

Is Trade Facilitation a Free Lunch? A General Equilibrium Approach

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Abstract

Multilateral negotiations on tariff liberalization at the WTO have shifted toward non-tariff trade policy issues. Among the recent initiatives is the Trade Facilitation Agreement (TFA), signed at the Bali Ministerial Conference in December 2013. This paper provides the first assessment of the potential economic impact of the TFA based on a dedicated Computable General Equilibrium model. We implement a micro-funded definition of overall trade costs, relate them to the OECD Trade Facilitation Indicators (TFI) and allocate bilaterally the burden of trade facilitation measures. The Computable General Equilibrium model MIRAGE is adapted to this definition of trade facilitation as part of trade costs. Beyond this modeling effort, we integrate in the exercise results of the OECD evaluation relying on the Trade Facilitation Indicators (TFI), the impact of the TFA on such indicators and ultimately the consequences on trade costs. An important value added of our ex ante evaluation is to account for the costs associated with such implementation. We show that the outcomes of the Trade Facilitation Agreement are very sensitive to the diligence in implementation and timing, and that the impact of the introducing the costs of implementation is not negligible but relatively modest.

Keywords: Trade Facilitation Agreement; CGE model

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Introduction

Quantifying how the Trade Facilitation Agreement will impact world trade is more complex than simply tackling a phasing-out of tariffs. Part of the border obstacles related to trade facilitation are pure inefficiency, and part is administrative work, mainly at the customs. Accordingly, reducing the cost of commerce is not simply cutting the “iceberg” by a certain percentage: the trade cost is multidimensional. On the other hand, one has also to account for the costs associated with TFA implementation. Adjusting procedures, improving the efficiency of administrations in charge of custom procedures, dematerializing and automatizing the procedures, is costly. In a nutshell, implementing the TFA is no free-lunch.

Several attempts to assess the economic impact of trade facilitation have been done using computable general equilibrium (CGE) models. One of the first attempts is related to the evaluation of the economic impact of the trade agreement between Japan and Singapore. Hertel et al. (2001) use a recursive-dynamic extension of the standard GTAP model and introduce a reduction in trade costs parameterized on the basis of empirical evidence. Practically, they introduce a wedge between the observed and effective price of important products in the model. Francois et al. (2005) introduce a 1.5 percentage point reduction in trade costs in their evaluation of the potential economic impact of the Doha Development Agenda (DDA) and get a USD 63 bn increase in world GDP attributable to this measure. Decreux and Fontagné (2015) also combine liberalization of trade in goods and services with trade facilitation in their quantification of the DDA. They incorporate trade costs that add up to the ordinary freight costs already present in the MIRAGE model. In the experiment, only time induced by customs procedures and time at the port are reduced (they divide by two the processing time exceeding the median level, for each category of trade costs). However, no cost of implementation of trade facilitation is incurred, leading to a USD 68 bn gain in world GDP in the long term. Finally, Walkenhorst et al. (2004) use a modified version of the GTAP model where “direct” trade costs like clearance type are of an iceberg type and “indirect” costs like filling forms, modeled as a tax paid by exporters to their government. Their scenario is a 1 percent reduction in trade costs associated with trade facilitation, leading to a USD 41bn gain in world GDP.

Against this background, we implement a micro-funded definition of overall trade costs, relate them to the OECD Trade Facilitation Indicators (TFI) and allocate bilaterally the burden of trade facilitation measures. The Computable General Equilibrium model MIRAGE is then adapted to this definition of trade facilitation as part of trade costs. Doing so allows us to encompass the large heterogeneity in terms of ambition in the commitments of countries, as demonstrated by the OECD – developing countries tend to be less ambitious than developed countries – and to assess whether the risk of lagging behind compared to competitors can make trade facilitation a very expensive lunch for some countries.

Finally, an important value added of our ex ante evaluation is to account for the cost of implementing the trade facilitation agenda. Here, we assume that the customs have to be better staffed, and we calibrate this additional cost for the public sector based on evidence on related implementation costs and share of the custom authorities in total public employment.

The rest of the paper is organized as follows. In section 1 we derive a micro-funded representation of trade costs and adjust MIRAGE to the standard modeling of trade costs in structural gravity models. In section 2 we use trade facilitation indicators of the OECD and derive country-pair specific reduction in trade costs requested to reach TFA commitments, and implement these reductions in MIRAGE. Section 3 discusses the results of this first step of the analysis. In section 4, we modify the approach and address the cost of implementation of the TFA in order to see how the overall gains are affected by this change.

1 Introducing micro-funded trade costs in a CGE model

1.1 Micro-funded trade costs

We start from the standard theoretically founded gravity framework by Anderson et al. (2004), as derived by Chen and Novy (2009). Assuming an Armington specification with an elasticity of substitution σ_k for trade, a CES utility function for demand and the presence of a trade cost t_{ij}^k that is ad-valorem, they provide a micro-funded measure for total trade costs in sector k θ_{ij}^k that is symmetric between country i and j , and multiplicative, based on the *values* traded with foreign countries (x_{ij}^k and x_{ji}^k) and the value consumed domestically x_{ii}^k .

The authors also show that this indicator is the geometric average of the ad-valorem trade cost t_{ij}^k , as follows:

$$\theta_{ij}^k = \left(\frac{t_{ij}^k t_{ji}^k}{t_{ii}^k t_{jj}^k} \right)^{\frac{1}{2}} = \left(\frac{x_{ii}^k x_{jj}^k}{x_{ij}^k x_{ji}^k} \right)^{\frac{1}{2(\sigma_k - 1)}} \quad (1)$$

We follow Chen and Novy (2009) in interpreting this θ_{ij}^k as a measure of bilateral sector-specific trade frictions: the more countries trade one with another, compared to their respective domestic consumptions, the lower our measure. A value of 1 would mean that trade is frictionless: the cost to export is equal to the cost to sell locally. Inversely, θ_{ij}^k will tend to infinity as a country tends to be a closed economy (facing infinite trade costs).

1.2 The MIRAGE model

We rely on MIRAGE (Modeling International Relationships in Applied General Equilibrium),¹ which is a multi-sector and multi-regional computable general equilibrium model dedicated to trade policy analysis (Fontagné et al., 2013; Decreux and Valin, 2007; Bhir et al., 2002). Each sector is modeled as a representative firm with constant returns to scale (perfect competition). International trade follows an Armington specification (goods from different origins are not perfect substitutes) and is impacted by tariffs and NTMs. Consumers and the government are represented by a single agent by region, which maximizes its instantaneous utility function and owns all primary factors (skilled and unskilled labor, land, capital and natural resources) and these factors are fully employed.

¹The actual version used is nicknamed MIRAGE-e 1.0.3. A two-page summary of the model and the full set of equations is available in the online appendix

Our version of MIRAGE is built mainly on the GTAP database version 9 (Narayanan et al., 2015), but also include several other sources. The business as usual scenario, in which MIRAGE's factor accumulation and technological level are calibrated, is built after the EconMap database version 2.4 (Fouré et al., 2012; Fouré et al., 2013). Tariff data are drawn from the CEPH-ITC MAcMap-HS6 database for year 2011 (an updated version based on methodology described in Guimbard et al., 2012).

1.3 An extension to micro-funded trade costs

1.3.1 Data

The first step is to express x_{ij}^k from the GTAP database.² MIRAGE uses data from the GTAP database but aggregated at a different level, both regarding regions and sectors. As a consequence, for a given sector k in a region i , there are two different domestic flows: actual *domestic demand* D_i^k corresponds to the sum of domestic demands of countries inside region i ; and *inner trade* X_{ii}^k which correspond to trade between different countries that are aggregated in region i . Contrary to domestic demand, inner trade is subject to tariffs, transportation costs, etc. Ultimately, foreign trade $x_{ij}^k \equiv X_{ij}^k$ at the aggregated MIRAGE level, while domestic trade $x_{ii}^k \equiv D_i^k + X_{ii}^k$.³

On the other hand, $\sigma_{IMP} \equiv \sigma_k$ is also provided by GTAP as $\sigma_{IMP} = ESUBM_k$. Finally, we have:

$$\Theta_{ij}^{k0} = \left(\frac{(D_i^k + X_{ii}^k)(D_j^k + X_{jj}^k)}{X_{ij}^k X_{ji}^k} \right)^{\frac{1}{2(\sigma_{IMP}-1)}} \quad (3)$$

1.3.2 An iceberg trade costs to link modeling to theory

The objective of this section is to link the micro-funded measure of trade costs Θ_{ij}^{kt} to the structure of MIRAGE. First, we will express Θ_{ij}^{kt} as a function of variables present in the model, leading to the definition of an iceberg trade cost that fills the gap between explicit trade costs and total trade costs. Then, we will discuss how trade costs are likely to change over time and after a trade facilitation agreement.

First, specific attention has to be paid to the demand structure in MIRAGE. In its standard version, regional demand (which include both demand for final consumption and intermediate consumption) follows a two-level CES demand function *à la* Armington (1969) with home bias. Unfortunately, deriving the Anderson et al. (2004) model with such a demand function does not allow to

²We will use the convention of naming by uppercase letters in MIRAGE the counter part of the lowercase letter from theory.

³Expressed from variables in GTAP, this corresponds to

$$\begin{aligned} D_i^k &= VDPM_i^k + VDGM_i^k + VDFM_i^{CGDS,k} + \sum_l VDFM_i^{l,k} \\ X_{ij}^k &= \frac{VIMS_{ij}^k}{\sum_r VIMS_{rj}^k} \left(VIPM_j^k + VIGM_j^k + VIFM_j^{CGDS,k} + \sum_l VIFM_j^{l,k} \right) \end{aligned} \quad (2)$$

where $VDPM_i^k$, $VDGM_i^k$, $VDFM_i^{l,k}$ and $VIMS_{ij}^k$ are the variables from the GTAP database (corresponding to domestic demand by households, by the government and by firms, as well as to bilateral trade).

obtain a simple expression for the average trade cost θ_{ij}^k .⁴ As a consequence, in this paper, we simplify MIRAGE demand such that we stick to the vanilla Armington assumption with a single elasticity of substitution.

Second, in MIRAGE, there is no standard expression of total trade costs. Instead, several costs are embedded in the this total trade cost. Namely, we consider a production tax (tax_i^{Pkt}), a tariff ($Tariff_{ij}^{kt}$), an export tax (tax_{ij}^{EXPkt}), transportation costs per unit of volume ($\mu_{ij}^k PTr_{ij}^{kt}$) where μ_{ij}^k is the calibrated after the international margin data, and an iceberg cost ($iceberg_{ij}^{kt}$) that will capture the remaining part of trade costs. The resulting expression for demand price $P^{DEM}_{ij}^{kt}$ is then:

$$P^{DEM}_{ij}^{kt} = (1 + iceberg_{ij}^{kt}) (1 + Tariff_{ij}^{kt}) \left[P_i^{Ykt} (1 + tax_i^{Pkt}) (1 + tax_{ij}^{EXPkt}) + \mu_{ij}^k PTr_{ij}^{kt} \right] \quad (4)$$

In order to make MIRAGE comparable to theory derived in Section 1.1, we need to match the variables in the two framework. Namely production price $p_i^k \equiv P_i^{Ykt}$ in MIRAGE, and consumer price $p_{ij}^k \equiv P_{ij}^{DEMkt}$. In turn, total trade costs $\theta_{ij}^k = p_{ij}^k / p_i^k$ are equivalent in MIRAGE to $\Theta_{ij}^k = P_{ij}^{DEMkt} / P_i^{Ykt}$

$$\Theta_{ij}^{kt} = (1 + iceberg_{ij}^{kt}) (1 + Tariff_{ij}^{kt}) \left[(1 + tax_i^{Pkt}) (1 + tax_{ij}^{EXPkt}) + \mu_{ij}^k \frac{PTr_{ij}^{kt}}{P_i^{Ykt}} \right] \quad (5)$$

Over time, all components of Θ_{ij}^{kt} are likely to change. Except for transportation costs, all other components of total trade costs are determined by policy. Tariffs, production tax and export tax are explicit policy instruments, while iceberg trade costs $iceberg_{ij}^{kt}$ may respond to any policy that can impact trade. We can for instance think of a change in non-tariff measures, including a trade-facilitation agreement, or a change in cultural distance (more people in country i speak the language of country j). On the contrary, transportation costs are endogenous in the model and correspond to the production of the transportation sector.

From the previous expression, we can see that all the components are determined by data, excepted iceberg trade costs $iceberg_{ij}^{kt}$ that need to be calibrated in MIRAGE such that its total trade costs match the Chen and Novy (2009) definition:

$$iceberg_{ij}^{kt} = \frac{\Theta_{ij}^{kt}}{(1 + Tariff_{ij}^{kt}) \left[(1 + tax_i^{Pkt}) (1 + tax_{ij}^{EXPkt}) + \mu_{ij}^k \frac{PTr_{ij}^{kt}}{P_i^{Ykt}} \right]} - 1 \quad (6)$$

⁴The closest expression we obtain from the model is

$$\tilde{\theta}_{ij}^k = \frac{(t_{ij}^k t_{ji}^k)^{1-\sigma_k}}{(t_{ii}^k t_{jj}^k)^{1-\sigma_k^A}} = \frac{x_{ij}^k x_{ji}^k}{(x_{ii}^k x_{jj}^k)^{\frac{1-\sigma_k^A}{1-\sigma_k}}} (x_j^k - x_{jj}^k)^{\frac{\sigma_k^A - \sigma_k}{1-\sigma_k^A}} (x_i^k - x_{ii}^k)^{\frac{\sigma_k^A - \sigma_k}{1-\sigma_k^A}}$$

where σ_k represents the substitution between foreign goods and σ_k^A represents the substitution between local and foreign goods.

2 From Trade Facilitation Indicators to simulating a Trade Facilitation Agreement

Modeling the implementation of a Trade Facilitation Agreement (TFA) in MIRAGE implies to find the answer to the question : how a TFA will impact trade costs ? To do so, we will rely on indicators provided by the OECD (Moisé et al., 2013) and estimations conducted by the authors on the impact of such TFA on TFI, and ultimately on trade costs. However, the impact measured by the authors is not bilateral and we will have to split reduction in trade costs between partners.

2.1 Measuring Trade Facilitation

2.1.1 Trade Facilitation Indicators (TFI)

As detailed in Moisé et al. (2011), Trade Facilitation Indicators are 12 indicators (labeled from “A” to “L”). Each of these 12 indicators are built after the 12 articles included in the WTO agreement on Trade Facilitation, although in a re-organized fashion (some articles are similar or share components). These indicators give information on several trade facilitation measures, like for instance “information availability”, “formalities”, “advance rulings” or “governance and impartiality”. Each TFI corresponds to the simple average score obtained over specific criterion (they are more than a hundred), each of them being coded as a multiple binary scheme (0, 1 or 2) in which the top score (2) corresponds to the best performance.

2.1.2 An estimate of the Trade Facilitation Agreement using TFIs

Building on the definition of these TFIs, Moisé et al. (2013) try to evaluate how an improvement in trade facilitation measures (such as the Trade Facilitation Agreement) can have an impact on trade costs and use gravity estimations to do so. For each of the 12 indicators, the authors consider the average between partners $TFI_*^c = \sqrt{TFI_i^c TFI_j^c}$ and estimate the impact of such average indicator on total trade costs θ_{ij}^k .

In the end, the estimated coefficient and different scenarios on the impact of the Trade Facilitation Agreement on TFIs lead to reductions in total trade costs:

$$\theta_{ij}^{k*} = \theta_{ij}^k (1 - \delta_{ij}^k) \quad (7)$$

Where θ_{ij}^{k*} is the total trade cost after implementing the TFA and therefore δ_{ij}^k is the relative decrease in trade cost due to the agreement. However, the available data on the trade costs reduction is only on a country-by-country basis, and not by bilateral flow. The indicator we have is then:

$$\delta_i^k = \frac{1}{2J} \sum_j \delta_{ij}^k + \delta_{ji}^k \quad (8)$$

2.2 Scenarios for the Trade Facilitation Agreement (TFA)

In order to correctly evaluate potential impact of the Trade Facilitation Agreement, and starting from the trade costs reductions δ_i^k , we need to proceed in two steps. The first step is to find a country-pair-specific reduction in trade costs δ_{ij}^k , and then to implement it in MIRAGE.

2.2.1 Towards a bilateral reduction in trade costs

We start from average trade cost reductions δ_i^k .⁵ In order to recover bilateral information, we need to assume a specific functional form that links the bilateral reduction to country-specific characteristics.

The retained functional form should (i) allow for the trade cost reduction to vary from 0 to 1, since an iceberg cost cannot be negative and the TFA is not supposed to increase costs ; (ii) preserve tractability by relying on one country-specific variable, such that the system of equation we solve remains square, and (iii) in each specific country pair make most of the reduction operated by the country with the highest initial trade cost. To match these three criteria, we use a geometric average of country-specific effort ϕ_i^k , weighted by a country-specific score of trade cost s_i^k .

$$\delta_{ij}^k = (\phi_i^k)^{\frac{s_i^k}{s_i^k + s_j^k}} (\phi_j^k)^{\frac{s_j^k}{s_i^k + s_j^k}} \quad (9)$$

This functional form also has interesting properties. It is multiplicative, so that the contribution to the reduction in trade costs can be shared in any proportion between the two countries. Sensitivity to this functional form has also been tested both regarding the functional form and regarding the weighting scheme.

Weighting scheme We use a country-specific score s_i^k to allocate the effort between exporter and importer. In order to make sure that these scores will allocate most of the decrease in total trade costs to the country which has more progress to do on trade facilitation, the weights are computed as the average iceberg trade cost $iceberg_{ij}^k$ (i.e. once tariffs, transportation and export tax are deduced from total trade cost) over imports and exports.

$$s_i^k = \frac{\sum_j iceberg_{ij}^k X_{ij}^k + iceberg_{ji}^k X_{ji}^k}{\sum_j X_{ij}^k + X_{ji}^k} \quad (10)$$

Solving for country-specific effort Once we have selected the functional form and weighting scheme, we are left with $K \times J$ parameters ϕ_i^k to calibrate, given that we know the value of their $K \times J$ regional average δ_i^k . Given that the analytical solution for such a system is complex to obtain, we rely on the numerical resolution of the following system of equations:

$$\begin{cases} \delta_{ij}^k = (\phi_i^k)^{\frac{s_i^k}{s_i^k + s_j^k}} (\phi_j^k)^{\frac{s_j^k}{s_i^k + s_j^k}} \\ \delta_i^k = \frac{1}{2J} \sum_j \delta_{ij}^k + \delta_{ji}^k \end{cases} \quad (11)$$

under the constraint that $0 < \phi_i^k < 1$

⁵We aggregate the δ_i^k provided at the MIRAGE level using GDP as weight

Alternative specifications Since the specification chosen to make reductions bilateral is ad-hoc, we define alternative specifications that also match our criteria:

$$\left\{ \begin{array}{ll} 1 - \widehat{\delta}_{ij}^k = \left(1 - \widehat{\phi}_i^k\right)^{\frac{s_i^k}{s_i^k + s_j^k}} \left(1 - \widehat{\phi}_j^k\right)^{\frac{s_j^k}{s_i^k + s_j^k}} & \text{with } \widehat{\phi}_i^k < 1 \\ \bar{\delta}_{ij}^k = \frac{s_i^k}{s_i^k + s_j^k} \bar{\phi}_i^k + \frac{s_j^k}{s_i^k + s_j^k} \bar{\phi}_j^k & \text{with } 0 < \bar{\phi}_i^k < 1 \end{array} \right. \quad (12)$$

In addition to these alternative specifications, each of the three specifications (the central one and the two just above) will be tested with 2 alternative weighting schemes: one with equal scores ($s_i^k = 1$) and one with a score that is the simple average of iceberg trade costs.

2.2.2 Scenarios for the TFA

To sum up, the modelling strategy is the following. During the “business-as-usual” (BAU) scenario, no TFA is implemented. However, several BAU assumptions impact the different components of total trade costs – following the baseline calibration from Fontagné and Fouré (2013), which was designed to make BAU trade growth consistent with past observations. In particular, total factor productivity growth in the transportation sector is higher than other services by 2 percentage points. In addition, the ad-valorem equivalent for time spend in customs is assumed to follow the decline observed in the data (not due to an agreement on trade facilitation), i.e. a reduction by 25% by 2035. During the BAU, total trade costs will also vary due to the change in transportation costs as determined endogenously by the model.

Regarding TFA scenarios, the information we finally obtain from the estimations by OECD and the “bilateralization” we provide is about a reduction in total trade costs Θ_{ij}^{kt} and not directly in iceberg trade costs $iceberg_{ij}^{kt}$. In addition, we need to take into account that transportation costs vary endogenously in the model at the same time as we implement the TFA. As a consequence, during TFA simulations, iceberg trade costs $iceberg_{ij}^{kt}$ will be adjusted endogenously such that total trade costs Θ_{ij}^{kt} match the objective estimated in Section 2.2.1, given the endogenous transportation cost – as described in Equation 6.

We will consider two potential outcomes of the TFA, as estimated by the OECD, depending on how zealously countries implement the agreement. Namely, we consider two partial implementation (“pi”) of the Trade Facilitation agreement, where the highest value for each indicator is attributed only to countries who pledged positive commitment over respectively 75% of TFI subcomponents (“pi75”), and more restrictively over 95% of TFI subcomponents (“pi95”). As a comparison, we also consider a full, instantaneous tariff liberalization (with no change in trade facilitation policy), labelled as “tariff”.⁶

⁶Alternatively, the OECD also provides among others a “full-implementation” scenario, in which the maximum indicator value is attributed to all countries. Although useful as a benchmark, such an assumption seems unrealistic.

Table 1: Summary of scenarios

Item	Expression	BAU Scenario	TFA Scenarios
Total trade costs	Θ_{ij}^{kt}	Endogenous	Reduction determined by scenario (“pi75” or “pi95”)
Transportation costs	$\mu_{ij}^k \frac{P^{Tr,kt}}{P^{Y,kt}}$	Endogenous	Endogenous
Iceberg trade costs	$iceberg_{ij}^{kt}$	-25% by 2035 for the “time-spent” part; constant at calibration level for the rest	Endogenous
Tariffs	$Tariff_{ij}^{kt}$	Constant	Constant (“pi”) or full liberalization (“tariff”)
Production tax	$tax_i^{P,kt}$	Constant	Constant
Export tax	$tax_{ij}^{EXP,kt}$	Constant	Constant

3 Results

3.1 Bilateral reductions in trade costs

We present here our estimates for trade cost reduction. Figure 1 presents absolute reduction in total trade cost ($\Theta_{ij}^{*k} - \Theta_{ij}^k$, where Θ_{ij}^{*k} is the total trade cost after TFA implementation) in percentage points as a function of initial trade cost Θ_{ij}^k , for the (less restrictive) “pi75” scenario. Additional lines are drawn to illustrate the shape of the distribution of reductions in percentage of Θ_{ij}^k . In that particular case of a pi75 implementation of the Trade Facilitation Agreement, decrease in total trade cost range from -0.0% to -21.4% , with a median around -7.7% .

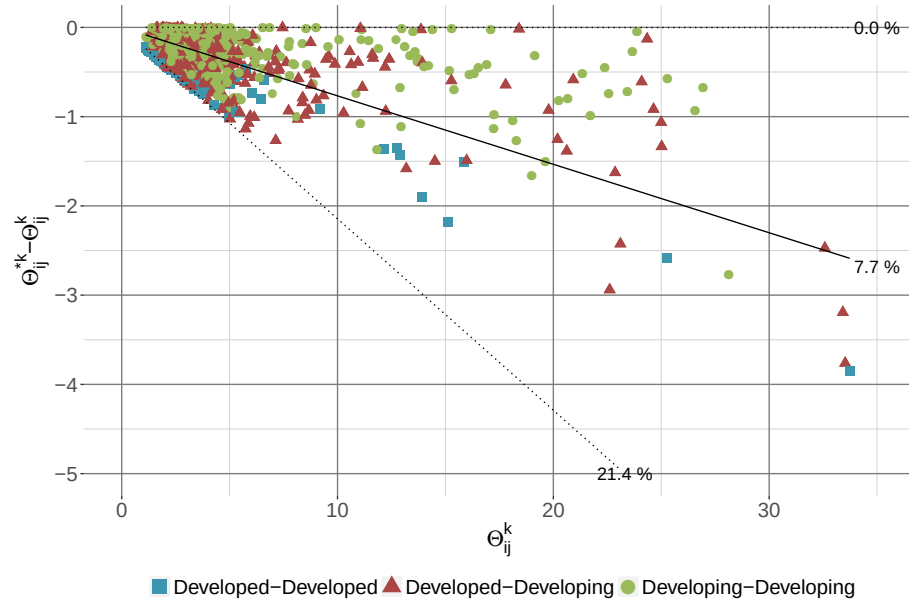
As described in Section 2.2.2, such an impact on *total* trade cost does not directly translate into a decrease in *iceberg* trade costs because it also embodies the variation in transportation costs which are endogenous to MIRAGE.

The second scenario, labeled “pi95” is more restrictive in terms of impacts of the TFA on total trade costs. The bilateral reductions are depicted in Figure 2 and show reduction in total trade cost by between 0 and 27.1% with a median at 5.0%.

In both cases, several trends seem to emerge. First, whatever be the ambition in implementing the TFA, developed countries tend to assume the largest part of reducing trade costs: the upper bound in reduction is hit mainly between developed countries, while the dispersion of reduction in trade costs for other flows is larger. The lowest reductions are only achieved for trade flows concerning developing countries. Although not depicted in Figure 1, the median decrease in trade cost is 19.2% for developed-developed trade, 10.2% for developed-developing and 4.7% for developing-developing trade.

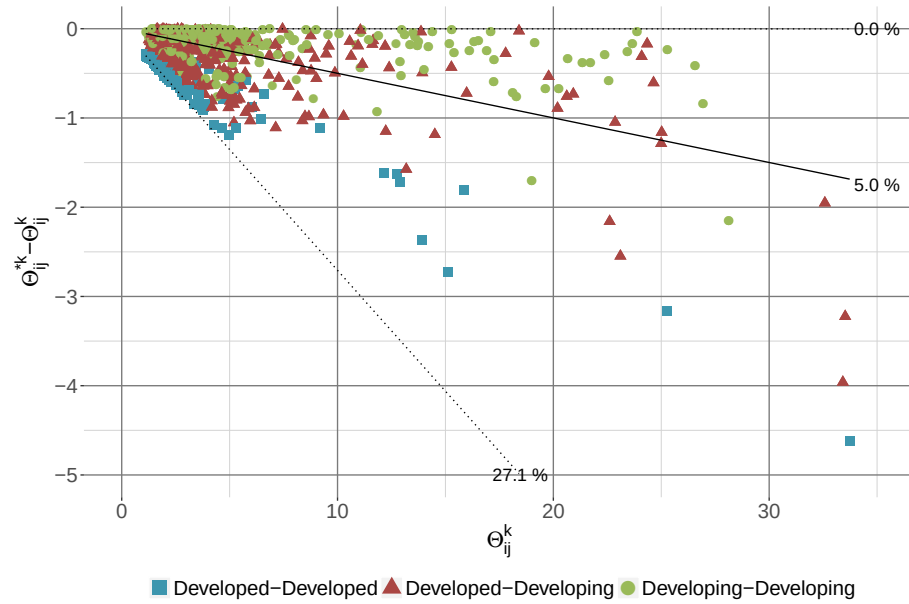
Second, this difference by level of development increases in the “pi95” scenario where TFA is implemented less diligently, as depicted in Figure 2. This reflects the fact that developed countries pledged to improve on more TFI items than developing countries.

Figure 1: Reduction in total trade cost Θ_{ij}^k and initial value (“pi75” scenario)



Note: Lines represent the minimum, 1st decile, median, 9th decile and maximum variation.
Source: Authors' computation based on GTAP9.

Figure 2: Reduction in total trade cost Θ_{ij}^k and initial value (“pi95” scenario)



Note: Lines represent the minimum, 1st decile, median, 9th decile and maximum variation.
Source: Authors' computation based on GTAP9.

3.2 Macroeconomic impacts at zero cost

Now that we have bilateral reductions in total trade cost, we implement the scenarios in MIRAGE. Recall from the theoretical implementation that a drop by $x\%$ in total trade costs will not result in a reduction by exactly $x\%$ in iceberg trade costs, since we need to subtract the impact of the scenario on transportation costs.

We will first focus on the direct impact of the TFA on trade and then turn to actual macroeconomic impacts. Table 2 presents variation in volume export by region due to the TFA in 2030, compared to the baseline.

Table 2: Variation in 2030 Exports in volume due to the TFA, pct. change w.r.t. BAU

Country	pi75	pi95	tariff
Total developed	57.95	68.45	6.66
European Union	39.02	47.12	3.60
EFTA	20.14	25.09	7.88
NAFTA	90.86	106.17	9.28
Japan	103.77	119.78	15.02
Oceania	32.78	36.99	10.06
Total developing	42.01	20.41	19.88
Other Europe	38.36	32.23	16.39
MERCOSUR	91.78	42.46	21.13
Other Latin America	36.30	17.21	21.50
North Africa	2.86	4.47	32.14
Middle-East	5.97	1.75	10.60
Sub-saharan Africa	-5.56	-4.91	27.54
China & HK	58.12	13.18	19.68
India	3.50	-2.36	32.89
Korea & Taiwan	72.94	78.92	18.75
ASEAN	41.99	14.72	14.13
Other Developing Asia	-0.65	-5.44	43.15

Source: Authors' calculations using MIRAGE.

The first noticeable thing in trade results is the wide heterogeneity not only between countries by level of development – and especially in the “pi95” scenario – but also between countries with the same level of development. For instance among developed countries in the more ambitious scenario (“pi75”), the average increase in exports is 58% but variations range between 20% for EFTA to 104% for Japan. Such variations can be explained by the level of commitment, but also by the distribution of destination countries (including between developed and developing regions). It is also worth noting that our simulations show that for two regions – Sub-saharan Africa and to a lesser extent Other Developing Asia – the projected ambition in the TFA implementation is so low compared to other countries that they may lose market shares.

Second, Table 2 shows an interesting pattern when comparing scenarios: on average, a less diligent application of the TFA (mainly by developing regions) can be more profitable for developed countries. The reason for this outcome is that developed countries in the “pi95” scenario keep roughly the same level of opening while developing countries open less compared to “pi75”. As a consequence, potential market share gains for developed countries are greater because they face less competition. The same pattern can also be observed among developing countries: North Africa and Korea and Taiwan seem to benefit from

their competitors' lower ambition.

Finally, results for the full tariff liberalization only are provided in the last column and show that for developed countries the interest for trade facilitation measures is much greater than for tariff negotiations, the potential gains being higher by far. On the contrary, a less ambitious implementation of the TFA is roughly comparable to a full tariff liberalization for developing countries, although in the details this result hides vast heterogeneity.

Table 3: Variation in 2030 GDP in volume due to the TFA, pct. change w.r.t. BAU

Country	pi75	pi95	tariff
Total developed	7.77	9.29	0.27
European Union	8.42	10.13	0.25
EFTA	8.25	10.26	2.37
NAFTA	7.49	8.83	0.06
Japan	7.77	9.48	0.53
Oceania	4.82	5.49	0.43
Total developing	7.64	3.88	1.35
Other Europe	8.79	7.45	0.72
MERCOSUR	9.15	4.13	0.55
Other Latin America	7.29	3.78	1.24
North Africa	1.47	1.75	3.35
Middle-East	1.92	0.51	-0.53
Sub-saharan Africa	-1.06	-0.89	2.35
China & HK	7.78	1.76	1.23
India	1.14	-0.01	3.23
Korea & Taiwan	22.34	24.99	2.16
ASEAN	14.08	5.80	0.91
Other Developing Asia	1.20	0.10	3.70

Source: Authors' calculations using MIRAGE.

The direct impact on trade flows translates into total economic gains, when taking into account potential trade deviation, recalling that we still do not account for the cost of implementation. Results in terms of GDP are displayed in Table 3. First, this table shows that contrary to trade, overall gains are comparable between developed and developing countries. This reflects the lower dependence on trade of developing countries, but with the notable exception of Asian countries (especially Korea, Taiwan and ASEAN countries).

As for trade, the ambition in TFA implementation is key when determining potential gains, in particular for developing countries. In particular, China and ASEAN countries GDP gains can be divided by 4 and 2.5 respectively.

4 Potential costs of a Trade Facilitation Agreement

Implementing trade facilitation measure is not without cost, but the literature often consider such costs as negligible compared to potential benefits. The objective of this section is to review current knowledge on the cost of trade facilitation and try to draw scenarios in order to check the validity of a “no-cost” assumption. To do so, we will gather data in order to build a plausible range of potential costs.

4.1 Review of the literature

To our knowledge, there is no comprehensive analysis on the cost of trade facilitation at the global level. However, several papers focus on past experience of mainly developing countries that implemented trade facilitation measures.

Moïsé (2013) distinguishes between two different types of cost: inception costs (fixed costs that are required once in order to implement trade facilitation measures) and operation costs (regular expenses needed to maintain the trade facilitation measure). Depending on the type of trade facilitation measure, one type or the other dominates. The author analyzes 9 case studies (Burkina Faso, Colombia, Costa Rica, the Dominican Republic, Kenya, Lao PDR, Malaysia, Mongolia and Sierra Leone) to draw conclusions on the relative costs to be covered. Among other, one can think about internet publication of information (customs web site, duty rates, online enquiry desk) for which the authors find that inception costs are far greater than operation costs (with a ratio of 1-to-10) or putting in place a framework for Authorized Economic Operators (AEO). On the other side of the spectrum, we find advance rulings (written decision provided by customs prior to the importation that sets forth the treatment of the good regarding tariff classification, valuation methods, quotas, etc.) where operational costs is higher than inception cost.

This paper, along with its predecessor (Moïsé, 2004), provides more details on a specific part of operation costs: the number of additional staff needed to maintain trade facilitation measures. Data gathered from these papers is summarized in Table 4.

Table 4: Percentage increase in customs staff in case studies

Country	Publication	Internet	Rulings	Appeal	Data	Risk	Audit	TOTAL
Argentina	0.28	0.15	0.64	0.19 ^a	—	1.17	1.97	4.40
Barbados	—	—	1.7	—	—	1.45	4.37 ^a	7.52
Cambodia	—	0.17	—	0.69	—	—	—	0.86
Chile	—	0.15	—	—	—	0.9	—	1.05
Jamaica	—	—	—	—	—	0.54	—	0.54
Mauritius	—	—	—	—	—	2.40	—	2.40
Mozambique	—	—	—	2.67 ^a	1.09 ^a	0.77	—	4.53
Senegal	0.20	—	—	—	0.69 ^a	0.46	4.80	6.15
Tanzania	—	—	—	—	—	2.82	0.91	3.73
Thailand	—	—	—	—	—	—	1.66	1.66
Uganda	—	—	—	—	—	0.66	—	0.66
Zambia	—	—	1.63	1.63	—	1.45	1.45	6.46
Min	0.20	0.15	0.64	0.19	0.69	0.54	0.91	3.32
Max	0.28	0.17	1.7	2.67	1.09	2.82	4.80	13.53

^a : These figures are not directly provided as a percentage increase, and are approximated using other information in the paper.

Source: Moïsé (2004).

From Table 4 we can conclude that from previous case studies that 3.3—13.5% of customs staff is allocated to the operation of trade facilitation measures. This corresponds to an increase in customs staff by between 3.8% and 15.7%. Such evaluation has however a drawback: only developing countries are considered, and we lack of information on developed countries. We will therefore make the assumption that these figures can be applied to developed countries too.

4.2 Assumptions

4.2.1 Customs staff in MIRAGE

Customs staff is not explicit in the GTAP database, nor in the MIRAGE model. The only piece of information available is the aggregate revenue from skilled and unskilled labor in the Public Administration sector (OSG). In order to take into account additional customs staff, we start by gathering data on all public services staff and customs staff in several countries, mainly those for which we have data on staff increases plus two developed countries (USA and France). The majority of the information comes from countries' customs websites, and quite often the year for which data is provided is not explicit. Other sources include approximations using numbers from Moïsé (2004) and data on public employment on the ILO database. As a consequence, this data shall only be interpreted as order of magnitude, and it will help us build a plausible range for potential cost of trade facilitation. Data is gathered in Table 5.

Table 5: Customs and civil service staff in selected countries

Country	Year	Customs staff	Civil services staff	Percentage
USA		25,880	1,800,000	1.44
France	2013	16,870	5,216,000	0.32
Morocco	2014	4,517	865,000	0.52
Tunisia		5,342	700,000	0.76
China	2009	50,000	10,000,000	0.50
Peru	2000	2,629	1,015,900	0.26
Latvia	2004	2,000	313,500	0.64
Argentina		4,619	1,717,000	0.27
Barbados		481	24,500	1.96
Chile		1,333	572,500	0.23
Mauritius		958	94,400	1.02
Senegal		1,458	111,400	1.31
Thailand		6,024	2,878,800	0.21
Min				0.21
Max				1.96

Source: Authors computations based on customs websites, ILO and approximations from Moïsé (2004).

4.2.2 Scenarios

We retain from the data presented above that implementing trade facilitation measures may lead to an increase in customs staff by 3.8—15.7 percent, in countries where customs staff represent 0.2—2.00 percent of total civil services staff. Therefore, we propose to evaluate the operation cost of trade facilitation measures by 0.1—0.3 percent.

As noted above, given that MIRAGE is not a model with heterogenous firms, fixed costs cannot be directly studied and only operation cost can be taken into account. We will however also consider as a sensitivity analysis a potential increase in capital demand. In addition, MIRAGE does not provide employment in number of people or nominal salary, and we do not have information in our data sources about the skill level of the required additional staff. As a consequence, we will consider a tentative measurement of the cost of trade

facilitation measures through productivity.⁷

To do so, we introduce a factor-specific productivity in the production function of MIRAGE’s representative firms, that we will shock for the Public Administration sector.

We consider three variants of potential costs in terms of staff. The “low” variant will consist in increasing labor demand by the minimum observed (3.4% increase in staff)⁸ considering that the share of civil servants in customs services is the lowest (0.2%). At the opposite, the “high” variant assumes the highest increase (13.5%) with the most important customs staff (2.0% of civil servants). Finally, the “shared” variant is intermediate and non-homogenous: this variant assumes an average size of customs in civil service (0.5% of civil servants) and that the cost of implementation varies depending on the average effort of the country.⁹ Alternatively, as a sensitivity analysis, we also present results for the same scenarios and variants but where the productivity scenario is applied on capital in addition to labor.

4.3 Results

In this section we present the results coming from the introduction of the factor cost to implement the TFA. Table 6 presents these results for the “pi75” scenario: the first column recalls GDP gains when no implementation cost is considered, and the subsequent columns present the reduction in these GDP gains after the implementation cost is introduced. For instance in developed countries the initial gain is a 7.77% increase in GDP. Introducing a high cost as labor productivity leads to a lowering of gains by 0.89% (i.e. the increase in GDP including costs is 7.00%), which is a modest cost. This result is also valid for other developed countries, but among developing countries the outcome is again more heterogeneous. On average, the factor cost only represents 1% of GDP gains. This is not the case only for countries whose initial gains are relatively low (North Africa, Sub-Saharan Africa) and this has to be taken with caution: in the “low” and “high” variants, the cost is incurred whatever is the effort regarding implementation of the TFA. In the “shared” variant, the effort is taken into account and as a consequence countries with lower pledges incur lower costs.

Broadly speaking, adding a cost of implementation on capital in addition to labor cost leads to a mitigation of the effects of cost introduction. The reason behind is that the public sector is not very intensive in capital (and unskilled labor) while being more skill-intensive compared to other sectors. As a consequence, after an increase in labor demand, skilled labor will be more impacted and substitution with other factors will be limited, while such substitutions occur more easily when capital productivity is concerned.

⁷We are well aware of the risks of playing with exogenous productivity variations in a CGE, as it allows for building completely ad-hoc results. Yet we propose an evaluation, but advice caution when interpreting the results we provide in terms of costs: we hope our order of magnitude are plausible and only broad conclusion can be drawn from our results.

⁸Starting from Table 4, if $x\%$ of staff is allocated to trade facilitation measures (e.g. 3.3 for the minimum observed), then our scenrio will consist in a increase by $x/(1-x)\%$ of customs staff – 3.4% in our example.

⁹Namely, the average effort is measured by the average of scores s_i^k and the cost linearly increase with effort, the low cost mentioned above corresponding to the lowest effort and the high cost to the highest effort.

Table 6: Variation in 2030 GDP in volume due to the TFA with costs, pct. change w.r.t. BAU, “pi75” scenario

Country	Gains from pi75 (pct. of gains)	Reduction in gains due to Labor cost (pct. of gains)			Reduction in gains due to Labor & Capital cost (pct. of gains)		
		low	shared	high	low	shared	high
Total developed	7.77	-0.02	-0.07	-0.89	-0.01	-0.05	-0.63
European Union	8.42	-0.03	-0.07	-1.15	-0.02	-0.05	-0.87
EFTA	8.25	-0.02	-0.10	-1.03	-0.02	-0.08	-0.86
NAFTA	7.49	-0.02	-0.05	-0.69	-0.01	-0.03	-0.47
Japan	7.77	-0.01	-0.08	-0.59	-0.00	-0.03	-0.20
Oceania	4.82	-0.03	-0.37	-1.42	-0.03	-0.28	-1.11
Total developing	7.64	-0.02	-0.11	-0.70	-0.01	-0.09	-0.57
Other Europe	8.79	-0.01	-0.03	-0.27	-0.00	-0.02	-0.18
MERCOSUR	9.15	-0.03	-0.36	-1.34	-0.03	-0.31	-1.18
Other Latin America	7.29	-0.03	-0.25	-1.44	-0.03	-0.22	-1.30
North Africa	1.47	-0.21	-1.50	-8.96	-0.19	-1.35	-8.02
Middle-East	1.92	-0.09	-0.31	-3.94	-0.06	-0.20	-2.57
Sub-saharan Africa	-1.06	0.11	0.72	4.87	0.09	0.58	3.89
China & HK	7.78	-0.01	-0.06	-0.48	-0.01	-0.05	-0.41
India	1.14	-0.01	-0.07	-0.58	0.00	0.02	0.16
Korea & Taiwan	22.34	-0.01	-0.05	-0.51	-0.01	-0.04	-0.41
ASEAN	14.08	-0.01	-0.04	-0.42	-0.01	-0.03	-0.36
Other Developing Asia	1.20	-0.06	-0.46	-2.58	-0.03	-0.26	-1.46

Source: Authors’ calculations using MIRAGE.

When it comes to the (more restrictive) “pi95” scenario, the same interpretation as for the previous scenario still holds, but the orders of magnitude for costs in terms of GDP are higher. In the low and high cost variants, this result is not very informative (we add the same cost to every country as if they had implemented fully the agreement), but the “shared” variant tells us that this result still holds even when developing countries are less diligent (recall that in this scenario the cost is proportional to the effort in implementing the TFA).

These results about the cost of trade facilitation have however a drawback: since we implement the cost in terms of productivity, the effect on the economy is not exactly the same as if the public sector simply hired staff. In particular, a productivity loss in this sector will imply an increase in price of the public good produced in the model, hence diminishing the demand for public services. On the contrary, implementing the TFA should lead to an increased consumption of public good by exporting firms. In order to deal with this issue, along with other issues about the ad-hoc specification chosen in the body text, we provide a sensitivity analysis in Appendix A where we introduce an additional subvention to labor in order to maintain the production of public services at its no-cost level (the standard “pi75” scenario), and this simple assumption is sufficient to double the cost of implementation in the “high” labor cost variant – but this cost still represents less than 2% of TFA GDP gains. This suggest that further attention has to be paid to this modelling issue, especially for cases where the cost incurred are likely to be higher.

Along with this issue of modelling the increase in labor demand, Appendix A also provides a sensitivity analysis on the specification of score and functional form in Section 2.2.1. This sensitivity analysis broadly confirms our results

Table 7: Variation in 2030 GDP in volume due to the TFA with costs, pct. change w.r.t. BAU, “pi95” scenario

Country	Gains from pi95 (pct.)	Reduction in gains due to Labor cost (pct. of gains)			Reduction in gains due to Labor & Capital cost (pct. of gains)		
		low	shared	high	low	shared	high
Total developed	9.29	-0.02	-0.06	-0.75	-0.01	-0.04	-0.53
European Union	10.13	-0.02	-0.06	-0.96	-0.02	-0.04	-0.72
EFTA	10.26	-0.02	-0.08	-0.83	-0.02	-0.07	-0.70
NAFTA	8.83	-0.01	-0.04	-0.59	-0.01	-0.03	-0.40
Japan	9.48	-0.01	-0.07	-0.49	-0.00	-0.02	-0.16
Oceania	5.49	-0.03	-0.32	-1.25	-0.02	-0.25	-0.97
Total developing	3.88	-0.03	-0.21	-1.37	-0.03	-0.17	-1.12
Other Europe	7.45	-0.01	-0.03	-0.32	-0.00	-0.02	-0.21
MERCOSUR	4.13	-0.07	-0.77	-2.92	-0.06	-0.68	-2.55
Other Latin America	3.78	-0.06	-0.47	-2.74	-0.06	-0.43	-2.49
North Africa	1.75	-0.18	-1.27	-7.58	-0.16	-1.14	-6.78
Middle-East	0.51	-0.35	-1.15	-14.80	-0.23	-0.76	-9.65
Sub-saharan Africa	-0.89	0.14	0.86	5.81	0.11	0.69	4.64
China & HK	1.76	-0.05	-0.27	-2.06	-0.04	-0.23	-1.77
India	-0.01	1.21	6.55	51.56	-0.33	-1.72	-14.48
Korea & Taiwan	24.99	-0.01	-0.05	-0.46	-0.01	-0.04	-0.37
ASEAN	5.80	-0.02	-0.08	-0.99	-0.02	-0.07	-0.86
Other Developing Asia	0.10	-0.70	-5.28	-29.76	-0.39	-3.03	-16.80

Source: Authors’ calculations using MIRAGE.

(ranking between gains in developed and developing countries, magnitude of cost impact).

Conclusion

In this paper, we tried to evaluate potential gains from the trade facilitation agreement, including when the implementation of such an agreement is costly. It turned out that, although developing countries are more concerned by trade facilitation issues, the outcome of the agreement seems to be particularly in favor of developed countries, where the main economic gains are likely to happen. Furthermore, there is so much heterogeneity in countries’ commitments that some participants of the agreement face the risk of lagging behind their competitors, and even loose market shares at the profit of countries with higher commitments.

On average, the cost of implementing trade facilitation measures does impede economic gains from the reduction in transaction cost, especially if the agreement is less diligently implemented, but these costs remain modest compared to the direct impact of trade facilitation measures. Although we identified some sensitivity of this result to the modelling of implementation costs, our sensitivity analysis confirms that they remain marginal. This allows us to conclude that the main potential issue with the trade facilitation agreement is not that trade facilitation measures are tremendously costly, but rather that the implementation of the agreement should to be monitored to guarantee that no country is lagging behind the others.

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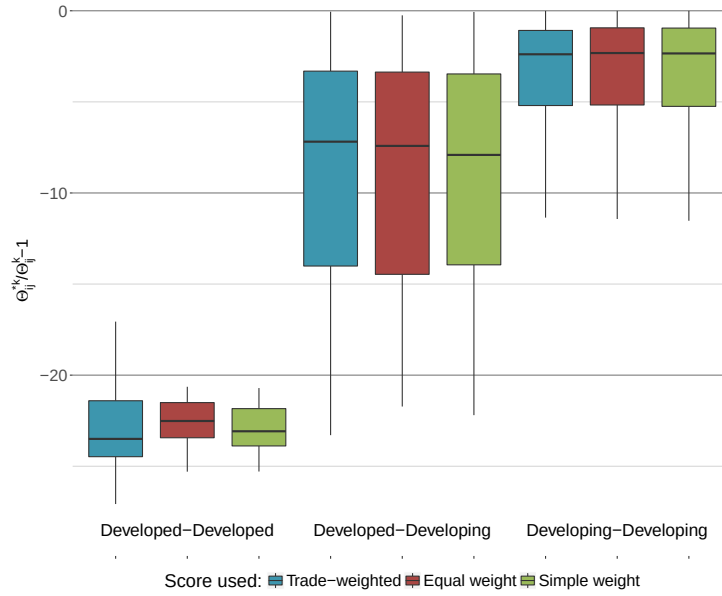
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A Sensitivity analysis

A.1 Sensitivity to score specification

Figure 3: Reduction in total trade cost Θ_{ij}^k under alternative score specifications (“pi75” scenario, pct. change)



Note: Lines represent the 1st decile, 1st quartile, median, 3rd quartile and 9th decile.
Source: Authors' computation based on GTAP9.

A.2 Sensitivity to specification for bilateral reductions

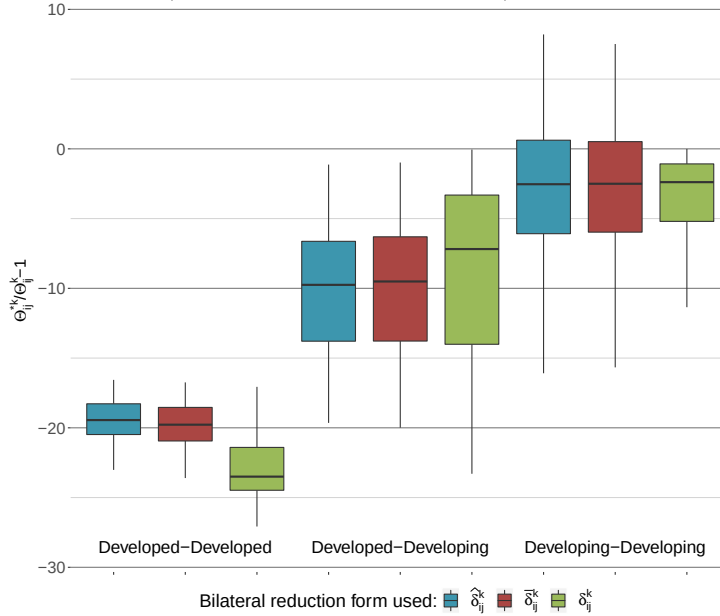
A.3 Sensitivity to cost implementation

Table A.8: Variation in 2030 GDP in volume due to the TFA with costs, pct. change w.r.t. BAU, alternative score specifications

Country	Trade-weighted	Equal weight	Simple weight
Total developed	7.77	7.42	9.22
European Union	8.42	10.13	10.03
EFTA	8.25	10.26	10.18
NAFTA	7.49	8.83	8.78
Japan	7.77	9.48	9.43
Oceania	4.82	5.49	5.42
Total developing	7.64	3.88	3.82
Other Europe	8.79	7.45	7.43
MERCOSUR	9.15	4.13	4.01
Other Latin America	7.29	3.78	3.67
North Africa	1.47	1.75	1.62
Middle-East	1.92	0.51	0.43
Sub-saharan Africa	-1.06	-0.89	-0.94
China & HK	7.78	1.76	1.73
India	1.14	-0.01	-0.02
Korea & Taiwan	22.34	24.99	24.87
ASEAN	14.08	5.80	5.74
Other Developing Asia	1.20	0.10	0.07

Source: Authors' calculations using MIRAGE.

Figure 4: Reduction in total trade cost Θ_{ij}^k under alternative reduction form specifications ("pi75" scenario, pct. change)



Note: Lines represent the 1st decile, 1st quartile, median, 3rd quartile and 9th decile.
Source: Authors' computation based on GTAP9.

Table A.9: Variation in 2030 GDP in volume due to the TFA with costs, pct. change w.r.t. BAU, alternative specifications

Country	Multiplicative	Linear	Cumulative
Total developed	7.77	7.70	7.65
European Union	8.42	8.33	8.23
EFTA	8.25	8.17	8.09
NAFTA	7.49	7.44	7.40
Japan	7.77	7.72	7.70
Oceania	4.82	4.75	4.70
Total developing	7.64	7.59	7.52
Other Europe	8.79	8.76	8.72
MERCOSUR	9.15	9.03	8.92
Other Latin America	7.29	7.18	7.08
North Africa	1.47	1.34	1.24
Middle-East	1.92	1.84	1.77
Sub-saharan Africa	-1.06	-1.11	-1.16
China & HK	7.78	7.74	7.68
India	1.14	1.13	1.12
Korea & Taiwan	22.34	22.22	22.12
ASEAN	14.08	14.02	13.95
Other Developing Asia	1.20	1.17	1.13

Source: Authors' calculations using MIRAGE.

Table A.10: Variation in 2030 GDP in volume due to the TFA with costs, pct. change w.r.t. BAU, alternative cost specification for pi75

Country	Gain from pi75 (pct.)	Reduction in gains due to Labor cost (pct. of gains)	
		high	with sub.
Total developed	7.77	-0.89	-1.63
European Union	8.42	-1.15	-2.25
EFTA	8.25	-1.03	-1.99
NAFTA	7.49	-0.69	-1.16
Japan	7.77	-0.59	-0.92
Oceania	4.82	-1.42	-2.46
Total developing	7.64	-0.70	-1.52
Other Europe	8.79	-0.27	-0.80
MERCOSUR	9.15	-1.34	-2.47
Other Latin America	7.29	-1.44	-2.81
North Africa	1.47	-8.96	-15.63
Middle-East	1.92	-3.94	-7.43
Sub-saharan Africa	-1.06	4.87	9.04
China & HK	7.78	-0.48	-1.24
India	1.14	-0.58	-1.84
Korea & Taiwan	22.34	-0.51	-0.97
ASEAN	14.08	-0.42	-0.91
Other Developing Asia	1.20	-2.58	-6.06

Source: Authors' calculations using MIRAGE.