



Full length articles

Rules of origin and the profitability of trade deflection[☆]Gabriel Felbermayr^{a,d,*}, Feodora Teti^b, Erdal Yalcin^c^a Kiel Institute for the World Economy - IfW, Kiellinie 66, 24105 Kiel, Germany^b ifo Institute – Leibniz Institute for Economic Research at the University of Munich, Poschinger Str. 5, 81679 Munich, Germany^c Konstanz University of Applied Sciences, Alfred-Wachtel-Str. 8, 78462 Konstanz, Germany^d Christian Albrechts University Kiel, CESifo, GEP, Germany

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ABSTRACT

When a country grants preferential tariffs to another, either reciprocally in a free trade agreement (FTA) or unilaterally, rules of origin (RoOs) are defined to determine whether a product is eligible for preferential treatment. RoOs exist to avoid that exports from third countries enter 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 all bilateral product-level comparisons within FTAs, trade deflection is not profitable because external tariffs are rather similar and transportation costs are non-negligible; in the case of unilateral trade preferences extended by rich countries to poor ones that ratio is a striking 98%. The pervasive and unconditional use of RoOs is, therefore, hard to rationalize.

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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 9% of all trade agreements signed since 1945 are CUs (Dür et al., 2014).

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

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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 are unilateral i.e. non-reciprocal trade preferences.

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., 2018; Krishna and Krueger, 1995). They reduce preference utilization rates (PURs) to less than 100%, sometimes substantially so (Keck and Lendle, 2012). RoOs are, therefore, the unsavory sauce to Bhagwati's (1995) spaghetti bowl of bilateral trade agreements. According to advocates of RoOs, without them 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.

Similarly, RoOs are also imposed on exporters from developing countries benefiting from unilateral tariff preferences granted by rich countries under preference schemes like the Generalized System of Preferences (GSPs). By burdening poor countries with red tape, they have the effect of counteracting the trade-creating effects; in some of the arrangements PURs are as low as 66% (Keck and Lendle, 2012).

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 trade agreement (which may be questioned *per se* on other grounds).

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 fact that, to the best of our knowledge, has been overlooked so far: for most country-pairs in FTAs, trade deflection is unprofitable. The reason for this is that tariffs are generally low, countries in a common FTA tend to have similar external tariff levels, and when tariff levels differ, deflection is profitable at most for one country in the pair. When preferences are granted unilaterally by a rich country to a poor one, trade deflection is almost never profitable by design: the poor countries maintain their (often high) external tariffs *erga omnes* so that goods from third countries can rarely be profitably transshipped through them to the rich country or through the rich country to them.

The upshot is that FTAs or GSP arrangements 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).

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 clearly 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 classification, 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 food product falling under HS heading 19.01 ("Malt Extract"): "*A change from any other heading, provided that: (a) the net weight of non-originating material of heading 10.06 or 11.01 through 11.08 used in production does not exceed 20 per*

cent of the net weight of the product, (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 with potentially different and conflicting RoOs.⁴

In the recent revision of the North American Free Trade Agreement (NAFTA) between Canada, Mexico, and the United States, a lot of political capital was invested into tightening RoOs, in particular for autos. By requiring the minimum share of regional value added to increase from 62.5% to 75%, the new agreement squeezes out third country input suppliers with the objective to protect domestic suppliers.

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. Exporters 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 (2018) 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 to 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 de 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. (2018) show that in the absence of RoOs, Mexican imports of intermediates from third countries relative to NAFTA partners would have been 45% higher. Further, firm-level evidence suggests heterogeneity across firms as mostly larger firms actually comply with the RoOs while smaller firms have difficulties doing so (Cadot et al., 2014; Demidova et al., 2012). Firm surveys show that RoOs hinder firms use of FTA preferences (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.

⁴ To be fair, there have been numerous attempts towards simplifying RoOs-regimes, e.g., by allowing for various ways of cumulation. However, the general necessity of RoOs is rarely questioned 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.

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).

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

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.

Section 2 of the present paper presents the simple analytical conditions under which trade deflection is profitable. This analysis guides our empirical analysis. Section 3 presents the data. Besides tariff data and information about trade agreements we also need bilateral transportation costs. In this section, 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. For countries in the same FTA, in 29% of all country-pair×product×third-country combinations for the year 2014, countries set identical external tariffs. Trade deflection means taking advantage of arbitrage possibilities. Therefore, by definition trade deflection could be profitable for one of the members of a pair, while for the other it cannot be profitable; this is the case for 38% of candidate cases. For 4% of all cases, external tariffs are different but the preferential tariff between ij is still high so that deflection is not profitable. So, in only 29% of all cases, the tariff situation could make trade deflection profitable if there were no transportation costs. In 16% of all cases, the tariff savings are smaller than additional transportation costs. Hence, in sum, for fully 86% of all cases, in FTAs, trade deflection is not profitable.

In non-reciprocal preferential trade arrangements (GSP), only in 7% of all cases are tariffs such that trade deflection could work in the absence of transportation costs. Factoring in the latter, the fraction falls to a mere 2%. Note that these numbers are conservative because we consider only transportation costs, disregarding other trade costs such as those related to writing and enforcing contracts, exchange rate risk, management costs, and so on.

Our analysis suggests that, in a large number of cases, there is no economic rationale for RoOs. Section 5 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 should agree on a full set of RoOs for all products, but that the requirement to prove origin be activated only if external tariffs of FTA members differ by some minimum amount. In the case of non-reciprocal preferential trade arrangements (GSP), RoOs should be activated only for those products where the beneficiary country undercuts the MFN tariffs of the preference granting country. 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 $i = 1, \dots, N$, and an exporting country $c = 1, \dots, N$. Denote the ad valorem tariff applicable on a good $k = 1, \dots, K$ in factor form by $t_{ick} \geq 1$ (so that $(t_{ick} - 1) \times 100\%$ is the ad valorem tariff in percent). When useful, we distinguish between preferential tariffs t_{ick}^* and MFN tariffs $\tilde{t}_{ick} = \tilde{t}_{ijk}$ for all c not subject to preferential tariffs.

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 . For now we assume that countries i and j do not have an FTA with third countries c .

This constellation opens the possibility for trade deflection if $t_{ick} \neq t_{jck}$.⁷ 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. Such a document testifies that, to be eligible for tariff-free trade from j to i , the good actually originates from country j and not from some third country c .

Generally, whenever $t_{ick} \neq t_{jck}$, in the absence of transportation costs, 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-trade agreement transactions, exporters are legally required to document that their products satisfy the RoOs.

Let there be a fixed cost f_k of 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.⁸ The tariff applicable to a transaction between i and j will be $\tilde{t}_{ijk}$ instead of t_{ijk}^* whenever the preference margin $\tilde{t}_{ijk} - t_{ijk}^*$ 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 trade agreement make use of preferential tariffs but some apparently prefer to remain subject to the MFN tariff. RoOs can therefore act as de-facto trade barriers and diminish the value of trade agreements, in particular for smaller firms. When they distort the sourcing decision of firms they also have direct implications for third countries because they exacerbate the discrimination inherent in any preferential trade agreement. Conconi et al. (2018) present an excellent recent empirical investigation of NAFTA, which provides clear evidence of this point.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, $\tau_{ijk} < \tau_{ick}\tau_{jck}$, where $c \neq i, j$ is any third country. Also, for simplicity, assume a market structure (perfect competition, or monopolistic competition with CES preferences) such that consumers bear all trade costs. Then, the delivery price p_{ick} in country i of a good k produced in country c will be $p_{ick} = p_{ck}^0 t_{ick} \tau_{ick}$ where p_{ck}^0 is the factory gate price of good k . Similarly, its price in country j would be equal to $p_{jck} = p_{ck}^0 t_{jck} \tau_{jck}$. 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

$$p_{ck}^0 t_{ick} \tau_{ick} > p_{ck}^0 t_{ijk} \tau_{ijk} t_{jck} \tau_{jck} \quad (1)$$

Now, let us assume that i and j have an FTA so that $t_{ijk} = t_{ijk}^*$, but elsewhere MFN tariffs apply, assuming for simplicity for now that country i and j do not have an FTA with country c . We will relax this assumption later on. Then, there are arbitrage possibilities if and only if

$$1 > \frac{\tau_{ick}}{\tau_{ijk}\tau_{jck}} > \frac{t_{ijk}^* \tilde{t}_{jck}}{\tilde{t}_{ick}}$$

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 through j to i will never be profitable. In the case of an FTA with $t_{ijk}^* = 1$,

⁷ 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)).

⁸ RoOs may also affect variable costs by incentivizing firms to switch to more costly suppliers.

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

trade deflection is profitable if and only if

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

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

So far, we have restricted our analysis to a world where the third country c does not have an FTA with either of the two countries i and j . However, reality is more complicated. For example while the United States and Mexico may have the US-Mexico-Canada Agreement (USMCA, formerly NAFTA) in place, both Mexico and Canada have FTAs with the European Union, too. When we also allow for FTAs with third countries c it is not enough to focus only on MFN tariffs. Even though countries i and j might have the same MFN tariff ($\tilde{t}_{ik} = \tilde{t}_{jk}$) it could still be possible that country c and j have an FTA, leading to $\tilde{t}_{ik} > t_{jck}^*$. If this were the case and proof of origin were not required, trade deflection would be profitable even though the MFN tariffs are the same. Thus, ignoring the preferential tariffs will understate the real potential for trade deflection. Furthermore, because of phasing-in the tariffs between FTA members might not always be zero, i.e. $t_{ijk} > 1$. Therefore, the inequality that determines whether arbitrage is profitable or not has to be modified to

$$\frac{t_{ick}}{t_{ijk}t_{jck}} > \frac{\tau_{ijk}\tau_{jck}}{\tau_{ick}} > 0 \quad (2)$$

where t_{ick} equals to the effectively applied tariff that country i imposes against country c for good k . This tariff equals the MFN tariff, unless an FTA is in effect, and then t_{ijk} is the preferential tariff that country i imposes against country j .

Proof of origin is not only required in reciprocal FTAs but also in non-reciprocal preferential trade arrangements such as GSPs, which is the most prominent example for these types of arrangements.¹¹ The missing reciprocity in GSPs is the main difference between the two types of trade agreements: instead of bilateral tariff concessions, only one country, typically a developed country, offers preferential access, while the other country keeps imposing MFN tariffs. To determine the profitability of trade deflection and thus the economic justification of RoOs the same reasoning as above applies, i.e. trade deflection is only profitable if Eq. (2) is fulfilled. In our empirical analysis we will focus on both types of trade agreements, FTAs and GSPs.

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 country c for product k , we define the transportation-cost augmented difference in external tariffs as

$$\Delta T_{ijk,c} \equiv \max\{0, T_{ick} - T_{ick}^j\}, \text{ with } T_{ick} \equiv t_{ick}\tau_{ick} \text{ and } T_{ick}^j \equiv t_{ijk}t_{jck}\tau_{ijk}\tau_{jck} \quad (3)$$

¹⁰ We do not allow for pricing to market. In this case, factory gate prices may be specific to the destination market and $p_{ick}^* \neq p_{jck}^*$. Writing $p_{ick}^* = \mu_{ick}k_{ick}$, where μ_{ick} is a variable markup, Eq. (1) would be $\mu_{ick}k_{ick}t_{ick}\tau_{ick} > \mu_{jck}k_{jck}t_{ijk}\tau_{ijk}t_{jck}\tau_{jck}$. 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 4 in the Appendix), so that our assumption seems largely innocuous.

¹¹ Our analysis is not restricted to the General System of Preferences (GSPs) but includes all sorts of non-reciprocal preferential trade arrangements like GSP+, Everything but Arms or the African Growth and Opportunity Act. Whenever we write "GSPs" we mean the broader definition.

where T_{ick} and T_{ick}^j measure transport-cost augmented tariffs on the direct route from country c to i and on the indirect one, where the good is transhipped 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, (3) simplifies to

$$\Delta t_{ijk,c} = \max\{0, t_{ick} - t_{ick}^j\}, \text{ with } t_{ick}^j \equiv t_{ijk}t_{jck}, \quad (4)$$

where the costs of servicing market i with a product from c through j , t_{ick}^j , is the product of country j 's tariff on good k from c , t_{jck} , and the tariff that country i applies on good k from country j , t_{ijk} . Note that t_{ijk} does not have to be necessarily equal to 1 as tariffs in FTAs and GSPs are often being phased-in or remain larger than zero on certain products. In some parts of our analysis, we work with this "simple" measure, because it characterizes a useful necessary condition for the profitability of trade deflection.¹³

The goal of this paper is to measure the potential for trade deflection in FTAs and GSPs. Therefore, we are only interested in those cases where the preferential tariff that country i imposes against country j is less than i 's MFN tariff since otherwise arbitrage is not possible. We exclude all the cases where this is violated.

Although the measures of the scope for trade deflection are very intuitive, calculation is subject to a major practical challenge. In our data, for the year 2014 we have 5729 country pairs ij , on average 2640 products k , and 170 third countries c so that the number of observations is equal to more than 2 billion per year. A meaningful analysis of data of that size runs into severe computational issues.

We deal with this problem by focusing only on the 20 most important third countries c that export product k to i .¹⁴ Although this baseline measure covers 98% of the trade for the countries in the sample i.e. for which we have information on tariffs and transportation costs and 86% of world trade, it might suffer from selection bias. A third country's exports to i might be too low to qualify as one of the 20 most important exporters because of high import tariffs t_{ick} . However, it is exactly in those cases that arbitrage is most likely to be profitable (see Eq. (2)).

To eliminate this type of bias we 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 transportation costs) between any c' and c , all shipments from c' would be profitably directed through c . We define a measure of maximum trade deflection

$$\Delta T_{ijk}^{\max} = \max_{c \neq i,j} \left[\max\{0, T_{ick} - T_{ick}^j\} \right] \quad (5)$$

and analogously $\Delta t_{ijk}^{\max}$ for $\Delta t_{ijk,c}$.

This procedure selects the third party relation with the largest scope for trade deflection, independently of actual trade flows. 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

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 Moreover, the simple measure can be directly measured in the data, while the more general measure requires the estimation of transportation costs.

¹⁴ We consider the top 20 exporters mostly for computational reasons. Moreover, the median number of exporters of a specific good to a certain destination is exactly equal to 20.

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.

As another alternative to deal with the dimensionality problem, we randomly draw 20 countries out of all third countries c . Finally, we also average over the third country dimension such that $\Delta T_{ijk}^{\text{avr}} = \frac{1}{N-2} \sum_{c \neq i, j} \max\{0, T_{ick} - T_{jck}^j\}$ and analogously for the simple measure (with transportation costs set to zero).¹⁵

3. Data

For our empirical analysis, we require data on (applied) product-level tariffs, MFN and preferential, for all country pairs. We also need information on transportation costs by product for each country pair, and on RTAs. Since we have tariff data until 2014 we will do our analysis for this year.

3.1. Tariffs

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, rich countries also do not report yearly to the WTO or the United Nations (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 for recent years.¹⁶ Therefore, to carry out our analysis, a massive investment into data cleaning and imputation is needed. More specifically, 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 (see Appendix A for details).

3.2. Transportation costs

The second key variable entering Eq. (3) 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 mention retail and wholesale distribution costs. Thus, 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, such 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 in both cif and fob terms.¹⁷ We proceed as follows: first, using US data, originally provided by the US Census and cleaned and regularly updated by Peter Schott (Schott, 2008), we measure 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 in fob and cif terms at the ten-digit HS level by exporter country and entry-port for the years 1989 until 2016. This allows constructing a US specific measure of transportation costs at the 6-digit level for every product-exporter combination. We want to minimize measurement error induced by outliers. To do so, we add four years (two years before 2014 and two years after) and then calculate the median for every exporter $\times$ product (6-digits) combination.

In a second step, we use the cif/fob ratios of the US to predict transportation costs for all other product-pair combinations. We assume transportation costs to be a function of distance D_{ij} such that $\tau_{ij}^k = \alpha^k (D_{ij})^{\delta^k}$ with $\delta^k \in (0, 1)$ so that non-tariff trade costs are an increasing, strictly concave function of geographical distance.¹⁸

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 , $D_{US, i} \geq 1$.¹⁹ 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.²⁰

Next, for every country-pair and for every product k we predict a measure of transportation cost $\hat{\tau}_{ij}^k = \exp(\hat{\alpha}^k + \hat{\delta}^k \ln(D_{ij}))$. For 2014, this procedure provides us with transportation costs for 3853 products (out of the available 4455 tariff lines). Fig. 1(a) shows the observed 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.²¹ The estimated transportation costs equal on average 6%, which squares very well the evidence cited in Anderson and Van Wincoop (2004).²²

Besides for the US, cif/fob data are also available for New Zealand.²³ We use these data to check how well the prediction based on US data performs. Fig. 1(b) shows the observed and the predicted values for New Zealand. Overall, the fit is reasonably good although the predicted

¹⁵ In the working paper version of this article, we used the averaging method as our baseline measure. However, this procedure does not put enough weight on trade links where a preferential tariff is applicable. When looking at all 170 third countries c in our sample most countries have preferential access to very few markets, and for the vast majority the MFN tariff is imposed. Therefore we believe that focusing the analysis on the 20 most important third countries c is a better way to deal with the dimensionality problem and to measure the potential for trade deflection. However, the main results are not very sensitive to this modification.

¹⁶ 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). CEPIL's MacMap (Guimbard et al., 2012) is another comparable database. However, it does not deal with missing data at all and the most recent data are only from 2007.

¹⁷ 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 on very implausible values.

¹⁸ 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 $D_{ic} = D_{ij} + D_{jc}$.

¹⁹ Information on bilateral distances comes from CEPIL.

²⁰ Following Hummels (2007), we have added the weight/value-ratios as an additional explanatory factor in the transportation cost function ($\tau_{ij}^k = \alpha^k (D_{ij})^{\delta^k} (w_i/v_i)^{\gamma}$). This approach increases the explanatory power of the regressions slightly, but it lowers the number of estimated pair-product transportation costs significantly as weight/value-ratios are available only when countries actually trade.

²¹ Alternatively, we could estimate bilateral, product specific trade costs exploiting a structural gravity model of bilateral trade using the methodology proposed by Jaks 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.

²² In Appendix B, we provide information on the distribution of estimated parameters $\hat{\alpha}^k$, $\hat{\delta}^k$ and their relation as well as a histogram of estimated $\hat{\tau}_{ij}^k$.

²³ 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.

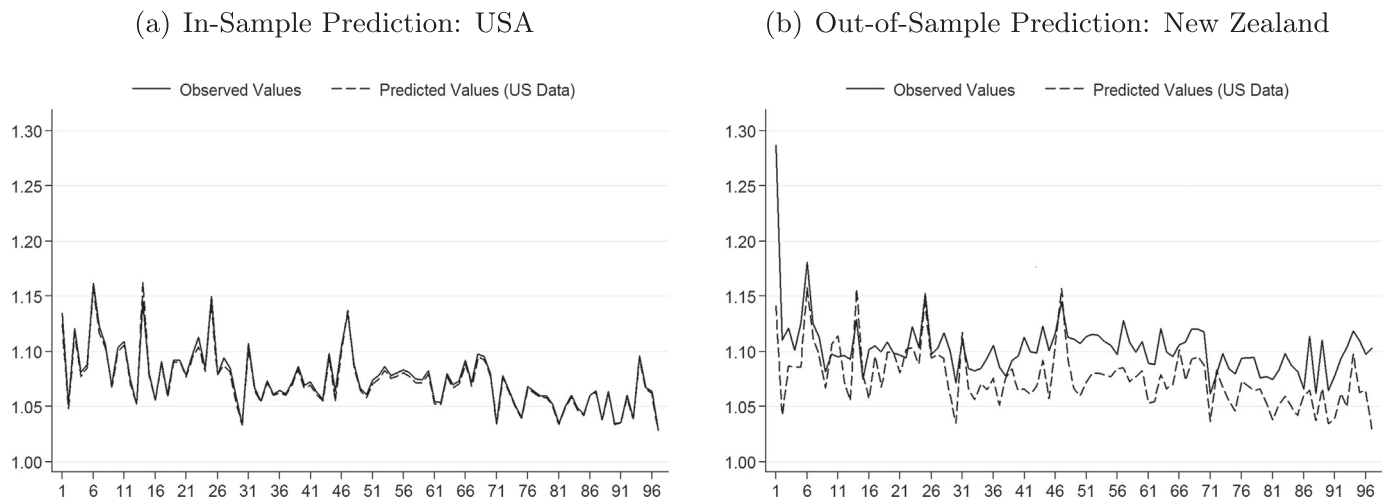


Fig. 1. Predicting transportation costs. Note: The graphs show the observed cif/fob ratios and the predicted values for the United States (a) $\hat{\tau}_{US,j} = \exp(\ln(\hat{\alpha}) + \hat{\delta} \ln(D_{US,j}))$ and New Zealand (b) $\hat{\tau}_{NZ,j} = \exp(\ln(\hat{\alpha}) + \hat{\delta} \ln(D_{NZ,j}))$. We aggregate by taking the average over the two-digit products (listed on the x-axis of the graphs). The data stem from the US Census, Statistics New Zealand and CEPII.

values tend to be somewhat lower than the observed ones.²⁴ Fig. A3 in the Appendix confirms this pattern when we plot the differences between the predicted and the observed transportation costs without aggregating up to 2-digit products.

3.3. Data on trade agreements

Trade deflection is an issue only in FTAs and in the non-reciprocal trade arrangements (GSP), but not in customs unions where all members have identical external tariffs by definition. Therefore, we are only interested in country-pairs that are in an FTA or a GSP. Although our tariff data can tell us about the existence of a preferential tariff it remains unclear whether the respective agreement is actually of interest. Therefore, we need detailed information about the type of the agreement. Further we want to be able to differentiate between unilateral trade arrangements like the GSP—where RoOs are also relevant but that are of a very different type than the bilateral FTAs.

In addition, all third-countries that belong to the same FTA as the pair ij should also be excluded, since here no potential for trade deflection exists. For example, in the case of Canada and the United States we exclude Mexico from the set of third countries c .²⁵ To do so, we need information about the members of all FTAs.

Our analysis builds on the DESTA database provided by Dür et al. (2014).²⁶ It comprises over 600 regional trade agreements (FTAs and CUs) and the corresponding accessions and withdrawals.²⁷ In 2014, the probability of a country-pair having an FTA equals 40%, while it equals 6% for having a CU.²⁸ For the unilateral arrangements (GSP), we use Baier et al. (2014) and update the data to 2014 ourselves. In our analysis we distinguish FTAs by their vintage. All FTAs that entered into force after 2008 are considered to be new FTAs, all others belong to

Table 1
Summary statistics.

	Mean	SD	Median	FTA	GSP	Δ
Δt_{ij} (in %)	1.07	11.12	0.00	2.05	0.30	1.76***
ΔT_{ij} (in %)	0.51	11.34	0.00	1.05	0.09	0.96***
t_{ij} (in %)	0.85	4.41	0.00	1.12	0.63	0.49***
t_{ic} (in %)	3.30	12.94	0.00	5.15	1.85	3.30***
t_{jc} (in %)	10.11	14.88	7.50	6.44	13.00	−6.56***
τ_{ij} (in %)	6.25	3.62	5.69	6.07	6.38	−0.31***
τ_{ic} (in %)	5.52	5.11	5.29	5.86	5.25	0.61***
τ_{jc} (in %)	6.34	3.50	5.77	6.30	6.37	−0.07***
Year of Entry into Force	1994.10	15.40	2001.00			
GSP [0,1]	0.56	0.50	1.00			
New Agreement [0,1]	0.16	0.37	0.00			

Note: The number of observations equals 117,509,125. The tariff data stem 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 trade agreements is based on own research, while the information on the presence of PTAs is from Dür et al. (2014) and Baier et al. (2014).

the group of old ones. 16% of FTAs in the sample are thus classified as ‘new’ ones.

Table 1 provides summary statistics. It shows that, for 2014 the average simple measure for the scope for trade deflection between country pairs is 1.07%, the average of the transportation-cost augmented measure is 0.51%. Comparing FTAs and GSPs we can see that in GSPs the scope for trade deflection is much lower than in FTAs. We will analyze this finding in more detail below.

4. The scope for trade deflection

This section presents new evidence on the scope for trade deflection across different country pairs and heterogeneity across types of FTAs, regions, and industry sectors. We show cross-sectional data at the 6 digit product-level for 2014.

4.1. Limited potential for trade deflection

To draw cumulative distribution functions (C.D.F.s), we refer to our measures (3) and (5). We start by ignoring transportation costs; see Panel (a) of Fig. 2 (solid line). In 2014, without accounting for transportation costs, for 83% of all country-pair×product×third-country combinations, trade deflection cannot be profitable. This number refers to the 20 most important exporting countries c ,

²⁴ One potential explanation for this pattern is that the US is 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 observed ones, which—as explained above—will work against us.

²⁵ We do so after determining the 20 most important third country exporters.

²⁶ We use the version of 27th of June 2016. <https://www.designoftradeagreements.org/>.

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

²⁸ One shortcoming of the DESTA data is that they do 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.

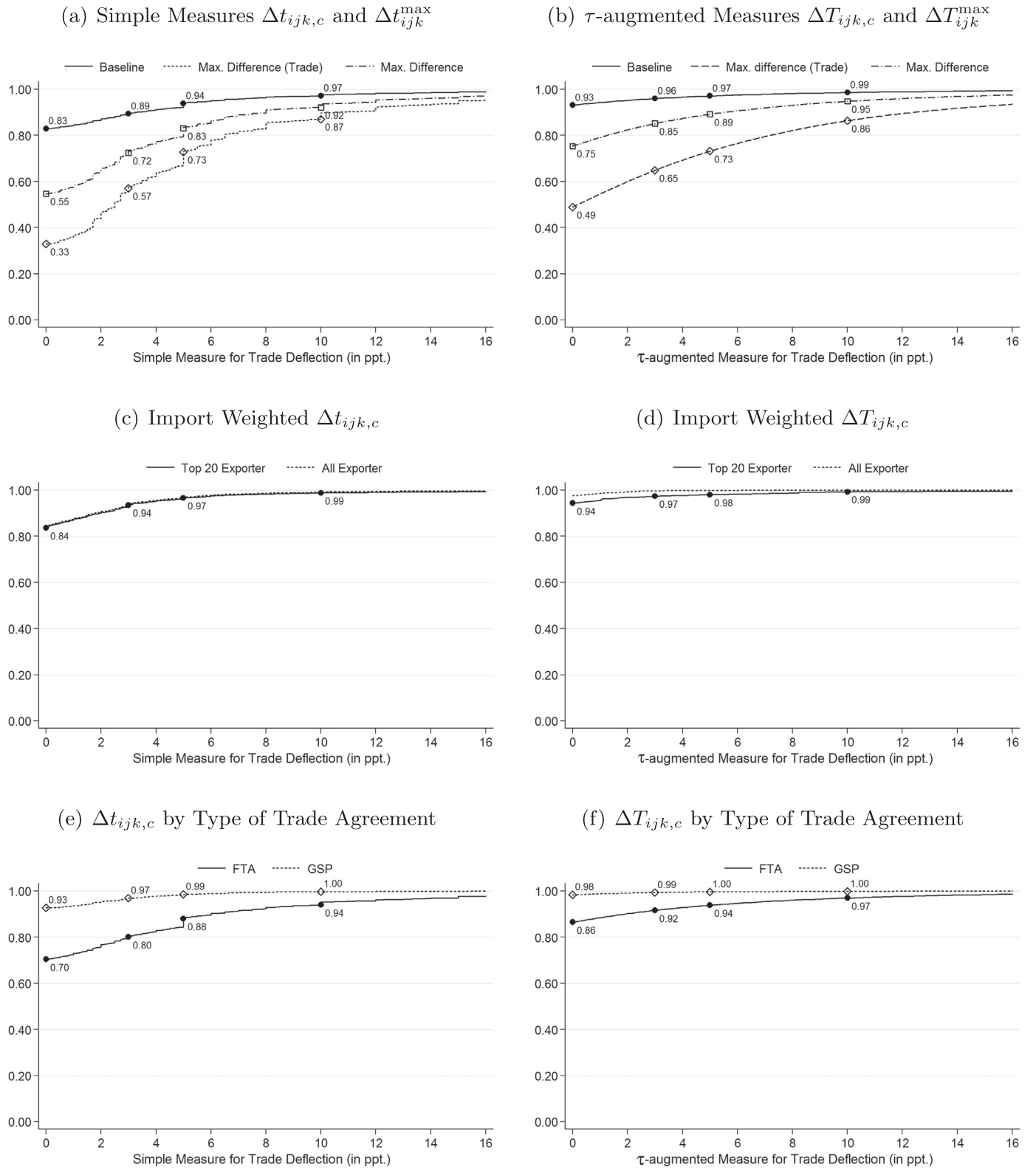


Fig. 2. C.D.F.s of the potentials for trade deflection, 2014. Note: $\Delta t_{ijk,c}$, $\Delta t_{ijk}^{\max}$, $\Delta T_{ijk,c}$ and $\Delta T_{ijk}^{\max}$ are defined in Section 2.2. All graphs are truncated to values ≤ 16 . All results are based on our baseline sample with the 20 most important third countries c that export product k to i . In Panel (c) and (d) we add the results for the full sample. In Panel (e) and (f) we differentiate between bilateral FTAs and GSPs.

which cover almost all trade. Panel (b) allows for transportation costs and finds that for 93% of all cases trade deflection cannot be profitable. In 10% ($93\% - 83\% = 10\%$) of all cases, there is tariff savings but it does not exceed the additionally arising transportation costs.

Out of these 83%, in 18% trade deflection is unprofitable because country i and j impose the same tariff against the third-country c . In 63% of all cases trade deflection is unprofitable because country j 's tariff t_{jck} is higher than country i 's t_{ick} . In the remaining 2% the preferential tariff that i grants j is not low enough to make trade deflection

Table 2
Decomposing the potential for trade deflection (in % of country-pair $\times$ product $\times$ third-country combinations).

	All (1)	GSP (2)	FTA (3)	Old (4)	New (5)
$\Delta T = 0$	93	98	86	94	88
$\Delta T > \Delta t$	10	6	16	9	17
$\Delta t = 0$	83	93	70	85	71
$t_{ic} < t_{jc}$	63	82	38	66	44
$t_{ic} = t_{jc}$	18	10	29	17	22
$t_{ic} > t_{jc} \mid t_{ij} > 1$	2	1	4	2	4

Note: The table decomposes the scope for trade deflection into the following cases: (i) the tariff savings do not exceed the additionally arising transportation costs ($\Delta T > \Delta t$), (ii) the tariff that country i imposes is lower than the one of country j ($t_{ic} < t_{jc}$), (iii) the tariffs of i and j are equal ($t_{ic} = t_{jc}$), and (iv) the preferential tariff that i grants j is not low enough to make trade deflection profitable, although $t_{ic} > t_{jc}$. The results are based on our baseline sample with the 20 most important third countries c that export product k to i .

profitable, although $t_{ick} > t_{jck}$. This decomposition is summarized in Table 2, column (1).

Panels (c) and (d) in Fig. 2 show the cumulative share of imports as a function of the two measures for the potential of trade deflection. Besides the results for the baseline sample i.e. restricting the number of third countries to the 20 most important exporting countries c , we also show the import shares when including all exporting countries (dotted line). The two lines are very close to each other indicating that results are unbiased when focusing on the top 20 exporters instead of all exporting third countries c . In 2014, for 84% of global imports no scope for trade deflection between the trade partners exists; for 94% $\Delta t_{ijk, c}$ is no more than 3%-points, and for 97% it amounts to at most 5%-points. When we account for transportation costs, the pattern is even more pronounced: for 94% of world trade trade deflection is unprofitable. So, the largest share of trade takes indeed place within country pairs and products with very little scope for trade deflection.

One drawback of our baseline measure is that we induce some selection bias by focusing only on the potential for trade deflection for only the 20 most important origin countries of imports to country i and disregarding those ic relationships where tariffs are prohibitively high which, in principle, increases incentives for arbitrage. We use $\Delta t_{ijk}^{\max}$ and $\Delta T_{ijk}^{\max}$ defined in Section 2.2 to address this issue. Over all third countries, the measure selects the one with the largest scope for trade deflection regardless of whether a third country c exports to i . We calculate two versions of the measure: one that, over all third countries, picks the one with the largest scope for trade deflection independent of whether a third country c exports to i or not; and another which disregards all third countries c that do not export to i .

In the graph the curve in the middle corresponds to the trade-weighted measure, the lower dashed line picks over all third countries the one with the largest scope for trade deflection. Necessarily, both lie below the 83% reported above. 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. In 33% of all cases, maximum tariff differences between two countries relative to any third country are zero. It abstracts from any additional transportation costs or tariffs that might have to be paid when transshipping through this third country c . $\Delta t_{ijk}^{\max}$, therefore, is an extremely conservative measure.

Accounting for transportation costs affects the maximum measure of trade deflection $\Delta t_{ijk}^{\max}$ much more than the baseline measure. As Panel (b) shows, the tariff savings do not exceed the additionally arising transportation costs in 16% of all cases for the $\Delta t_{ijk}^{\max}$ measure that includes all third countries. This finding shows that in many cases where tariff savings are relatively large the additionally arising transportation costs make trade deflection unprofitable: countries with high differences in external tariffs also tend to be far apart geographically.

Even when using the extremely conservative measure $\Delta T_{ijk}^{\max}$, we find that trade deflection is unprofitable in half of all candidate cases. Therefore, we are confident that our baseline results are not simply

due to selection bias. More importantly, for all those trade flows that can actually be observed, trade deflection is almost never profitable.

4.2. Heterogeneity in the scope for trade deflection

The evidence presented so far documents surprisingly little scope for trade deflection. Now, we want to explore heterogeneity across different dimensions. First, we categorize the types of FTAs into different groups; second, we check for differences across different regions; and third, we show differences across sectors.

Making use of the enabling clause of GATT (Article XVIII) members of the WTO can offer non-reciprocal preferential access to developing countries. Typically the latter keep their MFN tariffs against the developed countries in place to protect their domestic industries against foreign import competition. The main goal of these programs is to foster export-led growth. In 1971 the first program - the General System of Preferences (GSP) - was established. Since then many variants of the program have entered into force. Prominent examples are the “Everything but Arms (EBA)” through which the European Union grants least developed countries tariff-free access for almost all products, and the “African Growth and Opportunity Act (AGOA)”, which is the United States’ counterpart.

Many critics of the unilateral trade arrangements agree that strict RoOs hinder developing countries from using the preferences and thus decrease the gains from the unilateral trade arrangements (Ornelas, 2017). Indeed, in 2014 the preference utilization rates for using the EU’s GSP arrangements were extremely low for Iraq (3%), Somalia (5%), Liberia (12%) and Sierra Leone (16%).²⁹ For 88% of all Liberian exports the exporting firms decided against filing the necessary paperwork to be granted the preferential tariff and instead were willing to pay the higher MFN tariff. But is there actually any substantial danger of trade deflection in those unilateral preferential trade agreements?

We calculate the cumulative distribution functions (C.D.F.s) of measures of the potential for trade deflection for different trade policy environments such that $P(\Delta t_{ijk, c} \leq c \mid \text{type}_{ij} = 1)$ and $P(\Delta T_{ijk, c} \leq c \mid \text{type}_{ij} = 1)$, with type_{ij} indicating a bilateral FTA or a GSP arrangement. Fig. 2 (e) and (f) present the findings for $\Delta t_{ijk, c}$ and the transport cost augmented $\Delta T_{ijk, c}$ for 2014. The scope for trade deflection is very low for pairs with a unilateral trade agreement: in 93% of all cases trade deflection is not profitable; when accounting for transportation costs this number increases to 98%.

The reason for this result is straightforward: Typically, country i is a developed country with lower overall levels of tariffs, while country j is a developing country with high tariffs. Therefore, the necessary condition for profitable trade deflection $t_{jck} \leq t_{ick}$ is violated in most cases, making arbitrage unprofitable. Table 1 reports the average tariff levels conditional on the type of trade agreement and makes this point explicit. In FTAs, external tariffs are on average relatively similar (5% and 6%); this is different in non-reciprocal preferential trade arrangements (GSPs) (2% and 13%). In fact, the developed countries have much lower tariffs towards third countries than the preference-receiving developing countries. As columns (2) and (3) in Table 2 show, the share of identical tariffs for pairs in a bilateral agreement equals 29% and is much higher than for pairs with a unilateral agreement (10%). Also, only in 1% of all cases, the preferential tariffs t_{ij} are not low enough to make trade deflection profitable. So, the main reason for unprofitable arbitrage in unilateral trade agreements is simply the violation of the necessary condition $t_{jck} < t_{ick}$ (Fig. 3).

Furthermore, we can differentiate FTAs and GSPs with respect to their vintage. Whenever an agreement entered into force from 2009 onwards it is considered to be ‘new’. For the simple measure of the scope for trade deflection we find that for country pairs with an old agreement the

²⁹ We calculate these numbers based on data provided by Eurostat through ComExt. The data can be accessed using the following link: <http://epp.eurostat.ec.europa.eu/newxtweb/>.

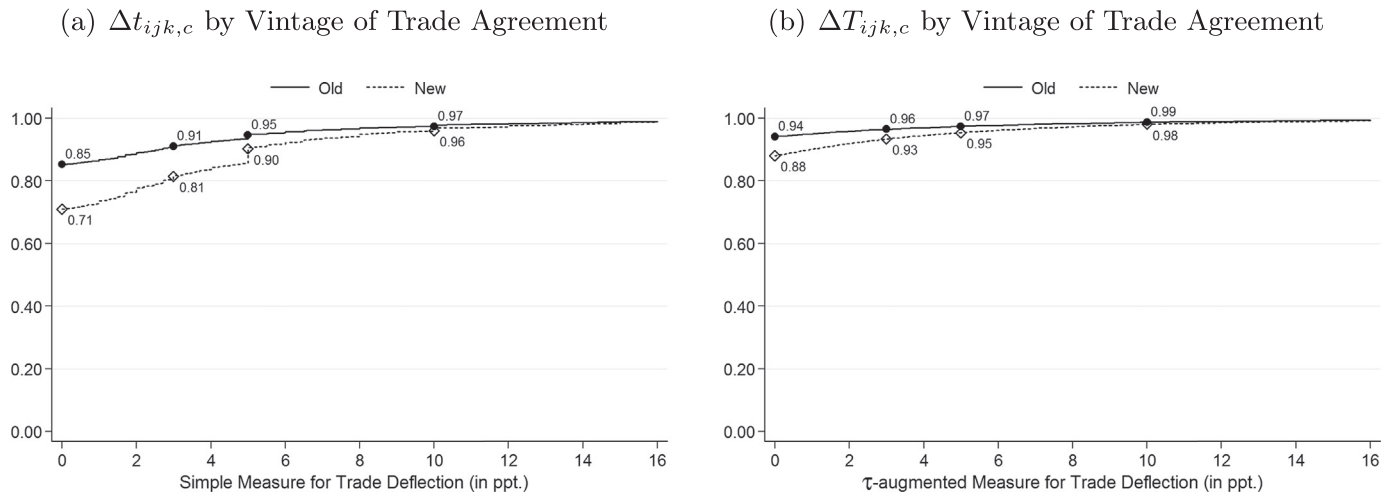


Fig. 3. Heterogeneity in the potentials for trade deflection across different trade agreements, 2014. Note: $\Delta t_{ijk,c}$ and $\Delta T_{ijk,c}$ are defined in Section 2.2. All graphs are truncated to values ≤ 16 . The results are based on our baseline sample with the 20 most important third countries c that export product k to i . All trade agreements that entered into force after 2008 are considered to be “new” agreements.

profitability of trade deflection is less than for those with a new agreement. The same is true when we account for transportation costs. Now, for pairs with an old agreement, trade deflection is not profitable in 94% of all cases and for pairs with a new one it is unprofitable in 88% of all cases. There are at least two explanations for this pattern. First, many of the GSPs have entered into force before 2009. As explained above those type of agreements tend to have a lower scope for trade deflection and therefore drive down the overall scope for trade deflection for older agreements. Second, more recent deals seem to have more ambitious tariff cuts, making trade deflection more profitable.

Next, we check for heterogeneity across regions and across products. Table 3 shows conditional cumulative probabilities for the simple measure $\Delta t_{ijk,c}$ and the transportation cost augmented measure $\Delta T_{ijk,c}$. A number of interesting facts stand out. First, North-South country pairs

have significantly less scope for trade deflection than other pairs, with North-North pairs having somewhat lower scope for trade deflection than South-South pairs; see Panel (a) of Table 3. In North-South pairs, $\Delta t_{ijk,c}$ is in 87% zero; accounting for transportation costs, in 96% of all cases there is no scope for trade deflection. That number falls to 83%–85% of cases in pairs containing only Northern or only Southern countries. These facts are mostly a reflection of unilateral trade agreements.

Second, transportation costs reduce the profitability of trade deflection for North-North pairs much more than in pairs involving the South. While for the north pairs additionally arising transportation costs exceed the tariff savings in 23% of the cases, for the other pairs this number ranges only between 9%–15%. The Australia-Canada FTA, the Australia-New Zealand FTA, the Australia-US FTA, USCMA, Canada-EFTA are a few examples of FTAs between north pairs. Third, the difference in the

Table 3

Heterogeneity across regions and types of RTAs: conditional C.D.F.s $P(\Delta t_{ijk,c} \leq \bar{c})$ and $P(\Delta T_{ijk,c} \leq \bar{c})$ for 2014.

	Simple measure $\Delta t_{ijk,c}$						τ -Weighted measure $\Delta T_{ijk,c}$					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
$\bar{c}$:	0	3	6	9	12	max	0	3	6	9	12	max
(a) Regions												
North-North	62	76	91	95	97	100	85	93	96	98	99	100
North-South	87	93	97	98	99	100	96	98	99	99	99	100
South-South	68	76	87	91	94	100	83	89	93	95	97	100
(b) North-North												
Unilateral	.	.	.	.	.	.	.	.	.	.	.	.
Bilateral	62	76	91	95	97	100	85	93	96	98	99	100
Old-FTA	60	76	93	97	99	100	86	94	97	99	99	100
New-FTA	67	77	86	92	94	100	83	89	93	95	97	100
(c) North-South												
Unilateral	93	97	99	100	100	100	99	99	100	100	100	100
Bilateral	75	85	93	96	97	100	90	95	97	98	99	100
Old-FTA	89	94	97	98	99	100	96	98	99	99	99	100
New-FTA	77	87	95	98	99	100	92	96	98	99	99	100
(d) South-South												
Unilateral	84	91	96	98	99	100	95	98	99	99	100	100
Bilateral	63	72	85	89	93	100	80	86	91	94	96	100
Old-FTA	71	78	88	92	95	100	85	90	93	95	97	100
New-FTA	57	68	84	89	94	100	78	86	91	94	96	100

Note: The table shows the shares of tariff lines (in %-points) whose measures for trade deflection lie below a certain threshold $\bar{c}$. In the different panels, we focus on heterogeneity across regions and types of RTAs and show data on the simple measure $\Delta t_{ijk,c}$ in column (1)–(6), and when accounting for transportation costs $\Delta T_{ijk,c}$ in column (7)–(12). Panel (a) shows the distribution of the measures for potential 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 Panels (b)–(d) we look at the different regional and RTA types simultaneously. We use data for 2014. The results are based on our baseline sample with the 20 most important third countries c that export product k to i .

scope for trade deflection between old and new FTAs is largest for South-South countries and it is also prevalent when using the transportation-cost augmented measure.

Fig. 4 explores heterogeneity across 21 product sectors for the year of 2014. It shows the bottom and top 5% percentiles of our deflection measures and the means by sector. Then we plot the means within each section. Both, for the simple measure $\Delta t_{ijk,c}$ and for the transport cost augmented measure $\Delta T_{ijk,c}$, we observe that the potential for trade deflection varies quite substantially across sectors. The products with the largest scope for trade deflection belong to the agricultural sector, pulp and paper, and the sector of works of art. In contrast, for mineral products, wood products, machinery and electrical equipment, and optics $\Delta t_{ijk,c}$ never exceeds 5%-points. Accounting for transportation-costs does not change the general picture.

4.3. Sensitivity analysis

4.3.1. Bound tariffs

To exclude the possibility that countries with “water in the tariff”, i.e. higher bound MFN tariffs than applied MFN tariffs, might later change the applied tariffs and make trade deflection profitable, when it was not under the tariffs in our data, we have conducted the analysis described above using bound MFN rates. The picture remains broadly the same. In 79% 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 Fig. 5. Hence, our analysis and conclusions do not depend on the use of applied tariffs.

4.3.2. Alternative measures for transportation costs

We have based our estimation of product-level transportation costs on US data and on 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 proxy transportation cost for our sample. One could also assume that transportation costs are additive rather than multiplicative. Further, instead of using OLS we estimate coefficients using the Poisson-Pseudo-Maximum-Likelihood (PPML) estimator. Finally, we assume symmetric transportation costs, $\tau_{ick} = \tau_{jck}$.

Fig. 6 shows that our main results are not sensitive to the construction of transportation costs. Proxying transportation costs around the

world using observed US values slightly increases the scope for trade deflection, because the US exhibits relatively low transportation costs compared to the rest of the world leading to lower transportation costs than in our baseline.

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 transportation costs. Fig. A2 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 observed 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, in our context, could lead to wrong conclusions. However, as Panel(c) shows, results do not change much, when using New Zealand data. We prefer using the US data for another practical reason: The US is a much larger importer than New Zealand and imports many more products. Therefore, we can extract many more product-specific transportation costs from these data than from the New Zealand's. Moving to additive transportation costs, symmetric transportation costs as well as using PPML leaves the scope for trade deflection roughly the same as when we use our preferred measure.

4.3.3. Selection bias

As discussed in Section 4.1 the baseline measure for the scope for trade deflection might suffer from selection bias. Focusing on those third countries c that are the most important exporters to country i might focus on those links that have low levels of tariffs and therefore by construction less scope for trade deflection. Using the most conservative measures for the profitability of trade deflection $\Delta t_{ijk,c}^{\max}$ and $\Delta T_{ijk,c}^{\max}$ we can show that trade deflection is not even profitable in these extreme cases. Another way of checking whether selection biases our results is to draw third countries randomly rather than choosing them conditional on their exports to i . Fig. 7 shows that the baseline results do not change drastically when 20 random third countries are drawn. The scope for trade deflection increases a bit (from 17% (=100 - 83) in the baseline to 28%) but the general picture remains the same. Taking these pieces of evidence together we are quite confident that our results are not biased due to selection.

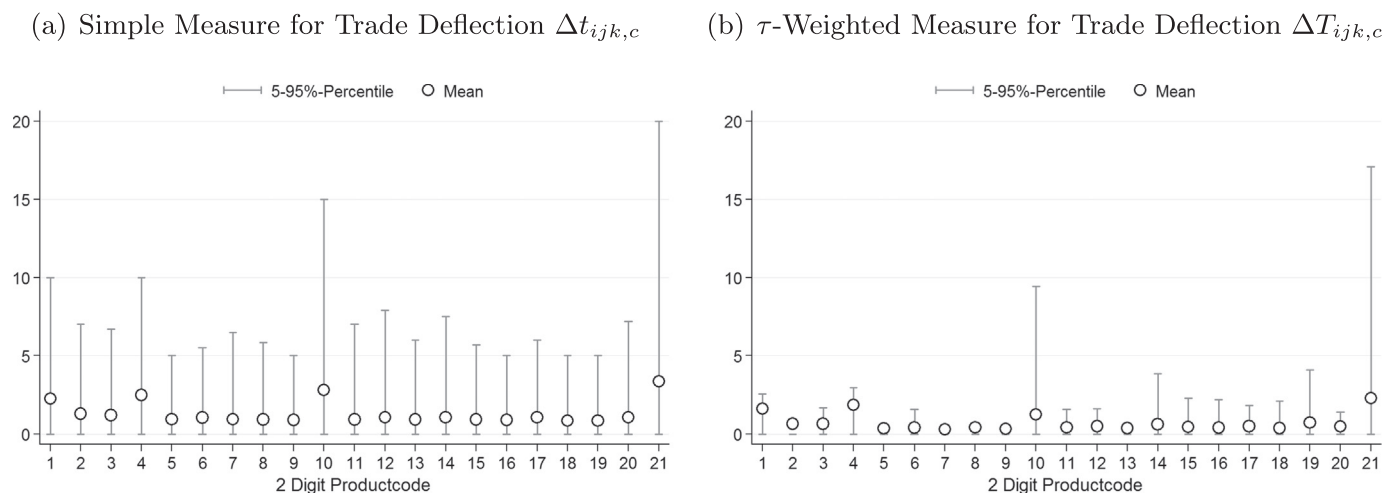


Fig. 4. Heterogeneity across sectors, 2014. Note: Sectors: 1 Live Animals (01–05); 2 Vegetable Products (06–14); 3 Fats and Oils (15); 4 Food, Bev. & Tobacco (16–27); 5 Mineral Products (25–27); 6 Chemicals (28–38); 7 Plastics (39–40); 8 Leather Goods (41–43); 9 Wood Products (44–46); 10 Pulp and Paper (47–49); 11 Textile and App. (50–63); 12 Footwear (64–67); 13 Stone and Glass (68–70); 14 Jewellery (71); 15 Base Metals (72–83); 16 Mach. & Elec. Eq. (84–85); 17 Transportation Eq. (87–89); 18 Optics (90–92); 19 Arms & Ammun. (93); 20 Misc. Manufactured Articles (94–96); 21 Works of Art. (97–98). Δt_{ijk} and ΔT_{ijk} are defined in Section 2.2. We show data for 2014. The results are based on our baseline sample with the 20 most important third countries c that export product k to i .

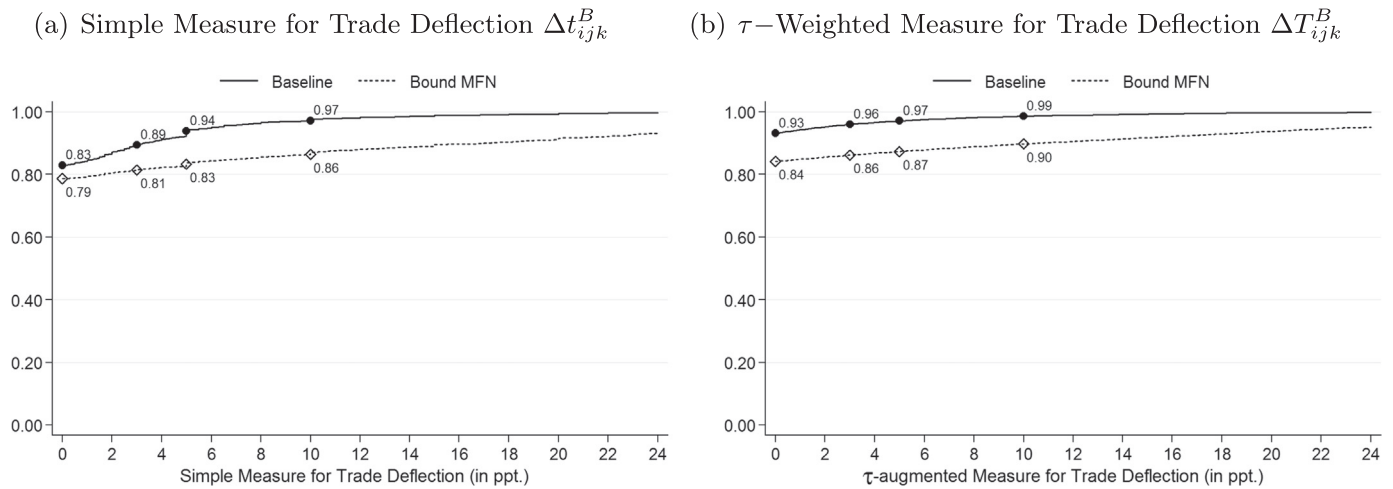


Fig. 5. C.D.F.s of measures of scope for trade deflection: bound MFN tariffs. Note: Δt_{ijk}^B and ΔT_{ijk}^B are defined as the baseline measures (see Section 2.2) but instead of the applied tariff we use the bound MFN tariff that country i imposes for product k . The results are based on our baseline sample with the 20 most important third countries c that export product k to i and the data are for 2014.

4.3.4. Averaging over the third country dimension

Finally, to deal with the dimensionality problem we can also average over the third country dimension, i.e. $\Delta t_{ijk}^{avr} = \frac{1}{N-2} \sum_{c \neq i,j} \Delta t_{ijk,c}$, and for ΔT_{ijk}^{avr} analogously. Fig. 7 Panels (c) and (d) show the C.D.F.s of this measure of the scope for trade deflection. A couple of interesting facts stand out: First, the overall picture remains the same. Also when using this variant of the measure for trade deflection, it is in most of the cases unprofitable. Second, the share of product-pair combinations for which Δt_{ijk}^{avr} and ΔT_{ijk}^{avr} are equal to zero corresponds to the one of Δt_{ijk}^{max} and ΔT_{ijk}^{max} that we introduced in Section 2.2, 33% for the simple measure and 49% for the transportation cost augmented measure, respectively. However, with increasing scope for trade deflection the average scope for trade deflection converges to the measure of trade deflection when using MFN tariffs, the dashed line in the graph. The explanation for this pattern is straightforward: The number of RTAs is relatively low compared to the number of pairs where the MFN tariff is still applicable. Therefore, when averaging over all third countries c , those few preferential tariffs have very little weight, resulting in a measure that is similar to the one when only using MFN tariffs. The disadvantage is that one could understate the real potential for trade deflection as preferential tariffs might make trade deflection profitable. Our baseline measure does not have this bias and is therefore superior.

4.3.5. 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. 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 greater trade deflection than we estimate only exists when the standard deviation of tariffs within 6-digit product categories is larger than zero in a country-pair ij . In 2014 this is only the case in 1.36% of the product-pair combinations, indicating that aggregation bias most likely does not bias our results.

5. Policy conclusions

Economists have long been skeptical of free trade agreements (FTAs) and have preferred customs unions (CUs). Rules of origin

(RoOs) make sure that members of FTAs can in effect set independent trade policies with respect 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. The problem is that RoOs involve burdensome red tape and that they distort supply chains.

Our empirical exercise shows that, in practice, the scope for trade deflection is generally low in FTAs. The reason is that countries set relatively similar external tariffs, and tariffs are low on average. Where tariffs against third parties differ, transportation costs further reduce the profitability of trade deflection. Trade deflection is almost never profitable in non-reciprocal preferential trade arrangements (GSPs) where high MFN tariffs and a lack of ambitious FTAs of beneficiary countries mute arbitrage possibilities.

Across all country pairs in regional trade agreements (FTAs or GSPs), according to our estimates, trade deflection is profitable only in 7% of country-pair $\times$ product $\times$ third-country combinations considered. That share is 2% in GSPs and 14% in FTAs. Within FTAs, differences in external tariffs allow for profitable trade deflection in 30% of all cases, but in more than half of these candidate configurations trade costs are too high to make arbitrage deals worthwhile.

In 'new' trade agreements, the likelihood for profitable trade deflection is somewhat larger than in 'old' ones, reflecting more ambitious tariff cuts in more recent deals. Interestingly, North-South FTAs are less prone to trade deflection than North-North ones as higher geographical distance drives up transportation costs in the former constellation. In North-South non-reciprocal agreements, trade deflection is worthwhile only in 1% of all cases considered, while in South-South GSPs that share is five times as high.

These findings are robust to alternative ways of dealing with the third-country dimension and to 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% (Keck and Lendle, 2012). 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 of a protectionist bias in FTAs.

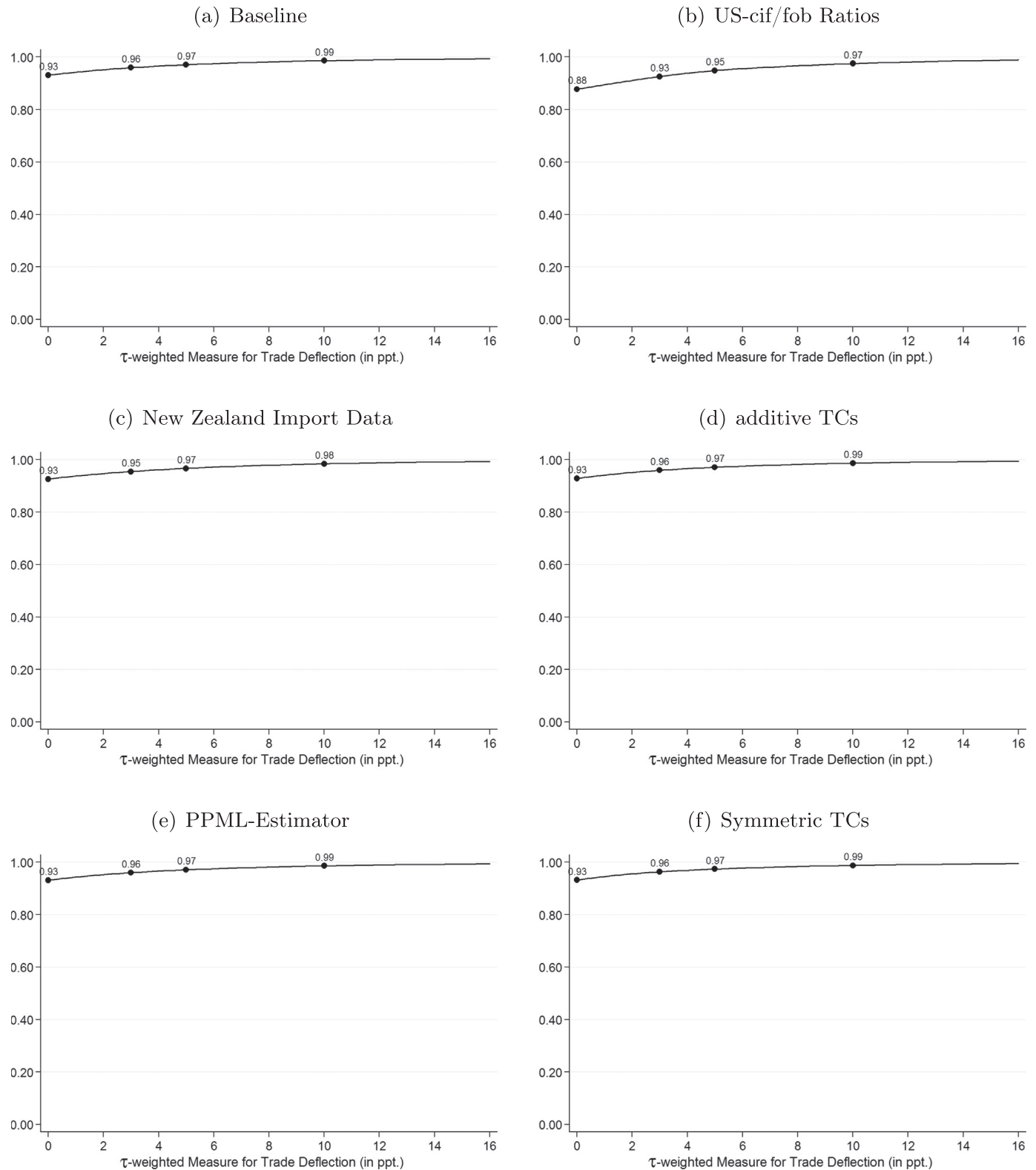


Fig. 6. C.D.F.s of measures of scope for trade deflection: alternative proxies for transportation costs, 2014. Note: $\Delta T_{ijk, c}$ is defined in Section 2.2. Panel (a) shows the baseline way of constructing the transportation costs, in Panel (b) we use the import data of New Zealand in order to 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. Panel (e) uses the Poisson-pseudo-maximum-likelihood (PPML) estimator instead of OLS and in Panel (f) we assume that the transportation costs between i and c and j and c respectively are the same ($\tau_{ick} = \tau_{jck}$). The data are for 2014. The results are based on our baseline sample with the 20 most important third countries c that export product k to i .

Our analysis suggests a fundamental re-thinking of the use of RoOs in FTAs and GSPs, as one could substantially relax the requirements to prove the origin of goods in many trade agreements

without risking any trade deflection. More specifically, we suggest that, in new FTAs, negotiators should agree on a full set of simple RoOs for all products, but that the requirement to prove origin

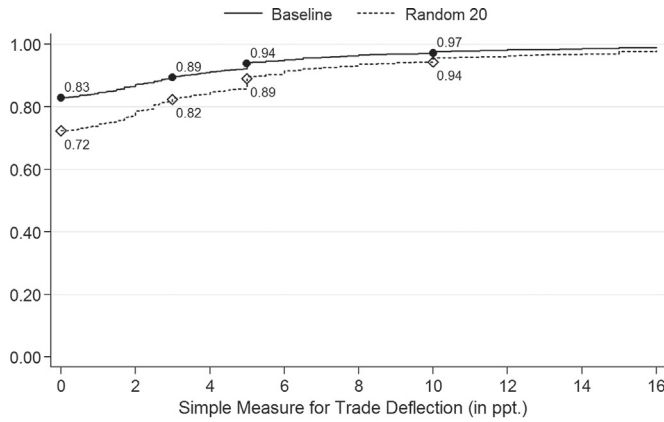
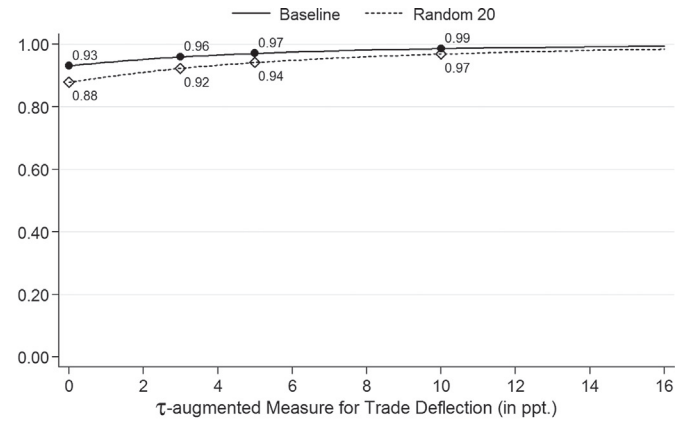
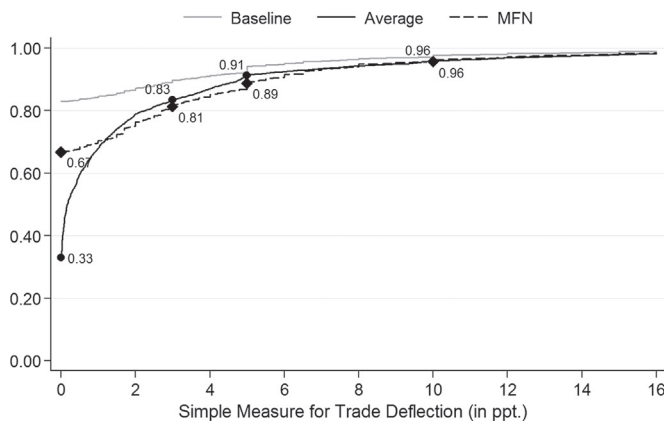
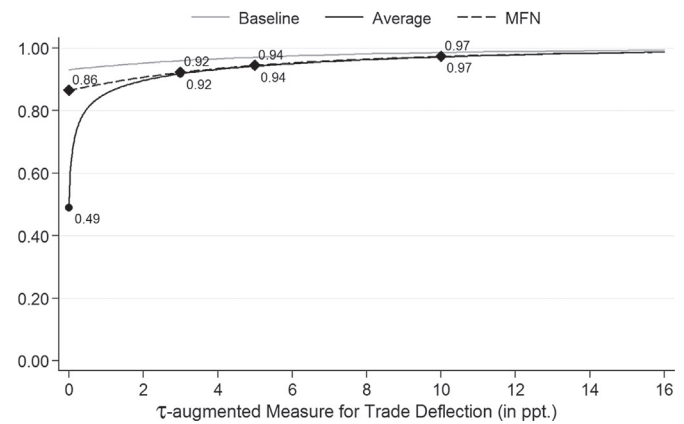
(a) 20 Randomly drawn Third Countries $c \Delta t_{ijk,c}^{Rand}$ (b) 20 Randomly drawn Third Countries $c \Delta T_{ijk,c}^{Rand}$ (c) Averaging over the Third Countries Δt_{ijk}^{avr} (d) Averaging over the Third Countries ΔT_{ijk}^{avr} 

Fig. 7. C.D.F.s of measures of scope for trade deflection: alternatives of dealing with the third-country dimension. Note: $\Delta t_{ijk,c}^{Rand}$ and $\Delta T_{ijk,c}^{Rand}$ are defined as the baseline measures (see Section 2.2) but instead of restricting the number of third countries c by only keeping the 20 most-important exporters we now draw 20 third countries randomly. In Panel (c) and (d) we show Δt_{ijk}^{avr} and ΔT_{ijk}^{avr} , which are defined in Section 2.2. Additionally, we show in Δt_{ijk}^{MFN} and ΔT_{ijk}^{MFN} , which are defined exactly as the baseline measures (see Section 2.2) but instead of the applied tariff we use the applied MFN tariff that country i imposes for product k .

should be 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 GSPs, RoOs should be activated only for those products where the beneficiary country undercuts the MFN tariffs of the preference granting country.

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.³⁰ 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 necessary to facilitate tariff concessions in the first place, since they may help deal with conflicts of interest between final and intermediate input producers within countries. 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 towards 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.

³⁰ We thank James Lake and Maurizio Zanardi for pointing this out to us.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jinteco.2019.07.003>.

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