

Teti, Feodora; Felbermayr, Gabriel; Yalcin, Erdal

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## Free Trade Agreements, Customs Unions In Disguise?

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# Free Trade Agreements, Customs Unions in Disguise?

GABRIEL FELBERMAYR\*, FEODORA TETI<sup>†</sup> and ERDAL YALCIN<sup>‡</sup>

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## Abstract

Using 19 years of tariff data for 121 countries and 4579 products, we document a hitherto overlooked stylized fact: countries' external tariff schedules are surprisingly similar. The correlation is particularly striking for countries belonging to the same deep preferential trade agreement. We show that most of this is due to selection effects rather than to ex post convergence. Bilateral tariff differences at the product level are smaller in absolute level than transportation costs for 70% of all country pairs. This has an important implication: In most preferential trade agreements, for a vast majority of products, trade deflection is not profitable even in the absence of costly rules of origin.

**Keywords:** Free Trade Agreements, Rules of Origin, External Tariffs

**JEL-Classification:** F10, F13, F15

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\*CESifo and Ifo Institute - Leibniz Institute for Economic Research at the University of Munich, Poschinger Str. 5, 81679 Munich, Germany; LMU Munich, & GEP; Phone: +49 89 9224 1428; E-mail: felbermayr@ifo.de

<sup>†</sup>Ifo Institute – Leibniz Institute for Economic Research at the University of Munich, Poschinger Str. 5, 81679 Munich, Germany; Phone: +49 89 9224 1389; E-mail: teti@ifo.de

<sup>‡</sup>CESifo and Ifo Institute - Leibniz Institute for Economic Research at the University of Munich, Poschinger Str. 5, 81679 Munich, Germany; Phone: +49 89 9224 1420; E-mail: yalcin@ifo.de

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# 1 Introduction

As multilateral negotiations seem to be on a deadlock, regional trade agreements (RTAs) proliferate. In general there are two types of the latter, namely preferential trade agreements (PTAs) and customs unions (CUs). In a PTA participating countries keep autonomy over external tariffs, whereas members share a common external tariff structure in a CU. On the one hand the absence of the common external tariff makes it easier for the negotiating countries to reach a trade agreement because institutions for a common trade policy do not have to be installed. It is therefore not surprising that the vast majority of RTAs are PTAs (Dür et al. 2014; Freund and Ornelas 2010). In 2016 only roughly 10% of the RTAs were CUs.

On the other hand differences in external tariffs can change trade flows in PTAs substantially. To gain intuition assume a PTA between country  $i$  and country  $j$ , where country  $i$  imposes a tariff of 10% on product  $k$  and country  $j$  of 5%. The preferential tariff within the PTA area equals 0%. If a third country's final export destination was country  $i$ , it would transship its exports through country  $j$ , in order to pay the lower tariff and then export from country  $j$  to country  $i$  at the preferential tariff. Such a change in trade flows is known as "Trade Deflection". If this behavior were possible the preferential character of a PTA would be eroded as not only the countries participating in the PTA enjoy lower tariffs but the trade liberalization would in fact be extended to third countries. Although from a global perspective desirable, trade deflection would make the process to reach an agreement significantly harder, imposing similar difficulties as current multilateral negotiations are facing.

The Rules of Origin (RoO) are installed to put an end to trade deflection. To make sure that preferences are only granted to PTA-members it is necessary to determine the country of origin. Typically, the last country in which a product underwent a substantial transformation is considered the country of origin. If this country is within the free trade area, the product is eligible for the preferential tariff; otherwise the most favored nation (MFN) tariff will be applied. The RoO define the criteria to be met to suffice "a substantial transformation". As an example consider the product-specific rule in the Trans-Pacific Partnership agreement (TPP) for a textile good falling under HS heading 5804.10 ("Tulles and other Net Fabrics")

*A change to a good of subheading 5804.10 from any other chapter, except from heading*

*51.11 through 51.13, 52.04 through 52.12 or 54.01 through 54.02, subheading 5403.33 through 5403.39 or 5403.42 through 5403.49, or heading 54.04 through 54.08, or chapter 55.*

However, RoO come at a price. Deardorff (2016) shows in a simplistic set-up that even when every country has a PTA with every other country RoO can yield a lower level of welfare than in the situation where no PTA was present and only MFN tariffs apply. The theoretical literature points to three reasons why complying with RoO is costly: first, the detailed and highly complex product-by-product criteria make them hard to meet. Exporter need to build up (legal) know-how to comply with the rules. Second, exporters face different RoO depending on the export-destination due to multiple PTAs with little overlap in the design of the RoO<sup>1</sup>. Third, exporters might want to change production processes to meet RoO requirements, distorting trade patterns and investment flows (K. Krishna 2006; K. Krishna and Krueger 1995).

The empirical evidence confirms the negative effects of complying with RoOs. The compliance costs associated with meeting RoO requirements range from 3-15% of final product prices depending on the method used to measure the restrictiveness of RoO (Anson et al. 2005; Cadot, Estevadeordal, et al. 2006; Carrere and Melo 2006; Estevadeordal 2000). Andersson (2015), Augier et al. (2005), and Bombarda and Gamberoni (2013) use the liberalization of the EU's RoO as a natural experiment and find it to have a positive effect on total trade. Constructing a new database on the NAFTA RoO Conconi et al. (2016) show that RoO on final goods reduce imports of intermediate goods from third countries by around 30%-points. Further, firm-level evidence suggests heterogeneity across firms as mostly larger firms actually comply with the RoO (Cadot, Graziano, et al. 2014; Demidova et al. 2012). Firm surveys show that RoO hinder firms to use PTA preferences (Suominen and Harris 2009; Wignaraja et al. 2010). Also preference utilization rates of less than 100% indicate the high fixed costs associated with RoO making it unprofitable for exporters to comply with the rules (Keck and Lendle 2012).

These costs are only justified when country-pairs in a PTA set external tariffs sufficiently different, otherwise RoO would not be justified. As stressed above, the effects of the RoO on trade flows have been analyzed extensively, but to the best of our knowledge the question

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<sup>1</sup>Estevadeordal and Suominen (2006) review the types of RoO used around the world and find significant heterogeneity with respect to the exact requirements as well as the level of restrictiveness.

whether they are actually necessary has not been answered yet. We aim to fill this gap. In this paper we want to check how large the differences in external tariffs actually are, and whether country-pairs with a PTA have systematically lower differences in external tariffs.

There are at least three reasons that leave us to question the necessity of the harmful RoO: first, the overall low level of tariffs - especially in light of non negligible other trade costs - makes trade deflection unprofitable for exporters. Second, selection could drive results as the same covariates might correlate with the probability of having a PTA and the difference in external tariffs (*Selection Channel*). For example countries with a similar economic structure might find it easier to form a PTA because interests of lobbyists coincide. Third, the PTA might have an effect on itself e.g. when industry structures change through processes like technological transfers of foreign direct investment (FDI) (*PTA-Effect*). Further external trade liberalizations following the formation of a PTA are an alternative mechanism of the *PTA-Effect*.

We introduce a new tariff database, that deals with the well-known issue of missing data in the standard sources for tariffs (TRAINS and World Bank), and use it to assess the differences in external tariffs. The level of tariff similarity is high, especially when focusing on imported goods: for 77% of the imports in 2014 the difference in external tariffs was at most 3%-points. When explicitly accounting for other transportation costs, the picture becomes even clearer, as for 70% of the tariff lines the differences in external tariffs do not exceed the transportation costs. Therefore, trade deflection becomes unprofitable and the economic rationale for RoO vanishes.

Furthermore, the data indicates a diverging pattern depending on the type of PTA. While country-pairs with a deep PTA also set tariffs more alike than pairs without a PTA, the opposite is true for shallow PTAs. To find out whether positive selection drives the results or if indeed the PTA on its own has an effect on the differences in external tariff we employ a difference-in-differences approach. We compare country-pairs with a deep and shallow PTA respectively to those without. The structure of our data allows to account in the most flexible way possible for omitted variables by a full set of fixed effects. We find the *Selection Channel* to be dominant for pairs with a deep PTA, for pairs with a shallow PTA the *PTA Effect* is instead larger. We can show that this pattern is mostly driven by lower tariff levels. The pattern in the data suggests rethinking the current practice of installing RoO by default, which has significant implications for future trade policy.

Additionally to the RoO literature described above, we contribute to at least two other strands of the literature: first, we add to the literature, which analyzes whether preferential trade liberalization leads to lower or higher external tariffs (see Freund and Ornelas (2010) for an extensive literature review). Theory does not yield clear predictions. While Bagwell and R. W. Staiger (1999), Ornelas (2005a,b), and Richardson (1993) argue in favor of the decrease in external tariffs as a result of a PTA, Karacaovali and Limão (2008) and Limão (2006) show the exact opposite. Empirical analysis based on developing countries finds evidence for the positive relationship between preferential tariffs and external tariffs (Calvo-Pardo et al. 2011; Crivelli 2016; Estevadeordal, Freund, et al. 2008). For developed countries the effect seems to depend on the type of the PTA: while Ketterer et al. (2014) finds evidence for preferences promoting external tariff liberalization in the case of Canada when analyzing the Canada-US FTA, Karacaovali and Limão (2008) and Limão (2006) find the opposite for the EU and the US, respectively<sup>2</sup>.

Second, we contribute to the literature analyzing the determinants of tariffs. Much of the empirical literature focuses on the predictions of the protection for sale model of Grossman and Helpman (1994) and identifies the interest of special interest groups, the transparency of the country's government, its form of governance, and its responsiveness to public welfare to determine the level of tariffs (i.e. Goldberg and Maggi (1999) and Mitra et al. (2002), see Gawande and P. Krishna (2003) for an overview). For developing countries tariffs might pose a way of collecting government revenues. Gawande, P. Krishna, and Olarreaga (2015) show theoretically and empirically that developing countries with weak tax systems often weigh tariff revenue heavily, while more developed countries weigh producer interests the most. Additionally, Bagwell, R. Staiger, et al. (2011), Broda et al. (2008), and Ludema and Mayda (2013) find that terms-of-trade manipulation matter when governments set their tariffs.

The rest of the paper is organized as follows. Section 2 describes the data and the variables used in the empirical analysis and section 3 shows the relationship between tariff similarity and PTAs. In section 4 we describe the empirical strategy used to identify potential channels and

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<sup>2</sup>Ketterer et al. (2014) stress that while the focus of CUSFTA was on reciprocal market-access, many of the agreements that Karacaovali and Limão (2008) and Limão (2006) were analyzing have a different scope, namely promoting development in other areas such as intellectual property enforcement, democracy, human rights, labor standards or deeper integration issues. They argue that these differences with respect to the PTAs are the reason for the different empirical results.

present our estimation results. Section 5 concludes.

## 2 Data

Our goal is to analyze the differences in external tariffs between country-pairs, check how large they are, and quantify to what amount pairs with a PTA set tariffs in a more similar way than those without. In this section we first describe the novel underlying tariff database, second we explain our measure for tariff similarity, third the source for the PTA data is presented, and fourth we show data on product-pair specific transportation costs.

### 2.1 New Tariff Database

For the empirical analysis ideally we would need data on the effectively applied tariff imposed by an importer for every good from any destination country. The effectively applied tariff equals the MFN tariff for imports from countries where no PTA is in place, whenever there is a PTA we are interested in the preferential tariff. To minimize the aggregation bias the ideal data would be as disaggregated as possible. As trade deflection could happen in theory with any third country where a PTA exists, the perfect data would provide information for the universe of countries. In the empirical strategy we will use time variation in the presence of the PTAs to disentangle the channels at work. Therefore, the longer the panel, the better for identification.

Using the World Bank's World Integrated System (WITS) software, which pools data from the United Nations and the World Bank, we combine all publicly available information on MFN tariffs, preferential tariffs as well as ad valorem equivalents of non advalorem tariffs. We gather information of more than 150 countries on the 6-digit product level of the common HS system with some of the data dating back to 1988. Whenever more than one preferential scheme applies (i.e. a bilateral PTA and the General System of Preferences), multiple preferential tariffs might be observable for trade in a particular product between two countries. We always assume the lowest preferential tariff to be effectively in place.

Even though in theory the data provided by the WITS should be exactly what we are looking for, its substantial incompleteness is a major issue. As Anderson and Wincoop (2004) state *"the grossly incomplete and inaccurate information on policy barriers available to researchers is*

*a scandal and a puzzle*” (p. 693). Most countries do not report tariffs every year: for example in 1999 out of 121 reporting countries only 43% reported tariffs. Although the coverage improved over time, it is far from perfect even in the recent years. Even more troublesome for any empirical analysis is the fact that the set of countries that report only sporadically is not random but rather consists mostly of developing countries (see Figure A1 in the appendix). As tariffs tend to be systematically different between developing and developed countries, the non-random pattern of missing data will bias results.

So far, there is no consensus in the literature how to tackle the problem. We deal with the missing data in the following way: rather than replacing missing MFN tariffs by linearly interpolating observations, missing values are set equal to the nearest preceding observation. The procedure accounts for the fact that countries are more likely to update schedules after a significant tariff change. If there is no preceding observation, missing MFN tariffs are set equal to the nearest succeeding observation. For preferential tariffs interpolating is significantly harder because PTAs have often been phased-in instead of cutting all tariffs immediately when the PTA enters into force. We use information on the agreed phasing-in for more than 500 PTAs provided by DESTA (Dür et al. 2014) to impute the data in the most adequate way (see the appendix for details).

Table A2 in the appendix shows the number of observations that WITS provides and the number of observations that we end up having after the interpolation. The difference is especially in the early years of the sample striking, for later years the reporting coverage improves significantly. Except for Caliendo et al. (2015)<sup>3</sup> to the best of our knowledge there is no comparable data base for tariffs in terms of country- and time-coverage as well as level of disaggregation at hand.

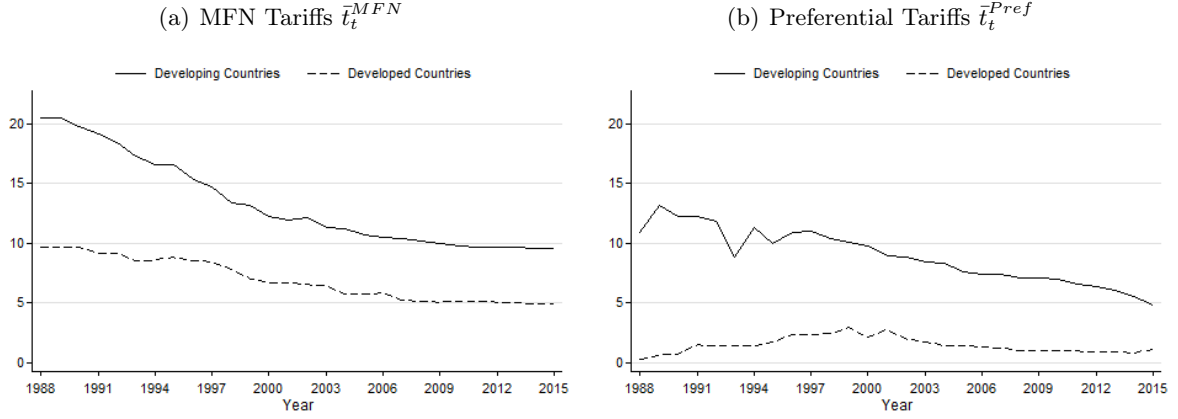
As Figure 1(a) shows, the MFN tariffs have decreased quite substantially since the late 80’s. We show for each year  $t$  the unweighted mean  $\bar{t}_t^{MFN} = \sum_k \frac{1}{|\mathcal{K}|} \sum_i \frac{1}{|\mathcal{I}|} t_{ikt}^{MFN}$ , with  $k$  products, and  $i$  importing countries for developing and developed countries separately. For both developed and developing countries the level of MFN tariffs halved between 1988 and 2015. Developing

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<sup>3</sup>Caliendo et al. (2015) have constructed a similar database. Additionally to the tariffs provided by the WITS they add data from three other sources: manually collected tariff schedules published by the International Customs Tariffs Bureau, US tariff schedules from the US International Trade Commission, and US tariff schedules derived from detailed US tariff revenue and trade data provided by the Center for International Data at UC Davis. The imputation algorithm is very similar to ours with the drawback that they only have information on approximately 100 PTAs and their phasing-in regimes.



**Figure 1:** MFN and Preferential Tariffs over Time

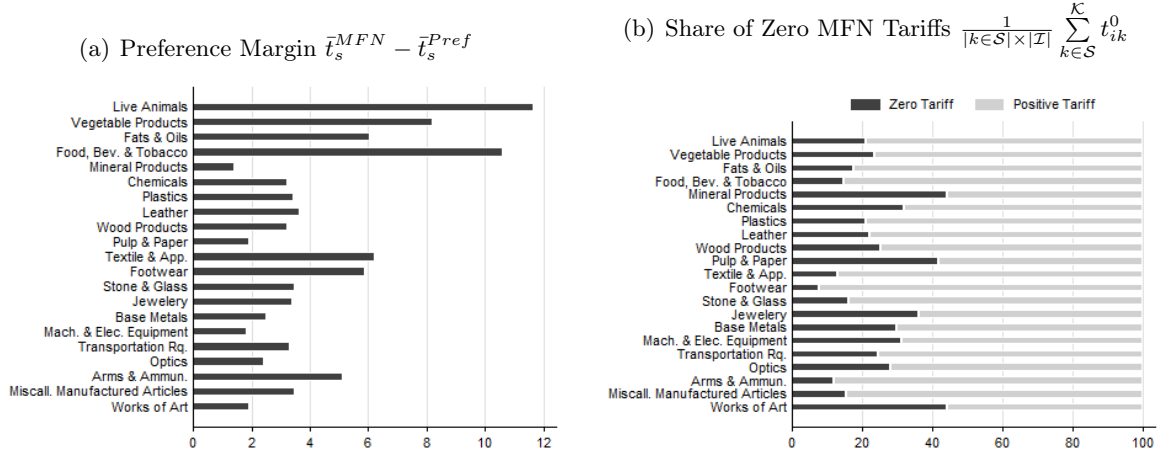


We use the UN definition to determine the development status of a country. Developed countries are Australia, Canada, the member countries of EFTA and the European Union, Japan, New Zealand, and the US. All others belong to the group of developing countries. We show unweighted averages:  $\bar{t}_t^{MFN} = \sum_k \frac{1}{|\mathcal{K}|} \sum_i \frac{1}{|\mathcal{I}|} t_{ikt}^{MFN}$  and  $\bar{t}_t^{Pref} = \sum_k \frac{1}{|\mathcal{K}|} \sum_i \frac{1}{|\mathcal{I}|} \sum_j \frac{1}{|\mathcal{J}|} t_{ijkt}^{Pref}$ , with  $k$  products,  $i$  importing countries,  $j$  exporting countries, and  $t$  equals years.

countries had on average a MFN tariff of 20.49% in 1988, while it equals only 9.63% in 2015. For developed countries MFN tariffs decreased in the period of observation from 9.70% to 4.92%. One can observe for both groups of countries a sharp decline between 1988 and 2005, afterwards the MFN tariffs remain rather stable. The observed pattern shows the success of the Uruguay Round, which was concluded in 1994 and stipulated tariff cuts to be put into effect until 2005. Since 1988 the preferential tariffs (see Figure 1(b)) of the developed countries have been on a rather low level, ranging between 0.31 and 2.94%-points. For the developing countries, a decreasing time trend can be observed resulting in an average preferential tariff in 2015 of 5.60%-points. Again, we are showing an unweighted average of the preferential tariff over all products and country-pairs,  $\bar{t}_t^{Pref} = \sum_k \frac{1}{|\mathcal{K}|} \sum_i \frac{1}{|\mathcal{I}|} \sum_j \frac{1}{|\mathcal{J}|} t_{ijkt}^{Pref}$ , with  $k$  products,  $i$  importing countries,  $j$  exporting countries, and  $t$  equals years.

The preference margin - the difference between MFN and preferential tariffs  $\bar{t}_s^{MFN} - \bar{t}_s^{Pref}$  - is essential when determining the relevance of RoO: exporters will only comply with them, when the preference margin is large. In 2014, it equals on average 4.23%-points. However, there is large heterogeneity across the different industry sectors. Figure 2(a) shows for 2014 the preference margin by section. It is lowest for mineral products (1.44%-points), and highest for live animals (11.66%-points). Overall it is largest for the agricultural sector - live animals, vegetable products, fats & oils, and food, beverages & tobacco. The textile sector (textile &

**Figure 2:** Preference Margin and Share of Zero MFN Tariffs (%-points) by HS-Sections



The preference margin is the difference between the MFN tariff a country applies and the preferential tariff it offers its PTA partners. The share of zero MFN Tariffs is the number of zero MFN tariffs as a percentage of the total number of MFN tariffs. We present unweighted averages for 2014:

$$\bar{t}_s^{MFN} = \sum_{k \in S} \frac{1}{|K|} \sum_i \frac{1}{|I|} t_{ikt}^{MFN}, \bar{t}_s^{Pref} = \sum_{k \in S} \frac{1}{|K|} \sum_i \frac{1}{|I|} \sum_j \frac{1}{|J|} t_{ijkt}^{Pref}, \text{ and } \frac{1}{|k \in S| \times |I|} \sum_{k \in S} t_{ik}^0 \text{ with } k \text{ products, } i \text{ importing countries, } j \text{ exporting countries, } S \text{ HS-Sections, and } t_{ik}^0 = \{1 | t_{ik}^{MFN} = 0\}.$$

apparel and footwear) as well as arms and ammunition are with 5 to 6%-points somewhat in the middle, while the preference margin is rather low for the remaining products.

Every product for which the MFN tariff equals zero is not affected by RoO at all because the exporter has no incentive to comply with the RoO in the first place. Again, depending on the specific sector the probability of a zero MFN tariff differs. The higher the share of products with a zero MFN tariff, the weaker the argument in favor of the RoO for the respective sector, because trade deflection is not an issue in these cases. Figure 2(b) shows the share of zero MFN tariffs by the different sections. The sections with the highest percentage of zero MFN tariffs (more than 40%) are Mineral Products, Pulp & Paper, and Works of Art. In contrast, the share only equals 7.78%-points for Footwear, for Textiles & Apparel, and Arms & Ammunition it equals roughly 12%-points.

## 2.2 Tariff Similarity

To evaluate whether harmful RoO are justified, the external tariff vectors between country  $i$  and country  $j$  have to be compared. The most intuitive way to do so is to use the absolute difference between the tariff that country  $i$  imposes against a third country  $c$  and the tariff that country  $j$

imposes against  $c$ . If  $i$  and  $j$  set the same external tariffs, e.g. if they are members of a customs union, the difference equals zero. Thus, tariff similarity is lower the higher the difference. In theory we could calculate these differences for every country-pair  $ij$  with respect to a third country  $c$ . As we have data on the HS-6-digit level we can do so for every product  $k$ . However, with more than 5,000 products, the time- and pair-dimension, the number of observations would increase to a level impossible to handle. We deal with this issue by constructing first an import weighted tariff  $t_{ikt}^w$  for country  $i$ , product  $k$ , and time  $t$ . In a second step we calculate absolute differences in external tariffs using the weighted tariff.

Equation 1 describes how, in the first step, we construct the weighted tariff for each country  $i$  product  $k$  and time  $t$  combination.  $t_{ikt}^w$  is an import weighted average of the effectively applied tariff of country  $i$  for imports from country  $j$ .  $t_{ijkt}$  equals the preferential tariff if the country-pair  $ij$  has a PTA. Otherwise,  $t_{ijkt}$  equals the MFN tariff. The import weight  $\frac{imp_{ijkt}}{imp_{ikt}^{tot}}$  equals the imports from  $j$  to  $i$  for a specific product  $k$   $imp_{ijkt}$  as a share of the total value of imports of country  $i$  for product  $k$  ( $imp_{ikt}^{tot}$ ), so the higher the relevance of a tariff in terms of import flows, the higher its weight in the import weighted tariff. The data for the imports stems from BACI (Gaulier and Zignago 2010). We end up with one weighted external tariff for country  $i$ , product  $k$ , for each year  $t$ .

$$t_{ikt}^w = \sum_{j=1}^n t_{ijkt} \times \frac{imp_{ijkt}}{imp_{ikt}^{tot}} \quad (1)$$

In a second step we construct the measure for tariff similarity between country  $i$  and  $j$  by calculating the absolute difference between the weighted tariff  $t_{ikt}^w$  of country  $i$  and  $t_{jkt}^w$  of country  $j$  for every product  $k$  at time  $t$  (see equation 2). The smaller the absolute difference in external tariffs  $\Delta t_{ijkt}$  for country-pair  $ij$  the higher the level of congruency of the external tariff vector of country  $i$  and  $j$ . As Table 1 shows, on average the absolute difference in external tariffs equals 10.69%-points.

$$\Delta t_{ijkt} = |t_{ikt}^w - t_{jkt}^w| \quad (2)$$

As the quality of the tariff data in terms of percentage of countries reporting improves signifi-

cantly after the entering into force of the World Trade Organization (WTO) in 1995 and is again surprisingly bad for 2015 (see Figure A1 in the Appendix), we will focus on the period 1996-2014 for our analysis. In order to have a balanced panel we only keep countries for the analysis that are observed in every year of interest, leaving us with 121 countries (see the appendix for a complete list of the countries in the sample). Again, dimensionality is a curse: with 19 available years, roughly 2,500 products for each country-pair, and  $121 \times 120 = 14,520$  country-pairs, if we did a yearly analysis the number of observations would exceed 666 Million. We restrict therefore the analysis to 1996 and 2014.

**Table 1:** Summary Statistics

	Mean	SD	Shallow PTA	Deep PTA	$\Delta$
Absolute Difference in Tariffs	10.69	30.93	12.70	6.77	5.93***
Trade Costs (Product-Pair)	7.29	7.28	7.05	5.76	1.29***
Year of Entry into Force	1,997.47	9.73	1,991.53	2,004.70	-13.17***
Depth-Index [0, 7]	2.34	2.43	1.08	5.81	-4.73***
PTA [0, 1]	0.35	0.48			
Deep PTA [0, 1]	0.13	0.33			
Shallow PTA [0, 1]	0.28	0.45			
Customs Union [0, 1]	0.16	0.37			

The maximum number of observations equals 34.5 Million. The tariff data stems from WITS, the trade costs are based on own calculations using data from Schott (2008), the Year of Entry Into Force of the RTAs is based on own research, while all other information concerning RTAs is taken from DESTA (Dür et al. 2014).

## 2.3 PTA Data

Our analysis builds on the DESTA database by Dür et al. (2014), in the version of 27<sup>th</sup> of June 2016. It comprises over 600 RTAs (PTAs as well as CUs) and the corresponding accessions and withdrawals, which is to the best of our knowledge the most complete list currently available (see Dür et al. (2014) for a detailed description)<sup>4</sup>. For our sample, on average the probability of a country-pair having a PTA equals 35%, while it equals 16% for having a CU. For the analysis it is important to clearly distinguish between those two types as RoO are only an issue with

<sup>4</sup>Country-pairs might have signed more than only one PTA. For example, the Canada-United States FTA was signed in 1988 and was superseded by NAFTA in 1994. In our data such cases are modeled as follows: from 1988 until 1994 the Canada-United States FTA is the PTA between Canada and the US, and as soon as NAFTA entered into force it takes its place. Thus, the database accounts for changes in the PTA-landscape. In the few cases where the more recent PTA features a lower depth-index than the already existing one, the latter was used. The procedure ensures that for each country-pair only one PTA is included in the database.

PTAs. Besides the extraordinary high number of RTAs included in DESTA, for each agreement a measure of coverage depth is provided. The depth-index ranges from 0 to 7 and counts the number of provisions (partial scope agreement, substantive provisions on services, investments, standards, public procurement, competition, and intellectual property rights). So, if a RTA covers all seven provisions it will get assigned a depth-index of 7.

This classification is a big advantage of the DESTA database over other PTA-compilations like the WTO-RTA gateway, as it allows to exploit the heterogeneity across RTAs. In our analysis we group all PTAs into two groups, namely shallow and deep agreements. All PTAs with a depth-index of less than 4 belong to the shallow PTAs, the remainder to the deep PTAs. The later is less common in our data: the probability of having a deep PTA equals 13% while the probability of having a shallow PTA is more than twice as much (28%). As the summary statistics show, for shallow PTAs the tariff similarity is significantly smaller than for deep PTAs, the differential equals 5.93%-points. We have manually researched the year of entry into force (EiF) for the PTAs in DESTA. In the few cases when we could not find an EiF-year, we used the year of ratification instead. On average the PTAs in our sample were entered into force between 1997 and 1998, however, there seem to be two generations of PTAs: the deep PTAs are a lot younger than the shallow PTAs (see Table 1).

## 2.4 Transportation Costs

When evaluating the necessity of RoO, it is important to compare the absolute differences in external tariffs with the trade costs arising from trade deflection. A third country  $c$  will only transship its exports through country  $i$  to the final destination  $j$  when the difference in external tariffs  $|t_{jck} - t_{ick}|$  exceeds the additionally arising trade costs. Therefore, it is crucial to have for every product-pair combination an adequate measure for those costs. Besides tariffs, other trade costs like transportation costs, information costs, contract enforcement costs, costs associated with the use of different currencies, legal and regulatory costs, and local distribution costs arise (Anderson and Wincoop 2004). Ideally we would have a product-pair measure of all trade costs other than tariffs. However, due to data availability and partly the private nature of certain types of trade costs such as those associated with information barriers and contract enforcement this is impossible to do. We focus therefore in our analysis on transportation costs i.e. freight

charges and insurance and present now how we construct those.

Anderson and Wincoop (2004) propose industry or shipping firm information to be the first best source of data for transportation costs as it is a direct measure. However, available data is scarce. Alternatively one can use cif/fob ratios. The ratio gives, for each country, the value of imports inclusive of carriage, insurance and freight, relative to their free on board value, the cost of the imports and all charges incurred in placing the merchandise aboard a carrier in the exporting port. Therefore, the closer the ratio gets to one, the lower the costs arising due to trade costs other than tariffs. Again, data limitations make this approach unfeasible: reliable data on cif- and fob-imports are not available for the set of countries we are interested in.

We go about this problem in the following way: first, using US data, originally provided by the US Census and cleaned by Schott (2008), we can determine bilateral ad-valorem transportation costs between the US and all its trade partners for every product  $k$ . The data includes information on the import value at fob and cif bases at the ten-digit HS level by exporter country for the years 1989 until 2015. Thus, we end up with a US-specific measure of transportation costs

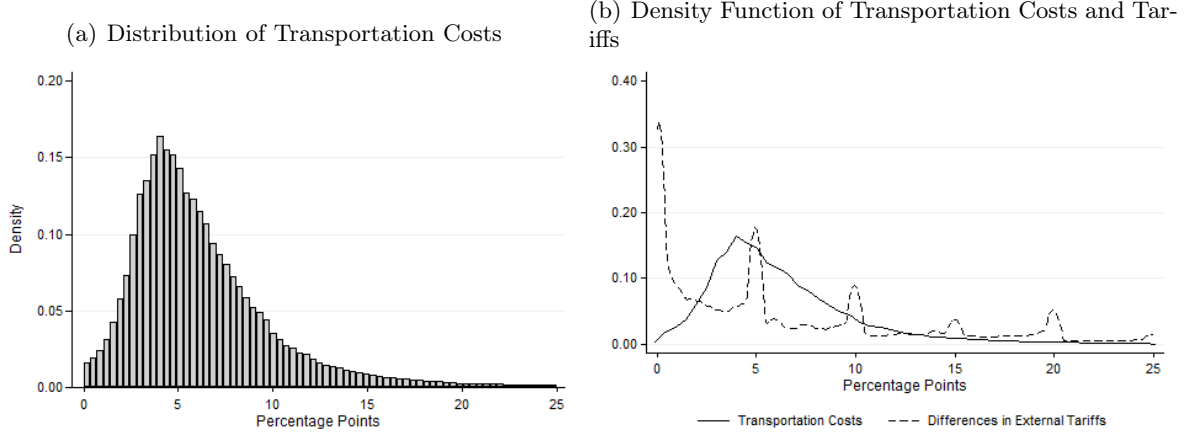
$$\tau_{US,i}^k = \frac{imp_{US,i}^{k,cif}}{imp_{US,i}^{k,fob}} \geq 1 \text{ for every product-exporter } k - i \text{ combination.}$$

In a second step we want to use the cif-fob ratios for the US to infer transportation costs for all other product-pair combinations. We assume the transportation costs to be a function of distance such that  $\tau_{ij}^k = \alpha^k (D_{ij})^{\delta^k}$  with  $\delta^k \in (0, 1)$  so that non-tariff trade costs are an increasing, strictly concave function of geographical distance. Thus, it is possible to estimate the parameters  $\alpha^k$  and  $\delta^k$  for every product  $k$  for the US using  $\tau_{US,c}^k$  and the bilateral distances between the US and its trading partners  $i$ ,  $D_{US,i}$ . The information about the bilateral distances stem from CEPII. Taking logs makes OLS a feasible estimator. The regression equation equals  $\ln(\tau_{US,i}^k) = \alpha^k + \beta^k \ln(D_{US,i}) + u^k$ .

Now, it is possible to out-of-sample predict, for every country-pair and for every product  $k$ , an estimate transportation cost  $\hat{\tau}_{ij}^k = \exp(\hat{\alpha}^k + \hat{\delta}^k \ln(D_{ij}))$ . The trade costs equal on average 7.29% but are significantly lower between country-pairs with a PTA. Further, the deeper a PTA, the lower the transportation costs (see Table 1). Figure 3(a) shows the distribution of the estimated transportation costs. In Panel(b) the density functions for the difference in external tariffs and the transportation costs are plotted. One can see at a glance that there exist many tariff lines for which the tariffs are very similar (i.e. identical or at most 5%-points) and the transportation

costs are greater than zero.

**Figure 3:** Transportation Costs (Pair-Product Specific)



The estimated transportation costs for every product-pair combination are for the year 2014. The data are truncated to values  $\leq 25$  and  $\geq 0$ .

### 3 Tariff Similarity and PTAs

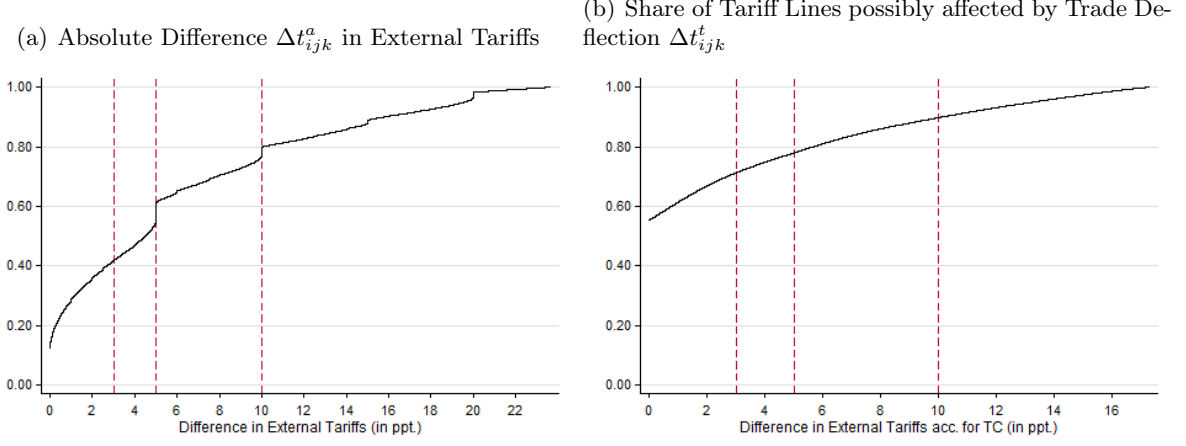
In this section we will present new stylized facts about tariff similarity in terms of the overall level, the comparison with transportation costs, and heterogeneity across types of RTAs, regions, and industry sectors. We show cross-sectional data on the 6 digit product-level for 2014.

#### 3.1 High Tariff Similarity

To evaluate whether RoO are necessary it is important to understand better how large the differences in the external tariffs between countries actually are. A good indication is the cumulative distribution function for  $\Delta t_{ijk}^a$ , which is shown in figure 4(a). The higher up the graph, the higher the probability of having similar external tariff vectors. For 12% of the product-pair combinations the tariffs are identical between  $i$  and  $j$ , and for 42% the absolute difference in external tariffs amounts to at most 3%-points. In 61% of the cases  $\Delta t_{ijk}^a$  equals at most 5%-points, and for less than 20% it exceeds 10%-points. The evidence so far already suggests a rather high degree of tariff-similarity between country-pairs. However, it is hard to tell whether the congruency between countries is high enough to make trade deflection unprofitable and therefore RoO

unnecessary from an economic point of view.

**Figure 4:** Cumulative Distribution Function



$\Delta t_{ijk}^a = |t_{ikt} - t_{jkt}|$  with country  $i$ , country  $j$ , product  $k$ , and time  $t$ ;  $\Delta t_{ijk}^t = \max\{0, |t_{ikt}^w - t_{jkt}^w| - \tau_{ijk}\}$  with country  $i$ , country  $j$ , product  $k$ , time  $t$ , and  $\tau$  transportation costs. We show data for 2014. Panel (a): truncated to values  $\leq 22$ , Panel (b): truncated to values  $\leq 18$ .

A definite statement on the necessity of RoO is only possible when also considering the transportation costs and checking how many tariff lines could be possibly affected by trade deflection. To understand better how we can determine whether exporter have an incentive to transship products, consider the following reasoning: let total trade costs between  $i$  and  $j$  (for some product  $k$ ) be given by tariffs  $t_{ij}^k$  and the minimum non-tariff trade costs  $\tau_{ij}^k$  such that

$$T_{ij}^k = t_{ij}^k + \tau_{ij}^k.$$

Trade deflection would be worthwhile if cross-hauling through country  $c$ , with whom country  $i$  has a preferential trade agreement (PTA), leads to lower total trade costs, i.e., if

$$\begin{aligned} T_{ij}^k &> T_{ic}^k + T_{cj}^k \\ t_{ij}^k - (t_{ic}^k + t_{cj}^k) &> (\tau_{ic}^k + \tau_{cj}^k) - \tau_{ij}^k > 0, \end{aligned}$$

where the last inequality follows from the definition of  $\tau_{ij}^k$ . So, the tariff saving through deflection must be at least as large as the additional transportation costs that arise when the good



is channeled through country  $c$ . The last inequality follows from the fact that we define  $\tau_{ij}^k$  as being the minimum non-tariff trade costs between  $i$  and  $j$ .

Since countries  $i$  and  $c$  are both member in the same PTA, we posit  $t_{ic}^k = 0$ . We may have the following cases:

1. Country  $c$  and countries  $i$  have the same external tariff such that  $t_{ij}^k = t_{cj}^k$ . Then, it is clear that the above inequality never can be met since  $0 > 0$  is impossible.
2. Trade deflection is possible if  $t_{cj}^k < t_{ij}^k$ . However, this would require that

$$\Delta t_{ic}^k \equiv t_{ij}^k - t_{cj}^k > \tau_{ic}^k + \tau_{cj}^k - \tau_{ij}^k.$$

To make further progress, assume that transportation costs are a function of distance such that  $\tau_{ij}^k = \alpha^k (D_{ij})^{\delta^k}$  with  $\delta^k \in (0, 1)$  so that non-tariff trade costs are an increasing, strictly concave function of geographical distance. Since we define  $\tau_{ij}$  as the minimum trade costs between  $i$  and  $j$ , it cannot be, that passing through  $c$  lowers trade costs. Moreover, even in the extreme case, where passing through  $c$  does not entail a longer route, so that  $D_{ic} + D_{cj} = D_{ij}$ , with a strictly concave functional form, we have

$$\left( \tau_{ic}^k + \tau_{cj}^k \right) > \tau_{ij}^k$$

since

$$(D_{ic})^\delta + (D_{cj})^\delta > (D_{ic} + D_{cj})^\delta.$$

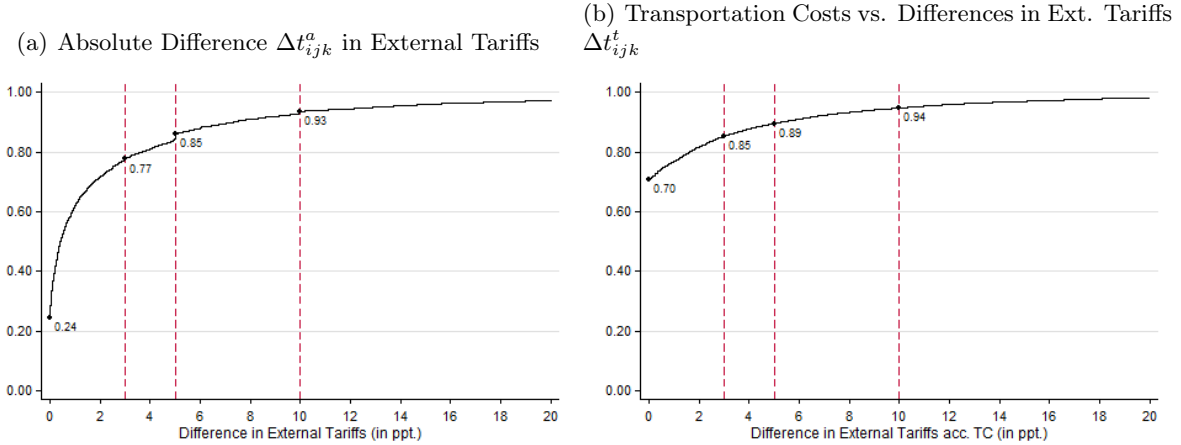
Now, it is an empirical question, whether the difference in external tariffs  $\Delta t_{ic}^k$  is large enough relative to the additional trade costs.

As described in section 2.4, we can generate an adequate measure for transportation costs for every product-pair combination. The transportation costs are in ad-valorem terms. Therefore, it is possible to compare them directly with the differences in external tariffs  $\Delta t_{ijk}^a$ . Trade deflection is only profitable if the savings in paid tariffs exceed the arising costs of transshipment. Therefore, even though there might be products with a strictly positive difference in external tariffs, the difference might not be sufficiently large enough for trade deflection to become profitable once a PTA is in place. Subtracting the predicted product-pair specific trade costs  $\hat{\tau}_{ij}^k$

from the absolute difference in external tariffs  $\Delta t_{ijkt}^a$  yields a modified measure of tariff similarity  $\Delta t_{ijkt}^t = \max\{0, |t_{ikt}^w - t_{jkt}^w| - \tau_{ijkt}\}$  that accounts directly for this. Whenever we find the transport costs to exceed absolute differences in external tariffs, we assume  $\Delta t_{ijkt}^t$  to be equal to zero since the prohibitive high transport costs have the same effect as a difference in external tariffs of zero: trade deflection becomes unprofitable. Recall, the trade costs other than tariffs exceed the transportation costs. Thus, even if  $t_{ijkt}^t$  is greater than zero, trade deflection might still not be profitable because of the other trade costs than tariffs and transportation costs that arise due to trade deflection and which we are unable to capture in our analysis. Thus, the results we present are a conservative assessment of the potential for trade deflection.

Figure 4(b) plots the cumulative distribution of the modified measure of tariff similarity  $\Delta t_{ijkt}^t$  accounting for transportation costs. For almost 60% of the cases the difference in external tariffs does not exceed the trade costs, and for almost 80% of the product-pair combinations the  $\Delta t_{ijkt}^t$  is at most 5%-points. For more than half of the product-pair combinations the necessity of RoO is more than doubtful, because there is no potential for trade deflection whatsoever.

**Figure 5:** The Share of Imports by the Differences in External Tariffs



$\Delta t_{ijkt}^a = |t_{ikt} - t_{jkt}|$  with country  $i$ , country  $j$ , product  $k$ , and time  $t$ ;  $\Delta t_{ijkt}^t = \max\{0, |t_{ikt}^w - t_{jkt}^w| - \tau_{ijkt}\}$  with country  $i$ , country  $j$ , product  $k$ , time  $t$ , and  $\tau$  transportations costs. The trade data stem from BACI. We show data for the year 2014. Truncated to values  $\leq 20$ .

For RoO imports matter: only if the demand for foreign products is there, trade deflection could potentially be a problem. Therefore, we check next how much of the total imports fall upon products with small differences in external tariffs. If most of the imported products had large differences in external tariffs, we could not make a statement about the necessity of RoO.

Figure 5(a) shows the share of imports as a function of the absolute difference in external tariffs. For 24% of the imports the difference in external tariffs is non-existent, for 77% it is less or equal 3%-points, and for 85% it amounts to at most 5%-points. So, indeed by far the most imports take place when the difference in external tariffs is low. When we account for the transportation costs the pattern is even more pronounced: for 70% of the products the differences in external tariffs does not exceed the transportation costs and thus RoO are not necessary.

### 3.2 Heterogeneity across Regions and Types of RTAs

We check next for heterogeneity in the absolute differences in external tariffs across regions and types of RTAs. The results are summarized in Table 2. It shows for different subgroups - for example when both countries are developed countries - the probability  $P(a < t_{ijk}^a \leq b)$  of a tariff line to lie within a certain range of the absolute difference in external tariffs  $t_{ijk}^a$  (column (1) to (6)), and the probability  $P(a < t_{ijk}^t \leq b)$  of a tariff line to lie within a certain range of the tariff-differences when accounting for transportation costs  $t_{ijk}^t$  (column (7) to (12)). The columns show the bins, the rows show the subgroups, adding up to 100%-points. Panel (a) shows the probabilities for North-North, North-South, and South-South country-pairs. We use again the UN definition to determine the development status of a country. Panel (b) differentiates between pairs without a PTA, with a deep PTA, shallow PTA, and a Customs Union. The information on the type of the RTAs is taken from DESTA (Dür et al. 2014). In Panel (c)-(e) we look at the different regional and RTA types simultaneously. The cumulative distributions functions focusing on heterogeneity can be found in the appendix (Figures A2, A3, and A4).

The way countries set tariffs differs quite substantially between developing and developed countries since the former have a higher overall level of tariffs than the latter (see Figure 1). Therefore, for the tariff similarity we expect heterogeneity across regions. North-North countries show the highest degree of tariff similarity. For 25% of the tariff lines no difference in external tariffs is apparent whatsoever and for 88% the difference amounts to at most 3%-points (see Table 2 Panel(a)). Furthermore, for the vast majority of products (75%) trade deflection is not profitable, because even when the external tariffs are not identical, the transportation costs exceed the difference as column (7) shows. More pronounced intra-industry trade and therefore more similar industry-structures as well as low levels of tariffs overall can explain the

high degree of tariff similarity for developed countries. For North-South and South-South pairs the differences in external tariffs are larger than for North-North. Nevertheless, also for those country-pairs the tariff similarity is strikingly high: for around half of the tariff lines the transportation costs exceed the differences in the tariffs (see Column (7)).

**Table 2:** Heterogeneity across Regions and Types of RTAs (in %-points)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	$t_{ijk}^a$						$t_{ijk}^t$					
	0	0-3	3-6	6-9	9-12	>12	0	0-3	3-6	6-9	9-12	>12
<b>(a) Regions</b>												
North-North	24.99	63.18	8.31	1.76	0.64	1.12	74.91	14.55	5.59	2.29	1.05	1.62
North-South	10.69	27.57	21.94	6.76	9.15	23.89	52.96	13.73	8.40	6.24	4.84	13.82
South-South	10.29	20.40	25.31	8.90	11.55	23.54	47.26	16.65	10.82	7.88	5.82	11.58
<b>(b) PTA</b>												
No PTA	11.24	24.46	23.36	7.71	9.91	23.31	53.76	14.28	8.93	6.61	5.28	11.13
Deep PTA	14.25	35.96	25.63	5.93	4.39	13.84	64.74	14.94	6.05	3.92	3.16	7.18
Shallow PTA	6.85	20.88	22.00	8.51	12.77	28.99	42.09	15.04	11.16	8.23	6.03	17.46
Customs Union	20.84	42.88	14.96	4.84	7.10	9.37	52.17	19.60	10.61	6.73	3.58	7.30
<b>(c) North-North</b>												
No PTA	21.27	55.75	16.24	3.39	1.44	1.92	90.86	5.33	1.88	0.79	0.39	0.74
Deep PTA	27.06	59.06	7.96	2.11	0.65	3.16	73.39	15.72	5.25	1.88	0.82	2.93
Shallow PTA	39.77	41.91	11.74	2.23	1.44	2.91	88.61	5.89	2.16	1.42	0.92	0.99
Customs Union	25.56	67.98	5.13	0.95	0.16	0.22	66.67	19.41	7.62	3.07	1.37	1.86
<b>(d) North-South</b>												
No PTA	11.40	28.49	21.95	7.24	8.92	22.00	55.87	13.48	8.44	6.24	4.80	11.17
Deep PTA	13.06	35.10	26.09	6.01	4.51	15.23	64.97	14.29	5.66	3.96	3.39	7.74
Shallow PTA	6.69	17.34	17.72	6.42	14.73	37.11	35.69	13.21	10.96	8.65	6.52	24.97
Customs Union	17.40	37.33	21.91	10.08	3.29	9.99	48.78	21.65	11.92	5.61	2.83	9.20
<b>(e) South-South</b>												
No PTA	10.22	18.81	25.00	8.43	11.38	26.16	48.91	15.65	9.92	7.40	6.06	12.05
Deep PTA	14.45	20.61	39.85	9.34	7.03	8.72	52.22	22.09	11.87	5.68	3.02	5.12
Shallow PTA	6.53	23.78	26.00	10.48	11.17	22.04	47.24	16.81	11.46	7.94	5.66	10.90
Customs Union	16.88	20.71	23.24	7.91	13.69	17.56	39.87	19.60	13.10	10.01	5.56	11.86

The table shows the shares of tariff lines (in %-points) whose absolute difference in external tariffs lies within a certain range. We focus in the different panels on heterogeneity across regions and types of RTAs and show data on the absolute difference in external tariffs in column (1)-(6), and when accounting for transportation costs in column (7)-(12). Panel (a) shows the distribution of the absolute difference in external tariffs for North-North, North-South, and South-South country-pairs. I.e. for North-North countries 24.99% of the tariff lines are identical. We use the UN definition to determine the development status of a country. Developed countries (North) are Australia, Canada, the member countries of EFTA and the European Union, Japan, New Zealand, and the US. All others belong to the group of developing countries (South). Panel(b) differentiates between pairs without a PTA, with a deep PTA, shallow PTA, and a Customs Union. The information on the type of the RTAs is taken from DESTA (Dür et al. 2014). In Panel (c)-(e) we look at the different regional and RTA types simultaneously. I.e. for North-North countries without a PTA the share of identical tariff lines equals 21.27%, while for North-South countries without a PTA only 11.40% of the tariff lines have the same external tariff. We use data for 2014.

If PTAs were only formed in order to promote inter-industry trade, the tariff structure between country-pairs with a PTA would not necessarily be similar but instead differ quite substantially. However, if the main goal of a PTA is to promote intra-industry trade or to make general trade liberalization possible, the opposite were true. Furthermore, there might be confounding factors

that matter for both, tariff similarity and the probability of having a PTA (i.e. countries' GDPs or bilateral distance). To check for potential heterogeneity across country-pairs depending on the presence of a PTA we add information on PTAs and its depth and calculate again the probability of a tariff line lying within the different bins of differences in external tariffs. In the appendix the cumulative distribution functions can be found. Distinguishing between the different types of the RTAs yields a very interesting picture.

As Figure A3(a) and (b) and Table 2 Panel (b) show, while country-pairs with a deep PTA set their tariffs more alike than when no PTA is present, for those with a shallow PTA the opposite is true. The probability of having a tariff difference of at most 3%-points equals 36% for pairs without a PTA, 50% for pairs with a deep PTA, and only 28% for pairs with a shallow PTA. When accounting for transportation cost the picture becomes even clearer (see column (7)-(12)). Forth both types of PTAs the Kolmogorov-Smirnov test shows that the distributions of the differences in external tariffs are significantly different from the pairs with no PTA.

By definition, the absolute difference in external tariffs should equal 0 as in a CU countries agree to a common external tariff. Although the external tariffs exhibit a higher degree of similarity, the common external tariff cannot always be observed as Table 2 and Figure A3(c) show. One reason could be that specific products are excluded from the agreement. Since only information about the agreement is available but not on the specific arrangement for the respective products, differences in external tariffs can arise. Another reason could be that although countries are officially part of a CU, they might not be able or willing to stick to the common external tariff.

We have shown significant differences in tariff similarity across regions as well as across the types of PTAs. We check next whether the differences between deep and shallow PTAs can be found in the data for all regional types. Figure A4(a) and Table 2 Panel(c) show the results for North-North country-pairs for the different types of PTAs. Independently of the depth, North-North pairs with a PTA also set tariffs more similarly than those pairs without a PTA. Overall, the North-North pairs with a deep PTA set tariffs even more alike than those with a shallow PTA.

For North-South pairs a completely different picture emerges (Table 2 Panel(d) and Figure A4(b)): pairs with a deep PTA have a higher degree of tariff similarity than those North-South

pairs without a PTA, whereas pairs with a shallow PTA set tariffs more differently. One potential explanation could be the very different nature of deep and shallow PTAs between North-South countries. The scope of shallow North-South PTAs is often not so much on bilateral trade liberalization but instead North countries try to promote growth and implement better living conditions via the PTA. For South-South pairs no large differences between different types of PTAs can be observed (Table 2 Panel(e) and Figure A4(c)), although the pairs with a deep PTA set again their tariffs somewhat more similarly. Thus, the heterogeneity across types of RTAs that can be observed in the aggregate, seems to stem mostly from North-South pairs.

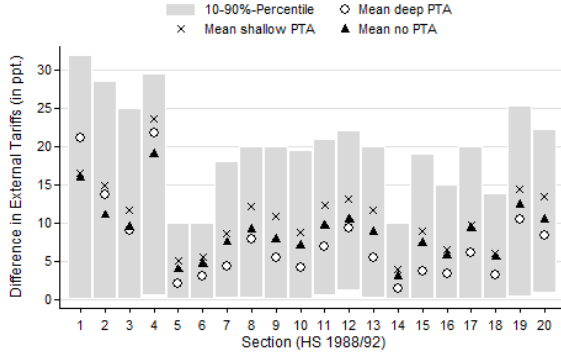
### 3.3 Heterogeneity across Products

Even though we can present compelling arguments for an overall high degree of tariff similarity, we want to check for heterogeneity across products. Assume for all but one sector low differences in external tariffs. Only analyzing the mean will suggest redundancy of harmful RoO, however, for this one sector, the RoO have indeed a right to exist. Figure 6 shows the heterogeneity across products. The products are grouped into 20 sections. We show the range of the differences in external tariffs within a section excluding the extreme values. Then we plot the means within each section for pairs with a deep PTA, with a shallow PTA, and those without a PTA. All pairs that are in a CU are excluded to avoid to bias the measures with pairs that do not matter when thinking about RoO. The analysis is conducted for both, the absolute difference in external tariffs  $\Delta t_{ijkt}^a$  and the modified measure  $\Delta t_{ijkt}^t$  to account for transportation costs.

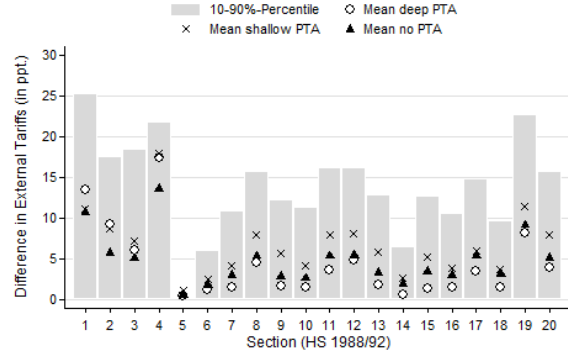
First, the range of the observed differences in external tariffs varies quite substantially across the sections. The products with the biggest variation in the absolute tariff differences belong to the agricultural sector (section 1 to 4) and the sector of arms and ammunition (19). In contrast, for mineral products (5), chemicals (6), and jewelery (14) the tariff differences do never exceed 10%-points. Second, large heterogeneity within sections is apparent depending on the type of the PTA. The absolute difference in external tariffs is for country-pairs with a shallow PTA never lower than for those pairs without a PTA, in fact, in many cases it is on average substantially larger. This is also true when taking the transportation costs into account (see figure 6(b)). The same is true for pairs with a deep PTA for the agricultural sector. However, in all the other

**Figure 6:** Absolute Differences in External Tariffs - by Goods (Sections HS 1988/92)

(a) Absolute Difference  $\Delta t_{ijk}^a$  in External Tariffs



(b) Trade Costs vs. Differences in Ext. Tariffs  $\Delta t_{ijk}^t$



**Sections (HS88/92-2 digits):** 1 *Live Animals* (01-05); 2 *Vegetable Products* (06-14); 3 *Fats and Oils* (15); 4 *Food, Bev. & Tobacco* (16-27); 5 *Mineral Products* (25-27); 6 *Chemicals* (28-38); 7 *Plastics* (39-40); 8 *Leather Goods* (41-43); 9 *Wood Products* (44-46); 10 *Pulp and Paper* (47-49); 11 *Textile and App.* (50-63); 12 *Footwear* (64-67); 13 *Stone and Glass* (68-70); 14 *Jewelery* (71); 15 *Base Metals* (72-83); 16 *Mach. & Elec. Eq.* (84-85); 17 *Transportation Rq.* (87-89); 18 *Optics* (90-92); 19 *Arms & Ammun.* (93); 20 *Works of Art.* (97-98). The information about the RTAs stems from DESTA (Dür et al. 2014) and no CUs are included.  $\Delta t_{ijk}^a = |t_{ik} - t_{jk}|$  with country  $i$ , country  $j$  and product  $k$ ;  $\Delta t_{ijk}^t = \max\{0, |t_{ikt}^w - t_{jkt}^w| - \tau_{ijk}\}$  with country  $i$ , country  $j$ , product  $k$ , time  $t$ , and  $\tau$  transportation costs. We show data for 2014.

sectors, pairs with a deep PTA set their tariffs much more alike than pairs without a PTA. Furthermore, the level of the average difference in external tariffs is for country-pairs with a deep PTA in many sectors particularly low (i.e. mineral products or jewelery).

When accounting for transportation costs, the level naturally decreases, and also the differential between deep PTAs and pairs without a PTA decreases. The most remarkable example are the products within the mineral products section, for which the differences in external tariffs never exceed the transportation costs. But also in other sections the means are rather low, indicating the little threat for trade deflection. The large heterogeneity across sectors stresses the different implications for RoO: while for some products they might be indeed justified, for many other products the tariff similarity is high. The differences across types of PTAs cannot be observed in the agricultural sector, but hold up for all of the remaining sectors.

## 4 Selection vs. Convergence: Why have PTA members similar External Tariffs?

So far, we have presented new stylized facts that already question the current practice of installing harmful RoO by default when a PTA is negotiated. We find large differences across the types of PTAs. For country-pairs with a deep PTA the tariff similarity is even higher than for pairs without a PTA, for pairs with a shallow PTA this cannot be said. In the remainder of the paper we want to try to give some more insights to this discussion and find out what drives these results. Are the pairs with a deep PTA systematically different and are those different characteristics the reason for the higher tariff similarity or does the PTA itself induce a change in the external tariffs?

### 4.1 Potential Channels and Empirical Strategy

The difference in external tariffs depends crucially on the “depth” of the agreement, defined as *“the extent to which (an agreement) requires states to depart from what they would have done in its absence”* (Downs et al. 1996). The very different nature of the two types of PTAs - deep versus shallow - could most likely cause the observed heterogeneity: first, the extent of the PTAs differs starkly across types. In shallow PTAs often whole sectors are excluded from the PTA, which is not the case for deep PTAs. Second, especially shallow PTAs between developed and developing countries might not have the primary goal to liberalize trade but instead serve as means to reach other goals. Third, deep PTAs often include many additional aspects than just tariff cuts potentially resulting in the observed differences across PTA types. Based on the existing literature we see two distinct channels through which PTAs, their depth, and tariff similarity might be related.

First, the literature on the formation of trade agreements (e.g. Baier and Bergstrand 2004) has identified some variables to increase the probability of agreeing upon a PTA, namely geographical distance, relative economic size, and factor endowment. These variables also determine the optimal tariff. Therefore, omitted variables could be the reason why we observe in the data country-pairs with a PTA to set tariffs in a more similar way. For deep PTAs reconciling special interests is even harder and therefore omitted variables might be of greater importance. Further,



the overall level of tariffs decreases with the degree of development: industrialized countries have significantly lower levels of tariffs than their developing counterpart. At the same time in most of the deep PTAs at least one of the participating countries is a highly developed one. As the differences in external tariffs naturally decline with lower levels, the degree of development could drive the results. We will call this the *Selection Channel*.

Second, the PTA might have an effect of itself on tariff similarity. We will refer to the *PTA Effect* when talking about this mechanism. A PTA might change the economic structures of the partner-countries and thus induce convergence for example through technological transfers or FDI. Then the preferences for protection also converge, yielding more similar tariffs. As suggested by the “building block” literature, bilateral PTAs might give rise to further external trade liberalizations (see Freund and Ornelas (2010) for an overview). If both countries respond to a PTA with lower external tariffs, the absolute difference in the external tariffs will decrease as well, as tariffs of both countries converge to zero. One theoretical explanation for this behavior is the “Juggernaut Effect” put forward by Baldwin and Robert-Nicoud (2015)<sup>5</sup>.

The domestic-commitment theory suggested by Maggi and Rodríguez-Clare (2007) can serve as an explanation for higher tariff similarity for North-South country-pairs. It says that trade agreements can serve as a commitment device for a government to close the door to domestic lobbies<sup>6</sup>. If the objective of a South country is to liberalize, one will observe as a result of the PTA a decrease in overall tariffs of this specific country. The difference in external tariffs will diminish because the former high-tariff country from the South transforms by means of the PTA to a low-tariff country and is as such more similar in its tariff-structure to the North-country than before.

To disentangle these two effects we employ a difference-in-differences (DiD) approach. When simply comparing differences in means the differential between those country-pairs with a PTA and those without includes both effects, the *Selection* and the *PTA Effect*. The main idea is to

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<sup>5</sup>They can show that trade liberalizations might shift interests of lobbyists such that trade talks based on the principle of reciprocity lead to lower MFN tariffs. The key ingredients in this model are reciprocity and gradual firm exit and entry. Because of reciprocity exporters become anti-protectionists at home since foreign tariffs will come down only if domestic tariffs decrease as well. At the same time due to the trade liberalization the number of exporting firms increases while the opposite is true for importer. The result is a reshaped political economy landscape where lobbyists are more pro-trade, yielding lower MFN tariffs.

<sup>6</sup>For example Whalley (1998) states that Mexican negotiators of NAFTA “were less concerned to secure an exchange of concessions between them and their negotiating partners, and were more concerned to make unilateral concessions to larger negotiating partners with whom they had little negotiating leverage... The idea was clearly to help lock in domestic policy reforms”.

remove any potential bias induced by selection and to carefully identify the effect of the PTA. We do so by exploiting time variation in terms of having a PTA within a country-pair. We regress the absolute difference in external tariffs on the PTA dummy and control with a full set of fixed-effects in the most flexible way for omitted variables. Equation 3 shows the final specification:

$$\Delta t_{ijk}^a = \beta_0 + \beta_1 PTA_{ijt} + \gamma_{it} + \gamma_{jt} + \gamma_k + \gamma_{kt} + \gamma_{ij} + u_{ijkt} \quad (3)$$

where  $\Delta t_{ijk}^a$  equals the absolute difference in external tariffs between country  $i$  and  $j$  for product  $k$  at time  $t$ ,  $PTA_{ijt}$  is a dummy variable, switching to 1 when a PTA between country  $i$  and  $j$  is at time  $t$  in place and 0 otherwise;  $\gamma_{it}$ ,  $\gamma_{jt}$ ,  $\gamma_k$ ,  $\gamma_{kt}$ , and  $\gamma_{ij}$  are respectively importer-year, exporter-year, product, product-year, and pair fixed-effects.  $u_{ijkt}$  represents the error term<sup>7</sup>.

The country-pair fixed-effects account for all variables that might affect both the probability of having a PTA as well as the general propensity of having similar external tariffs. All time-invariant variables like distance, remoteness, and also - at least to a certain extent - the development status are accounted for when only exploiting time variation. The structure of our data allows to control for more potentially omitted variables: we allow country  $i$  and country  $j$  to be on different time trends by including  $i - year$  and  $j - year$  fixed-effects. Thus, we can eliminate any potentially time varying factors i.e. general country-trends like election cycles. As the analysis is conducted with only two periods, the  $\gamma_{it}$  and  $\gamma_{jt}$  fixed-effects also account for country-specific differences i.e. due to historical reasons. Product fixed-effects even potentially different levels depending on the specific product in the differences in external tariffs out, while product-time fixed-effects account for differing time trends of products. To account for potential correlations of the errors within a country-pair as well as within each product the standard-errors are two-way clustered on the pair-level and the product-level.

The size of the causally interpretable coefficient will determine which effect is driving the pattern in the data: if the dominant mechanism is the *PTA Effect*, we expect the difference

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<sup>7</sup>Additionally to the dimensionality problem discussed in section 2, when employing a Difference-in-Differences approach with yearly panel data such an analysis yields severely understated standard errors of the coefficient of interest (Bertrand et al. 2004). One solution to those two problems is to collapse the data into a “pre”- and “post”-period. Besides calculating correct standard errors, the procedure also keeps the number of observations as small as possible by only including two years. We use the years 1996 and 2014 for the analysis.

between country-pairs with a PTA and the ones without to remain big and significantly different from zero once we control for omitted variables. If this is not the case, the *Selection Channel* seems to be stronger.

## 4.2 Results and Discussion

The results of the baseline regression analysis are reported in Table 3, column (1) and (2), the remainder of the table reports the results of the robustness checks. While we focus in Panel A and B on deep and shallow PTAs separately, in Panel C all PTAs are included. The results of the unconditional comparison in means are presented in column (1), (3), (5), (7), (9), (11), and (13), the other columns report the results for the specification including the full set of fixed-effects.

As suggested by the descriptive evidence, our results show that country-pairs with a deep PTA set tariffs in a more similar way. The comparison in means yields a 4.49%-point lower absolute difference in external tariffs compared to pairs without a PTA. On average the absolute difference in external tariffs equals 10.69%-points. Thus, a coefficient of -4.49%-points can be considered as rather large. When accounting for selection (see column (2)), and therefore only exploiting time-variation in the PTA variable, one can see that having a deep PTA yields a 0.97%-point lower absolute difference in external tariffs. Comparing the *PTA Effect* with the unconditional difference in means of column (1) in terms of size, stresses the importance of selection into treatment: our estimates suggest that the *PTA Effect* can only account for 21% of the observed lower difference in tariff similarity between pairs with and without a deep PTA, the remainder is due to positive selection.

For shallow PTAs no such thing can be said: country-pairs with a PTA have on average a higher difference in external tariffs by 1.44%-points, when no controls are included. More interestingly, the vast majority of this difference stems from the *PTA Effect*, which is shown in column (2): introducing a shallow PTA increases the absolute difference in external tariffs by 1.04%-points (significant on the 1%-level). Comparing the coefficient with the unconditional difference in means from column (1) yields that 72% of the observed higher absolute difference in external tariffs between pairs with a shallow PTA and those without can be attributed to the *PTA Effect*. This contrasts the findings for the pairs with the deep PTAs starkly, where a higher degree of tariff-harmonization can be found and the *Selection Channel* is dominant.

**Table 3:** Analyzing the Channels of the Heterogeneity in Differences in External Tariffs by the Type of RTAs

	$\Delta t^a$		$\Delta t^{mean}$		$\Delta t^{mf n}$		$\Delta t^t$		$\Delta t^n$		$\Delta t^w$		$\Delta t^{orig}$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
<b>Panel A: Only deep PTAs</b>														
Deep PTA	-4.486*** (0.166)	-0.966*** (0.192)	-5.444*** (0.110)	-0.078*** (0.013)	-4.121*** (0.153)	-0.169 (0.152)	-2.180*** (0.147)	-0.781*** (0.142)	-0.341*** (0.015)	-0.087*** (0.016)	-4.687*** (0.169)	-0.608*** (0.212)	-3.820*** (0.176)	-1.335*** (0.209)
Observations	22692029	22691974	22692029	22691974	22692029	22691974	21406975	21406951	22692029	22691974	22692029	22691974	13304006	13303977
R <sup>2</sup>	0.00	0.14	0.01	0.26	0.00	0.16	0.00	0.11	0.01	0.26	0.00	0.18	0.00	0.14
<b>Panel B: Only shallow PTAs</b>														
Shallow PTA	1.444*** (0.184)	1.040*** (0.303)	0.926*** (0.151)	-0.145*** (0.021)	0.832*** (0.209)	0.539** (0.254)	1.724*** (0.165)	0.504* (0.260)	0.185*** (0.016)	0.123*** (0.027)	0.564*** (0.173)	1.068*** (0.279)	1.697*** (0.212)	0.564 (0.672)
Observations	27676049	27675938	27676049	27675938	27676049	27675938	26250440	26250395	27676049	27675938	27676049	27675938	15386771	15386708
R <sup>2</sup>	0.00	0.14	0.00	0.26	0.00	0.16	0.00	0.12	0.00	0.28	0.00	0.18	0.00	0.16
<b>Panel C: All PTAs</b>														
PTA	-0.135 (0.164)	-0.190 (0.184)	-0.770*** (0.138)	-0.102*** (0.011)	-0.486*** (0.179)	0.098 (0.147)	0.692*** (0.142)	0.003 (0.149)	0.045*** (0.015)	-0.017 (0.016)	-0.678*** (0.157)	0.116 (0.185)	-0.189 (0.183)	-0.824*** (0.259)
Observations	30513508	30513392	30513508	30513392	30513508	30513392	28967788	28967743	30513508	30513392	30513508	30513392	17638744	17638681
R <sup>2</sup>	0.00	0.13	0.00	0.25	0.00	0.15	0.00	0.11	0.00	0.26	0.00	0.17	0.00	0.14
FE	✓		✓		✓		✓		✓		✓		✓	

Two-way clustered (country-pairs and products) standard errors in ( ). \*\*\*/\*\*/\* Indicate significance at the 1%/5%/10% level. Column (1), (3), (5), (7), (9), (11), and (13) report the results for the unconditional comparison in means. In the remaining columns the full set of fixed-effects (importer-time, exporter-time, product, product-time, and pair fixed-effects) is included. While we focus in Panel A and B on deep and shallow PTAs separately, in Panel C all PTAs are included.  $\Delta t^a$  is the absolute difference in external tariffs,  $\Delta t^{mean}$  is the average of the two tariffs of the country-pair,  $\Delta t^{MFN}$  is the absolute difference in MFN tariffs,  $\Delta t^t$  is the absolute difference in external tariffs when accounting for transportation costs,  $\Delta t^n$  is the absolute difference in external tariffs normalized with the average tariff of the rest of the world,  $\Delta t^w$  includes import weights, and  $t^{orig}$  only uses data, where neither of the two tariffs has been imputed.

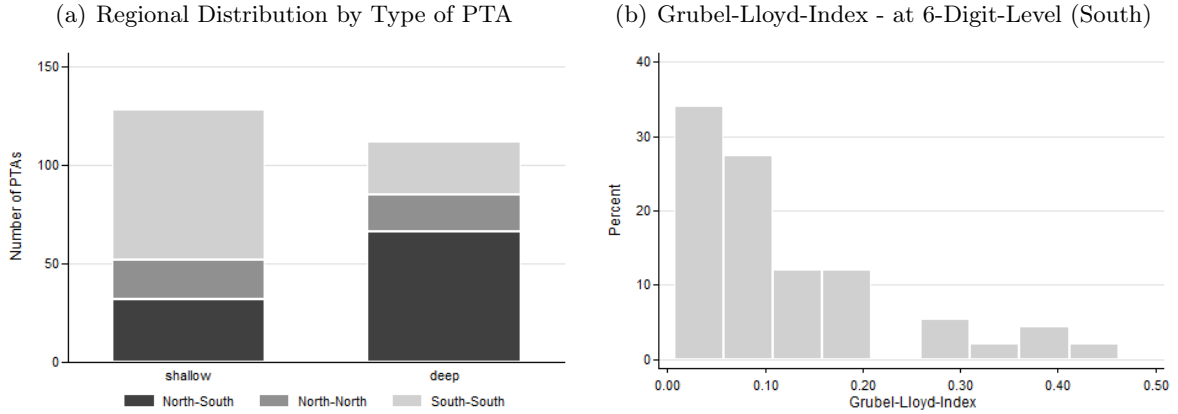
When we do not differentiate between the two types of PTAs, and just compare country-pairs with and without a PTA, we can determine whether one of the two opposing effects outweighs the other: if in the aggregate country pairs with a PTA have a higher degree of tariff similarity, the negative effect of the deep PTAs on the absolute difference in external tariffs offsets the counteracting one stemming from the shallow PTAs. The results of this analysis are displayed in Panel C. The coefficient of interest is in both specifications negative and also rather stable, however, it is hardly significant and small. So overall, the diverging patterns of the two types of PTAs seem to even each other out.

So far, we have established two interesting facts: first, country-pairs with a deep PTA seem to be systematically different from those without a PTA, causing them to set the external tariffs more alike. This positive selection accounts for 79% of the differential in the absolute difference in external tariffs between pairs with a deep PTA and those without. Second, for pairs with a shallow PTA the opposite is true. Not only is the level of tariff similarity in general lower than for pairs without a PTA, but also the PTA can explain a much larger portion of the tariff setting behavior of countries than for deep PTAs.

To understand the discrepancy across types of PTAs better, we group in figure 7(a) the PTAs by regional distribution of the country-pairs. Most of the shallow PTAs are agreements between South-South countries, while the majority of the deep PTAs are between North-South countries. The unweighted average tariff in 2014 for South countries equals 8.74%-point, while for North countries it is only 1.30%. Therefore, if South countries react to a PTA as the literature proposes with further decreases in external tariffs (e.g. Crivelli (2016) and Estevadeordal, Freund, et al. (2008)), the difference in external tariffs between the low-tariff North and the former high-tariff South will decline. This effect will be stronger for deep PTAs for two reasons: first, the number of North-South agreements is higher for deep PTAs than for shallow PTAs. Second, the scope of shallow North-South PTAs is often not so much on bilateral trade liberalization but instead North countries try to promote growth and implement better living conditions via the PTA. This fact can explain the negative and significant *PTA Effect* for deep PTAs.

We can check for this channel directly, looking at the mean of the tariffs  $\Delta t_{ijkt}^{mean} = \frac{1}{2}(t_{ikt}^w + t_{jkt}^w)$  for country  $i$ , country  $j$ , and product  $k$ , at time  $t$ . The results of the analysis are displayed in Table 3 column (3) and (4). The unconditional comparison in means shows that country-pairs

**Figure 7:** Differences between North and South countries



We use the UN classification for developing (south) and developed (north) countries. North: Australia, Canada, the member countries of EFTA and the European Union, Japan, New Zealand, and the US. All remaining countries belong to South. The Grubel-Lloyd-Index is an unweighted mean and calculated using trade data for 2014.

with a deep PTA have on average 5.73%-point lower tariffs than those without a PTA. Once accounting for omitted variables, no significant effect remains. The low level of tariffs seems to be indeed one of the driving forces behind the lower differences in external tariffs for country pairs with a deep PTA. However, no adjustment happens due to the PTA, but instead those country-pairs that manage to conclude a deep PTA also have lower tariff levels. The lower level of tariffs might indicate a higher degree of openness, which could be the reason for the higher preference for deep PTAs but because of many confounding factors no statement on the direction of causality can be made.

For the shallow PTAs, a higher degree of specialization in different sectors could be one potential explanation for the higher difference in external tariffs in the baseline specification. If country-pairs engaging in shallow PTAs mostly exhibit inter-industry trade one will observe very different industry structures, resulting in large differences across sectors in the level of protection. Instead of importing the same goods and thus having lower tariffs for these goods, the trading countries will have very different tariffs for the same goods. As figure 7(b) shows, for the South-countries the Grubel-Lloyd Index is close to zero, indicating indeed inter-industry trade to be prevalent.

Furthermore, the level of tariffs is rather high for South countries. Therefore, if countries react to a PTA with reducing the tariffs also against third countries but the adjustment is not

symmetric across the two countries, larger differences in external tariffs will be the result, as suggested by our baseline results for shallow PTAs. We would expect the mean of the tariffs  $\Delta t_{ijkt}^{mean}$  to decrease when a shallow PTA has been entered into force, which can be observed in the data: as Table 3 column (3) and (4) shows, the country-pairs with a shallow PTA have on average a slightly higher (0.93%-points)  $\Delta t_{ijkt}^{mean}$ . However, when fully controlling for omitted variables, we find that the PTA actually has a negative effect on the tariff level. Our results confirm the existing evidence (i.e. Calvo-Pardo et al. (2011), Crivelli (2016), and Estevadeordal, Freund, et al. (2008)) on the negative relationship between PTAs and external tariffs.

Summing up, our results show that additionally to the overall high level of tariff similarity pairs with deep PTAs set tariffs even more similarly, mostly because of positive selection. RoO are for at least two reasons more harmful in deep PTAs than in shallow ones: first, the scope of deep PTAs in terms of number of products covered by the PTA is usually higher for deep PTAs, and therefore also the number of products whose RoO are explicitly regulated. Second, as the extent of the trade liberalization is larger for deep PTAs than for shallow ones - not only tariff cuts are included but also other aspects as the harmonization of standards etc. - lobbyists have stronger incentives to work for other forms of protection. As the tariff similarity is even higher for these country-pairs, one could argue that RoO are unnecessary from an economic point of view.

However, countries could potentially only agree to large tariff cuts when negotiating a PTA because of the protective effects of RoO working as a substitute to the previously high tariff. Thus, the negative *PTA Effect* we find in our baseline specification could just be a result of tariff cuts by participating countries. Recall, the absolute differences in external tariffs are calculated using a weighted average  $t_{ikt}^w$  for each country  $i$ . Assuming everything else equal, when a PTA enters into force and causes for country  $i$  and  $j$  massive tariff cuts, the weighted average will decrease for both countries leading to lower absolute differences in external tariffs. Ideally we would want to control for the strictness of the RoO in each PTA, which is due to data unavailability impossible. However, MFN tariffs should not be affected by RoO. If a PTA has indeed a liberalizing effect, also MFN tariffs - although to a lesser extent - should be affected.

To check whether RoO are indeed abused as a protective measure we use the difference in MFN tariffs  $\Delta t_{ijkt}^{MFN} = t_{ikt}^{MFN} - t_{jkt}^{MFN}$  for our analysis. The results are shown in Table 3 columns (5)

and (6). The unconditional comparison in means shows that pairs with a deep PTA also have on average lower MFN tariffs (4.12 %-points), but the difference is no longer significant when controlling for selection. Therefore, we cannot rule out that RoO make tariff cuts possible in the first place. This result weakens somewhat our argument in favor of the abolishment of the RoO but it does not make it invalid, as the *PTA Effect* accounts in any case only for very little of the observed pattern. For shallow PTAs the *PTA Effect* still accounts for the biggest share of the difference between pairs with and without a PTA.

The descriptive evidence in section 3 has already shown that the difference in external tariffs is for most of the product-pair combinations not large enough to exceed transportation costs  $\tau_{ijkt}$ , making trade deflection unprofitable and therefore RoO obsolete. We want to check now whether the heterogeneity by the type of the PTA is still present when accounting for trade costs and if so, determine the dominant channel at work. As before, we subtract the pair-product specific trade costs  $\tau_{ijkt}$  from the absolute difference in external tariffs to account for trade costs, yielding  $\Delta t_{ijk}^t = \max\{0, |t_{ikt}^w - t_{jkt}^w| - \tau_{ijkt}\}$ . The results of the analysis are shown in Table 3, column (7) and (8).

As column (7) shows, when accounting for trade costs the observed differential between pairs with a deep PTA and those without becomes smaller than in the baseline specification. For deep PTAs (see panel A) the unconditional mean in column (7) equals -2.79, which is still negative and significantly different from zero, but not as big as when ignoring other trade costs. Therefore, the other trade costs seem to be larger for the pairs without a PTA than for the pairs with a deep PTA<sup>8</sup>. The *PTA Effect* on the other hand, changes only very little for pairs with a deep PTA compared to the baseline specification, confirming that trade costs are an important mechanism for the positive selection of pairs with similar external tariffs into deep PTAs: the lower, the higher the probability for both, having a deep PTA and also more similar tariff vectors. For pairs with a shallow PTA the story is again different. While basically no change in the coefficient can be observed when looking at the comparison in means, once the full set of fixed-effects is included the shallow PTA yields only a fraction of the effect found in the baseline specification (0.48).

We want to check next for the importance of multilateral trade liberalization as an omitted

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<sup>8</sup>To see this, compare the coefficients from column (7) for  $\Delta t^a$  and  $\Delta t^t$ :  $\Delta t_{deep}^a - \Delta t_{no}^a < \Delta t_{deep}^t - \Delta t_{no}^t \Leftrightarrow \Delta t_{deep}^a - \Delta t_{no}^a < (\Delta t_{deep}^a - \tau_{deep}) - (\Delta t_{no}^a - \tau_{no}) \Leftrightarrow \tau_{deep} < \tau_{no}$ .



variable when looking at the unconditional comparison in means. One of the achievements of the Uruguay Round, which was concluded in 1994, was the commitment to reduce tariffs globally by one-third over ten years. As the overall level of tariffs has been for developed countries already rather low, most of the liberalization took place for developing countries leading to lower differences in external tariffs. At the same time the number of trade agreements increased significantly. Therefore, we want to make sure that what we observe in the baseline specification is not just a result of multilateral tariff cuts. To control for multilateral trade liberalizations we normalize the absolute difference in external tariffs  $\Delta t_{ijkt}^a$  with the average tariff of the rest of the world (RoW) for product  $k$   $t_{kt}^{RoW}$ :  $\Delta t_{ijkt}^n = \frac{|t_{ikt}^w - t_{jkt}^w|}{t_{kt}^{RoW}} = \frac{\Delta t_{ijkt}^a}{t_{kt}^{RoW}}$ . The results are shown in Table 3, columns (9) and (10). For both types of PTAs the sign of the coefficients stays the same as in the baseline specification but the magnitude decreases substantially.

In column (11) and (12) we account for the importance of the specific goods in terms of imports by including analytical weights,  $\Delta t_{ijkt}^w = |t_{ikt}^w - t_{jkt}^w| \times w_{ijkt}$  with country  $i$ , country  $j$ , product  $k$ , and time  $t$ . The import weights equal  $w_{ijkt} = \frac{imp_{ikt} + imp_{jkt}}{\sum_{n=1}^{n=k} imp_{it} + \sum_{n=1}^{n=k} imp_{jt}}$  where  $imp$  corresponds to imports (in \$ Dollar),  $k$  product, and  $t$  year. If a certain product accounts for most of the total imports of a country-pair it will receive a higher weight than those that do not matter. For deep PTAs no large changes compared to the baseline specification can be noticed. For shallow PTAs, in contrast, the unconditional comparison in mean decreases from 1.44 to 0.56, while the change of the coefficient in column (12) is only a slight one. The large difference between pairs with a shallow PTA and those without a PTA seems to be almost entirely due to products that are not imported by the corresponding country-pairs. However, the fixed-effects do a good job controlling for this, as otherwise a larger change in column (10) could be observed.

Columns (13) and (14) of Table 3 show the results for the analysis when omitting all differences in external variables where at least one of the two tariffs  $t_{ikt}^w$  and  $t_{jkt}^w$  was imputed. We expect the results for the shallow PTAs to be more sensitive to the modification, because the issue of missing tariff data is more pronounced for developing countries. The general picture does not change, which is reassuring, as it suggests that our results are not just due to data manipulation. On the other hand, the coefficients vary quite a lot in size and level of significance, indicating the severity of missing data when working with tariff data.

In an additional robustness check we have used yearly panel data instead of only comparing

1996 with 2014. As mentioned above, there are two reasons why this is not our preferred specification: incorrect standard errors and the curse of dimensionality. Therefore, results should be taken with a grain of salt. Table A3 show our findings for the 15% sample. The analysis suggest the same picture as our baseline specification: lower differences in external tariffs for pairs with a deep PTA, the opposite for pairs with shallow PTAs and while the *Selection Channel* is the one driving results for the deep PTAs, the *PTA Effect* is dominant for shallow ones. Measurement error in the explanatory variable is more severe when using yearly panel data than when only focusing on two periods, attenuates the coefficients.

## 5 Conclusion

We introduce a new tariff database, that deals with the well-known issue of missing data in the standard sources for tariffs (TRAINS and World Bank), and use it to assess the differences in external tariffs. Analyzing the similarity in external tariffs is relevant because it is the only justification for costly RoO in PTAs. RoO are installed to prevent trade deflection, which only becomes possible when countries set tariffs differently.

The level of tariff similarity is high, especially when focusing on imported goods: for 77% of the imports in 2014 the difference in external tariffs was at most 3%-points. When explicitly accounting for transportation costs, the picture becomes even clearer, as for 70% of the tariff lines the differences in external tariffs do not exceed the transportation costs. Therefore, trade deflection becomes unprofitable and the economic rationale for RoO vanishes. Further, we find that for countries with a deep PTA the tariff similarity is even more pronounced, however, the opposite is true for shallow PTAs. We analyze in more detail what drives the diverging results for pairs with deep and shallow PTAs. We find that country-pairs with similar tariffs self-select themselves into having a deep PTA. For shallow PTAs we can show that the PTA causes much of the larger difference in external tariffs by lowering tariffs in different sectors.

The empirical facts we present are new and highly relevant as they question the necessity of highly distortive and welfare-reducing RoO. This has an important policy implication: in most preferential trade agreements, for a vast majority of products, trade deflection is not profitable even in the absence of costly rules of origin. It is common practice for RoO to be automatically

implemented when a PTA is negotiated. With PTAs proliferating, also RoO are rampant. Therefore, a better understanding of them is essential. We see this paper as a starting point to shed light on that black box.

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## A Appendix

### A.1 How we tackle the Issue of Missing Tariff Data

In this section we will present in more detail our new approach to the solution of the well-known issue of missing data when working with tariff data. Using the World Bank’s World Integrated System (WITS) software, which combines data from the United Nations and the World Bank, we combine all publicly available information on MFN tariffs, preferential tariffs as well as ad valorem equivalents of non advalorem tariffs. We gather information of 156 countries on the 6-digit product level of the common HS system with some of the data dating back to 1988. Whenever more than one preferential scheme applies (i.e. a bilateral PTA and the General System of Preferences) multiple preferential tariffs might be observable for trade in a particular product between two countries. We always assume the lowest preferential tariff to be effectively in place.

We deal with the missing data in the following way: rather than replacing missing MFN tariffs by linearly interpolating observations, missing values are set equal to the nearest preceding observation. The procedure accounts for the fact that countries are more likely to update schedules after a significant tariff change. If there is no preceding observation, missing MFN tariffs are set equal to the nearest succeeding observation. As the MFN tariff only applies when a country is a member of the WTO, inferring tariffs without inducing large margins of error is only possible for countries that are WTO members. Thus, whenever the exporting or importing country is not a WTO-member we drop the tariff line.

Due to revisions of the Harmonized System in 1996, 2002, 2007 and 2012 the product-identifiers are not uniform across countries and over time in the original data. Thus, to impute the data it is necessary to convert all products into one revision. We use the HS-1988/92 revision.

For preferential tariffs interpolating is more problematic because PTAs have often been phased-in instead of cutting all tariffs immediately when the PTA enters into force. Typically, the tariffs are cut by the same amount over a certain number of years until the agreed tariff is reached (usually zero). Thus, if we knew for each product the target tariff and the year at which the PTA members are supposed to meet it, one could linearly interpolate the missing values. Unfortunately, such data are currently unavailable. However, although no product-specific information



can be found, DESTA (Dür et al. 2014) provides the maximum years allowed for tariff cuts for more than 500 PTAs. Hence, we can clearly differentiate between those PTAs that are phased-in and those that are not. Combining the information on phasing-in with the year the PTA entered into force (EiF), which we have manually researched by ourselves, yields three scenarios that require a different way of interpolation. They are shown in Table A1. Again, whenever one of the two - the importing or the exporting country - are not members of the WTO, we drop the observation altogether.

**Table A1:** Algorithm for Interpolating the Missing Data

Tariff available	PTA Phased-In?	
	Yes	No
(1) (Multiple) observation(s), no Information about PTA	Interpolate linearly	Interpolate linearly
(2) One observation when year equals EiF	Use the tariff for all succeeding observations	Use the tariff for all succeeding observations
(3) (Some) observation(s) after year equals EiF	Assume MFN tariff for the year before EiF, interpolate linearly between all available tariffs, and use the last available year for all succeeding years	Use the tariff for all preceding (whenever PTA has already entered into force) and succeeding observations

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We have researched the entry into force (EiF) year for every PTA contained in DESTA by ourselves.

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(1) *(Multiple) observation(s), no Information about PTA*

DESTA only includes agreements with some sort of reciprocity, therefore no additional information is available for unilateral agreements like the Generalized System of Preferences under which developed countries grant preferential tariffs to imports from developing countries. When an entry in the original data exists but no information about the PTA is available we assume the preferential tariff to be unilateral. Whenever the original data

reports observations for at least two years we interpolate linearly, when only one original entry is on hand, no further interpolation can be done.

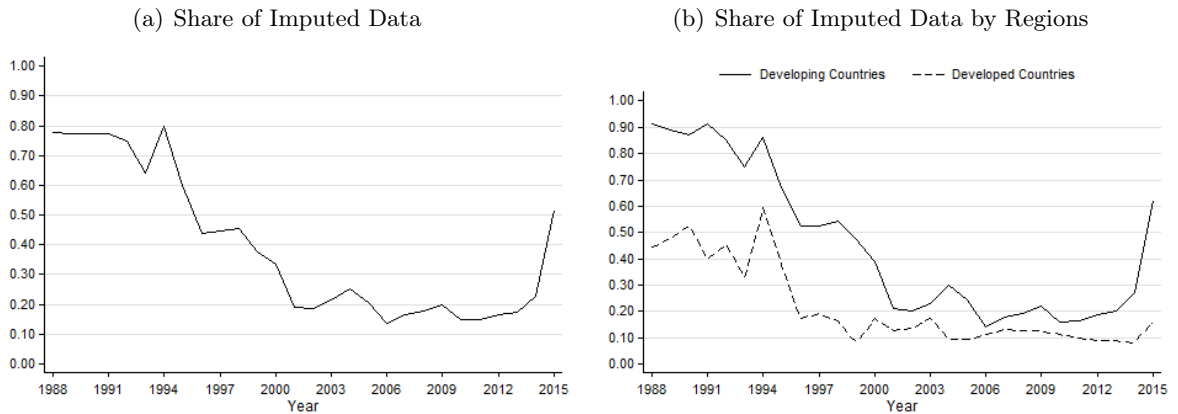
(2) *One observation when year equals EiF*

When tariff data is only available for the EiF-year and DESTA tells us that the tariff cuts were put into effect immediately we use that tariff for all succeeding observations. We use the same method when phasing-in is allowed but only the tariff for the EiF-year is available. Even though in this case the actual tariffs will most likely be lower after the EiF-year, the target tariff the two countries have agreed to is unknown, making further interpolating impossible.

(3) *(Some) observation(s) after year equals EiF*

Again, when no phasing-in is applicable and original data is available for at least one year after the EiF-year we use these data for all years after the PTA was into force. When phasing-in is allowed, we first assume the MFN tariff to be applied in the year before the PTA was entered into force, then one can interpolate linearly between all available tariffs. The last available tariff is assumed to be the target tariff agreed to in the PTA and will be used for all succeeding years.

**Figure A1:** Share of Imputed Data



We use the UN definition to determine the development status of a country. Developed countries are Australia, Canada, the member countries of EFTA and the European Union, Japan, New Zealand, and the US. All others belong to the group of developing countries.

Table A2 shows the number of observations that WITS provides (column (1)) and the number of observations that we end up having after the interpolation (column (2)). We end up in

**Table A2:** The Extent of Missing Data

Number of Observations			
	(1)	(2)	(3)
Year	Original Data	Imputed Data	Share
1988	9,606,425	42,840,168	77.6%
1989	9,789,272	42,840,169	77.1%
1990	10,539,553	46,629,697	77.4%
1991	11,273,581	42,569,994	73.5%
1992	12,984,417	51,577,671	74.8%
1993	22,467,973	62,209,397	63.8%
1994	15,745,480	77,520,216	79.7%
1995	31,456,706	78,293,204	59.8%
1996	45,354,301	80,801,820	43.9%
1997	47,528,520	84,650,869	43.8%
1998	46,908,799	85,939,566	45.4%
1999	55,235,390	88,566,890	37.6%
2000	63,390,233	95,308,275	33.5%
2001	80,495,039	99,471,885	19.1%
2002	82,191,719	100,889,757	18.5%
2003	81,528,520	103,729,599	21.4%
2004	79,837,640	106,612,441	25.1%
2005	85,602,453	108,060,844	20.8%
2006	93,493,665	108,060,853	13.5%
2007	92,402,919	110,954,104	16.7%
2008	93,810,550	113,899,543	17.6%
2009	91,212,401	113,899,532	19.9%
2010	97,176,014	113,902,869	14.7%
2011	97,166,904	114,676,960	15.3%
2012	98,967,205	118,676,960	16.6%
2013	100,417,500	121,664,637	17.5%
2014	93,919,178	121,667,575	22.8%
2015	58,466,517	121,284,942	51.8%

The table shows in column (1) the number of tariff lines that are available when combining TRAINS and IDB, in column (2) the number of tariff lines that we end up having after imputing the data, and column(3) equals the share of imputed data.

2015 with more than 100 Million observations. As Figure A1(a) shows, the share of imputed data decreased substantially over the years because of an increase in the number of countries reporting. In 1988 the number of tariff lines we imputed equals 77.6% and it stays at such a high level until the establishment of the WTO in 1996, when the availability of original data

increases substantially. In the 2000's the percentage of imputed data decreases even further to approximately 20%. Surprisingly in 2015 again the number of imputed data increases quite a lot, namely by 30%-points to 51.8%. The problem of missing data is substantially worse for developing countries (see Figure A1(b)). However, also for developed countries one can observe a jump in 1996, afterwards the share of imputed tariff lines remains rather stable.

Caliendo et al. (2015) have constructed a similar database. Additionally to the tariffs provided by the WITS they add data from three other sources: manually collected tariff schedules published by the International Customs Tariffs Bureau, US tariff schedules from the US International Trade Commission, and US tariff schedules derived from detailed US tariff revenue and trade data provided by the Center for International Data at UC Davis. The imputation algorithm is very similar to ours with the drawback that they only have information on approximately 100 PTAs and their phasing-in regimes. However, other than that to the best of our knowledge there is no comparable data base for tariffs in terms of country- and time-coverage as well as level of disaggregation at hand.

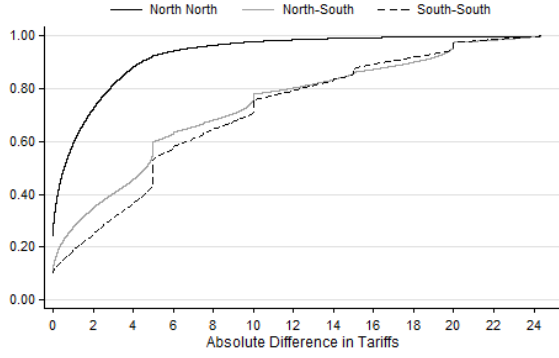
## **A.2 List of Countries in the Sample**

The following 121 countries are in the sample: Angola, United Arab Emirates, Argentina, Antigua and Barbuda, Australia, Austria, Burundi, Belgium, Benin, Burkina Faso, Bangladesh, Bulgaria, Bahrain, Belize, Bolivia, Brazil, Barbados, Brunei, Central African Republic, Canada, Chile, Cote d'Ivoire, Cameroon, Congo, Rep., Colombia, Costa Rica, Cuba, Cyprus, Czech Republic, Germany, Djibouti, Dominica, Denmark, Dominican Republic, Ecuador, Egypt, Arab Rep., Spain, Finland, Fiji, France, Gabon, United Kingdom, Ghana, Guinea, The Gambia, Guinea-Bissau, Greece, Grenada, Guatemala, Guyana, Hong Kong, China, Honduras, Haiti, Hungary, Indonesia, India, Ireland, Iceland, Israel, Italy, Jamaica, Japan, Kenya, St. Kitts and Nevis, Korea, Rep., Kuwait, St. Lucia, Sri Lanka, Macao, Morocco, Madagascar, Maldives, Mexico, Mali, Malta, Myanmar, Mozambique, Mauritania, Mauritius, Malawi, Malaysia, Niger, Nigeria, Nicaragua, Netherlands, Norway, New Zealand, Pakistan, Peru, Philippines, Papua New Guinea, Poland, Portugal, Paraguay, Qatar, Romania, Rwanda, Senegal, Singapore, Solomon Islands, Sierra Leone, El Salvador, Suriname, Slovak Republic, Slovenia, Sweden, Chad, Togo,

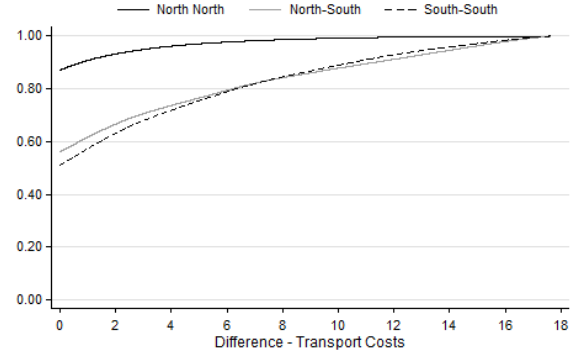
Thailand, Trinidad and Tobago, Tunisia, Turkey, Tanzania, Uganda, Uruguay, United States, St. Vincent and the Grenadines, Venezuela, South Africa, Zambia, and Zimbabwe.

**Figure A2:** Cumulative Distribution Function by Regions

(a) Absolute Difference  $\Delta t_{ijk}^a$  in External Tariffs

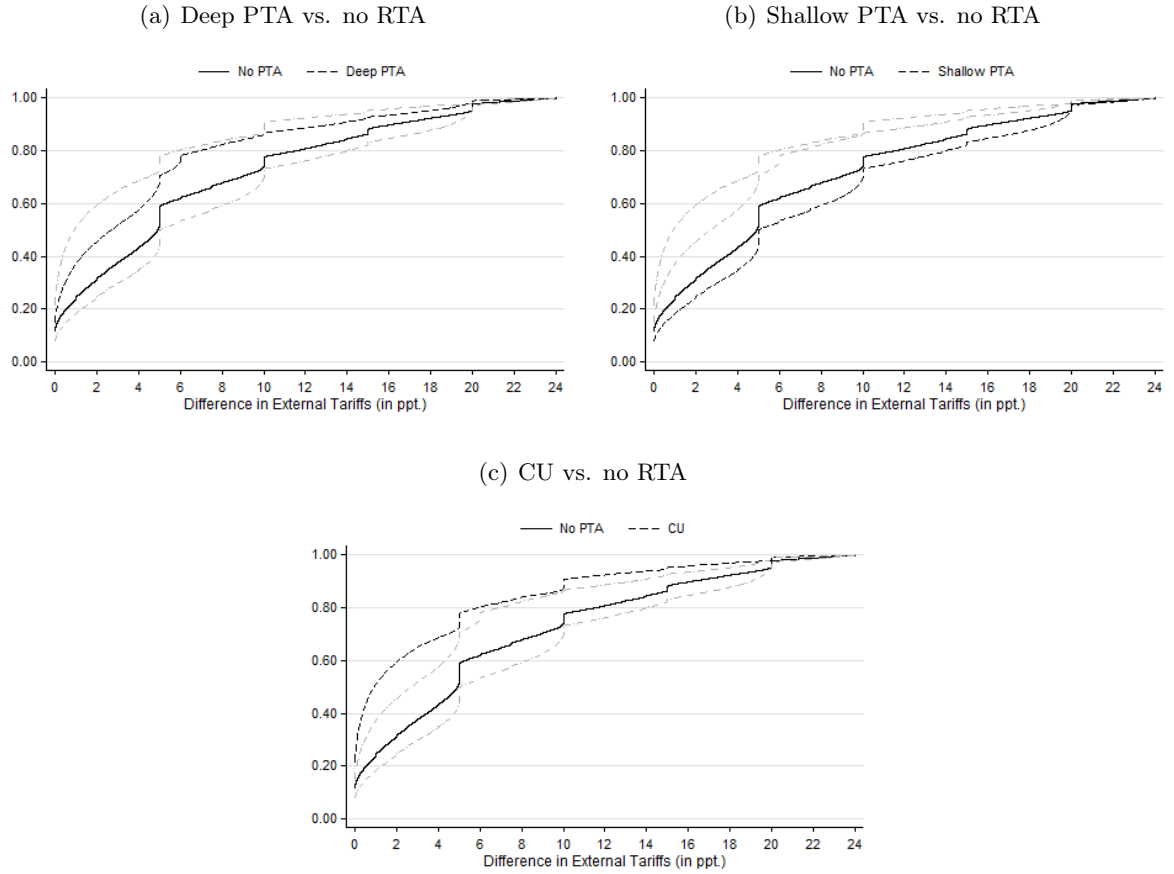


(b) Trade Costs vs. Differences in Ext. Tariffs  $\Delta t_{ijk}^t$



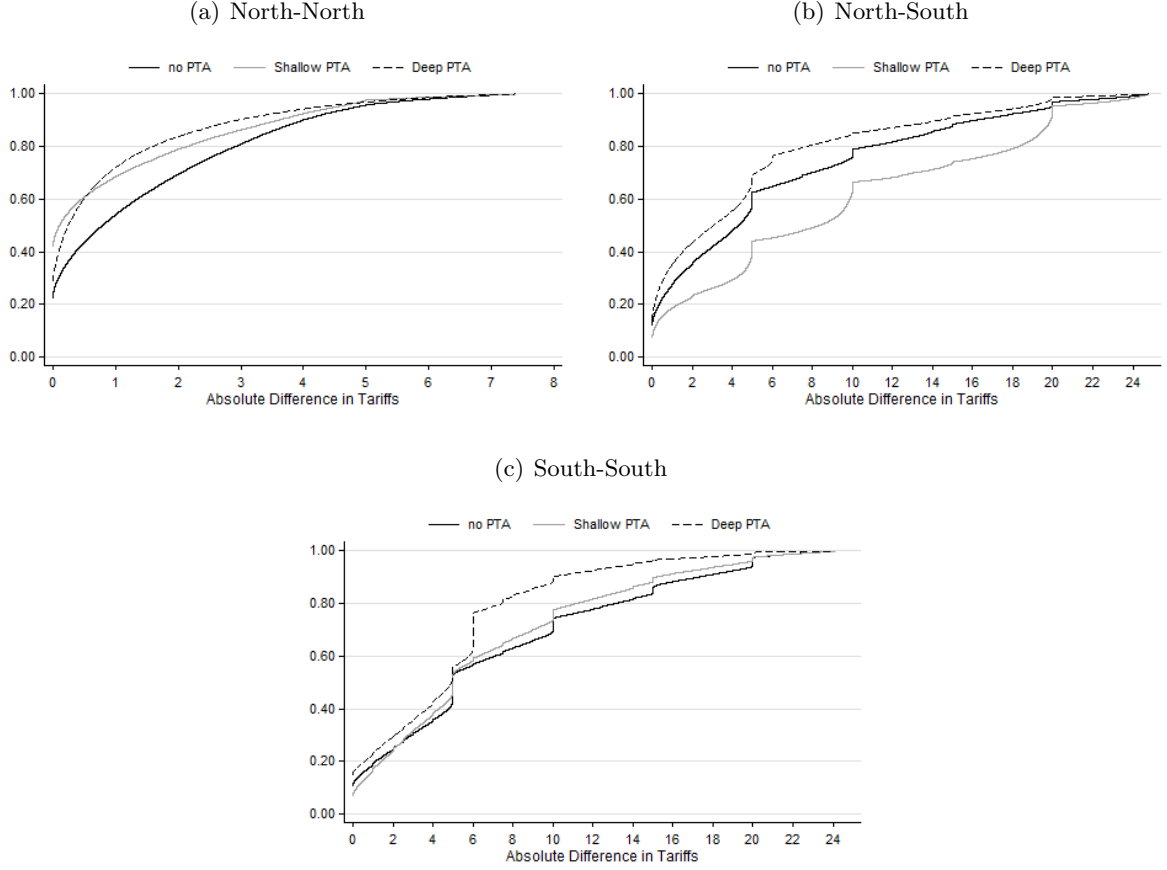
$\Delta t_{ijk}^a = |t_{ikt} - t_{jkt}|$  with country  $i$ , country  $j$ , product  $k$ , and time  $t$ ;  $\Delta t_{ijk}^t = \max\{0, |t_{ikt}^w - t_{jkt}^w| - \tau_{ijk}\}$  with country  $i$ , country  $j$ , product  $k$ , time  $t$ , and  $\tau$  transportation costs. We use the UN definition to determine the development status of a country. Developed countries (North) are Australia, Canada, the member countries of EFTA and the European Union, Japan, New Zealand, and the US. All others belong to the group of developing countries (South). All country-pairs with a CU are excluded. We show data for 2014. Panel(a): truncated to values  $\leq 25$ ; Panel(b): truncated to values  $\leq 18$ .

**Figure A3:** Cumulative Distribution of the Absolute Difference  $\Delta t_{ijk}^a$  in External Tariffs by RTA-Type



$\Delta t_{ijk}^a = |t_{ik} - t_{jk}|$  with country  $i$ , country  $j$  and product  $k$ ;  $\Delta t_{ijk}^t = \max\{0, |t_{ikt}^w - t_{jkt}^w| - \tau_{ijk}\}$  with country  $i$ , country  $j$ , product  $k$ , time  $t$ , and  $\tau$  transportation costs. The information about the RTAs stems from DESTA (Dür et al. 2014). We show data for 2014. Truncated to values  $\leq 24$ . Kolmogorov-Smirnov Test between Deep PTA/Shallow PTA/CU and no PTA: Difference 0.16/0.09/0.28, all significant on the 1%-level.

**Figure A4:** Cumulative Distribution of the Absolute Difference  $\Delta t_{ijk}^a$  in External Tariffs for Different Regions and Types of PTAs



$\Delta t_{ijk}^a = |t_{ikt} - t_{jkt}|$  with country  $i$ , country  $j$ , product  $k$ , and time  $t$ ; We use the UN definition to determine the development status of a country. Developed countries (North) are Australia, Canada, the member countries of EFTA and the European Union, Japan, New Zealand, and the US. All others belong to the group of developing countries (South). The information about the RTAs stems from DESTA (Dür et al. 2014) and no CUs are included. We show data for 2014. Panel (a): truncated to values  $\leq 8$ , Panel (b): truncated to values  $\leq 24$ , Panel (c): truncated to values  $\leq 24$ .



**Table A3:** Baseline Results: Heterogeneous RTA-Effects on  $\Delta t_{ijkt}^t$  (15% Sample)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<b>Panel A: Only deep PTAs</b>							
Deep PTA	-2.168*** (0.226)	-2.165*** (0.164)	-0.780*** (0.159)	-0.681*** (0.155)	-0.695*** (0.152)	-0.697*** (0.152)	-0.403*** (0.114)
Observations	29342629	29342629	29342629	29342629	29342629	29342322	29342322
R <sup>2</sup>	0.00	0.03	0.03	0.04	0.11	0.11	0.12
Cluster (Pairs)		4,953	4,953	4,953	4,953	4,953	4,953
Cluster (Products)		4,861	4,861	4,861	4,861	4,852	4,852
<b>Panel B: Only shallow PTAs</b>							
Shallow PTA	1.322*** (0.145)	-0.168 (0.109)	0.145 (0.109)	0.083 (0.106)	0.016 (0.105)	0.016 (0.105)	0.683*** (0.157)
Observations	37131798	37131798	37131798	37131798	37131798	37131425	37131425
R <sup>2</sup>	0.00	0.02	0.03	0.04	0.10	0.11	0.12
Cluster (Pairs)		6,092	6,092	6,092	6,092	6,092	6,092
Cluster (Products)		4,874	4,874	4,874	4,874	4,865	4,865
<b>Panel C: All PTAs</b>							
PTA	0.519*** (0.139)	-0.750*** (0.103)	-0.204** (0.101)	-0.278*** (0.100)	-0.332*** (0.099)	-0.333*** (0.099)	-0.060 (0.106)
Observations	40452929	40452929	40452929	40452929	40452929	40452570	40452570
R <sup>2</sup>	0.00	0.02	0.02	0.04	0.10	0.10	0.11
Cluster (Pairs)		6,219	6,219	6,219	6,219	6,219	6,219
Cluster (Products)		4,875	4,875	4,875	4,875	4,866	4,866
Imp.& Exp. FE		✓	✓				
Year FE			✓				
Imp.-Year& Exp.-Year FE				✓	✓	✓	✓
HS6 FE					✓	✓	✓
HS6-Year FE						✓	✓
Pair FE							✓

$\Delta t_{ijkt}^a = |t_{ikt} - t_{jkt}|$  with country  $i$ , country  $j$ , product  $k$ , and time  $t$ . We use a 15% sample of the panel with all 19 years (1996-2014). Twoway clustered (country-pairs and products) standard errors in ( ). \*\*\*/\*\*/\* Indicate significance at the 1%/5%/10% level.