Free Trade Agreements, Customs Unions in Disguise?

Gabriel Felbermayr[*], Feodora Teti[†], and Erdal Yalcin[‡]

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Abstract

Using 19 years of tariff data for 125 countries and 4,215 products, we document a hitherto overlooked but important and relevant stylized fact. In 67% of the product-pair combinations external tariffs of countries differ at most 3 percentage points. The degree of tariff similarity is even stronger for countries belonging to the same deep free trade agreement (FTA). 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 almost 80% of all country pairs. This has an important implication: In most FTAs, for a vast majority of products, given existing tariff vectors, trade deflection is not profitable. In these cases, there is no economic rationale for costly rules of origin (RoOs). Rather, the presence of extensive RoOs in modern FTAs shows the extent of rent-seeking in trade policy making.

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

JEL-Classification: F10, F13, F15

[*]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

[†]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

[‡]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

Traditionally, trade economists are skeptical of free trade agreements (FTAs) because of their preferential nature.[1] FTAs grant advantages to some trade partners but withhold them from others. In that way, they lead to harmful trade diversion. Amongst regional trade agreements, customs unions (CUs) are usually preferred over FTAs because the former create as much trade as the latter but typically divert trade less (Krueger 1997). Nonetheless, less than 10% of all trade agreements in 2016 are CUs (Dür et al. 2014; Freund and Ornelas 2010).

While CUs usually have a common external tariff (at least for a subset of products), this is not the case with FTAs, at least formally. For this reason, in contrast to CUs, FTAs require rules of origin (RoOs) that define under which conditions a good is said to originate from a member country of the FTA so that it can benefit from a preferential tariff. Complying with these rules causes costly red tape.[2] Moreover, they can distort firms' input sourcing (Conconi et al. 2016; Krishna and Krueger 1995). But without RoOs, each imported commodity would enter the FTA through the country with the lowest item tariff. This arbitrage activity, often referred to as trade deflection, would result in the FTA member with the lowest tariff de facto setting the common external tariff. If countries formed CUs instead of FTAs, Bhagwati's (1995) spaghetti bowl of bilateral trade regimes would be less indigestible. But, clearly, trade deflection would make the process to reach an agreement harder, imposing similar difficulties as current multilateral negotiations are facing.

Surprisingly, so far, no study has asked whether trade deflection is actually a realistic possibility. If it is not, the extensive use of RoOs in modern FTAs would have no rationale but rather be an indicator of the presence of rent seeking in trade negotiations.

In this paper, we use a newly compiled data set of MFN (most favored nation) and preferential tariffs at the 6-digit level. We document a stylized fact that, to the best of our knowledge, has been overlooked so far: countries tend to set their external tariffs quite similarly. This is even more pronounced amongst members of ambitious FTAs. So, while CUs are rare, it appears

[1] In this paper, we follow WTO definitions. Regional trade agreements (RTAs) are reciprocal preferential trade agreements between two or more partners. They take the form of free trade agreements (FTAs) and Customs Unions (CUs). In contrast, preferential trade arrangements (PTAs) are unilateral trade preferences.

[2] See Anson et al. (2005), Cadot et al. (2006), Carrère and Melo (2006), and Estevadeordal (2000) for attempts towards quantifying these costs.

that many modern FTAs are, in fact, CUs in disguise. With similar external tariffs, there is no economic rationale for RoOs. If in such cases we do observe RoOs, they must be due to protectionist motives, e.g., to make the use of preferences more costly or to manipulate firms' sourcing decisions. The upshot is that FTAs should not require proof of origin except for those few products where differences in external tariffs are larger than some threshold level (either zero, or the additional transportation costs that would arise if firms attempt to exploit tariff differences).

But why do FTA members set similar external tariffs? There are two leading hypotheses which we disentangle econometrically: first, similarity could be due to selection if countries with similar economic structures (and, hence, similar schedules of external tariffs) choose to form FTAs. Second, similarity could also result from some convergence process set off as a consequence of the FTA formation. We find that positive selection has a stronger support in the data.

Concern with RoOs and their side effects is wide-spread in the literature. It is a key ingredient in Bhagwati's (1995) "Spaghetti Bowl" parabole. In his words, RoOs are "*inherently arbitrary*". They make "*the occupation of lobbyists who seek to protect by fiddling with the adoption of these rules and then with the estimates that underlie the application of these rules ... immensely profitable at our expense.*" More generally, as also highlighted by Baldwin (2016), with the spread of international production networks it is increasingly problematic to operate trade policy on the assumption that one can cleanly identify the nationality of a product. As a consequence, FTAs are "*tying up trade policy in knots and absurdities facilitating protectionist capture* " (Bhagwati 1995).[3]

RoOs come in a multitude of forms. All regimes require that a product undergoes "substantial transformation" in the originating country. This could be a minimum value added content requirement, a change in tariff chapter, or a combination of these. For example, the text of a modern trade agreement, the Canada-EU Trade Agreement (CETA), defines the following RoOs for a textile good falling under HS heading 19.01 ("Malt Extract"): "*A change from any other heading, provided that: (a) the net weight of non-originating material of heading 10.06 or 11.01 through 11.08 used in production does not exceed 20 per cent of the net weight of the product,*

[3] These concerns apply mostly to tariffs; however, they also apply to other provisions in FTAs which are meant to be preferential. The arguments in this paper carry over to these cases.

(b) the net weight of non-originating sugar used in production does not exceed 30 per cent of the net weight of the product, (c) the net weight of non-originating material of Chapter 4 used in production does not exceed 20 per cent of the net weight of the product, and (d) the net weight of non-originating sugar and non-originating material of Chapter 4 used in production does not exceed 40 per cent of the net weight of the product." Needless to say, if countries are members to different FTAs, they have to comply to potentially different and conflicting RoOs.

These bureaucratic costs reduce the value of trade agreements. Recently, a host of papers have documented the costs of RoOs. Deardorff (2016) shows analytically by means of a simple model that even when every country has an FTA with every other country, due to RoOs the level of welfare in such a situation can be lower than in the situation where no FTA was present and only MFN tariffs apply. The theoretical literature points to three reasons why RoOs lead to costs for businesses and welfare losses: 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 RoOs depending on the export-destination due to multiple FTAs with little overlap in the design of the RoOs.[4] Third, exporters might want to change production processes to meet RoOs requirements, distorting trade patterns and investment flows (Krishna 2006; Krishna and Krueger 1995).

The empirical evidence confirms the negative effects of complying with RoOs. The compliance costs associated with meeting RoOs requirements range from 3-15% of final product prices depending on the method used to measure the restrictiveness of RoOs (Anson et al. 2005; Cadot et al. 2006; Carrère and Melo 2006; Estevadeordal 2000). Andersson (2015), Augier et al. (2005), and Bombarda and Gamberoni (2013) use the liberalization of the EU's RoOs as a natural experiment and find a positive effect on total trade. Constructing a new database on the NAFTA RoOs Conconi et al. (2016) show that RoOs 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 RoOs (Cadot et al. 2014; Demidova et al. 2012). Firm surveys show that RoOs hinder firms to use FTA preferences (Suominen and Harris 2009; Wignaraja et al. 2010). Also preference utilization rates of less than 100% indicate the high fixed costs associated with RoOs making it unprofitable for exporters to comply with

[4] Estevadeordal and Suominen (2006) review the types of RoOs used around the world and find significant heterogeneity with respect to the exact requirements as well as the level of restrictiveness.

the rules (Keck and Lendle 2012).[5]

There is also a theoretical literature on the choice between FTAs and CUs. We have already mentioned the seminal paper by Krueger (1997). In contrast to the case of CUs, in FTAs participating countries keep autonomy over external tariffs. This should make it easier to actually conclude a trade agreement because members do not have to delegate policy making authority to a common institution. Facchini et al. (2013) provide theoretical arguments to show that, in a political economy model with imperfect competition, FTAs might yield higher welfare for the prospective member countries when voters strategically choose a very protectionist representative to conduct the negotiations. Clearly, it is possible that, under certain conditions, members in FTAs could find it optimal to choose similar sets of external tariffs. Appelbaum and Melatos (2012) model this possibility and talk about "camouflaged" CUs. Their paper provides a theoretical explanation for our empirical findings.

The rest of this paper proceeds in three steps. Section 2 shows under which conditions trade deflection is actually profitable and guides therefore our empirical analysis. Section 3 introduces a new tariff database, that deals with the well-known issue of missing data in the standard sources for tariffs (TRAINS and World Bank). We improve on the standard way of interpolating missing MFN tariffs. Moreover, for preferential tariffs, we use information on more than 500 historical or existing FTAs.[6] Using the new tariff data we calculate the differences in external tariffs for every pair-product combination (6-digits). Furthermore, we construct pair-product specific transportation costs using disaggregated data on cif/fob imports for the US, model them using a simple econometric model, and provide out-of-sample predictions for all other product-pair combinations. We validate our approach using data from New Zealand.

Section 4 uses the data to assess countries' differences in external tariffs. We find that the level of tariff similarity is high: for 85% of the import values in 2014 the difference in external tariffs was at most 3%-points. For 86% of the global trade volume, the differences in external tariffs do not exceed the transportation costs. Therefore, trade deflection becomes unprofitable and the economic rationale for RoOs vanishes. Furthermore, the data indicate that members of a deep FTA choose more similar tariff schedules than country pairs without an FTA; the opposite

[5] For example, in the EU's most advanced bilateral trade agreement in force (with Korea), five years after entry into force of the agreement, the preference utilization rate is 71% (EU Commission, 2017.

[6] The relevant information comes from DESTA (Dür et al. 2014).

holds for shallow FTAs.

In Section 5, we investigate the structure of that correlation. In particular, we ask whether tariff similarity in deep FTAs is due to an ex-ante *Selection Effect* or to an ex-post *FTA Effect*. The former arises if countries with more similar external tariffs are more likely to form a deep FTA. The *FTA Effect* means that, once the FTA is concluded, countries choose more similar optimal schedules of external tariffs. We use simple panel econometrics to identify the relative strength of these potential channels. More precisely, we employ a difference-in-differences approach. We compare country-pairs with a deep and shallow FTA, 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 show that about two-thirds of the pattern can be explained due to the *Selection Effect*, but also ex-post convergence has some relevance. Low levels of tariffs drive mostly the results.[7] Section 6 shows the robustness of our results.

Finally, in Section 7, we draw policy conclusions. The most important is that one could substantially relax the requirements to prove the origin of goods in many FTAs because trade deflection is profitable only in a few product lines. More specifically, we suggest that, in new FTAs, negotiators do agree on a full set of RoOs for all products, but that the requirement to prove origin is activated only if external tariffs of FTA members differ by some minimum amount. Our proposal could disentangle Bhagwati's spaghetti bowl a bit. It could also help dealing with the exit of countries from long established CUs, such as Britain's or Turkey's potential exit from the EU's customs union. Under our proposed scheme, countries could exit the CU without unduly endangering existing production networks.

2 On the Profitability and Scope of Trade Deflection

2.1 The Profitability of Arbitrage

Consider an importing country $i = 1, ..., N$, and an exporting country $j = 1, ..., N$. Denote the ad valorem tariff applicable on a good $k = 1, ..., K$ in factor form by $t_{ijk} \geq 1$ (so that

[7] This part of our paper, adds to a literature which analyzes whether preferential trade liberalization leads to lower or higher external tariffs (see Freund and Ornelas (2010) for a review). Empirical analysis based on developing countries finds evidence for a positive correlation (Calvo-Pardo et al. 2011; Crivelli 2016; Estevadeordal et al. 2008). For developed countries the evidence is mixed; see Ketterer et al. (2014) for CUSFTA, and Karacaovali and Limão (2008) and Limão (2006) for the EU and the US, respectively.

$(t_{ijk} - 1) \times 100\%$ is the tariff in percent). When useful, we distinguish between preferential tariffs t^*_{ijk} and MFN tariffs $\tilde{t}_{ijk} = \tilde{t}_{ik}$ for all j.

Suppose i and j conclude a free trade agreement (FTA) such that $t^*_{ijk} = t^*_{jik} = 1$. However, they may maintain non-zero import tariffs on imports from some third country c such that $t_{ick} \geq 1, t_{jck} \geq 1$, where it is irrelevant for our argument whether these are MFN tariffs or preferential tariffs.

This constellation opens the possibility for trade deflection if $t_{ick} \neq t_{jck}$.[8] Suppose $t_{jck} < t_{ick}$. Then, without further provisions, a good originating from country c could enter country i through country j with the result that its tariff protection against imports from country c would be undercut as j's tariffs are lower than its own and trade between i and j is tariff-free. To avoid such trade deflection, for the granting of preferential treatment, all FTAs require a proof of origin that documents that the good eligible for tariff-free trade from j to i actually originates from country j and not from some third country c. There are many different "Rules of Origin" (RoOs) defining when a good "originates" in i : e.g., the share of country i value added in the value of the export good must lie above some threshold, or the good must have undergone some substantial transformation (again defined in various ways) within the FTA, or some other rule, or some combination of rules.

Generally, whenever $t_{ick} \neq t_{jck}$, without RoOs, there is scope for arbitrage leading to a situation where countries i and j de facto are in a customs union, since products from c enter both countries at the common effective tariff rate $t_{ck} = \min\{t_{ick}, t_{jck}\}$. When $t_{ick} = t_{jck}$, there is no scope for such an arbitrage activity. Nonetheless, for tariff-free intra-FTA transactions, exporters are required to document that their products satisfy the RoOs.

Let there be a fixed cost of c_k from respecting the RoOs for good k, either in the form of bureaucratic effort or because the RoOs require a firm to deviate from an otherwise optimal international sourcing policy. The tariff applicable to a transaction between i and j will be $\tilde{t}_{ik}$ instead of t^*_{ijk} whenever the preference margin $\tilde{t}_{ik} - t^*_{ijk}$ is low, c_k is large and/or the value of a transaction net of tariffs is small. For this reason, bureaucratic RoOs can explain the empirical fact that not all firms within an FTA make use of preferential tariffs but apparently

[8] The term *trade deflection* is not uniquely defined in the literature. For example, besides its meaning in the FTA literature, it is also used to describe a situation where a country's use of an import restricting trade policy distorts a foreign country's exports to third markets (see, e.g., Bown and Crowley (2007)).

prefer to remain subject to the MFN tariff. RoOs can therefore act as de-facto trade barriers and diminish the value of FTAs, in particular for smaller firms. When they distort the sourcing decision of firms they have direct implications for third countries because they exacerbate the discrimination inherent in any preferential trade agreement.[9]

So, the question arises: when is trade deflection profitable and therefore a valid concern in an FTA? Let $\tau_{ijk} \geq 1$ denote the *minimum* iceberg transportation costs between i and j. Then, by construction, $\tau_{ijk} < \tau_{ick}\tau_{cjk}$, where c is any third country. Also, for simplicity, assume a market structure (perfect competition, or monopolistic competition with CES preferences) such that consumers bear all trade costs. Then, the delivery price p_{ick} in country i of a good k produced in country c will be $p_{ick} = p^0_{ck} t_{ick} \tau_{ick}$ where p^0_{ck} is the mill price of good k. Similarly, its price in country j would be equal to $p_{jck} = p^0_{ck} t_{jck} \tau_{jck}$. Shipping that good through j to i would lead to additional transportation costs. Transshipping the good from c through j and onwards to i would make sense only if

$$p^0_{ck} t_{ick} \tau_{ick} > p^0_{ck} t_{ijk} \tau_{ijk} t_{jck} \tau_{jck}. \tag{1}$$

Now, let us assume that i and j have an FTA so that $t_{ijk} = t^*_{ijk}$, but elsewhere MFN tariffs apply. Then, there are arbitrage possibilities if and only if

$$1 > \frac{\tau_{ick}}{\tau_{ijk}\tau_{jck}} > \frac{t^*_{ijk}\tilde{t}_{jk}}{\tilde{t}_{ik}}. \tag{2}$$

Clearly, a necessary condition is that $\tilde{t}_{jk} < \tilde{t}_{ik}$, i.e., country j must apply a lower MFN tariff to the good than country i. In the case of an FTA with $t^*_{ijk} = 1$, trade deflection is profitable if and only if

$$\frac{\tilde{t}_{ik} - \tilde{t}_{jk}}{\tilde{t}_{jk}} > \frac{\tau_{ijk}\tau_{jck} - \tau_{ick}}{\tau_{ick}} > 0,$$

i.e., the tariff savings must be larger than the additional transportation costs. If both countries i and j had the same MFN tariffs, $\tilde{t}_{ik} = \tilde{t}_{jk}$, there are no tariff savings, and the above inequality would be immediately violated.

[9] See Krishna and Krueger (1995) for a more detailed analysis of the hidden protectionism in RoOs.

2.2 Measuring the scope for trade deflection

For our empirical analysis, we need a measure of the scope for trade deflection in the absence of RoOs. For this purpose, based on inequality (2), we define the trade cost weighted difference in external tariffs for every country pair ij relative to a third country c for product k at date d as

$$\Delta T^c_{ijkd} \equiv \max\left\{0, T_{ickd} - T^j_{ickd}\right\}, \text{ with } T_{ickd} \equiv t_{ickd}\tau_{ickd} \text{ and } T^j_{ickd} \equiv t_{jckd}\tau_{ijkd}\tau_{jckd} \quad (3)$$

where T_{ickd} and T^j_{ickd} measure transport cost weighted tariffs on the direct route from country c to i and from the indirect one, where the good is cross-hauled through country j (denoted by the superscript). In expression (3) we allow tariffs with the third country c to be MFN or preferential. If $\Delta T^c_{ijkd} = 0$, no profitable arbitrage possibilities exist.

In absence of transportation costs (and any other non-tariff trade barriers), (3) simplifies to

$$\Delta t^c_{ijkd} = \max\{0, t_{ickd} - t^j_{ickd})\} \quad (4)$$

where the costs of servicing market i with a product from c through j, t^j_{ickd}, is simply country $j's$ tariff on good k from c, t_{jckd}. In some parts of our analysis, we work with this "simple" measure, because it characterizes a useful sufficient condition for trade diversion.[10]

Although the measures for tariff similarity are very intuitive, they are subject to a major practical challenge. Let N denote the number of countries and K the number of products. Then, we need to compare $(N-1)N$ country pairs to $N-2$ third countries in K products, which yields $KN(N-1)(N-2)$ data points. With $N = 125$ and $K = 4,215$ in our data, this gives rise to about 8 billion data points per year. It goes without saying that a meaningful panel analysis of data of that size runs into severe computational issues.

We deal with this problem by averaging over the third country dimension so that

$$\Delta T_{ijkd} \equiv \max\left\{0, \bar{T}_{ikd} - \bar{T}^j_{ikd}\right\} \quad (5)$$

where $\bar{T}_{ikd} \equiv \left(\sum^N_{c\neq i,j} T_{ickd}\right) / (N-2)$ and $\bar{T}^j_{ikd} \equiv \left(\sum^N_{c\neq i,j} T^j_{ickd}\right) / (N-2)$, where $\bar{T}_{ikd}$ and $\bar{T}^j_{ikd}$

[10] Its main advantage is that it can be directly measured in the data, while the more general measure requires the estimation of transportation costs.

are the transport cost weighted arithmetic means of external tariffs for a direct import from c to i and for cross-hauling through j, respectively. Similarly, we average out the third country dimension from the simple measure (4)

$$\Delta t_{ijkd} = \max\{0, \bar{t}_{ikd} - \bar{t}^{j}_{ikd}\} \tag{6}$$

where $\bar{t}_{ikd}$ and $\bar{t}^{j}_{ikd}$ are the means of simple tariffs of i and j with all third countries in product k. Clearly, this procedure introduces some measurement error; we will discuss this issue at detail below. Note however, that there is no measurement error at all if countries i and j apply MFN tariffs to any third country c and if the focus is on the sufficient ("simple") condition.

3 Data

3.1 New Tariff Database

Ideally, for the empirical analysis, we would have 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 except in bilateral relations where a preferential arrangement (such as a CU, an FTA, or when a country unilaterally grants preferences (Generalized System of Preferences, GSP)). In those cases, we are interested in the preferential tariff. To minimize aggregation bias the ideal data would be as disaggregated as possible. As trade deflection could happen with any third country where an FTA exists, the perfect data would provide information for the universe of countries.

Using the World Bank's World Integrated System (WITS) software, which pools data from the United Nations and the World Trade Organization, we combine all publicly available information on MFN tariffs and preferential tariffs.[11] The data have information for more than 150 countries on the 6-digit product level of the common HS system with some of the data dating back to 1988.[12] Whenever more than one preferential scheme applies (i.e. a bilateral FTA or GSP), we

[11] In case of specific tariffs, the sources report ad valorem equivalents.

[12] Tariffs are typically defined at the 8-digit level. We use 6-digits because this is the most disaggregated level where product classifications are harmonized across countries; beyond 6-digits every country has its own product classification. Moreover, tariffs at such disaggregated levels are not available for a broad range of countries. We will provide sensitivity analysis related to the level of aggregation.

always assume the lowest preferential tariff to be effectively in place.

Unfortunately, the WITS data need substantial cleaning and completing. Anderson and Van 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 1996 out of 126 WTO-members only 49% reported tariffs. Even more troublesome, the set of countries that report only sporadically is not random but rather consists mostly of developing countries.[13] As tariffs tend to be systematically different between developing and developed countries, the non-random pattern of missing data could 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, we set them equal to the nearest preceding observation. This procedure accounts for the WTO logic of notification, when countries report only policy changes. 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 FTAs are often phased in. For a precise interpolation, we use detailed information for more than 500 FTAs.[14]

Since the quality of the tariff data improves significantly after the entering into force of the World Trade Organization (WTO) in 1995, we focus on the period 1996-2014. To the best of our knowledge there is no comparable publicly available data base for tariffs in terms of country- and time-coverage as well as level of disaggregation at hand.[15]

Let $\tilde{t}_d = (NK)^{-1} \sum_i \sum_k \tilde{t}_{ikd}$ be the unweighted average (across importers and products) MFN tariff. Figure 1(a) shows that, for both developed and developing countries, the level of MFN tariffs decreased by roughly 5%-points between 1996 and 2014. Developing countries had average MFN tariffs of 15.41% in 1996 and of 9.58% in 2014. In developed countries, MFN tariffs decreased from 8.98% in 1996 to 5.24% in 2014. For both groups, average tariffs declined sharply between 1996 and 2005, the phase-in period of the Uruguay commitments; afterwards the MFN

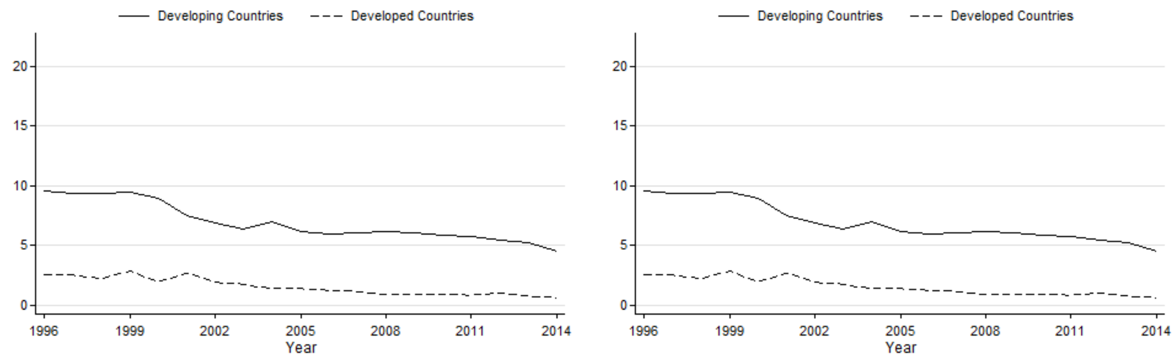
[13] See Figure A1(a) in the Appendix.

[14] The data is provided by DESTA (Dür et al. 2014). See the Appendix for details on the imputation. Note that the WITS data sometimes reports MFN tariffs when preferential tariffs should be reported and vice-versa. Our data imputation algorithm accounts for these peculiarities.

[15] Caliendo et al. (2015) have constructed a similar database which is, however, not publicly available yet. The imputation algorithm is very similar to ours with the drawback that they only have information on approximately 100 FTAs and their phasing-in regimes.

Figure 1: Average MFN and Preferential Tariffs over Time

(a) Average MFN Tariffs $\tilde{t}_d$ (b) Average Preferential Tariffs t_d^*



Note: 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 as defined in the text.

tariffs remain rather stable. Since 1996 the preferential tariffs (see Figure 1(b)) of developed countries have been on a rather low level, ranging between 0.53 and 2.86%-points. For developing countries, a decreasing time trend can be observed resulting in an average preferential tariff in 2014 of 4.52%-points.[16]

The preference margin (the difference between MFN and preferential tariffs $\tilde{t}_{ikd} - t^*_{ijkd}$) is essential when determining the relevance of RoOs: exporters only have incentives to comply with them, when the preference margin is large. In 2014, it equals on average 5.60%-points. However, there is substantial heterogeneity across industries. Figure 2(a) shows the average preference margin by HS-section.[17] The preference margin is lowest for Mineral Products (1.92%-points), and highest for Live Animals (14.47%-points). Overall it is largest for the agricultural sector. The textile sector (Textiles & Apparel and Footwear) as well as Arms and Ammunition lie somewhat in the middle (6.98 to 7.80%-points), while the preference margin is rather low for the remaining products.

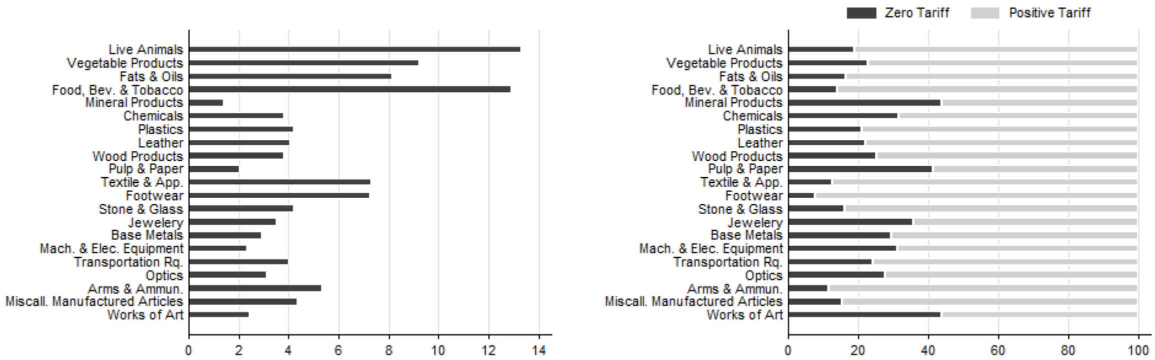
Products with MFN tariffs equal to zero are not affected by RoOs because there are no lower preferential tariffs. So, there is no scope for trade deflection. The probability of zero MFN tariffs differs across industries. Figure 2(b) shows the share of zero MFN tariffs by section. In

[16] We compute the average preferential tariff as $t_d^* = (N(N-1)K)^{-1} \sum_i \sum_j \sum_k t^*_{ijkd}$.

[17] We calculate the average margin as $\tilde{t}_s - t_s^* = (NK)^{-1} \sum_i \sum_{k \in K_s} \tilde{t}_{ikd} - (N(N-1)K)^{-1} \sum_i \sum_j \sum_{k \in K_s} t^*_{ijkd}$, where K_s denotes the set of products in a HS-section.

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

(a) Preference Margin $\tilde{t}_s - t_s^*$ (b) Share of Zero MFN Tariffs



Note: The preference margin is the difference between the MFN tariff a country applies and the preferential tariff it offers its FTA partners. The share of zero MFN Tariffs is the number of zero MFN tariffs as a percentage of the total number of MFN tariffs.

the areas of Mineral Products, Pulp & Paper, and Works of Art the percentage of zero MFN tariffs is highest (more than 40%). In contrast, the share only equals 7.70%-points for Footwear; for Textiles & Apparel, and Arms & Ammunition it equals roughly 12%-points.

3.2 Transportation Costs

The second key variable entering into the calculation of Equation 5 is a measure of transportation costs.[18] As surveyed by Anderson and Van Wincoop (2004), across a large number of countries and goods, transportation costs make up a trade cost equivalent of 21%, about half of which is attributable to the direct freight costs and the other half to the time value of goods in transit. However, the same survey also makes very clear that other border-related trade barriers are at least twice as important as transportation costs, not to speak of retail and wholesale distribution costs. Thus, focussing on transportation costs may actually underestimate the additional non-tariff trade costs that arise when trans-shipping a good through some third country in order to save on tariffs.

Anderson and Van Wincoop (2004) propose industry or shipping firm information to be the first best source of data for transportation costs. However, data are scarce. Alternatively one can use the ratio of transaction values denoted in cif (cost, insurance, freight) terms relative to

[18] Head and Ries (2001) or Novy (2013) derive comprehensive measures of trade costs from observed trade data. These include components that have more to do with retailing, contracting, etc., which are not relevant in our context and they are available for aggregate trade only.

the transaction values in fob (free on board) terms. In theory, this ratio should be identical to τ_{ijks} and also share the property $\tau_{ijks} \geq 1$. However, there are severe data limitations, except for very few countries.[19] We proceed as follows: first, using US data, originally provided by the US Census and cleaned by Schott (2008), we proxy bilateral ad-valorem transportation costs between the US and all its trade partners for every product k. The data include information on the import value at fob and cif terms at the ten-digit HS level by exporter country and entry-port for the years 1989 until 2015. This allows constructing an US specific measure of transportation costs at the 6-digit level for every product-exporter combination for the years 1996 and 2014.[20]

In a second step we use the cif/fob ratios of the US to predict transportation costs for all other product-pair combinations. We assume transportation costs to be a function of distance D_{ij} 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.[21]

Thus, it is possible to estimate the parameters α^k and δ^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, $D_{US,i}$.[22] Taking logs makes OLS a feasible estimator. The regression equation equals $ln(\tau_{US,i}^k) = \alpha^k + \delta^k ln(D_{US,i}) + u^k$. We regress the cif/fob ratios on the bilateral distance for every product separately to allow for product-specific constants. [23]

Next, for every country-pair and for every product k we predict a measure of transportation cost $\hat{\tau}_{ij}^k = exp(\hat{\alpha^k} + \hat{\delta^k} ln(D_{ij}))$. Figure 3(a) shows the actual values of the transportation costs for the US and the predicted values for every 2-digit product, there is virtually no difference between the two lines indicating a good in-sample prediction. This procedure provides us with transportation costs for 4,215 products (out of the available 5,018 tariff lines). The transportation costs equal

[19] Records of global trade data do not report cif and fob transactions at the sector-level; the Direction of Trade Statistics of the IMF do, but the resulting cif/fob ratios take very implausible values on the entire real line.

[20] We collapse first over the entry-ports within every 10-digit product and by years, as transportation costs might differ by ports and we do not want the cif/fob ratios to be skewed by outliers. To smooth out macroeconomic shocks we first add 10 years and aggregate then up to 6-digits using again the median. For 1996 the time period goes up until 2005, for 2014 instead we include the years 2006-2015.

[21] Assuming strictly concave transportation costs implies that stopping over in country j for customs reasons is always more costly than shipping a good straight from c to i even if $D_{ic} = D_{ij} + D_{jc}$.

[22] The information about the bilateral distances stem from CEPII.

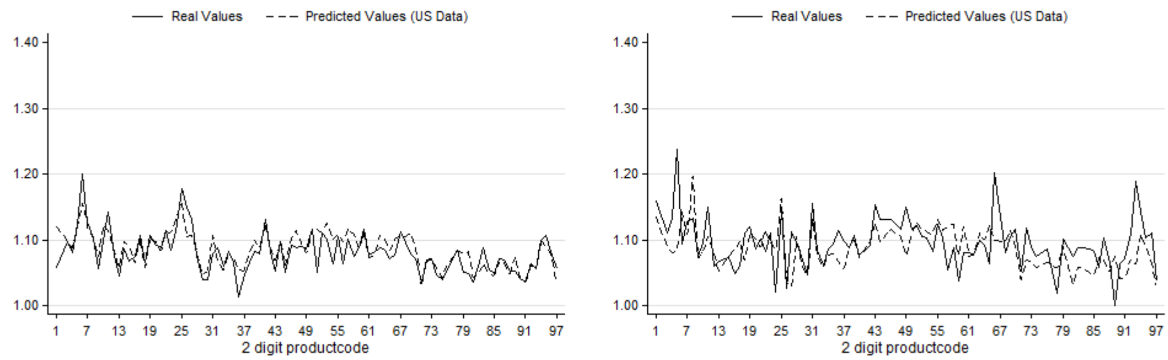
[23] See the Appendix on more details. Similarly to Hummels (2007) we have also added the weight/value-ratios as an additional explanatory factor in the transportation cost function ($\tau_{ij}^k = \alpha^k (D_{ij})^{\delta^k} \left(w/v_{ij}^k\right)^{\gamma^k}$) . However, this approach only slightly increases the explanatory power of the regressions, but lowers the number of estimated pair-product transportation costs significantly as weight/value-ratios are only available when countries actually trade.

on average 8% ((1.08-1)*100), which squares very well the evidence cited in Anderson and Van Wincoop (2004). Figure A2 shows the distribution of the estimated transportation costs for 2014.

Figure 3: Predicting Transportation Costs

(a) In-Sample Prediction: USA

(b) Out-of-Sample Prediction: New Zealand



Note: The graphs shows the observed cif/fob ratios and the predicted values for the United States (a) $\hat{\tau}_{US,j} = exp(ln(\hat{\alpha}) + \hat{\delta}ln(D_{US,j}))$ and New Zealand (b) $\hat{\tau}_{NZ,j} = exp(ln(\hat{\alpha}) + \hat{\delta}ln(D_{NZ,j}))$. We aggregate by taking the arithmetic average over the two-digit products. The data stem from the US Census, Statistics New Zealand and CEPII.

Besides for the US, cif/fob data are also available for New Zealand.[24] We use these data to check how well the prediction based on US data performs. Figure 3(b) shows the real and the predicted values for New Zealand. Overall, the fit is reasonably good although the predicted values tend to be somewhat lower than the real ones.[25]

3.3 FTA Data

Our analysis builds on the DESTA database provided by Dür et al. (2014).[26] It comprises over 600 regional trade agreements (FTAs and CUs) and the corresponding accessions and withdrawals.[27] For our sample, the probability of a country-pair having an FTA equals 40%, while it equals 6% for having a CU.[28]

[24] These are provided by Statistics New Zealand at http://www.stats.govt.nz/browse_for_stats/industry_sectors/imports_and_exports/overseas-merchandise-trade/HS10-by-country.aspx

[25] One potential explanation for this pattern is that the US are actually an outlier in that it pays much less for transportation than other countries Hummels (2007). Therefore, we expect the estimated transportation costs to understate the real ones, which - as explained above - will work against us.

[26] We use the version of 27^{th} of June 2016. https://www.designoftradeagreements.org/

[27] The database keeps track of regional trade agreements that are superseded by more recent – and typically more ambitions – versions, such as the Canada-US FTA (signed in 1998) by NAFTA (in 1994), or the Europe Agreements of Middle and Eastern European countries by full EU membership.

[28] One shortcoming of the DESTA data is that it does not include information on whether the agreement is still in place. This problem is especially pronounced for CUs. Therefore, we cross-check the DESTA data with

The DESTA data also measure the depth of each agreement. 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). We group FTAs into shallow and deep agreements. FTAs with a depth-index of less than 4 are classified as shallow, the remainder as deep FTAs. The probability of having a deep FTA equals 6% while the probability of having a shallow FTA is more than five times as much (31%). Over the sample period we observe that the probability of having an FTA increased by 14%-points (see Table 1 and that most of this increase was due to more deep FTAs.

the regional trade agreement dataset provided by Baier et al. (2014) and use their data to determine whether a CU is in place.

Table 1: Summary Statistics

	1996					2014				
	Mean	SD	Shallow FTA	Deep FTA	Δ	Mean	SD	Shallow FTA	Deep FTA	Δ
Δt	6.83	23.43	7.46	4.79	2.67***	3.96	16.88	4.51	3.25	1.26***
ΔT	4.37	24.65	5.09	3.49	1.60***	1.92	17.48	2.33	1.50	0.83***
Year of Entry into Force	1,995.62	8.07	1,990.18	1,992.97	-2.79***	1,999.17	8.27	1,994.51	2,007.91	-13.40***
Depth-Index $[0, 7]$	1.67	1.42	1.54	4.87	-3.33***	2.64	2.32	1.50	6.28	-4.77***
Trade Costs (Product-Pair)	1.08	0.05	1.07	1.05	0.03***	1.07	0.04	1.07	1.07	-0.00***
RTA $[0, 1]$	0.35	0.48				0.49	0.50			
Customs Union $[0, 1]$	0.03	0.18				0.06	0.25			
FTA $[0, 1]$	0.31	0.46				0.43	0.49			
Deep FTA $[0, 1]$	0.01	0.11				0.10	0.30			
Shallow FTA $[0, 1]$	0.30	0.46				0.32	0.47			

Note: The number of observations equals 130,652,688. The years 1996 and 2014 are included. The tariff data stems from WITS, the trade costs are based on own calculations using data from Schott (2008) and CEPII, the year of entry into force of the FTAs is based on own research, while all other information concerning FTAs is taken from DESTA Dür et al. (2014).

We have manually researched the year of entry into force for the FTAs in DESTA.[29] In order to have a balanced panel, we only keep countries that are observed in every year of interest, leaving us with 125 countries (see the Appendix for a complete list of the countries in the sample). For econometric reasons, we use only the years 1996 and 2014. On average, we observe for 4,215 products tariffs and transportation costs in both years, yielding over 130 million observations in our baseline specification.

Table 1 provides summary statistics. It shows that deep FTAs are substantially younger than shallow ones. Moreover, the scope for trade deflection as proxied by our measures (5) and (6) is significantly larger for shallow FTAs than for deep ones.

4 Tariff Similarity and FTAs

This section presents new stylized facts on the difference in countries' external tariffs, simple and transportation-cost weighted, and heterogeneity across types of FTAs, regions, and industry sectors. We show cross-sectional data on the 6 digit product-level for 1996 and 2014.

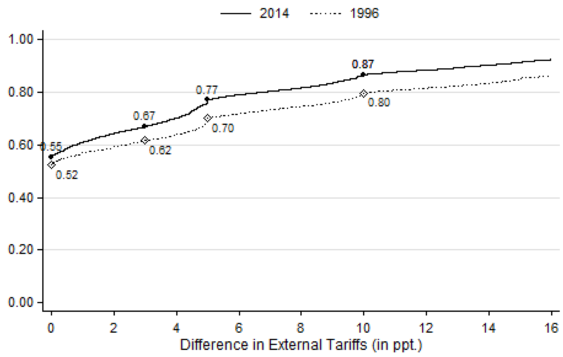
4.1 High Tariff Similarity

Figure 4(a) plots the cumulative distribution function of simple differences in external tariffs Δt_{ijk} for the years 1996 and 2014. First of all, a clear time trend can be observed, since tariff similarity is much higher in 2014 than in 1996. In the remainder we will focus mostly on 2014. In that year for 55% of all product-pair combinations in our data, external tariffs are identical between i and j, and for 67% of all product-pair combinations the simple difference in external tariffs amounts to at most 3%-points. In 77% of the cases Δt_{ijk} equals at most 5%-points, and for only 13% it exceeds 10%-points. So, country pairs seem to have rather similar external tariff structures and thus trade deflection can be profitable only in a limited share of cases. Naturally, factoring in transportation costs, the Figure 4(b) plots the cumulative distribution of the transportation-costs adjusted measure of tariff similarity ΔT_{ijkt}. Here the picture becomes even clearer: in 2014 for 78% of the cases there is no scope for trade deflection at all.[30]

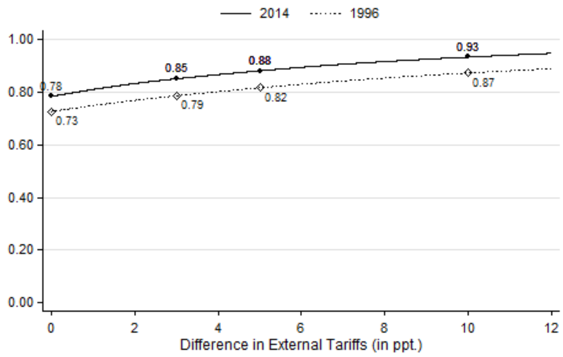
[29] In the few cases when we could not find the year of entry into force, we used the year of ratification.
[30] This result is not sensitive to the construction of the transportation costs (see Appendix Figure A3).

Figure 4: Descriptive Facts about Tariff Similarity, 2014

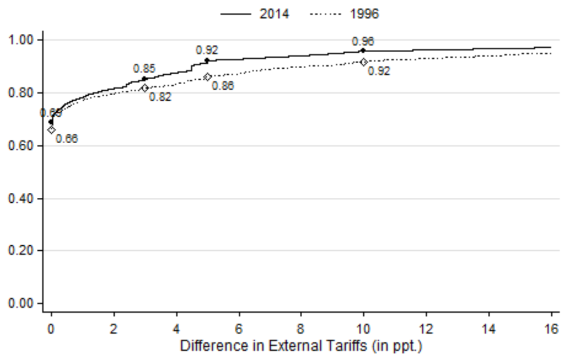
(a) C.D.F. of Simple Tariff Differences Δt_{ijk}



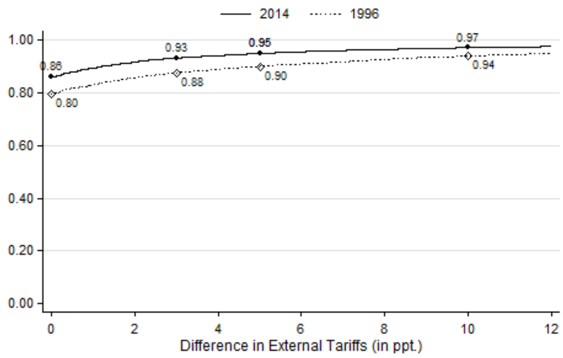
(b) C.D.F. of Weighted Tariff Differences ΔT_{ijk}



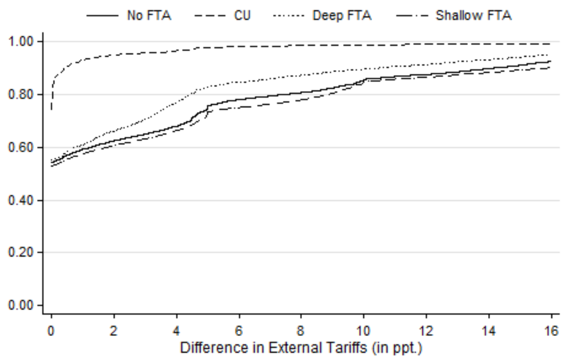
(c) C.D.F. of Import Weighted Δt_{ijk}



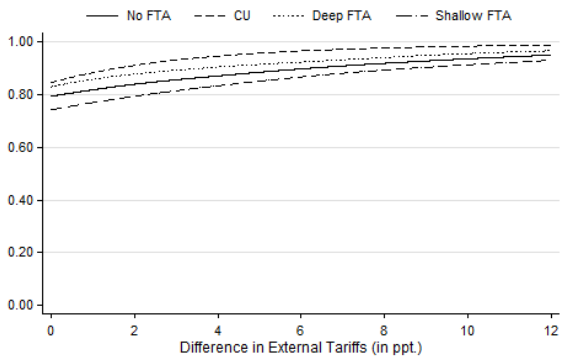
(d) C.D.F. of Import Weighted ΔT_{ijk}



(e) C.D.F. of Δt_{ijk} by Type of RTA (2014)



(f) C.D.F. of ΔT_{ijk} by Type of RTA (2014)



Note: Δt_{ijk} and ΔT_{ijk} are defined in Section 2.2. Panels (a), (c), and (e): truncated to values ≤ 16, Panels (b), (d), and (f): truncated to values ≤ 12.

Of course it could systematically be the case that within country pairs tariffs are similar when trade in the respective tariffs is very low and high else. To check this possibility, Figure 4(c) shows the cumulative share of imports as a function of the simple difference in external tariffs. In 2014 for 69% of global imports the difference in external tariffs between the trade partners

is zero; for 85% it is no more than 3%-points, and for 92% it amounts to at most 5%-points. So, the largest share of trade takes indeed place within country pairs at products with very small differences in external tariffs. When we account for transportation costs, the pattern is even more pronounced: for 86% of world trade the differences in product-level external tariffs between trade partners do not exceed the transportation costs.

4.2 Heterogeneity in Tariff Similarity

The evidence presented so far documents surprisingly little scope for trade deflection. This finding would be relevant for the economic rationale of RoOs only if it also holds for the 43% of all trade links in 2014 between countries that are members of an FTA. Therefore, we calculate the cumulative distribution functions (C.D.F.s) of our tariff similarity measures for different trade policy environments such that $P(t_{ijk} \leq c|RTA_{ij} = 1)$ and $P(T_{ijk} \leq c|RTA_{ij} = 1)$, with RTA_{ij} indicating a CU, a deep, or a shallow FTA). Figure 4(e) and (f) present the findings for the simple difference Δt_{ijk} and the transport cost weighted one ΔT_{ijk} for 2014. The results for 1996 can be found in the appendix Figure A4.

An interesting pattern emerges. While country-pairs with a deep FTA set their tariffs more alike than when no FTA is present, for those with a shallow FTA the opposite is true. The probability of having a tariff difference of at most 3%-points equals 65% for pairs without an FTA, 71% for pairs with a deep FTA, and 63% for pairs with a shallow FTA. When accounting for transportation costs, the differences are not as pronounced anymore because the level of tariff similarity is already rather high. Nevertheless the ranking across different types of RTAs is still the same as for Δt_{ijk}. Kolmogorov-Smirnov tests show that the C.D.F.s for the population of pairs with either type of FTA are significantly different from the C.D.F. for pairs without an FTA. The same applies also for the year 1996, although the values are somewhat smaller.

By definition, in a CU the difference in external tariffs should equal to zero. Although the external tariffs exhibit a significantly higher degree of similarity, the common external tariff cannot always be observed as Figure 4(e) shows. One reason could be that specific products or whole sectors are excluded from the agreement, such as in the EU-Turkey CU.[31] Another reason

[31] The EU-Turkey CU applies to industrial goods, while agricultural goods (and services) are excluded from the agreement.

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; this may be the case in Mercosur or in the South African CU.

Next we check for heterogeneity tariffs across regions and across products. Table 2 summarizes the patterns by showing conditional cumulative probabilities. Columns (1) to (6) present the probability of the difference in external tariffs Δt_{ijk} to be smaller than a certain threshold value c, i.e., $Pr(\Delta t_{ijk} \leq c)$. The remainder of the table shows similar statistics for the transportation cost weighted measure, i.e., $Pr(\Delta T_{ijk} \leq c)$). Panel (a) shows the probabilities for North-North, North-South, and South-South country-pairs. Panels (b)-(d) investigates the agreement across different trade policy arrangements within different country groups. Again, we only show results for 2014, for the corresponding analysis of 1996 see Table A3 in the appendix.

It is well known that developing countries apply higher tariffs on average than developed ones; see Figure 1. Since the maximum amount by which differences in external tariffs can differ decreases with the overall level of tariffs, countries with low levels of tariffs also have a lower potential for trade deflection than countries with high levels. Therefore, we expect heterogeneity across regions. Indeed, North-North countries exhibit the highest degree of tariff similarity. For 73% of the tariff lines there is no difference in external tariffs at all, and for 96% the difference amounts to at most 3%-points (see Table 2 Panel(a)). Furthermore, for the vast majority of products (90%) trade deflection is not profitable as additional transportation costs exceed tariff savings; see column (7).

The higher degree of tariff similarity amongst developed countries is likely to reflect the more similar patterns of comparative advantage as well as low average levels of tariffs. 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 degree of tariff similarity is strikingly high: for almost 80% of the tariff lines the transportation costs exceed the differences in the tariffs.

Table 2 Panel (b) shows the results for North-North country-pairs for the different types of FTAs. Independently of the depth, North-North pairs with an FTA also set tariffs more similarly than those pairs without an FTA. For North-South pairs not very much heterogeneity across the different types of RTAs can be observed, while for South-South pairs, those with a deep FTA have a higher degree of tariff similarity than those pairs without an FTA, whereas pairs with a

Table 2: Heterogeneity across Regions and Types of RTAs: Conditional Cumulative Probabilities $Pr(t_{ijk}) \leq c)$ and $P(T_{ijk}) \leq c)$ for 2014

	Δt_{ijk}						ΔT_{ijk}					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	0	3	6	9	12	max	0	3	6	9	12	max
(a) ***Regions***												
North-North	73	96	99	99	100	100	90	96	98	99	100	100
North-South	54	65	77	82	86	100	77	83	87	91	93	100
South-South	54	65	79	83	89	100	79	86	90	93	96	100
(b) ***North-North***												
No FTA	59	91	97	98	99	100	97	99	99	99	100	100
Deep FTA	65	87	94	98	99	100	92	97	99	99	99	100
Shallow FTA	69	89	97	98	99	100	97	99	99	99	99	100
Customs Union	79	99	99	100	100	100	87	95	98	99	100	100
(c) ***North-South***												
No FTA	55	66	77	82	87	100	78	84	88	92	94	100
Deep FTA	55	70	84	88	91	100	83	89	92	95	97	100
Shallow FTA	53	61	70	76	81	100	70	76	82	86	90	100
Customs Union	59	92	95	96	96	100	88	94	95	96	97	100
(d) ***South-South***												
No FTA	54	63	77	82	88	100	79	86	90	93	95	100
Deep FTA	61	73	90	94	97	100	81	91	95	97	98	100
Shallow FTA	53	65	78	83	90	100	77	85	90	93	95	100
Customs Union	66	91	96	97	98	100	79	89	94	97	98	100

Note: The table shows the shares of tariff lines (in %-points) whose absolute differences in external tariffs lie below a certain threshold c. In the different panels, we focus on heterogeneity across regions and types of RTAs and show data on the simple 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. 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). In Panel (b)-(d) we look at the different regional and RTA types simultaneously. We use data for 2014.

shallow FTA set tariffs more differently. Thus, the heterogeneity across types of RTAs that can be observed in the aggregate, seems to stem mostly from North-South pairs.

When comparing the patterns of heterogeneity over time i.e. comparing Table 2 with Table A3, it becomes clear that most of the increase in tariff similarity can be observed in North-North pairs. One potential explanation are the waves of EU enlargement that happened between 1996 and 2014. Further, the data show that North-North pairs with deep FTAs display a higher degree of tariff similarity. Δt_{ijk} only changes slightly for North-South and South-South pairs. However, again, pairs with a deep FTA show lower simple tariff differences. When using the weighted tariff differences $\Delta Tijk$, the dynamics are stronger, especially for pairs with a deep FTA regardless of the region. One explanation might be that many of the more recently concluded deep FTAs

are between countries that are relatively far from each other. Therefore transportation costs between the countries in the FTA increase, making trade deflection unprofitable.

In a next step, we explore heterogeneity across 20 product sections for the year of 2014.[32] The following facts stand out: first, differences in external tariffs vary quite substantially across the sections. The products with the largest differences in external tariffs belong to the agricultural sector, footwear and the sector of arms and ammunition. In contrast, for fats and oils, pulp and paper, and textiles Δt_{ijk} never exceeds 10%-points. Second, the degree of heterogeneity depends on the type of the FTA: in general, pairs with a deep FTA have more similar tariffs than pairs without an FTA an those with a shallow FTA.

5 Why have FTA Members Similar External Tariffs? Selection vs. Convergence

5.1 Potential Channels and Empirical Strategy

For country pairs within the same FTA, differences in external tariffs are smaller than for pairs without FTAs. This begs the question: are countries with more similar patterns of external tariffs more likely to form FTAs, or do countries harmonize their respective tariff schedules once they have formed an FTA? There are good arguments for both possibilities.

First, the literature has identified variables that explain the formation of FTAs (e.g. Baier and Bergstrand (2004)), namely geographical distance, relative economic size, and factor endowment. These variables also matter for the structure and the size of optimal tariffs, regardless of whether tariffs are set to maximize national welfare or through some political economy process. Therefore, the positive correlation between FTA membership and tariff-structure similarity may be driven by confounding unobserved factors. We call this the *Selection Effect*.

Second, the FTA itself may have an effect on external tariffs. We refer to this possibility as the *FTA Effect*. An FTA might change the economic structures of the partner-countries and thus

[32] We calculate 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 FTA, with a shallow FTA, and those without an FTA. All pairs that are in a CU are excluded to avoid to bias the measures with pairs that do not matter when thinking about RoOs. The analysis is conducted for both, the simple difference in external tariffs Δt_{ijk} and ΔT_{ijk}. See A6 in the Appendix for detailed results.

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 FTAs might give rise to further external trade liberalizations (see Freund and Ornelas (2010) for an overview). If both countries respond to an FTA 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).[33]

The sign and relative importance of these two effects is likely to depend on the depth of FTAs and on their structure (North-North, North-South, or South-South). According to Downs et al. (1996), depth is defined as *"the extent to which (an agreement) requires states to depart from what they would have done in its absence"*. Depth may matter for several reasons. First, shallow FTAs often exempt whole sectors, which is not the case for deep FTAs. Second, shallow FTAs are often formed between developed and developing countries not primarily to liberalize trade but to anchor domestic reforms. Third, deep FTAs involve deeper tariff cuts amongst the members and this is likely to have stronger effects on their optimal external tariffs.[34]

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.[35] If the objective of a Southern country is to liberalize, the FTA can facilitate a decrease in overall tariffs of this specific country.

More generally, the development status of countries will be crucial. More developed Northern countries have lower tariffs, and, thus, lower levels of tariff differences. Moreover, whenever a Northern country is involved in an FTA, the dissimilarity of external tariffs is likely to be lower

[33] 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.

[34] Two developed countries, with bound MFN tariffs, that have different external tariffs before forming the FTA, can only adjust them downwards. This is likely to make the tariff levels more similar as they cannot fall below zero neither.

[35] 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"*.

and the scope for further convergence is limited.

To disentangle the selection and the convergence effects we estimate versions of the following fixed effects model

$$\Delta Y_{ijkd} = \beta_0 + \beta_1 FTA_{ijd} + \beta_2 Deep_{ijd} + \beta_3 CU_{ijd} + \gamma_{ikd} + \gamma_{jkd} + \gamma_{ijk} + u_{ijkd}, \qquad (7)$$

where the dependent variable Y_{ijkd} is either equal to the simple difference in external tariffs Δt_{ijkd} or to the transportation cost weighted one ΔT_{ijkd}. FTA_{ijd} is a binary variable that takes the value of unity when countries i and j form an FTA at time d and is zero otherwise; $Deep_{ijd}$ equals 1 whenever the FTA is a deep one and CU_{ijd} is 1 if the agreement is a CU. γ_{ikd}, γ_{jkd}, and γ_{ijk} are importer-product-year $(i-k-d)$, exporter-product-year $(j-k-d)$, and pair-product $(ij-k)$ fixed-effects, respectively. u_{ijkd} represents the error term.

This specification is identical to a simple difference-in-differences (DiD) estimator, because we include only two years into the analysis, 1996 and 2014. This corresponds to the critique of Bertrand et al. (2004) on the use of panel estimators drawing on yearly data. Moreover, the approach is also computationally feasibly; moving to yearly data would result in a data set containing more than 200 million observations. We posit that the coefficients β_1 to β_3 in Equation 7 identify the causal effects of concluding agreements on external tariff differences, i.e., we assume that the identifying assumption $E\left(\Delta Y_{ijkd} | FTA_{ijkd}, Deep_{ijd}, CU_{ijd}, \gamma_{ikd}, \gamma_{jkd}, \gamma_{ijk}, u_{ijkd}\right) = 0$ holds. Under these conditions, β_1 to β_3 measure the *FTA Effect*.

The logic of the procedure is simple: by using a saturated fixed effects model, any potential bias induced by selection can be netted out and therefore the causal effect of the FTA can be identified. We do so by exploiting time variation in terms of having an FTA within a country-pair and the same product. The country-pair-product fixed-effects account for all variables that might affect both the probability of having an FTA as well as the general propensity of having similar external tariffs within a 6-digit product. 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 $i-k-d$ and $j-k-d$

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 γ_{ikd} and γ_{jkd} fixed-effects also account for country-specific differences i.e. due to historical reasons. Since we allow the importer/exporter-time fixed-effects to be on different trends depending on the specific product k even potentially different levels depending on the specific product in the differences in external tariffs and potentially differing time trends of products are accounted for. The standard-errors are two-way clustered on the pair- and the product-level. We do so to address the Bertrand et al. (2004)-critique, saying that the conventional DiD standard-errors severely understate the standard deviation of the estimators.

The size of the causally interpretable coefficient will determine which effect is driving the pattern in the data: if the dominant mechanism is the *FTA Effect*, we expect the difference between country-pairs with an FTA 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* is the dominant force.

5.2 Baseline Results

Table 3 shows the baseline results of the regression analysis for Δt_{ijkd} and ΔT_{ijkd}. The goal of the empirical analysis is to identify a potentially causal effect of FTAs on tariff similarity. Throughout the analysis, we will always control for general time trends i.e. due to the implementation of the Uruguay-Round or globalization-trends, by including time-product fixed-effects ($d-k$ fixed-effects). The results are reported in column (1) and (5) respectively, then we gradually include various fixed-effects. Our preferred specification includes the full set of fixed-effects (importer-product-time, exporter-product-time, and pair-product fixed-effects) and can therefore control for selection into treatment (see column (4)/(8)). We will first describe the results for the simple differences in external tariffs Δt_{ijkd} and then focus on the transportation-costs adjusted measure ΔT_{ijkd}.

We can show, that the pattern we observe in the descriptive evidence, is not only due to general time trends. When controlling for them, the results for Δt_{ijkd} (see column (1)) confirm the results from Section 4.2: while country-pairs with a deep FTA set tariffs in a more similar way than those without an FTA, the opposite is true for pairs with a shallow FTA, which have

on average a higher difference in external tariffs by 0.46%-points. When a deep FTA is present the simple difference in tariffs Δt_{ijkd} is by 1.07%-points $(0.456 - 1.527 = -1.071)$ lower than for pairs without an FTA. Since the average simple difference in external tariffs equals 3.96%-points in 2014 those coefficients can be considered as rather large.

Table 3: Baseline Results

	Δt				ΔT			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FTA	0.455***	0.001	-0.125***	0.266***	0.654***	0.374***	0.292***	0.229***
	(0.110)	(0.040)	(0.030)	(0.064)	(0.091)	(0.036)	(0.029)	(0.061)
Deep FTA	-1.527***	-0.220***	-0.678***	-0.656***	-1.053***	-0.096	-0.582***	-0.609***
	(0.113)	(0.083)	(0.039)	(0.057)	(0.081)	(0.069)	(0.037)	(0.059)
Customs Union	-4.849***	-3.760***	-4.164***	-3.113***	-2.399***	-1.651***	-1.985***	-2.154***
	(0.104)	(0.084)	(0.072)	(0.116)	(0.090)	(0.076)	(0.070)	(0.105)
R^2	0.040	0.802	0.968	0.989	0.033	0.802	0.968	0.988
d-k FE	✗	✗			✗	✗		
i-k FE		✗				✗		
j-k-FE		✗				✗		
i-k-d FE			✗	✗			✗	✗
j-k-d FE			✗	✗			✗	✗
ij-k FE				✗				✗

Note: Two-way clustered (country-pairs and products) standard errors in parentheses. ***/**/* Indicate significance at the 1%/5%/10% level. The number of observations equals 130,652,688.

By including exporter-product and importer-product fixed-effects we can account for country-specific characteristics i.e. development status or a country's tendency to liberalize. To allow the countries to be on different time-trends i.e. one country starting its liberalization process earlier than others, we use importer-product-time (i-k-d fixed effects) and exporter-product-time (j-k-d fixed effects) fixed effects, respectively. This changes the results of interest substantially indicating the importance of country characteristics for positive selection into treatment (see column (2) and (3)) .

For shallow FTAs the coefficient of interest jumps quite a lot throughout the different specifications. Our preferred specification in column (4) shows that having a shallow FTA increases the differences in external tariffs by 0.27%-points compared to pairs without an FTA. Inter-industry trade and the resulting specialization might be one potential explanation for this pattern. The more omitted variables are accounted for, the smaller the differential between pairs with a deep FTA and those without. This finding implies that pairs with similar tariffs have at the same time a higher probability of concluding a deep FTA. When including pair-product fixed effects

(see column (4)), and therefore only exploiting time-variation in the FTA variable, one can see that having a deep FTA yields a 0.39%-point ($0.266 - 0.656 = -0.389$) lower simple difference in external tariffs compared to pairs without an FTA. Comparing this coefficient with the specification in column (1) when only controlling for general time-trends in terms of size, stresses the importance of the *Selection-Channel*: our estimates suggest that conditional on general time trends 57% of the observed lower difference in tariff similarity between pairs with and without a deep FTA is due to positive selection, the remainder is caused by the FTA.

RoOs are not an issue for CUs since no proof of origin has to be provided. We conduct therefore the analysis for this type of RTA more as a sort of robustness check for our findings: it would be very troubling if we do not find an effect of the CU on the difference in external tariffs as the common external tariff is the main feature of a CU. As expected we find them to have a significantly higher degree of tariff similarity than pairs without a trade agreement whatsoever. When only including $d - k$ fixed effects the difference in external tariffs is 4.85%-points lower than for pairs with a shallow FTA. Furthermore, much of this can be attributed directly to the CU, since the coefficient of interest only changes relatively little in column (4).

When we explicitly account for transportation costs the differences by the different type of RTA are not as large as when looking at Δt_{ijkd} (see column (6)). The reason is that the level of tariff similarity is overall very high, leaving little room for potential heterogeneity across types of RTAs. Nevertheless, also when checking ΔT_{ijkd} the same ordering can be observed as when disregarding the transportation costs: pairs with a shallow FTA have less similar tariffs, while pairs with a deep FTA exhibit a higher degree of tariff similarity than those without. Pairs with a CU have unsurprisingly the lowest values for ΔT_{ijkd}. Again, the country-characteristics are driving much of the results. Most interestingly, when we fully control for omitted variables (column (8)), the coefficients of interest are in the same order of magnitude as in column (4), thus when we do not account for transportation costs. This finding reassuringly implies that the FTA has no effect on the transportation costs.

Summing up, our findings so far suggest that country pairs with a deep FTA set tariffs more similarly than those pairs without, while the opposite is true for pairs with a shallow FTA. For pairs with a deep FTA the *Selection Channel* is most pronounced, while for pairs with a shallow FTA most of the differential can be attributed to the FTA. Next, we will try to disentangle the

mechanisms at work.

5.3 Mechanisms

The baseline results show very little potential for trade deflection for country pairs with a deep FTAs. Much of this can be attributed to the *Selection Effect.* Next, we want to analyze the mechanisms that drive this result. There are several reasons why one might observe lower differences in external tariffs, two of them being lower tariff levels overall and more similar tariff structure. The lower the level of tariffs, the higher the degree of tariff similarity because of the convergence towards zero. Therefore, if all countries participating in an FTA lower their external tariffs as for example Estevadeordal et al. (2008) report, Δt_{ijkd} and ΔT_{ijkd} decrease. On the other hand, countries with similar industry structures will also have similar tariffs as the preferences for protectionism coincide. We will check next, which one of the two mechanisms drives the observed pattern in the data by using the probability of having low levels of tariffs and the probability of more similar tariff-structures as dependent variables in our baseline specification.

To define the probability of having low levels of tariffs, we use a dummy variable that equals one when both countries i and j set for a product k the tariff at most equal to 5%-points and zero otherwise.

$$P^{low}_{ijkd} = \begin{cases} 1 & \text{if } \bar{t}_{ikd} \leq 5 \cap \bar{t}_{jkd} \leq 5 \\ 0 & \text{otherwise} \end{cases}$$

The cut-off level of 5%-points is approximately equal to the mean MFN tariff for developed countries after the full implementation of the Uruguay-Round (compare Figure 1(a)). On average the probability of having tariffs less than 5%-points amounts to 32.7%.

To measure the similarity in the tariff-structure we first rank all products for every country i. Since tariff data are not available for all countries for the same number of products k and therefore not readily comparable between countries, we normalize the ranks for i as follows: $rank^{norm}_{ikd} = \frac{rank_{ikd} - rank^{min}_{id}}{rank^{max}_{id} - rank^{min}_{id}}$. The dummy variable measuring the probability of having a similar tariff-structure equals one for product k if both countries of the pair ij assigned the same normalized rank to the product, and zero otherwise. On average the same rank is assigned in

Table 4: Mechanisms

	P^{low}		P^{same}	
	(1)	(2)	(3)	(4)
FTA	-0.056***	-0.024***	-0.005***	-0.043***
	(0.003)	(0.004)	(0.001)	(0.005)
Deep FTA	0.243***	0.016***	0.026***	-0.044***
	(0.005)	(0.004)	(0.003)	(0.004)
Customs Union	0.494***	0.245***	0.299***	0.288***
	(0.009)	(0.009)	(0.010)	(0.014)
R^2	0.301	0.935	0.183	0.813
k-d	✗		✗	
Panel		✗		✗

Note: Two-way clustered (country-pairs and products) standard errors in parentheses. ***/**/* Indicate significance at the 1%/5%/10% level. Column (1) and (3) report the results for the unconditional comparison in means, column (2) and (4) include importer-year, exporter-year, product-year and product-pair fixed-effects). The number of observations equals 131,054,724.

our sample with a probability of 6.3%.

$$P_{ijkd}^{same} = \begin{cases} 1 & \text{if } rank_{ikd}^{norm} = rank_{jkd}^{norm} \\ 0 & \text{otherwise} \end{cases}$$

Table 4 shows the results of the estimation of the linear probability models. Column (1) and (3) report the findings when conditioning on general time-trends ($k-d$ fixed-effects), columns (2) and (4) include the full set of fixed-effects ($i-k-d$, $j-k-d$, and $ij-k$ fixed-effects). The deeper the degree of integration of the trade agreement, the higher the probability of having low levels of tariffs: for pairs with a deep FTA the probability increases by 24.3%-points compared to pairs with a shallow FTA, while for pairs in a CU it is 49.4%-points higher. When we control for selection into treatment, we can see that most of the observed pattern in the data is due to omitted variables and only a small part of it can be attributed to ex-post convergence.

The analysis of the structure of tariffs yields also an interesting picture: pairs with a deep FTA and a CU have a more similar structure of tariffs, while the opposite is true for pairs with a shallow FTA. However, this pattern in the data seems to be driven mostly by confounding factors: the specification including the full set of fixed-effects shows that both types of FTAs yield less similarity in the structure of tariffs. The data suggests, that the FTA causes a higher

degree of specialization resulting in a less similar tariff structure.

Taking these two pieces of evidence together, we can say that pairs with lower levels of tariffs and a more similar structure self-select themselves into having a deep FTA. Although both mechanisms account for the *Selection Channel*, the lower tariff levels seem to be more important. In contrast, the *FTA Effect* of having a deep FTA seems to be entirely driven by lower levels of tariffs. Our findings go in line with the existing literature on the effects of FTAs on the external tariff (i.e. Crivelli (2016) and Estevadeordal et al. (2008)).

6 Robustness Checks and Sensitivity Analysis

6.1 RoOs - the Reason for higher Tariff Similarity?

The results suggest that RoOs are not justified from an economic point of view. To large parts this conclusion can be attributed to the *Selection Channel*. However, one might be worried that the *FTA Effect* can only be observed because of RoOs i.e. only because of the protective effects of RoOs, governments agree to tariff cuts, thus RoOs are used as a substitute to tariffs. To eliminate the concern we would need a measure for the restrictiveness of the product-specific RoOs. The best data publicly available is the "Facilitation-Index" proposed by Estevadeordal and Suominen (2006), which we describe next.

Besides product-specific RoOs in every FTA there are also so-called "regime-wide" RoOs (Estevadeordal and Suominen 2006), which are general RoOs that are employed for every product - including the degree of de minimis, the type of cumulation, drawback, and the certification method.[36] The "Facilitation-Index" is based on five components: de minimis, diagonal cumulation, bilateral cumulation, drawback, and self-certification. The maximum index value of 5 results when the level of de minimis is 5% or higher and when the other four variables are

[36] The De minimis rule allows for a specified maximum percentage of non-originating materials to be used without affecting origin. The higher the defined percentage, the easier it is to meet the RoOs. Cumulation allows producers of one FTA member to use materials from another FTA member without losing the preferential status on the final product. Besides bilateral cumulation (two FTA partners), there is also diagonal cumulation, under which countries tied by the same set of preferential origin rules can use products that originate in any part of the common RoOs zone. Many FTAs prohibit duty drawback - the refunding of tariffs on non-originating inputs that are subsequently included in a final product that is exported to an FTA partner. This increases the costs of non-originating components and makes therefore a shift to suppliers in the cumulation area more likely. A complex method of certifying the origin of goods can impose high administrative costs on exporters. The most lenient one is self-certification by exporters. For a more detailed description of "regime-wide" RoOs see Estevadeordal and Suominen (2006).

permitted.[37]

To check, whether stricter RoOs might actually cause a higher degree of tariff similarity we include the "Facilitation-Index" ($RoOs_{ijd}$) in the baseline specification. As we do not have information on the RoOs regime for CUs we exclude pairs with a CU entirely for this part of the analysis. The more permissive RoOs are in an FTA, the higher $RoOs_{ijd}$. Thus, if strict RoOs were indeed a substitute to high tariffs then we would observe in the panel-analysis a positive and large coefficient: the more lenient RoOs, the higher the difference in external tariffs. The results are shown in table 5 for both measures of tariff similarity.

Table 5: The role of RoOs

	Δt				ΔT			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FTA	0.518*	2.359***	-1.139***	-1.285***	1.077***	1.874***	-0.820***	-0.823***
	(0.298)	(0.291)	(0.092)	(0.107)	(0.249)	(0.248)	(0.082)	(0.097)
RoOs		-1.277***		0.083***		-0.553***		0.002
		(0.032)		(0.032)		(0.029)		(0.029)
R^2	0.044	0.046	0.990	0.990	0.040	0.040	0.989	0.989
k-d	✗	✗			✗	✗		
Panel			✗	✗			✗	✗

Note: Two-way clustered (country-pairs and products) standard errors in ( ). ***/**/* Indicate significance at the 1%/5%/10% level. Column (1), (3), (5), (7), (9), and (11) report the results for the unconditional comparison in means. The facilitation index $RoOs_{ijd}$ stems from Estevadeordal and Suominen (2006). The number of observations equals 69,033,736.

Unfortunately only for a small subset of FTAs (102) information about the stringency of RoOs are available. Out of these only very few belong to the group of deep FTAs. Therefore, we do not distinguish between the different types for this part of the analysis.

In column (1), (3), (5) and (7) we report the baseline results with the adjusted sample. In column (2) and (6) we include the measure for RoOs and only condition on time -trends while in column (4) and (8) the full set of fixed-effects is included. First, it has to be noted that the sample changes quite substantially compared to the baseline as the large changes in the coefficients in column (1), (3), (5) and (7) indicate. Second, controlling for $RoOs_{ijd}$ alters the cross-sectional results quite substantially, indicating that the measure for RoOs seems to pick up some omitted variables that are otherwise lumped together with the FTA indicator.

[37] Unfortunately no digital data is available. We digitized the information included in the text and then calculated the Index using the rule proposed in the text. Then we matched manually by using the name of the FTA the "Facilitation-Index" to the FTAs in our data.

In the cross-section $RoOs_{ijd}$ correlates with both measures for tariff similarity negatively, indicating that FTAs with more permissive RoOs are particularly present for country-pairs with more similar external tariffs. When we include the full set of fixed-effects in column (4) and (8) the coefficients of interest do not change substantially compared to the specification without $RoOs_{ijd}$ (see column (3) and (7)). For ΔT_{ijkd} the results remain basically the same and more importantly the measure for the restrictiveness of RoOs is close to zero and not statistically significant, suggesting that the substitution-argument has no foundation, at least for the subset of FTAs we have data on.

For Δt_{ijkd} we find a slight change in magnitude of the coefficients and a small but statistically significant coefficient for the Facilitation-Index, thus, we cannot fully rule out that country-pairs use RoOs as a substitute for tariffs. However, since this cannot be found when explicitly accounting for additional trade costs, the substitution effect seems to happen only for a subsample of products, namely those where the additionally arising transportation costs are so high that trade deflection becomes unprofitable anyways.

6.2 Exogeneity of Transportation Costs

As stressed above, transportation costs play a major role in our setting since trade deflection is only profitable when the tariff savings exceed the additional non-tariff trade costs. One could worry that RoOs might have an effect on non-tariff trade costs i.e. strict RoOs might also increase - either directly or indirectly through omitted variables - the arising non-tariff trade costs. If this were the case, one could not claim RoOs to be economically unjustified due to high non-tariff trade costs, as those are only high because of the RoOs.

First of all, this is only a problem when explicitly accounting for transportation costs. Since the findings for Δt_{jkd} go in the same direction, we are confident that trade deflection is not just unprofitable due to high transportation costs caused by strict RoOs but rather because of high tariff similarity.

Second, the way the transportation costs have been constructed leaves little room for potential endogeneity with respect to RoOs. The predicted transportation costs use US-specific cif/fob ratios, which are - conditional on bilateral distance - exogenous to country-pair ij's FTAs and

Table 6: Placebo Test

	(1)	(2)	(3)	(4)	(5)
FTA	-1.688***	-1.777***	-1.801***	-1.910***	0.116***
	(0.075)	(0.077)	(0.076)	(0.076)	(0.040)
RoOs	-0.123***	0.021***	0.025***	0.018	0.002
	(0.009)	(0.007)	(0.006)	(0.011)	(0.006)
R^2	0.007	0.857	0.888	0.899	0.975
k-d		✗	✗		
i-k			✗		
j-k			✗		
i-k-t				✗	✗
j-k-d				✗	✗
ij-k					✗

Note: The dependent variable in this model is τ_{ijkd}, the bilateral transportation costs arising when exporting product k from j to i at time d. τ_{ijkd} is estimated using US data on cif/fob ratios (see 3.2 for details). The facilitation index $RoOs_{ijt}$ stems from Estevadeordal and Suominen (2006), the information about the FTAs is from DESTA (Dür et al. 2014). The number of observations equals 69,033,736.

therefore also RoOs. Thus, once controlling fully for omitted variables that might correlate with bilateral distance i.e. by means of fixed-effects, we are confident that RoOs defined in the FTA between country i and j will not change τ_{ijkd}.

Using the Facilitation-Index $RoOs_{ijd}$ we can directly test whether RoOs have a causal effect on transportation costs. We regress the previously introduced measure for restrictiveness of RoOs $RoOs_{ijd}$ on the bilateral transportation costs τ_{ijkd} (see Table 6). As $corr(distance_{ij}, RoOs_{ijt}) \neq 0$, unsurprisingly the unconditional mean in column (1) suggests a correlation between more permissive RoOs and transportation costs, that is significantly different from zero. However, once the full set of fixed-effects is included, no effect of RoOs on transportation costs can be found confirming our prior about the exogeneity of transportation costs.

6.3 Aggregation Bias

We conduct our analysis using the most disaggregated data available, namely 6-digit level. However, tariffs are often defined at a much finer level, i.e. the 8-, 10- or even 12-digit level. We do not use this type of data for two reasons: first of all, such disaggregated level of tariffs is not available for the set of countries we are interested in. Second, even if data on tariffs at such disaggregated level were available the used nomenclatures at those finer levels are country-specific and therefore no longer comparable across countries, thus we would need to aggregate

to the 6-digit level anyways to make an empirical analysis possible. Nevertheless, it could be possible that although on the 6-digit level countries' tariff vectors look very much aligned, this is not true for the more disaggregated products within 6-digit categories.

Table 7: Aggregation Bias within 6-digit Products

	Δt^{simple}				Δt^{t}			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FTA	3.546***	3.552***	-0.372***	-0.402***	2.913***	2.889***	-0.229***	-0.234***
	(0.733)	(0.767)	(0.085)	(0.090)	(0.611)	(0.642)	(0.078)	(0.079)
Deep FTA	-4.248***	-4.358***	-0.017	0.015	-3.394***	-3.467***	-0.032	-0.025
	(0.677)	(0.703)	(0.147)	(0.149)	(0.569)	(0.595)	(0.167)	(0.167)
Customs Union	-6.622***	-6.620***	-2.273***	-2.239***	-4.202***	-4.168***	-1.236***	-1.224***
	(0.694)	(0.727)	(0.300)	(0.302)	(0.585)	(0.615)	(0.248)	(0.250)
SD		0.009		0.203		0.027		0.111
		(0.312)		(0.161)		(0.282)		(0.117)
SD × FTA		0.005		0.314***		0.318		0.056
		(1.001)		(0.069)		(0.888)		(0.095)
SD × Deep		2.099*		-0.620***		1.628*		-0.138
		(1.114)		(0.184)		(0.959)		(0.169)
SD × CU		1.346		-0.234		0.421		0.063
		(1.084)		(0.340)		(0.985)		(0.300)
R^2	0.153	0.153	0.999	0.999	0.110	0.110	0.993	0.993
k-d	✗	✗			✗	✗		
Panel			✗	✗			✗	✗

Note: Two-way clustered (country-pairs and products) standard errors in ( ). ***/**/* Indicate significance at the 1%/5%/10% level. Column (1), (3), (5), (7), (9), and (11) report the results for the unconditional comparison in means. The number of observations equals in the panel 3,621,104.

We use a different approach to check for this problem. The original data provided by the IDB provide the standard deviation of tariffs within 6-digit product categories. We construct a dummy variable SD_{ijkd} that equals 1 whenever at least for one of the two 6-digit level tariffs used ($\bar{t}_{ikd}$ or $\bar{t}_{jkd}$) the standard deviation is larger than zero. Otherwise SD_{ijkd} is zero. We include this new variable and its interaction terms with the RTA types in our regression analysis. The results are reported in Table 7. Column (1), (3), (5), and (7) show again the baseline results with the modified sample[38], the remainder shows how things change when we account for the aggregation bias.

Overall, the results are robust: when conditioning on time-trends including the SD_{ijkd}-interaction terms only alters the coefficients of interest slightly. Including the full set of fixed effects does

[38] Unfortunately only IDB but not TRAINS provides data on the standard deviation of tariffs. This reduces the number of reporters and available tariff lines substantially. Further, we only use original data and do not carry out any interpolation as we did for the tariff data. Therefore, the sample shrinks substantially and we end up in the panel analysis with only 3,585,708 observations.

change results but the main message continues to hold: although due to different samples, a comparison with the baseline results is problematic, lower differences in external tariffs are not just driven by aggregation bias on finer defined products.

6.4 Transportation Costs

To evaluate the potential for trade deflection, high-quality data on transportation costs on the product-pair level is essential. As discussed above, we use estimated measures, $\hat{\tau}_{ijkd}$; we analyze next how robust our estimates are to alternative measures of transportation costs.

Instead of using US imports when estimating the transportation costs, we can also use data on imports to New Zealand. It is not the preferred solution for two reasons: first, due to New Zealand's peculiarities - especially in terms of its size and remoteness - exporting might be systematically more expensive than to other countries, leading to upwards biased estimated transportation costs.[39] Assuming concave transportation costs, i. e. the direct transportation costs are always less than when cross-hauling, overstated transportation costs would lead us to underestimate the potential for trade deflection, which would lead in our context to wrong conclusions. Second, New Zealand is much smaller and as such also imports less goods from less destinations. Therefore, there are less data points that can be used for the estimation and more observations will be lost.

The difference in external tariffs equals now $\Delta T^{NZ}_{ijkd} = max\{0, \bar{t}_{ikd}\bar{\tau}^{NZ}_{ikd} - \bar{t}_{jkd}\bar{\tau}^{NZ}_{jkd}\tau^{NZ}_{ijkd})\}$ and is lower than the one we use in our baseline specification. The results of the regression analysis are shown in Table 8 column (2) and (4). Since the sample composition changes compared to the baseline specification, a comparison with the results of Table 3 is not possible. Therefore, we rerun the analysis for ΔT_{ijkd} with the modified sample. The results are shown in column (1) and (3). Neither the results of the specification when only including product-year fixed-effects nor the ones with the full set of fixed effects are very sensitive to use of the alternative transportation costs. Since the overall tariff similarity is higher the coefficients of interest are somewhat smaller in magnitude but the ordering by the type of FTA and the statistical significance remains.

To eliminate all potential measurement error induced by the estimation procedure one can

[39] Figure A9 shows the in-sample and out-of-sample fit when using imports for New Zealand. If an upwards bias were present, we would expect the predicted values to be higher than the real ones. Indeed, for the US $\hat{\tau}_{ijkd}$ are always higher than the actual ones.

also only use the observed cif/fob ratios for the US as a proxy for all other product-pair combinations. The drawback of this measure is that transportation costs are only available for destination-product combinations that are actually imported by the US. Therefore product-pair combinations with prohibitively high transportation costs and thus no potential for trade deflection, will drop out of the sample yielding higher potential for trade deflection i.e. higher coefficients of interest. Column (5) and (7) show the baseline results with the modified sample, while column (6) and (8) show the results for the differences in external tariffs when using the US cif/fob ratios ΔT^{cf}_{ijkd}. Again, the coefficients of interest do not change much, lessening concerns about measurement error in the estimated transportation costs $\hat{\tau}_{ijkt}$.

Throughout the analysis we assume iceberg trade costs, that is $p_{ijkd} = p^0_{jkd} t_{ijkd} \tau_{ijkd}$, where p^0_{jkd} is the mill price of good k exported by country j. However, Hummels (2007), Hummels and Skiba (2004), and Irarrazabal et al. (2015) make the point that per unit transport costs are typically not (only) of the iceberg type but also consist of an additive cost component. Therefore, we want to rule out that our results vary when assuming an additive structure - i.e. $p_{ijkd} = p^0_{jkt}(t_{ijkd} + \tau_{ijkd})$. To do so, we modify the difference in external tariffs to $\Delta T^{add}_{ijkd} = max\{0, \bar{t}_{ik} + \bar{\tau}_{ik} - \bar{t}_{jk} - \bar{\tau}_{jk} - \tau_{ijk}\}$. The results do only change slightly, as shown in table 8 columns (9) to (12). Summing up, using alternative ways of determining the transportation costs instead of our baseline method only leads to slight changes suggesting that our baseline results are rather robust and the estimated transportation costs $\hat{\tau}$ are not substantially biased.

Table 8: Sensitivity Checks: Measure of Transportation Costs

	ΔT	ΔT^{NZ}	ΔT	ΔT^{NZ}	ΔT	ΔT^{cf}	ΔT	ΔT^{cf}	ΔT	ΔT^{add}	ΔT	ΔT^{add}
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
FTA	0.734***	0.580***	0.297***	0.254***	1.696***	1.465***	0.072	0.044	0.654***	0.628***	0.229***	0.207***
	(0.097)	(0.092)	(0.069)	(0.065)	(0.162)	(0.164)	(0.081)	(0.079)	(0.091)	(0.086)	(0.061)	(0.055)
Deep FTA	-1.137***	-1.035***	-0.713***	-0.617***	-2.324***	-2.498***	-0.710***	-0.583***	-1.053***	-1.037***	-0.609***	-0.558***
	(0.088)	(0.080)	(0.064)	(0.061)	(0.135)	(0.136)	(0.082)	(0.076)	(0.081)	(0.076)	(0.059)	(0.053)
Customs Union	-2.822***	-2.586***	-2.451***	-1.699***	-4.523***	-5.155***	-2.901***	-2.163***	-2.399***	-2.332***	-2.154***	-2.001***
	(0.098)	(0.093)	(0.117)	(0.108)	(0.145)	(0.144)	(0.138)	(0.140)	(0.090)	(0.084)	(0.105)	(0.097)
R^2	0.029	0.029	0.987	0.987	0.038	0.038	0.986	0.984	0.033	0.034	0.988	0.989
k-d	✗	✗			✗	✗			✗	✗		
Panel			✗	✗			✗	✗			✗	✗
N	9.01e+07	9.01e+07	9.01e+07	9.01e+07	3.63e+07	3.63e+07	3.63e+07	3.63e+07	1.31e+08	1.31e+08	1.31e+08	1.31e+08

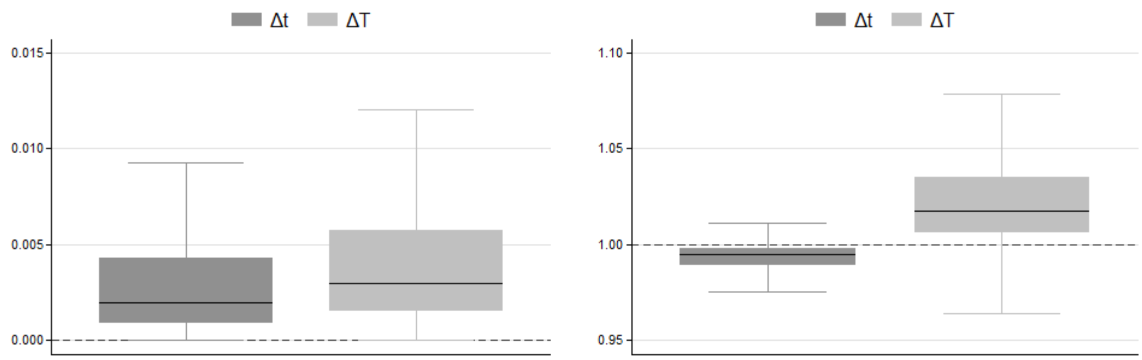
Note: Twoway clustered (country-pairs and products) standard errors in parentheses. ***/**/* Indicate significance at the 1%/5%/10% level. Column (1), (2), (5), (6), (9), and (10) report the results when only including year fixed-effects. In the remaining columns the full set of fixed-effects (importer-time-product, exporter-time-product, and pair-product fixed-effects) is included. For $\Delta T^{NZ}_{ijkd} = max\{0, \bar{t}_{ikd}\bar{\tau}^{NZ}_{ikd} - \bar{t}_{jkd}\bar{\tau}^{NZ}_{jkd}\tau^{NZ}_{ijkd})\}$ we use the import data of New Zealand in order to predict the transportation costs. ΔT^{cf}_{ijkd} uses the observed US cif/fob-ratios as a proxy for all other product-pair combinations. In $\Delta T^{add}_{ijkd} = max\{0, \bar{t}_{ik} + \bar{\tau}_{ik} - \bar{t}_{jk} - \bar{\tau}_{jk} - \tau_{ijk}\}$ instead of iceberg trade costs we assume an additive form. ΔT is always our baseline definition (see section 2.2). The number of observations varies over the different specifications because of data availability.

6.5 Measurement Error from Averaging Out the Third Country Dimension

While averaging out the third country dimension keeps things tractable, it induces some measurement error. To check how much the measures of differences in average external tariffs ΔT_{ijkd} and Δt_{ijkd} suffer from measurement error we compare them product-by-product with the unaveraged data ΔT^c_{ijkt} and Δt^c_{ijkt}, respectively, the differences in external tariffs for every country-pair ij with respect to all third countries c. We focus on the year 2014. We regress for every product the averaged data on the unaveraged one, $\Delta t^c_{ijk} = \delta^k_0 + \delta^k_1 \Delta t_{ijk} + u^c_{ijk} \forall k$ and $\Delta T^c_{ijk} = \delta^k_0 + \delta^k_1 \Delta T_{ijk} + u^c_{ijk} \forall k$. If for all products δ^k_0 were equal to zero and δ^k_1 equal to one, no systematic measurement error would be present. We do the analysis product-wise for two reasons: first, it generates more precise results as the measurement error could be heterogeneous across products. Second, the analysis for the whole sample is due to computationally unfeasible.

Figure 5: Quantification of the Potential Aggregation Bias

(a) Constant δ_0 (b) δ_1 Coefficient



Note: The boxplots show the results of the comparison of the first best solution for the differences in external tariffs $\Delta t^c_{ijk}/\Delta T^c_{ijk}$ and the aggregated measure $\Delta t_{ijk}/\Delta T_{ijk}$. We regress for every product the first best solution on the aggregate measure (see text). The analysis is based on the year 2014. The figure shows the distribution of the constants δ^k_0 and the slope-coefficients δ^k_1 for all 4,215 products k.

We end up with 4,215 sets of δ^k_0 and δ^k_1 coefficients for both measures of tariff similarity Δt_{ijk} and ΔT_{ijk}. Figure 5 shows the distributions of the constant δ^k_0 and the δ^k_1 coefficients. The median of the slope-coefficient δ^k_1 for Δt_{ijk} equals 0.995 with a variance of 0.00001; for ΔT_{ijk} it equals 1.018 with a variance of 0.001 respectively. The median of the constant equals 0.002 for the simple measure of differences in external tariffs and 0.003 for ΔT_{ijk}. The results indicate that the averaged measures do not seem to suffer from any substantial bias. The reason for this finding is that FTAs and therefore also preferential tariffs are a relatively rare event. Therefore,

for most country-pairs the MFN tariff is actually applicable. As the MFN tariff does not have a third country dimension, in those pairs, there is no measurement error.[40]

Furthermore, we can show that the baseline regression results are not sensitive to any error from averaging. To do so we conduct a product-wise regression analysis of the baseline specification using the first-best measures as our main dependent variable $\Delta t^c_{ijkd}/\Delta T^c_{ijkd}$.

$$\Delta Y^c_{ijt} = \alpha^k_0 + \alpha^k_1 FTA_{ijt} + \alpha^k_2 Deep_{ijt} + \alpha^k_3 CU_{ijt} + \gamma_{it} + \gamma_{jt} + \gamma_{ij} + u_{ijt} \quad \forall k \tag{8}$$

In a next step we rerun the baseline analysis for every product k separately and compare the resulting coefficients α^k_z, with $z = 1, 2, 3$.[41] To do so we plot for every product k the results of the two types of analyses against each other. See Figure 6. We plot the comparison for each of the coefficients of interest separately. Panel (a), (c), and (d) show the results for the simple tariff differences, the remaining panels show how things change when using the transportation-cost adjusted measure. The vast majority of the products k aligns nicely on the 45-degree line indicating that the baseline and the first best solution deliver almost identical results. This is true for both types of measures and for all coefficients of interest.[42]

Further we have analyzed the signs of the resulting coefficients in more detail. As Table A4 shows the share of the products for which the coefficients have the same sign when using the aggregated measure $\Delta t/\Delta T$ compared to when using the first best solution $\Delta t^c/\Delta T^c$ is unity for both measures of tariff similarity. Even when only focusing on those coefficients that are significantly different from 0 (column (2) and column (4), Table A4) for the vast majority of the products the coefficients of the baseline and the first best solution coincide. Taking all this evidence together, we are rather confident that the aggregation step does not lead to biased results.

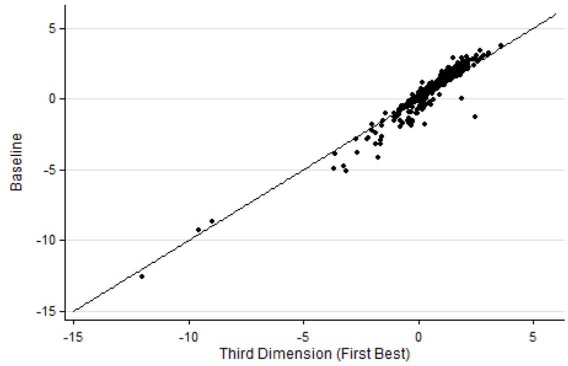
[40] Alternatively, we have used import weights to average over the third country dimension. The import weight $\frac{imp_{ijkd}}{imp^{tot}_{ikd}}$ equals the imports from j to i for a specific product k imp_{ijkd} as a share of the total value of imports of country i for product k (imp^{tot}_{ikd}), so the higher the relevance of a tariff and non-tariff trade cost in terms of import flows, the higher its weight. The data for the imports come from UN COMTRADE, more precisely, we use the cleaned data provided by CEPII in the BACI data set (Gaulier et al. 2010). The measurement error when using this measure is much larger (compare Figure A8), which is the reason why we use the simple mean throughout the analysis.

[41] Due to the product-wise analysis it is not necessary to include importer/exporter/pair-year-*product* fixed effects.

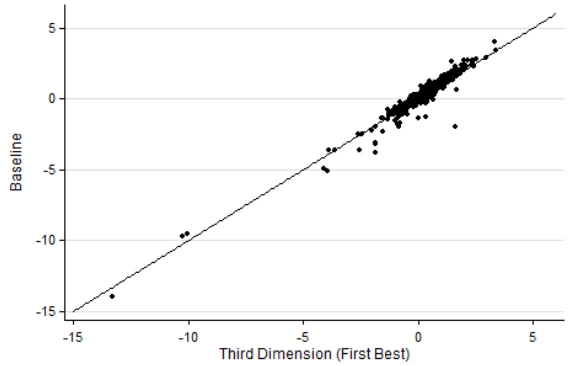
[42] Figure A7 shows the distribution of the difference between the coefficients when using the the aggregated measure and the first best solution.

Figure 6: Comparison of the Baseline Results $\Delta t_{ijkd}/\Delta T_{ijkd}$ with the First Best Solution $\Delta t^c_{ijkd}/T^c_{ijkd}$

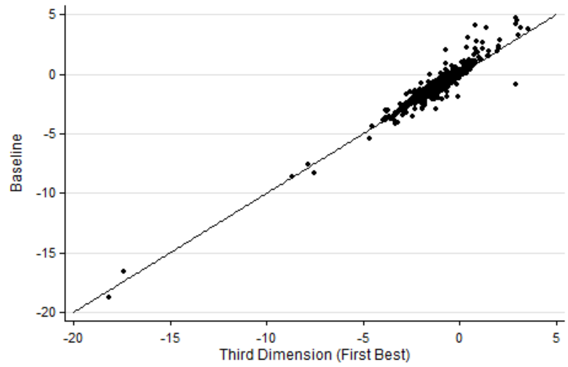
(a) Simple Tariff Differences Δt_{ijkd}: Shallow FTA



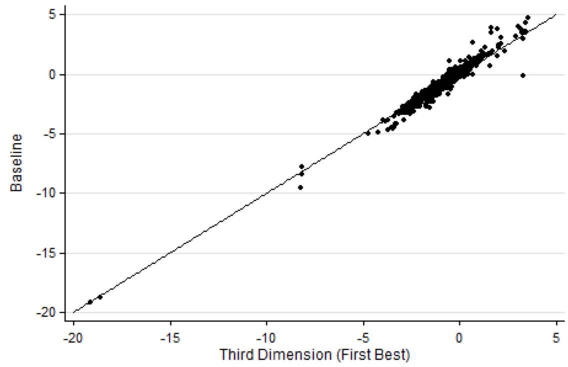
(b) Weighted Tariff Differences ΔT_{ijkd}: Shallow FTA



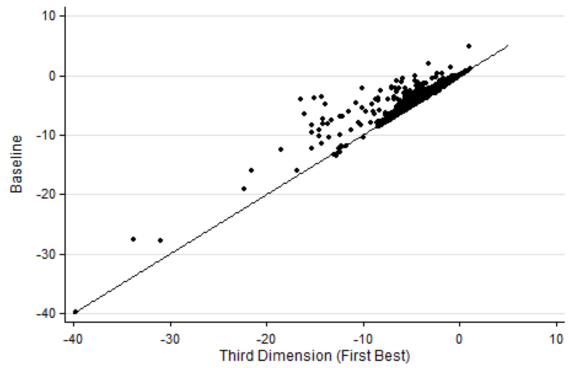
(c) Simple Tariff Differences Δt_{ijkd}: Deep FTA



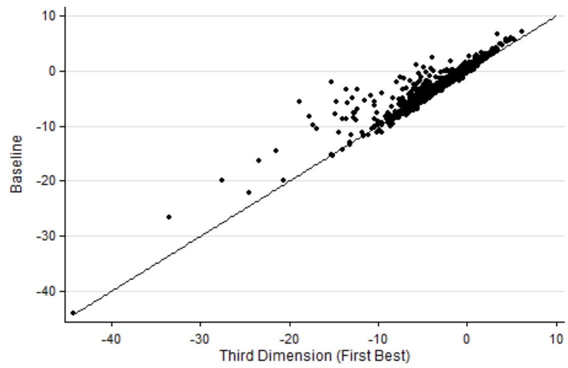
(d) Weighted Tariff Differences ΔT_{ijkd}: Deep FTA



(e) Simple Tariff Differences Δt_{ijkd}: CU



(f) Weighted Tariff Differences ΔT_{ijkd}: CU



Note: To evaluate the aggregation bias we compare in this graph our baseline measures $\Delta t_{ijkd}/\Delta T_{ijkd}$ with the first best $\Delta t^c_{ijkd}/\Delta T^c_{ijkd}$ where country i, country j, third country c, product k, and time t. For this purpose we conduct for both variables our baseline regression analysis by product k. To compare the results of the two types of analysis, the graphs above plot the resulting coefficients against each other. The baseline is always plotted on the y-axis, the First Best solution on the x-axis. The closer the data to the 45-degree line, the less of an bias is present in the data. Data points above/below the 45-degree line indicate that the aggregated measure overstates/understates the real ones.

6.6 Measurement Error in the FTA Variable

We want to check next whether our results still hold when using different measures of depth. The DESTA data on RTAs comes with at least two shortcomings: first, its measure of depth is rather crude as it only includes seven provisions. Second, unfortunately no information is provided on the current status of the RTA i.e. whether it is still in force. Both types of FTAs, deep and shallow, are affected by the former, yielding attenuated coefficients due to measurement error. The latter is a bigger concern for shallow FTAs[43] and it biases the coefficient even further downwards: we wrongly assume country-pairs to have an FTA while in fact they do not.

Table 9: Different Measure for FTAs

	Δt				ΔT			
	(1) DESTA	(2) WB-Core	(3) WB-All	(4) WB-Legal	(5) DESTA	(6) WB-Core	(7) WB-All	(8) WB-Legal
Depth Measure	-0.070***	-0.070***	-0.038***	-0.071***	-0.007	-0.028***	-0.017***	-0.027***
	(0.014)	(0.005)	(0.003)	(0.005)	(0.009)	(0.004)	(0.002)	(0.003)
R^2	0.000	0.001	0.001	0.001	0.000	0.000	0.000	0.000
N	6.11e+07	6.07e+07	6.07e+07	6.07e+07	6.11e+07	6.07e+07	6.07e+07	6.07e+07
mean(Depth)	1.656	2.522	4.362	2.368	1.656	2.522	4.362	2.368
Marginal Effect(Depth)	-0.116	-0.177	-0.166	-0.169	-0.012	-0.069	-0.076	-0.065

Note: Two-way clustered (country-pairs and products) standard errors in ( ). ***/**/* Indicate significance at the 1%/5%/10% level. Column (1), (3), (5), (7), (9), and (11) report the results for the unconditional comparison in means. The number of observations varies due to differences in terms of the presence of a CU between DESTA and the GPTAD.

Both issues are addressed in the World Bank's Global Preferential Trade Agreement Database (GPTAD). It only includes agreements in force as of 2015 and covers many more dimensions of the heterogeneity in content across FTAs by coding 52 provisions instead of only seven. Additionally, it specifies which provision is legally enforceable and allows therefore a finer distinction between the different FTAs (see Hofmann et al. (2017) for a detailed description of the database). On the other hand, because it only focuses on RTAs in force as of December 2015 it does not include FTAs that have been superseded by newer ones i.e. Canada-US Free Trade Agreement or all FTAs between the EU and its new members that preceded their accession to the EU. Therefore, the World Bank data is unfortunately not suitable to disentangle between the *Selection Channel* and the *FTA Effect* but we can use it for the cross-sectional analysis. Depending on how much the results alter, we can say something about the severity of the measurement error in the DESTA data.

[43] When comparing DESTA with the World Bank's Global Preferential Trade Agreements Database we can see this. One potential explanation for this pattern might be the higher costs associated with a deep FTA: it is much harder to reach a deep agreement. Therefore the costs of dissolving such an FTA are higher.

One problem with the new measures of depth from the GPTAD is that it is hard to define the threshold-level to distinguish between deep and shallow FTAs. We deal with this issue by simply regressing on the continuous variable instead of constructing discrete variables as we did in the baseline analysis. Since we are interested in FTAs we exclude in all specifications the pairs with a CU. The results of this analysis are shown in Table 9 for both measures of tariff similarity. In column (1) and (5) we use the RTAs provided by DESTA, in the remaining columns we show the results using data from the World Bank's GPTAD. For "WB-Core" we use the presence of core provisions as a measure for depth. The depth index calculated in the "WB-All"-columns is based on all 52 provisions coded and can therefore differentiate on a finer margin between the depth of FTAs. Whenever using "WB-Legal" the measure only considers those provisions that are legally enforceable.

The measures of depth derived from the GPTAD yield higher tariff similarity for both measures Δt_{ijkd} and ΔT_{ijkd} for all pairs with an FTA irrespective of the depth. This is true for the coefficients of interests as well as the marginal effects (compare Table 9, last row). As expected, the results show that the depth measure from DESTA introduces measurement error leading to attenuated estimates. The measurement error seems to be especially a problem when using the measure transportation costs adjusted measure of tariff similarity. However, the bias should work against us as the true effect of FTAs on tariff similarity will be understated. Therefore, our baseline results should be considered as conservative.

6.7 Does the Choice of Years matter?

In the baseline specification we only use data for 1996 and 2014. The choice of those two years is mainly data driven as after 1996 the data quality improves significantly and we want to keep the number of observations tractable, which is the reason to only use two years. In this section we will check whether our results are sensitive to the chosen years. First, we reproduce Table 3 using averages over the years 1996, 1997, and 1998 as the "before" period and averages over 2012, 2013, and 2014 for the "after" period of the difference-in-differences approach.[44] As Table A6 shows, the results only change slightly, indicating that our findings are not specific to the chosen years. Further, our results also hold when using a 5% sample of yearly data (see Table

[44] To keep things comparable we restrict our analysis on the same product-pair combinations as in the baseline specification.

A7).

6.8 Missing Data

The original tariff data suffers from two sources of biases: first, the systematical pattern of missing will lead to an over representation of developed countries. Second, peculiarities of the WITS-database - assigning preferential tariffs even though MFN is applicable and vice-versa - induce measurement error yielding attenuated coefficients. We reproduce Table 3 only using original data and omitting all differences in external variables where at least one of the two tariffs $\bar{t}_{ikt}$ and $\bar{t}_{jkt}$ was imputed. The results are reported in Table A5 in the Appendix. We expect the results for the shallow FTAs to be more sensitive to the modification, because the issue of missing tariff data is more pronounced for developing countries, which also are less often involved in deep FTAs and CUs. Reassuringly, the general picture does not change, 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.

7 Conclusion

Economists have long been skeptical of free trade areas (FTAs) and have preferred customs unions (CUs). Burdensome rules of origin (RoOs) make sure that members of FTAs can in effect set independent trade policies with regard to third parties. Otherwise, in the absence of transportation costs, the member with the lowest external tariff would de facto determine the common one.

However, our empirical exercise shows that, in practice, members of FTAs, especially of deep ones, find it optimal to set tariffs that are surprisingly similar. In 67% of country-pair product combinations, tariff differences are smaller than 3%-points. Bilateral tariff differences at the product level are smaller in absolute levels than transportation costs for almost 80% of all country pairs. In deep FTAs, that share is even bigger. Thus, trade deflection, i.e., the cross-shipping of goods from the low-tariff FTA member to the high-tariff one, is profitable only in rare cases where tariff differences exceed transportation costs. These findings are robust to

alternative definitions of transportation costs, they are unlikely to be driven by aggregation bias, and they are not driven by our specific sample. It follows that RoOs can rarely be justified by the objective of avoiding trade deflection.

Nonetheless, even in modern trade agreements such as the EU-Canada agreement (CETA) hundreds of pages are devoted to defining complicated RoOs. Exporters regularly complain about their complexity and the cost of compliance. They are the most important reason for preference utilization rates below 100%. Moreover, RoOs distort input choices. Hence, to some extent their unconditional existence is proof of a protectionist bias in FTAs.

We analyze in more detail what drives the diverging results for pairs with deep and shallow FTAs. Using simple panel econometrics, more precisely a difference-in-difference approach, we show that about two-thirds of the pattern can be explained due to positive selection but also ex-post convergence has some relevance. Low levels of tariffs drive mostly the results, which is broadly in line with existing literature.

We find that pairs with higher differences in external tariffs self-select themselves into shallow FTAs, while the deep FTAs seem to have a strong effect on itself on tariff similarity, as 79% of the observed lower differences in external tariffs can be directly attributed to the deep FTA. In line with the existing literature we can show that much of the empirical pattern can be attributed to lower tariffs due to FTAs.

Our analysis suggests that one could substantially relax the requirements to prove the origin of goods in many FTAs without risking any trade deflection. More specifically, we suggest that, in new FTAs, negotiators do agree on a full set of RoOs for all products, but that the requirement to prove origin is activated only if external tariffs of FTA members differ by some minimum amount. This threshold could be product specific in order to reflect different transportation costs and actual tariffs should be periodically evaluated against it, since applied tariffs may change over time.

In this paper, we have focused on the role of RoOs in the context of preferential tariffs. However, RoOs also matter in determining whether a product is subject to a bilateral mutual recognition agreement. Complex rules could lead to firms not using this possibility. In contrast to the case of tariffs, with product standards, the lack or necessity to have RoOs in place is, however, not

easily checked.

Clearly, besides the efficiency gains stressed in this paper, relaxing the requirement to proof origin would have distributional effects.[45] First, RoOs make sure that goods shipped from a third country through one FTA party to the other generate tariff revenue in both FTA members. Without RoOs, such transactions generate income only for the FTA member through whom the product first enters, the final destination country loses out. To deal with such configurations some tariff sharing agreement would be needed. Second, when one FTA member aligns a higher tariff downwards to its partner's level, so that RoOs are no longer applicable according to our proposal, it deprives the partner of tariff income. In our context, this is welcome from a global efficiency point of view, but such a move has obvious distributional consequences. Finally, RoOs can effectively sustain market segmentation by increasing transaction costs. Thus, abolishing them typically lowers producer surplus while consumer surplus can rise (but need not if the producer stops serving the market).

Also, it needs to be noted that, in complex bargaining situations, RoOs could actually be necessary to facilitate tariff concessions in the first place. We leave it to future research to develop a better understanding of the political economy of RoOs.

While we do not want to appear naive as to the real-world chances of seeing our proposal through, making proof of origin conditional on actual tariff differences would go some way in disentangling Bhagwati's spaghetti bowl. It could also help dealing with the exit of countries from long established CUs, such as Britain's from the EU. Under our proposed scheme, countries could exit the CU without unduly endangering existing production networks.

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[45] We thank James Lake for pointing this out to us.

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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 FTA 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.

Unfortunately we have found some errors in the preferential tariff data. In some cases even though no RTA is in place WITS nevertheless reports a preferential tariff[46]. To minimize errors, we cross-check preferential tariffs with the presence of a RTA: only if our list of agreements, which combines bilateral RTAs form DESTA Dür et al. 2014 and unilateral GSPs from Baier et al. 2014 as well as the WTO's list of preferential trade agreements[47], indicates that preferential market access is granted we use the preferential tariffs otherwise the MFN tariff is used.

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.

[46] The issue seems to be that the list of beneficiary countries does not always account for changes over time. For example Bulgaria is coded to be a member of the Global System of Trade Preferences among Developing Countries since 1988 even though it left the program when it acceded the EU in 2007.

[47] http://ptadb.wto.org/ptaList.aspx

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 FTAs have often been phased-in instead of cutting all tariffs immediately when the FTA 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 FTA 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 FTAs. Hence, we can clearly differentiate between those FTAs that are phased-in and those that are not. Combining the information on phasing-in with the year the FTA 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.

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

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 FTA 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

Table A1: Algorithm for Interpolating the Missing Data

Tariff available	**FTA Phased-In?**	
	Yes	No
(1) (Multiple) observation(s), no Information about FTA	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 FTA has already entered into force) and succeeding observations

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

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 FTA was into force. When phasing-in is allowed, we first assume the MFN tariff to be applied in the year before the FTA 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 FTA and will be used for all succeeding years.

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 2014 with more than 120 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

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%

Note: 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.

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%. 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.

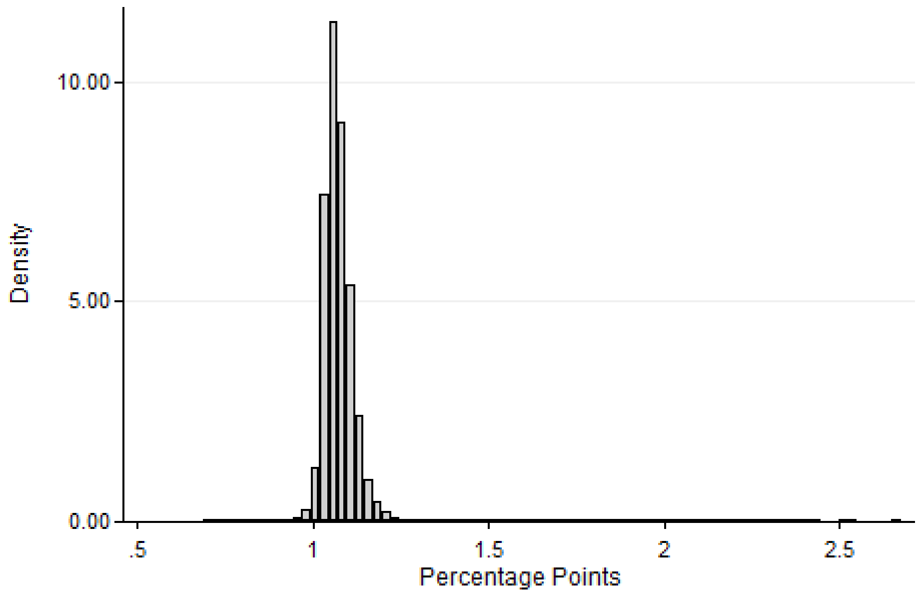
Caliendo et al. 2015 have constructed a similar database. Additionally to the tariffs provided by the WITS they add data from three other sources: manually collected tariff schedules published by the International Customs Tariffs Bureau, US tariff schedules from the US International Trade Commission, 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 FTAs 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 125 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.

A.3 Additional Descriptive Evidence

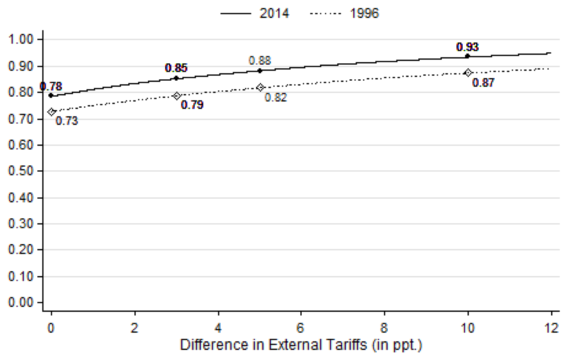
Figure A2: Distribution of Transportation Costs



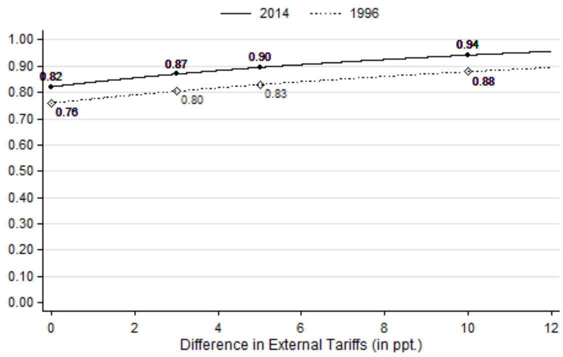
Note: The estimated transportation costs for every product-pair combination are for the year 2014. 2.36% of the product-pair transportation costs are ≤ 25 or ≥ 0. We omit those from the analysis.

Figure A3: Robustness of Descriptive Facts about Tariff Similarity

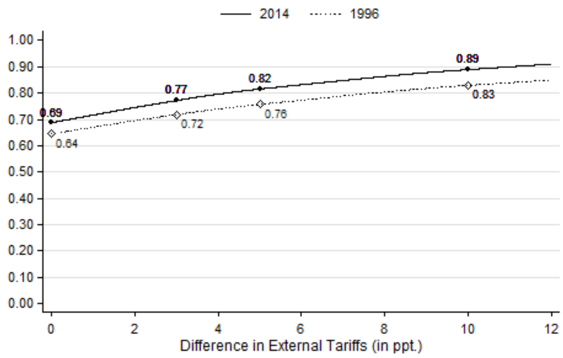
(a) Baseline



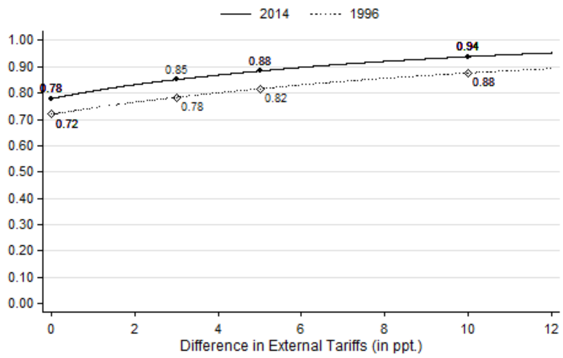
(b) New Zealand Import Data



(c) US-cif/fob Ratios



(d) additive TCs



Note: Δt_{ijk} and ΔT_{ijk} are defined in Section 2.2. Panel (a) shows the baseline way of constructing the transportation costs, in Panel (b) we use the import data of New Zealand in order to predict the transportation costs. Panel (c) uses the observed US cif/fob-ratios as a proxy for all other product-pair combinations and in Panel (d) we assume additive instead of iceberg transportation costs. The data are for 2014.

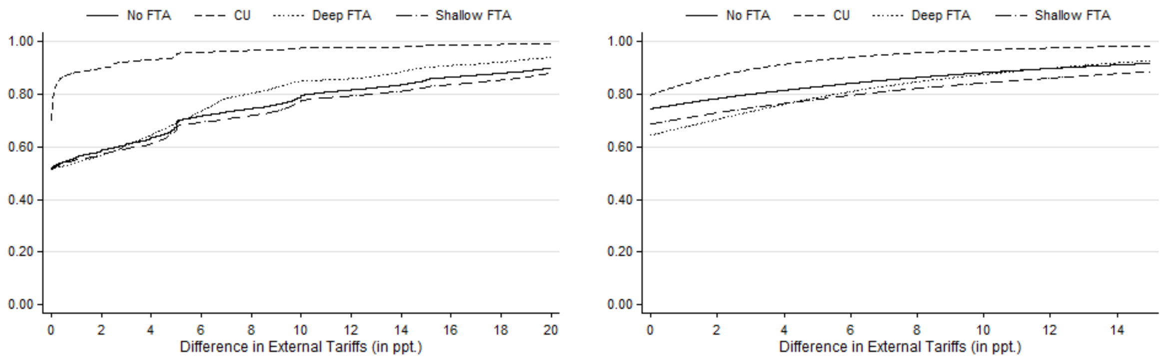
Table A3: Heterogeneity across Regions and Types of RTAs: Conditional Cumulative Probabilities $Pr(t_{ijk}) \leq c)$ and $P(T_{ijk}) \leq c)$ for 1996

	t_{ijk}						T_{ijk}					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	0	3	6	9	12	max	0	3	6	9	12	max
(a) ***Regions***												
North-North	58	76	85	90	93	100	78	86	90	93	95	100
North-South	51	61	71	76	81	100	73	78	83	86	89	100
South-South	52	61	71	75	81	100	72	78	83	86	89	100
(b) ***North-North***												
No FTA	53	72	82	89	92	100	83	88	92	94	96	100
Deep FTA	51	60	74	82	85	100	64	73	80	86	89	100
Shallow FTA	53	63	77	87	91	100	69	79	87	91	93	100
Customs Union	71	97	99	99	100	100	84	93	97	99	99	100
(c) ***North-South***												
No FTA	52	62	72	77	82	100	74	80	84	88	90	100
Deep FTA	53	62	70	78	87	100	73	79	86	91	95	100
Shallow FTA	50	58	69	73	77	100	68	74	78	81	84	100
Customs Union	53	74	90	95	95	100	81	91	94	96	96	100
(d) ***South-South***												
No FTA	52	60	71	75	81	100	74	80	84	87	89	100
Deep FTA	50	63	76	92	98	100	73	83	91	96	98	100
Shallow FTA	52	60	69	74	80	100	69	75	80	84	87	100
Customs Union	70	89	94	94	96	100	75	85	90	94	96	100

Note: The table shows the shares of tariff lines (in %-points) whose absolute differences in external tariffs lie below a certain threshold c. In the different panels, we focus on heterogeneity across regions and types of RTAs and show data on the simple 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. 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). In Panel (b)-(d) we look at the different regional and RTA types simultaneously. We use data for 1996.

Figure A4: Descriptive Facts about Tariff Similarity, 1996

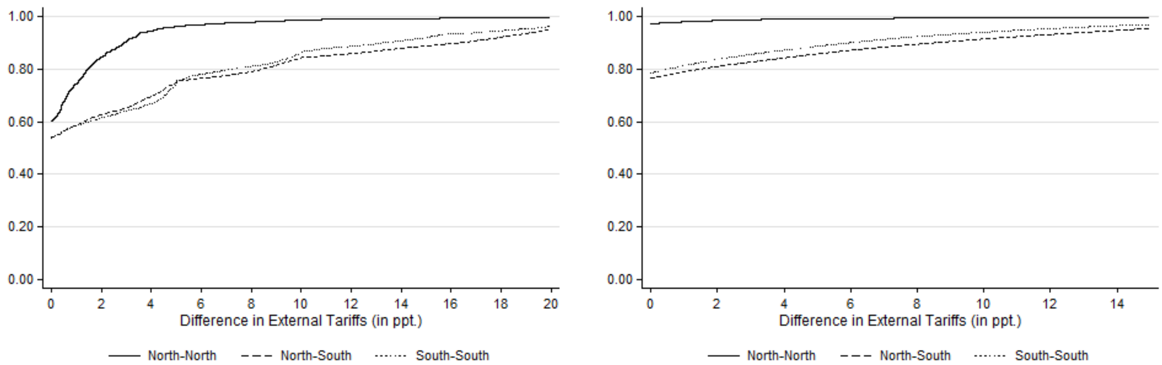
(a) C.D.F. of Δt_{ijk} by Type of RTA (2014) (b) C.D.F. of ΔT_{ijk} by type of RTA (2014)



Note: Δt_{ijk} and ΔT_{ijk} are defined in Section 2.2. Panel (a): truncated to values ≤ 16, Panel (b): truncated to values ≤ 12. The information on the type of the RTA stems from DESTA (Dür et al. 2014). We show data for 1996.

Figure A5: Cumulative Distribution Function by Regions

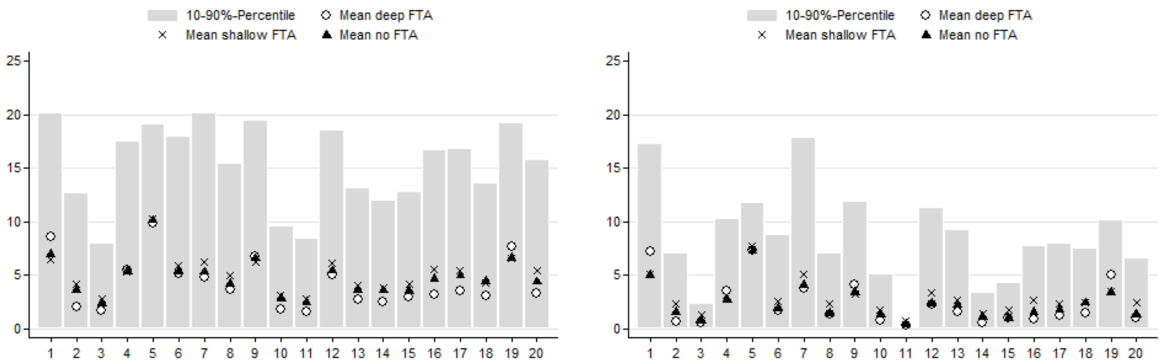
(a) Absolute Difference Δt^a_{ijk} in External Tariffs (b) Trade Costs vs. Differences in Ext. Tariffs Δt^t_{ijk}



Note: Δt_{ijk} and ΔT_{ijk} are defined in Section 2.2. 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 data are for 2014.

Figure A6: Absolute Differences in External Tariffs (in ppt.) - by Goods (Sections HS 1988/92)

(a) Δt_{ijk} (b) ΔT_{ijk}

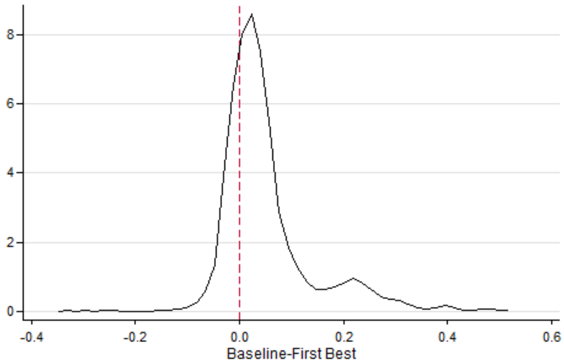


Note: Sections (HS88/92-2 digits): 1 *Live Animals* (01-05); 2 *Vegetable Products* (06-14); 3 *Fats and Oils* (15); 4 *Food, Bev. & Tobacco* (16-27); 5 *Mineral Products* (25-27); 6 *Chemicals* (28-38); 7 *Plastics* (39-40); 8 *Leather Goods* (41-43); 9 *Wood Products* (44-46); 10 *Pulp and Paper* (47-49); 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. Δt_{ijk} and ΔT_{ijk} are defined in Section 2.2. We show data for 2014.

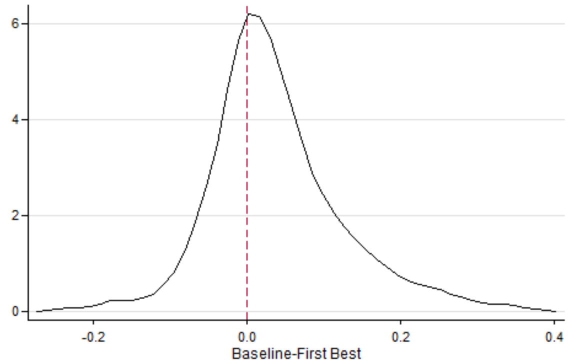
A.4 Additional Results

Figure A7: Density Function of the Difference between the Baseline $\Delta t_{ijkd}/\Delta T_{ijkd}$ and the First Best Solution $\Delta t^c_{ijkd}/T^c_{ijkd}$

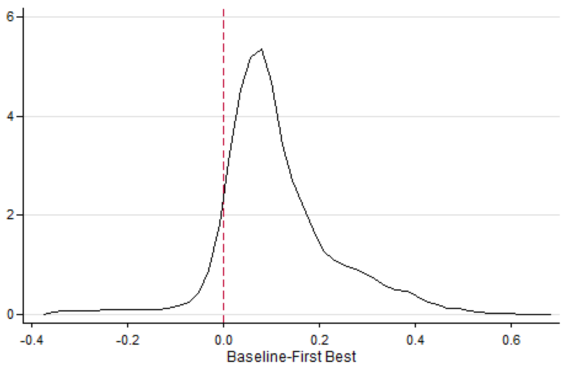
(a) Simple Tariff Differences Δt_{ijkd}: Shallow FTA



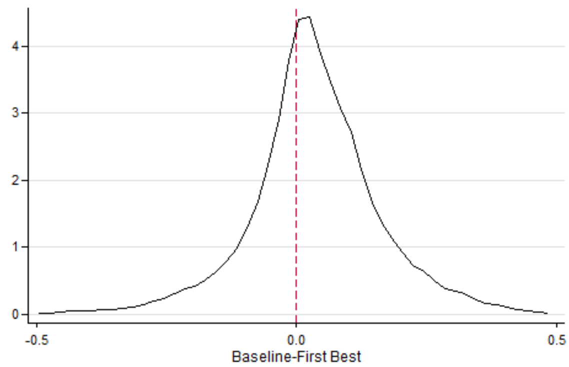
(b) Weighted Tariff Differences ΔT_{ijkd}: Shallow FTA



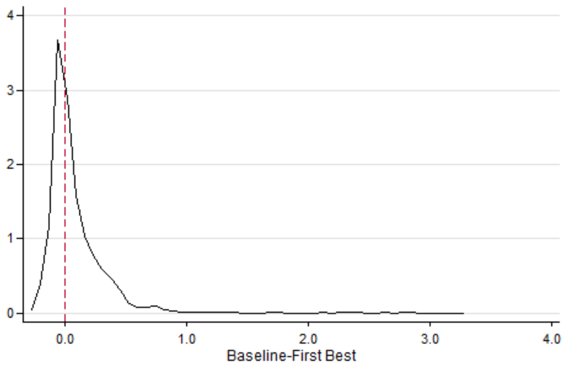
(c) Simple Tariff Differences Δt_{ijkd}: Deep FTA



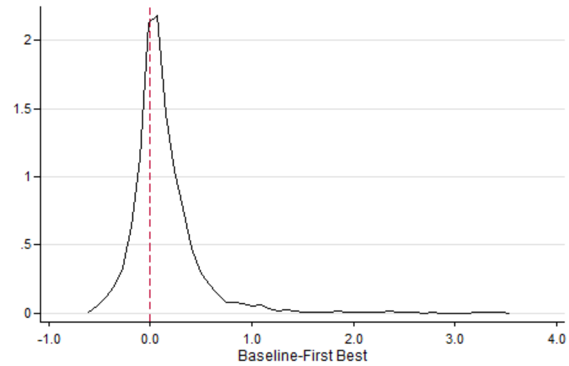
(d) Weighted Tariff Differences ΔT_{ijkd}: Deep FTA



(e) Simple Tariff Differences Δt_{ijkd}: CU



(f) Weighted Tariff Differences ΔT_{ijkd}: CU



Note: To evaluate the aggregation bias we compare in this graph our baseline measures $\Delta t_{ijkd}/\Delta T_{ijkd}$ with the first best $\Delta t^c_{ijkd}/\Delta T^c_{ijkd}$ where country i, country j, third country c, product k, and time t. For this purpose we conduct for both variables our baseline regression analysis by product k. To compare the results of the two types of analysis, the graphs above plot the distribution of the difference between the resulting coefficients. Data points right/left the 0-line indicate that the aggregated measure overstates/understates the real ones.

Table A4: Comparison of the Sign of the Baseline Results $\Delta t/\Delta T$ with the First Best Solution $\Delta t^c/\Delta T^c$

	Δt		ΔT	
	(1)	(2)	(3)	(4)
	Same	Significant	Same	Significant
FTA	0.96	0.63	0.94	0.65
Deep FTA	0.93	0.78	0.92	0.72
Customs Union	1.00	0.98	0.96	0.89

Note: The table shows the shares of all products k for which the baseline results $\Delta t/\Delta T$ and the first best solution $\Delta t^c/\Delta T^c$ yield coefficients with the same sign (column (1) and (3)); column (2) and (4) only significant coefficients are included.

Table A5: No Missing Data: Analyzing the Channels of the Heterogeneity in Differences in External Tariffs by the Type of RTAs

	Δt				ΔT			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FTA	0.634***	-0.157**	-0.135**	-0.064	0.696***	0.199***	0.224***	0.014
	(0.204)	(0.077)	(0.055)	(0.109)	(0.152)	(0.070)	(0.053)	(0.107)
Deep FTA	-1.460***	0.151	-0.207***	-0.588***	-0.969***	0.099	-0.282***	-0.539***
	(0.185)	(0.129)	(0.057)	(0.086)	(0.128)	(0.112)	(0.052)	(0.090)
Customs Union	-4.748***	-3.543***	-3.958***	-3.268***	-2.301***	-1.745***	-2.069***	-2.083***
	(0.186)	(0.133)	(0.103)	(0.135)	(0.144)	(0.118)	(0.100)	(0.125)
R^2	0.057	0.677	0.960	0.985	0.044	0.655	0.960	0.984
k-d	✗				✗			
i-k		✗				✗		
j-k								
i-k-d			✗	✗			✗	✗
j-k-d			✗	✗			✗	✗
ij-k				✗				✗

Note: For the analysis we only use data that has not been imputed. Twoway clustered (country-pairs and products) standard errors in parentheses. ***/**/* Indicate significance at the 1%/5%/10% level. The number of observations equals 33,709,152.

Table A6: 3 Year Averages

	Δt				ΔT			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FTA	0.441***	0.011	-0.095***	0.331***	0.679***	0.422***	0.358***	0.240***
	(0.100)	(0.036)	(0.027)	(0.065)	(0.080)	(0.032)	(0.027)	(0.060)
Deep FTA	-1.322***	-0.221***	-0.536***	-0.514***	-0.798***	-0.055	-0.412***	-0.510***
	(0.123)	(0.078)	(0.041)	(0.053)	(0.085)	(0.062)	(0.040)	(0.053)
Customs Union	-4.705***	-3.811***	-4.120***	-3.051***	-2.130***	-1.573***	-1.830***	-2.023***
	(0.099)	(0.079)	(0.069)	(0.118)	(0.086)	(0.073)	(0.069)	(0.106)
R^2	0.040	0.836	0.971	0.991	0.033	0.839	0.971	0.991
k-d	✗				✗			
i-k		✗				✗		
j-k		✗				✗		
i-k-d			✗	✗			✗	✗
j-k-d			✗	✗			✗	✗
ij-k FE				✗				✗

Note: For the analysis we only use data that has not been imputed. Twoway clustered (country-pairs and products) standard errors in parentheses. ***/**/* Indicate significance at the 1%/5%/10% level. The number of observations equals 33,709,152.

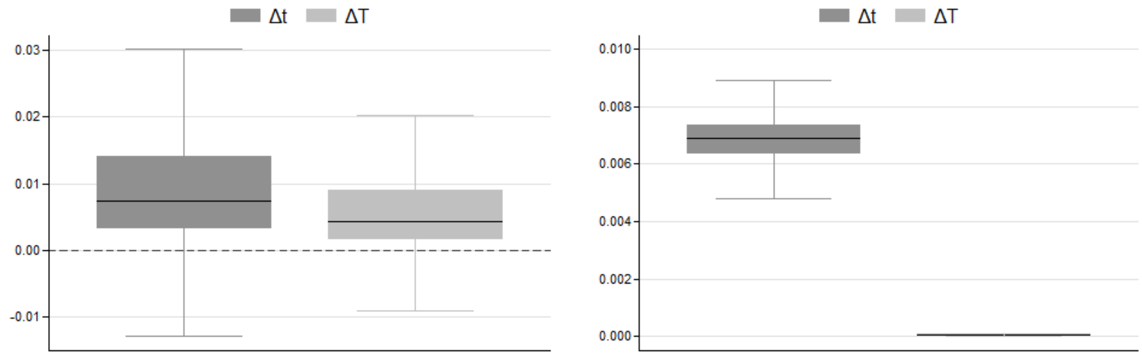
Table A7: No Missing Data: BASELINE Analyzing the Channels of the Heterogeneity in Differences in External Tariffs by the Type of RTAs

	Δt				ΔT			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FTA	-0.338***	0.185***	0.018	0.201***	0.306***	0.542***	0.428***	0.111***
	(0.083)	(0.027)	(0.019)	(0.024)	(0.065)	(0.023)	(0.018)	(0.022)
Deep FTA	-0.404***	-0.405***	-0.427***	-0.118***	-0.010	-0.123**	-0.080**	-0.146***
	(0.146)	(0.061)	(0.032)	(0.024)	(0.114)	(0.051)	(0.036)	(0.023)
Customs Union	-3.879***	-3.755***	-4.016***	-2.915***	-1.526***	-1.521***	-1.649***	-1.896***
	(0.091)	(0.064)	(0.055)	(0.071)	(0.083)	(0.059)	(0.056)	(0.064)
R^2	0.037	0.720	0.982	0.994	0.031	0.713	0.983	0.994
k-d	✗	✗			✗	✗		
i-k		✗				✗		
j-k		✗				✗		
i-k-d			✗	✗			✗	✗
j-k-d			✗	✗			✗	✗
ij-k FE				✗				✗

Note: For the analysis we only use data that has not been imputed. Twoway clustered (country-pairs and products) standard errors in parentheses. ***/**/* Indicate significance at the 1%/5%/10% level. The number of observations equals 33,709,152.

Figure A8: Quantification of the Potential Aggregation Bias for Weighted Average

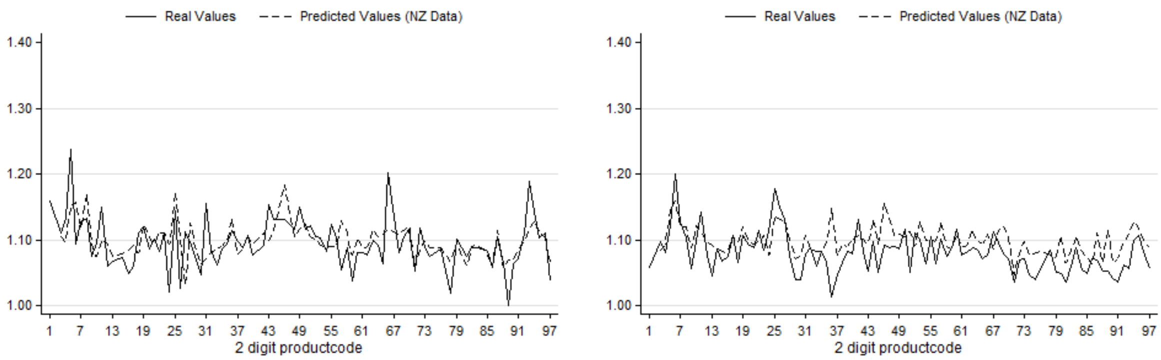
(a) Constant δ_0 (b) δ_1 Coefficient



Note: The boxplots show the results of the comparison of the first best solution for the differences in external tariffs Δt^c_{ijkt} and the aggregated measure Δt^w_{ijkt}. We regress for every product the first best solution on the aggregate measure, $\Delta t^c_{ijk} = \delta^k_0 + \delta^k_1 \Delta t^w_{ijk} + u^c_{ijk} \forall k$. The analysis is based on the year 2014. The figure shows the distribution of the constants δ^k_0 and the slope-coefficients δ^k_1 for all 5,018 products k.

Figure A9: Predicting Transportation Costs using Import Data from New Zealand

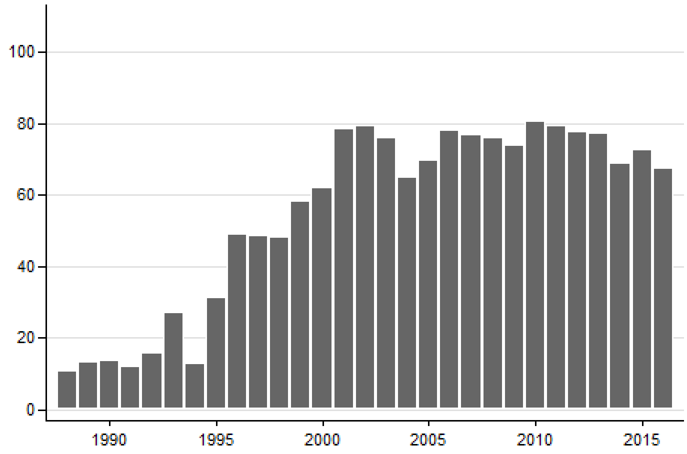
(a) In-Sample Prediction: New Zealand (b) Out-of-Sample Prediction: USA



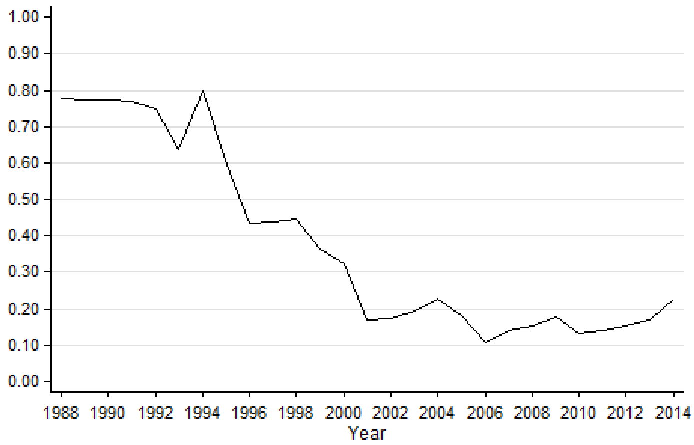
Note: The graphs shows the observed cif/fob ratios and the predicted values for New Zealand (a) $\hat{\tau}_{NZ,j} = exp(ln(\hat{\alpha}) + \hat{\delta} ln(D_{NZ,j}))$ and the United States (b) $\hat{\tau}_{US,j} = exp(ln(\hat{\alpha}) + \hat{\delta} ln(D_{US,j}))$. We aggregate by taking the arithmetic average over the two-digit products. The data stem from the US Census, Statistics New Zealand and CEPII.

Figure A1: The Issue of Missing Data

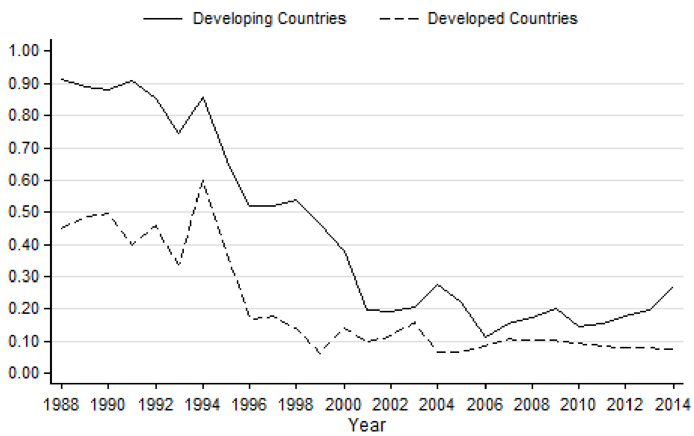
(a) Share of Reporting WTO-Members



(b) Share of Imputed Data



(c) Share of Imputed Data by Regions



Note: 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.