DISCUSSION PAPER SERIES

DP17853

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INTERNATIONAL MACROECONOMICS AND FINANCE

CEPR

ISSN 0265-8003

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Discussion Paper DP17853
Published 29 January 2023
Submitted 28 January 2023

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JEL Classification: F13, F14, F15

Keywords: Trade retaliation, Protectionism, Antidumping

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Acknowledgements
Views expressed in this paper are those of the authors and should not be attributed to the IMF. This paper benefited from financial support provided by the UK's Foreign Commonwealth & Development Office. We thank Chad Bown, Fred Campano, Meredith Crowley, Lionel Fontagne, Jerome Hericourt, Robert Koopman, Philippe Martin, Dominick Salvatore as well as participants of the 2021 ASSA session on "International Trade: Crucial for World Economic Recovery and Growth", and at a CEPII internal seminar.

Retaliation through Temporary Trade Barriers*

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January 26, 2023

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1 Introduction

The GATT/WTO multilateral processes have succeeded in reducing world average tariffs below 3%, while leaving countries space to adapt trade barriers to external shocks. However, as countries sought to use WTO-compliant instruments to protect firms from foreign competition through Temporary Trade Barriers (TTBs)—see Figures A1 and A2 for the use of TTBs across countries—tensions, involving retaliation threats, began to emerge at the beginning of the 2000s. Retaliation is likely to amplify the trade cost of the first protectionist move.

Temporary trade barriers are legitimate when applied in exceptional circumstances to compensate specific industries and companies for unfair practices from trading partners. The WTO allows governments to: (i) act against dumping where there is genuine ("material") injury to the competing domestic industry; (ii) launch its own investigation and ultimately charge extra duty (known as "countervailing duty") on subsidized imports that are found to be hurting domestic producers; and (iii) restrict imports of a product temporarily (take "safeguard" actions) if its domestic industry is seriously injured or threatened with injury caused by a surge in imports.

Empirical evidence, however, casts doubt that TTBs are used exclusively for these purposes: Bown and Crowley (2013a) show that these trade barriers respond to macroeconomic conditions in exporting and importing countries, underscoring that they are used at least in part for macroeconomic reasons, which may or may not be correlated with the damage to particular sectors from unfair practices. Countries also use TTBs as a safety valve. Because of their temporary nature, TTBs can be used to compensate for an official tariff decrease, which would translate into a gradual decrease in trade barriers, as shown by Bown and Tovar (2011). In this sense, Kuenzel (2020) provides evidence that there is a substitution between WTO requirements and TTBs: when the bound tariff decreases, more TTBs are used. Perhaps of more concern is if TTBs are used to retaliate against foreign government policy rather than to mitigate a specific sectoral injury, as this would run against the grain of multilateral trade cooperation promoted by the WTO. In this context, Bown (2022) describes how TTBs have been disproportionately targeting China.

However, the response of a country to a new foreign trade barrier cannot always be labeled as non-cooperative. When a country faces what is perceived as unfair trade barriers, several options exist. First, it can do nothing, perhaps out of concern that the

imposing country could retaliate further. Second, it can file an official dispute with the WTO dispute settlement body, and engage in negotiations with the imposing country. In the case where no agreement is reached between the parties and injury is proven, the targeted country would have the right to retaliate. Finally, for countries unwilling to engage in WTO litigation, a third way is to decide to retaliate directly by launching a new TTB investigation, an option which Bown (2005) calls "vigilante justice". While rules-consistent retaliation can be labeled as a cooperative use of TTBs (see Bown and Crowley, 2013b), because it stands within WTO rules, rules-inconsistent retaliation is equivalent to a non-cooperative use of TTBs. The focus of this paper is the non-cooperative use of TTBs, as we seek to provide evidence of rules-inconsistent retaliation.

The empirical evidence around the use of TTBs for strategic motives is largely inconclusive, first because one needs to disentangle the rationale for the use of TTBs in the first place (which is challenging for reasons discussed above), and second because of fundamental identification problems. A first issue relates to the definition of retaliation. To estimate the probability of a country j to retaliate in year t, foreign measures imposed on country j are included as explanatory variables—typically the literature considers a dummy variable that takes the value of one if country i filed a TTB against j prior to year t (e.g., Prusa and Skeath, 2005; Boffa and Olarreaga, 2012; Feinberg and Reynolds, 2006). A key problem with this approach is that retaliatory measures that take place within a year—as we show later the large majority—will not be captured and nor will be the intensity of retaliation (how many TTBs are introduced in response).

Another set of issues concerns the use of country-level data. TTBs are initiated at the product (industry) level, so an understanding of the factors affecting such decisions should rely on industry-level data. Moreover, country-level analysis is vulnerable to the criticism that impacts attributed to retaliation may reflect other unobserved macroeconomic shocks, such as changes in economic conditions as found in Bown and Crowley (2013a).

In this paper we try to address these issues. Our definition of retaliation encompasses those actions (TTBs) taken by country j that are not too distant from TTBs taken by a trading partner i, where not too distant is formalized by not more than x days, where x is the median response time (in days) between j's actions and those of all its trading partners. In particular, we estimate the intensity of retaliation by country j as the number of country j's TTB measures following a TTB measure imposed by country i within an

interval of x days. In this first step, we use daily data on TTBs from the World Bank's TTB Database (Bown, 2015) at the 6-digit Harmonized System (HS6) product level. The high frequency of the data is key to capture the TTB actions by countries j and i, and thus reducing the concern that TTB actions implemented by country i are endogenous. Regarding the econometric analysis, our sample covers 1220 subsectors (HS4 digits) across 25 advanced and emerging economies over 1989-2019. Use of sectoral data allows us to disentangle same-sector versus cross-sector retaliatory measures. This is important as strategic behaviors are likely to be relevant when countries respond by imposing TTBs across many sectors. In addition, the four-dimensional panel (domestic country j, partner country i, time t and k sectors) of our data allows us to control for country- and sector-shocks through country–time and sector–time fixed effects, which obviously would not be feasible using an aggregate country-level panel.[1]

We show that while retaliation is common, there is wide dispersion across countries in the recourse to such policy, with smaller countries and emerging market economies retaliating less than larger or richer countries. We also show that recourse to retaliatory TTBs has increased over time, peaking in the early 2000s and after the Global Financial Crisis (GFC). Retaliation seems more focused on protecting non-injured sectors than the injured sector and seeks to protect many sectors simultaneously. This suggests that retaliation may be driven more by perceptions of unfair foreign policies than specific sectoral injuries.

Our estimates suggest that a one standard-deviation increase in the number of new TTB in a given HS4 sector by country i on country j increases the number of newly targeted products by j on i by 1% both in the same sector and in other sectors. This result is robust to controlling for other trade policy instruments, such as tariff variations and trade disputes. In addition, such retaliatory actions are larger when tariffs cannot be used, e.g. in the presence of a trade agreement, when both countries are in a trade dispute, or when the domestic economy is foreseeing further retaliation. They are also larger in periods of higher unemployment.

The remainder of the paper is organized as follows. Section II presents a brief literature review on import protection with focus on TTBs and trade retaliation. Section III discusses the data used in the analysis, presents our proposed definition of retaliation, and

[1] As a robustness check, we also show that the results are robust when controlling for country-pair-time fixed effects.

highlights trade retaliation facts and patterns. Section IV discusses the empirical strategy. Section V presents the baseline results and robustness checks. Section VI concludes.

2 Literature review

There is an extensive literature highlighting the theoretical determinants of import protection from a political-economy perspective (e.g., Grossman and Helpman, 1994, Grossman and Helpman, 1995; Nicita et al., 2018), for macroeconomic reasons (e.g., Bagwell and Staiger, 2003) or strategic ones (e.g. Bagwell and Staiger, 1990; Harrison and Rutstrom, 1991; Blonigen and Bown, 2003; Martin and Vergote, 2008).

Grossman and Helpman (1994) develop a model in which special-interest groups make political contributions to influence a government's choice of trade policy. The model shows that "protection is for sale" as politicians maximize their own welfare, which depends on total contributions collected in addition to the welfare of voters. In subsequent work, Grossman and Helpman (1995) show that political pressures on governments can induce countries to increase their level of import protection, which would in turn lead to retaliation. More recently, Nicita et al. (2018) build a political-economy model highlighting that, in the absence of cooperation, there is a positive relationship between importers' market power and their import tariffs. Bagwell and Staiger (2003) propose a theoretical framework that is consistent with empirical studies documenting the countercyclical nature of trade barriers (see e.g. Bohara and Kaempfer, 1991): rapid trade growth during booms underpins relatively liberal trade. Bagwell and Staiger (1990) develop a theory of "managed trade" that correlates periods of unusually high trade volumes with increased protection: trade protection emerges as the endogenous outcome of countries' attempt to dampen fluctuations in trade volumes through recourse to protection. Harrison and Rutstrom (1991) presented an alternative approach to the quantitative analysis of trade policy evaluation based on notions of non-cooperative trade wars and cooperative trade negotiations. It was shown that it is indeed possible to rationalize a free trade agreement between the United States and Canada if the alternative to such a negotiated outcome is a retaliatory trade war. Blonigen and Bown (2003) develop a trigger price model which allows for the threat of an antidumping (AD) action to restrain AD activity.

While the theoretical literature on import protection is extensive, empirical evidence

on the strategic use of trade barriers remains scarce. Blonigen and Bown (2003) use AD data for the US to test the impact of retaliation threats. Using data for 645 decisions by the US AD authority, they find that an industry is more likely to file an AD petition the greater the import penetration and the lower the exposure to retaliation. Prusa and Skeath (2002) find evidence to support both economic and strategic motives for AD filings.

Using industry-level data, Feinberg and Reynolds (2006) find that the likelihood of a country filing a case is higher against countries that targeted it in the previous year. Moore and Zanardi (2011) show that retaliation variables help explain the probability of observing an AD petition except for developing countries that have become heavy users of AD. Boffa and Olarreaga (2012) find no evidence of retaliatory motives driving protectionism during the GFC and show that a protectionist measure imposed by a trading partner reduces the probability of a measure imposed by the home country. Tabakis and Zanardi (2017) develop a dynamic game where two competing importers can impose AD measures on a third country, and document that AD echoing—different countries sequentially imposing AD measures on the same product and exporter—is common among users of AD.

Another strand of the literature aims at analyzing the cost of trade conflicts. Crozet and Hinz (2020) evaluate the costs of international sanctions for the diplomatic conflict between the Russian Federation and the European union. Results indicate that both countries suffered from both foreign and domestic trade sanctions. In particular, Western countries suffered from an unintended, largely self-inflicted cost. Using firm-level data, Crozet et al. (2021) study exporting firms' behavior to trade sanctions, showing strong heterogeneity along the firm dimensions, with unpredictable results on which firms keep exporting to the sanctioned country.

Finally, there is a literature that focuses on case studies. For example, a thoroughly studied case was the outbreak of a trade war after the United States adopted the Smoot-Hawley tariff in June 1930. Irwin (1998) first examined closely two years after the imposition of the Smoot-Hawley tariff, and found that the volume of U.S. imports fell over 40%. Using partial and general equilibrium assessments, it was also shown that the Smoot-Hawley tariff itself reduced imports by 4-8 percent. Recently, Mitchener et al. (2022) use new quarterly data on bilateral trade for ninety-nine countries and show that U.S. exports to retaliators fell by 28%–32% and the retaliators' welfare gains from trade fell

by 8%–16%.

3 Data

3.1 Temporary trade barriers within the WTO framework

The WTO delegates the authority of implementing temporary trade barriers to national governments. For example, the United States International Trade Commission (USITC) and the European Commission have authority in this matter for the USA and the European Union respectively. The process takes place in two steps. First, a firm, or a group of firms forming a lobby, files a complaint with the national trade authority, which launches an investigation. Let us consider the case where a European firm suspects a U.S. firm to dump its exports at below-market prices. One recourse for the European firm is to file a dumping complaint, demanding an anti-dumping tariff to be imposed on the product coming for the U.S. At this date, an investigation is launched, to determine whether the European firm is facing an injury. During the investigation, a temporary additional tariff may be applied, making the investigation costly for the foreign economy.[2][3] Second, by the end of the investigation, the trade authority makes a decision: if the injury is proven, a temporary trade barrier (in our case an anti-dumping duty) is implemented.

The process of TTB implementation relies on two actors: the firm deciding to file a complaint and the national trade authority deciding whether to implement a new TTB. The public records provide us with the dates of each step of a TTB investigation. The empirical literature provides evidence that an investigation in itself can be damaging for the foreign economy, and can thus provoke a response (Staiger et al., 1994). However, to investigate the timing of retaliatory TTBs, we focus on the trade authority's decision, and consider only the determination date. While an individual firm would not necessarily be concerned by a foreign measure imposed in another domestic sector, it is more than possible that the domestic trade authority would consider strategic reasons to implement TTBs as a measure of retaliation. In other words, the trade authority may be more inclined to implement a new TTB (based on a petition filed by a firm) targeting a foreign

[2]Investigations are public, and records can be found online. In the case of EU, the Commission opens an anti-dumping investigation by publishing a notice in the EU's Official Journal. See the following website: https://tron.trade.ec.europa.eu/investigations/ongoing.

[3]The duration of investigations varies from time to time: in our dataset we find that the average time between the start of the investigation and the determination date is of 12 months (see Figure A3).

economy which has just implemented a new TTB against the domestic economy.

The WTO litigation framework gives the foreign economy, here the U.S., three ways to respond. First, it can file a complaint through the Dispute Settlement Body: if the measure is proven to be unfair, the U.S. may be authorized to implement a trade barrier to compensate the trade loss. Second, it can do nothing, for fear of further retaliation. Finally, it can implement a new TTB against the EU to retaliate illegally, bypassing WTO rules. This type of rules-inconsistent retaliation, dubbed as non-cooperative, is the focus of this paper.

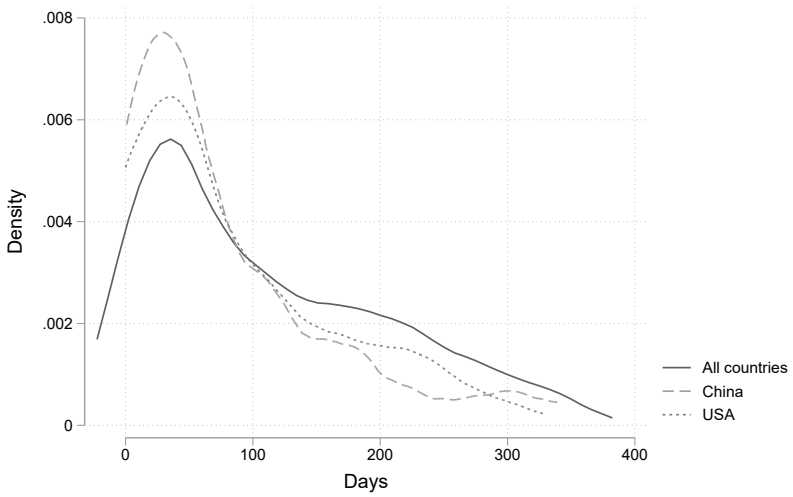
3.2 Temporary trade barriers data

We use a panel dataset of bilateral measures of import protection for 25 advanced and emerging market economies for the period 1989-2019 (see Table B1 in Appendix for the list of countries included in the analysis).[4] The daily data on temporary trade barriers (TTBs) is drawn from the World Bank's TTB Database (based on Bown, 2015). This database provides bilateral trade policy actions at the 6-digit Harmonized System (HS6) product level for the period 1989-2019, classified in three categories: anti-dumping (AD), countervailing (CVD) and global safeguards (GS). As discussed by Bown and Crowley (2013a), inclusion of all forms of temporary import restrictions is important because recent measures, such as the 2009 China-specific safeguard imposed by the US on tire imports, have focused more on CS and GS TTBs rather than AD ones, and thus it is critical not to restrict the analysis to antidumping.

The advantage of this dataset is threefold. First, the daily frequency allows us to construct within-year measures of retaliation. Second, having a four-dimensional (k sectors, j domestic country, i partner country, and t time periods) dataset allows us to control for aggregate (country-time) and country-sector shocks by including country–time and sector–time fixed effects. The inclusion of the country–time fixed effects is critical to absorb any unobserved cross-country heterogeneity in the macroeconomic shocks affecting decisions to introduce a TTB, as well as trade deflection at the country-level and the indirect impacts of TTBs through other trading partners. In a country-level analysis, this would not be possible as the impact that would have been attributed to retaliation could have been due to other unobserved macroeconomic shocks. Third, the sectoral disaggregation

[4]Data and part of the stylized facts were first presented in Furceri et al. (2021).

Figure 1: Distribution of responses



Note: The figure plots the distribution of the number of days between a new measure from country i on country j and a potential response from country j.

of the data allows to distinguish between retaliation to measures introduced by trading partners in the same sector or other sectors.

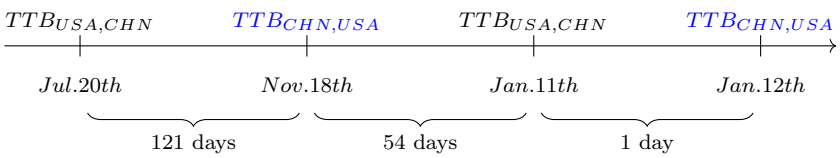
This dataset is used to construct both the dependent variable of interest—the number of implemented domestic TTB—as well as our measure of retaliation. The former is the count of HS6 imported products on which the government of j implements a TTB against trading partner i in year t. We aggregate this count to the HS4 product level to limit situations in which the variable assumes only zero or one. This also allows us to account for the intensive margin of retaliation (number of HS6 products targeted in each HS4 sector) rather than just on the extensive margin of retaliation.[5] To capture retaliation, we thus count TTBs implemented by country i against j within x days of j's action—where x is the typical (median) time it takes country j to implement a TTB following measures introduced in all its trading partners.

3.3 Constructing a new measure of trade retaliation

We present in Figure 1 the distribution of the number of days between a country j's measures and country i's measures. As evident in the figure, most actions occur well

[5]While governments impose temporary trade barriers on HS8 or HS10-digit products, the HS6 digit is the most disaggregated level by this classification that is comparable across countries. We count as one product all HS8-digit products falling into the same HS6 category.

Figure 2: Timeline for China-US in 2016-2017



Note: Timeline of TTB measures China and the US imposed against each other during the period 2016-2017. Over this period, the US is the first mover, initiating a set of measures against China on July 20th. China set off a series of measures on November 18th, that is 121 days after the American ones. 54 days after, on January 11th, the US undertook another set of measures, followed by Chinese measures 1 day after, on January 12th. To build our retaliation variable we build on the country-specific reaction thresholds, i.e. the median number of days between two opposing measures, which are 63 days for China, and 81 days for the US. Therefore, when considering determinants of Chinese measures, the first set of US measures will not be counted in our retaliation variable, but the second set will be, since they precede Chinese measures by 1 day, which is more than the Chinese response threshold. However, when considering determinants of US measures, Chinese TTBs happening in November will be included in our retaliation variable, since they precede US measures by less than 81 days, the US reaction threshold.

within the span of a year, with a mode of around 50 days and median of 165 days. Moreover, the mode and median between opposing measures vary significantly across countries (Table 1, Figure A4). For example, within our sample, the median number of days for China to introduce a TTB following TTBs introduced by its trading partners is 63 days, while for the US the number is 81 days and for the European Union 100 days. Interestingly, the median number of days between opposing measures is larger for smaller countries. The pattern in the daily data raises a red flag for approaches in the literature that consider responses only for measures implemented in the previous calendar year. Indeed, two thirds of the TTBs will not be classified as retaliation according to the previous calendar year measure.[6]

We define a country-specific reaction threshold that includes as retaliatory measures those that follow foreign country TTB by at most x days, where x is the median number of days taken by country j to implement a TTB following measures introduced in all its trading partners. To illustrate, Figure 2 provides a timeline of TTB measures that China and the US imposed against each other during the period 2016-2017. The US implemented a measure against China on July 20th; China introduced a set of measures on November 18th—that is, 121 days after the U.S. investigation took place; 54 days later,

[6] Assuming retaliation occurs within 165 days, only TTB measures implemented from January to May will be considered as retaliation when using the previous calendar year measure. Figure A5 presents the average number of HS6 products targeted by a TTB investigation: only a third of them are implemented within January-May period.

Table 1: Country-specific median of number of days between two opposing measures

Country	Median response	Country	Median response
ARG	186	MEX	139.5
AUS	469	MYS	646
BRA	239	NZL	318
CAN	386	PAK	1301
CHL	314	PER	482.5
CHN	63	PHL	456
COL	2324	RUS	271
CRI	798	THA	330
EUN	100	TUR	233
IDN	161	TWN	64
IND	103.5	USA	81
ISR	1110	VEN	432
JPN	214	ZAF	376.5
KOR	135	**Whole sample**	165

Note: The table provides for each country j the median number of days between a new TTB from a trading partner i and a potential response from country j. The last item provides the sample average median threshold.

on January 11th, the US introduced another set of measures; followed by Chinese TTB measures 1 day afterwards, on January 12th. Given the median number of days between two opposing measures for China (63 days), when considering the determinants of Chinese TTB measures, the first set of US measures will not be counted in our retaliation variable, but the second set will be since they precede Chinese measures by 1 day. However, when considering determinants of US TTB measures (whose median response time is 81 days), the Chinese TTBs of November 18th will be counted since they precede US measures by 54 days. This approach allows us to effectively deal with the pervasiveness of within-year actions and limits endogeneity issues to those cases in which country i's actions precede those introduced by j by x days. While our approach relies on the choice of threshold for each country, we show below that our baseline results are robust to alternative thresholds—such as the whole sample median (165 days) or the first quartile by country.

Table 2: Probabilities of a domestic measure

	Whole sample	Largest users (12 countries)
Probability of at least one domestic measure $P(TTB_{jit} > 0)$	3.9	58
Probability of at least one domestic measure preceded by a foreign measure $P(TTB_{ijt} > 0 \mid TTB_{jit} > 0)$	4.6	26.7
Probability of a domestic measure preceded by more than 9 foreign measures $P(TTB_{ijt} > 8 \mid TTB_{jit} > 0)$	12	41
Probability of a domestic measure preceded by less than 9 foreign measures $P(TTB_{ijt} < 8 \mid TTB_{jit} > 0)$	3.8	58
Probability of several domestic measures preceded by more than 9 foreign measures $P(TTB_{ijt} > 8 \mid TTB_{jit} > 10)$	25	29
Probability of a domestic measure preceded by less than 9 foreign measures $P(TTB_{ijt} < 8 \mid TTB_{jit} > 10)$	8.9	13

Note: This table presents probabilities (in percent) of foreign measures preceding domestic measures conditional on having at least one domestic measure. The 12 largest users are China, Indonesia, Mexico, Turkey, Russia, Argentina, Venezuela, Chile, Canada, India, European Union, United States.

3.4 Facts and patterns of trade retaliation

Table 2 presents the unconditional and conditional probabilities of implementing a domestic measure and responding to a foreign measure within 165 days. The unconditional probability of at least one domestic measure per year is of 3.9% for the whole sample, and goes up to 58% for the largest TTB users. Likewise, the probability of a foreign measure preceding a new domestic investigation is of 4.6% for the whole sample, and 26.7% for the largest users—such as the United States and the European Union—suggesting strong strategic rationale for the use of TTBs. As presented in the previous section, some of the literature on trade retaliation focuses on dummies for domestic and foreign measures, focusing only on the extensive margin of retaliation. To explore the intensive margin of retaliation, the second part of Table 2 presents conditional probabilities of responding to a foreign measure while accounting for the number of products targeted by both countries. In particular, the probability of a foreign measure preceding a domestic one is larger when the foreign country targeted at least 9 products within the last 165 days (12% for the whole sample, 41% for the largest users).[7] Likewise, the probability of targeting more than 9 foreign products is larger when the foreign country also targeted several products (29%, against 25% when the foreign economy targeted less than 8 products). The importance of the intensive margin in the probability of retaliation will shape our estimation strategy and we will focus on the number of targeted products by each country (see Section 4).

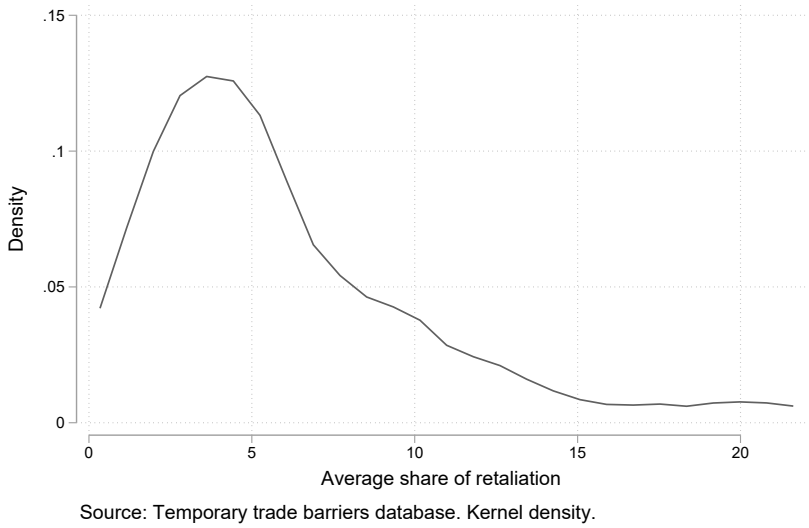
Figure 3 reports the cross-country distribution of the share of retaliation relative to all TTBs for each country in the sample: retaliation represents around 10% of TTB use sample-wide. At the same time, there is heterogeneity across countries, with retaliation representing 20% of TTB use for some countries.[8] Figure 4 reports that retaliation increased during the 1990s with a peak share to total measures of 14% in the 2000s. After a decline, the share rose again after the GFC, reaching 9% in 2012 and again in 2019.

Do countries retaliate against the same sector targeted by the trading partner or in different sectors? For each country-pair ji or dyad, we compute how many times a specific sector has been targeted by country i, how many times country j retaliates in the same

[7] We consider two thresholds of large and low amounts of targeted products, as being above or below the average number of targeted products when using TTBs: when launching new investigations, an economy targets 9 products on average.

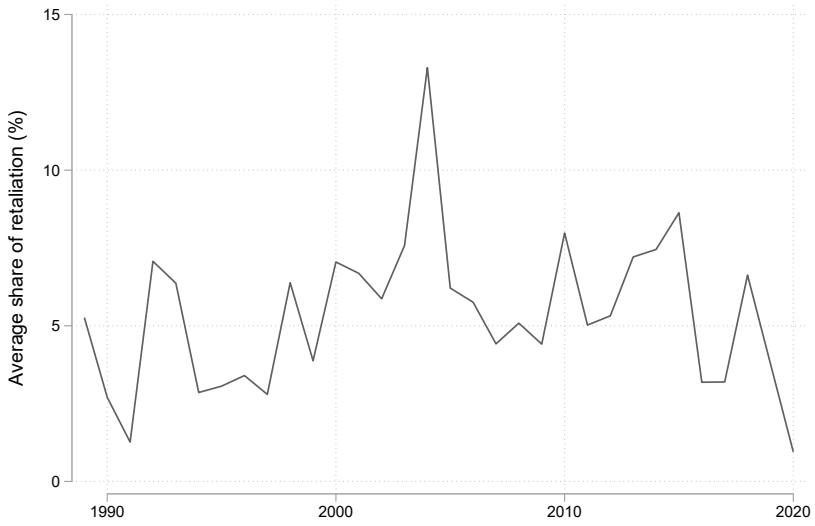
[8] Large countries appear to retaliate as much as small countries, while advanced economies retaliate more than other countries (Figure A6). Figure A7 presents the same statistics broken down by trading partner: all countries retaliate more against small and emerging countries on average.

Figure 3: Distribution of share of retaliatory measures across countries



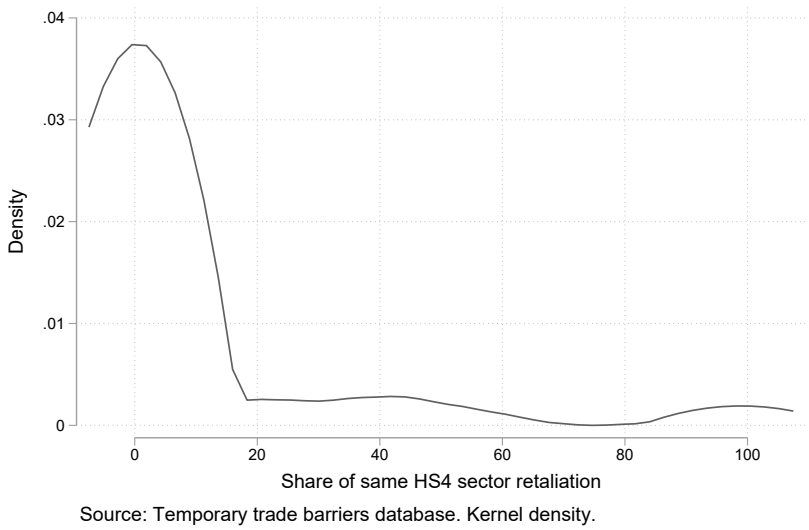
Note: The figure plots the distribution of the average share of retaliation. We compute for each country the share of TTBs identified as potential retaliation out of the total number of new TTBs.

Figure 4: Share of retaliatory measures across time



Note: The figure plots the share of retaliatory measures per year, over the whole sample.

Figure 5: Same HS4 sector retaliation



Note: We examine within a country-pair ji, which sectors are generally targeted by i, and which sectors j generally retaliate to, distinguishing whether those sectors are the same or different. In particular, we compute for each sector, within each dyad, how many times a specific sector has been targeted by country i, and how many times did country j retaliate in this sector, and then aggregate this same sector-retaliation at the country-pair level. The figure plots the distribution of the same HS4-sector retaliation.

sector, and then aggregate sector-retaliation observations to the country-pair level. Figure 5 plots the density of the share of same-sector to total retaliation. The modal share is close to zero and the density shows that retaliation occurs in many sectors at the same time. Therefore, TTBs are not typically used as a response designed to counteract damage to the sector that was originally targeted.

The following section presents the empirical strategy and details the control variables used to isolate retaliatory motives from other drivers of the use of TTBs. It also investigates whether these stylized facts hold in a more formal empirical analysis.

4 Empirical framework

In our analysis, we consider the number of HS6 products that are targeted with a TTB in a specific HS4 sector k, either from country i on country j, or from country j on country i. We aggregate this count to the HS4 sector-level for two reasons. First, it is unlikely that a country will strategically respond to foreign measures targeting the exact same HS6

product. Second, it allows us to account for the intensity of retaliation.[9] The dependent variable is the count of HS6 imported products aggregated to HS4 sector k on which the government of economy j implements a new temporary trade barrier against trading partner i in year t ($TTB_{jik,t}$). The dependent variable is a non- negative count which exhibits over-dispersion in that the variance of the number of trade barriers per time period exceeds the mean. To address this issue, and consistent with the recent literature on estimating count data (see e.g., Silva and Tenreyro, 2006; Silva and Tenreyro, 2011), we estimate the following equation using the fixed-effect Poisson estimator:

$$TTB_{jik,t} = \beta_1 TTB_{ijk} + \beta_2 TTB_{ijk'} + \theta' Z_{ji,t-1} + \alpha_{jt} + \delta_{it} + \gamma_{st} + \mu_{ji} + \nu_{jik,t}. \quad (1)$$

where $TTB_{ijk,t}$, is our measure of retaliation differentiated between responses to measures introduced in sector k ($TTB_{ijk,t}$) and other sectors k' ($TTB_{ijk',t}$); ($Z_{ri,t-1}$) is the set of bilateral-time varying controls described below; μ_{ji} are country-pair fixed effects to control for unobservable country-pair characteristics such as cultural ties, distance, etc.; α_{rt} and δ_{it} are country-time fixed effects to account for time-varying country specific factors in each country—such as changes in real GDP and unemployment; and γ_{st} are sector-time varying fixed effects to account for sectoral specific trends—such as increased global protection in a specific sector (e.g. IT).[10][11] β_1 and β_2 are the coefficients capturing retaliation and represent the semi-elasticity of $TTB_{jik,t}$ to $TTB_{ijk,t}$ and $TTB_{ijk',t}$, respectively. β_1 (β_2) thus denote the percent change in $TTB_{jik,t}$ for a unitary increase in $TTB_{ijk,t}$ ($TTB_{ijk',t}$). Standard errors are clustered at the country-pair-HS4-sector (jik) level, the most conservative level possible.

We extend the baseline framework in equation 1 to consider potential non-linear retaliation effects including through interactions with macro variables. We include interactions between our retaliation measures and the set of macro variables as follows:

$$\begin{aligned} TTB_{jik,t} = {} & \beta_1 TTB_{ijk,t} + \beta_2 TTB_{ijk',t} + \theta' Z_{ji,t-1} + \beta_3 TTB_{ijk,t} M_{ji,t-1} \\ & + \beta_4 TTB_{ijk',t} M_{ji,t-1} + \alpha_{jt} + \delta_{it} + \gamma_{st} + \mu_{ji} + \nu_{jik,t}, \end{aligned} \quad (2)$$

[9] We provide robustness test by estimating the baseline equation at the HS6-digit level in Table 6.

[10] Domestic measures on country i can also echo third-party measures on country i, because foreign measures could induce trade diversion by shifting exports of country i from third countries to country j. In that case, an increase in domestic measures should not be dubbed as retaliation. This effect should be accounted for by the sector-time fixed effects.

[11] We use the broader HS2 classification here as the HS4 time fixed effects estimation does not converge.

In this specification, the effect of retaliation is linear in the set of variables in M: $\beta_1 + \beta_3 M_{ji,t-1}$ for retaliation to measures in the same sector; $\beta_2 + \beta_4 M_{ji,t-1}$ for retaliation to measures in other sectors; and it allows one to test whether retaliation varies with M—e.g. whether retaliation is more frequent in periods of higher unemployment, and less frequent against larger trade partners.

While focusing on the role of the rules-inconsistent use of TTBs, we control for other ways to respond to foreign TTB measures. First, we control for the number of WTO disputes launched between country pairs using WTO records on trade disputes filed by member countries to contest a foreign TTB measure. In particular, we included present and future domestic WTO disputes to account for the fact that country j may choose the rule-consistent path to respond. Second, we include past and present foreign WTO disputes, to account for tensions in bilateral relations.[12] As some countries may choose not to respond at all, we include the share of country j's exports towards country i: the larger it is, the more country j may fear further retaliation and will choose to do nothing.

Following Knetter and Prusa (2003) and Bown and Crowley (2013a, 2014), we include macroeconomic control variables and we use data on import levels and growth from CEPII's BACI dataset to capture the impact of import surges on trade protectionism. We include the variation of the real exchange rate from the USDA on the grounds that an appreciation of the domestic currency may drive increased protection through TTBs. Finally, because restoring trade competitiveness may increase incentives to use protectionism we incorporate bilateral trade balance.

As TTBs can be used as a substitute for standard trade policy, we also control for tariff levels, tariff changes, tariff overhang—defined as the difference between bound and applied tariffs—using information from the UNCTAD TRAINS database. We also introduce a dummy for countries belonging to the same Regional Trade Agreement using data from CEPII's database *Gravity*. To account for the possibility of lobbying or domestic market power, we introduce a comparative advantage index, computed as the ratio of the share of exports in sector k to a country's total exports, over the share of exports in the same sector k in world exports. A value of the index larger than one indicates that the country's productivity in the sector is greater than the worldwide average: we create a dummy equal

[12] WTO trade dispute data come from the WTO website. We only have information on the country-pair and the time when the dispute was initiated by the targeted country. Since 1995, more than 600 complaints have been filed at the Dispute Settlement Body. The number of disputes has been decreasing since 1996, with the exception of the year 2018.

Table 3: Descriptive Statistics

Variable	Mean	Standard deviation	Min	Max
$TTB_{jik,t}$	.0060998	.1810874	0	29
$TTB_{ijk,t}$	.0000156	.0077636	0	5
$TTB_{ijk',t}$	.0011662	.167196	0	84
$\Delta Imports_{jik,t-1}$	40.57498	13450.24	-.9999998	1.27e+07
$\Delta RER_{ji,t-1}$	-.0972273	11.5155	-66.25534	139.914
$TradeBalance_{ji,t-1}$	6.97538	12.42457	.0130383	85.05662
$ExportShare_{ji,t-1}$	.7171183	12.66001	-52.59512	83.90308
$Overhang_{jik,t-1}$	12.45125	15.17271	-358.69	724.17
$\Delta Tariff_{jik,t-1}$	.2674783	3.675996	-796.83	774.34
$Disputes_{ji,t-1}$	.1074071	.4354979	0	6
N. of observations	1,476,615			

Note: Descriptive statistics for the whole sample. The number of observations corresponds to the standard TTB estimation, column (1) in Table 4.

to one when the exporter (importer) has a comparative advantage in the sector k, CA_{ik} (CA_{rk}). Table 3 presents the summary statistics for the variables used.

5 Results

5.1 Baseline results

Table 4 reports the results using our baseline specification (equation 1): on average, a one standard deviation increase in the number of TTBs in a HS4-sector by country i on country j increases the number of newly targeted products by j on i by 0.97% in the same sector and 1% in another sector (column 6). This finding confirms that countries retaliate. The statistical significance of the results is robust to alternative sets of controls.

Among the sets of control variables considered, we find that tariff overhang has a negative effect on the decision of a country to introduce a new TTB: having room to raise tariffs decreases incentives to resort to TTBs, which is consistent with Kuenzel (2020). However, we find that an increase in the applied tariff when the overhang is null increases the use of TTB measures, suggesting an complementarity in trade policy instruments when there is less room for change.

We also control for rules-consistent ways to respond to a foreign measure, in order to

Table 4: Baseline specification

	Dependent variable: TTB_{jikt}					
	(1)	(2)	(3)	(4)	(5)	(6)
$TTB_{ijk,t}$	0.592***	0.961***	0.610***	0.595***	0.613***	1.212***
	(0.0971)	(0.222)	(0.104)	(0.0984)	(0.103)	(0.249)
$TTB_{ijk',t}$	0.0747***	0.0672***	0.0769***	0.0750***	0.0766***	0.0696***
	(0.0108)	(0.00976)	(0.0106)	(0.0108)	(0.0105)	(0.00943)
$\Delta Imports_{jik,t-1}$	-0.000126	-0.000211	-0.000127	-0.000127	-0.000116	-0.000182
	(0.000146)	(0.000258)	(0.000147)	(0.000146)	(0.000120)	(0.000205)
$\Delta RER_{ji,t-1}$	0.0389	0.0458	0.0420	0.0397	0.0409	0.0500
	(0.0333)	(0.0408)	(0.0328)	(0.0335)	(0.0331)	(0.0391)
$RTA_{ji,t-1}$		0.0515				-0.0118
		(0.127)				(0.132)
$Overhang * \Delta Tariff_{jik,t-1}$		-6.80e-06				-1.08e-05
		(2.50e-05)				(2.67e-05)
$\Delta Tariff_{jik,t-1}$		0.0114***				0.0112***
		(0.00249)				(0.00252)
$Overhang_{jik,t-1}$		-0.0142***				-0.0136***
		(0.00275)				(0.00267)
$Disputes_{ji,t}$			-0.0988			-0.269***
			(0.0623)			(0.0763)
$Disputes_{ji,t+1}$			0.233***			0.222***
			(0.0574)			(0.0657)
$Disputes_{ij,t}$			0.122**			0.119**
			(0.0521)			(0.0592)
$Disputes_{ij,t-1}$			0.114**			0.115**
			(0.0504)			(0.0506)
$TTB_{ij,t+1}$				0.00427**		0.00927***
				(0.00193)		(0.00254)
$lnImports_{ij,t-1}$				-0.644		0.0193
				(1.007)		(1.230)
$ExportShare_{ji,t-1}$				0.00159		0.0302
				(0.0127)		(0.0193)
$TradeBalance_{ji,t-1}$					-0.000175	-0.0182**
					(0.00458)	(0.00780)
CA_{jk}					-0.291***	-0.261***
					(0.0523)	(0.0611)
CA_{ik}					0.740***	0.691***
					(0.0497)	(0.0563)
Observations	2,044,522	1,291,826	2,044,522	2,044,522	2,044,514	1,291,822
FE jt-it-ji-st	Yes	Yes	Yes	Yes	Yes	Yes
FE jkt-ikt-ji-st						
Cluster	jik	jik	jik	jik	jik	jik
Effect of one SD increase in TTB_{ijkt} (%)	0.472	0.767	0.486	0.474	0.489	0.966
Effect of one SD increase in $TTB_{ijk't}$ (%)	1.117	1.005	1.150	1.122	1.145	1.041
Pseudo-R2	0.372	0.384	0.373	0.372	0.381	0.394
LL	-51573	-37310	-51522	-51567	-50809	-36737

Note: Standard errors are in parentheses and clustered at the country-pair-hs4 sector dimension (jik), and significance levels are defined such as *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Each estimation contains both country-time (jt and it), country-pair (ji) and HS2 sector-time (st) fixed effects. The dependent variable TTB_{jikt} is the number of HS6 products on which country j imposed a new TTB against country i, in HS4 sector k in year t. The variables of interest, TTB_{ijkt} and $TTB_{ijk't}$, are the number of HS6 products targeted by country i, on country j, in the same sector k or in all other sectors k', x days before any measure from country j. All other control variables are lagged by one year.

ensure that what we capture is the "illegal" retaliation. To this end, we add in column (3) the number of trade disputes filed at the WTO dispute settlement body within the country pair. In particular, we consider the disputes that country j filed in year t and will file in the next year, assuming that this opportunity to respond would be associated with lower rule-inconsistent retaliation. We also introduce disputes implemented by the trading partner, in the previous and current years. We find that current domestic and foreign disputes are associated with an increase in the number of domestic TTBs, suggesting that countries do not refrain from using TTBs despite the existence of the dispute settlement body. We control for potential fear of retaliation, by including future foreign measures, and the share of country j's exports with country i.[13] The estimates suggest that more attacks in the future tend to foster domestic protectionism.

Finally, we find that import protection tends to be lower in sector with comparative advantage, suggesting that governments tend to protect less competitive sectors. On the other hand, countries tend to target the comparative advantage sectors of their trading partners. These findings are consistent with the notion that trade protection is higher when the domestic economy has a trade deficit with the trading partner as shown by Delpeuch et al. (2021).

In contrast to the previous literature, we do not find convincing evidence that macro factors are significant drivers of retaliation as most of their variation is captured by country-time fixed effects. To check this, we re-estimate the model but include only sector-time and country-pair fixed effects. The comparison in R-squared values indicates that these fixed effects alone account for almost 6% of the total variance in the data. Table 5 presents the results when those fixed effects are dropped. First, a real appreciation of the domestic currency increases the number of TTBs against the exporting country. Second, a reduction in the trade balance is associated with an increase in TTBs, suggesting that TTBs may be implemented to restore competitiveness and improve the trade balance (see Delpeuch et al., 2021). Third, retaliation tends to occur more frequently against countries where the retaliating country exports more. Finally, the results point to a positive statistical effect for the RTA dummy, suggesting that when countries belong to the same RTA, they tend to use alternative trade barriers more, perhaps because they are unable to deploy tariffs against each other.

[13] Ideally, we would like to control for the expectation at time t of foreign measures introduced in $t+1$. The result should also be treated with caution given the potential endogeneity of future foreign measures.

Table 5: Specification including only sector-time and country-pair fixed effects

	Dependent variable: TTB_{jikt}					
	(1)	(2)	(3)	(4)	(5)	(6)
$TTB_{ijk,t}$	0.774***	1.157***	0.772***	0.789***	0.805***	1.216***
	(0.0691)	(0.176)	(0.0683)	(0.0698)	(0.0735)	(0.191)
$TTB_{ijk',t}$	0.0466***	0.0415***	0.0491***	0.0477***	0.0500***	0.0502***
	(0.0112)	(0.0112)	(0.0111)	(0.0112)	(0.0109)	(0.0106)
$\Delta Imports_{jik,t-1}$	-0.000121	-0.000202	-0.000118	-0.000117	-0.000106	-0.000140
	(0.000137)	(0.000255)	(0.000134)	(0.000132)	(0.000116)	(0.000173)
$\Delta RER_{ji,t-1}$	0.00658***	0.0105***	0.00649***	0.00718***	0.00604***	0.0106***
	(0.00131)	(0.00142)	(0.00131)	(0.00133)	(0.00134)	(0.00147)
$RTA_{ji,t-1}$		0.566***				0.559***
		(0.122)				(0.132)
$Overhang * \Delta Tariff_{jik,t-1}$		-1.59e-07				8.35e-07
		(7.05e-06)				(5.64e-06)
$\Delta Tariff_{jik,t-1}$		0.0153***				0.0137***
		(0.00408)				(0.00375)
$Overhang_{jik,t-1}$		-0.0131***				-0.0121***
		(0.00223)				(0.00221)
$Disputes_{ji,t}$			0.137***			0.0620
			(0.0467)			(0.0511)
$Disputes_{ji,t+1}$			0.0691			-0.00559
			(0.0461)			(0.0477)
$Disputes_{ij,t}$			0.0284			-0.00999
			(0.0408)			(0.0416)
$Disputes_{ij,t-1}$			0.0866**			0.0171
			(0.0382)			(0.0395)
$TTB_{ij,t+1}$				0.000852		0.00212
				(0.00158)		(0.00222)
$lnImports_{ij,t-1}$				0.221***		0.537***
				(0.0832)		(0.137)
$ExportShare_{ji,t-1}$				0.0147*		0.0232*
				(0.00786)		(0.0125)
$TradeBalance_{ji,t-1}$					-0.00503*	-0.0248***
					(0.00304)	(0.00468)
CA_{jk}					-0.322***	-0.296***
					(0.0540)	(0.0596)
CA_{ik}					0.757***	0.722***
					(0.0506)	(0.0567)
Observations	3,095,363	1,829,299	3,095,363	3,095,360	3,090,684	1,829,292
FE ji-st	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	jik	jik	jik	jik	jik	jik
Pseudo-R2	0.290	0.318	0.291	0.291	0.300	0.330
LL	-61777	-43474	-61707	-61726	-60905	-42677

Note: Standard errors are in parentheses and clustered at the country-pair-hs4 sector dimension (jik), and significance levels are defined such as *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Each estimation contains both country-pair (ji) and HS2 sector-time (st) fixed effects. The dependent variable TTB_{jikt} is the number of HS6 products on which country j launched an investigation against country i, in HS4 sector k in year t. The variables of interest, TTB_{ijkt} and $TTB_{ijk't}$, are the number of HS6 products targeted by country i, on country j, in the same sector k or in all other sectors k', x days before any measure from country j. All other control variables are lagged by one year.

5.2 Robustness checks

Next, we check robustness of the baseline results to alternative model specifications, control variables, and retaliation thresholds. We start by investigating whether changes in the estimation framework may affect the results. To this end, we re-estimate equation (1) using OLS rather than the fixed-effect Poisson estimator. The results in the first column of Table 6 confirm the statistically significant retaliation effects from the baseline. We also consider including country-pair-time fixed effects (ijt) to account for bilateral political tensions (e.g. US-China tensions). Estimates as well as the impact of a standard deviation increases slightly (column (2)). Subsequently, we check the results using HS6 digit level of disaggregation which confirm the existence of retaliation. The results in column (3) confirm that retaliation occurs in different products.

We also check whether the results are robust to alternative ways to construct our dependent variable. We start by re-estimating equation (1) using only AD. The results are not statistically different from those reported in the baseline (column 4, Table 6). Then, we check sensitivity of our results to the time threshold for retaliation, repeating the analysis using alternative thresholds such as the whole sample median (120 days) and each country's first quartile. The results reported in columns 5 and 6 of Table 6 confirm our baseline findings.

Finally, we checked the sensitivity of our results to alternative time- and country-samples. The results obtained splitting the sample before and after the GFC, as well as between advanced and emerging market economies, reconfirm our findings (Table 7), while suggesting that retaliation seems stronger in the recent decade, mainly coming from advanced economies.

5.3 Nonlinearities

In this subsection, we investigate the role of specific variables in mediating the decision to retaliate. In particular, we investigate whether the potential for other trade policy instruments and other ways to retaliate affect this non-cooperative behavior. We also examine whether retaliation effects vary over time, depending on economic conditions as well as the potential for raising tariffs, and how they vary across countries depending on economic size and income status, and on the sector that is being targeted. To this end, and to limit the number of interaction terms and possibility for multicollinearity, we

Table 6: Robustness tests

	Dependent variable: TTB_{jikt}					
	OLS	ijt FE	HS6-digit level	AD only	25th percentile threshold	Median threshold
	(1)	(2)	(3)	(4)	(5)	(6)
$TTB_{ijk,t}$	0.822	2.036***	4.868***	3.697***	5.151***	2.559***
	(0.546)	(0.455)	(0.944)	(0.850)	(0.623)	(0.667)
$TTB_{ijk',t}$	0.0799***	0.912***	0.0832***	1.146***	0.271**	0.0700***
	(0.0252)	(0.147)	(0.00897)	(0.0906)	(0.107)	(0.00944)
$\Delta Imports_{jik,t-1}$	-1.77e-10	-0.000164	-2.07e-06	-0.00251	-0.000186	-0.000183
	(2.00e-10)	(0.000182)	(4.63e-06)	(0.00289)	(0.000210)	(0.000207)
$\Delta RER_{ji,t-1}$	6.01e-05		0.0669*	0.0819**	0.0417	0.0447
	(5.24e-05)		(0.0342)	(0.0360)	(0.0390)	(0.0391)
$RTA_{ji,t-1}$	0.000633***		0.129	-0.129	0.0462	0.0124
	(0.000237)		(0.129)	(0.154)	(0.132)	(0.133)
$Overhang * \Delta Tariff_{jik,t-1}$	6.35e-09**	-8.52e-05*	-3.00e-05*	3.54e-05	-1.08e-05	-1.08e-05
	(3.05e-09)	(5.03e-05)	(1.58e-05)	(2.23e-05)	(2.67e-05)	(2.70e-05)
$\Delta Tariff_{jik,t-1}$	3.36e-05***	0.0143***	0.0290***	0.0177***	0.0111***	0.0113***
	(6.67e-06)	(0.00404)	(0.00424)	(0.00338)	(0.00251)	(0.00254)
$Overhang_{jik,t-1}$	-2.04e-05***	-0.0130***	-0.0163***	-0.0186***	-0.0133***	-0.0136***
	(3.07e-06)	(0.00275)	(0.00306)	(0.00387)	(0.00267)	(0.00267)
$Disputes_{ji,t}$	0.000173		-0.151**	-0.325***	-0.249***	-0.248***
	(0.000296)		(0.0712)	(0.0853)	(0.0759)	(0.0748)
$Disputes_{ji,t+1}$	-1.54e-05		0.228***	0.219***	0.143**	0.165**
	(0.000276)		(0.0687)	(0.0767)	(0.0670)	(0.0653)
$Disputes_{ij,t}$	0.000748**		0.270***	0.175***	0.0927	0.109*
	(0.000342)		(0.0646)	(0.0675)	(0.0594)	(0.0590)
$Disputes_{ij,t-1}$	0.000917**		0.282***	-0.0345	0.0934*	0.105**
	(0.000389)		(0.0604)	(0.0563)	(0.0499)	(0.0504)
$TTB_{ij,t+1}$	1.61e-05**			0.00548	0.00754***	0.00765***
	(7.10e-06)			(0.00341)	(0.00252)	(0.00249)
$lnImports_{ij,t-1}$	-0.00572*			0.105	0.0731	-0.113
	(0.00296)			(1.568)	(1.208)	(1.228)
$ExportShare_{ji,t-1}$	-0.000120**		0.0468**	0.0447**	0.0179	0.0225
	(4.79e-05)		(0.0192)	(0.0198)	(0.0189)	(0.0191)
$TradeBalance_{ji,t-1}$	-2.42e-06		-0.0145*	-0.0352***	-0.0155**	-0.0159**
	(7.11e-06)		(0.00791)	(0.00897)	(0.00746)	(0.00754)
CA_{jk}	-0.000968***	-0.252***	-0.0122	-0.263***	-0.261***	-0.261***
	(0.000144)	(0.0613)	(0.0542)	(0.0645)	(0.0614)	(0.0614)
CA_{ik}	0.00151***	0.694***	0.711***	0.846***	0.676***	0.686***
	(0.000144)	(0.0562)	(0.0428)	(0.0599)	(0.0559)	(0.0561)
Observations	4,705,103	490,699	1,966,244	1,038,950	1,291,822	1,291,822
FE jt-it-ji-st	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	jik	jik	jik	jik	jik	jik
Effect of one SD increase in TTB_{ijkt} (%)	0.357	2.528	0.491	0.628	0.453	0.390
Effect of one SD increase in $TTB_{ijk't}$ (%)	0.748	21.24	1.153	8.505	2.692	1.196
R2	0.0210					
Pseudo-R2		0.379	0.271	0.355	0.393	0.393
LL		-32233	-19711	-24994	-36800	-36813

Note: Standard errors are in parentheses and clustered at the country-pair-hs4 sector dimension (jik), and significance levels are defined such as *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Each estimation contains both country-time (jt and it), country-pair (ji) and HS2 sector-time (st) fixed effects. The dependent variable TTB_{jikt} is the number of HS6 products on which country j imposed a new TTB against country i, in HS4 sector k in year t. The variables of interest, TTB_{ijkt} and $TTB_{ijk't}$, are the number of HS6 products targeted by country i, on country j, in the same sector k or in all other sectors k', x days before any measure from country j. All other control variables are lagged by one year.

consider foreign measures without distinguishing the domestic sector being targeted. In Table 10 we therefore reproduce the baseline estimations with this variable. The results confirm the existence of retaliation.

In Table 9 we focus on the trade policy environment and interact the number of foreign

measures with several trade policy variables. Previous results indicate that countries belonging to the same RTA may resort to TTBs. Estimates in column (1) show that countries with a RTA retaliate more against each other. Likewise, retaliation is not stronger when past tariffs have been reduced, as shown by the non-statistically significant interaction in column (2).

To deal with trade conflicts and promote cooperation, countries can file a dispute at the Dispute Settlement Body to engage in official negotiations. However, estimates in column (4) show that a rise in the number of trade disputes from country j against country i increases retaliation. In other words, the opportunity of dealing with unfair measures through official rules-based channels does not reduce rules-inconsistent retaliation. On the other hand, current disputes initiated by country i are positively correlated with increased retaliation from country j (column (5)). Finally, the prospect of future responses does not seem to play towards peace, as the future number of foreign measures increases retaliation (column (6)).[14] These results suggest that countries retaliate using all measures available, despites the effort of the WTO to maintain peaceful trade relationships.

Table 10 presents results regarding the role of the macroeconomic environment on retaliation. Starting with the unemployment rate, we find that retaliation is stronger during periods of higher unemployment. The result is consistent with Bown and Crowley (2013a) who find that TTBs are set counter-cyclically and in response to weaker cyclic conditions. We find that the intensity of retaliation varies across countries. Large TTB users do not necessarily retaliate the most (column (4)), although some of the largest users as the United States, the European Union and China retaliate significantly more than other countries in our sample (column (2)). Finally, we investigate whether countries retaliate more to protect themselves or to exert injury on the foreign economy. To do so, we distinguish between foreign measures targeting a domestic or a foreign comparative advantage sector, or none of those. The results suggest that TTBs tend to be used more against the comparative sector of the trading partner. The results in column (3) indicate that retaliation is stronger when the foreign economy first intended to protect one of its own comparative advantage sectors.

[14] We use the actual number of foreign measures in $t+1$ as a proxy for expected foreign measures.

6 Conclusion

This paper has revisited the question of whether TTBs are used by countries as a means of retaliation. Having developed a novel sectoral measure of retaliation that accounts for within-year actions, we uncover new notable patterns and facts. First, there is wide dispersion across countries in the extent of reliance on TTBs for retaliation, with some using up to 20% of TTBs they introduce for retaliatory purposes. Second, retaliation through TTBs has increased over time, peaking in the early 2000s. Third, retaliatory TTBs are not in general tailored to a single injured sector but tend to occur in many sectors at the same time: this evidence suggests that TTBs may be introduced to combat general governmental policies that are perceived to be unfair. These patterns are confirmed by formal empirical analysis as well as numerous robustness checks.

The larger incidence of retaliation identified in this work compared to that recognized in earlier literature, and the resulting distortive effects on international trade, underscore the urgency to strengthen WTO Dispute Settlement mechanisms so that countries will have confidence that legitimate injuries will be adjudicated promptly and according to the rules. This is especially important in the present environment of resurgent protections (see e.g. Fajgelbaum et al., 2020) and geo-economic fragmentation (see e.g. Garcia-Saltos et al., 2023) which risk global economic recovery and reversals in poverty reduction especially in dynamic, highly open, economic regions (notably Asia).

Table 7: Alternative samples

	Dependent variable: TTB_{jikt}			
	(1)	(2)	(3)	(4)
	1989-2007	2008-2019	Advanced economies	Emerging economies
$TTB_{ijk,t}$	4.422***	0.251	2.772***	0.0932
	(0.684)	(2.074)	(0.625)	(0.398)
$TTB_{ijk',t}$	0.0537***	0.880***	0.539***	0.405***
	(0.00918)	(0.0768)	(0.168)	(0.0749)
$\Delta Imports_{jik,t-1}$	-0.00167	-4.85e-05	4.07e-06	-0.000715
	(0.00184)	(7.46e-05)	(7.58e-05)	(0.000931)
$\Delta RER_{ji,t-1}$	0.0662*	0.176*	0.124	0.0639
	(0.0387)	(0.0899)	(0.117)	(0.0411)
$RTA_{ji,t-1}$	-0.343	0.0389	-0.137	0.0963
	(0.265)	(0.239)	(0.249)	(0.180)
$Overhang * \Delta Tariff_{jik,t-1}$	-2.74e-05	-0.000169	-4.45e-05**	-9.31e-05
	(3.71e-05)	(0.000146)	(1.91e-05)	(0.000123)
$\Delta Tariff_{jik,t-1}$	0.0118***	0.0237**	0.00833**	0.0382***
	(0.00312)	(0.00925)	(0.00339)	(0.00690)
$Overhang_{jik,t-1}$	-0.0112***	-0.0160***	-0.0239***	-0.00818***
	(0.00330)	(0.00433)	(0.00558)	(0.00305)
$Disputes_{ji,t}$	-0.272***	-0.113	-0.513***	0.128
	(0.101)	(0.138)	(0.114)	(0.147)
$Disputes_{ji,t+1}$	0.0872	0.385***	0.187	-0.0573
	(0.104)	(0.132)	(0.121)	(0.164)
$Disputes_{ij,t}$	0.165*	0.267***	0.0403	-0.0566
	(0.0940)	(0.102)	(0.0840)	(0.152)
$Disputes_{ij,t-1}$	0.0953	0.395***	0.154**	-0.0486
	(0.0906)	(0.105)	(0.0706)	(0.177)
$TTB_{ij,t+1}$	0.0139***	0.0227***	0.0129**	0.0239***
	(0.00311)	(0.00660)	(0.00561)	(0.00562)
$lnImports_{ij,t-1}$	-4.621		-0.645	
	(2.826)		(1.958)	
$ExportShare_{ji,t-1}$	-0.0232	0.0428	0.0885*	0.0344
	(0.0497)	(0.0381)	(0.0458)	(0.0225)
$TradeBalance_{ji,t-1}$	-0.0210	-0.0372**	-0.0658***	-0.0125
	(0.0142)	(0.0155)	(0.0247)	(0.00889)
CA_{jk}	-0.377***	-0.196**	-0.451***	-0.234***
	(0.0802)	(0.0807)	(0.0917)	(0.0866)
CA_{ik}	0.685***	0.682***	0.719***	0.669***
	(0.0787)	(0.0689)	(0.0867)	(0.0666)
Observations	481,145	693,531	286,052	561,279
FE jt-it-ji-st	Yes	Yes	Yes	Yes
Cluster	jik	jik	jik	jik
Pseudo-R2	0.421	0.399	0.439	0.373
LL	-14446	-20909	-15469	-17963

Note: Standard errors are in parentheses and clustered at the country-pair-hs4 sector dimension (jik), and significance levels are defined such as *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Each estimation contains both country-time (jt and it), country-pair (ji) and HS2 sector-time (st) fixed effects. The dependent variable TTB_{jikt} is the number of HS6 products on which country j imposed a new TTB against country i, in HS4 sector k in year t. The variables of interest, TTB_{ijkt} and $TTB_{ijk't}$, are the number of HS6 products targeted by country i, on country j, in the same sector k or in all other sectors k', x days before any measure from country j. All other control variables are lagged by one year. Advanced economies are Australia, Canada, European Union, Israel, Japan, Korea, New Zealand, United States.

Table 8: All foreign measures

	Dependent variable: TTB_{jikt}					
	(1)	(2)	(3)	(4)	(5)	(6)
TTB_{ijt}	0.0789***	0.0722***	0.0811***	0.0793***	0.0808***	0.0744***
	(0.0110)	(0.00985)	(0.0110)	(0.0111)	(0.0109)	(0.00983)
$\Delta Imports_{jik,t-1}$	-0.000127	-0.000213	-0.000127	-0.000127	-0.000117	-0.000182
	(0.000146)	(0.000260)	(0.000148)	(0.000147)	(0.000120)	(0.000207)
$\Delta RER_{ji,t-1}$	0.0388	0.0427	0.0416	0.0398	0.0408	0.0445
	(0.0332)	(0.0406)	(0.0328)	(0.0335)	(0.0330)	(0.0391)
$RTA_{ji,t-1}$		0.0575				0.00448
		(0.128)				(0.132)
$Overhang * \Delta Tariff_{jik,t-1}$		-7.25e-06				-1.09e-05
		(2.56e-05)				(2.71e-05)
$\Delta Tariff_{jik,t-1}$		0.0115***				0.0113***
		(0.00251)				(0.00254)
$Overhang_{jik,t-1}$		-0.0141***				-0.0135***
		(0.00275)				(0.00267)
$Disputes_{ji,t}$			-0.0905			-0.248***
			(0.0620)			(0.0749)
$Disputes_{ji,t+1}$			0.219***			0.171***
			(0.0575)			(0.0641)
$Disputes_{ij,t}$			0.120**			0.113*
			(0.0522)			(0.0591)
$Disputes_{ij,t-1}$			0.114**			0.108**
			(0.0505)			(0.0505)
$TTB_{ij,t+1}$				0.00401**		0.00784***
				(0.00192)		(0.00248)
$lnImports_{ij,t-1}$				-0.705		-0.140
				(1.010)		(1.235)
$ExportShare_{ji,t-1}$				0.000327		0.0247
				(0.0127)		(0.0191)
$TradeBalance_{ji,t-1}$					-0.000421	-0.0168**
					(0.00453)	(0.00753)
CA_{jk}					-0.292***	-0.260***
					(0.0524)	(0.0614)
CA_{ik}					0.737***	0.688***
					(0.0496)	(0.0562)
Observations	2,044,522	1,291,826	2,044,522	2,044,522	2,044,514	1,291,822
FE jt-it-ji-st	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	jik	jik	jik	jik	jik	jik
Effect of one SD increase in TTB_{ijt} (%)	1.193	1.091	1.226	1.198	1.221	1.125
Pseudo-R2	0.371	0.384	0.372	0.371	0.381	0.393
LL	-51621	-37345	-51572	-51615	-50860	-36787

Note: Standard errors are in parentheses and clustered at the country-pair-hs4 sector dimension (jik), and significance levels are defined such as *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Each estimation contains both country-time (jt and it), country-pair (ji) and HS2 sector-time (st) fixed effects. The dependent variable TTB_{jikt} is the number of HS6 products on which country j launched an investigation against country i, in HS4 sector k in year t. The variable $TTB_{ij,t}$ is the total number of HS6 products targeted by country i on country j irrespective of the HS4 sector. All control variables are similar to the baseline estimation.

Table 9: Trade policy cooperation

	Dependent variable: TTB_{jikt}					
$TTB_{ij,t}$	0.0692***	0.0732***	0.0572***	0.0643***	0.112***	0.0547***
	(0.00960)	(0.0116)	(0.0113)	(0.00957)	(0.0259)	(0.0116)
$*RTA_{ji,t-1}$	0.668***					
	(0.0906)					
$*\Delta Tariff_{jik,t-1}$		0.00259				
		(0.00851)				
$*Overhang_{jik,t-1}$			0.00783***			
			(0.00178)			
$*Disputes_{ji,t}$				0.0596		
				(0.0367)		
$*Disputes_{ji,t+1}$				0.371**		
				(0.145)		
$*Disputes_{ij,t}$					-0.0689**	
					(0.0278)	
$*Disputes_{ij,t-1}$					0.313***	
					(0.0654)	
$*TTB_{ij,t+1}$						0.00481***
						(0.000880)
$RTA_{ji,t-1}$	-0.00207	0.00577	0.0175	-0.00755	0.000913	-0.00258
	(0.133)	(0.133)	(0.131)	(0.133)	(0.132)	(0.134)
$Overhang * \Delta Tariff_{jik,t-1}$	-1.35e-05	-1.07e-05	-1.03e-05	-2.08e-05	-1.03e-05	-1.09e-05
	(2.70e-05)	(2.67e-05)	(2.61e-05)	(3.14e-05)	(2.67e-05)	(2.68e-05)
$\Delta Tariff_{jik,t-1}$	0.0111***	0.0112***	0.0111***	0.0117***	0.0108***	0.0112***
	(0.00249)	(0.00251)	(0.00248)	(0.00273)	(0.00260)	(0.00253)
$Overhang_{jik,t-1}$	-0.0130***	-0.0136***	-0.0137***	-0.0135***	-0.0134***	-0.0136***
	(0.00269)	(0.00267)	(0.00266)	(0.00275)	(0.00271)	(0.00268)
$Disputes_{ji,t}$	-0.255***	-0.248***	-0.262***	-0.318***	-0.334***	-0.250***
	(0.0751)	(0.0749)	(0.0751)	(0.0795)	(0.0860)	(0.0744)
$Disputes_{ji,t+1}$	0.160**	0.170***	0.177***	0.150**	0.184***	0.175***
	(0.0642)	(0.0641)	(0.0632)	(0.0697)	(0.0694)	(0.0646)
$Disputes_{ij,t}$	0.115*	0.112*	0.112*	0.134**	0.110	0.118**
	(0.0590)	(0.0590)	(0.0590)	(0.0632)	(0.0690)	(0.0590)
$Disputes_{ij,t-1}$	0.118**	0.107**	0.100**	0.0906*	0.0585	0.112**
	(0.0507)	(0.0505)	(0.0503)	(0.0514)	(0.0497)	(0.0505)
$TTB_{ij,t+1}$	0.00772***	0.00782***	0.00815***	0.00760***	0.00767***	0.00739***
	(0.00249)	(0.00248)	(0.00248)	(0.00269)	(0.00270)	(0.00248)
Observations	1,291,822	1,291,822	1,291,822	1,291,822	1,291,822	1,291,822
FE jt-it-ji-st	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	jik	jik	jik	jik	jik	jik
Pseudo-R2	0.396	0.393	0.394	0.399	0.399	0.393
LL	-36584	-36787	-36737	-36421	-36425	-36762

Note: Standard errors are in parentheses and clustered at the country-pair-hs4 sector dimension (jik), and significance levels are defined such as *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Each estimation contains both country-time (jt and it), country-pair (ji) and HS2 sector-time (st) fixed effects. The dependent variable TTB_{jikt} is the number of HS6 products on which country j launched an investigation against country i, in HS4 sector k in year t. The variable $TTB_{ij,t}$ is the total number of HS6 products targeted by country i on country j irrespective of the HS4 sector. All control variables are similar to the baseline estimation.

Table 10: Non-linearities

	Dependent variable: TTB_{jikt}			
	(1)	(2)	(3)	(4)
$TTB_{ij,t}$	-0.00845	0.105***		0.121**
	(0.0315)	(0.0216)		(0.0526)
$*Unemployment_{j,t-1}$	0.0144***			
	(0.00523)			
TTB $CAj_{ij,t}$			0.763***	
			(0.0448)	
TTB $CAi_{ij,t}$			1.059***	
			(0.178)	
Other $TTB_{j,t}$			-0.105***	
			(0.0301)	
$*$Large user$_j$				-0.0539
				(0.0537)
$*USA_j$		-0.0530**		
		(0.0248)		
$*EUN_j$		0.666***		
		(0.0882)		
$*CHN_j$		1.255***		
		(0.137)		
Observations	1,109,806	1,291,822	1,291,822	1,291,822
FE jt-it-ji-st	Yes	Yes	Yes	Yes
Cluster	jik	jik	jik	jik
Pseudo-R2	0.420	0.398	0.405	0.393
LL	-30845	-36485	-36072	-36772

Note: Standard errors are in parentheses and clustered at the country-pair-hs4 sector dimension (jik), and significance levels are defined such as *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Each estimation contains both country-time (jt and it), country-pair (ji) and HS2 sector-time (st) fixed effects. The dependent variable TTB_{jikt} is the number of HS6 products on which country j launched an investigation against country i, in HS4 sector k in year t. The variable of interest, $TTB_{ij,t}$ is the total number of HS6 products targeted by country i, on country j, irrespective of the HS4 sector, x days before any measure from country j. All other control variables are lagged by one year. In Column (3) we split the foreign measures by distinguishing those targeting a domestic or foreign comparative advantage sector, or neither of those.

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A Additional figures

Figure A1: Total number of new investigations per country

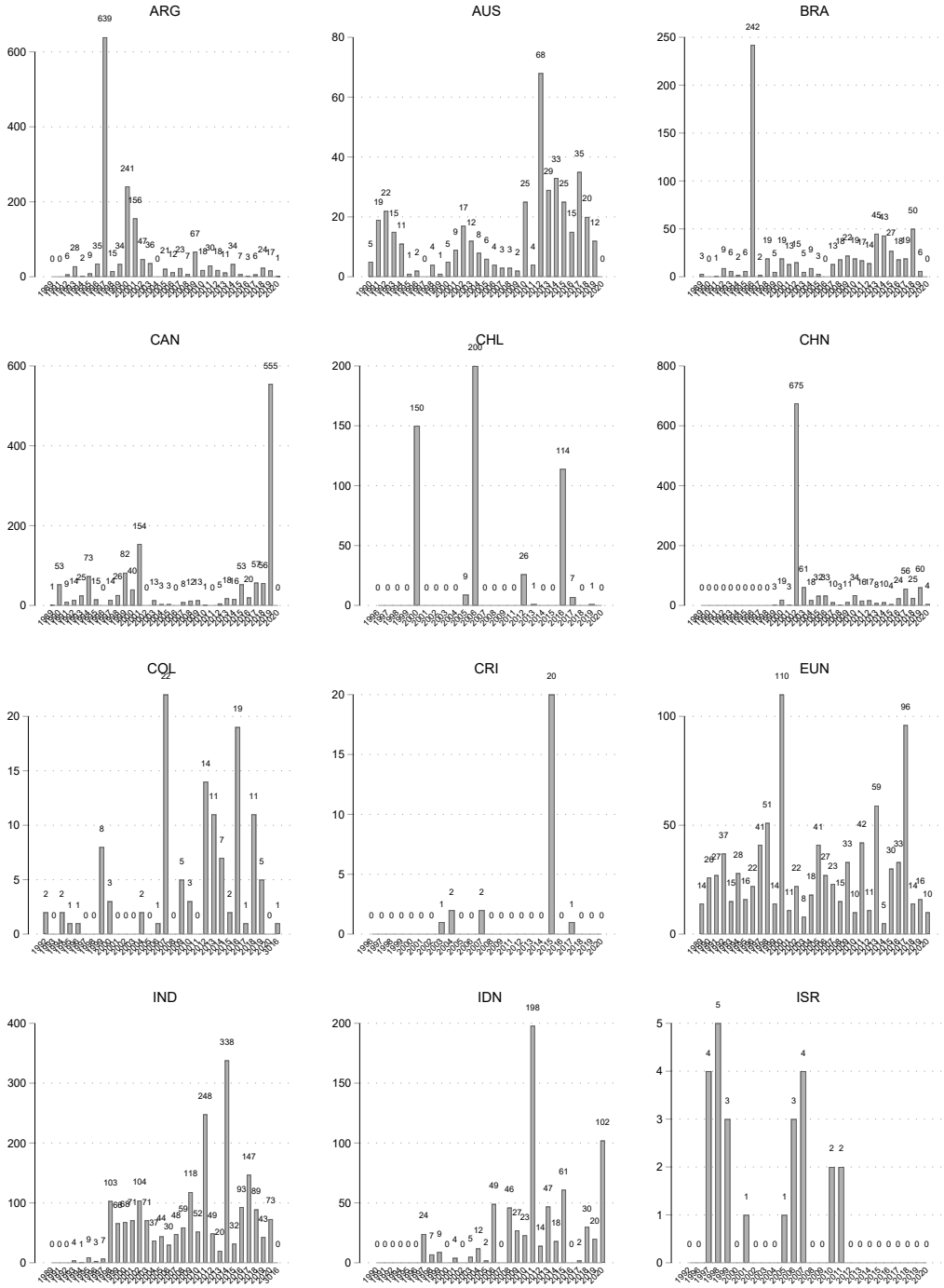


Figure A2: Total number of new investigations per country *(cont.)*

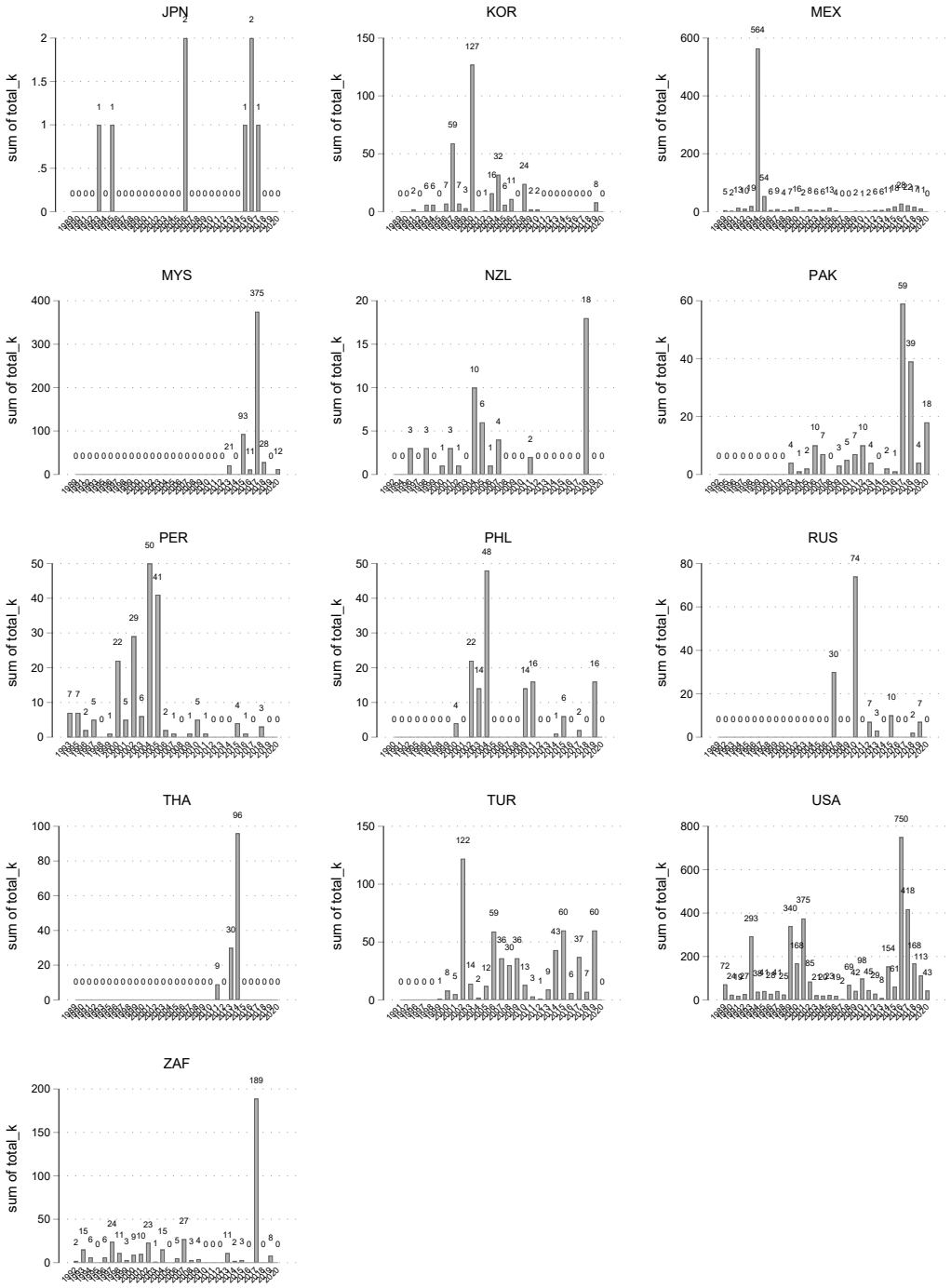
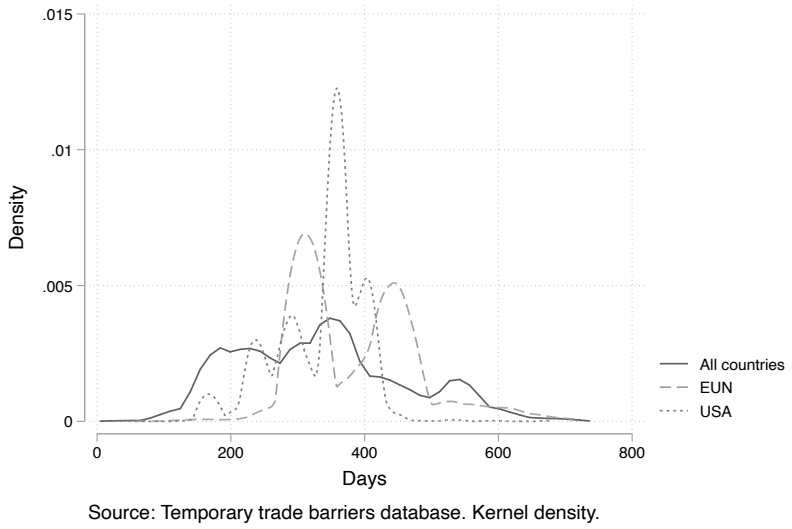


Figure A3: Average duration of a TTB investigation



Note: Average duration of a TTB investigation computed over all countries in our sample. All investigations are considered, including those where no injury was found by the trade authority.

Figure A4: Number of days before investigation

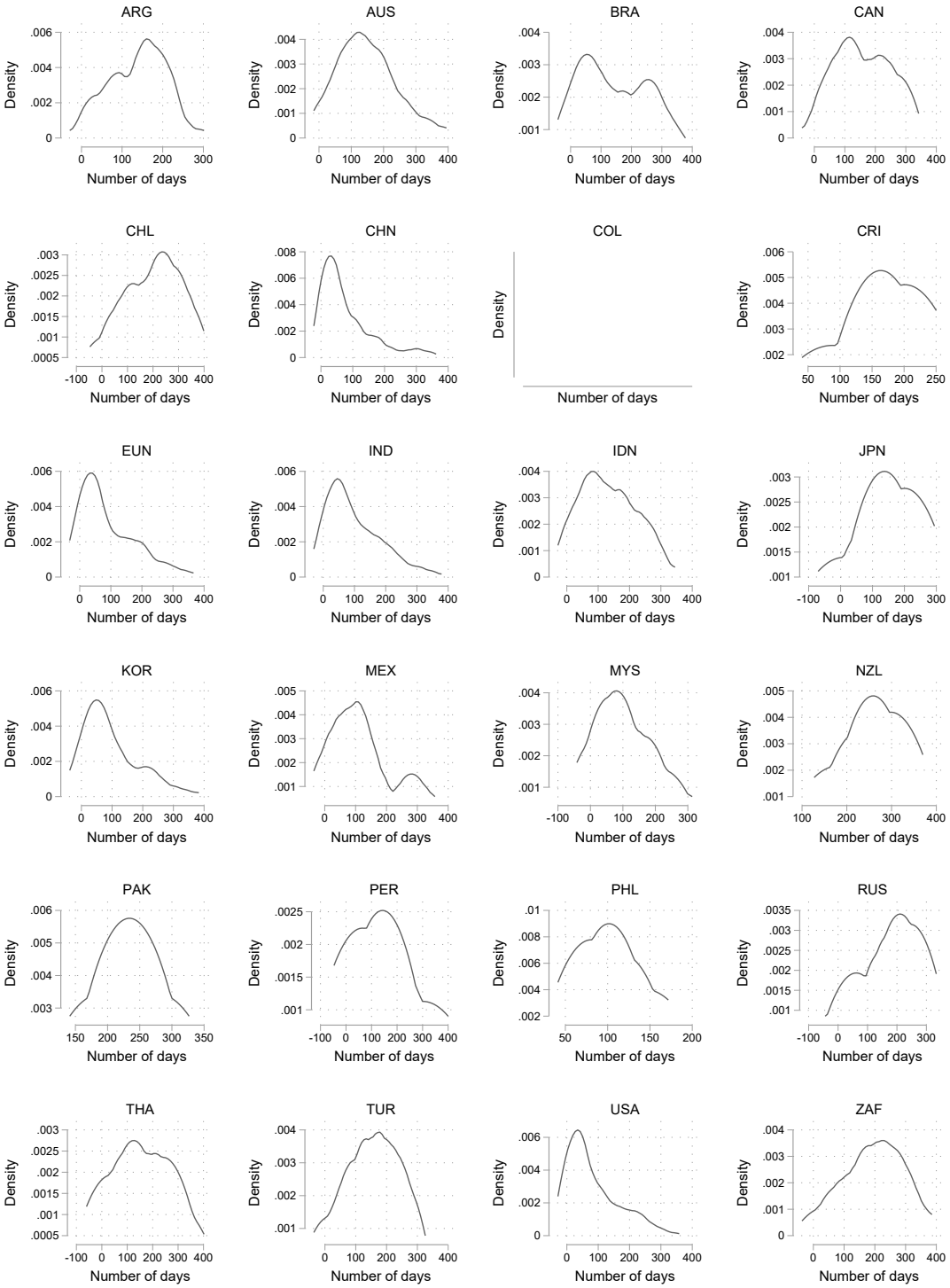
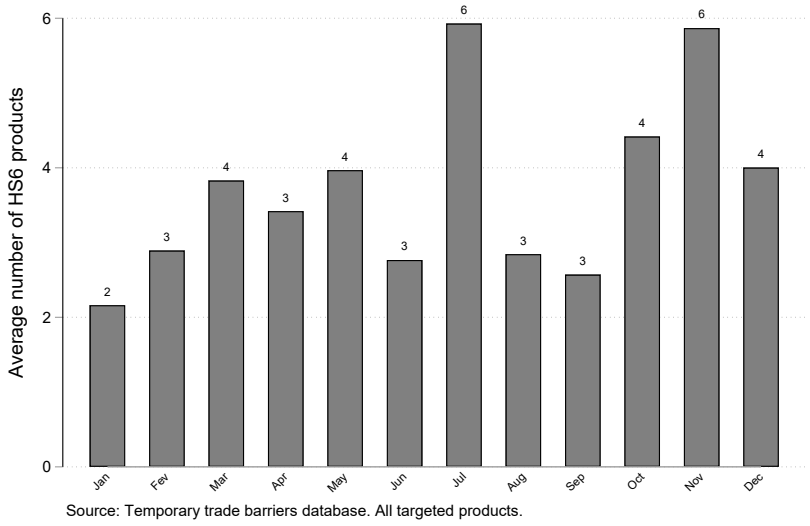
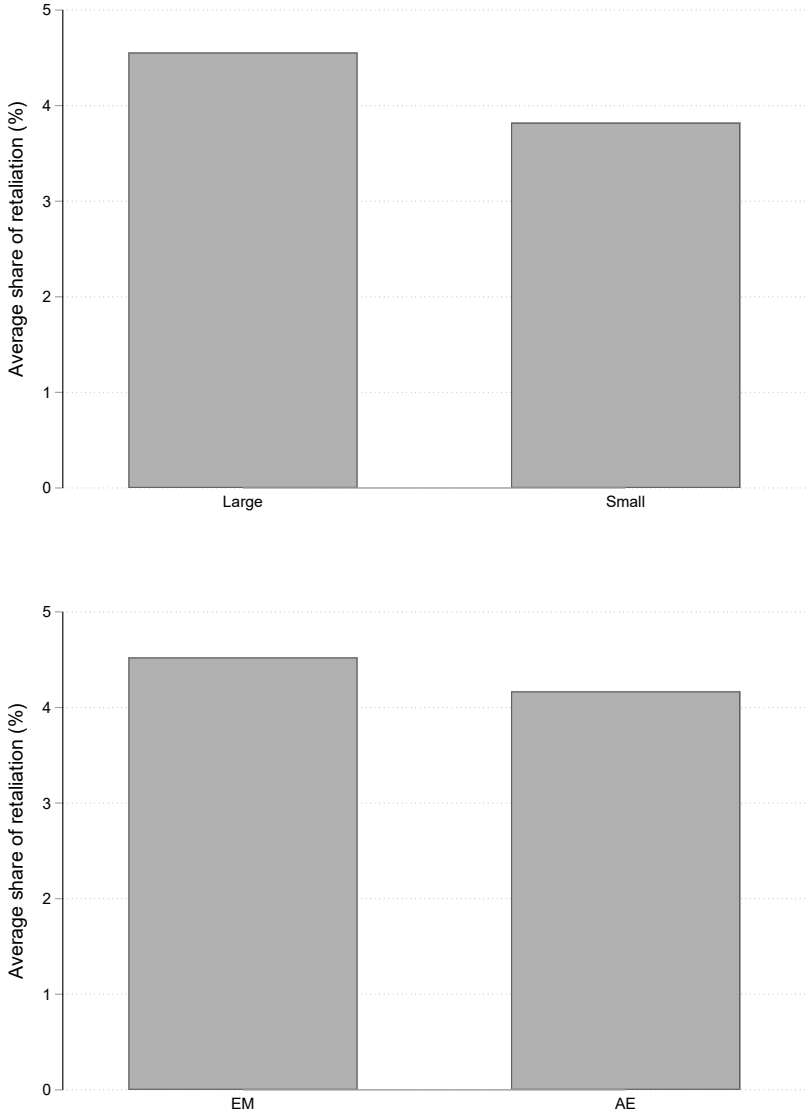


Figure A5: Average number of TTBs per month



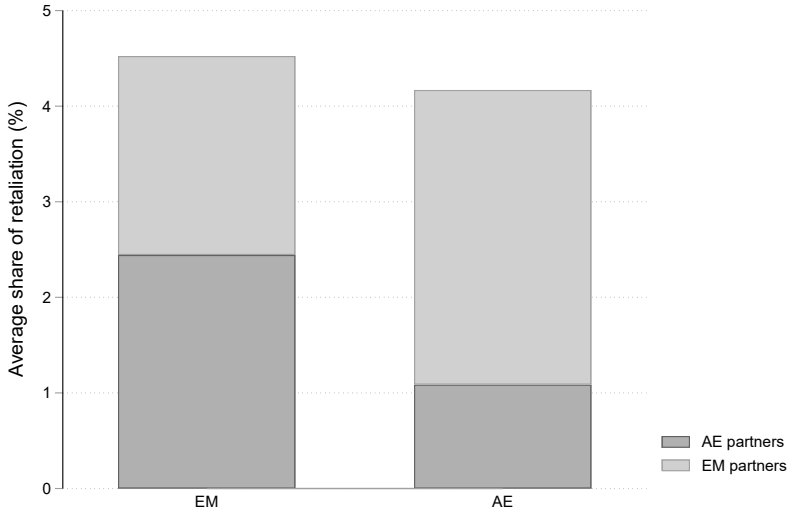
Note: The figure plots the average number of HS6 products targeted by a TTBs in our sample. Two thirds of them are implemented from June to December.

Figure A6: Share of retaliatory measures across countries



Note: The figure plots the distribution of the average share of retaliation. We compute for each country the share of TTB identified as potential retaliation out of the total number of new TTB. Large (small) importers defined as those with average imports above sample median. AE (EM) grouping is based on IMF classification.

Figure A7: Share of retaliatory measures across partners



Note: The figure plots the distribution of the average share of retaliation. We compute for each country the share of investigations identified as potential retaliation out of the total number of new investigations. Large (small) importers defined as those with average imports above sample median. AE (EM) grouping is based on IMF classification.

B Additional tables

Table B1: List of countries in the sample

Country	
Argentina	Mexico
Australia	Malaysia
Brazil	New Zealand
Canada	Pakistan
Chile	Peru
China	Philippines
Colombia	Russia
Costa Rica	Thailand
European Union	Turkey
Indonesia	Taiwan
India	United States
Israel	Venezuela
Japan	South Africa
Korea	

Table B2: Total number of investigations per HS2 sector

HS2	Sector	Nber of investigations	Largest investigator
1	Animals; live	USA	3
		MEX	3
2	Meat and edible meat offal	USA	54
3	Fish and crustaceans, molluscs...	EUN	16
4	Edible products of animal origin	CHL	350
5	Animal originated products	CHN	3
6	Trees and other plants, live	USA	1
7	Vegetables and certain roots and tubers; edible	KOR	100
8	Fruit and nuts, edible; peel of citrus fruit or melons	BRA	17
9	Coffee, tea, mate and spices		0
10	Cereals	CRI	20
11	Products of the milling industry; malt, starches, inulin, wheat gluten	CHL	39
12	Oil seeds and oleaginous fruits; miscellaneous grains, seeds and fruit		0
13	Lac; gums, resins and other vegetable saps and extracts	ARG	1
14	Vegetable plaiting materials		0
15	Animal or vegetable fats and oils and their cleavage product	PER	19
16	Meat, fish or crustaceans, molluscs; preparations thereof	USA	10
17	Sugars and sugar confectionery	CHN	50
18	Cocoa and cocoa preparations		0
19	Preparations of cereals, flour, starch or milk; pastrycooks' products	KOR	25
20	Preparations of vegetables, fruit, nuts or other parts of plants	ARG	26
21	Miscellaneous edible preparations	USA	9
22	Beverages, spirits and vinegar	EUN	8
23	Food industries, residues and wastes thereof; prepared animal fodder	ZAF	14
24	Tobacco and manufactured tobacco substitutes	AUS	1
25	Salt; sulphur; earths, stone; plastering materials, lime and cement	PHL	30
26	Ores, slag and ash	USA	2
27	Mineral fuels, mineral oils and products of their distillation	EUN	14
28	Inorganic chemicals; compounds of precious or rare metals	IND	211
29	Organic chemicals	IND	610
30	Pharmaceutical products	CAN	5
		AUS	5
31	Fertilizers	EUN	22
32	Tannins, dyes, pigments, inks and other colouring matter;	USA	16
33	Essential oils and resinoids		0
34	Soap, organic surface-active agents	PAK	5
35	Albuminoidal substances; modified starches; glues; enzymes	USA	3
36	Explosives; pyrotechnic products; matches; pyrophoric alloys	TUR	11
37	Photographic or cinematographic goods	IND	32
38	Chemical products n.e.c.	IND	133
39	Plastics and articles thereof	IND	156
40	Rubber and articles thereof	USA	76
41	Raw hides and skins (other than furskins) and leather	AUS	4
42	Articles of leather; travel goods, handbags and similar containers	TUR	9
43	Furskins and artificial fur; manufactures thereof		0
44	Wood and articles of wood; wood charcoal	USA	57
45	Cork and articles of cork		0
46	Manufactures of straw, esparto; basketware and wickerwork	USA	4
47	Pulp of wood or other fibrous cellulosic material		0
48	Paper and paperboard	USA	142

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Table B2 – *Continued from previous page*

HS2	Sector	Nber of investigations	Largest investigator
49	Products of the printing industry	MEX	1
50	Silk	IND	5
51	Wool, fine or coarse animal hair	ARG	15
52	Cotton	IDN	160
53	Vegetable textile fibres; paper yarn	MEX	11
54	Man-made filaments, textile materials	TUR	206
55	Man-made staple fibres	EUN	65
56	Wadding, felt and nonwovens, twine, cordage, ropes and cables	IND	14
57	Carpets and other textile floor coverings	CAN	3
58	Fabrics	USA	21
59	Textile fabrics	USA	14
60	Fabrics; knitted or crocheted	TUR	8
61	Apparel and clothing accessories; knitted or crocheted	MEX	17
62	Apparel and clothing accessories; not knitted or crocheted	USA	32
63	Textiles, made up articles	IDN	58
64	Footwear; gaiters and the like; parts of such articles	ARG	871
65	Headgear and parts thereof	USA	1
66	Umbrellas, sticks, whips		0
67	Feathers and down, prepared		0
68	Stone, plaster, cement, asbestos	IND	20
69	Ceramic products	IDN	81
70	Glass and glassware	PHL	53
71	Natural, cultured pearls; precious, semi-precious stones and metals		0
72	Iron and steel	USA	3565
73	Iron or steel articles	USA	484
74	Copper and articles thereof	IND	20
75	Nickel and articles thereof		0
76	Aluminium and articles thereof	AUS	35
78	Lead and articles thereof		0
79	Zinc and articles thereof	EUN	4
79		KOR	4
80	Tin; articles thereof	CAN	1
80		MEX	1
81	Metals; n.e.c., cermets and articles thereof	USA	33
82	Tools, implements, cutlery, spoons and forks, of base metal	ARG	50
83	Metal; miscellaneous products of base metal	EUN	9
		MEX	9
		USA	9
84	Nuclear reactors, boilers, machinery and mechanical appliances	USA	237
85	Electrical machinery and equipment	MEX	161
86	Railway, tramway locomotives, rolling-stock	USA	4
87	Vehicles; other than railway or tramway rolling stock	ARG	71
88	Aircraft, spacecraft and parts thereof	USA	8
89	Ships, boats and floating structures		0
90	Optical, photographic, cinematographic, medical instruments	USA	27
91	Clocks and watches and parts thereof	EUN	2
92	Musical instruments; parts and accessories of such articles	USA	1
93	Arms and ammunition; parts and accessories thereof	CAN	2
94	Furniture	USA	37
95	Toys, games and sports requisites	BRA	241
96	Miscellaneous manufactured articles	TUR	27
97	Works of art; collectors' pieces and antiques		0

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Table B2 – *Continued from previous page*

HS2	Sector	Nber of investigations	Largest investigator
99	Commodities not specified according to kind	USA	3
		IND	3