.

Kamal, Y. and Zaki, C. (2018). How do technical barriers to trade affect exports? evidence from egyptian firm-level data. *Journal of Economic Integration*, 33(4):659–721.

Orefice, G. (2017). Non-tariff measures, specific trade concerns and tariff reduction. *The World Economy*, 40(9):1807–1835.

Possada, K. C., Ganne, E., and Piermartini, R. (2020). The role of wto committees through the lens of specific trade concerns raised in the tbt committee. *World Trade Review*, pages 1–21.

Santeramo, F. G. and Lamonaca, E. (2019). The effects of non-tariff measures on agri-food trade: A review and meta-analysis of empirical evidence. *Journal of Agricultural Economics*, 70(3):595–617.

Shepherd, B. (2007). *Product standards, harmonization, and trade: evidence from the extensive margin*, volume 4390. World Bank Publications.

Shepotylo, O. (2016). Effect of non-tariff measures on extensive and intensive margins of exports in seafood trade. *Marine Policy*, 68:47–54.

Silva, J. S. and Tenreyro, S. (2006). The log of gravity. *The Review of Economics and statistics*, 88(4):641–658.

Singh, R. and Chanda, R. (2021). Technical regulations, intermediate inputs, and performance of firms: Evidence from india. *Journal of International Economics*, 128:103412.

Yotov, Y. V., Piermartini, R., Larch, M., et al. (2016). *An Advanced Guide to Trade Policy Analysis: The Structural Gravity Model*. WTO iLibrary.

Appendix

Tables

Table 4: ITPDE sectors cumulatively covering more than 50% of TBT STCs

ITPDE Code	**ITPDE**	**Number of STCs in 2000-2016 period**	**Number of STCs in 1995-2021**	**Percent coverage 2000-2016 (out of 256 STCs)**	**Percent coverage 1995-2021 (out of 725 STCs)**
48	Wines	36	94	14%	13%
87	Soap cleaning & cosmetic preparations	34	89	13%	12%
47	Distilling rectifying & blending of sp..	32	82	13%	11%
88	Other chemical products n.e.c.	31	86	12%	12%
128	Accumulators primary cells and batteries	30	38	12%	5%
49	Malt liquors and malt	29	70	11%	10%
46	Other food products n.e.c.	29	80	11%	11%
38	Dairy products	25	71	10%	10%
34	Processing/preserving of meat	23	61	9%	8%
35	Processing/preserving of fish	22	50	9%	7%
153	Other manufacturing n.e.c.	21	62	8%	9%
19	Eggs	18	39	7%	5%
138	Motor vehicles	18	54	7%	7%
36	Processing/preserving of fruit & veget..	18	50	7%	7%
50	Soft drinks; mineral waters	18	48	7%	7%
52	Textile fibre preparation; textile wea..	18	46	7%	6%
37	Vegetable and animal oils and fats	18	49	7%	7%
44	Cocoa chocolate and sugar confectionery	17	45	7%	6%
39	Grain mill products	17	46	7%	6%
7	Other oilseeds (exc. peanuts)	17	45	7%	6%
40	Starches and starch products	17	46	7%	6%
132	TV/radio transmitters; line comm. appa..	17	55	7%	8%
42	Bakery products	16	44	6%	6%
123	Domestic appliances n.e.c.	16	62	6%	9%
13	Fresh vegetables	16	41	6%	6%
43	Sugar	16	38	6%	5%
8	Animal feed ingredients & pet foods	15	32	6%	4%
129	Lighting equipment and electric lamps	15	45	6%	6%
45	Macaroni noodles & similar products	15	41	6%	6%
6	Soybeans	15	34	6%	5%

Source: Author's calculations on the updated STC database for 2000-2021 period, WTO.

Notes: we calculate the percent coverage based on the 725 STCs available for the entire period. For the 2000-2016 period, 256 STCs are available. While there is not a big difference in terms of ranking, Accumulators primary cells and batteries cover 12% of the STCs in this period and only 5% for the entire time period.

Table 5: Baseline TBT impacts for all sectors (PPML)

Dep. var.: exports	(1)	(2)	(3)
ln_tariff	-1.788	-1.094	-0.173
	(0.236)***	(0.129)***	(0.082)**
TBT	-0.273	-0.127	-0.014
	(0.050)***	(0.035)***	-0.014
nonTBT	0.295	0.175	0.045
	(0.043)***	(0.035)***	(0.012)***
SMCTRY	2.781	0	0
	(0.071)***	(.)	(.)
ln_DIST	-0.874	0	0
	(0.022)***	(.)	(.)
contiguity	0.377	-0.16	-0.268
	(0.047)***	-0.156	(0.163)*
common_language	0.165	0	0
	(0.037)***	(.)	(.)
colony_ever	0.046	0	0
	-0.041	(.)	(.)
	(0.361)***	(0.017)***	(0.013)***
Importer-sector-time FE	Yes	Yes	Yes
Exporter-sector-time FE	Yes	Yes	Yes
Country-Pair FE	No	Yes	No
Country-Pair Sector FE	No	No	Yes
Pseudo R^2	0.9766	0.9827	0.9951
No. Of Observations	20819320	20617494	20613468

Notes: Here is the report of estimates for all 131 sectors from ITPD-E which have been hit in at least one period and in one exporting country. In column (1), those variables are respectively written as follows: TBTs w/o STCs for "TBTs without STCs" accounts for all TBTs except TBT STCs, NTMs w/o TBTs for "Other NTMs than TBTs" accounts for all NTMs except TBTs and TBT STCs. In the other columns, NTMs w/TBTs w/o STCs is for "NTMs including TBTs excluding TBT STCs" accounts for all NTMs other than TBT STCs. In parentheses are the standard errors. The intranational variables are averages across all country specific intranational estimates. Standard errors in parentheses * p <0.10, ** p <.05, *** p <.01. See text for further details.

Table 6: TBT STCs impacts for all sectors (PPML)

Dep. Var. Sector	(1)	(2)	(3)
INIT	0.247	0.043	-0.005
	(0.056)***	-0.029	-0.01
INFORCE	0.326	0.144	-0.028
	(0.075)***	(0.039)***	(0.013)**
FRAISED	0.256	0.053	-0.013
	(0.047)***	(0.028)*	-0.01
ALLRAISED	0.308	0.05	-0.002
	(0.051)***	(0.025)*	-0.009
ALLRAISED_INTRA	-0.024	0.022	-0.003
	(0.007)***	(0.007)***	(0.001)**
Importer-sector-time FE	Yes	Yes	Yes
Exporter-sector-time FE	Yes	Yes	Yes
Country-Pair FE	No	Yes	No
Country-Pair Sector FE	No	No	Yes
Pseudo R^2	0.9766	0.9827	0.9951
No. Of STCs	555	555	555
No. Of Observations	20819320	20656038	20613468

Notes: Here is the report of estimates for all 131 sectors from ITPD-E which have been hit in at least one period and in one exporting country. In column (1), those variables are respectively written as follows: TBTs w/o STCs for "TBTs without STCs" accounts for all TBTs except TBT STCs, NTMs w/o TBTs for "Other NTMs than TBTs" accounts for all NTMs except TBTs and TBT STCs. In the other columns, NTMs w/TBTs w/o STCs is for "NTMs including TBTs excluding TBT STCs" accounts for all NTMs other than TBT STCs. In parentheses are the standard errors. The intranational variables are averages across all country specific intranational estimates. Standard errors in parentheses * p <0.10, ** p <.05, *** p <.01. See text for further details.

Table 7: All Sectors Pooled PPML & OLS Estimates

Exports (log for OLS)										
	(1)		(2)		(3)		(4)		(5)	
	All Sectors		Agriculture		Mining and Energy		Manufacturing		Services	
Dep. Var.	OLS	PPML	OLS	PPML	OLS	PPML	OLS	PPML	OLS	PPML
TARIFF	0.004	-1.837	0.083	-0.415	3.914	7.489	0.012	-0.115	13.869	40.506
	(0.010)	(0.231)***	(0.085)	(0.170)**	(1.885)**	(2.261)***	(0.029)	(0.014)***	(13.281)	(13.365)***
NTMs w/o STCs	-1.361	-0.162	-0.782	-0.199	-1.449	-0.645	-1.432	-2.379	-0.255	0.458
	(0.021)***	(0.018)***	(0.057)***	(0.071)***	(0.297)***	(0.204)***	(0.022)***	(0.276)***	(0.196)	(0.332)
INIT	0.673	0.247	0.136	0.235	1.139	0.141	0.799	0.192	1.616	1.241
	(0.088)***	(0.056)***	(0.221)	(0.119)**	(0.446)**	(0.244)	(0.095)***	(0.052)***	(0.690)**	(0.174)***
× INTRA	0.294	-0.014	0.462	-0.007	0.000	0.000	0.220	-0.016	-1.034	-0.638
	(0.084)***	(0.008)*	(0.203)**	(0.003)**	(.)	(.)	(0.091)**	(0.008)**	(0.678)	(0.143)***
INFORCE	0.930	0.326	0.872	0.481	1.365	0.205	1.003	0.223	-0.381	-2.829
	(0.129)***	(0.075)***	(0.368)**	(0.173)***	(0.428)***	(0.256)	(0.128)***	(0.068)***	(0.587)	(0.463)***
× INTRA	0.018	-0.045	-0.024	-0.045	0.000	0.000	-0.035	-0.027	0.711	3.346
	(0.126)	(0.010)***	(0.350)	(0.018)**	(.)	(.)	(0.124)	(0.008)***	(0.529)	(0.441)***
FRAISED	0.671	0.308	0.033	0.207	1.243	0.125	0.792	0.202	1.548	1.443
	(0.094)***	(0.051)***	(0.209)	(0.103)**	(0.482)***	(0.291)	(0.104)***	(0.046)***	(0.671)**	(0.153)***
× INTRA	0.364	-0.024	0.597	-0.003	0.000	0.000	0.278	-0.015	-1.182	-0.785
	(0.090)***	(0.007)***	(0.188)***	(0.002)	(.)	(.)	(0.100)***	(0.009)*	(0.658)*	(0.163)***
ALLRAISED	0.670	0.256	0.149	0.333	0.832	-0.020	0.796	0.246	1.803	1.287
	(0.089)***	(0.047)***	(0.216)	(0.122)***	(0.610)	(0.291)	(0.098)***	(0.046)***	(0.691)***	(0.182)***
× INTRA	0.303	-0.013	0.471	-0.008	0.000	0.000	0.227	-0.024	-1.022	-0.604
	(0.085)***	(0.008)	(0.194)**	(0.003)**	(.)	(.)	(0.093)**	(0.008)***	(0.677)	(0.146)***
R^2	0.638		0.650		0.598		0.634		0.853	
N	10068312	20819320	409733	1006303	117435	264749	9509974	19490636	31170	57632

Notes: Here is the report of estimates for all 131 sectors from ITPD-E which have been hit in at least one period and in one exporting country. In parentheses are the standard errors. All estimates are obtained with exporter-time, importer-time fixed effects and pair fixed effects (not reported for brevity). We have performed four regressions to get each of four dates (INIT, INFORCE, FRAISED, and ALLRAISED). Across those four regressions, all the other gravity estimates remained very similar and we show only the ones for the regression with INFORCE dates. TARIFF is $ln(1 + tariff)$ with $tariff$ being in percent. Each "× INTRA" variable stands next to their respective TBT STC timing variable. Standard errors in parentheses * p <0.10, ** p <.05, *** p <.01. See text for further details.

Table 8: All Sectors Pooled Estimates comparing without (1) and with (2) country pair FE

Exports										
	(A) All Sectors		(B) Agriculture		(C) Mining and Energy		(D) Manufacturing		(E) Services	
Dep. Var.	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
TARIFF	-1.837	-1.155	-0.415	0.212	7.489	6.016	-2.379	-1.746	40.506	73.424
	(0.231)***	(0.142)***	(0.170)**	(0.068)***	(2.261)***	(1.592)***	(0.276)***	(0.159)***	(13.365)***	(14.945)***
NTMs w/o STCs	-0.162	-0.091	-0.199	0.043	-0.645	-0.410	-0.115	-0.036	0.458	1.710
	(0.018)***	(0.015)***	(0.071)***	(0.048)	(0.204)***	(0.169)**	(0.014)***	(0.012)***	(0.332)	(0.484)***
INIT	0.247	0.043	0.235	0.089	0.141	0.188	0.192	0.018	1.241	0.198
	(0.056)***	(0.028)	(0.119)**	(0.062)	(0.244)	(0.162)	(0.052)***	(0.027)	(0.174)***	(0.070)***
× INTRA	-0.014	0.015	-0.007	0.002	0.000	0.000	-0.016	-.002	-0.638	-0.155
	(0.008)*	(0.005)***	(0.003)**	(0.001)**	(.)	(.)**	(0.008)**	(0.004)	(0.143)***	(0.063)**
INFORCE	0.326	0.144	0.481	0.212	0.205	0.307	0.223	0.050	-2.829	-1.53
	(0.075)***	(0.039)***	(0.173)***	(0.068)***	(0.256)	(0.145)**	(0.068)***	(0.036)	(0.463)***	(0.339)***
× INTRA	-0.045	-0.045	-0.045	0.001	0.000	0.000	-0.027	-0.026	3.346	0.956
	(0.010)***	(0.008)***	(0.018)**	(0.001)	(.)	(.)	(0.008)***	(0.006)***	(0.441)***	(0.322)***
FRAISED	0.308	0.053	0.207	0.048	0.125	0.016	0.202	0.034	1.443	0.240
	(0.051)***	(0.028)*	(0.103)**	(0.072)	(0.291)	(0.174)***	(0.046)***	(0.026)	(0.153)***	(0.074)***
× INTRA	-0.024	0.010	-0.003	0.002	0.000	0.000	-0.015	-0.005	-0.785	-0.126
	(0.090)***	(0.004)**	(0.188)***	(0.001)**	(.)	(.)	(0.100)***	(0.003)	(0.658)*	(0.063)**
ALLRAISED	0.256	0.050	0.333	-0.044	-0.020	0.206	0.246	0.060	1.287	0.320
	(0.047)***	(.025)*	(0.122)***	(0.079)	(0.291)	(0.219)	(0.046)***	(0.024)**	(0.182)***	(0.062)***
× INTRA	-0.013	0.022	-0.008	0.001	0.000	0.000	-0.024	-0.005	-0.604	-0.244
	(0.008)	(0.006)***	(0.003)**	(0.001)*	(.)	(.)**	(0.008)***	(0.003)	(0.146)***	(0.078)***
N	20819320	20656038	1006303	993443	264749	264505	19490636	19340399	57632	57539

Notes: Here is the report of estimates for all 131 sectors from ITPD-E which have been hit in at least one period and in one exporting country. In parentheses are the standard errors. All estimates are obtained with exporter-time, importer-time fixed effects for columns (1) and (2) and pair fixed effects for columns (2). (1) is without country pair fixed effects, (2) includes it. We have performed four regressions to get each of four dates (INIT, INFORCE, FRAISED, and ALLRAISED). Across those four regressions, all the other gravity estimates remained very similar and we show only the ones for the regression with INFORCE dates. TARIFF is $ln(1+tariff)$ with $tariff$ being in percent. Each "× INTRA" variable stands next to their respective TBT STC timing variable. Standard errors in parentheses * p <0.10, ** p <.05, *** p <.01. See text for further details.

Table 9: Dummy choice for STC date according to three timings, Pooled PPML of average effect Estimates and no pair FEs

Exports					
Dep. Var. Sector	All sectors	Agriculture	Mining & Energy	Manufacturing	Services
In Force before First Raised					
INIT	0.254***	0.078	-0.388	0.202***	1.253***
INFORCE	0.317***	0.255	-0.221	0.226***	-1.529***
FRAISED	0.288***	0.062	-1.981***	0.231***	1.450***
ALLRAISED	0.327***	0.150	-1.858***	0.277***	1.253***
In Force between multiple raised dates for the same TBT STC					
INIT	0.287***	-0.094	0.311	0.237***	1.242***
INFORCE	0.309***	0.239	0.438	0.279***	-2.909***
FRAISED	0.255***	-0.132	0.400	0.206***	1.444***
ALLRAISED	0.380***	-0.125	0.311	0.322***	1.288***
In Force after the Last Raised date					
INIT	0.324***	0.135	-1.762***	0.270***	1.254***
INFORCE	0.373*	2.477 ***	0.000	0.229	0.000
FRAISED	0.335***	-0.114	-1.762***	0.274***	1.451***
ALLRAISED	0.415***	0.102	-1.762***	0.364***	1.254***

Notes: Here is the report of pooled PPML estimates for all sectors and broad sectors from ITPD-E which have been hit by TBT STCs in at least one period and in one exporting country, when the in-force date is either before, during or after the raised dates. For brevity, we do not report the standard errors. All estimates are obtained with exporter-time and importer-time fixed effects (not reported for brevity). We have performed four regressions to get each four dates (INIT, INFORCE, FRAISED, and ALLRAISED). Across those four regressions, all the other gravity estimates are not reported for brevity. Estimates with zeros result from a lack of data for the specific date and industry studied. Significance levels: * p <0.10, ** p <.05, *** p <.01. "." are missing estimates due to a lack of time for the 5th of June deadline. See text for further details.

Table 10: Dummy choice for STC date according to three timings, Pooled PPML Estimates with country pair FE

Exports			
Dep. Var. Sector	All sectors	Agriculture	Manufacturing
In Force < First Raised			
INFORCE	0.152***	0.202**	0.038
FRAISED	0.030	0.066	0.028
First Raised < In Force < Last Raised			
INFORCE	0.206***	0.196	0.177***
FRAISED	0.067***	-0.100	0.083**
Last Raised < In Force			
INFORCE	0.195	0.646***	0.069
FRAISED	0.094**	-0.130	0.124***

Table 11: Industry-Level Gravity Estimates for a sample of industries, PPML, 2000-2016

	INFORCE	ALLRAISED	FIRST	INIT	N	STCs
7	0.137	0.073	-0.027	-0.059		45
Other oilseeds (exc. peanuts)	(0.130)	(0.105)	(0.116)	(0.126)	98839	
30	0.417	-1.157	-1.157	0.135		2
Mining of iron ores	(0.143)***	(0.151)***	(0.151)***	(0.161)	24796	
34	-0.167	-0.164	-0.093	-0.050		34
Processing/preserving of meat	(0.097)*	(0.056)***	(0.064)	(0.060)	156256	
48	0.088	0.001	0.023	0.027		94
Wines	(0.027)***	(0.025)	(0.036)	(0.037)	116646	
49	-0.024	0.064	0.060	0.053		70
Malt liquors and malt	(0.065)	(0.064)	(0.068)	(0.066)	97375	
50	-0.022	-0.044	-0.055	0.008		48
Soft drinks; mineral waters	(0.073)	(0.065)	(0.067)	(0.066)	147644	
65	-0.029	0.241	0.020	0.015		3
Builders' carpentry and joinery	(0.330)	(0.379)	(0.373)	(0.344)	122076	
87	0.017	0.036	0.047	0.026		89
Soap cleaning & cosmetic preparations	(0.020)	(0.016)**	(0.022)**	(0.027)	228591	
88	-0.020	0.004	0.040	0.062		86
Other chemical products n.e.c.	(0.066)	(0.004)	(0.033)	(0.049)	260440	
151	0.487	-0.442	0.472	0.444		15
Sports goods	(0.155)***	(0.156)***	(0.161)***	(0.154)***	182704	
162	-2.065	0.208	0.037	-0.011		7
Telecommunications, computer, and info..	(0.394)***	(0.058)***	(0.069)	(0.066)	27431	

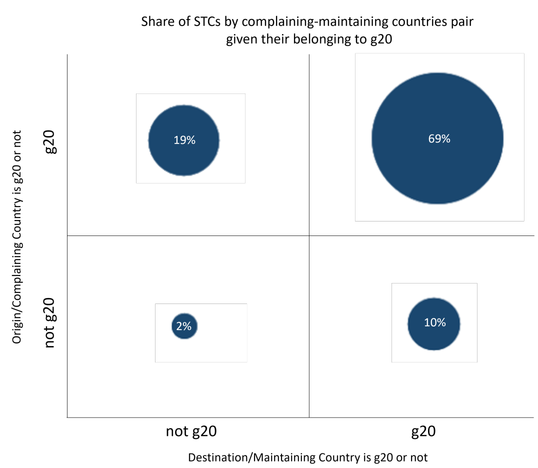
Notes: Here is the report of estimates for a sample of sectors from ITPD-E which have been hit in at least one period and in one exporting country. In parentheses are the standard errors. All estimates are obtained with exporter-time and importer-time fixed effects (not reported for brevity). We have performed four regressions to get each four dates (INIT, INFORCE, FRAISED, and ALLRAISED). Across those four regressions, all the other gravity estimates remained very similar and we show only the ones for the regression with INFORCE dates. TARIFF is $ln(1 + tariff)$ with $tariff$ being in percent. The SMCTRY variables are averages across all country specific SMCTRY estimates. STCs column is the count of STCs in each industry. For representativity, we showed at least one sector in each broad sector, and sectors which were both containing a high number of STCs (such as Wine) and a low number of STCs (such as Mining of Iron Ores). Standard errors in parentheses * p <0.10, ** p <.05, *** p <.01. See text for further details.

Table 12: European exporters complaining against TBTs in other countries in the world, PPML, 2000-2016

Variables	EU exporters in manufacture complains
Inforce	-0.262
	(0.084)***
Importer-sector-time FE	Yes
Exporter-sector-time FE	Yes
Country-Pair FE	No
No. Of STCs	134
No. Of Observations	350663

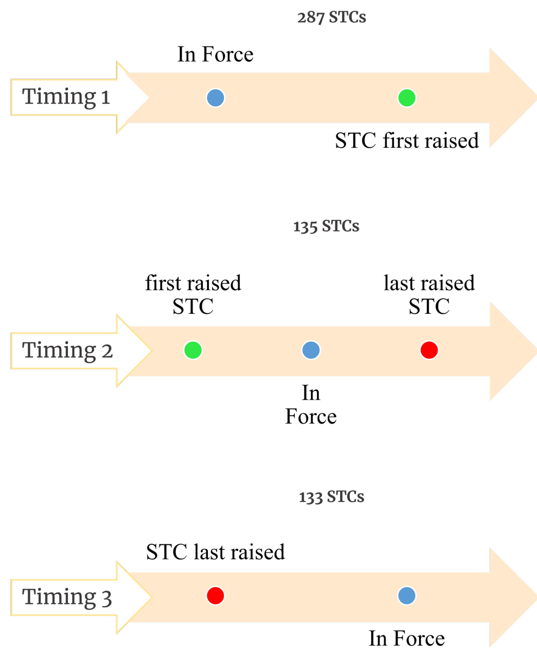
Figures

Figure 3: Composition and proportion of pair of countries complaining-raising given their belonging to OECD



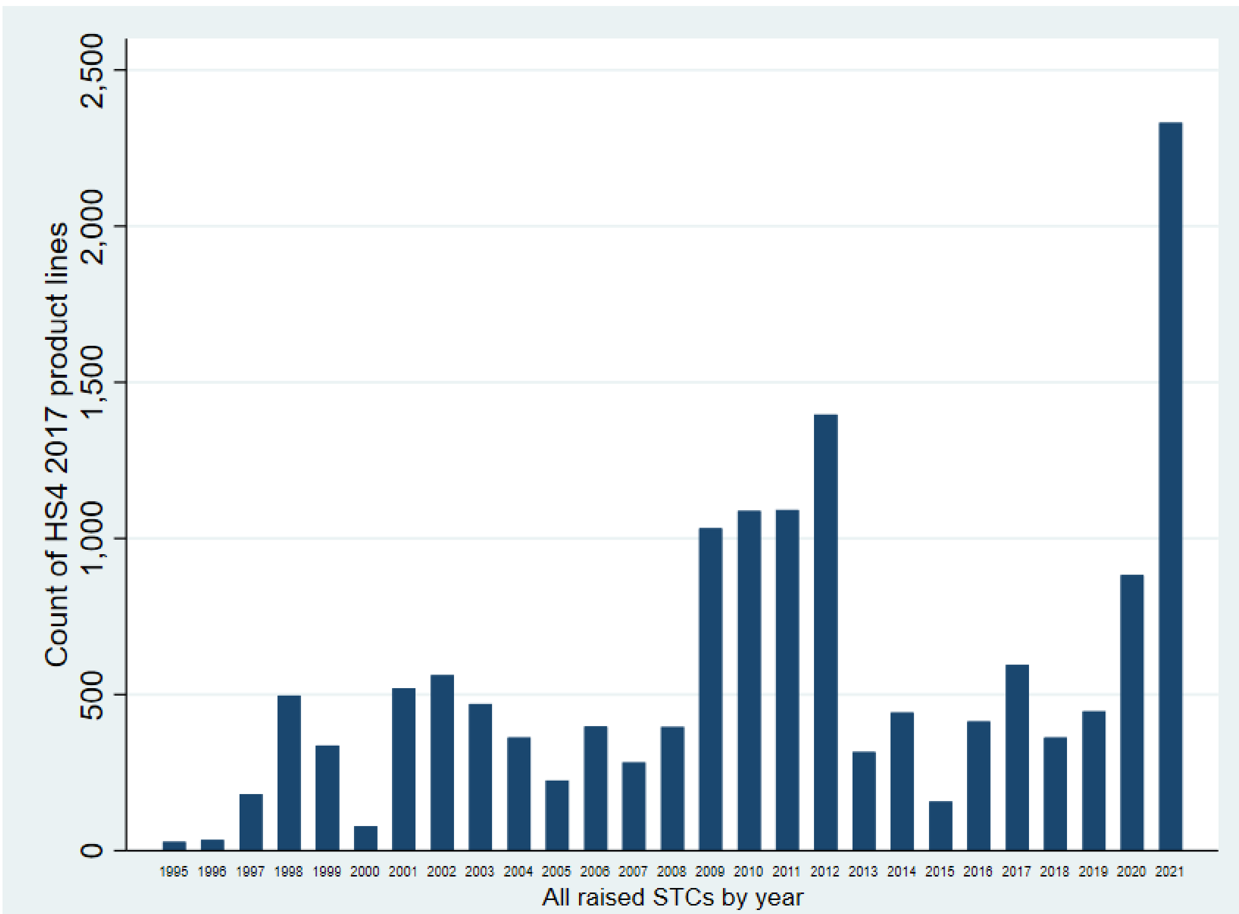
Calculation are made knowing each STCs can be raised by several countries belonging or not belonging to OECD. For example, if two countries from OECD and one not from OECD complains against one OECD country TBT measure, it counts for two observation in OECD-OECD pair, and one in not OECD-OECD pair.

Figure 4: Timings observed across TBT STCs



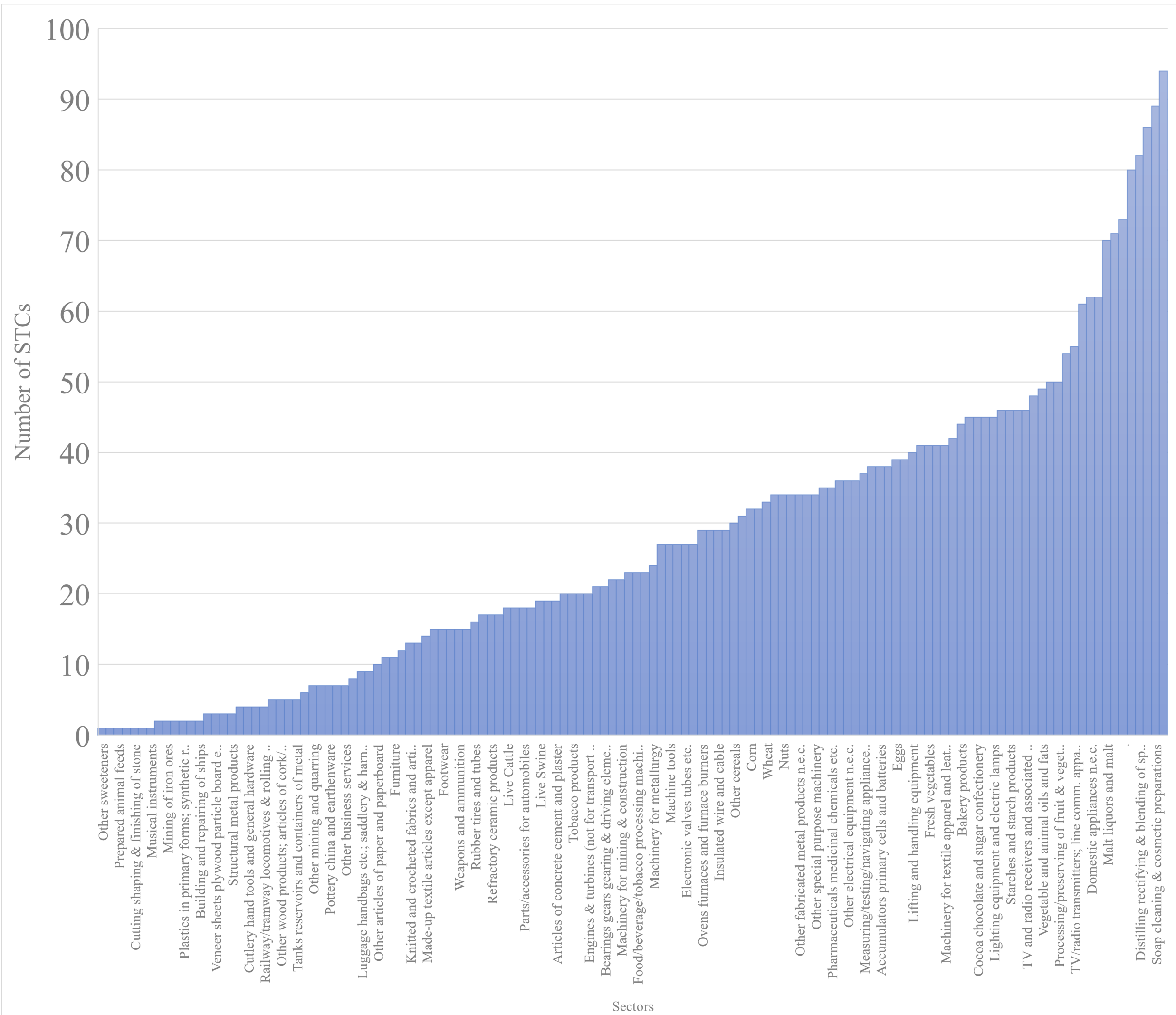
Three timelines illustrating the three versions of timings happening between STCs and their respective TBT enforcement dates, as well as their statistics. For almost half of STCs with available in-force dates, they follow the in-force date. Then, we split evenly the remaining STCs between STCs raised before the in-force date or for which the in-force dates are between different raised dates at the WTO for the same STC. Each case must be interpreted separately.

Figure 5: Number of HS4 2017 product lines in raised STCs by year



Notes: author's calculations using HS4 codes contained in both STC database and WIIW database. The number of HS4 lines through time is increasing.

Figure 6: Number of STCs by sector (1995-2021)



Notes: author's calculations over 131 sectors, 10 deciles of 13 sectors (14 for the 10th). The distribution shows an unequal distribution. The top 10% of most concerned sectors cover the same number of complaints as the bottom 60%.