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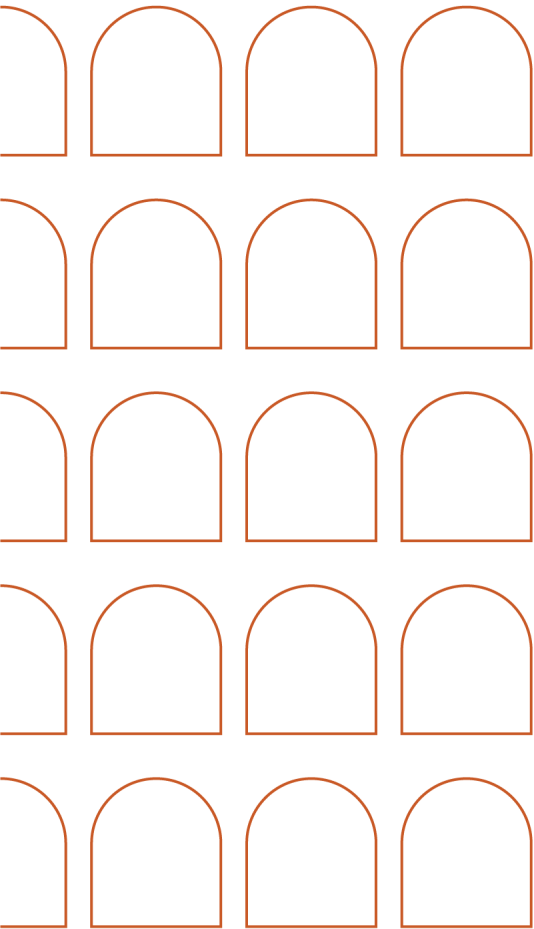
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RSC 2023/26  
Robert Schuman Centre for Advanced Studies  
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# WORKING PAPER

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Julien Gourdon, Karin Gourdon, Jaime de Melo

European University Institute  
**Robert Schuman Centre for Advanced Studies**  
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## **Abstract**

Rules of Origin (RoO) are critical components of Preferential Trade Agreements (PTAs). They are designed to stop products coming into a PTA through the partner that applies the lowest tariff – a phenomenon known as trade deflection. While RoO are necessary, complex RoO may undo the benefits of trade agreements. Using a novel database of RoO, this paper evaluates the incidence and restrictiveness of different types of Product-Specific Rules of Origin (PSRs) across 128 reciprocal PTAs for the period 1990 - 2015. Results, based on a structural gravity model controlling for confounding factors, display wide heterogeneity across different categories of PSRs attached to preferential margins, with more flexible PSRs associated with a significantly stronger trade effect compared to more restrictive ones where exporters do not have a choice among PSRs or have to satisfy multiple PSRs. A simulation exercise reveals that a radical simplification reform leading to the adoption of flexible PSRs providing alternative choices to prove origin would have increased global trade under PTAs on average by between 2.7 and 4 percent during the sample period.

## **JEL classification**

F1, F14, F15

## **Keywords**

Rules of origin, Product-specific rules of origin, Regime-wide rules of origin, compliance costs

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## 1. Introduction

Preferential Trade Agreements (PTAs) require Rules of Origin (RoO) to establish the conditions products must meet to be eligible for preferential market access to prevent transshipment of products across partners with low tariffs in which there is negligible regional content (e.g. repackaging). These RoO are almost invariably product-specific rules (PSR). They vary across partners for the same product with countries often engaged in multiple PTAs with the same partner, adding to the compliance costs of meeting origin requirements to benefit from preferential access.<sup>1</sup> In practice, as documented in the literature, RoO are a nightmare for producers and customs officials alike and may undercut the objective of stimulating trade flows among PTA partners.<sup>2</sup> Some observers describe the result as giving preferences with one hand and taking them away with the other through RoO.<sup>3</sup> Observers have advocated reforms, ranging from simplification to outright elimination of RoO.<sup>4</sup>

The proliferation of PTAs has created a situation reminiscent of the rise in non-tariff barriers (NTBs) following the reduction in tariffs negotiated under the GATT rounds of multilateral tariff reductions. Noguès, Olechowski and Winters (1986) were the first to systematically document the rise, extent, and diversity in NTBs across industrial countries' imports. As in Noguès et al. (1986), our interest is in moving the international community towards liberalization [simplification] of such restrictions. We draw on the World Bank Deep Trade Agreements (DTA) database that collects information on 172<sup>5</sup> PTAs covering 181 exporter/importer country pairs for the period 1990-2015. The DTA data base does not cover all preferences – non-reciprocal preference schemes are excluded – and important information is missing, notably Preference Utilization Rates (PURs). As in Noguès et al. (1986), our first objective is to inform on the landscape of PSRs across a large number of PTAs. Our second objective is to try to detect the impact of PSRs on bilateral trade flows.<sup>6</sup> This exercise is exploratory because of the lack of data on PURs. The lack of systematic data on PURs imposes challenges on the evaluation of the effects of PSRs as they cannot be directly associated with the corresponding amount of trade realized under a specific PTA.<sup>7</sup> Hence the “(more)” in the paper's title.

We use gravity estimation at the detailed HS6-product level where PSRs apply to compare trade flows between PTA partners and nonmembers. Controlling for the level of preferential margins, our estimates show that rules allowing choice between alternatives of rules have the strongest positive impact on trade value. On the other hand, adopting stricter rules like imposing combinations of different rules annihilate the positive trade effect of granting preferential tariffs. Simulation-based estimates suggest that a simplification of PSRs would be associated with larger bilateral trade flows at the product level. A simulation of a radical simplification reform that leads to the adoption of flexible rules (i.e. choice of PSRs) increases global trade under PTA by between 2.7 and 4 percent on average during the sample period.

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1 For example, consider a Vietnamese producer wishing to export cotton shirts (HS 6205.20.00) to Japan. The options available for the producer are (i) entering under MFN (and paying a 7.4% tariff) or (ii) using one of four reciprocal FTAs or (iii) entering under GSP with Japan and benefit from preferential tariffs conditional on complying with the PSRs and RWRs attached to the agreements (see Gourdon et al. 2021, figure 1). Choosing the most suitable (least cost) option involves search costs and implementation costs of those different PSRs. Conceptually, the choice is easy to make: if these costs are less than the corresponding tariff reduction, also called preferential margin (defined as the difference between the MFN tariff and the preferential tariff), the exporter should choose to declare her exports under the preferential regime.

2 Estevadeordal (2000) and Estevadeordal and Suominen (2006) were the first to document the complexity of RoO, distinguishing between Regime Wide Rules (RWRs) and Product-Specific Rules (PSRs). Inama (2022) discusses PSRs in detail. For an overview of RoO across PTAs see ITC (2022).

3 Recent surveys include Abreu (2016) and Kniahin and Melo (2022).

4 Early on, Llyod (1993) proposed modifying the traditional assignment of a trade flow to a single country to one where assignment would be in proportion to the share of value-added originating in that country, resulting in multi-country RoO, with efficiency advantages over single-country rules. Cadot and Melo (2008) proposed elimination of RoO requirements for 'nuisance tariffs' and a simplification in criteria. Hoekman and Inama (2018) observed some convergence across non-preferential RoO and argue for PTA members to agree on equivalence regimes for RoO. Mavroidis and Vermulst (2018) argued for abolition.

5 In our final sample, we keep 128 PTAs out of the 172 PTAs in the raw data base.

6 Lack of data on PURs excludes estimates of PSRs on PURs. Kniahin and Melo (2022) review the evidence on preference utilization.

7 PURs are only available for some years for PTAs involving the EU, US, Japan and Canada. For other PTAs, trade flows are not available by type of registration (MFN or a specific PTA).

The remainder of the paper is organized as follows. Section 2 classifies different PSRs across 128 reciprocal PTAs covered in the paper explaining assumptions used to classify them in sufficiently broad categories to be amenable to statistical analysis. Section 3 presents the final dataset and descriptive statistics. Section 4 presents the gravity results. Section 5 provides supplementary estimates. Section 6 reports simulation estimates of the effects of a move towards simpler PSRs. Section 7 concludes.

## 2. Classification of PSRs

This section presents the classification of seven categories of PSRs for empirical analysis. It furthermore describes the calculation of tariff reductions approximated by preferential margins and the final dataset. To explore the role of different Product-Specific Rules (PSRs) of origin on bilateral trade, we draw on three datasets: (i) bilateral trade flows from CEPII's BACI database; (ii) on tariffs from World Integrated Trade Solutions (WITS) database to derive preferential margins; (iii) information about PSRs in PTAs from the World Bank Deep Trade Agreement (WB DTA) database (see questionnaire for classification in Annex A3 "Categorizing PSRs"). Neither WITS nor CEPII data bases register trade flows by type of regime used, i.e. MFN or some (to be specified) preferential regime. This is a major shortcoming in evaluating the effects of RoO since one cannot compute preference-utilisation rates.<sup>8</sup>

Two databases cover PSRs across PTAs. ITC's Rule of Origin Facilitator (ROF) covers 370 PTAs, both reciprocal and non-reciprocal.<sup>9</sup> The ROF database is the most comprehensive but the data cannot be downloaded. The Deep Trade Agreement database is also comprehensive in terms of PTA coverage (159 PTAs for PSR, 280 PTAs for RWR) across reciprocal PTAs. It is available to the public and is the source for the PSRs used in this paper.

We use the Deep Trade Agreement (DTA) database (Angeli et al. 2020).<sup>10</sup> The DTA classifies RoO under two categories: regime-wide rules (RWRs) and product-specific rules of origin (PSRs). RWRs cover general conditions for qualification under the preferential regimes as well as certification requirements. While both general conditions and certification requirements vary across PTAs, differences across RWRs are much less than for PSRs. We focus only on the impact of PSRs which, unlike RWRs, are non-overlapping at the product-country-PTA level, whereas the RWRs are not unique at the HS-level. Hence it is difficult to compare two sets of RWRs as the selected criteria often have little overlap. Non-overlap in PSRs is important since the objective is to use observed trade flows at the same HS6 level under different PSRs to estimate differences in compliance costs across PSRs.

PSRs are defined at the HS6 tariff level. As the Harmonized System (HS) was not designed to confer origin, methods for determining sufficient processing or substantial transformation of a product differ across the universe of PTAs. This complicates the task of PSR classification.<sup>11</sup> Figure 1a describes the two types of criteria used to identify origin and how they are mapped into the 7 non-overlapping PSR categories defined in Figure 1b.<sup>12</sup>

8 The US, EU, Canada, Australia record transactions according to import regime. This data is publicly available. In recent years, grantors of GSP and other non-reciprocal schemes are required to transmit utilization rates to the WTO to help assess the associated RoO. However, this data is not public. See Crivelli et al (2021) for the use of this data to flag origin requirements that might be up for modification.

9 This data base can be consulted with a search engine to download texts agreements, consult differences between MFN and preferential rates, RWRs and PSRs to help firms choose the best regime in its export decisions. See <https://mag.wcoomd.org/magazine/wco-news-87/rules-of-origin-facilitator/>

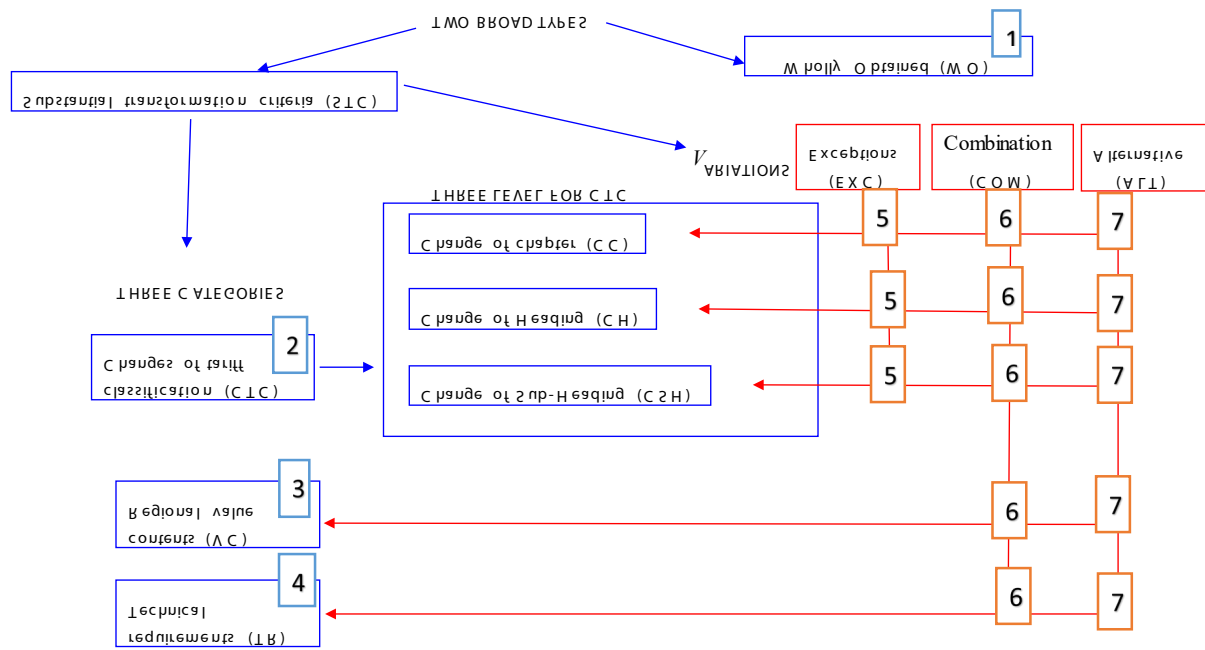
10 Mattoo et al. (2020) and Breinlich et al. (2022) give overviews of Deep Trade Agreements but do not delve into the classification of PSRs

11 Gourdon et al. (2021) use the ITC Rules of Origin Facilitator to identify some 1600 different categories of PSRs across PTAs.

12 The data were obtained from an administered questionnaire requesting categorization into 17 mutually exclusive PSR categories. Angeli et al. (2020) give details about the translation of answers (mostly YES/NO) into 17 PSR categories.



**Figure 1 (a): Mapping of types and construction of PSR categories**



**Figure 1 (b) Construction of seven groups of mutually exclusive PSR categories**

<u>4 stand-alone rules:</u>	<u>3 composite rules:</u>
<ul style="list-style-type: none"> <li>• WO: wholly obtained (1)</li> <li>• CTC: change in tariff classification (2)</li> <li>• VCR: value content (3)</li> <li>• TR: technical requirement (4)</li> </ul>	<ul style="list-style-type: none"> <li>• EXC: Any rule with a CTC and an exception [5]</li> <li>• COM: rules with combination ('and') criteria (without exception in CTC) [6]</li> <li>• ALT: rules with alternative ('or') criteria (without exception in CTC) [7]</li> </ul>

Notes: Numbering in parenthesis relates to the PSR category defined in Figure 1a.

Source: Figure 1a is based on Gourdon et al. (2021) and Cadot and Ing (2016). Figure 1b: Authors' classification.

The Wholly Obtained (WO) criterion is self-explanatory: all materials entering production of the final good must originate, i.e. must come, from PTA members. The Substantial transformation criterion (STC) specifies that the country of origin is the country where the last substantial transformation took place, and this transformation must be sufficient to give its essential character to a commodity. STC is further identified by three additional rules: (i) Change of Tariff Classification (CTC) at three levels (chapter, heading and subheading); Value Content Requirement (VCR), and a Technical Requirement (TR). Under the Value Content (VC) rule, the exported good must reach a threshold percentage value of locally or regionally (i.e. among PTA members) produced inputs. In our sample, a percentage value is reported for about 60% of PSRs with a VC. About a quarter of VCs with available values require a VC of 40% with the rest being about equally distributed below and above this value. In some comparisons, we break down VCs in three categories, below or equal to 40% and above 40%. A technical requirement (TR) rule requires an exported good to have undergone specified manufacturing or processing operations, such as a chemical reaction, which are deemed to confer origin of the country in which they were carried out.

The STC criterion is also implemented by composite alternatives (variations on the right-hand side of figure 1b) First, the three STC categories are used in existing trade agreements as stand-alone or in combination with other rules (COM), or as alternative rules (ALT). Second, exceptions (EXC) can be attached to a particular CTC rule, generally prohibiting the use of non-originating materials from a particular HS subheading, heading, or chapter for goods supposed to qualify via a CTC.

Figure 1b lists the seven mutually exclusive categories we designed for this exploration.<sup>13</sup> This reflects decisions not to disaggregate CTC according to sub-levels and to group all types of combinations into one group (COM), all types of alternatives into one group (ALT), and all rules with an exception to CTC into one group (EXC). These 7 categories are entered separately in the regressions reported in section 4.

This classification of categories is close to the one followed by Ayele et al. (2023) for the construction of their ROO restrictiveness index (ROO-RI) in their examination of the determinants of preference utilization in the post-Brexit Trade Cooperation (BTC) agreement with the EU, but it is less detailed. Also, we refrain from assigning an ordinal index to each category, preferring to keep comparisons by broad groups of PSRs across the large sample of FTAs. Taking this broader categorization of rules also makes it easier to carry out simulations of changes in PSRs since reforms would take place at the level of broad categories (e.g. a change to CTC or to VCR).

## 2.1 Ranking PSRs by degree of restrictiveness

Overlapping membership in PTAs complicates the exporter's decision whether to apply for preferential status. Put simply, if the preferential margin for an HS product is less than the compliance cost that must be added to unit production costs, it is not profitable for a firm to file for preferences. Assuming the exporter knows all opportunities and RoO associated with each one, observing which option was selected when filing at customs would be an indicator of the least-cost option and an indication that choosing preferential access is less costly than exporting under MFN status.<sup>14</sup>

Unfortunately, data on utilization of preferences required to assess the restrictiveness of RoO are limited. Only a few countries publish trade statistics according to the trade regime requested by exporters.<sup>15</sup> Thus, data on PURs are rarely available even at the aggregate (annual) flow level. Data at the transaction level, needed to disentangle fixed from variable costs, are only available in a few instances.<sup>16</sup> Even if PURs are available, positive PURs are only suggestive that preferential margins are greater than compliance costs given that firms have different production costs, may produce multiple products, and prices will deviate from production costs under imperfect competition.<sup>17</sup>

The literature attempts to rank PSRs using an observation rule inspired from Estevadeordal's (2000) restrictiveness index ("R-index") as, for example, Ayele et al. (2023) with their constructed ROO Restrictiveness Index (ROO-RI). To facilitate comparison across PSRs, we decide to classify most categories as stand-alone rules. Composite rules – that are more difficult to evaluate since they involve several PSRs – are chosen to be fairly distinct (e.g. alternative rules (ALT) are presumably less restrictive than combination (COM) rules).

<sup>13</sup> The annex in the discussion paper version gives the mapping from the 17 categories in Angeli et al. (2020) into the 7 categories in Figure 1b.

<sup>14</sup> Compliance includes fixed (administrative) and variable (related to volume and frequency of transactions) costs. The variable transaction costs include a distortionary (regional value content minima) and a rent-sharing component between the exporter of intermediate goods and the captive downstream producer when the exporter charges a higher price for captive downstream producers. Kniahin and Melo (2022) discuss this decomposition formula. Estimates of compliance costs from threshold (and other) techniques applied to data at the sector level for NAFTA, suggest compliance costs in the 3% to 5% range (Francois et al. 2006, Carrère and Melo 2006).

<sup>15</sup> Australia, Canada, the European Union, Japan and the United States report PURs by HS category under different PTAs.

<sup>16</sup> Nilsson (2016) and Kasteng and Inama (2018) estimate that about two-thirds of EU exporters use tariff-free access in their exports to partners while partners use preferences for over 90% of their exports to the EU. Using data on PURs for the EU, Crivelli et al. (2021) identify products with PURs below 70% and preference margins above 2 percent.

<sup>17</sup> Hayakawa et al. (2019) estimate a fixed-cost ratio of PURs for Japan's PTAs. They develop a shortcut method relying only on import data by tariff schemes. Considering that fixed-cost ratios are higher for products using more inputs, they estimate that Japan's imports from PTA partners under preferential status requires 8-10% additional fixed costs.

Despite these efforts at clarity, as discussed below, one can only be sure of restrictiveness for different values of value-content percentages at the firm level (when percentages are available) and for one classification among stand-alone rules, the CTC (with no exceptions attached): A change of chapter (CC) has higher compliance costs than a change of heading (CH), itself easier to satisfy than a change of subheading (CS), i.e.  $CS \leq CH \leq CC$  across CTC categories. Ranking other PSRs is ambiguous given heterogeneity in firm costs within an HS6 category. Expected rankings of compliance costs are discussed in the results section.

## 2.2 Approximation of applied tariff reductions by preferential margins

Virtually all reciprocal PTAs are FTAs. For our final sample, WITS, the data source for tariffs does not report preferential tariffs for 63% of the tariff lines, forcing us to impute the MFN tariff for the preferential margin, an assumption also adopted in other studies.<sup>18</sup> In our large sample, this simplification will, in some instances, at least, result in an over-estimate of the preferential margin. Two characteristics prevail in negotiations of tariff reductions when confronting bilateral trade flows with estimates of bilateral tariffs. First, the reduction of applied bilateral tariffs is over a period, often 10 years, with a large chunk of tariff reductions taking place at the end of the period. Espitia et al. (2020) report national tariff line level data for 2016 covering 97% of world trade at the HS6 level. Second, as detailed in annex “A2. Descriptive Statistics”, they report that only 5.5% of imports under PTAs are subject to positive tariffs but that nearly one quarter of tariff lines with MFN tariffs over 15% are excluded from preferential liberalization. As a result, in some cases, our approach will overestimate actual preferential margins.

## 3. The PSR Landscape

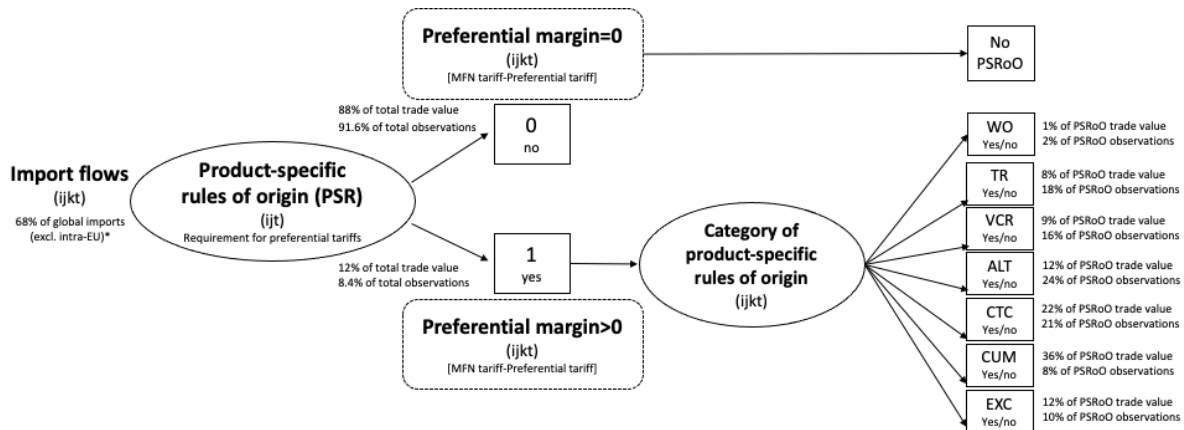
Table A1 in annex “A1. Dataset preparation” describes the seven steps taken to prepare the sample for the descriptive statistics and econometric estimates. First, excluding countries with low export values removes small countries (e.g. small islands) below the 25<sup>th</sup> percentile. Second, the sample excludes exporting countries (*ijk*) that sold a certain product to a certain country for less than six years within the sample period to omit occasional exports (in the spirit of Fontagné et al., 2015). Third, we restrict the panel period to six 5-years intervals starting in 1990 to let trade flows enough time to adjust to changes in trade policies, as suggested by Treffer (2004), Baier and Bergstrand (2007) and Anderson and Yotov (2016). Fourth, we exclude trade flows below 1,000 USD. These small flows make up only 0.003% of total sample trade value but represent 13.5% of total sampling observations. Fifth, we drop observations for which MFN tariffs are already zero prior to the implementation of the PTA. In these cases, preferences are void. Sixth, we exclude observations that are part of PTAs but without PSR, hence, without preferential treatment. The final data sample represents around 68% of global imports (excluding intra-EU trade) on average across years (Annex “A2. Descriptive Statistics”, table A2).

Figure 2 describes the structure of the final dataset. The data covers import flows at the exporter-importer-product-year (*ijkt*)-level which either are outside of a PTA and hence have no option to obtain a preferential tariff (on average 88% of total trade value and 91.6% of total observations), or are part of an RTA and therefore can obtain a preferential tariff (on average 12% of total trade value and 8.4% of total observations) when the origin requirements (PSRs) are fulfilled. Important to note, the preferential margin is above zero percent only for observations with a PSR while it is zero for the control group, this means without PSR (no PTAs). As described in the section on approximating preferential margins, we excluded all zero MFN tariffs for observations with a PSR and define zero preferential tariffs for observations with a PSR.

<sup>18</sup> See e.g. Cadot et al. (2008) and Conconi et al. (2018).

Within the PSR category, the lowest share of trade value (1%) and observations (2%) are reported for the WO requirement. TR, VCR, ALT and EXC have relatively low shares in observations compared to their shares in trade value. This suggests that these rules are mostly present in low-value products. The contrary is found for the COM category which reports 36% of trade value but only 8% of observations, suggesting that this rule is mainly present for high-value traded goods.

**Figure 2: Final data structure**



Notes: in *ijkt*, *i* stands for exporter, *j* importer, *k* HS6-product, *t* panel year. \*indicates the average across all sample years. PSR categories: WO = wholly obtained; TR = technical requirement; VCR = value content requirement; ALT = alternative ('or'); CTC = change in tariff classification; COM = combination ('and'); EXC = exception.

Source: Authors.

Figure 3 shows the number of PTAs over the panel for six 5-year periods with the composition across the 7 categories of PSRs. For each year, the panel is obtained by omitting trade flows less than \$1000 and export values below the 25<sup>th</sup> percentile. We also drop observations for which MFN tariffs are already zero prior to the implementation of the PTA. The final data sample represents around 68% of global imports (excluding intra-EU trade) on average across years. This is the data set used in the results reported in sections 4 and 5.

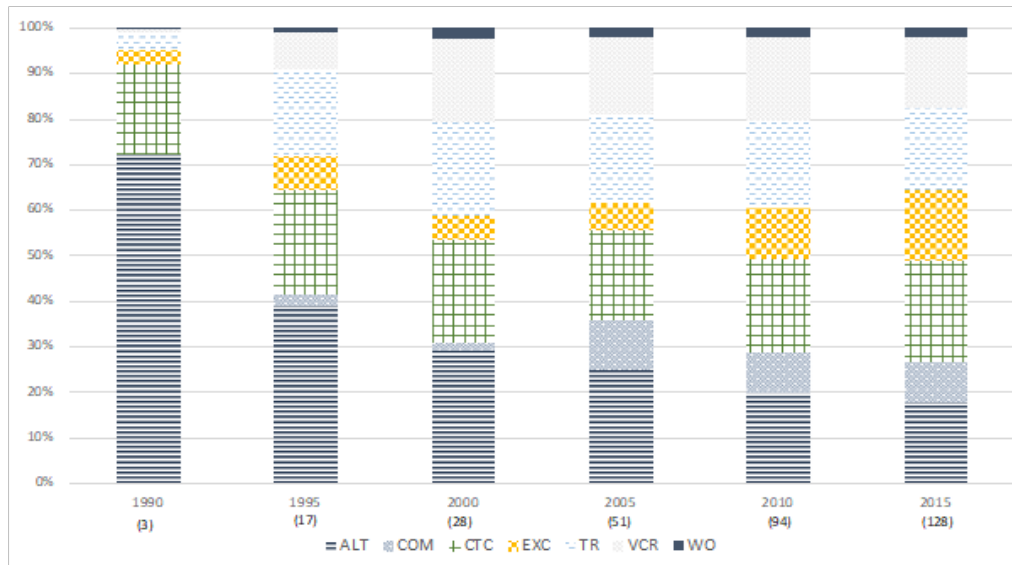
Across the panel, within the PSR category, the lowest share of trade value (1%) and observations (2%) are reported for the WO requirement. TR, VCR, ALT and EXC have relatively low shares in observations compared to their shares in trade value. This suggests that these rules are mostly present in low-value products. The opposite holds for the COM category which reports 36% of trade value but only 8% of observations, suggesting that this rule is mainly present for high-value traded goods.

During the 1995-2015 period the following shifts in the distribution on PSRs are observed:

- (i) the share of flexible rules (ALT) diminished by one half;
- (ii) the share of value content requirements (VCR) doubled;
- (iii) the share of technical requirements (TR) and exceptions (EXC) fell;
- (iv) the share of wholly obtained (WO) remained constant.

Overall, except for WO which is by far the least used PSR (about 10% of the other categories), the distribution of PSRs is fairly evenly distributed around the other categories. Prima facie, these observations over the period 1995-2015 suggest two opposite trends since, (i) is an indication of a shift towards more restrictiveness while (iii) suggests a shift towards less restrictive rules. (see Annex "A3. Categorizing PSRs" in figure A5 for distribution of PSRs by trade value).

**Figure 3: Composition of PSR categories over the sample period**

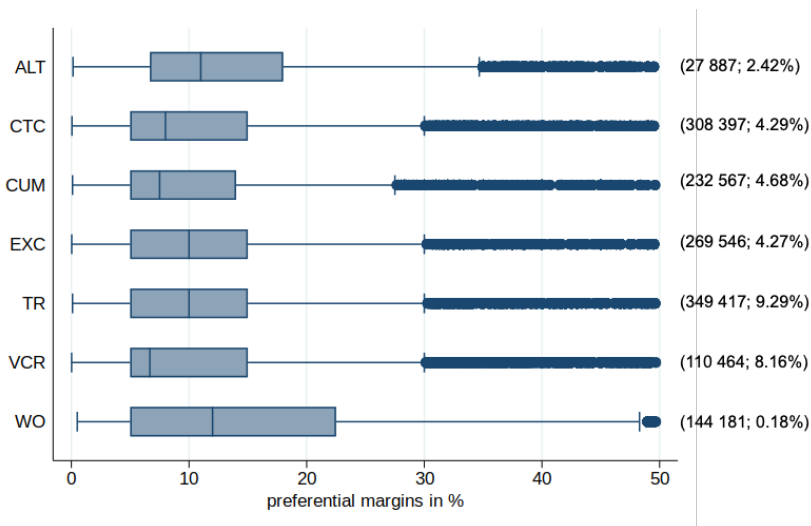


Notes: Average number of PTAs in parenthesis below year.

Source: Authors.

Figure 4 reports the distributions of preference margins across all seven PSR categories. Please note that we assume full liberalization so that our preferential tariff is zero, hence the preference margin equals the MFN tariff.<sup>19</sup> About half of the observations are in the 5%-15% margin across all PSR categories.<sup>20</sup> The TR and VCR categories are the most dispersed while the WO and ALT categories are the least dispersed.

**Figure 4: Boxplots of preferential margins (in %) by PSR category (all years).**



Notes: Total number of observations over the six 5-year periods and share of outliers in parentheses. Preferential margins above 50% are excluded (1.2% of observations).

Source: Authors.

<sup>19</sup> This is not satisfactory because often products with high MFN rates are excluded from the negotiations. Note however that trade flows exempted from tariff reductions in PTAs are excluded from the regressions.

<sup>20</sup> The frequency distributions of PSR categories in A6 shows a stable right skewed distribution over the sample.

Tables A5 and A6 give further characteristics of the distributions of PSRs across HS2 categories, their spread and their distribution across preferential margins. Figure A6 displays the frequency distributions of PSR categories across 7 bins of preferential margins for 1995 and 2015 and shows a stable right skewed distribution over the sample. The largest share of observations is located between margins above 5% and below or equal to 20%. The CTC criterion accounts for over 10% of PSRs in all HS categories except textiles, machinery and transportation. Flexibility captured by the ALT category accounts for over 20% of PSRs for 7 sectors. Animal products is the only sector with less than 10% of ALT rules. Technical requirements, TR, are concentrated in plastics, textiles, and transportation.

Turning to the distribution of PSRs across HS sections, textiles and machinery/electrical rely on a large array of PSRs. Textiles, the subject of many studies has a large array of relatively evenly distributed PSRs: value content requirement (VCR), technical requirements (TR), exceptions (33% of EXC) but also a relatively large share of choices (with 17%, the highest share of ALT across HS). Chemicals and machinery/electrical stand out with a large share of CTC at the subheading level. Textiles and machinery/electrical stand out as the two sectors with the largest dispersion of PSRs, particularly the combination of restrictive (COM) and flexible (ALT) PSRs. These dispersions suggest further investigation for these 2 sectors.

In sum, the 7 categories of PSRs constructed for this paper are widespread, being present in all sections with some sections having simultaneously a high combination of ALT and COM categories, the combination making it difficult to assess the restrictiveness of the PSRs on that product, and even more so at the section level. To borrow from Johnson's (1960) appraisal of tariffs in the period of high tariff protection, the overall picture is one of "made-to-measure" PSRs. The next sections try to tease out patterns in this maze of PSRs.

## 4. Trade Flows sensitivity to PSRs

We start by investigating the sensitivity of bilateral trade flows to PSRs by comparing correlates of bilateral trade flows in the group of countries that have reciprocal PTAs (almost all FTAs) against corresponding bilateral trade flows in a control group consisting of all other trade flows under MFN (i.e. all products under bilateral PTAs have a PSR). Then, we restrict the sample to countries which have reciprocal PTAs. This sample allows for a sharper identification of the effect of PSRs on trade flows by comparing trade flows with different PSRs across PTAs.

### 4.1 Cross-section patterns

As a prelude to the panel estimates where effort is focused on establishing causality, table 1 reports cross-section OLS estimates of bilateral trade flows at the HS-level for each of the 6 years. For each year two sets of observations are reported: one where a dummy variable for trade flows under a PTA with the standard gravity variables (distance, common language, contiguity) but no control for the preferential margin (odd cols.) and one where the preferential margin is reported along with each one of the 7 PSR categories described in figure 1.<sup>21</sup>

Four results stand out. First, even at this very disaggregated level, the coefficients on common language, distance and contiguity (except for 1990) carry the expected significant signs with stable coefficient values across years. Second, the dummy variable for PTA membership is also always positively associated significantly with trade flows, but the coefficient estimate is lower in later years. Third, the intensity of bilateral trade flows are both higher than in the control group (trade flows under MFN) and this is positively related to preferential margins. Fourth, controlling for preferential margins, except for the CTC dummy which is prevalent across all HS categories (see table A6 in annex "A3. Categorizing PSRs"), PSRs are not always correlated with the intensity of trade flows.

<sup>21</sup> Entering the preferential margin and PSR with the gravity variables results in a loss of significance for the preferential margin but gives same signs and similar significance levels for each PSR variable.



## 4.2 Full sample

The full sample consists of bilateral imports from origin  $i$ , to destination  $j$  of HS6 product  $k$  in panel year  $t$  where  $ijkt$ -combinations are either not part of a reciprocal PTA and hence are assumed to trade under MFN-tariff, or are part of a reciprocal PTA between countries  $ij$  in year  $t$ . Under a given PTA between a pair of  $ij$ -countries, each bilateral trade flow included in the agreement has one of the seven ( $l=1, \dots, 7$ ) PSR categories described in figure 1. Within the same PTA, different HS6 products will typically have PSRs in different categories. For example, for all countries that have signed the CAFTA-DR agreement, trade under HS6 product 8207.19 (rock drilling or earth boring tools) falls under the PSR category CTC which needs to be fulfilled to obtain a preferential tariff (if not fulfilled the firm exports under MFN tariff). HS6 product 854419 (insulated electric conductors) was allocated a PSR category COM. These PSR categories are indexed at the HS6 level ( $r_{ijkl}$ ) within an PTA and do not change over time once the PTA has been signed. Products excluded from the PTA negotiations are not included in the dataset.<sup>22</sup>

We estimate the following baseline specification (1) in the spirit of Cadot and Ing (2016):

$$X_{ijkt} = \exp[\beta_0 + \beta_1 \ln(1 + \text{tar}_{jkt}^{\text{MFN}}) + \beta_2 I_{ijt}^{\text{RTA}} + \beta_3 (I_{ijt}^{\text{RTA}} \times \ln(1 + \text{tar}_{jkt}^{\text{MFN}})) + \sum_{l=1}^7 \beta_{4l} r_{ijkl} + \sigma_{ijk2} + \eta_{it} + \theta_{jt}] + \epsilon_{ijkt} \quad (1)$$

where  $i=1, \dots, 135$ ;  $j=1, \dots, 181$ ;  $k=1, \dots, 5018$ ;  $t=1, \dots, 6$

The dummy variable

$$I_{ijt}^{\text{RTA}} = \begin{cases} 1, & i \text{ and } j \text{ are members of the same PTA in year } t \\ 0, & \text{otherwise} \end{cases}$$

indicates whether  $i$  and  $j$  belong to the same PTA.

$$r_{ijkl} = \begin{cases} 1, & \text{if rule } \text{PSR}_l \text{ applies to product } k \text{ in the agreement between } i \text{ and } j \\ 0, & \text{otherwise} \end{cases}$$

is a set of dummies indexed over for each of the 7 PSR categories. Since the categories are non-overlapping, only one PSR is applicable to each HS6 product in a PTA between  $i$  and  $j$ .

In (1),  $X_{ijkt}$  is the trade value of HS6 product  $k$ , between origin  $i$  and destination  $j$  in panel year  $t$ ,  $\ln(1 + \text{tar}_{jkt}^{\text{MFN}})$  is the logarithm of the applied MFN tariff  $\ln(1 + \text{MFN}_{jkt}/100)$  on product  $k$  defined by the destination country for all origin countries (most-favored nation rule). Coefficient ( $\beta_0$ ) measures the average trade value of the control group. Coefficient  $\beta_1$  is the tariff elasticity. It measures the response of bilateral trade flows to a percentage change in the MFN tariff. Coefficient  $\beta_2$  captures the effect of PTA membership alone. The coefficient,  $\beta_3$ , on the interaction between PTA membership and the MFN tariff captures the trade effect of a change in tariff-preference margins in a PTA ( $I_{ijt}^{\text{RTA}} \times \text{tar}_{jkt}^{\text{MFN}}$ ) as we assume full tariff liberalization for products under a PTA.<sup>23</sup> Coefficients  $\beta_{4l}$  captures the differential effects of PSRs on trade flows among PTA.

A set of fixed effects controls for omitted confounding factors:  $\sigma_{ijk2}$  are omitted origin-destination-product fixed effects ( $ijk2$ -level) at the HS2 product level. These fixed effects account for endogeneity concerns due to reverse causality since signing a PTA and thereby offering preferential tariffs seems more likely with economies that are already a significant trading partner with the liberalizing economy (Baier and Bergstrand, 2007) the gravity equation has been a workhorse for cross-country empirical analyses of international trade flows and - in particular - the effects of free trade agreements (FTA the

<sup>22</sup> There are always exception lists of products in PTAs. In our sample around 5% of bilateral trade flows do not have a PSR as they are excluded from the PTA agreement.

<sup>23</sup>  $\left( PM_{ij}^k = \frac{(1 + \text{tar}_{jkt}^{\text{MFN}}) - (1 + \text{tar}_{jkt}^{\text{PREF}})}{(1 + \text{tar}_{jkt}^{\text{PREF}})} = \text{tar}_{jkt}^{\text{MFN}} - \text{tar}_{jkt}^{\text{PREF}} = \text{tar}_{jkt}^{\text{MFN}} \right)$  under the assumption of full liberalization ( $\text{tar}_{jkt}^{\text{PREF}} = 0$ )

for all products included in the PTA, i.e. an FTA. According to Espitia, Mattoo, Mimouni, Pichot, & Rocha, (2020), "only 5.5 percent of global imports are subject to positive tariffs under PTAs" as of 2016. Trade outside the PTAs in the sample is carried out under MFN.



gravity equation has been a workhorse for cross-country empirical analyses of international trade flows and - in particular - the effects of free trade agreements (FTAs. With these fixed-effects we exploit variation across time and control furthermore for time-invariant origin-destination characteristics, such as bilateral distance.<sup>24</sup> Non-observable outward and inward Multilateral Resistance (MLR) terms are captured by  $\eta_{it}$  and  $\theta_{jt}$ .<sup>25</sup> As these fixed-effects capture any time-varying origin and destination specific characteristics, they also absorb the size terms  $Y_{i,t}$  and  $E_{j,t}$  in the gravity equation.  $\epsilon_{ijkt}$  is the error term clustered at the treatment level level (*ijk2*).

All estimates are over 5-year intervals. This gives trade flows enough time to fully adjust to the implementation of PTAs (Anderson & Yotov, 2016; Baier & Bergstrand, 2007; Heid, Larch, & Yotov, 2021; Trefler, 2004)the gravity equation has been a workhorse for cross-country empirical analyses of international trade flows and - in particular - the effects of free trade agreements (FTAs. This time-interval approach does not allow to capture dynamic adjustment effects that can be identified using consecutive-year data as in Egger et al. (2022). The trade data are from CEPII's BACI data base based on UN COMTRADE but that reconciles direct and mirrored data. Applied MFN tariffs are from UN COMTRADE.

We use the Poisson Pseudo Maximum Likelihood (PPML) estimator to account for heteroscedasticity in trade data (Silva & Tenreyro, 2006).<sup>26</sup> Due to data limitations we cannot include intra-national trade flows as suggested in Yotov (2012) and Bergstrand et al. (2015).<sup>27</sup>

Table 2 reports the results. Column 1 explores membership in reciprocal PTAs relative to all other trade flows. The estimates do not include PSRs. The coefficient estimate ( $\beta_2$ ) is insignificant indicating that PTA membership alone does not result in a significant difference in bilateral trade flows. The trade elasticity to a change in MFN tariffs in the control group is negative and significant, ( $\beta_1 = -2.216$ ). For PTA members, an increase in tariffs is an increase in the preferential margin (under the assumption of full tariff liberalization), ( $\beta_3 = +1.457$ ). Both coefficients are estimated with precision and conform with expectations.

Column 2 decomposes the distribution of bilateral trade flows PSR categories,, relative to corresponding trade flows under the control group. To identify all seven categories of PSRs in the estimations, table 1 drops the stand-alone dummy on PTA membership ( $\beta_2 I_{ijt}^{RTA}$ ). Trade flows are significantly larger under the PSR category of technical requirements (TR) and significantly smaller under the large group of trade flows with a change of tariff classification (CTC). Therefore, complex PSRs, such as technical requirements, appear to be prevalent among large bilateral trade flows under RTAs. All other categories are insignificant. The estimate of the elasticity of trade with respect to MFN tariffs decreases in absolute terms to  $\beta_1 = -1.854$  compared to column 1, which is plausible as we do not control in this specification for the positive effect of the preference margin on trade under a PTA.

Column 3 adds the preferential margins through the interaction term ( $\beta_3$ ) The results suggest that the major driver of the positive effects of PTA arises through the preferential tariff ( $\beta_3 = 1.396$ ), slightly lower than the coefficient in column 1.

24 Pair-fixed effects capture all time time-invariant bilateral trade costs whereas traditional gravity variables (bilateral cultural and geographic trade cost determinants) do not control to the same extent for all bilateral time-invariant trade cost determinants. See e.g. Egger and Nigai (2015) and Agnosteva et al. (2019).

25 Note that setting the MLR fixed effects at the product-level (*jkt*, *ikt*), as in would absorb the MFN tariff (*jkt*-level).

26 Due to computational challenges, we do not include zero trade flows to obtain a rectangular panel (resulting in around 735 million observations) to exploit information from non-traded products, as suggested in Silva & Tenreyro, 2006.

27 Currently available intranational trade data covers 170 industries (Borchert, Larch, Shikher, & Yotov, 2021) which is too aggregated to match our HS6-categories

**Table 2: Results (full sample)**

	(1)	(2)	(3)	(4)	(5)
Sample	All	All	All	All	excluding non-reciprocal RTAs
Dependent variable:					
$\beta_1$ MFN tariff (log)	-2.216*** (0.299)	-1.854*** (0.267)	-2.216*** (0.299)	-2.214*** (0.299)	-2.326*** (0.314)
$\beta_2$ if Reciprocal RTA=1	-0.073 (0.068)				
$\beta_3$ Reciprocal PTA * MFN tariff (log)	1.457*** (0.340)		1.396*** (0.338)		
ALT dummy		0.022 (0.109)	-0.088 (0.112)	-0.185 (0.129)	-0.195* (0.116)
CTC dummy		-0.287** (0.117)	-0.390*** (0.118)	-0.404*** (0.137)	-0.411*** (0.146)
CUM dummy		0.291 (0.258)	0.180 (0.258)	0.207 (0.265)	0.188 (0.262)
EXC dummy		-0.089 (0.180)	-0.207 (0.185)	-0.193 (0.232)	-0.212 (0.239)
TR dummy		0.215* (0.123)	0.088 (0.128)	0.049 (0.139)	0.033 (0.140)
VCR dummy		0.395 (0.261)	0.291 (0.267)	0.420 (0.319)	0.364 (0.321)
WO dummy		0.323 (0.279)	0.187 (0.296)	0.116 (0.325)	0.003 (0.264)
ALT dummy * MFN tariff (log)				2.394*** (0.876)	2.438*** (0.895)
CTC dummy * MFN tariff (log)				1.584*** (0.601)	1.747*** (0.590)
COM dummy * MFN tariff (log)				0.963* (0.556)	1.080* (0.570)
EXC dummy * MFN tariff (log)				1.199 (0.924)	1.371 (0.920)
TR dummy * MFN tariff (log)				1.804*** (0.526)	1.986*** (0.534)
VCR dummy * MFN tariff (log)				-0.068 (1.245)	0.162 (1.227)
WO dummy * MFN tariff (log)				1.905*** (0.361)	2.071*** (0.352)
Constant	9.697*** (0.018)	9.673*** (0.018)	9.692*** (0.019)	9.692*** (0.019)	9.714*** (0.020)
Fixed-effects	it, jt, ijk2	it, jt, ijk2	it, jt, ijk2	it, jt, ijk2	it, jt, ijk2
Observations	15,086,003	15,086,003	15,086,003	15,086,003	14,590,914
Pseudo R2	0.551	0.551	0.551	0.551	0.557
Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1					

Notes: PPML estimates. Standard errors are clustered at the treatment level (*ijk2*). Huntington-Klein (2021).

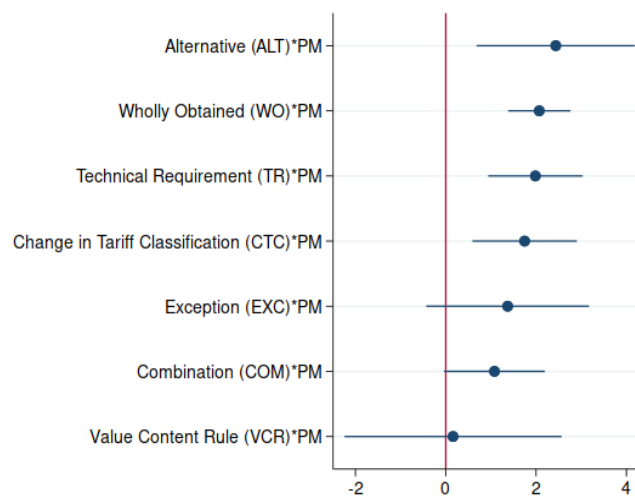
Source: Authors' estimates

Column 4 decomposes the effect of changes in the preferential margin on bilateral trade flows across the PSR categories by interacting changes in the preferential margin with each of the seven PSR categories,. An increase in the MFN tariff significantly reduces bilateral trade for the control group with an elasticity of . This estimate, stable across further splits in PSR categories into sub-groups (different CTCs and two categories of VCRs) has the expected sign but is on the high side, possibly reflecting omitted factors not captured by the fixed effects.

Importantly, the estimates of the interaction term across PSR categories are heterogenous, suggesting that a same percentage change in preference margin has significantly different trade effects across the 7 categories. The estimated response is strongest under the ALT rule (2.934) followed by WO, TR, CTC and COM while EXC and VCR are insignificant. The values and rankings are reported in figure 3 However, it is difficult to place much confidence in the rankings since the control group is poorly defined, including trade flows under non-reciprocal RTAs also subject to PSRs.

In column 5, we therefore exclude bilateral trade flows of partner countries that are part of a non-reciprocal RTA. This reduces the sample by 5 percent. Results are largely unchanged. Overall, the trade elasticity of preference margins is stronger for PSRs with choice (ALT) while PSRs requiring meeting several criteria (COM) have the lowest elasticity.

**Figure 5: PSR responses to an increase in preferential margin (full sample)**



Notes: The figure reports the coefficients in table 1, column 5. Note that those coefficients crossing the red line are not significantly different from the effect of the control group (MFN tariff for trade under MFN).

To sum up, our specification is based on the idea that we exploit variation across time to capture the trade effect of PTA membership with different PSR categories at the product-level. The results in table 2 suggest that the preference margin is the driving force of the trade effect of PTA membership. Since compliance costs vary across PSRs, they will offset to a different extent the tariff reductions realized when complying to a specific PSR category. Furthermore, the results in table 2 suggest that flexible PSRs where exporters have a choice among PSRs respond more strongly to an increase in the preference margin than all other (less flexible) PSR categories. This suggests that variable compliance costs (as captured by a % of trade value) are significantly lower for flexible rules than for all other PSR categories. PSR categories with a low trade elasticity of preference margins would be stricter as the costs of complying offset the tariff reductions reflected in the preference margin.

### 4.3 PTA sample

Now we restrict the sample to all countries involved in a reciprocal PTA. As in Carrère et al. (2021), all comparisons are across the different PSRs. The baseline specification becomes:

$$X_{ijkt} = \exp[\beta_0 + \beta_1(1 + \text{tar}_{jkt}^{\text{MFN}}) + \sum_{l=1}^6 \beta_{4l} r_{ijkl} + \sigma_{ijk2} + \eta_{it} + \theta_{jt}] + \epsilon_{ijkt} \quad (2)$$

All coefficients have the same interpretation as for table 1 except that  $\beta_1$  captures the effect of a change in preferential margin for the EXC category which is excluded and used as reference category.<sup>28</sup>

Table 3 reports the results of estimating equation (2). The sample is still large (1,455,683 observations) even though it is reduced to around 10 percent of the full sample used in table 1. The overall fit, as measured by the pseudo R2 is tighter (0.59) than in the full sample (0.55). Note that restricting the sample to PTAs, results in little variation across time as the observations are always part of a PTA throughout the sample period and PSRs do not change across time.

Column 1 shows that the effect of MFN tariffs on bilateral trade under PTA  $\beta_1$  is negative: a one percent increase in tariffs is associated with a decline in bilateral trade of 0.58 percent. A comparison of the PSR coefficients,  $\beta_{4l}$ , trade under the VCR rule is on average significantly higher (1.06) compared to the EXC category followed by WO, TR while COM and ALT are not significantly different from the EXC rule.<sup>29</sup> This could be an indication that compliance costs are less under a VCR rule than other rules.

Column 2 reports the trade elasticities of PSRs to a change in preference margin where in this specification the coefficient on the MFN tariff ( $\beta_1$ ) captures the trade elasticity of preference margins associated with the reference category, EXC. Coefficient estimates for the PSRs dummies are close to those in column 1 except for the WO and TR dummies which are now insignificant. The relatively close values for the PSR dummies in columns 1 and 2 suggest that the model is not mis-specified. The trade elasticities to an increase in preference margin (coefficients on the interaction term between MFN tariff and preferential margin) are heterogenous across PSRs and are not significant under clustering for the standard errors as further confirmed by the ordered elasticities with associated 5% confidence intervals in figure 4.

28 Since all products that are part of reciprocal PTAs have a PSR, one category has to be excluded to prevent perfect multicollinearity among PSRs in this PTA sample.

29 For example, the trade elasticity of an increase in tariff for the TR category is (-0.102=+0.486-0.584) and for the VCR category (0.78=1.062-0.584)

**Table 3: Results for PTA sample**

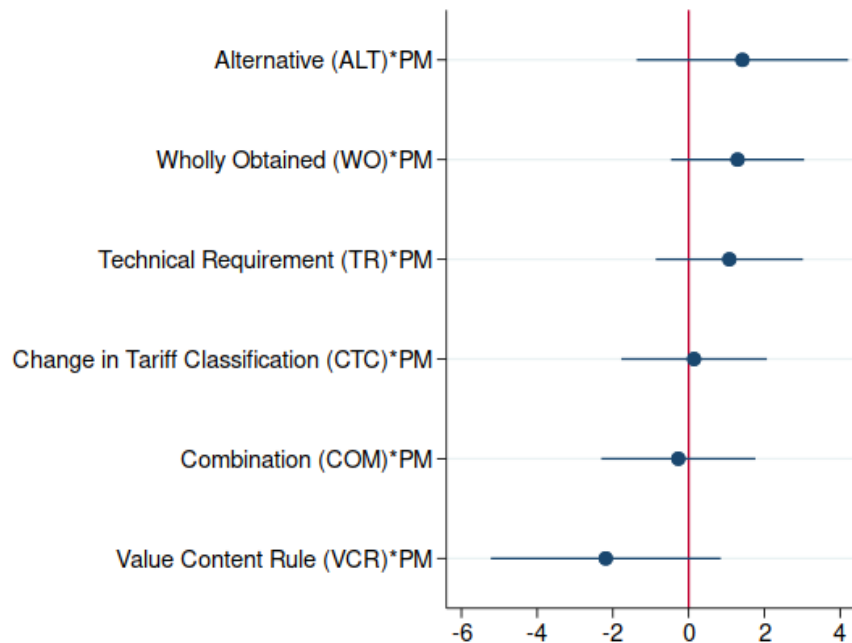
	(1)	(2)	(3)	(4)
Dependent variable: $X_{ijkt}$	PTA sample	PTA sample	PTA sample (SE not clustered)	HS6-level FEs
$\beta_1$ : MFN tariff (log)	-0.584** (0.297)	-0.759 (0.888)	-0.759 (0.472)	-1.143 (0.729)
ALT dummy	0.344 (0.288)	0.192 (0.321)	0.192 (0.201)	0.326*** (0.117)
CTC dummy	-0.231 (0.181)	-0.243 (0.218)	-0.243*** (0.087)	0.155 (0.106)
COM dummy	0.400 (0.434)	0.417 (0.476)	0.417*** (0.115)	0.133 (0.254)
TR dummy	0.486* (0.290)	0.386 (0.319)	0.386** (0.164)	0.121 (0.195)
VCR dummy	1.062* (0.591)	1.279** (0.642)	1.279*** (0.487)	0.271* (0.142)
WO dummy	0.665* (0.403)	0.525 (0.440)	0.525 (0.360)	-0.338* (0.200)
ALT dummy * MFN tariff (log)		1.420 (1.425)	1.420* (0.808)	0.615 (0.857)
CTC dummy * MFN tariff (log)		0.143 (0.981)	0.143 (0.591)	0.618 (0.779)
COM dummy * MFN tariff (log)		-0.273 (1.039)	-0.273 (0.937)	-2.221* (1.295)
TR dummy * MFN tariff (log)		1.074 (0.991)	1.074** (0.524)	-0.044 (0.814)
VCR dummy * MFN tariff (log)		-2.189 (1.550)	-2.189** (0.927)	-0.795 (1.061)
WO dummy * MFN tariff (log)		1.292 (0.897)	1.292** (0.523)	2.291*** (0.887)
Constant ( $\beta_0$ )	9.995*** (0.241)	10.006*** (0.280)	10.006*** (0.084)	11.590*** (0.116)
Fixed-effects	it, jt, ijk2	it, jt, ijk2	it, jt, ijk2	it, jt, ijk6
Standard-errors (in parentheses)	clustered at ijk2-level	clustered at ijk2-level	Not clustered	clustered at ijk6-level
Observations	1,455,683	1,455,683	1,455,683	1,289,349
Pseudo R2 (Adjusted R2 for OLS)	0.595	0.596	0.596	0.924

Notes: PPML estimates. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Source: Authors' estimates.

Column 3 reports the results when errors are not clustered so that any remaining correlation pattern between pairs of countries over time are not controlled for, as it is when errors are clustered over country-pairs as done in table 2 following the suggestion of Bertrand et al. (2004). Now, coefficient estimates for ALT, TR, VCR and WO are significant. Since the point estimates are unchanged, the descending order is still: ALT, WO, TR, and VCR. In sum, the pattern follows those in the full sample where the trade elasticity of preference margins is stronger for PSRs with choice (ALT).

**Figure 5: PSR responses to an increase in preferential margin (PTA sample)**



Notes: The figure reports the coefficients in table 2, column 2 relative to the excluded group, EXC. Note that those coefficients crossing the red line are not significantly different from the effect of the control group (EXC rule).

Source: authors' estimates.

As robustness, column 4 replicates the estimates of column 2 by controlling for confounding factors at the HS6-product level instead of HS2-level through *ijk6*-level fixed effects. The overall fit improves (pseudo R<sup>2</sup> of (0.92)). The coefficients on the PSR dummies are now positive and significant for the ALT and CTC category and negative for the WO rule. Compared with column 2, the point estimates on the interaction between PSR dummies and MFN tariffs is still positive and significant for the WO rule but insignificant for the ALT rule. Also, the estimate of the elasticity of MFN tariffs associated with the COM rule is negative (-2.22) and significantly different from the EXC rule (reference category). In sum, the conclusion holds that the COM rule, often classified as one of the most stringent PSRs, has the strongest negative effect of changes in tariffs on bilateral trade.<sup>30</sup>

<sup>30</sup> We also run OLS for specification of column 2. Estimates on the interaction term between MFN tariff and PSR dummy show the highest positive coefficient for the WO rule, followed by CTC and TR while all other rules are insignificant. However, the OLS estimator does not control for the effect of heteroscedastic trade data leading to inconsistent standard errors.

## 5. Supplementary tests

Estimates in table 2 show that rules associated with changes in tariff classifications (CTC) have a positive and significant trade effect. Yet, CTC rules can vary at the HS-level requiring either a product transformation that leads to changes at the chapter-level (CC), at the heading-level (CH) or at the sub-heading level (CS).

We therefore estimate our model in OLS (PPML estimates indicate non-significant results) for the full sample by including the three sub-categories of the CTC rule in table A9 of annex 5 “A5. Investigation on CTC types and VC threshold”. The results highlight that the strongest trade effect is realized for the CS rule, which is considered the least restrictive PSR within the CTC category since it stipulates that a product is substantially transformed once it has changed the HS6-subheading. In contrast, the most restrictive CTC subcategory, CC, has the smallest effect on trade, and is significant only at the 10% significance level. Furthermore, CC is significantly lower than the less restrictive CS subcategory (at the 5% significance level based on Wald test). CH lies in between both subcategories, although its effect is not statistically different from CC and CH based on the results of a Wald test.

Turning to the estimation results for the VCR category, the percentage requirement for local content (i.e. limit for the % of import content) is a critical factor in defining the degree of restrictiveness for the VCR category. We therefore test in OLS estimates on the full sample whether different % requirements for local content changes the impact of the VCR category on trade.<sup>31</sup> The results are based on observations with available information on local content %, hence not the entire data sample of our previous results (Figure A7). We report the results in table A10 of annex “A5. Investigation on CTC types and VC threshold”. While elasticity of preferential margins is positive and significant for VCRs requiring a minimum local content share equal or below 40%, the trade effect is negative for local content shares above 40%.

## 6. Simulating trade effects from moving to a flexible PSR category

To quantify the trade effect of simplifying PSRs, we use the estimates in table 2 column 5 in the full sample and those in table 3, column 3, for the PTA sample.<sup>32</sup> We simulate a scenario in which observations with restrictive PSR categories, namely EXC, COM, TR, WO, CTC and VCR, adopt the alternative rule, ALT, arguably the most flexible PSR rule in our classification. This amounts to replacing in equation 1 for the full sample the estimated coefficient values for each of the restrictive PSR for observation  $ijkt$  with the corresponding ALT coefficient, keeping the original preferential margin attached to each  $ijkt$ -combination.

To quantify the trade effect of simplifying PSRs, we proceed as follows. We draw on our results estimated based on equation 2 and presented in table 2, column 5. First, we predict the average trade value for each  $ijkt$ -combination with our model (see equation 3). To see how well the model predicts trade flows, figure 6 plots the predicted trade values (in log) from our model on the y-axis and the observed ones on the x-axis for 61,064 observations ( $ij$ ) keeping in mind that the predicted values include the estimated constant and all fixed effects.

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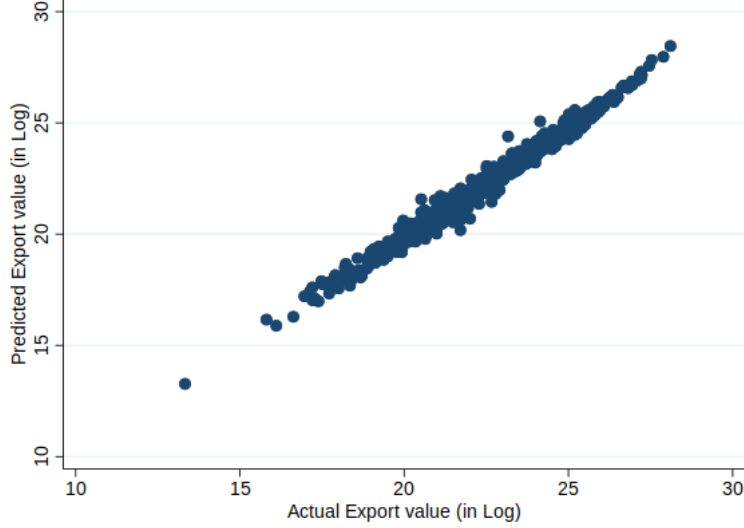
<sup>31</sup> Our data unfortunately reports the % requirements for only 60% of observations in the VCR category see Figure A7. We nevertheless decide to continue with this exercise based on the available number of observations containing information about the % requirements

<sup>32</sup> In the discussion paper version we show that including fixed effects produces predicted average trade values for each  $ijkt$ -combination close to the observed flows.

The values follow the red highlighted diagonal in figure 6, implying a good fit between predicted and observed trade values.

$$\begin{aligned} \ln \hat{X}_{ijkt} = & \hat{\beta}_0 + \hat{\beta}_{ALT} D_{ijkt}^{ALT} + \hat{\beta}_{VCR} D_{ijkt}^{VCR} + \hat{\beta}_{CTC} D_{ijkt}^{CTC} + \hat{\beta}_{WO} D_{ijkt}^{WO} + \hat{\beta}_{TR} D_{ijkt}^{TR} + \hat{\beta}_{COM} D_{ijkt}^{COM} + \\ & \hat{\beta}_{EXC} D_{ijkt}^{EXC} + \hat{\gamma}_{ALT} D_{ijkt}^{ALT} \ln PM_{ijkt} + \hat{\gamma}_{VCR} D_{ijkt}^{VCR} \ln PM_{ijkt} + \hat{\gamma}_{CTC} D_{ijkt}^{CTC} \ln PM_{ijkt} + \\ & \hat{\gamma}_{WO} D_{ijkt}^{WO} \ln PM_{ijkt} + \hat{\gamma}_{TR} D_{ijkt}^{TR} \ln PM_{ijkt} + \hat{\gamma}_{COM} D_{ijkt}^{COM} \ln PM_{ijkt} + \hat{\gamma}_{EXC} D_{ijkt}^{EXC} \ln PM_{ijkt} + \\ & \hat{\sigma}_{ijt} + \hat{\delta}_{ijk} + \hat{\eta}_{ikt} + \hat{\theta}_{jkt} + \hat{\varepsilon}_{ijkt} \end{aligned} \quad (3)$$

Figure 6: Predicted versus observed trade value for country pairs, 1990-2015 (equation 3)



Source: Authors.

Second, we simulate a scenario in which observations with restrictive PSR categories, namely EXC, COM, TR, WO and CTC, adopt one of the most flexible PSR types, in our case the alternative rule (ALT category). To do so, we set the coefficient of restrictive PSR of observation  $ijkt$  to the ALT coefficient, keeping the original preferential margin attached to each  $ijkt$ -combination. Equation (4) represents the simulated trade value once observations with a restrictive PSR adopt ALT rules.

$$\begin{aligned} \ln \hat{X}_{ijkt}^{simulated} = & \hat{\beta}_0 + \hat{\beta}_{ALT} D_{ijkt}^{ALT} + \hat{\beta}_{VCR} D_{ijkt}^{VCR} + \hat{\beta}_{CTC} D_{ijkt}^{CTC} + \hat{\beta}_{WO} D_{ijkt}^{WO} + \hat{\beta}_{TR} D_{ijkt}^{TR} + \\ & \hat{\beta}_{COM} D_{ijkt}^{COM} + \hat{\beta}_{EXC} D_{ijkt}^{EXC} + \hat{\gamma}_{ALT} D_{ijkt}^{ALT} \ln PM_{ijkt} + \hat{\gamma}_{VCR} D_{ijkt}^{VCR} \ln PM_{ijkt} + \\ & \hat{\gamma}_{ALT} D_{ijkt}^{CTC} \ln PM_{ijkt} + \hat{\gamma}_{ALT} D_{ijkt}^{WO} \ln PM_{ijkt} + \hat{\gamma}_{ALT} D_{ijkt}^{TR} \ln PM_{ijkt} + \hat{\gamma}_{ALT} D_{ijkt}^{COM} \ln PM_{ijkt} + \\ & \hat{\gamma}_{ALT} D_{ijkt}^{EXC} \ln PM_{ijkt} + \hat{\sigma}_{ijt} + \hat{\delta}_{ijk} + \hat{\eta}_{ikt} + \hat{\theta}_{jkt} + \hat{\varepsilon}_{ijkt} \end{aligned} \quad (4)$$

Adopting the more flexible ALT rule in the PTAs in the DTA database would increase bilateral trade under PTA on average by 2.7 percent during the sample period by using the coefficients of the full sample (table 2, column 5) and 4 percent by using the results of the PTA sample (table 3, column 3).

Figure 7 plots the densities of simulated trade growth separately for OECD and non-OECD exports for all pairs of countries under PTAs when adopting the ALT rule across the board using the coefficients of the full sample. Both densities are right-skewed. The average effect on the intensive margin of trade is highest for non-OECD exports to non-OECD countries (3%) and OECD exports to non-OECD countries (2.9%), followed by non-OECD exports to OECD countries (1.86%) and OECD to OECD countries (1.5%).<sup>33</sup> The simulation results suggest that the trade effect is generally stronger for accessing to non-OECD markets, where preferential margins are higher on average due to higher MFN tariffs.<sup>34</sup>

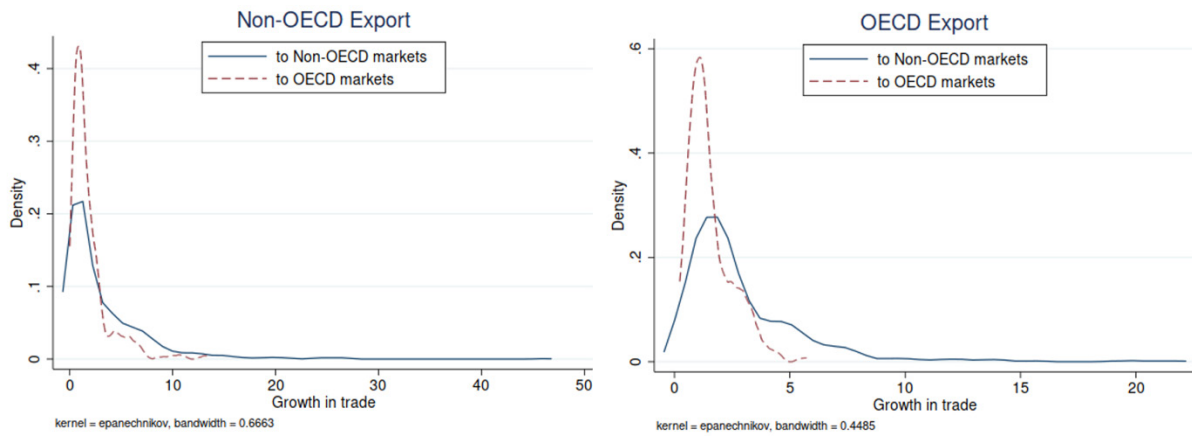
33 Our simulation results using the RTA sample and coefficients from table 2, column 2 are in line with the simulated results of the full sample. The simulation based on the RTA sample leads to an increase in bilateral trade under PTA on average by 4 percent during the sample period. The average effect on the intensive margin of trade is highest for non-OECD exports to non-OECD countries (5.4%), followed by OECD exports to non-OECD countries (4%) and non-OECD exports to OECD countries (2.5%) while OECD exports to OECD countries remains almost unchanged (-0.4%).

34 Summary statistics across country groups during the sample period show average MFN tariffs for OECD partners of 5.6%, for non-

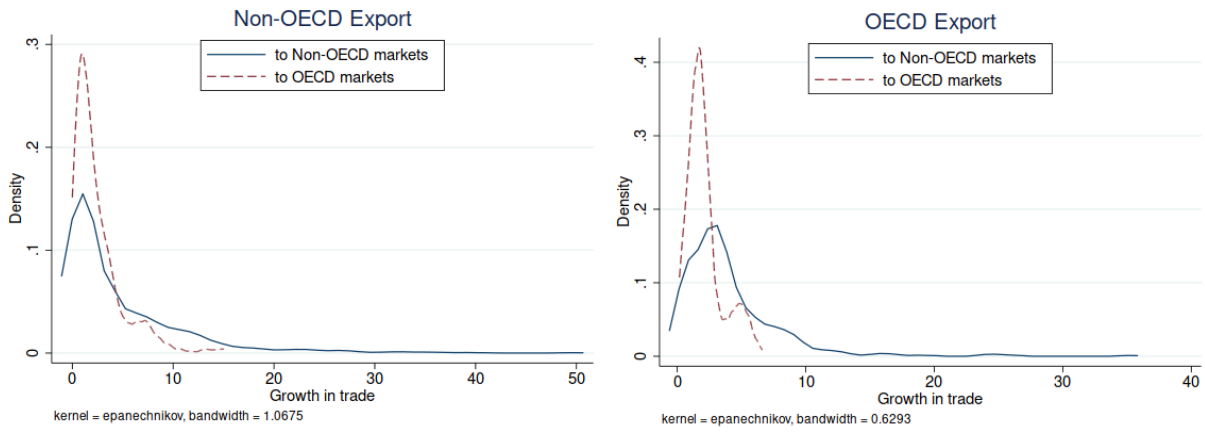


**Figure 7: Simulated effects on bilateral exports of moving to more flexible PSRs**

**(a): Full sample**



**(b): PTA sample**



Notes: Each one of EXC, COM, TR, WO, VCR and CTC PSRs coefficients in coefficients are replaced by the ALT coefficients. Growth rates between -0.5% and 50%  
 7(a) coefficients from table 2, column 5. 7(b) Estimates from table 3 column 3.

Source Authors' estimates.

---

OECD partners of 12.5%, for OECD to non-OECD partners of 10.9% and for non-OECD to OECD partners of 6.1%.

## **7. Conclusions**

Rules of origin are necessary instruments in preferential trade agreements to ensure that a product fulfills origin requirements before it enters a member country with the aim to avoid trade deflection. Yet, the existing literature emphasizes the non-negligible compliance costs associated with product-specific rules of origin (PSRs). Empirical evidence points towards adverse effects of these rules on bilateral trade and calls for simplification.

This paper systematically explores the effect of PSRs on the intensity of bilateral trade across 128 reciprocal preferential trade agreements and investigates heterogeneity across seven mutually-exclusive categories of PSRs. The paper exploits a large database from the World Bank's newly released Deep Trade Agreement (DTA) database covering information on product-specific rules of origin at the HS6-level over the period 1990 to 2015. To our knowledge, this is the first documented evidence of trade effects of different categories of PSRs across the quasi-full range of worldwide reciprocal PTAs.

Compliance costs of PSRs vary across different categories of PSRs. Controlling for the level of preferential margins, the results show that rules allowing to choose between alternatives have the strongest positive impact on trade value. On the other hand, adopting stricter rules like imposing combinations of different requirements largely annihilate the positive trade effect of granting preferential tariffs.

These results are particularly relevant in the context of trade policy negotiations. In defining PSRs in PTAs, policy makers may want to consider moving from restrictive PSR categories, and thus from those associated with higher compliance costs, towards more flexible ones. Our simulation exercise quantifies the trade effect of simplifying PSRs. A simulation of a radical simplification reform that leads to the adoption of rules where producers can choose among alternative PSRs increases global trade under PTA by between 2.7 and 4 percent on average during the sample period. Overall, the exploratory results in this paper support calls for simplification of PSRs voiced in the literature (Cadot and Melo (2007), Mavroidis and Vermulst (2018), Hoekman and Inama (2018)).

This paper is exploratory. More satisfactory calculations of preferential margins will be possible when applied bilateral tariffs become available. Importantly, preference utilization rates on reciprocal RTAs and non-reciprocal RTAs, like AGOA and EBA, would allow one to get a better appreciation of benefits of preferential tariffs once PSRs are factored in.

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## Annexes to A (more) Systematic Exploration of product-specific Rules of Origin on Trade Flows

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## A1. Dataset preparation

This annex describes the sample used in the text resulting from the 6 steps described in table A1. First, we exclude exporting countries with a total export value by destination country below the 25th percentile. Second, we keep only bilateral exports for a product if it is traded at least 3 times during the sample period. This excludes occasional exporter flows (Fontagné et al., 2015). Third, we restrict the panel period to six 5-years intervals starting in 1990 to let changes trade flows to adjust for changes in trade policies, as suggested by Trefler (2004), Baier and Bergstrand (2007) and Anderson and Yotov (2016). Fourth, we exclude trade flows below 1,000 USD. These small flows make up only 0.003% of total sample trade value but represent 13.5% of total sample observations. Fifth, we drop observations for which MFN tariffs are already zero prior to the implementation of the PTA. In these cases, preferences are void. Sixth, we exclude observations that are part of PTAs but without PSR likely to represent products excluded from the tariff negotiations.

Table A1 shows the sample size at each step. The sample is reduced by 19% from excluding trade flows with less than 5 years worth of data and another 13% from excluding trade flows of less than \$1000. Taking data at 5-year intervals reduces further the sample by close to 80%. Remaining exclusions only reduce the sample marginally, notably the exclusion of products with no PSRs once it is recognized that 23% correspond to trade flows with zero applied MFN tariffs.

**Table A1: Data coverage resulting from sample selection**

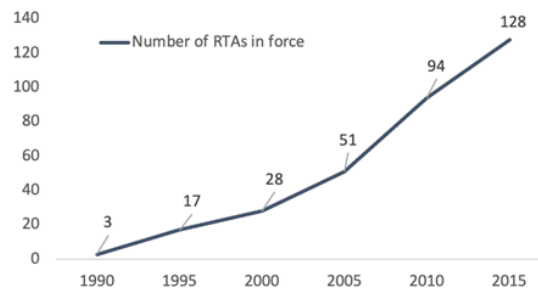
Steps	Sample period	Nbr of countries	Nbr of products	Change in nbr of observations	Nbr of observations	Change in trade value	Trade value (in billion USD)
Raw data	1990-2015	181	5 018		121 224 927		156 580
exclude small exporters (<25 percentile)				-1,2%	119 820 171	-0,2%	156 324
exclude if <=5 years of observed trade				-18,7%	97 435 976	-1,7%	153 721
data at 5 years intervals	1990, 1995, 2000, 2005, 2010, 2015	<b>135 exporters, 181 Importers</b>		-77,6%	21 803 233	-77,7%	34 280
exclude trade flows<1000 USD				-13,5%	18 854 670	-0,003%	34 279
exclude if MFN=0 & PSR=1				-2,4%	18 393 110	-6,1%	32 171
exclude products in RTA without PSR				-5,0%	17 480 272	-9,7%	29 061
Final data	1990, 1995, 2000, 2005, 2010, 2015	<b>135 exporters, 181 Importers</b>	5 018		17 480 272		29 061

Notes: \* 22.8% of those products (207,790 observations) are in an RTA with a zero applied MFN tariff. Changes in number of observations and in trade value are from each step.

Source: Authors.

## A2. Descriptive Statistics

**Figure A1: Number of RTAs in force across year intervals in the sample**



Note:

Source: Authors. See list of RTAs in table A2

**Table A2: Import value in final sample as share of global imports**

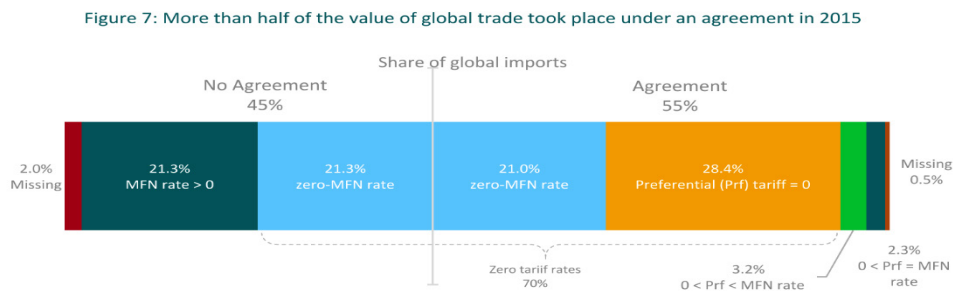
Year	Global imports excl. intra-EU trade (WITS)	Final sample imports	%
1990*	2 300 003 514	1 138 170 208	49%
1995	3 557 836 193	2 909 374 138	82%
2000	4 937 452 035	3 763 072 935	76%
2005	7 898 848 827	5 483 828 681	69%
2010	11 700 417 627	7 986 584 799	68%
2015	12 553 474 443	7 780 723 234	62%
Average		4 843 625 666	68%

Notes: Data in 1,000 USD. \*For the year 1990, we use global import values in SITC from WITS instead of HS nomenclatures because in 1990 trade data was mainly based on STIC rather than HS nomenclatures.

Source: Authors.

In practice, FTA negotiations result in the reduction of applied bilateral tariffs over a period, often 10 years, with a large chunk of reductions taking place at the end. Espitia et al. 2020 report national tariff line code data for 2016 covering 97 percent of world trade at the HS6 level. They report that PTAs have brought an extra 28% of global imports to zero tariffs with only 5.5% of imports under PTAs subject to positive tariffs (figure A2). However, they report that nearly one quarter of tariff lines with MFN tariffs over 15% are excluded from preferential liberalization.

**Figure A2: Share of global imports by tariff lines (2016)**



Source: Authors' calculation using ITC/World Bank database

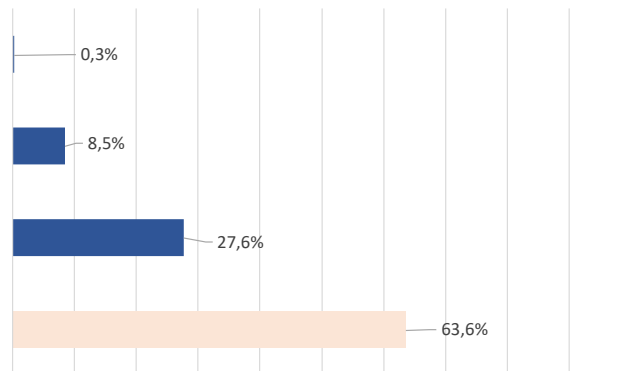
Notes: MFN tariffs between members of a customs union are excluded from the data

Source: Espitia et al. (2020, figure 7).



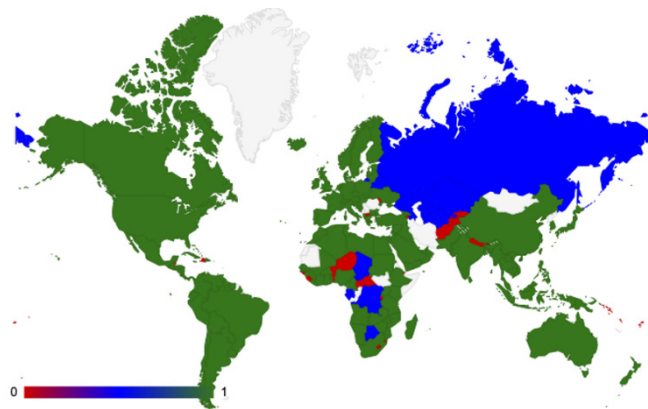
Espitia et al. report applied bilateral tariff data for 141 countries for 2016 and for others for a prior year (Figure A2). Their data does not extend to earlier years. Therefore applied bilateral tariffs are taken from WITS where available and a preferential margin equal to the MFN tariff has to be calculated for the remainder. Figure A1 shows that preferential tariffs are missing for 63% of the tariff lines (approximately the same percentages are obtained for import-weighted tariffs). Faced with this situation, we have assumed an applied bilateral tariff of zero for all flows, implying at preferential margin equal to the MFN tariff.

**Figure A3: Distribution of preferential tariffs by category of MFN (final sample, all sample years)**



Source: Authors.

**Figure A4: Country coverage in sample data**



Notes: The final sample covers 135 exporting countries out of 181. Countries highlighted in green and blue are included in the sample. Green highlighted countries have at least one RTA in place during the sample period while this is not the case for blue highlighted economies (AZE, BLR, BWA, COG, GAB, GNQ, KAZ, RUS, TCD, TKM, UZB).

Countries highlighted in red were dropped from the sample during the sample reduction process (AFG, AND, ARM, ATG, BDI, BEN, BLZ, BRB, BTN, CAF, COK, COM, CPV, DJI, DMA, FJI, FSM, GMB, GNB, GRD, HTI, KGZ, KIR, KNA, LCA, LSO, MDA, MDV, MKD, MSR, NER, NIU, NPL, NRU, RWA, SLB, SLE, SMR, SWZ, SYC, TJK, TON, TUV, VCT, VUT, WSM).

Source: Authors

### A3. Categorizing PSRs.

Below is the questionnaire used to categorize the PSRs described in Angeli et al. (2020). The square-bracketed terms below refer to the corresponding variables in the Angeli et al. (2020) dataset available at WB Deep Trade agreement database. Examples are listed in boxes.

#### **Does the agreement contain product-specific Rules of Origin? [SR\_psr]**

The WTO Rules of Origin Agreement and the WCO Kyoto Convention<sup>35</sup> recognise two basic criteria for determining origin: wholly obtained and substantial transformation, classification of which is discussed in turn.

##### Wholly obtained

The wholly obtained (WO) criterion specifies that the country of origin of a product is the country where the commodity has been wholly produced (or grown, harvested or extracted for non-manufactured products). In this case, the origin requirement is met if a product or commodity does not use any foreign components or materials.

#### **Is the product's origin defined as wholly obtained? [SR\_who]**

EFTA-Central America (2014), Annex I on Rules of Origin and Methods of Administrative Cooperation, Article 2: Origin Criteria:

For the purposes of this Agreement, a product shall be considered as originating in a Party if:

- (a) it has been wholly obtained in a Party, in accordance with Article 3 (Wholly Obtained Products);
- (b) the non-originating materials used in the working or processing of that product have undergone sufficient working or processing in a Party, in accordance with Article 4; or
- (c) it has been produced in a Party exclusively from materials originating in one or more Parties.

##### Substantial transformation

The substantial transformation criterion specifies that the country of origin is the country where the last substantial transformation took place, and this transformation must be sufficient to give its essential character to a commodity.

#### **Is the product's origin defined through substantial transformation criteria? [SR\_stc]**

Russian Federation-Serbia (2006), Article 4(1): Criterion of sufficient processing (treatment):

Product is considered to be subjected to sufficient processing or treatment in one of the States Parties, if such a product is processed or treated and the value of used in this process materials (raw materials, semi-finished and finished goods), originating from other countries (other than States Parties), or the value of materials of unknown origin does not exceed 50 percent of exported goods' value.

Furthermore, three distinct sets of criteria are used to express "substantial transformation":

1. Change of tariff classification (which can be at the Chapter (CC), Heading(CH), or Subheading level(CS));
2. Value Content Requirement (VC). Note that different methodologies are used to compute the threshold, depending if the focus is on the originating or the non-originating materials);
3. Technical Requirement (TR) such as a chemical reaction.

<sup>35</sup> The International Convention on the Simplification and Harmonization of Customs Procedures.

According to the value content (VC) criterion, the exported good must reach a threshold percentage value of produced inputs either locally or among RTA members.

### Is the product's origin defined through a value content requirement? [SR\_vcr]

South Asian Free Trade Agreement (2012), Product Specific Rules Under SAFTA Rules of Origin, Explanatory Notes(4):

The Domestic Value Added (DVA) in percentage shall mean the minimum value addition in the Exporting Contracting State, calculated as per the following formula:

$$\text{DVA} = \frac{(\text{FOB value of the export product} - \text{value of non originating materials})}{\text{FOB value of the art. product}} \times 100$$

For the VC entry, one additional sub-entry are be distinguished, with respect to the reference values:

Illustration on VC thresholds. Transpacific Partnership (2019?), Annex 3-D (Product-Specific Rules of Origin)

87.07: No change in tariff classification required for a good of heading 87.07, provided there is a regional value content of not less than:

- (a) 35 per cent under the build-up method; or
- (b) 35 per cent under the net cost method; or
- (c) 45 per cent under the build-down method.

Alternatively to the VC criterion, a product can be considered to have undergone substantial transformation by undergoing a change in tariff classification (CTC): the exported good must have a different tariff classification from any imported inputs to change a product into a different product category. The CTC rule is based on the harmonized system (HS), and the change can be specified at either the chapter level (HS2, with 99 categories), the heading level (HS4, with over 1'000 categories) or sub-heading (HS6, with over 5'000 categories).

### Is the product's origin defined through a change in tariff classification? [SR\_ctc]

This category can be further broken down by the level of aggregation at which the change in tariff classification change must occur. :

### Is the product's origin defined through a change in chapter? [SR\_cc]

Transpacific Partnership (2019?), Annex 3-D (Product-Specific Rules of Origin)

05.01 - 05.11: A change to a good of heading 05.01 through 05.11 from any other chapter.

### Is the product's origin defined through a change in heading? [SR\_ch]

Transpacific Partnership (2019?), Annex 3-D (Product-Specific Rules of Origin)

1208.90: A change to any other good of subheading 1208.90 from any other heading.

The distribution of CTCs across the three categories retained in the sample is : CH=71%; CC=15%; CS=14%.

### Is the product's origin defined through a change in subheading? [SR\_cs]

Transpacific Partnership (2019?), Annex 3-D (Product-Specific Rules of Origin)

0801.32: A change to a good of subheading 0801.32 from any other subheading.

**Table A3: List of PTAs in database**

The data base covers only reciprocal PTAs, mostly FTAs. Non-reciprocal PTAs like GSP, EBA and AGOA which also rely on RoO, are not covered in the data base. PTAs dropped during sample preparation in bold.

1.	AGADIR (1998, FTA)	49.	Colombia-Costa Rica
2.	APTA	50.	Costa Rica – Singapore (2013, FTA/EIA)
3.	ASEAN free trade area (1992, FTA)	51.	Dominican Republic - Central America (2001, FTA/ EIA)
4.	ASEAN-Australia-New Zealand (2010, FTA/EIA)	52.	EC-Albania (2006, FTA/EIA)
5.	ASEAN-Korea (2010, FTA/EIA)	53.	EC-Bosnia Herzegovina (2008, FTA)
6.	Australia-China	54.	EC-CARIFORUM (2008, FTA/EIA)
7.	Australia-New Zealand (ANZCERTA) (1983, FTA/ EIA)	55.	EC-Cameroon (2009, FTA)
8.	Australia-Singapore (2003, FTA/EIA)	56.	EC-Chile (2003, FTA/EIA)
9.	Australia-Thailand (2005, FTA/EIA)	57.	EC-Cote d'Ivoire (2009, FTA)
10.	Brunei Darussalam - Japan (2008, FTA/EIA)	58.	EC-Croatia (2002, FTA/EIA)
11.	CAFTA-DR (2006, FTA/EIA)	59.	EC-Egypt (2004, FTA)
12.	CAN (1988, CU)	60.	EC-Mexico (2000, FTA/EIA)
13.	CIS	61.	ECOWAS (1993)
14.	COMESA (1994)	62.	EFTA – Albania (2010, FTA)
15.	Canada – Chile (1997, FTA/EIA)	63.	EFTA - Central America (Costa Rica and Panama) (2014, FTA/EIA)
16.	Canada – Colombia (2011, FTA/EIA)	64.	EFTA - Chile (2004, FTA/EIA)
17.	Canada – Costa Rica (2002, FTA)	65.	EFTA – Colombia (2011, FTA/EIA)
18.	Canada – Honduras (2014, FTA/EIA)	66.	EFTA – Egypt (2007, FTA)
19.	Canada – Israel (1997, FTA)	67.	EFTA – Hong Kong, China (2012, FTA/EIA)
20.	Canada – Jordan (2012, FTA)	68.	EFTA – Lebanon (2007, FTA)
21.	Canada – Rep. Of Korea (2015, FTA/EIA)	69.	EFTA – Peru (2011, FTA)
22.	Canada-EFTA (2009, FTA/EIA)	70.	EFTA – Singapore (2003, FTA/EIA)
23.	Canada-Peru (2009, FTA/EIA)	71.	EFTA - Tunisia (2005, FTA)
24.	Caribbean Community and Community Market (CARICOM) (1973, CU/EIA)	72.	EFTA – Ukraine (2012, FTA/EIA)
25.	Central American Common Market (CACM) (1961, CU)	73.	EFTA-Israel (1993, FTA)
26.	Chile – Colombia (2009, FTA/EIA)	74.	EFTA-Korea (2006, FTA/EIA)
27.	Chile - Costa Rica (Chile - Central America) (2002, FTA/EIA)	75.	EU – Andorra (1991, CU)
28.	Chile - El Salvador (Chile - Central America) (2002, FTA/EIA)	76.	EU – Central America (2013, FTA/EIA)
29.	Chile - Guatemala (Chile - Central America) (2010, FTA/EIA)	77.	EU – Colombia and Peru (2013, FTA/EIA)
30.	Chile - Honduras (Chile - Central America) (2008, FTA/EIA)	78.	EU – Georgia (2014, FTA/EIA)
31.	Chile – Malaysia (2012, FTA)	79.	EU – Korea, Republic of (2011, FTA/EIA)
32.	Chile – Mexico (1999, FTA/EIA)	80.	EU - Papua New Guinea/Fiji (2009, FTA)
33.	Chile – Viet nam (2014, FTA)	81.	EU - Republic of Moldova (2014, FTA/EIA)
34.	Chile-Australia (2009, FTA/EIA)	82.	EU – Ukraine
35.	Chile-China (2006, FTA/EIA)	83.	East African Community (EAC) (2000, CU/EIA)
36.	Chile-Japan (2007, FTA/EIA)	84.	El Salvador - Honduras - Chinese Taipei (2008, FTA/EIA)
37.	Chile-Korea (2004, FTA/EIA)	85.	Guatemala - Chinese Taipei (2006, FTA/EIA)
38.	China – Costa Rica (2011, FTA/EIA)	86.	Gulf Cooperation Council (GCC)-Singapore (2013, FTA/EIA)
39.	China – Macao, China (2003, FTA/EIA)	87.	Hong Kong, China – Chile (2014, FTA/EIA)
40.	China-ASEAN (2005, FTA/EIA)	88.	Hong Kong, China - New Zealand (2011, FTA/EIA)
41.	China-Hong Kong (2004, FTA/EIA)	89.	Iceland – China (2014, FTA/EIA)
42.	China-New Zealand (2008, FTA/EIA)	90.	India – Thailand (2010, FTA/EIA)
43.	China-Peru (2010, FTA/EIA)	91.	India-Malaysia (2011, FTA/EIA)
44.	China-Singapore (2009, FTA/EIA)	92.	India-Singapore (2005, FTA/EIA)
45.	Colombia - Mexico (1995, FTA/EIA)	93.	Israel – Mexico (2000, FTA)
46.	Colombia - Nicaragua	94.	Japan – Australia (2015, FTA/EIA)
47.	Colombia - Northern Triangle (El Salvador, Guatemala, Honduras) (2009, FTA/EIA)	95.	Japan – Peru (2012, FTA/EIA)
48.	Colombia – Panama	96.	Japan-ASEAN (2008, FTA)
		97.	Japan-Indonesia (2008, FTA/EIA)
		98.	Japan-Malaysia (2006, FTA/EIA)
		99.	Japan-Mexico (2005, FTA/EIA)
		100.	Japan-Philippines (2008, FTA/EIA)
		101.	Japan-Singapore (2002, FTA/EIA)
		102.	Japan-Switzerland (2009, FTA/EIA)

103. Japan-Thailand (2007, FTA/EIA)
104. Japan-Viet Nam (2009, FTA/EIA)
105. Korea, Republic of - Australia (2014, FTA/EIA)
106. Korea, Republic of - Turkey
107. Korea, Republic of - US (2012, FTA/EIA)
108. Korea, Republic of-India (2010, FTA/EIA)
109. Korea, Republic of-Singapore (2006, FTA/EIA)
110. Korea-China
111. Korea-NZ
112. Korea-Vietnam (2010, FTA/EIA)
113. Latin American Integration Association (LAIA)
114. MERCOSUR (1991, CU/EIA)
115. MERCOSUR - Chile
116. Malaysia - Australia (2013, FTA/EIA)
117. Mauritius - Pakistan
118. Mexico - Bolivia
119. Mexico - Central America (2012, FTA/EIA)
120. Mexico - Uruguay (2004, FTA/EIA)
121. NAFTA (1994, FTA/EIA)
122. New Zealand - Chinese Taipei (2013, FTA/EIA)
123. New Zealand - Malaysia (2010, FTA/EIA)
124. Nicaragua - Chinese Taipei (2008, FTA/EIA)
125. PAFTA (1998, FTA)
126. Pakistan - Malaysia (2008, FTA/EIA)
127. Panama - Chile (2008, FTA/EIA)
128. Panama - Chinese Taipei (2004, FTA/EIA)
129. Panama - Costa Rica (Panama - Central America) (2008, FTA/EIA)
130. Panama - El Salvador (Panama - Central America) (2003, FTA/EIA)
131. Panama - Guatemala (Panama - Central America) (2009, FTA/EIA)
132. Panama - Honduras (Panama - Central America) (2009, FTA/EIA)
133. Panama - Nicaragua (Panama - Central America) (2009, FTA/EIA)
134. Panama - Singapore (2006, FTA/EIA)
135. Peru - Chile (2009, FTA/EIA)
136. Peru - Korea, Republic of
137. Peru - Singapore (2009, FTA/EIA)
138. Peru - Thailand
139. Southern African Development Community SADC (1992, FTA)
140. Singapore - Chinese Taipei (2014, FTA/EIA)
141. Switzerland - China (2014, FTA/EIA)
142. Thailand - New Zealand (2005, FTA/EIA)
143. Trans-Pacific Strategic Economic Partnership (2006, FTA/EIA)
144. Turkey - Chile
145. Turkey - Georgia (2008, FTA)
146. Turkey - Mauritius (2013, FTA)
147. Turkey-EFTA (1992, FTA)
148. US - Colombia (2012, FTA/EIA)
149. US - Panama (2012, FTA/EIA)
150. US-Australia (2005, FTA/EIA)
151. US-Chile (2004, FTA/EIA)
152. US-Israel (1985, FTA)
153. US-Jordan (2001, FTA/EIA)
154. US-Morocco (2006, FTA/EIA)
155. US-Oman (2009, FTA/EIA)
156. US-Peru (2009, FTA/EIA)
157. US-Singapore (2004, FTA/EIA)
158. West African Economic and Monetary Union (WAEMU) (2000, CU)

In the technical requirement (TR) criterion, the exported good must have undergone specified manufacturing or processing operations which are deemed to confer origin of the country in which they were carried out.

### Is the product's origin defined through a technical requirement? [SR\_tr]

Transpacific Partnership (2019?), Annex 3-D (Product-Specific Rules of Origin)

Notwithstanding the applicable product-specific rules of origin, a good of chapter 27 that is the product of a chemical reaction is an originating good if the chemical reaction occurred in the territory of one or more of the Parties.

#### Variations

#### Combinations and alternatives

Those three criteria are used in existing trade agreements as stand-alone or in combination with other criteria, or as alternative criteria.

### Do two or more origin criteria apply cumulatively? [SR\_com]

Transpacific Partnership (2019?), Annex 3-D (Product-Specific Rules of Origin)

1901.20: A change to a good of subheading 1901.20 containing more than 30 per cent by dry weight of rice flour from any other chapter, provided that the value of non-originating rice flour of subheading 1102.90 does not exceed 30 per cent of the value of the good

### Do two or more origin criteria apply alternatively? [SR\_alt]

Transpacific Partnership (2019?), Annex 3-D (Product-Specific Rules of Origin)

1515.19: A change to a good of subheading 1515.19 from any other chapter; or

No change in tariff classification required for a good of subheading 1515.19, provided there is a regional value content of not less than 40 per cent under the build-down method.

#### Exceptions

Exceptions can be attached to a particular CTC requirement, generally prohibiting the use of non-originating materials from a particular HS subheading, heading, or chapter for goods supposed to qualify via CTC, and thereby making the requirement more restrictive:

### Are one or more HS codes or product groups explicitly excluded from being used as inputs for originating goods? [SR\_ctc\_exc]

Transpacific Partnership (2019?), Annex 3-D (Product-Specific Rules of Origin)

1102.90: A change to a good of subheading 1102.90 from any other chapter, except from heading 10.06.

From the answers to those 12 questions, Angeli et al. constructed 17 mutually exclusive PSR categories. As in Estevadeordal (2000)--the first to build an index of restrictiveness ('R-index') and subsequent modifications (see the comprehensive description in Inama (2022)-- the aggregation into 17 categories followed an 'observation' rule. The choice is built around five rules:

- Composite rules are distinguished according to whether the presence of multiple criteria relax the rule by giving more choice (i.e. 'or' rules) or make the rule stricter ('and' rules). For example, the PSR [CTH and RVC 40%] is not the same as PSR [CTH or RVC 40%]. Therefore, the rule was separated into two alternative sub-rules so that the two PSRs are classified separately.

- No differentiation across VC rules according to the required percentage of originating materials since percentages are not available across all.
- We group in the same category the combination of a CTC with a TR or with a VC rule
- We group in the same category the alternative of a CTC with a TR or a VC.
- We group in the same category the exception even if there are alternatives or combination associated to the exception.

Table A4 gives the mapping from the 17 categories in Angeli et al. to the 7 categories in table 1 in the main text.

**Table A4: Mapping of PSRs categories in Angeli et al. into the 7 categories in table 1.**

17 categories in Angeli et al.	Mapping into the 7 categories in table 1	Distribution (%)	
		1995	2015
1 WO	1: WO	0,5	1,9
2.CC	2: CTC	3,3	4,3
3. CH	2: CTC	13,3	15,1
4. CS	2: CTC	4,0	3,2
5. VC	3: VC	6,7	15,4
6. TR	4: TR	21,4	17,2
7. CC with EXC	5: EXC	2,4	3,1
8. CH with EXC	5: EXC	3,8	10,3
9. CS with EXC	5: EXC	0,5	0,3
10. CC and TR/VC	6: COM	0,6	1,6
11. CH and TR/VC	6: COM	1,9	2,1
12. CS and TR/VC	6: COM	0,4	0,1
13. TR and VC	6: COM	0,2	7,0
14. CC or TR/VC	7: ALT	0,8	1,8
15. CH or TR/VC	7: ALT	36,8	13,2
16. CS or TR/VC	7: ALT	1,2	2,6
17. TR or VC	7: ALT	0,1	0,3
Number of trade flows under PSR		105,038	345,337
Number of PTAs		17	128
VCR<40%		0.0	3.0
VCR=40%		11.0	66.7
VCR>40%		89.0	30.3

Table A5 shows three major shifts in the distribution on PSRs over the 20-year period: (i) the share of flexible rules (ALT) diminished by 2/3 to 13.2%;(ii). The share of VCRs more than doubled to 15.4%; (iii) the share of technical requirement (TR) fell to 17.2%. While it is difficult to surmise from these trends if these shifts changed compliance costs, it is likely that the reduction in the share of ALT category (flexible PSRs) captures an increase in compliance costs while the increase in the share of VCs could suggest a reduction in compliance costs if the VC thresholds are low. Indeed, for those VCRs for which percentages are available, the share of trade flows with a VCR above 40% has decreased from 89% in 1995 to 30.3% in 2015.

Table A5 shows the distribution of PSR categories by HS sections and table A6 across HS sections over 1990-2015. Looking at HS categories, all categories, except textiles, machinery and transportation have over 10% of their RoO fulfilled by a CTC criterion and the ALT category accounts for over 20% of RoO for 7 sectors and only animal products have less than 10% of sectors with some choice. TR requirements are concentrated in plastics, textiles, and transportation.

**Table A5: Distribution of PSR categories by HS sections (average over 1990-2015)**

HS section   PSR category	WO	CTC	VCR	TR	ALT	CUM	EXC	CC	CH	CS	
Animal products	22,8	20,1	4,5	15,4	9,0	3,3	4,9	12,3	7,4	0,3	100
Vegetables	17,0	23,3	4,7	12,9	11,9	4,8	2,1	10,4	11,0	1,9	100
Foodstuffs	5,0	21,2	6,5	13,3	16,5	3,3	13,1	7,4	11,9	1,9	100
Mineral products	0,9	22,1	8,0	15,4	21,8	6,7	3,0	3,8	18,2	0,1	100
Chemicals	0,0	16,7	12,9	14,4	27,0	6,1	6,2	0,5	10,5	5,7	100
Plastic/rubbers	0,1	14,5	16,7	17,9	21,5	8,6	6,3	0,0	12,4	2,0	100
Raw hides, skins, leathers	0,1	31,0	2,8	7,6	18,3	2,8	6,4	7,6	22,9	0,4	100
Wood products	0,1	30,9	6,7	10,5	13,1	3,9	4,0	2,3	25,8	2,8	100
Textiles	0,3	7,8	11,7	23,2	22,9	7,6	18,6	2,5	5,3	0,0	100
Footwear/headgear	0,0	20,4	9,8	11,2	17,6	4,8	15,8	2,3	13,1	5,0	100
Stone/glass	0,0	25,7	8,0	12,1	16,8	5,3	6,3	4,6	20,3	0,9	100
Metals	0,0	27,4	4,8	10,5	16,7	5,4	7,9	3,0	23,3	1,1	100
Machinery/electrical	0,2	8,5	30,8	19,8	20,8	5,8	5,6	0,0	4,6	3,8	100
Transportation	0,0	8,6	27,2	19,5	19,2	11,3	5,6	0,1	6,4	2,1	100
Miscellaneous	0,0	17,2	15,5	11,5	25,3	9,2	4,0	2,0	9,9	5,3	100



Turning to the distribution of PSRs across HS sections, textile and machinery/electrical rely on a large array of PSRs. Textiles, the subject of many studies a large array of relatively evenly distributed PSRs: threshold content requirement (VCR), technical requirements (TR), exceptions (EXC) but also a relatively large share of choices (highest share of ALT across HS). Chemicals and machinery/electrical stand out with a large share of CTC at the subheading level.

**Table A6: Distribution of PSR categories across HS sections (average over 1990-2015)**

HS section   PSR category	WO	CTC	VCR	TR	ALT	CUM	EXC	CC	CH	CS
Animal products	26,8	2,2	0,7	1,9	0,9	1,0	1,2	8,7	1,2	0,3
Vegetables	50,0	6,5	1,7	4,1	2,9	3,7	1,2	18,4	4,4	3,7
Foodstuffs	17,6	7,1	2,9	5,1	4,9	3,1	9,4	15,8	5,7	4,4
Mineral products	0,7	1,6	0,8	1,3	1,4	1,3	0,5	1,7	1,9	0,0
Chemicals	0,0	10,3	10,5	10,1	14,7	10,6	8,3	1,8	9,3	25,0
Plastic/rubbers	0,3	5,5	8,3	7,6	7,1	9,1	5,1	0,1	6,7	5,4
Raw hides, skins, leathers	0,1	2,7	0,3	0,8	1,4	0,7	1,2	4,3	2,9	0,3
Wood products	0,3	9,4	2,7	3,6	3,5	3,3	2,6	4,5	11,2	5,9
Textiles	2,2	6,6	13,1	22,3	17,0	18,1	33,6	13,6	6,4	0,1
Footwear/headgear	0,0	2,2	1,4	1,4	1,7	1,5	3,7	1,6	2,1	3,8
Stone/glass	0,1	7,0	2,9	3,7	4,0	4,0	3,7	7,9	7,9	1,7
Metals	0,4	21,8	5,1	9,4	11,6	12,0	13,4	14,9	26,5	6,0
Machinery/electrical	1,3	6,9	33,1	18,2	14,8	13,2	9,8	0,1	5,3	22,0
Transportation	0,0	1,5	6,3	3,9	2,9	5,5	2,1	0,1	1,6	2,6
Miscellaneous	0,1	8,7	10,3	6,6	11,2	13,0	4,4	6,4	7,2	18,8
	100	100	100	100	100	100	100	100	100	100

**Figure A5: PSR categories as share of trade value**

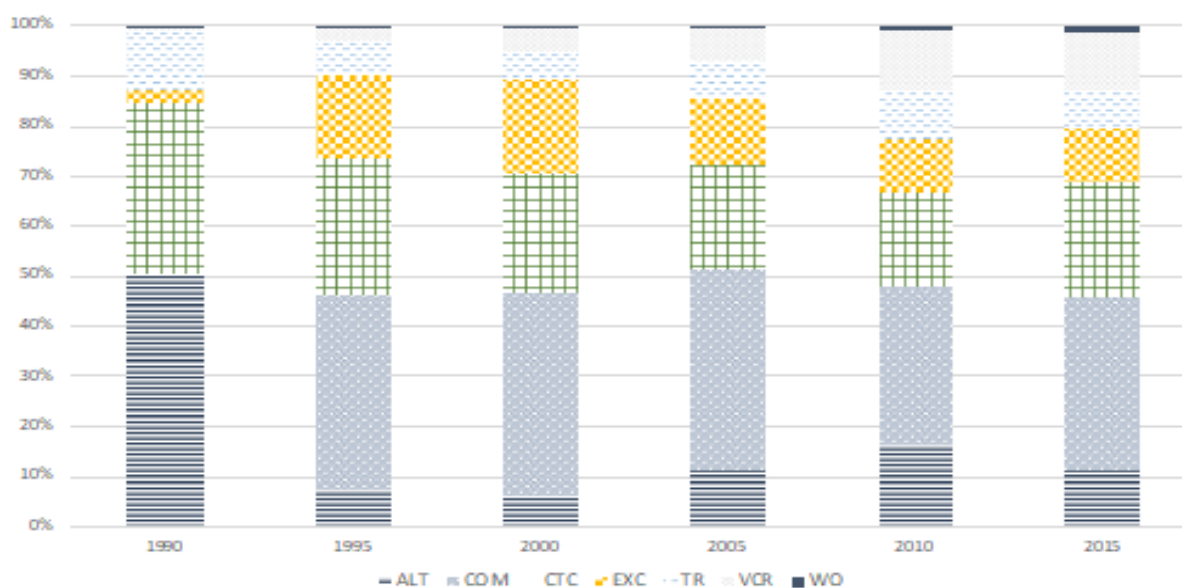
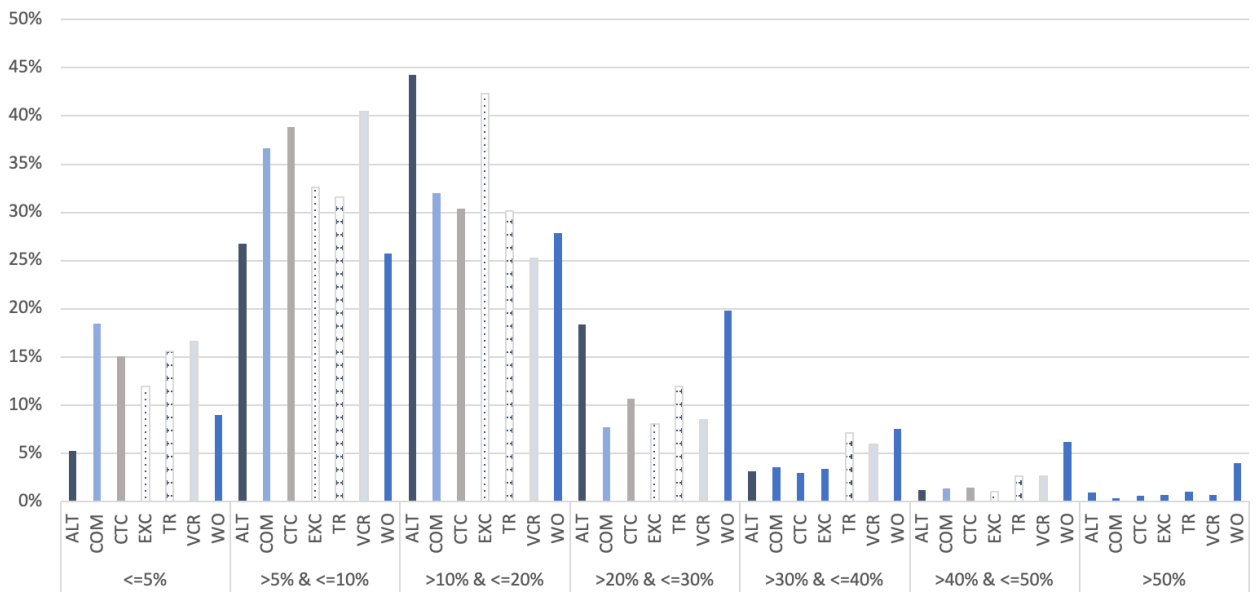


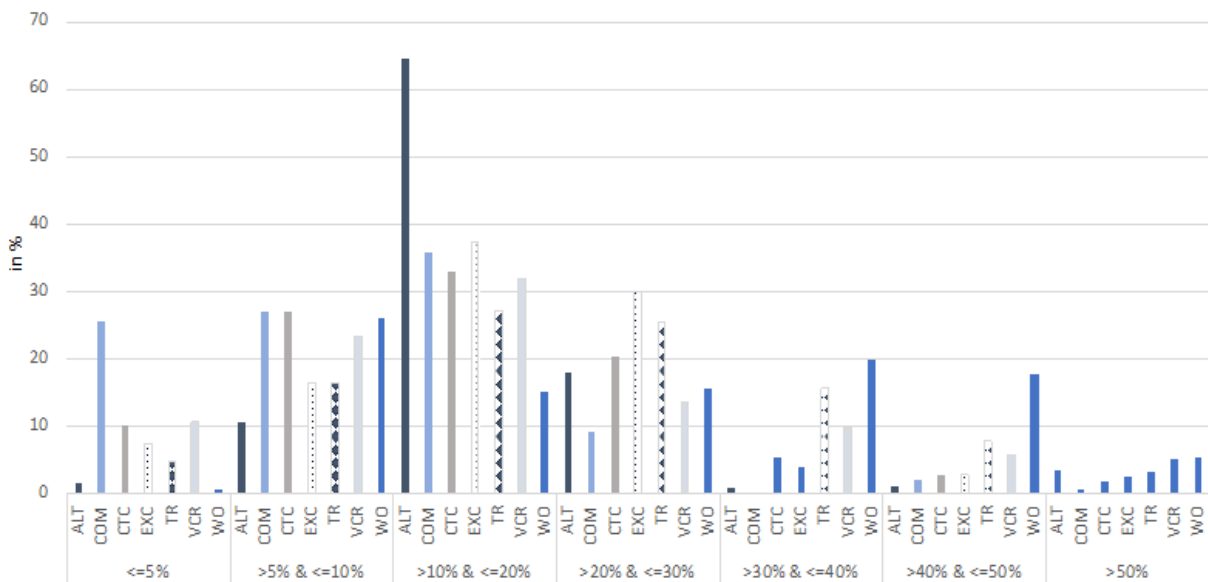
Figure A6 shows the frequency distributions of the PSR categories across 7 bins of preferential margins for 1995 and 2015. The largest share of observations is located between margins above 5% and below or equal to 20% and is gradually decreasing afterwards. Distributions are relatively similar overall. The distribution is flatter in 2015 than 1995. The flexibility (ALT) category is concentrated in the 10%-20% range.

**Figure A6: Frequency distribution of preferential margins across PSR categories by bins**



**1995**

**2015**



Notes: Figure displays the distribution of PSRs across 7 bins. Distribution of PSRs across bins adds up to 100%. Abbreviations to PSRs introduced in table 1.

Source: Authors.

#### A4. Additional descriptive statistics

**Table A7: Summary statistics of MFN tariff across country groups**

	count	mean	sd	min	max
OECD to OECD: MFN tariff	2 215 980	5.6	9.8	0.0	835.9
non-OECD to non-OECD: MFN tariff	4 158 378	12.5	16.2	0.0	3 000
OECD to non-OECD: MFN tariff	6 187 037	10.9	14.5	0.0	3 000
non-OECD to OECD: MFN tariff	2 560 888	6.1	8.9	0.0	835.9

Source: Authors.

Table A5 gives summary statistics of VCRs for 1995 and 2015 and figure A5, the distribution of % of value content.

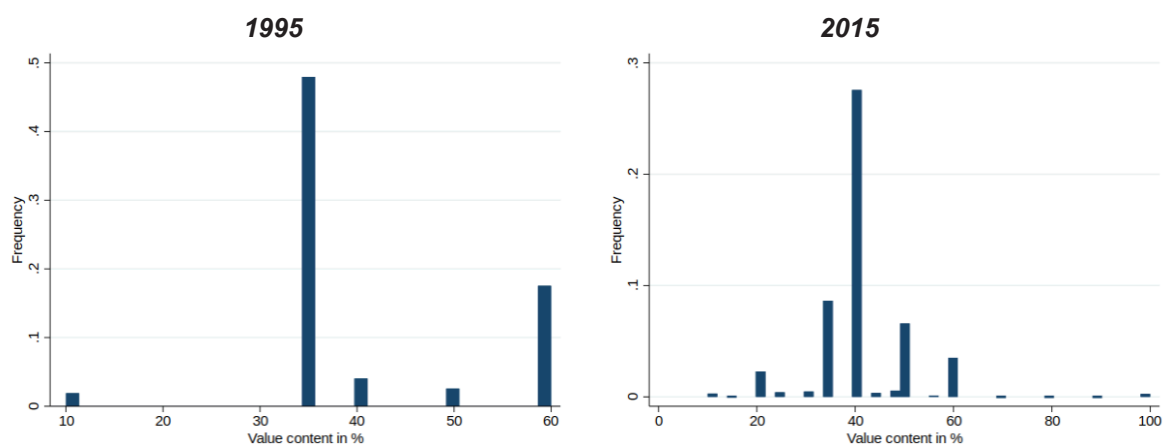
**Table A8: Summary statistics of value content %, 1995 and 2015**

	count	mean	sd	min	max
1995: value content %	5646	41.1	11.7	10.0	60.0
2015: value content %	43499	41.0	9.5	10.0	100.0

Notes: 1995: missing 5109/10755 (48%); 2015: missing 19475/62974 (30%)

Source: Authors

**Figure A7: Distribution of % of value content in VCR category**



## A5. Investigation on CTC types and VC threshold

Table A9: Results on preferential margin and CTC categories

Dependent variable:	Import value in million USD		$X_{ijkt}$
	(1)	(2)	(3)
Ln Preference margin (PM) <sup>-</sup>	0.425*** (0.046)		
Ln PM * Wholly obtained (WO) dummy		0.267* (0.155)	0.236 (0.154)
Ln PM * Change in Tariff Classification only (CTC) dummy		0.454*** (0.106)	
Ln PM * Change in Chapter (CC) dummy			0.257* (0.153)
Ln PM * Change in Heading (CH) dummy			0.497*** (0.147)
Ln PM * Change in Subheading (CSH) dummy			0.809*** (0.222)
Ln PM * Value content requirement only (VCR) dummy		0.960*** (0.101)	0.964*** (0.102)
Ln PM * Technical Requirement only (TR) dummy		0.120 (0.092)	0.123 (0.092)
Ln PM * Alternative (ALT) dummy		0.911*** (0.081)	0.912*** (0.081)
Ln PM * Combinations (COM) dummy		-0.130 (0.127)	-0.130 (0.127)
Ln PM * Exception (EXC) dummy		-0.223** (0.107)	-0.224** (0.107)
Wholly obtained (WO) dummy	-0.047 (0.034)	-0.092** (0.042)	-0.045 (0.089)
Change in Tariff Classification only (CTC) dummy	0.040*** (0.012)	-0.029 (0.018)	
Change in Chapter (CC) dummy			0.022 (0.081)
Change in Heading (CH) dummy			0.019 (0.081)
Change in Subheading (CSH) dummy			-0.037 (0.081)
Value content requirement only (VCR) dummy	0.027 (0.018)	-0.089*** (0.023)	-0.045 (0.082)
Technical Requirement only (TR) dummy	-0.036 (0.024)	-0.067** (0.028)	-0.023 (0.084)
Alternative (ALT) dummy	0.047*** (0.016)	-0.062*** (0.020)	-0.020 (0.081)
Combinations (COM) dummy	0.068*** (0.020)	0.048* (0.026)	0.088 (0.082)
Exception (EXC) dummy	-	-	0.042 (0.081)
Constant	10.770*** (0.001)	10.775*** (0.001)	10.772*** (0.006)
Fixed effects	ijk, ikt, jkt, ijt		
No. of observations	15,218,668	15,218,668	15,218,668
Adjusted R-squared	0.68	0.68	0.68

Robust standard errors, clustered at symmetric country-pairs and product (ijk)-level, are in parentheses.

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

**Table A10: Results on preferential margin and decomposition of VCR category**

Dependent variable:	Import value in million USD $X_{ijk\ell}$			
	(1)	(2)	(3)	(4)
Ln PM * Wholly obtained (WO) dummy	0.256* (0.155)	0.259* (0.155)	0.255 (0.155)	0.258* (0.155)
Ln PM * Change in Tariff Classification only (CTC) dummy	0.424*** (0.108)	0.426*** (0.108)	0.424*** (0.108)	0.426*** (0.108)
Ln PM * Value content requirement only (VCR) dummy	0.572*** (0.126)			
Ln PM * VCR dummy: if content % <= median (40%)		0.836*** (0.138)		
Ln PM * VCR dummy: if content % > median (40%)		-0.688** (0.304)		-0.687** (0.304)
Ln PM * VCR dummy: if content % < median (40%)			0.433** (0.204)	0.432** (0.204)
Ln PM * VCR dummy: if content % >= median (40%)			0.618*** (0.150)	
Ln PM * VCR dummy: if content % = median (40%)				0.981*** (0.173)
Ln PM * Technical Requirement only (TR) dummy	0.206** (0.093)	0.207** (0.093)	0.207** (0.093)	0.208** (0.093)
Ln PM * Alternative (ALT) dummy	0.882*** (0.082)	0.884*** (0.082)	0.884*** (0.082)	0.889*** (0.082)
Ln PM * Combinations (COM) dummy	-0.146 (0.127)	-0.143 (0.127)	-0.145 (0.127)	-0.139 (0.127)
Ln PM * Exception (EXC) dummy	-0.229** (0.108)	-0.236** (0.108)	-0.228** (0.108)	-0.233** (0.108)
Wholly obtained (WO) dummy	-0.097** (0.042)	-0.097** (0.042)	-0.099** (0.042)	-0.099** (0.042)
Change in Tariff Classification only (CTC) dummy	-0.029 (0.018)	-0.029 (0.018)	-0.029 (0.018)	-0.030 (0.018)
Value content requirement only (VCR) dummy	-0.045* (0.024)			
VCR dummy: if content % <= median (40%)		-0.054** (0.026)		
VCR dummy: if content % > median (40%)		0.040 (0.043)		0.038 (0.043)
VCR dummy: if content % < median (40%)			0.062 (0.042)	0.060 (0.042)
VCR dummy: if content % >= median (40%)			-0.067** (0.026)	
VCR dummy: if content % = median (40%)				-0.087*** (0.029)
Technical Requirement only (TR) dummy	-0.083*** (0.028)	-0.085*** (0.028)	-0.085*** (0.028)	
Alternative (ALT) dummy	-0.064*** (0.020)	-0.065*** (0.020)	-0.068*** (0.021)	
Combinations (COM) dummy	0.048* (0.026)	0.047* (0.026)	0.046* (0.026)	
Exception (EXC) dummy	-	-	-	
Constant	10.778*** (0.001)	10.778*** (0.001)	10.778*** (0.001)	10.778*** (0.001)

Fixed effects

ijk, ikt, jkt, ijt

No. of observations 15,132,316 15,132,316 15,132,316 15,132,316

Adjusted R-squared 0.68 0.68 0.68 0.68

Robust standard errors, clustered at symmetric country-pairs and product (ijk)-level, are in parentheses.

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

-ln PM stands for ln(Preference margin)=ln(1+MFN tariff)-ln(1+Preferential tariff) following Conconi et al. (2018)

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