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On the Profitability of Trade Deflection and the Need for Rules of Origin

Abstract

When two countries conclude a free trade agreement (FTA), they define rules of origin (RoOs) to determine whether a product is eligible for preferential treatment. RoOs exist to avoid that exports from third countries enter the FTA through the member with the lowest tariff (trade deflection). However, RoOs distort exporters' sourcing decisions and burden them with red tape. Using a global data set, we show that, for 86% of global trade and 78% of bilateral product-level comparisons, trade deflection is not profitable because external tariffs are rather similar and transportation costs are non-negligible; in the presence of a deep FTA, deflection is significantly less profitable still. We find evidence for both ex post adjustment of external tariffs and ex ante selection effects. The pervasive and unconditional use of RoOs is, therefore, hard to rationalize.

JEL-Codes: F100, F130, F150.

Keywords: trade deflection, rules of origin, external tariffs, free trade agreements.

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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). Moreover, CUs are less likely to be stumbling blocks for further trade liberalization (Missios et al. 2016). Nonetheless, only 6% of all trade agreements in 2014 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. forthcoming; Krishna and Krueger 1995). RoOs are, therefore, the unsavory sauce to Bhagwati's (1995) spaghetti bowl of bilateral trade agreements. However, without RoOs, each imported commodity would enter the FTA through the country with the lowest tariff. In the absence of transportation costs, this arbitrage activity, often referred to as trade deflection, would have the consequence that the FTA member with the lowest tariff de facto sets a common external tariff for all FTA members.

Surprisingly, so far, no study has asked whether trade deflection is actually realistic empirically. If it is not, the existence of hundreds of pages of text on RoOs in modern FTAs would be indicative of rent seeking rather than necessary due to the inherent logic of a preferential trade agreement.

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: for most country-pairs, trade deflection is unprofitable. This is even

[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.

more pronounced amongst members of ambitious FTAs. The reason for this is that tariffs are generally low, countries of similar development status set similar tariff levels, and once in a common FTA, member states may have incentives to adjust their external tariffs further. The upshot is that FTAs should not require proof of origin by default, except for those few products where differences in external tariffs are larger than some threshold level (determined by the additional transportation costs that would arise if firms attempt to exploit tariff differences).

Why is there less scope for trade deflection in country pairs with an FTA? There are two leading hypotheses which we disentangle econometrically. First, our finding may reflect selection. Countries with similar economic structures (and, hence, similar schedules of optimal external tariffs and low scope for trade deflection) might find it more beneficial to form FTAs. Second, similarity could also result from some convergence process ex post, i.e., as a consequence of concluding an FTA. We find that the data support the first hypothesis (positive selection) more strongly than the second (convergence).

Concerns with RoOs and their side effects is wide-spread in the literature. It is a key ingredient in Bhagwati's (1995) "Spaghetti Bowl" parable. 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*

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

through 11.08 used in production does not exceed 20 per cent of the net weight of the product, (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.[4]

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.[5] Third, if exporters need to adjust their global supply chains to meet RoOs requirements, trade patterns and investment flows are distorted (Krishna 2006; Krishna and Krueger 1995). This can have extreme implications. In a simple model, Deardorff (2016) shows 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 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 NAFTA RoOs, Conconi et al. (forthcoming) 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

[4] To be fair, there have been numerous attempts towards simplifying RoOs-regimes, e.g., by allowing for bilateral or diagonal cumulation. However, the general necessity of RoOs is rarely challenged by trade policy practitioners.

[5] 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.

preferences (Suominen and Harris 2009; Wignaraja et al. 2010). Also preference utilization rates of less than 100% indicate high fixed costs associated with RoOs (Keck and Lendle 2012).[6]

There is also a theoretical literature on the choice between FTAs and CUs. In FTAs participating countries do not have to delegate policy making authority to a common institution, which should facilitate concluding the agreement. Facchini et al. (2013) provide arguments why FTAs might yield higher welfare for the prospective member countries when voters strategically choose a very protectionist representative to conduct the negotiations. Appelbaum and Melatos (2012) model the conditions under which members in FTAs choose similar external tariffs; a situation they describe as "camouflaged"CUs. Lake and Yildiz (2016) also endogenize the choice between FTAs and CUs and explain why CUs are only intra-regional while FTAs are inter- and intra-regional.[7]

Section 2 of the present paper presents the simple analytical conditions under which trade deflection is actually profitable. This analysis guides our empirical analysis. Section 3 introduces a new global tariff database that deals with the well-known issue of missing data in the standard sources for tariffs and accounts for preferential tariffs in more than 500 historical or existing FTAs. Furthermore, we construct pair-product specific transportation costs using disaggregated data on cif/fob imports for the USA and use a simple econometric model to 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' scope for trade deflection, which is surprisingly low. In 25% of all country-pair×product×third-country combinations of the year 2014, countries set identical external tariffs. In half of the remaining cases trade deflection could be profitable, leaving 37.5% of candidate cases. Factoring in transportation costs, that share shrinks further. Averaging out the third-country dimension, the share of cases in which trade deflection is profitable is equal to 22%; in North-North country pairs it falls to only 10%. Therefore, in a large number of cases, there is no economic rationale for RoOs. Furthermore, the data indicate

[6] 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% (European Commission 2017).

[7] We also add to an empirical 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.

that members of a deep FTA have even lower potentials for trade deflection than country pairs without an FTA; the opposite holds for shallow FTAs.

In Section 5, we investigate the structure of that correlation. In particular, we ask whether the little scope for trade deflection in deep FTAs is due to an ex-ante *Selection Effect* or to an ex-post *FTA Effect*. The former arises if countries with less scope for trade deflection are more likely to form a deep FTA. The *FTA Effect* means that, once the FTA is concluded, trade deflection becomes unprofitable. We use a simple difference-in-differences approach to identify the relative strength of these potential channels. 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 by the *Selection Effect*, but also ex-post convergence has some relevance. Low levels of tariffs drive mostly the results.

Section 6 draws policy conclusions. The most important is that exporters should be required to prove the origin of goods only when trade deflection is a real possibility which is quite often not the case. 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 would create incentives for countries to align their external tariffs, thus emulating CUs. It could also help dealing with the exit of countries from long established CUs, such as Britain's or Turkey's potential exits from the EU's customs union.

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 $c = 1, ..., N$. Denote the ad valorem tariff applicable on a good $k = 1, ..., K$ in factor form by $t_{ick} \geq 1$ (so that $(t_{ick} - 1) \times 100\%$ is the tariff in percent). When useful, we distinguish between preferential tariffs t^*_{ick} and MFN tariffs $\tilde{t}_{ick} = \tilde{t}_{ik}$ for all c.

Suppose countries i and j conclude a free trade agreement (FTA). They grant each other preferential tariffs such that $t^*_{ijk} \leq t_{ick}$ and $t^*_{jik} \leq t_{jck}$ for all third countries c.

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.

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 f_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, f_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 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

[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)).

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

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, otherwise trade deflection will never be profitable. 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 (both in %) . 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.[10]

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), for every country pair ij relative to a third

[10] We do not allow for pricing to market. In this case, factory gate prices may be specific to the destination market and $p^o_{ick} \neq p^o_{jck}$. Writing $p^o_{ick} = \mu_{ick} k_{ck}$, where μ_{ick} is a variable markup, equation (1) would be $\mu_{ick} k_{ck} t_{ick} \tau_{ick} > \mu_{jck} k_{ck} t_{ijk} \tau_{ijk} t_{jck} \tau_{jck}$. A necessary condition for the inequalities discussed above is $\mu_{ick} \geq \mu_{jck}$, i.e., the markup in the high-tariff country i should not be smaller than the markup in the low-tariff country j. Empirically, at the country level, there is a negative correlation between average tariffs and the price level (compare Table A3 in the Appendix), so that our assumption seems largely innocuous.

country c for product k,[11] we define the trade cost weighted difference in external tariffs as

$$\Delta T_{ijk,c} \equiv \max\left\{0, T_{ick} - T^j_{ick}\right\}, \text{ with } T_{ick} \equiv t_{ick}\tau_{ick} \text{ and } T^j_{ick} \equiv t_{ijk}t_{jck}\tau_{ijk}\tau_{jck} \tag{3}$$

where T_{ick} and T^j_{ick} 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 between i and j and with the third country c to be MFN or preferential.[12] If $\Delta T_{ijk,c} = 0$, no profitable arbitrage possibilities exist.

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

$$\Delta t_{ijk,c} = \max\{0, t_{ick} - t^j_{ick})\} \tag{4}$$

where the costs of servicing market i with a product from c through j, t^j_{ick}, is simply country $j's$ tariff on good k from c, t_{jck}. In some parts of our analysis, we work with this "simple" measure, because it characterizes a useful sufficient condition for trade diversion.[13]

Although the measures for the scope for trade deflection are very intuitive, calculation is 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. In our data, we have $N = 125$ and $K = 4,215$, so that the number of observations is equal to about 8 billion per year. A meaningful analysis of data of that size runs into severe computational issues; even more so, when exploiting time variation.

We deal with this problem by averaging (3) over the third country dimension so that

$$\Delta T_{ijk} = \frac{1}{N-2}\sum_{c\neq i,j} \max\left\{0, T_{ick} - T^j_{ick}\right\}, \tag{5}$$

and similarly for the simple measure (with transport costs set to zero). Clearly, this procedure introduces some measurement error; we will discuss this issue in detail below. Note however,

[11] To avoid cluttered notation, we suppress time indices.

[12] Note the slight abuse of notation as $\Delta T_{ijk,c}$ is not a difference in the conventional sense since we replace it with zero whenever the difference is negative and trade deflection is not profitable.

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

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.

Alternatively, we can define the maximum potential for trade deflection. Assume that there are no transportation costs and that $t_{ijk} = t_{jik} = 1$. Further, let $t_{ick} > t_{jck}$. Then it would pay to ship from c to j and from there to i. Next, let there be another third country c' for which $t_{ic'k} = t_{jc'k}$ so that there is no scope for trade deflection with respect to that country. However, one can imagine that firms from c' ship their product to c first, and from there through j onwards to i. More generally, if the tariff difference between i and j were maximum with respect to third country c, in the case of no tariffs (and other trade costs) between any c' and c, all shipments from c' would be profitably directed through c. We define a measure of maximum trade deflection

$$\Delta T_{ijk}^{\max} = \max_{c \neq i,j} \left[\max \left\{ 0, T_{ick} - T_{ick}^{j} \right\} \right]. \tag{6}$$

Here, we pick that third party relation with the largest scope for trade deflection. This leads to overestimation because routing shipments from any fourth country c' to c and from there through i to j involves transportation costs and possibly also tariffs, and this remains unaccounted for in $\Delta T_{ijk}^{\max}$. However, $\Delta T_{ijk}^{\max}$ serves as a conservative upper bound to our estimates of the scope for trade deflection.

3 Data

For our empirical analysis, we require data on (applied) product-level tariffs, MFN and preferential, for country pairs over time. We also need information on transportation costs by product for each country pair, and on RTAs.

3.1 A New Global Tariffs Database

One could think that tariff data were easily available for all country pairs and products, at least for recent years. However, this is not the case. 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)*; with some minor qualifications, this statement still applies today. There is a lot of missing information, in particular for developing countries. Moreover, also rich countries do not report yearly to the WTO or the World Bank (who maintain tariff data bases). Besides, there are many mistakes in official data.

To the best of our knowledge no comprehensive and cleaned tariff data set on the product level is publicly available.[14] Therefore, to carry out our analysis, a massive investment into data cleaning and imputation is needed. For example, we need to impute missing data, in particular when tariffs are phased in over time, complement the official data with country-level information and with data from RTAs, to deal with measurement error. In the Online Appendix, we describe in great detail how we have constructed the tariff data set for our analyses.

The quality of the tariff data improves significantly after the entering into force of the World Trade Organization (WTO) in 1995. Therefore, we focus on the period 1996-2014. As described in more detail in the Online Appendix, between 1996 and 2014, we find that (unweighted average) MFN tariffs have fallen from 15.4% to 9.6% for developing countries and from 9.0% to 5.2% in developing countries. Preferential tariffs are substantially lower for both groups of countries; they have fallen from 9.5% to 4.5% in the former and from 2.9% to 0.5% in the latter case. Across all countries, a substantial share of MFN tariffs is equal to zero. In these cases, trade deflection cannot be an issue. That share differs across sectors: it is above 40% in the minerals, pulp & paper and works of art sectors but less than 10% in the footwear sector. Preference margins – the difference between (applied) MFN tariffs and preferential tariffs – can be as high as 13% on average in the live animals sector, and less than 2% in the minerals sector.

3.2 Transportation Costs

The second key variable entering equation (5) is a measure of transportation costs. 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,

[14] 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 (we account for about 500 FTAs).

focusing on transportation costs underestimates the additional non-tariff trade costs that arise when trans-shipping a good through some third country.

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 infer the costs of international transportation from detailed data on imports by using the ratio of transaction values denoted in cif (cost, insurance, freight) terms relative to the transaction values in fob (free on board) terms. In theory, this ratio should be identical to τ_{ijk} and satisfy $\tau_{ijk} \geq 1$. Unfortunately, only few countries report disaggregated transaction data both in cif and fob terms.[15] 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 a US specific measure of transportation costs at the 6-digit level for every product-exporter combination for the years 1996 and 2014.[16]

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 $\tau_{ij}^k = \alpha^k \left(D_{ij}\right)^{\delta^k}$ with $\delta^k \in (0,1)$ so that non-tariff trade costs are an increasing, strictly concave function of geographical distance.[17]

Thus, it is possible to estimate the parameters α^k and δ^k for every product k for the US using $\tau_{US,i}^k$ and the bilateral distances between the US and its trading partners i, $D_{US,i} \geq 1$.[18] Taking logs makes OLS a feasible estimator. The regression equation equals $\ln(\tau_{US,i}^k) = \ln \alpha^k + \delta^k \ln(D_{US,i}) + u^k$. We regress the cif/fob ratios on the bilateral distance for every product separately to allow for product-specific constants.[19]

[15] 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 so for aggregate trade, but the resulting cif/fob ratios take very implausible values on the entire real line.

[16] 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.

[17] 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 $D_{ic} = D_{ij} + D_{jc}$.

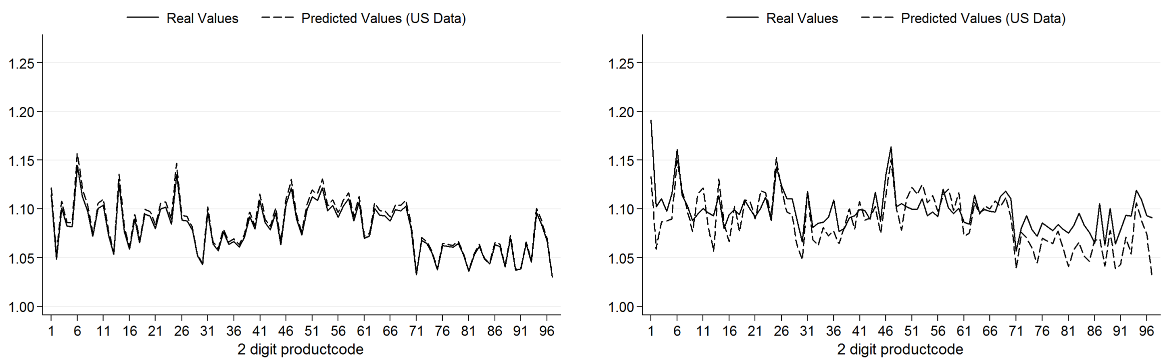
[18] Information on bilateral distances stems from CEPII.

[19] See Appendix B on further details. Following Hummels (2007), we have added the weight/value-ratios as an additional explanatory factor in the transportation cost function ($\tau_{ij}^k = \alpha^k \left(D_{ij}\right)^{\delta^k} \left(w/v_{ij}^k\right)^{\gamma^k}$). This approach increases the explanatory power of the regressions slightly, but it lowers the number of estimated pair-product

Next, for every country-pair and for every product k we predict a measure of transportation cost $\hat{\tau}_{ij}^k = exp(\widehat{\alpha^k} + \hat{\delta}^k ln(D_{ij}))$. This procedure provides us with transportation costs for 4,215 products (out of the available 5,018 tariff lines). Figure 1(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.[20] The transportation costs equal on average 8% ((1.08-1)*100), which squares very well the evidence cited in Anderson and Van Wincoop (2004).[21]

Figure 1: Predicting Transportation Costs

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



Note: The graphs show 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 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.[22] We use these data to check how well the prediction based on US data performs. Figure 1(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.[23]

transportation costs significantly as weight/value-ratios are only available when countries actually trade.

[20] Alternatively, we could estimate bilateral, product specific trade costs exploiting a structural gravity model of bilateral trade using the methodology proposed by Jacks et al. (2008). We do not use this method because it may very well overestimate trade costs by attributing any deviation from the gravity norm to frictions instead of differences in tastes. Thus, our focus on transportation costs represents a very conservative approach which generally stacks the cards in favor of trade deflection and against our argument.

[21] In Appendix B, we provide information on the distribution of estimated parameters $\hat{\alpha}, \hat{\delta}$ and their relation as well as a histogram of estimated $\hat{\tau}_{ij}^k$.

[22] 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

[23] 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.

3.3 RTA Data

Our analysis builds on the DESTA database provided by Dür et al. (2014).[24] It comprises over 600 regional trade agreements (FTAs and CUs) and the corresponding accessions and withdrawals.[25] For our sample, in 2014, the probability of a country-pair having an FTA equals 40%, while it equals 6% for having a CU.[26]

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 6) and that most of this increase was due to more deep FTAs. We have manually researched the year of entry into force for the FTAs in DESTA.[27]

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 6 in the Appendix provides summary statistics. It shows that, for 2014, the average simple tariff difference between country pairs is 3.96%, the average of the transportation-cost weighted measure is 1.92; for pairs within the same deep FTA, the differences average 3.25% and 1.50%, respectively.

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

[25] 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.

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

[27] In the few cases when we could not find the year of entry into force, we used the year of ratification.

4 The Scope for Trade Deflection

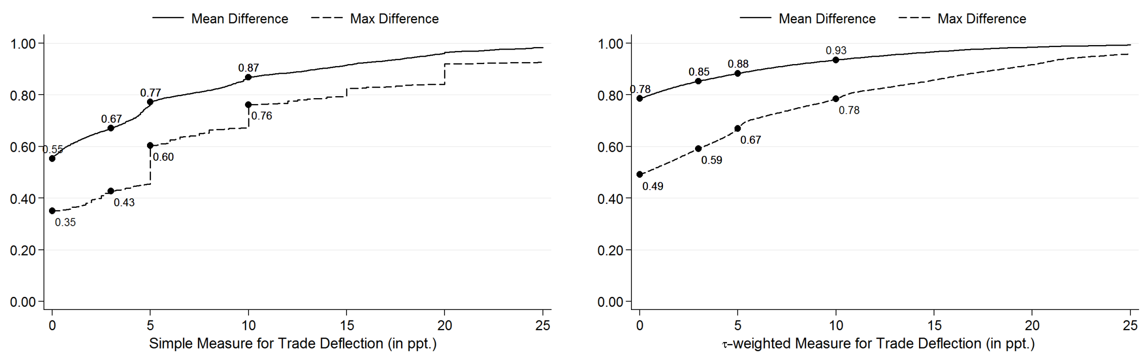
This section presents new stylized facts on the scope for trade deflection across different country pairs, simple and transportation-cost weighted, and heterogeneity across types of FTAs, regions, and industry sectors. We show cross-sectional data on the 6 digit product-level for 1996 and 2014.

4.1 Limited Potential for Trade Deflection

In 2014, for about 25% of all country-pair×product×third-country combinations, external tariffs are entirely identical. No trade deflection can happen here. For exactly half of the remainder, trade deflection could be profitable (absent of transportation costs) for one of the members of a pair, while for the other it cannot be profitable. Hence, even without accounting for transportation costs, across all products and around the globe, for 62.5% of all country-pair×product×third-country combinations, trade deflection cannot be profitable.

Figure 2: C.D.F.s of Average and Maximum Potential for Trade Deflection, 2014

(a) Simple Measure for Trade Deflection Δt_{ijk} (b) τ-Weighted Measure for Trade Deflection ΔT_{ijk}



Note: Panel (a) shows simple measures for trade deflection. The solid line is the C.D.F. of Δt_{ijk}, the dashed line that of Δt_{ijk}^{max}. Panel (b) shows transportation-cost augmented measures of trade deflection. The solid line is the the C.D.F. of ΔT_{ijk}, the dashed line that of ΔT_{ijk}^{max}.

To draw cumulative distribution functions (C.D.F.s), we refer to our measures (5) and (6). We start by ignoring transportation costs; see Panel (a) of Figure 2. The lower dashed curve corresponds to $\Delta t_{ijk}^{\max}$ defined in Section 2.2.[28] In 35% of all cases, maximum tariff differences between two countries relative to any third country is zero. Necessarily, this number lies below

[28] For simplicity we omit the time index d in this section.

the 62.5% reported above, because over all third countries, it picks the one with the largest scope for trade deflection. Very often, tariff differences are zero with most third countries and non-zero for very few; the $\Delta t_{ijk}^{\max}$ picks exactly those cases. This is, therefore, an extremely conservative measure. Panel (b) allows for transportation costs. The dashed line shifts up, and for 49% of all cases, $\Delta t_{ijk}^{\max}$ is zero now.

Turning to, Δt_{ijk}, which averages across third countries and avoids the extreme assumption behind $\Delta t_{ijk}^{\max}$, Figure 2 reports even smaller potentials for trade deflection. Ignoring transportation costs, Panel (a) shows that, in 55% of all cases, no scope for trade deflection exists. For 87% of all cases, tariff differences are not larger than 10%-points. Panel (b) allows for transportation costs and finds that for 78% cases trade deflection cannot be profitable. In the remainder, we focus on the average measure of trade deflection, but all results are available for $\Delta T_{ijk}^{\max}$, as well.

Figure 3 focuses on Δt_{ijk} and ΔT_{ijk}. It elaborates on changes over time and illustrates the role of transportation costs. Panels (a) to (d) reveal the existence of a clear time trend; in all pictures, the potential for trade deflection is much lower in 2014 than in 1996.[29] This is due to lower average tariff levels and, possibly, also to convergence within country pairs. When factoring in transportation costs the time trend is still apparent.

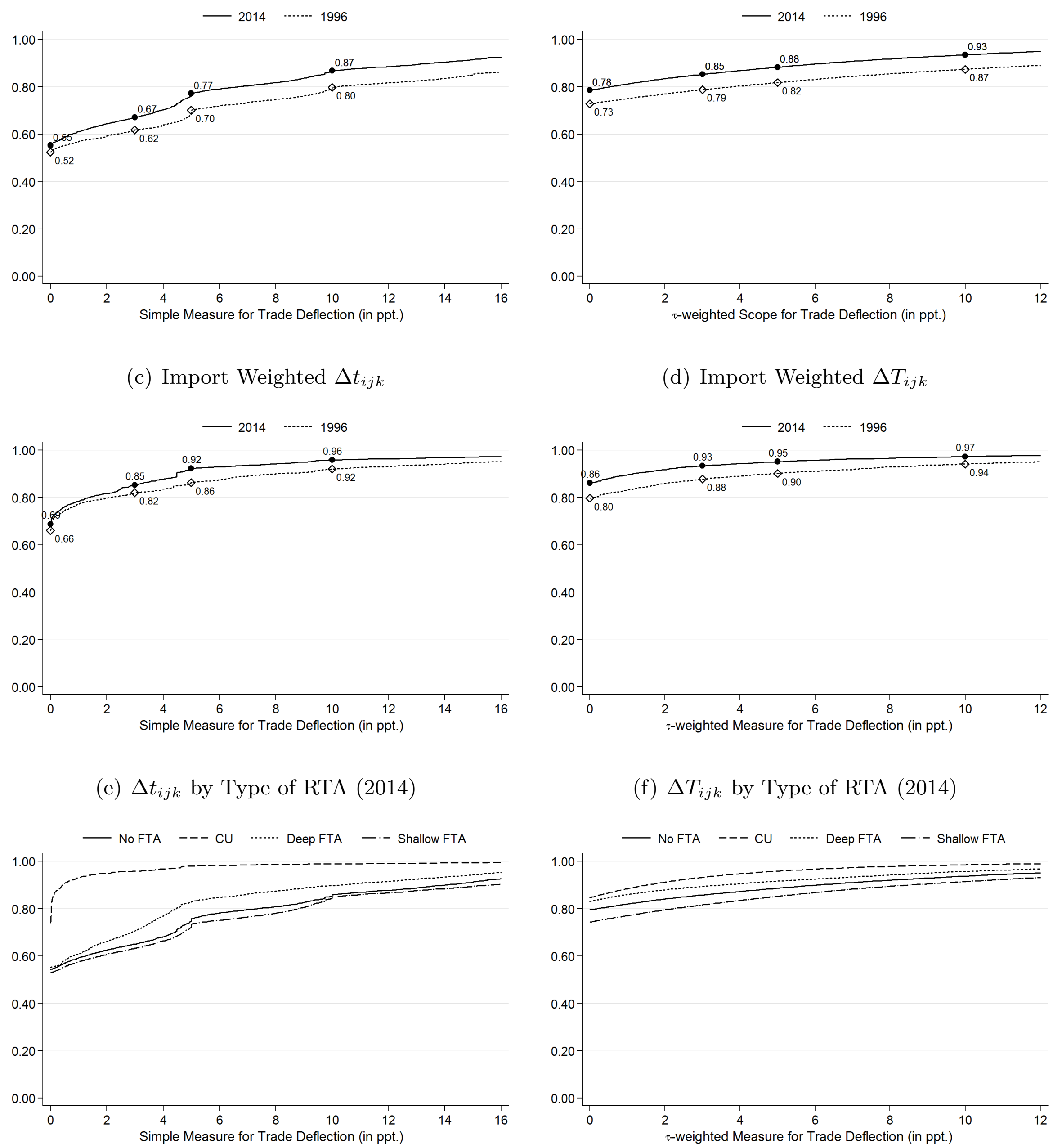
Panels (c) and (d) in Figure 3 show the cumulative share of imports as a function of the two measures for trade deflection. In 2014, for 69% of global imports no scope for trade deflection between the trade partners exists; for 85% Δt_{ijk} is no more than 3%-points, and for 92% it amounts to at most 5%-points. When we account for transportation costs, the pattern is even more pronounced: for 86% of world trade trade deflection is unprofitable. So, the largest share of trade takes indeed place within country pairs at products with very little scope for trade deflection.

4.2 Heterogeneity in the Scope for Trade Deflection

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 enjoy preferential tariffs. Therefore, we calculate the cumulative distribution functions (C.D.F.s) of measures of the potential for trade deflection

[29] The solid line in panel (a) reproduces the C.D.F. of Δt_{ijk} from panel (a) in Figure 2.

Figure 3: C.D.F.s of Average Potentials for Trade Deflection



(a) Simple Measure for Trade Deflection Δt_{ijk}

(b) τ-Weighted Measure for Trade Deflection ΔT_{ijk}

(c) Import Weighted Δt_{ijk}

(d) Import Weighted ΔT_{ijk}

(e) Δt_{ijk} by Type of RTA (2014)

(f) 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.

for different trade policy environments such that $P(\Delta t_{ijk} \leq c|RTA_{ij} = 1)$ and $P(\Delta T_{ijk} \leq c|RTA_{ij} = 1)$, with RTA_{ij} indicating a CU, a deep, or a shallow FTA). Figures 3(e) and (f) present the findings for the simple difference Δt_{ijk} and the transport cost weighted one ΔT_{ijk}

for 2014.[30]

An interesting pattern emerges. While country-pairs with a deep FTA have a lower potential for trade deflection than when no FTA is present, for those with a shallow FTA the opposite is true. The probability of having a Δt_{ijk} 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 the potential for trade deflection is already rather low. 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.

By definition, due to the common external tariff in a CU the difference in external tariffs should be equal to zero and thus no scope for trade deflection exists. Although the external tariffs exhibit a significantly higher degree of similarity, external tariffs are not always identical as Figure 3(e) shows. Certain agreements exclude specific products or whole sectors, such as the EU-Turkey CU. In other CUs, members seem unwilling or unable 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 across regions and across products. Table 1 shows conditional cumulative probabilities for the simple Δt_{ijk} and the transportation cost weighted measures ΔT_{ijk} (both averaged over third countries). A number of interesting facts stand out. First, North-North country pairs have significantly less scope for trade deflection than other pairs, with South-North and South-South pairs looking relatively similar; see Panel (a) of Table 1. In North-North pairs, Δt_{ijk} is in 96% not larger than 3%-points; accounting for transportation costs, in 90% of all cases there is no scope for trade deflection. That number falls to 77%-79% of cases in pairs containing one or more Southern countries. These facts are mostly a reflection of low MFN tariffs in North. Second, amongst North-North pairs, when countries are members of the same RTA, Δt_{ijk} is smaller than when they are not; see Panel (b) of Table 1. When adjusting for transportation costs, in 97% of cases where no RTA exists, there is no trade deflection. So, when Northern countries negotiate FTAs, they have no reason to be overly concerned with RoOs. Third, while trade deflection is more of an issue in pairs involving the South (Panels (c) and (d)),

[30] Figure A5 in the Appendix presents the evidence for 1996.

Table 1: Heterogeneity across Regions and Types of RTAs: Conditional C.D.F.s $P(\Delta t_{ijk} \leq c)$ and $P(\Delta T_{ijk} \leq c)$ for 2014

	Simple Measure Δt_{ijk}						**τ-Weighted Measure 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 measures for trade deflection 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 measure Δt_{ijk} in column (1)-(6), and when accounting for transportation costs ΔT_{ijk} in column (7)-(12). Panel (a) shows the distribution of the measures for trade deflection 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.

only in about 20% of country-pair×product combinations there is any scope for trade deflection; in deep existing FTAs the scope is smaller then when no FTA is present, but the difference is relatively minor.

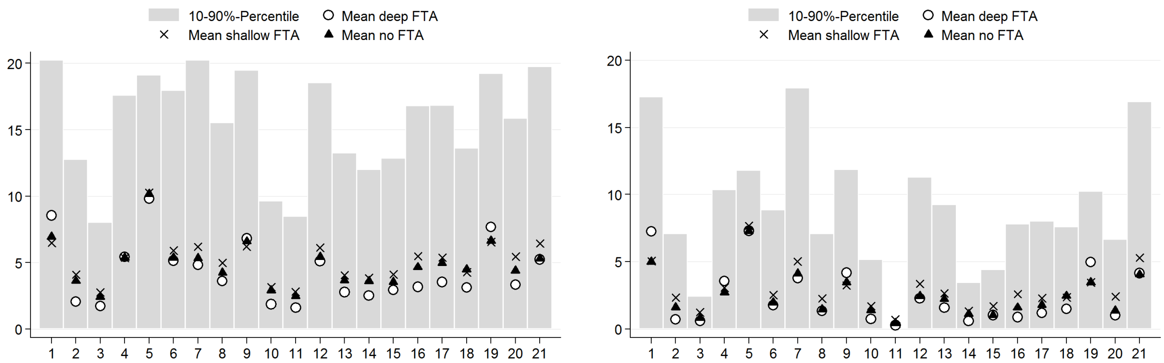
Figure 4 explores heterogeneity across 21 product sections for the year of 2014. We calculate the range of the differences in external tariffs within a section excluding the extreme values. Then we plot the means within each section for pairs with a deep FTA, with a shallow FTA, and those without an FTA.[31] Both, for the simple measure Δt_{ijk} and for the transport cost augmented measure ΔT_{ijk}, we observe that the potential for trade deflection varies quite substantially across the sections. The products with the largest scope for trade deflection belong to the agricultural

[31] All pairs belonging to a CU are excluded

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. Moreover, the degree of heterogeneity depends on the type of the FTA: in general, pairs with a deep FTA have smaller scope for trade deflection than pairs without an FTA an those with a shallow FTA.

Figure 4: Heterogeneity across Goods (Sections HS 1988/92), 2014

(a) Simple Measure for Trade Deflection Δt_{ijk} (b) τ-Weighted Measure for Trade Deflection 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 *Misc. Manufactured Articles* (94-96); 21 *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.

4.3 Sensitivity Analysis

Bound tariffs. To exclude the possibility that countries with "water in the tariff", i.e. higher bound MFN tariffs than applied MFN tariffs, change the applied tariffs and making trade deflection profitable again, we have conducted the analysis described above using bound MFN rates. The picture remains broadly the same. In about 60% of all cases, there is no scope for trade deflection even if transportation costs are ignored; when the latter are accounted for, the share of product×country-pairs, where trade deflection is conceivable, shrinks even further; see Figure A6 in the Appendix. Hence, our analysis and conclusions do not depend on our choice of applied tariffs.

Alternative measures for transportation costs. We have based our estimation of product-level transportation costs on US data and used a very simple econometric model to predict values for other country pairs. Instead of using predicted values, one could simply use the observed US cif/fob ratios, or use data from another country (New Zealand) to estimate transportation cost for our sample. Finally, one could also assume that transportation costs are additive rather than multiplicative. Figure A7 in the Appendix shows that our main results are not sensitive to the construction of the transportation costs. Using New Zealand data, we would find even less scope for trade deflection; proxying transportation costs around the world using observed US values slightly increases the scope, and moving to additive transportation costs leaves the scope for trade deflection basically the same as when we use our preferred measures.[32]

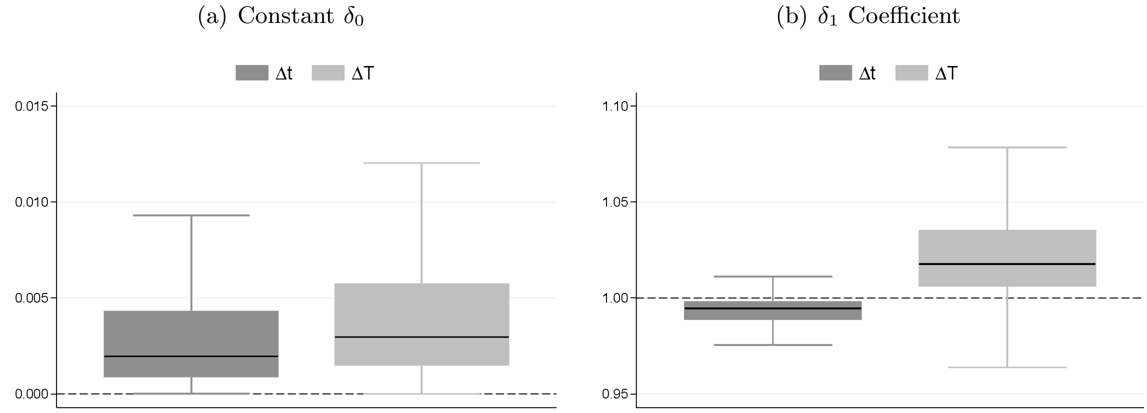
Measurement error from averaging out the third country dimension. Averaging out the third country dimension keeps the analysis tractable and avoids extreme predictions, but induces some measurement error. To check how much the average measures for trade deflection Δt_{ijk} and ΔT_{ijk} suffer from measurement error we compare them product-by-product with the unaveraged data $\Delta t_{ijk,c}$ and $\Delta T_{ijk,c}$, respectively, the scope for trade deflection for every country-pair ij with respect to all third countries c. We focus on the year 2014. For every product, we regress the averaged data on the unaveraged one, $\Delta t_{ijk,c} = \delta_0^k + \delta_1^k \Delta t_{ijk} + u_{ijk,c}$ for all k and $\Delta T_{ijk,c} = \delta_0^k + \delta_1^k \Delta T_{ijk} + u_{ijk,c}$ for all k. If for all products δ_0^k were equal to zero and δ_1^k equal to one, no systematic measurement error would be present.[33]

We end up with 4,215 sets of δ_0^k and δ_1^k coefficients for both measures of tariff similarity Δt_{ijk} and ΔT_{ijk}. Figure 5 shows the distributions of the constant δ_0^k and the δ_1^k coefficients. The median of the slope-coefficient δ_1^k 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

[32] Using New Zealand data is not our 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. Figure A8 in the Appendix 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 $\hat{\tau}_{ijk}$ are always higher than the actual ones. 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.

[33] 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 computationally unfeasible.

Figure 5: Quantification of the Potential Aggregation Bias



Note: The boxplots show the results of the comparison of the first best solution for the measures of trade deflection $\Delta t_{ijk,c}$ and $\Delta T_{ijk,c}$ and the aggregated measure Δt_{ijk} and ΔT_{ijk}, respectively. 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_0^k and the slope-coefficients δ_1^k for all 4,215 products k.

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 relatively rare. 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.[34]

5 Why is Scope for Trade Deflection Low Within FTAs? Selection vs. Convergence

5.1 Potential Channels and Empirical Strategy

For country pairs within the same FTA, trade deflection is less profitable than for pairs without FTAs. This begs the question: are countries with less potential for trade deflection more likely to form FTAs, or does the profitability of trade deflection decrease once they have formed an FTA? There are good arguments for both possibilities.

[34] Alternatively, we have used import weights to average over the third country dimension. The import weight $\frac{imp_{ijk}}{imp_{ik}^{tot}}$ equals the imports from j to i for a specific product k imp_{ijk} as a share of the total value of imports of country i for product k (imp_{ik}^{tot}), so the higher the relevance of a tariff and non-tariff trade costs 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 A9), which is the reason why we use the simple mean throughout the analysis.

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 lead to convergence in the structure of comparative advantage of two countries, e.g., through FDI or technological diffusion. 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 difference in the external tariffs will decrease as well, as tariffs of both countries converge to zero making trade deflection less profitable. One theoretical explanation for this behavior is the "Juggernaut Effect" put forward by Baldwin and Robert-Nicoud (2015).[35] Maggi and Rodríguez-Clare (2007) argue that trade agreements can serve as a commitment device for a government to close the door to domestic lobbies; it may therefore allow the country to lower MFN tariffs, too.

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). Depth may matter for several reasons. First, shallow FTAs often exempt more products than 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.[36]

We run two main specifications. In a first step, we run cross-sectional regression separately on data from 1996 or 2014. We also pool the two years. Next to trade policy indicators, we only

[35] 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.

[36] 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.

include product dummies γ_k (or product $\times$ year dummies in the case of the pooled cross-section)

$$Y_{ijk} = \alpha_0 + \alpha_1 FTA_{ij} + \alpha_2 deep_{ij} + \alpha_3 CU_{ij} + \gamma_k + \varepsilon_{ijk}, \tag{7}$$

where Y_{ijk} is either equal to our simple measure of trade deflection Δt_{ijk} or to the transportation cost weighted measure ΔT_{ijk}. The cross-sectional models are meant to be as close as possible to the descriptive analysis of chapter 4. In all of these regressions, it is very likely that ε_{ijk} correlates with the policy indicators, since selection into trade agreements is certainly not random. Hence, estimates of $\alpha_1, \alpha_2, \alpha_3$ should not be mistaken for causal effects. In particular, they may reflect ex ante selection as well as ex post adjustment effects.

In the next step, we want to disentangle these channels. For this reason, we exploit time variation within country-pairs and products for identification and estimate a model in first differences

$$\Delta Y_{ijk} = \beta_0 + \beta_1 \Delta FTA_{ij} + \beta_2 \Delta deep_{ij} + \beta_3 \Delta CU_{ij} + \gamma_{ik} + \gamma_{jk} + \upsilon_{ijk}, \tag{8}$$

where γ_{ik} and γ_{jk} are importer-product and exporter-product dummy variables, thus we estimate a fully saturated model. Effectively, this specification amounts to comparing changes in the scope for trade deflection within country pairs belonging to trade agreements or not, holding supply-side and demand-side product effects constant.[37] There are no reasons why we would expect $\hat{\alpha}_1 = \hat{\beta}_1$ (for example). We posit that the coefficients β_1 to β_3 in Equation (8) identify the causal effects of concluding agreements on external tariff differences, i.e., we assume that the identifying assumption $E\left(\Delta FTA_{ij}, \upsilon_{ijk} | \gamma_{ik}, \gamma_{jk}\right) = 0$ and similar for the other two policy variables holds. Under these conditions, β_1 to β_3 measure the *FTA Effect*.[38]

The size of the causally interpretable coefficient will determine which effect is driving the

[37] We use only two years, 1996 and 2014. This deals with the critique of Bertrand et al. (2004) about 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.

[38] We do not see any obvious reason why the identifying assumption should fail. First, notice that shocks υ_{ijk} have a product dimension, while the policy variables $FTA_{ij}, CU_{ij}, deep_{ij}$ have not. We have more than 4000 products in our data, so that it is unlikely that any single product-level shock can correlate with policy. Second, (unobserved) changes in overall trade policy stances which may make an FTA and the lowering of applied tariffs and hence of our trade deflection measure more likely, are accounted for by our fixed-effects γ_{ik} and γ_{jk}. Changes in transportation costs τ_{ijk} are by construction orthogonal to υ_{ijk}, since they are compiled using US-specific cif/fob ratios, which are uncorrelated with country-pair ij-specific shocks.

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 2 shows the baseline results of the regression analysis. Panel (A) shows results when we average over the third-country dimension (i.e., dependent variables are Δt_{ijk} and ΔT_{ijk}, respectively), while Panel (B) uses the maximum scope for trade deflection measures Δt_{ijk}^{max} and ΔT_{ijk}^{max}. The goal of the empirical analysis is to disentangle selection and adjustment effects of FTAs on the measure for the scope for trade deflection. Columns (1) and (2) focus on Δt_{ijk} and Δt_{ijk}^{max}. They present results from cross-sectional regressions for the years 1996 and 2014 respectively, controlling only for product fixed effects. Not surprisingly, within CUs, the scope for trade deflection is much lower than within FTAs and – comparing with averages – almost completely disappears. Generally, in FTAs, however, the scope of trade deflection is somewhat larger than outside. However, within deep FTAs, it is much smaller. In both cases, coefficients are statistically significant.

In 1996, in our sample, the average value for Δt_{ijk} was 6.83%-points; see Table 6. Being in the same FTA goes in line with a higher scope for trade deflection of 0.58%-points, but if that FTA is deep, the scope is 2.67%-points lower. Hence, the scope for trade deflection is about 30% lower in a deep FTA than in the sample average.[39] In 2014, the average was 3.96. Being in the same deep FTA reduces the scope by 0.92%, i.e., approximately 25% of the average.

Using our most conservative measure Δt_{ijk}^{max}, we find again that being part of the same deep FTA is strongly and significantly associated with a lower scope for trade deflection. In 1996, the effect of 2.74%-points amounts to almost 20% of the sample average; in 2014 the effect of 2.84%-points amounts to almost 30% of the sample average; see Table 6.

Columns (5) and (6) turn to the transport cost augmented measure of trade deflection. For the averaged measure ΔT_{ijk}, in both years, the sign patterns are the same as with the simple measure. The estimated coefficients imply that membership to a deep FTA is associated on

[39] $100 \times (0.58 - 2.67)/6.83$.

Table 2: Baseline Results

Model	Cross-Section			FD	Cross-Section			FD
	1996	**2014**	**96 & 14**	**96 & 14**	**1996**	**2014**	**96 & 14**	**96 & 14**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Mean Differences								
Dep. Variable	Δt				ΔT			
FTA	0.584***	0.344***	0.455***	0.266***	0.868***	0.450***	0.654***	0.229***
	(0.176)	(0.080)	(0.110)	(0.064)	(0.154)	(0.055)	(0.091)	(0.061)
Deep FTA	−2.670***	−1.259***	−1.527***	−0.656***	−1.599***	−0.827***	−1.053***	−0.609***
	(0.397)	(0.107)	(0.113)	(0.057)	(0.308)	(0.067)	(0.081)	(0.059)
Customs Union	−6.468***	−3.946***	−4.849***	−3.113***	−3.865***	−1.558***	−2.399***	−2.154***
	(0.174)	(0.084)	(0.104)	(0.116)	(0.153)	(0.068)	(0.090)	(0.105)
R^2	0.038	0.031	0.040	0.938	0.033	0.024	0.033	0.933
Panel B: Maximum Differences								
Dep. Variable	Δt^{max}				ΔT^{max}			
FTA	1.104***	0.650***	0.879***	0.106*	0.932***	0.409***	0.670***	−0.090
	(0.201)	(0.094)	(0.126)	(0.062)	(0.207)	(0.092)	(0.129)	(0.057)
Deep FTA	−2.738***	−2.841***	−2.950***	−0.405***	−3.054***	−2.348***	−2.580***	−0.668***
	(0.445)	(0.122)	(0.131)	(0.072)	(0.410)	(0.117)	(0.127)	(0.061)
Customs Union	−7.806***	−6.625***	−7.074***	−3.800***	−6.916***	−5.123***	−5.794***	−2.888***
	(0.228)	(0.139)	(0.146)	(0.198)	(0.212)	(0.119)	(0.135)	(0.167)
R^2	0.053	0.076	0.064	0.950	0.057	0.076	0.066	0.951

Note: Two-way clustered (country-pairs and products) standard errors in parentheses. ***/**/* Indicate significance at the 1%/5%/10% level. *CS:* Columns (1), (2), (5), and (6) show the results when only using 1996 and 2014, respectively and only including product fixed-effects. The number of observations equals 65 Million. *PCS:* In column (3) and (7) we show the results for the pooled cross-section (1996 and 2014) including product-year fixed-effects. The number of observations equals 130 Million. *FD:* Columns (4) and (8) show the results when estimating a fully saturated model by estimating in first-differences and adding importer-product and exporter-product fixed-effects. The number of observations equals 65 Million.

average with a lower profitability of trade deflection in both years by about 20%. Turning to the ΔT_{ijk}^{max} measure, the reduction in the scope for trade deflection is about 30% in both years.

Columns (3) and (7) show the results of the pooled cross-section i.e. including both years 1996 and 2014, and controlling for product-time fixed-effects. Estimated coefficients almost exactly are equal to averages over the 1996 and 2014 results. Columns columns (4) and (8) turn to our first-differenced (FD) models, which also contain importer-product and exporter-product effects.[40] In contrast to the pooled cross-section (PCS) the FD model reveal a treatment effect that is purged from selection. Comparing the estimates suggests that about 37% of the scope reduction as measured by Δt associated to a deep FTA is due to ex post adjustment; that share is about 78% when looking at ΔT. When the dependent variable is Δt^{max} and ΔT^{max}, the

[40] In the pooled model we have not added importer-product and exporter-product effects because these would already account for selection. In fact, it is them which explain the largest portion of the difference between the pooled cross-section and the first-differenced model.

fraction attributable to ex post adjustment is 14% and 40%, respectively. We conclude that about one third of the association between the scope for trade deflection and membership in a deep FTA is due to an adjustment of structures after the conclusion of the FTA, and two thirds are due to ex ante selection effects.

5.3 Mechanisms

Next, we explore three reasons for low differences in external tariffs and hence for low scope for trade deflection: identical external tariffs, lower tariff levels overall, and more similar tariff structures.[41]

We focus on the simple means of external tariffs of i and j with all third countries in product k and define three types of indicator variables. $P_{ijk}^{identical}$ takes the value of one if country i and j set the same external tariff for a product k, and zero otherwise. We let the indicator variable P_{ijk}^{low} take the value of one if both countries set their respective external tariffs for product k not higher than 5%, and zero otherwise.[42] Finally, to measure the similarity in the tariff-structure we first rank all products for every country i with rising average external tariff. 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: $rank_{ik}^{norm} = \frac{rank_{ik} - rank_i^{min}}{rank_i^{max} - rank_i^{min}}$. The dummy variable P_{ijk}^{same} equals one for product k if both countries of the pair ij assigned the same normalized rank to the product, and zero otherwise.[43]

We run linear probability models to check the effect of RTAs on proxies of external tariff similarity. Table 3 shows the results. Columns (1), (3) and (5) report the results for the pooled cross-section (years 1996 and 2014) while columns (2), (4) and (6) draw on time variation only to identify effects and includes a full set of fixed-effects combinations (importer-product and exporter-product). For pairs with a shallow FTA the probability is actually lower than for pairs without an FTA. The coefficient of interest almost doubles when including the control variables.

[41] The higher the probability of country-pair ij setting the same external tariff, the lower the potential for trade deflection. Furthermore, the lower the level of tariffs, the lower the potential for large differences in external tariffs because of the convergence towards zero, and thus lower potential for trade deflection. Therefore, if all countries participating in an FTA lower their external tariffs, as Estevadeordal et al. (2008) report, Δt_{ijk} and ΔT_{ijk} decrease. On the other hand, countries with similar industry structures will also have similar tariffs as the preferences for protectionism coincide. Higher tariff similarity will again yield less potential for trade deflection.

[42] 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. On average, P_{ijk}^{low} takes the value of 0.327.

[43] On average, in our sample, the probability of a same rank is 6.3%.

Table 3: Mechanisms

Dep. Variable	$P^{identical}$		P^{low}		P^{same}	
	PCS (1)	**FD** (2)	**PCS** (3)	**FD** (4)	**PCS** (5)	**FD** (6)
FTA	-0.015^{***}	-0.031^{***}	-0.056^{***}	-0.024^{***}	-0.005^{***}	-0.043^{***}
	(0.001)	(0.004)	(0.003)	(0.004)	(0.001)	(0.005)
Deep FTA	0.033^{***}	0.004	0.243^{***}	0.016^{***}	0.026^{***}	-0.044^{***}
	(0.003)	(0.005)	(0.005)	(0.004)	(0.003)	(0.004)
Customs Union	0.399^{***}	0.408^{***}	0.494^{***}	0.245^{***}	0.299^{***}	0.288^{***}
	(0.010)	(0.018)	(0.009)	(0.009)	(0.010)	(0.014)
R^2	0.196	0.418	0.301	0.690	0.183	0.462

Note: Two-way clustered (country-pairs and products) standard errors in parentheses. ***/**/* Indicate significance at the 1%/5%/10% level. *PCS:* In columns (1), (3), and (5) we show the results for the pooled cross-section (1996 and 2014) including product-year fixed-effects. The number of observations equals 130 Million. *FD:* Columns (2), (4), and (6) show the results when estimating a fully saturated model by estimating in first-differences and adding importer-product and exporter-product fixed-effects. The number of observations equals 65 Million.

For pairs with a deep FTA on the contrast, the probability of having identical tariffs is higher than for those with a shallow FTA and those without an FTA. This seems to be entirely driven by selection into treatment as the coefficient is no longer significantly different from zero when controlling for omitted variables. However, the size of the coefficients is rather small indicating that the probability of having identical tariffs might not be the driving mechanism in this context.

As columns (3) and (4) show, 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 27.5%-points compared to pairs with a shallow FTA, while for pairs in a CU it is 48.3%-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 also yields an interesting picture: pairs with a deep FTA or a CU have a more similar structure of tariffs, while the opposite is true for pairs with a shallow FTA. However, in the data this pattern 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 suggest, that FTAs causes a higher degree of specialization resulting in less similar tariff structure.

Taking these pieces of evidence together, we can say that pairs with more similar tariffs, lower levels of tariffs and a more similar structure self-select themselves into deep FTAs. Although all three 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 are in line with the existing literature on the effects of FTAs on external tariffs (i.e. Crivelli (2016) and Estevadeordal et al. (2008)).

5.4 Robustness Checks

Tables 4 and 5 report the results of a host of sensitivity checks. We run versions of the pooled cross-sectional and the first-differenced models (7) and (8).

Inclusion of US. Our measure of transportation costs is based on cif/fob ratios from the US. This proxy may be endogenous to the structure of external tariffs or to the presence of FTAs. However, since such a concern is valid only for US-related observations, we drop them. Columns (1) and (2) of Table 4 regress our policy variables on the transportation cost weighted measure of scope for deflection using a pooled cross-section and a panel, respectively. Qualitatively, the results are very similar to our baseline regressions (columns (6) and (8) of Table 2). Deep FTAs are associated with lower scope, and a significant share of the total effect is due to ex post adjustment.

Trade Costs and RoOs. Related to the above point, cif/fob ratios could reflect the existence and strength of RoOs, and would be no clean measure of the costs of transportation between countries i and j anymore. If this were important, we would find that our measure of transportation costs τ_{ijk} is systematically lower when RoOs are less stringent. To test for this, column (3) and (4) of Table 4 regress our measure of transportation costs τ_{ijk} on the RoOs Facilitation Index of Estevadeordal and Suominen (2006). These authors exploit information on "regime-wide" RoOs. These are general rules employed for every product - including the degree of de minimis, the type of cumulation, drawback, and the certification method.[44] Their Facilitation Index is

[44] 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

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 permitted.[45] The less restrictive RoOs are, the higher the index. We find no effect of the index on our measure of transportation costs, neither in the pooled cross-section nor in the panel. Interestingly, in the first-differenced model, being part of an FTA seems to lead to higher τ_{ijk}. If this is indeed true, concessions made in FTAs are at least partly undone by higher cif/fob ratios, possibly due to higher regulatory requirements.[46]

Table 4: Robustness Checks: Alternative Explanations

	without US		**RoOs**					
Dep. Variable	ΔT **PCS** (1)	ΔT **FD** (2)	τ **PCS** (3)	τ **FD** (4)	Δt **PCS** (5)	Δt **FD** (6)	ΔT **PCS** (7)	ΔT **FD** (8)
FTA	0.640***	0.223***	−1.777***	0.116***	2.359***	−1.285***	1.874***	−0.823***
	(0.092)	(0.062)	(0.077)	(0.040)	(0.291)	(0.107)	(0.248)	(0.097)
Deep FTA	−1.027***	−0.608***						
	(0.081)	(0.060)						
Customs Union	−2.397***	−2.158***						
	(0.090)	(0.106)						
Facil. Index			0.021***	0.002	−1.277***	0.083***	−0.553***	0.002
			(0.007)	(0.006)	(0.032)	(0.032)	(0.029)	(0.029)
R^2	0.03	0.93	0.86	0.73	0.05	0.95	0.04	0.95
N (in Mio.)	128.56	64.28	69.03	34.52	69.03	34.52	69.03	34.52

Note: The table shows various robustness checks. Two-way clustered (county-pairs and products) standard errors in parentheses. ***/**/* Indicate significance at the 1%/5%/10% level. Column (1) and (2) show the results when omitting the US. Columns (3) and (4) show the results when regressing transportation costs τ_{ijkd} on the facilitation index (Estevadeordal and Suominen 2006). In Column (5) to (8) we control for the facilitation index to see whether RoOs might be the reason for higher tariff similarity. *PCS:* In columns (1), (3), (5), and (7) we show the results for the pooled cross-section (1996 and 2014) including product-year fixed-effects. *FD:* Columns (2), (4), (6), and (8) show the results when estimating a fully saturated model by estimating in first-differences and adding importer-product and exporter-product fixed-effects.

RoOs - the Reason for higher Tariff Similarity? One might be worried that governments agree to tariff cuts in FTAs only because there are restrictive RoOs. In that sense, RoOs are substitutes to tariffs. If strict RoOs were indeed substitutes for high tariffs, we would observe a positive coefficient in the panel-analysis: the more lenient RoOs, the higher the difference in external tariffs. Thus, columns (5) to (8) of Table 4 add the RoOs Facilitation Index of

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).

[45] 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.

[46] Unfortunately only for a small subset of FTAs (102) information about the stringency of RoOs is 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.

Estevadeordal and Suominen (2006) to our regressions explaining the scope for trade deflection. First, it has to be noted that the sample changes quite substantially compared to the baseline. Second, 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, this cannot be found when explicitly accounting for additional trade costs.

Aggregation Bias. We conduct our analysis on the 6-digit level. However, tariffs are often defined at a much finer level, i.e. the 8-, 10- or even 12-digit level. However, at such a disaggregated level, data coverage is very low, and nomenclature is not harmonized so that we cannot compare across countries. Nevertheless, it could be possible that, although on the 6-digit level countries' potential for trade deflection is very limited, this is not true for the more disaggregated products within 6-digit categories. The original tariff data provided by the IDB report the standard deviation of tariffs within 6-digit product categories. Scope for trade deflection only exists when the standard deviation of tariffs within 6-digit product categories is larger than zero for both countries in country-pair ij. In 2014 this is only the case in 1.36% of the product-pair combinations indicating that aggregation bias will most likely not bias our results substantially.[47]

Does the Choice of Years matter? In the baseline panel, we have used data for the years 1996 and 2014. One may worry that our results are sensitive to this specific choice. First, we reproduce the baseline results (Table 2 Panel (a)) 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.[48] Table A6 in the Appendix shows that the results change only slightly, indicating that our findings are not specific to the chosen years. Further, our results also hold when we run our panel regressions on yearly data (using a random 5% sample for computational feasibility); see Table A6 in the Appendix. Being part of the same deep FTA

[47] 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 with only 6,702,640 observations for 2014 (instead of 65,326,344 in our baseline specification). Figure A11 shows that particularly for lower income countries data are missing.

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

is associated to lower scope for deflection. Note, however, that the relative roles of selection versus ex post adjustment do depend on.

Missing Data. The original tariff data suffers from two sources of biases: First, the fact that data are not likely to be missing for developing countries may lead to selection bias. 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 2 Panel (a) only using original data and omitting all observations where at least one of the two tariffs used to calculate the measures for the profitability of trade deflection was imputed. The results are reported in Table A6. 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: deep FTAs are associated with lower scope for trade deflection. Interestingly, in the panel regressions, we do no longer find that the presence of FTAs in general drive the scope for trade deflection up.

Transportation Costs. Next, we use alternative measures of transportation costs in empirical specifications with the $\tau-$weighted measure of trade deflection. Table 5 has three panels. In the first, we use our estimates of bilateral product-level transportation costs based on cif/fob ratios from New Zealand (NZ). Column (2) shows the pooled cross-section, using the proxies based on NZ-data; column (1) reports results obtained with our preferred proxy on exactly the same sample of about 90 million observations. Results do not appear to be sensitive to using NZ-data.[49] The same is true when moving to the panel regressions; see columns (3) and (4). Instead of estimating transportation costs based on US data, we can use the US cif/fob ratios directly as proxies for transportation costs between all country pairs. Columns (5) to (8) in Table 5 show the outcomes for such an approach. The number of observations is much lower than in the default specification (about 36 million compared to 130 million observations); this leads to quantitative but not qualitative differences relative to our findings in the baseline regressions presented in Table 2. Nonetheless, we continue finding strong negative associations between

[49] Also, the fact that using the NZ-data implies a different sample has no qualitative or quantitative importance for our results; compare columns (6) and (8) of Table 2.

Table 5: Sensitivity Checks: Alternative Measures of Transportation Costs

	cif/fob Ratios from NZ				**cif/fob Ratios from US**				**additive Transportation Costs**			
Dep. Variable	ΔT	ΔT^{NZ}	ΔT	ΔT^{NZ}	ΔT	ΔT^{cf}	ΔT	ΔT^{cf}	ΔT	ΔT^{add}	ΔT	ΔT^{add}
	PCS	**PCS**	**FD**	**FD**	**PCS**	**PCS**	**FD**	**FD**	**PCS**	**PCS**	**FD**	**FD**
	(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	0.03	0.03	0.92	0.92	0.04	0.04	0.93	0.91	0.03	0.03	0.93	0.94
N (in Mio.)	90.08	90.08	45.04	45.04	36.26	36.26	18.13	18.13	130.65	130.65	65.33	65.33

Note: Two-way clustered (country-pairs and products) standard errors in parentheses. ***/**/* Indicate significance at the 1%/5%/10% level. For $\Delta T^{NZ}_{ijk} = max\{0, \bar{t}_{ik}\bar{\tau}^{NZ}_{ik} - \bar{t}_{jk}\bar{\tau}^{NZ}_{jk}\tau^{NZ}_{ijk})\}$ we use the import data of New Zealand in order to predict the transportation costs. ΔT^{cf}_{ijk} uses the observed US cif/fob-ratios as a proxy for all other product-pair combinations. In $\Delta T^{add}_{ijk} = max\{0, \bar{t}_{ik} + \bar{\tau}_{ik} - \bar{t}_{jk} - \bar{\tau}_{jk} - \tau_{ijk}\}$ 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. *PCS:* In columns (1), (3), (5), (7), (9), and (11) we show the results for the pooled cross-section (1996 and 2014) including product-year fixed-effects. *FD:* Columns (2), (4), (6), (8), (10), and (12) show the results when estimating a fully saturated model by estimating in first-differences and adding importer-product and exporter-product fixed-effects.

deep FTAs and the scope for trade deflection. Turning to panel estimates, there is no evidence for shallow FTAs to increase scope for deflection. Finally, in column (9) to (12) of Table 5, instead of assuming multiplicative iceberg trade costs, we assume an additive structure - i.e. $p_{ijk} = p^0_{jk}(t_{ijk} + \tau_{ijk})$. To do so, we modify the difference in external tariffs to $\Delta T^{add}_{ijkd} = max\{0, \bar{t}_{ik} + \bar{\tau}_{ik} - \bar{t}_{jk} - \bar{\tau}_{jk} - \tau_{ijk}\}$. Results change only slightly.[50] 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 robust to alternative measures of transportation costs.

Measurement Error from Averaging Out the Third Country Dimension. In our central specifications, we average out the third country dimension when calculating the potential for trade deflection, and we pool our data across products. To check, whether this approach is prone to bias, we estimate Equation 8 separately for each product but we leave the third-country dimension. So, the dependent variables are $\Delta t_{ijk,c}$ and $\Delta T_{ijk,c}$. Second, we repeat the exercise, but average over third-countries. Figure A12 in the Online Appendix shows that differences in parameter estimates (the effects of shallow FTAs, deep FTAs, and CUs) between the two approaches are very minor. The sign patterns are almost 100% identical; see Table A7 in the Appendix. So, taking all this evidence together, we are rather confident that the aggregation step does not lead to biased results.

Measurement Error in the FTA Variable We have used DESTA as a source of information on the depth of FTAs. The World Bank's Global Preferential Trade Agreement Database (GPTAD) is an alternative data set which, however, cannot be used in our panel analysis because it does not include FTAs that have been superseded by newer ones. However, we can replicate the cross-sectional analysis with this data set. In Table A8 in the Appendix, we show that the source of information on FTAs does have a quantitative but no qualitative effect on our findings. We still find a strong negative association between the scope for trade deflection and the depth of trade agreements.

[50] In this case, we do not lose any observations compared to our baseline model.

6 Conclusion

Economists have long been skeptical of free trade agreements (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, due to trade deflection, the member with the lowest external tariff would de-facto determine the common one.

In practice, however, our empirical exercise shows that the scope for trade deflection is generally low, and even lower for members of deep FTAs. The reason is that countries set relatively similar external tariffs. Moreover, where tariffs against third parties differ, transportation costs put a brake to the profitability of trade deflection. Averaging out the third-country dimension, we find that in 10% of all country-pair$\times$product combinations external tariffs are identical. That share is 25% if we keep the third-country dimension. By construction, in exactly half of all remaining case, (45% of the total), the country through which third countries could potentially cross-haul sets a higher tariff than the final destination country, making trade deflection unprofitable. In about half of the cases, in which tariffs are such that trade deflection could theoretically be profitable, additionally arising transportation costs turn out to outweigh the tariff savings. So, in 78% of all country-pair$\times$product combinations, trade deflection is not profitable.

In North-North country pairs, and for pairs with deep FTAs, the share of cases in which trade deflection would be profitable is only 10% and 8%, respectively. 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 cited as the most important reason why preference utilization rates are often below 100%. Moreover, RoOs distort input choices. Hence, to some extent, the fact that all FTAs unconditionally require proof of origin to grant preferential access is a sign for a protectionist bias in FTAs.

We analyze in more detail what drives the diverging results for pairs with deep and shallow

FTAs. Using a simple difference-in-differences approach, we show that both selection into FTAs and ex post adjustment of tariff structures explain the fact that deep FTAs exhibit lower scope for trade deflection. Low levels of tariffs drive mostly the results, which is broadly in line with existing literature.

Our analysis suggests a fundamental re-thinking of the use of RoOs in FTAs, as 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 such provisions, thus wasting resources. In contrast to the case of tariffs, with product standards, whether RoOs are in fact necessary is not easily checked.

Clearly, besides the efficiency gains stressed in this paper, relaxing the requirement to prove origin would have distributional effects.[51] 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 should be noted that, in complex bargaining situations, RoOs could actually be nec-

[51] We thank James Lake an Maurizio Zanardi for pointing this out to us.

essary 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 the 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.

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Table 6: 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^{max}	9.84	25.41	10.86	8.12	2.74***	7.73	19.72	8.78	5.94	2.84***
ΔT	4.37	24.65	5.09	3.49	1.60***	1.92	17.48	2.33	1.50	0.83***
ΔT^{max}	8.24	28.01	9.17	6.00	3.18***	5.75	21.16	6.59	4.04	2.55***
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).

Online Appendix for

On the Profitability of Trade Deflection and the Need for Rules of Origin

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A A New Tariffs Data Set

A.1 Tariff Data

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.[52] 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.[53] Whenever more than one preferential scheme applies (i.e. a bilateral FTA or GSP), we 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).* Almost 15 years after writing these words, the situation is still not much better. 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 (see Figure A1(a)). 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.[54]

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

[53] 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.

[54] The data is provided by DESTA (Dür et al. 2014). 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.

A.2 How we tackle the Issue of Missing Tariff Data

In this section, we 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 ad valorem 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[55]. To minimize errors, we cross-check preferential tariffs with the presence of a RTA: only if our list of agreements, which combines bilateral RTAs from DESTA (Dür et al. 2014) and unilateral GSPs from Baier et al. (2014) as well as the WTO's list of preferential trade agreements[56], 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.

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

[55] 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.

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

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.

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.

(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*

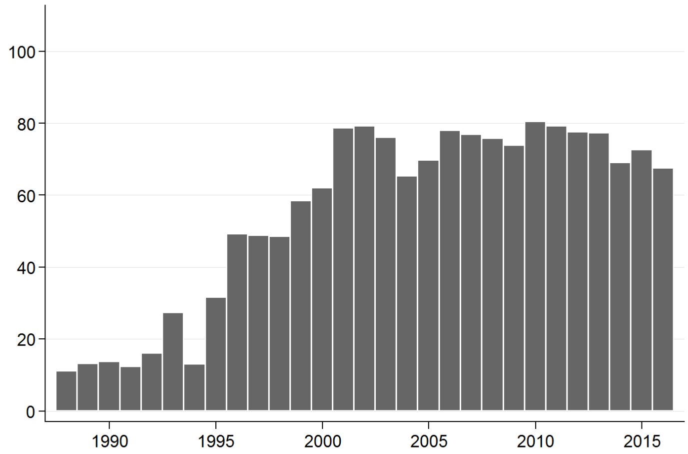
When tariff data is only available for the EiF-year and DESTA tells us that the tariff cuts were put into effect immediately we use that tariff for all succeeding observations. We use the same method when phasing-in is allowed but only the tariff for the EiF-year is available. Even though in this case the actual tariffs will most likely be lower after the 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*

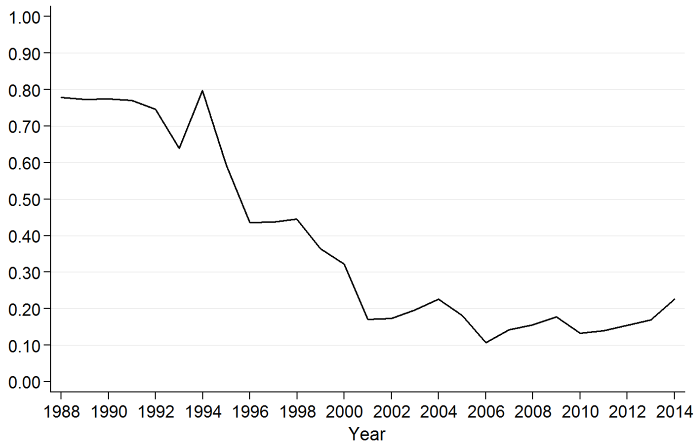
Again, when no phasing-in is applicable and original data is available for at least one year after the EiF-year we use these data for all years after the FTA was into force. When phasing-in is allowed, we first assume the MFN tariff to be applied in the year before the FTA was entered into force, then 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.

Figure A1: The Issue of Missing Data

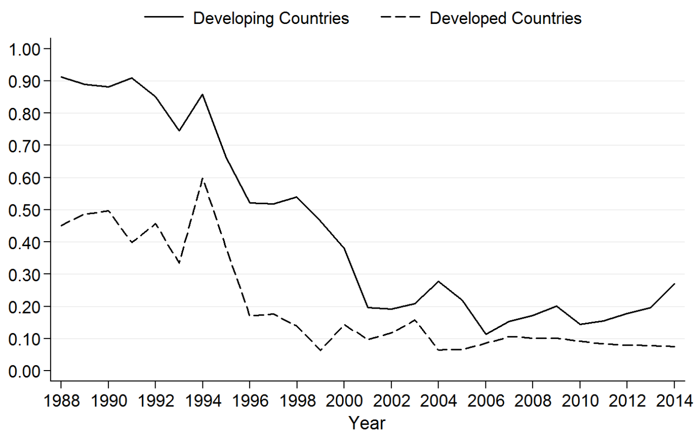
(a) Share of Reporting WTO-Members



(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.

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.

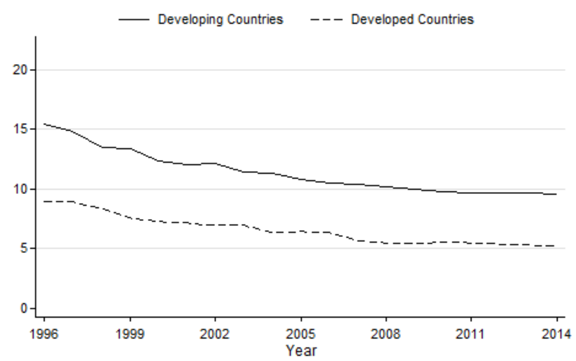
Table A2 shows the number of observations that WITS provides (column (1)) and the number of observations that we end up having after the interpolation (column (2)). We end up in 2014 with more than 120 Million observations. As Figure A1(a) shows, the share of imputed data decreased substantially over 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 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.

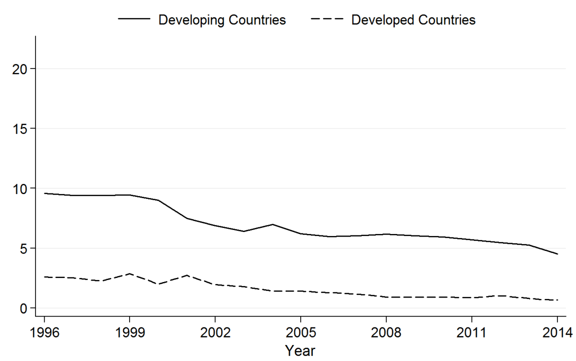
A.3 Tariffs over time and across sectors

Figure A2: Average MFN and Preferential Tariffs over Time

(a) Average MFN Tariffs $\tilde{t}_d$



(b) Average Preferential Tariffs t^*_d



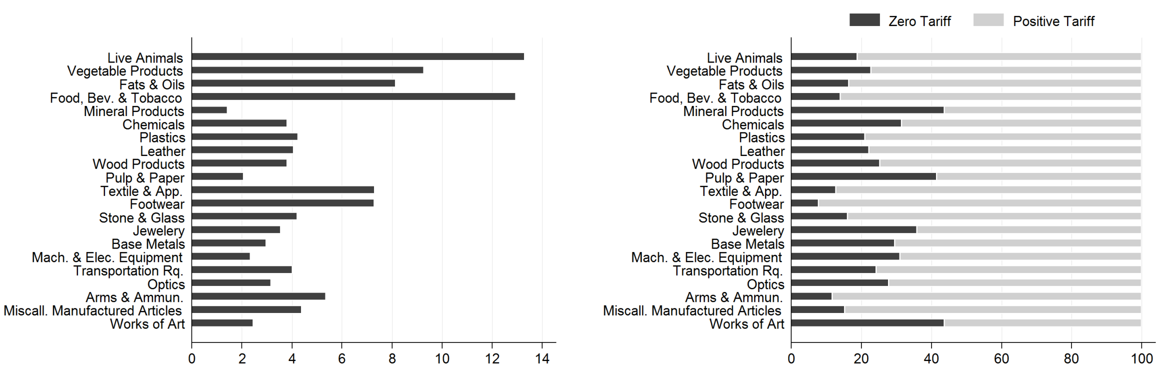
Note: We use the UN definition to determine the development status of a country. Developed countries are Australia, Canada, the member countries of EFTA and the European Union, Japan, New Zealand, and the US. All others belong to the group of developing countries. We show unweighted averages as defined in the text. We define as preferential tariffs all tariffs between two countries covered by an RTA that are strictly below the MFN tariff.

Let $\tilde{t}_d = (NK)^{-1} \sum_i \sum_k \tilde{t}_{ikd}$ be the unweighted average (across importers and products) MFN tariff. Figure A2(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. Since 1996 the preferential tariffs (see Figure A2(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.[57]

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 A3(a) shows the average preference margin by HS-section.[58] 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.

Figure A3: 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.

Products with MFN tariffs equal to zero are not affected by RoOs. So, there is no scope for

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

[58] 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.

trade deflection. The probability of zero MFN tariffs differs across industries. Figure A3(b) shows the share of zero MFN tariffs by section. In 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.

B Estimation of Transportation Costs

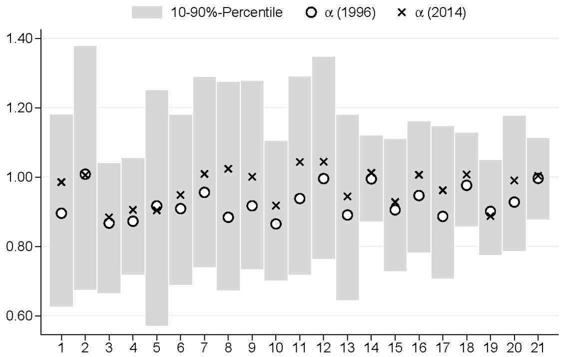
In this section, we give some background information on the estimation of transportation costs. We assume transportation costs to be a function of distance D_{ij} such that $\tau_{ij}^k = \alpha^k \left(D_{ij}\right)^{\delta^k}$ with $\delta^k \in (0,1)$. Thus, it is possible to estimate the parameters 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, $D_{US,i}$. Information on bilateral distances comes from CEPII. Taking logs makes OLS a feasible estimator. The regression equation equals $ln(\tau_{US,i}^k) = ln(\alpha^k) + \delta^k ln(D_{US,i}) + u^k$. We regress the cif/fob ratios on the bilateral distance for every product separately to allow for product-specific constants. One can interpret the estimated coefficients as follows: $\hat{\alpha}^k$ is the product-specific component that does not vary across pairs, $\hat{\delta}^k$ represents the component that is pair-specific. For example, perishable freight like vegetables will be more sensitive to the pair-specific bilateral distance than other goods.

Figure A4 Panel (a) shows the distribution of $\hat{\alpha}^k$, while Panel (b) focuses on the distribution of $\hat{\delta}^k$, with $k = 1, ..., 4,215$. We group the coefficients by sections. The figures show the range of the values (excluding the top and bottom 10%) and the mean for 1996 as well as 2014. There is large variation within as well as across sections. For example, while $\hat{\alpha}^k$ and $\hat{\delta}^k$ are relatively wide spread in sections 1, 2, 5, and 12 , the opposite is true for sections 4, 14, 18, 19, and 21. $\hat{\alpha}^k$ equals on average 0.956 and has a standard deviation of 0.228. The mean of $\hat{\delta}^k$ is 0.016 and the standard deviation equals 0.251.

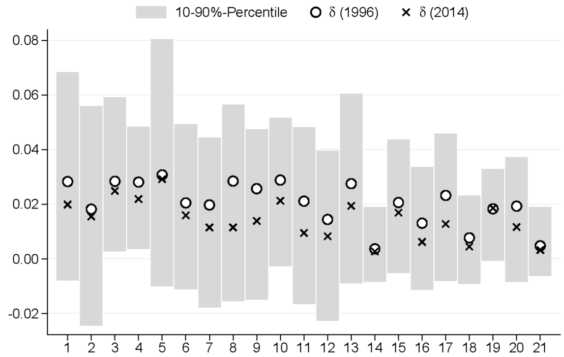
For $\hat{\tau}_{ijkd}$ to be sensible, i.e. $\hat{\tau}_{ijkd} \geq 1$, it must hold that $\hat{\alpha}^k < 1 \iff \hat{\delta}^k > 0$ and $\hat{\alpha}^k > 1 \iff \hat{\delta}^k < 0$. The economic interpretation is straightforward: whenever the product-specific (bilateral) component of transportation costs essentially does not matter, the transportation costs are entirely determined by bilateral (product-specific) characteristics. Therefore, if we had

Figure A4: Descriptive Facts about the estimated Transportation Costs

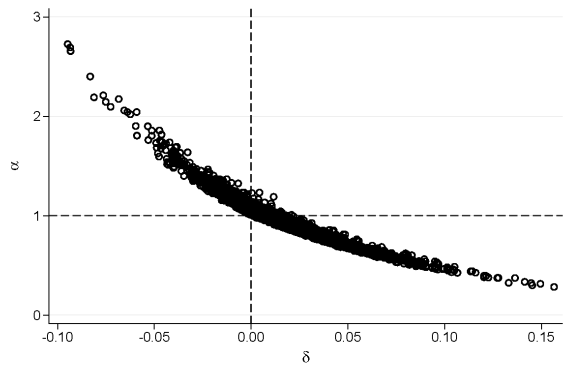
(a) Distribution of $\hat{\alpha}^k$



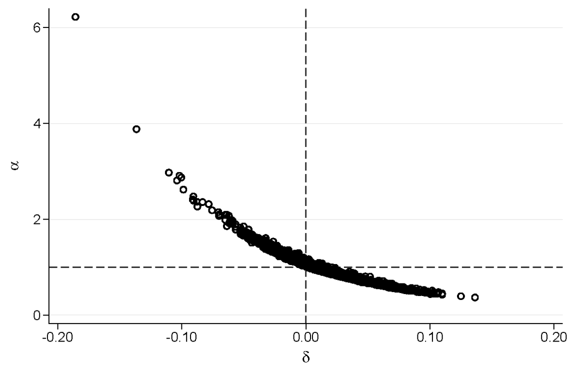
(b) Distribution of $\hat{\delta}^k$



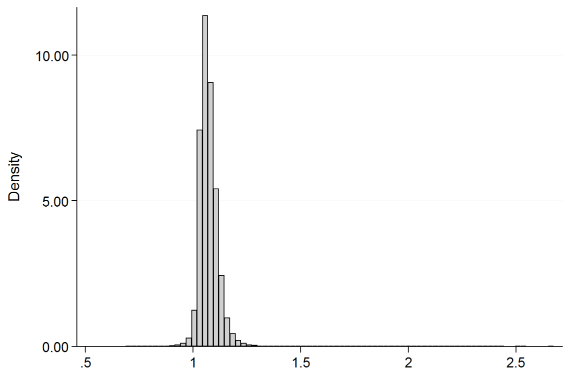
(c) Relationship between $\hat{\alpha}^k$ and $\hat{\delta}^k$ - 1996



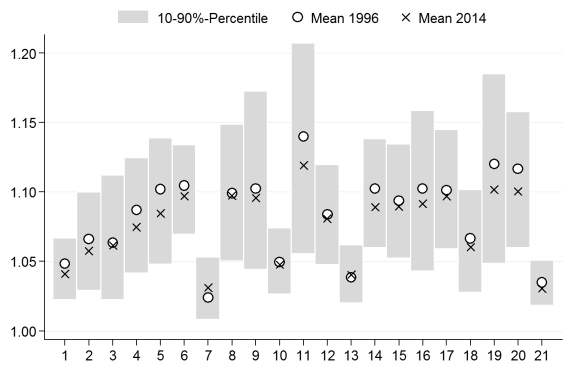
(d) Relationship between $\hat{\alpha}^k$ and $\hat{\delta}^k$ - 2014



(e) Distribution of estimated Transportation Costs $\hat{\tau}$ (2014)



(f) Transportation Costs $\hat{\tau}$ by Sections



Note: Panel (a) and (b) show the distribution of the $\hat{\alpha}^k$ and $\hat{\delta}^k$. The two coefficients result from estimating the following equation $ln(\tau^k_{US,i}) = ln(\alpha^k) + \delta^k ln(D_{US,i}) + u^k$, $\forall k$. Panel (c) and (d) show the relationship between the two coefficients of interest for 1996 and 2014. Panel (e) shows the estimated transportation costs for every product-pair combination for the year 2014. Panel (f) shows the estimated transportation costs across different sections.

many $\hat{\alpha}^k - \hat{\delta}^k$ combinations where these conditions are violated, we would end up with many unreasonable $\hat{\tau}_{ijkd}$'s. Panel (c) and (d) shows the relationship between $\hat{\alpha}^k$ and $\hat{\delta}^k$ for 1996 and

2014. A clear negative correlation between the two coefficients is apparent ($\rho = -0.96$). Further, there is not a single case where the pair of coefficients lies in the "critical" quadrant, i.e. with $\hat{\delta}^k < 0$ and $\hat{\alpha}^k < 1$.

Panel (e) shows the distribution of the estimated transportation costs for 2014. The values concentrate around 1.07, with most of the values laying below 1.25. As Panel (f) shows there is large heterogeneity across products in the transportation costs: while plastics belonging to the sections Plastics, Pulp and Paper, Stone and Glass, and Works of Art have transportation costs below the average, the opposite is true for Textiles and Arms & Ammunition.

C 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.

D Additional Descriptive Evidence

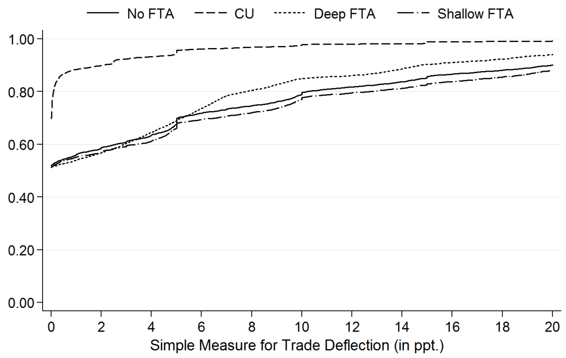
Table A3: Correlation between Prices and Tariffs

	Price Exports	Price Imports	Tariff (simple)	Tariff (weighted)	MFN (simple)	Pref. (simple)	MFN (weighted)	Pref. (weighted)
Price Exports	1							
Price Imports	0.116	1						
Tariff (simple)	−0.337***	−0.186*	1					
Tariff (weighted)	−0.318***	−0.263**	0.888***	1				
MFN (simple)	−0.248**	−0.164	0.963***	0.838***	1			
Pref. (simple)	−0.336***	−0.133	0.838***	0.818***	0.790***	1		
MFN (weighted)	−0.265**	−0.354***	0.890***	0.907***	0.901***	0.752***	1	
Pref. (weighted)	−0.369***	−0.0934	0.675***	0.698***	0.638***	0.860***	0.620***	1

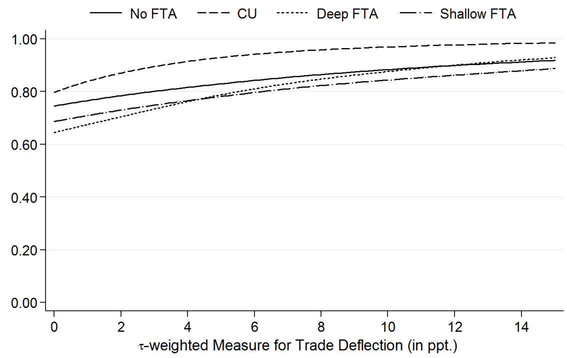
Note: The table shows correlations between tariff levels and relative prices of exports and imports, respectively. The data for the prices stem from (Feenstra et al. 2015). For the tariffs we use simple and trade-weighted means. *Tariff* is the effectively applied tariff, *MFN* the MFN-tariff and *Pref* the average over all preferential tariffs. We have data on prices for 121 out of the 125 countries in our sample, Cuba, Guyana, Papua New Guinea, and Solomon Islands are missing. ***/**/* Indicate significance at the 1%/5%/10% level.

Figure A5: C.D.F.s of Measures of Scope for Trade Deflection, 1996

(a) C.D.F. of Δt_{ijk} by Type of RTA



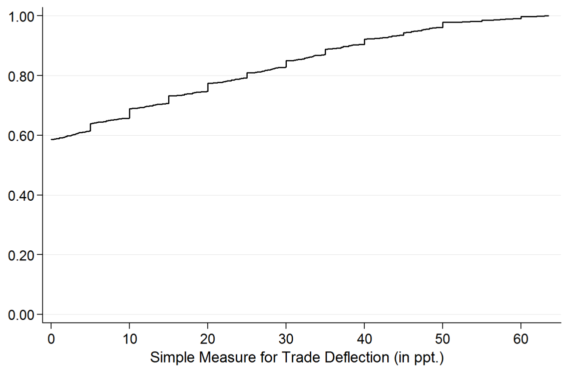
(b) C.D.F. of ΔT_{ijk} by type of RTA



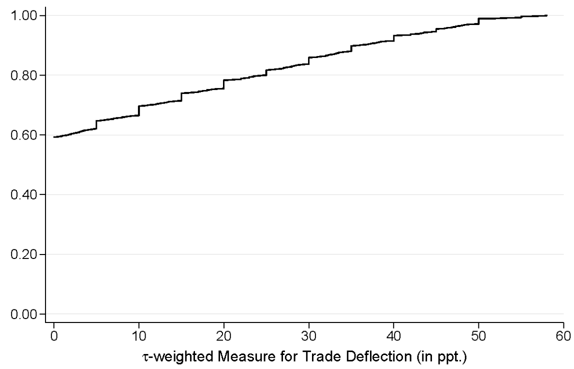
Note: Δt_{ijk} and ΔT_{ijk} are defined in Section 2.2. Panel (a): truncated to values ≤ 16, Panel (b): truncated to values ≤ 12. The information on the type of the RTA stems from DESTA (Dür et al. 2014). We show data for 1996.

Figure A6: C.D.F.s of Measures of Scope for Trade Deflection: Bound MFN Tariffs

(a) Simple Measure for Trade Deflection Δt^B_{ijk}

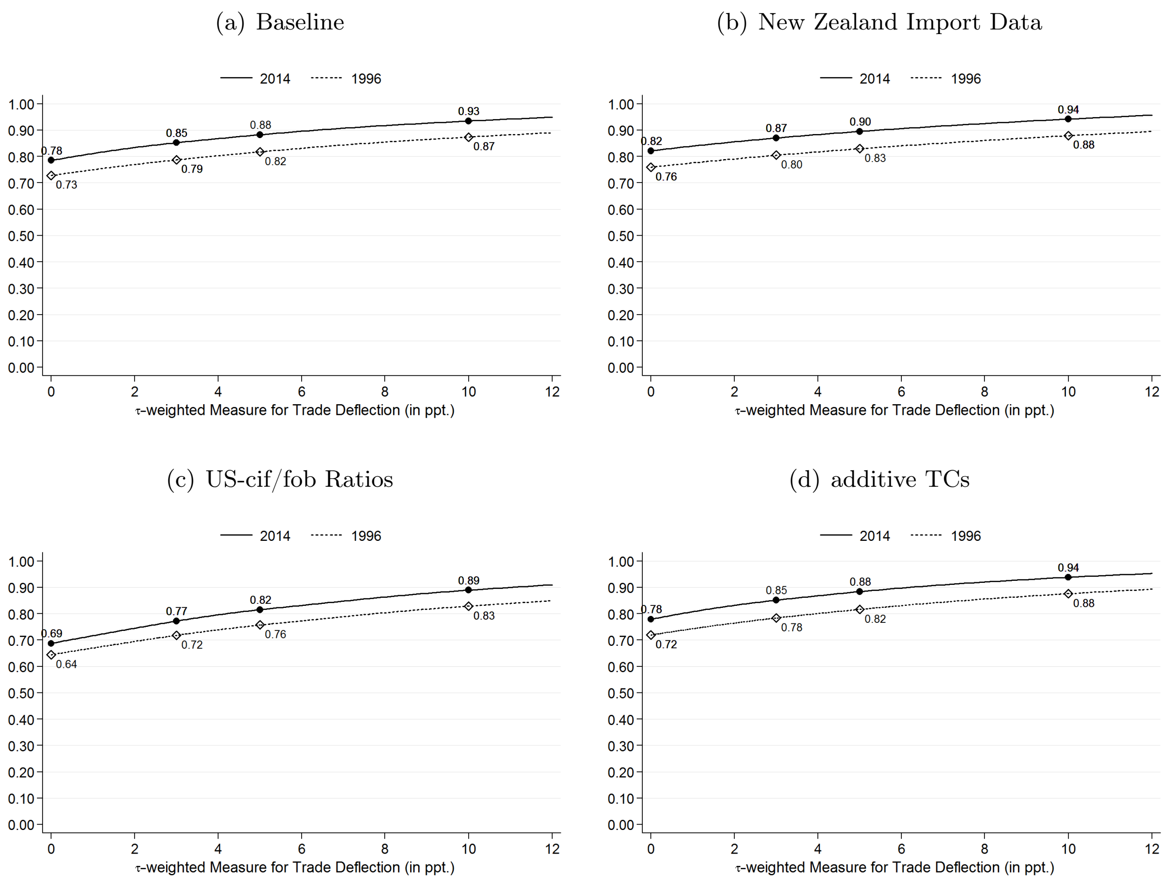


(b) $\tau-$Weighted Measure for Trade Deflection ΔT^B_{ijk}



Note: Δt^B_{ijk} and ΔT^B_{ijk} are defined as the baseline measures (see Section 2.2) but instead of the applied tariff we use the bound MFN tariff that country i imposes for product k. Bound MFN tariffs do not vary over time.

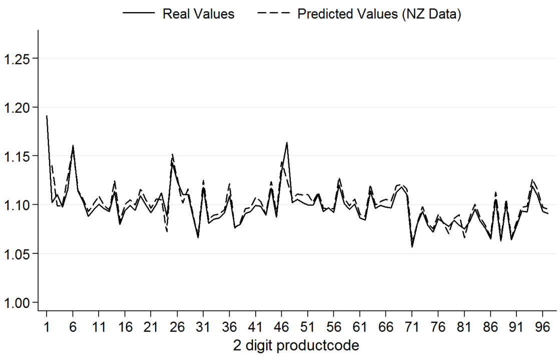
Figure A7: C.D.F.s of Measures of Scope for Trade Deflection: Alternative Proxies for Transportation Costs, 2014



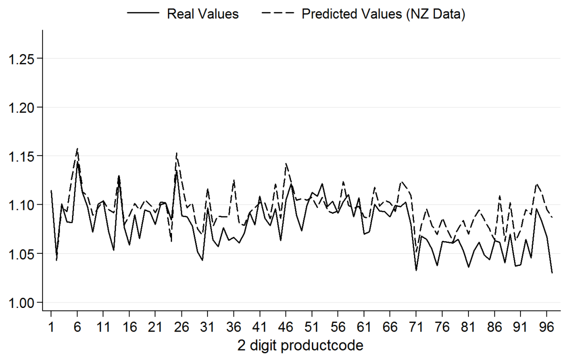
Note: Δt_{ijk} and ΔT_{ijk} are defined in Section 2.2. Panel (a) shows the baseline way of constructing the transportation costs, in Panel (b) we use the import data of New Zealand in order to predict the transportation costs. Panel (c) uses the observed US cif/fob-ratios as a proxy for all other product-pair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

Figure A8: Predicting Transportation Costs using Import Data from New Zealand

(a) In-Sample Prediction: New Zealand



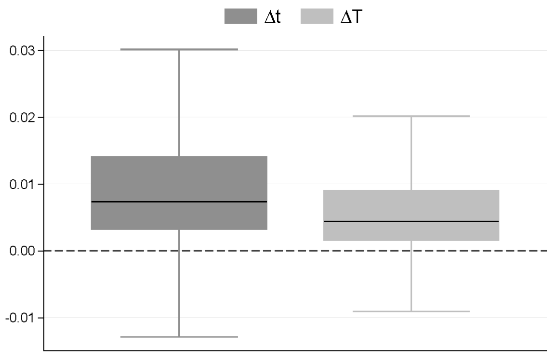
(b) Out-of-Sample Prediction: USA



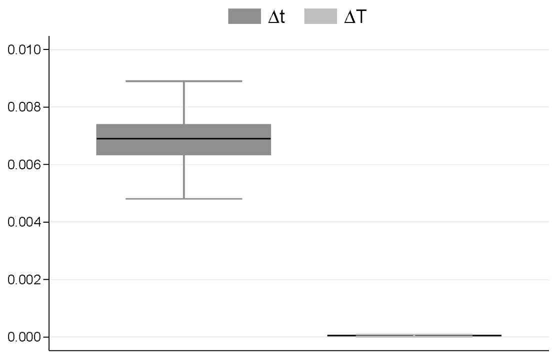
Note: The graphs shows the observed cif/fob ratios and the predicted values for New Zealand (a) $\hat{\tau}_{NZ,j} = exp(ln(\hat{\alpha}) + \hat{\delta} ln(D_{NZ,j}))$ and the United States (b) $\hat{\tau}_{US,j} = exp(ln(\hat{\alpha}) + \hat{\delta} ln(D_{US,j}))$. We aggregate by taking the arithmetic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

Figure A9: 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 measures of trade deflection $\Delta t_{ijk,c}$ and $\Delta T_{ijk,c}$ and the aggregated measure Δt_{ijk} and ΔT_{ijk}, respectively. 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_0^k and the slope-coefficients δ_1^k for all 4,215 products k.

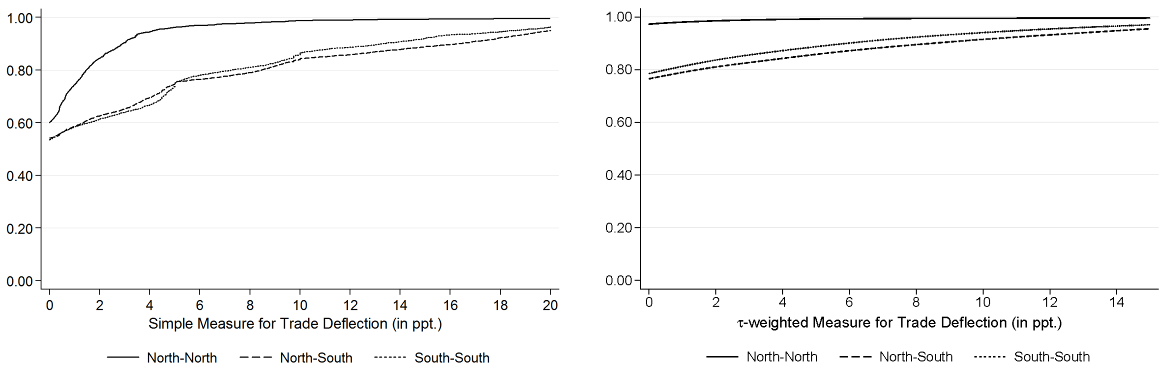
Table A4: Heterogeneity across Regions and Types of RTAs: Conditional C.D.F.s $P(\Delta t_{ijk}) \leq c)$ and $P(\Delta T_{ijk}) \leq c)$ for 1996

	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	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 measures for trade deflection 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 measure Δt_{ijk} in column (1)-(6), and when accounting for transportation costs ΔT_{ijk} in column (7)-(12). Panel (a) shows the distribution of the measures for trade deflection 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 A10: C.D.F.s of Measures of Scope for Trade Deflection: by Regions, 2014

(a) Absolute Difference Δt_{ijk} in External Tariffs (b) Trade Costs vs. Differences in Ext. Tariffs ΔT_{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.

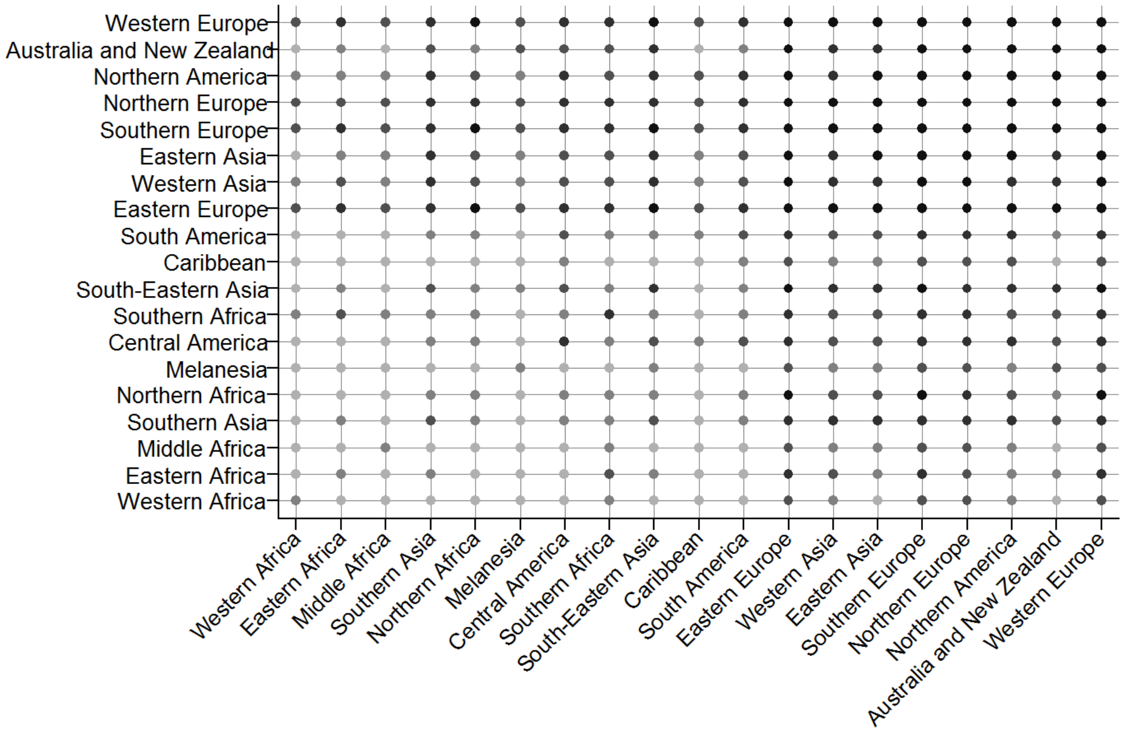
E Additional Results and Robustness Checks

Table A5: The Role of RoOs

Dep. Variable	Δt				ΔT			
	PCS (1)	**PCS** (2)	**FD** (3)	**FD** (4)	**PCS** (5)	**PCS** (6)	**FD** (7)	**FD** (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)
Facil. Index		-1.277^{***}		0.083^{***}		-0.553^{***}		0.002
		(0.032)		(0.032)		(0.029)		(0.029)
R^2	0.044	0.046	0.953	0.953	0.040	0.040	0.951	0.951

Note: Two-way clustered (country-pairs and products) standard errors in parentheses. ***/**/* Indicate significance at the 1%/5%/10% level. The facilitation index stems from Estevadeordal and Suominen (2006). *PCS:* In columns (1), (3), (5), and (7) we show the results for the pooled cross-section (1996 and 2014) including product-year fixed-effects. The number of observations equals 69,033,736. *FD:* Columns (2), (4), (6), and (8) show the results when estimating a fully saturated model by estimating in first-differences and adding importer-product and exporter-product fixed-effects. The number of observations equals 34,516,868.

Figure A11: Availability of Information on the Standard Deviation within 6-Digit Products, 2014



Note: The standard deviation within 6-digit products is not available for all country-pairs. The graph shows how the sample changes compared to the baseline. The darker the dots the higher the share of available data. Particularly data from less developed countries (i.e. Africa and South-East Asia) are more often missing. The data are for the year 2014. Information on the standard deviation stems from the IDB (WITS).

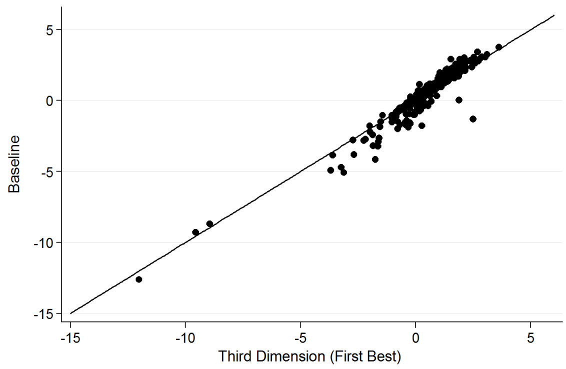
Table A6: Sensitivity Checks: Alternative Sample Specifications

	3 Year Averages (1996-98 vs. 2012-14)				**Yearly Data**				**No Missing Data**			
Dep. Variable	Δt **PCS**	Δt **FD**	ΔT **PCS**	ΔT **FD**	Δt	Δt	ΔT	ΔT	Δt **PCS**	Δt **FD**	ΔT **PCS**	ΔT **FD**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
FTA	0.441***	0.331***	0.679***	0.240***	−0.338***	0.201***	0.306***	0.111***	0.634***	−0.064	0.696***	0.014
	(0.100)	(0.065)	(0.080)	(0.060)	(0.083)	(0.024)	(0.065)	(0.022)	(0.204)	(0.109)	(0.152)	(0.107)
Deep FTA	−1.322***	−0.514***	−0.798***	−0.510***	−0.404***	−0.118***	−0.010	−0.146***	−1.460***	−0.588***	−0.969***	−0.539***
	(0.123)	(0.053)	(0.085)	(0.053)	(0.146)	(0.024)	(0.114)	(0.023)	(0.185)	(0.086)	(0.128)	(0.090)
Customs Union	−4.705***	−3.051***	−2.130***	−2.023***	−3.879***	−2.915***	−1.526***	−1.896***	−4.748***	−3.268***	−2.301***	−2.083***
	(0.099)	(0.118)	(0.086)	(0.106)	(0.091)	(0.071)	(0.083)	(0.064)	(0.186)	(0.135)	(0.144)	(0.125)
R^2	0.04	0.94	0.03	0.93	0.04	0.99	0.03	0.99	0.06	0.95	0.04	0.95
N (in Mio.)	130.65	65.33	130.65	65.33	66.76	66.76	66.76	66.76	33.71	16.85	33.71	16.85

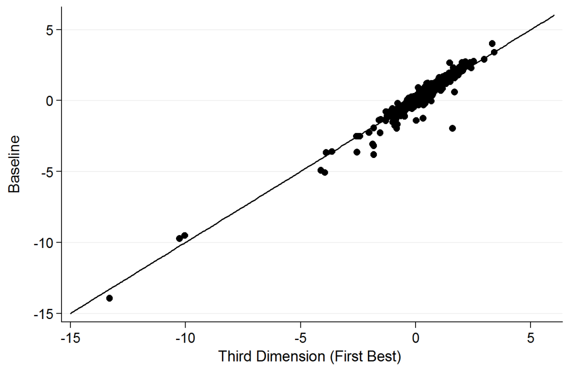
Note: Twoway clustered (country-pairs and products) standard errors in parentheses. ***/**/* Indicate significance at the 1%/5%/10% level. In column (1) to (4) instead of using only 1996 and 2014 we use the average of the years 1996-98 and 2012-14. In column (5) to (8) we use yearly data. To keep things tractable we only use a 5% sample. For the remainder i.e. column (9) to (12) we only use data that has not been imputed. *PSC:* In columns (1), (3), (9), and (11) we show the results for the pooled cross-section (1996 and 2015) including product-year fixed-effects. *FD:* Columns (2), (4), (10), and (12) show the results when estimating a fully saturated model by estimating in first-differences and adding importer-product and exporter-product fixed-effects.

Figure A12: Comparison of the Baseline Results Δt_{ijk} and ΔT_{ijk} with the First Best Solution $\Delta t_{ijk,c}$ and $\Delta T_{ijk,c}$

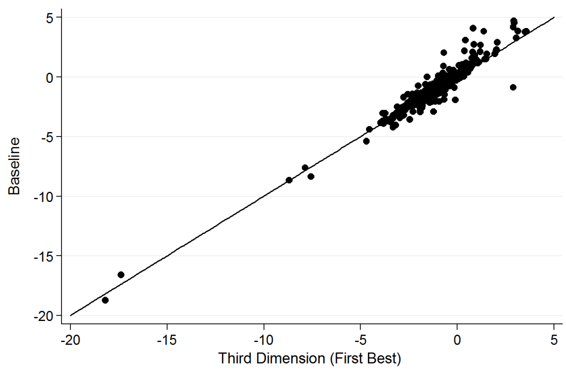
(a) Simple Measure for TD Δt_{ijk}: Shallow FTA



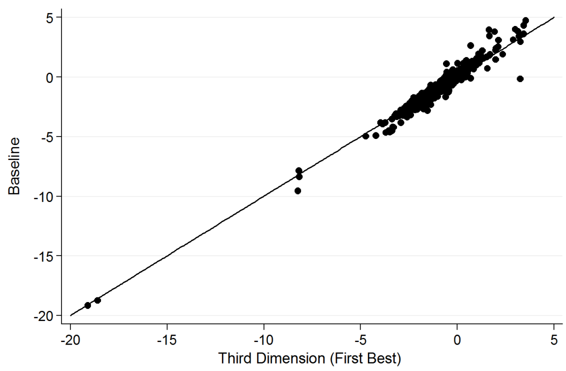
(b) τ-Weighted Measure for TD ΔT_{ijk}: Shallow FTA



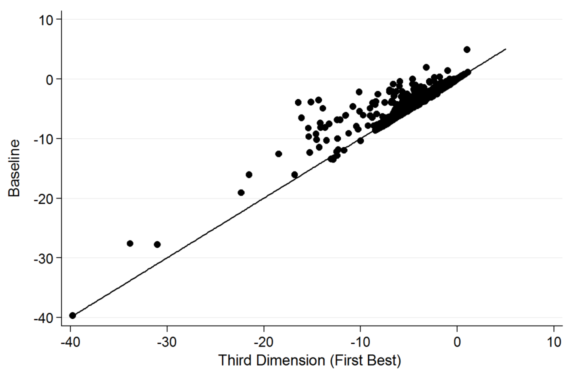
(c) Simple Measure for TD Δt_{ijk}: Deep FTA



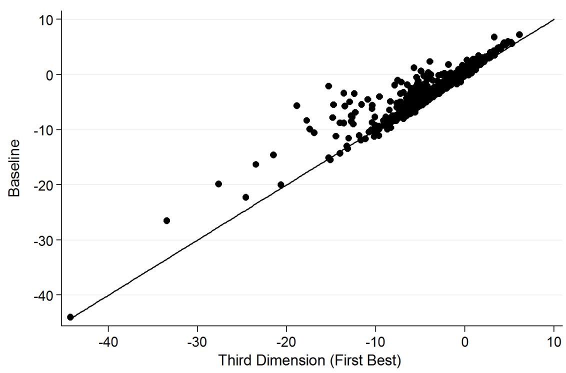
(d) τ-Weighted Measure for TD ΔT_{ijk}: Deep FTA



(e) Simple Measure for TD Δt_{ijk}: CU



(f) τ-Weighted Measure for TD ΔT_{ijk}: CU



Note: To evaluate the aggregation bias we compare in this graph our baseline measures Δt_{ijk} and ΔT_{ijk} with the first best $\Delta t_{ijk,c}$ and $\Delta T_{ijk,c}$, respectively, where country i, country j, third country c, and product k. 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.

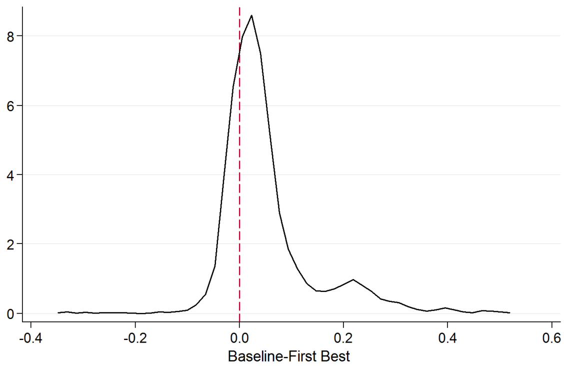
Table A7: Comparison of the Sign of the Baseline Results Δt_{ijk} and ΔT_{ijk} with the First Best Solution $\Delta t_{ijk,c}$ and $\Delta T_{ijk,c}$

Dep. Variable	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

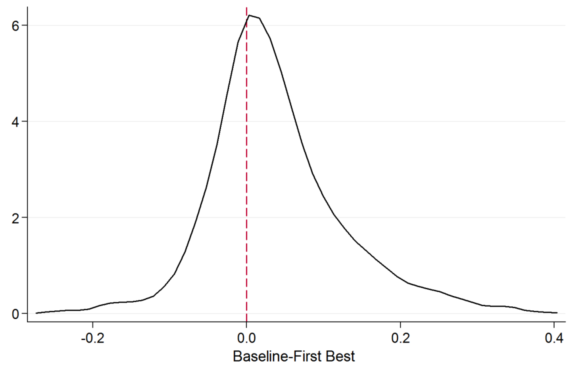
Note: The table shows the shares of all products k for which the baseline results Δt_{ijk} and ΔT_{ijk} and the first best solution $\Delta t_{ijk,c}$ and $\Delta T_{ijk,c}$ yield coefficients with the same sign (column (1) and (3)); in column (2) and (4) only significant coefficients are included.

Figure A13: Density Function of the Difference between the Baseline Δt_{ijk} and ΔT_{ijk} and the First Best Solution $\Delta t_{ijk,c}$ and $\Delta T_{ijk,c}$

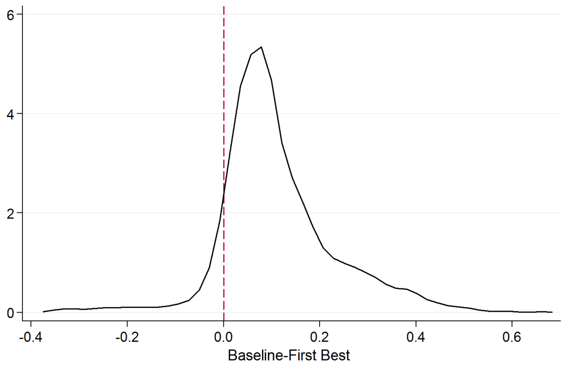
(a) Simple Measure for TD Δt_{ijk}: Shallow FTA



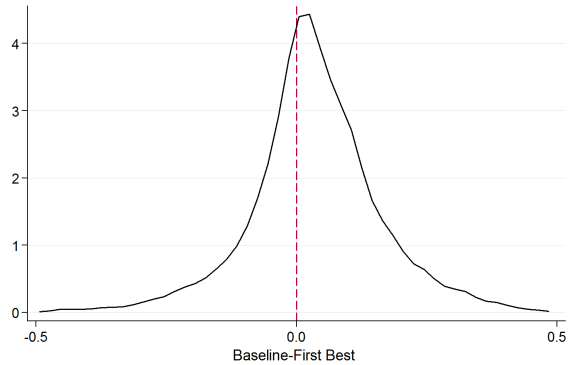
(b) τ-Weighted Measure for TD ΔT_{ijk}: Shallow FTA



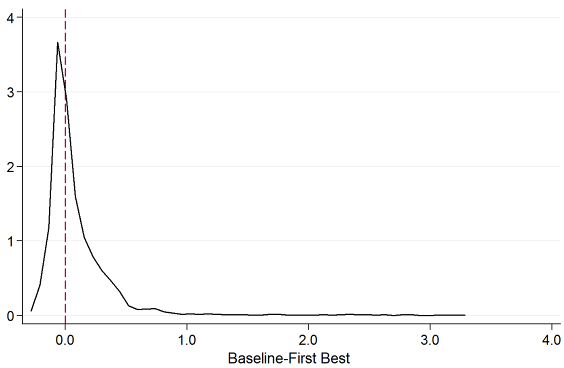
(c) Simple Measure for TD Δt_{ijk}: Deep FTA



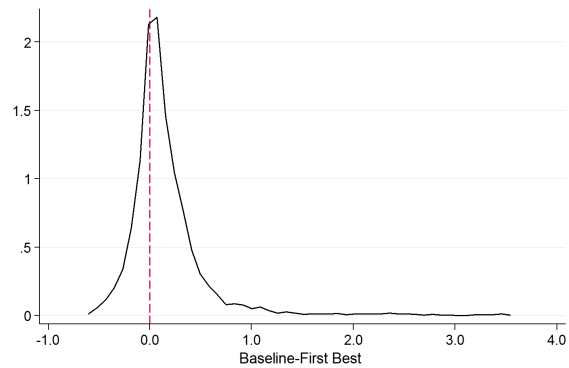
(d) τ-Weighted Measure for TD ΔT_{ijk}: Deep FTA



(e) Simple Measure for TD Δt_{ijk}: CU



(f) τ-Weighted Measure for TD ΔT_{ijk}: CU



Note: To evaluate the aggregation bias we compare in this graph our baseline measures Δt_{ijk} and ΔT_{ijk} with the first best $\Delta t_{ijk,c}$ and $\Delta T_{ijk,c}$, respectively, where country i, country j, third country c, and product k. 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 of the 0-line indicate that the aggregated measure overstates/understates the real ones.

Table A8: Different Measure for FTAs, 2014

Dep. Variable	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	-0.027^{***}	-0.017^{***}	-0.027^{***}
	(0.014)	(0.005)	(0.003)	(0.005)	(0.009)	(0.004)	(0.002)	(0.003)
mean(Depth)	1.66	2.52	4.36	2.37	1.66	2.52	4.36	2.37
Marginal Effect(Depth)	-0.12	-0.18	-0.17	-0.17	-0.01	-0.07	-0.08	-0.06
R^2	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
N (in Mio.)	61.10	60.73	60.73	60.73	61.10	60.73	60.73	60.73

Note: Two-way clustered (country-pairs and products) standard errors in parentheses. ***/**/* Indicate significance at the 1%/5%/10% level. All specifications report the results for the cross-section (2014) including product fixed-effects. The number of observations varies due to differences in terms of the presence of a CU between DESTA (Dür et al. 2014) and the GPTAD (Hofmann et al. 2017).