Staff Working Paper: Research ERSD-2024-01 **12 February 2024**

World Trade Organization

Economic Research and Statistics Division

TARIFF SPILLOVERS AND NEW RULES FOR MULTILATERAL TARIFF NEGOTIATIONS

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Manuscript date: 12 February 2024

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Tariff spillovers and new rules for multilateral tariff negotiations*

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ABSTRACT: Some countries have voiced unease about differences between their own tariff rates and those of major trading partners, calling for more "reciprocity". These calls raise the question how large the negative spillover effects of countries' tariffs on others have become over time. Given a presumed sense of "reciprocity" at the end of the Uruguay Round and for subsequent WTO accessions, an important question for the future of multilateral trade negotiations may be how cross-cutting formulae or "rules" could be developed that might address such spillovers. In this paper we (i) analyze the spillover effects of tariffs and (ii) explore possible tariff liberalization rules and their economic effects, employing the WTO Global Trade Model. We measure the spillover effects of tariffs by the export or terms of trade losses incurred by trading partners. The analysis shows that there are large differences in the per capita spillover effects of tariff rates and that about 70% of the spillover effects can be explained by initial tariff rates, the share in global imports, population, and a product's trade elasticity. Five possible tariff liberalization rules are introduced, with the fifth one being based on the determinants of the negative spillover effects on other countries. Simulating the tariff liberalization rules shows that they would address such spillovers to different extents and lead to global export increases of about 3%, with increases of more than 20% for some countries. Real income effects are positive in most regions, although welfare does not increase in all regions because of negative terms of trade effects. Under the fifth rule, real income and terms of trade effects are related to the adverse spillover effects imposed in other countries, i.e. regions generating larger adverse spillover effects benefit from smaller real income gains or incur larger real income losses. However, this relation is not perfect, suggesting that flexibility may be needed in the implementation of the rule.

Keywords: Tariff negotiations; reciprocity; terms of trade effects; CGE-modelling

JEL codes: F14

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*Thanks are due to Sofia Schroeter for excellent research assistance, to Edvinas Drevinskas for provision of tariff data, and to Robert Koopman who encouraged us to explore the topic of reciprocity in tariff negotiations.

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1 Introduction

The previous government of the United States has expressed unease about unequal tariff rates. As an example, former US President Trump has repeatedly referred to tariffs on passenger vehicles on which the US imposes 2.5% tariffs and faces a duty rate of 10% in the EU and 25% in China. Hence, there were calls for so-called reciprocal tariffs, in which the US would raise tariffs to the level imposed by its trading partners (absent tariff reductions of the latter to the level of the former). In fact, such an approach would lead to an increase in US tariffs for most of its trading partners. In Congress, the so-called "United States Reciprocal Trade Act" was proposed, giving the US President the right to impose the same tariff rates on products as the US is facing. Such a reciprocal tariff policy could be at odds with current tariff bindings and core WTO disciplines, such as the most-favoured nation (MFN) principle, one of the cornerstones of the multilateral trading system and in itself grounded in economic theory.[1] Nevertheless, the underlying concerns of such proposals merit further analysis, as they may relate to the uneven spillovers of countries' existing tariffs on other countries, given how the structure and shares in world trade have evolved in almost three decades, since Uruguay Round negotiations were concluded.

We employ the WTO Global Trade Model, a recursive dynamic computable general equilibrium (CGE) model to conduct the analysis. This model is similar in setup to the new quantitative trade models, such as Costinot and Rodriguez-Clare (2013). In comparison to these models the Global Trade Model includes various additional features such as non-homothetic preferences, a split of final demand into its various components, an adjusting trade balance, investment and capital accumulation. A comparison of the two classes of models can be found in Bekkers (2019). A formal description of the employed model can be found in Aguiar et al. (2019). In a first step, we analyze spillovers in more detail, by examining the trade and welfare losses that a country imposes on others by having tariffs in place. Employing our quantitative trade model, tariffs are eliminated for each country individually to analyze how the trade and welfare of trading partners is affected by such tariffs being in place. We then use the results of this exercise to determine the drivers of the spillover effects of currently applied tariffs. The analysis of the spillover effects of actual tariffs shows that there is a wide variation across countries as far as trade, terms of trade and welfare spillovers are concerned. In absolute terms, the countries generating the largest spillover effects in trade are the big countries and regions, such as China, the EU, India and the US. In per capita terms the largest spillovers (ranked by the size of spillover effects) are generated by tariffs of the Republic of Korea, Australia, the Kingdom of Saudi Arabia, the EFTA countries, the Russian Federation, high income Asian countries and the US. Although it seems at first sight difficult to identify clear common characteristics in the countries with the largest spillover effects, a regression analysis shows that more than 70% of the variation in spillover effects, as measured by lost exports or lost terms of trade, can be explained by only a few variables: the initial tariff rates, population, the share of imports in global imports, and the sectoral trade elasticity. Spillover effects rise in initial tariff rates[2], the

[1] Non-discrimination is required for efficiency purposes if more than two countries are involved in the negotiations, in order to prevent opportunistic gains from reciprocal liberalization at the expense of non-participants. For more see Bagwell and Staiger (2002).

[2] Interestingly, the spillover effects do not rise more than proportionally in initial tariff rates. This result seems

share of a country in global imports, and the sectoral trade elasticity, and fall in population.

In a second step, we formulate five possible tariff liberalization rules. We start with a practical "benchmark" tariff liberalization rule based on the "large country" argument, using the G20 as a proxy for the world's major economies. The other rules are directly inspired by the analysis of the determinants of spillover effects of tariffs. The five liberalization rules are: (i) a reduction of tariffs to the lowest/average bound tariff rate in all G20 countries; (ii) a reduction in proportion to initial tariffs (equal per cent reduction from initial tariffs); (iii) a reduction of tariffs in proportion to the share in global imports; (iv) a reduction of tariffs in proportion to the share in global demand (both imported and domestic), such that larger players in the global market imposing larger terms of trade losses on other countries have to reduce tariffs more; and (v) a reduction of tariffs based on the determinants of the negative spillover effects on other countries. Under this rule both countries with higher initial tariffs and countries with a larger share in global imports should do more to reduce spillover effects from their tariffs in the global economy. More precisely, countries would reduce tariffs based on the relationship of their initial tariff rates and their share in global imports relative to the global averages of these variables.

In our exercises, the tariff liberalization rules are implemented at the HS6-level. We calculate the implied changes in tariffs at the GTAP sector level, which serve as inputs into the model to simulate the economic repercussions of the different rules.[3]

Evaluation of the different tariff liberalization rules generates four main insights. First, the largest average reduction in tariffs would occur for the liberalization rule reducing tariffs to the minimum of G20 countries and the smallest reduction would be implied by a rule reducing tariffs to the average of G20 countries. Hence, rough "pragmatic" rules are bound to lead to a high degree of variation and imprecision in outcomes. Second, both in percentage points and as a per cent reduction of initial tariffs, the reductions in tariffs under the spillover rule are larger in low income regions. This is due to the fact that low-income regions display higher initial tariff rates and that these are an important determinant of the spillover effects of tariffs. Third, regions reducing tariffs more according to the spillover rule also encounter larger reductions in tariffs faced on their exports on average, although this relationship is far from perfect, with certain regions benefiting less on the export side. Fourth, the simulations provide insights into the relative importance of the initial tariff rate component and the global import share component in the fifth tariff liberalization rule that is based on the spillover effects of tariffs. The analysis shows that the initial tariff component is more important under the spillover rule in terms of the reduction of tariff rates in percentage points than the global import share component. The reason is not that this variable has more weight in the formula, but that the rule is operationalized by comparing the determinants of spillovers relative to the global average. Tariff rates are reduced under this rule based on a country's average of a variable relative to the global average. Initial tariff rates across regions tend to deviate more from average rates than

to deviate from a core principle of tax analysis that the welfare loss of a tax rises more than proportionally in a tariff. Our findings are not at odds with this principle, since we focus on the spillover effects of tariffs on other regions and not on the welfare losses for the country imposing a tariff.

[3]The rules could, of course, also be applied for tariff liberalization negotiations at a more detailed tariff line level.

countries' shares in global imports compared to the average share in global imports. Therefore, some developing countries would have to reduce tariffs more substantially than other regions.

Simulations with the different tariff liberalization rules allow us to assess the real income and production effects in different regions, thus providing guidance on where exemptions to the liberalization rules may need to be made. The main results are as follows: First, the trade effects of the various rules are positive: Global trade is projected to increase between 0.3% and 3.7%, with the spillover rule generating trade increases of about 2.8%. Second, real income effects are positive for most regions, and global real income is also positively affected under the different rules. However, owing to negative terms of trade effects, real incomes are negatively affected for some countries under some of the rules. Third and more generally, the simulations show that the distribution of gains across countries varies a lot depending on the outcome variable considered. Focusing on increases in exports (a mercantilistic perspective), countries such as Bangladesh and Pakistan display the largest gains. However, these countries are also the ones with the largest reductions in welfare (real income) and terms of trade. The latter result can be explained by the fact that these are also the countries with the largest tariff reductions on the import side, thus generating the largest terms of trade reductions. Hence, focusing on export gains might be misleading. Fourth, the simulations show that both the projected real income and terms of trade effects of countries under the spillover rule are related to the spillover effects they impose, i.e. regions generating larger adverse spillover effects benefit from smaller real income gains or incur larger real income losses. However, for some regions the real income and terms of trade effects are more positive or negative than what would be required according to the spillover effects they impose on other regions.

The last result suggests that the relative weighting of the components in tariff liberalization rules could be part of the negotiations to mitigate possible negative effects for developing countries.[4] As noted above, our analysis shows that some developing countries, such as Bangladesh and Pakistan, could incur larger terms of trade losses than required by the spillovers rule. Under this rule, East Asian and Southeast Asian countries, such as China, the Republic of Korea, Japan, Indonesia, and High-income Asia, would benefit from terms of trade gains, whereas terms of trade losses are projected for other developing countries as well as rich countries and regions such as the EU and the US.

Various strands of literature are relevant for our work. First, there is the literature on reciprocity in trade negotiations. For long, common wisdom has been that reciprocity defies a rigid (and economically based) definition, but refers to a purely political concept ("reciprocity is in the eye of the beholder") (Jackson, 1997).[5] At the same time, it has been noted that reciprocity is crucial to make trade agreements work and lead to increased trade opening over time.[6] Bagwell and Staiger (2001) introduce a mercantilist definition of reciprocity under which

[4] In fact, Hoda (2001) documents that in past negotiating rounds, even when formula approaches were used, significant deviations were negotiated for specific items and countries, and for some countries the formula was not applied at all.

[5] Indeed, while reciprocity is explicitly mentioned in GATT Article XXVIII bis (tariff negotiations), there is no precise definition in these or relevant disciplines in other areas, such as services.

[6] Reciprocity makes exporters from bystanders to opponents of tariff protection in their country – a process that will trigger the so-called "juggernaut" effect of increased liberalization over time (Baldwin and Robert-Nicoud, 2015).

a set of reciprocal tariff reductions is characterized by a balance of concessions if they lead to equal increases in the volume of exports and imports of each country. Using the framework of Bagwell and Staiger, Shirono (2004) finds that tariff liberalization under the Uruguay Round has indeed been reciprocal, and Finger (2005) confirms this from a political "mercantilist" perspective. Raimondos and Woodland (2018) modify the definition of reciprocity, imposing the requirement that the volume of trade increases by the same proportion in each country, and Freund (2017) explores to what extent different forms of reciprocity reduce power asymmetries. In a second and related strand of the literature, several scholars have analysed the economic effects of different tariff liberalization rules. Panagariya (2002) proposes different rules for tariff reductions in multilateral negotiations. Francois and Martin (2003) study the history of tariff negotiations and introduce a new tariff liberalization rule, the extended Swiss formula, which is related to our second rule. A range of studies, such as Bouet et al. (2007), Fontagné et al. (2005), Gouel et al. (2011) and others, examine different proposals for tariff liberalization under the Doha Round, including different formulae and the treatment of tariff peaks, in terms of their trade and welfare impacts.

Our paper seeks to make three main contributions to this literature. First, we develop a framework to analyze the spillover effects of a country's tariffs on other countries which can also be used in future work to analyze the spillover effects of other policies such as subsidies. We show that a small number of variables can explain most of the variation in the spillover effects of tariffs. Second, we propose a set of new tariff liberalization rules, which - to varying degrees - are anchored in our analysis of the spillover effects of tariffs. This analysis also illustrates that taking better account of spillovers may improve perceptions of reciprocity in tariff liberalization negotiations. Third, we study how such novel tariff liberalization rules would work out in practice in terms of trade and welfare impacts, when introduced at a global level, finding support for past practices of individual exceptions and special treatment at the country and sectoral level.

The paper is organized as follows. The next section provides an overview of our model and the construction of baseline data. Section 3 examines the size and drivers of tariff spillovers of different countries. Section 4 looks at the design of possible different tariff liberalization modalities and their trade and welfare impacts. Section 5 concludes.

2 Methodology

This section first provides a description of the quantitative model we employ. We then present the way in which spillover effects are analyzed. Finally, we map out the different tariff liberalization rules.

2.1 Quantitative model: WTO Global Trade Model

We employ the WTO Global Trade Model (GTM) to analyze both spillover effects from tariffs and to explore the economic effects of different tariff liberalization rules. The GTM is a recursive dynamic extension of the standard GTAP CGE model containing various additional features, such as endogenous capital accumulation and a choice between different ways to model trade,

notably an Armington and Melitz structure. In the model, a representative agent in each country spends her income (consisting of both factor income and tax and tariff revenues) on three types of final goods (private household consumption, government consumption, and savings). Welfare of the representative agent, defined as her real income, is thus impacted by changes in factor income, tax and tariff revenues, and prices of the different final goods.

Trade is modelled according to the Armington assumption, with consumers spending their income on goods from different countries of origin with a love-of-variety for varieties from each country, i.e. a desire to differentiate spending across goods from different origins. Savings in each country are channeled to a global trust which allocates global investment funds to different regions according to changes in the rate of return: regions with rising rates of return attract additional investment funds. This so-called closure rule determines changes to the trade balance. Firms produce employing both intermediate goods and factor inputs (capital, land, natural resources, and high-skilled and low-skilled labor). In the recursive dynamic version of the model, investment leads to additional capital over time. The supply of land is fixed and natural resources are characterized by an isoelastic supply function. Changes in labor supply are determined by IMF labour force projections together with projections on changes in education according to IIASA. Labour productivity grows endogenously over time, targeting IMF projections of GDP per capita growth.

Tariff liberalizaton rules are explored with the recursive dynamic version of the model over a five year period from 2018 to 2023. The GTAP Data Base, Version 10.2 with base year 2014 is aggregated to 28 regions (the G20 countries, some additional populous countries, such as Bangladesh and Nigeria, and regions covering the rest of the world, split up by geography), 35 goods, and 5 production factors. The 2014 data are first projected to 2018 using the recursive dynamic model and the IMF growth projections for GDP per capita, employment and population.

As a large number of simulations are required for the analysis of spillover effects iterating over both sectors and countries, this is done with the comparative static model (without capital accumulation) for the year 2018. In order to prevent changes in trade balances to have a large impact on the analysis, the ratio of the trade balance to GDP is fixed in this exercise. Further details about the GTM can be found in Aguiar et al. (2019), providing a technical description of the model, and Bekkers et al. (2018) containing a detailed overview of the mathematical structure of a model very similar to the GTM.

2.2 Analyzing spillover effects

The spillover effects of tariffs of country i in sector s onto other countries are analyzed by calculating how other countries are affected by the tariffs of country i in sector s. To do so, the tariffs of country i in sector s are reduced to zero. This exercise shows the impact of tariffs imposed by country i in sector s on their trading partners, given tariffs in other regions and other sectors. Three different metrics (changes in variables of trading partners) are employed to determine spillover effects: (i) trade volumes; (ii) welfare; and (iii) the terms of trade component

of welfare. For better comparability these metrics are analysed on a per capita basis.[7]

The outcomes of the spillover exercise are used to construct averages at the country level for the three metrics of spillover effects and to study the determinants of spillover effects, such as the initial tariff levels, the size of GDP, and the share of a country's imports in global imports. The outcome of this analysis will be used for the design of a possible spillover-based rule for tariff negotiations.

2.3 Tariff liberalization rules

We explore five different tariff liberalization rules, with the first rule acting as a pragmatic "benchmark" of operationalizing the "large country" argument in economics and the following four rules being grounded in the economic rationale of reducing negative spillovers and focusing on the main determinants of the latter. The tariff liberalization rules are implemented based on MacMap ITC data on applied and bound tariffs at the HS6 level and are aggregated to the 35 GTAP sectors used in the quantitative analysis by calculating trade weighted averages. The tariff liberalization rules are formulated for bound tariffs and will lead to actual reductions in applied tariffs whenever the new bound rate is below the initial applied tariff. The following tariff liberalization rules are examined:[8]

1. Reduction of bound tariffs to the average or lowest bound tariff rate of the G20 countries

   The G20 economies may be seen as the economically largest countries. Therefore, the lowest G20 tariff rate could constitute an ambitious tariff liberalization rule aiming to harmonize tariffs at the lowest level of the biggest economies in the world. Alternatively, the average G20 rate is a less ambitious but equally pragmatic rule, which would not lead to reductions in tariffs for some country-sector combinations, where bound tariffs are already below the G20 average.

2. Reduction of bound tariffs by an equal percentage of initial bound tariffs

   This rule implies that countries with a higher initial tariff will have to reduce rates more substantially. In the main text we analyse reductions by 50% of initial tariffs. As will be discussed below, this rule is inspired by the fact that higher initial tariff rates generate larger negative spillover effects on other countries. Historically, it has also been reflected in the application of the so-called "Swiss formula" of tariff reductions, which was employed for industrial goods tariff negotiations in the Tokyo Round (Hoda, 2001) and was proposed again for the Doha Round (e.g. Bouet et al., 2007).

3. Reduction of bound tariffs in proportion to the share in global imports per HS6 line

   This rule implies that countries with a larger share in global imports will have to reduce bound tariffs more substantially. The rule is inspired by the finding, discussed below, that countries with a larger share in global imports generate larger spillover effects. The rule

[7] This choice can be motivated as follows. If the aim of new tariff negotiations would be to achieve an equal reduction in spillover effects of tariffs of different countries, it should not be the case that splitting up a country into two would lead to a smaller required tariff of the two countries.

[8] Where applicable, the assumed per cent reductions for tariffs, market share thresholds etc. are purely hypothetical and for illustration purposes.

is implemented in two ways, with and without a threshold level such that only countries with larger import shares have to reduce tariffs.

(a) Reduction of bound tariffs in proportion to the global import share

Under this rule, countries reduce bound tariffs by 50 per cent of their initial bound tariffs times their own share in global imports divided by the import share of the country at the first quartile of the share in global imports. Import shares are calculated at the HS6 level based on MacMap ITC data. This implies that countries with a higher share in global imports than the first quartile reduce tariffs by more than 50 per cent of their initial bound tariff and countries below this share by less, based on the ratio of a country's own share in global imports and the first quartile benchmark import share.

(b) Reduction of bound tariffs in proportion to the global import share with threshold

Under this rule, only countries in the top quartile of largest imports in terms of share in global imports at the HS6 level reduce tariffs by 50 per cent of their initial tariffs. The other countries do not reduce tariffs for the specific HS6 line.

4. Reduction of bound tariffs in proportion to the share in total demand (imported and domestic) per HS6 line

This rule is identical to the previous one, except for the fact that it is based on a country's share in total demand for a given HS6 product line instead of only import demand. As such, it addresses a potential problem of the previous rule that large regions with high initial tariffs and therefore small initial imports would not have to reduce tariffs by much.

Since no data are available on domestic sales at the HS6 level for a large cross-section of countries, domestic spending at the HS6 level is approximated combining detailed trade data from MacMap with domestic spending data from the GTAP Data Base. In particular, domestic spending of country i for HS line k is constructed by multiplying domestic spending of country i in GTAP sector s to which HS line k belongs with the share of imports of country i in total imports in HS line k in import demand of country i in all HS lines belonging to GTAP sector s. Hence, for the lack of data this rule implicitly assumes that the share spent domestically on HS line k in GTAP sector s is equal to the corresponding share spent on imports.

5. Reduction of tariffs in proportion to the negative spillover effects onto other countries

This tariff liberalization rule depends on the analysis on the determinants of spillover effects in Section 3 and will thus be discussed in detail in this section.

3 Spillover effects of actual tariffs

Figure 1 displays the total trade spillovers for the different countries examined, defined as the loss in exports of a given country due to other countries' tariffs and summed up on a sector-by-sector basis. It shows that the largest export losses are generated by the tariffs encountered

in big countries and regions, such as China, the EU, India and the US. In Figure 2 trade spillovers are displayed in per capita terms. This figure conveys a different message. In per capita terms, the largest export losses are generated by the tariffs in place in the Republic of Korea, Australia, the Kingdom of Saudi Arabia, EFTA countries, the Russian Federation, high income Asian countries and the US, ranked by the size of spillover effects. The spillover effects engendered by Korean tariffs are about 50% larger than the ones from Australia, which comes second.

Figure 1: Trade spillovers: loss of exports by trading partners because of tariffs by country x

Figure 2: Trade spillovers per capita: loss of exports by trading partners because of tariffs by country x

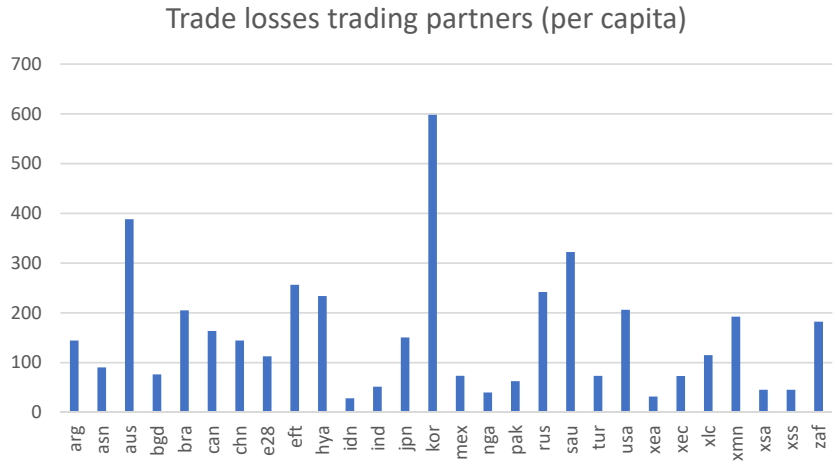


Figure 3 shows the spillover effects in per capita terms based on the terms of trade component of welfare. Although the figure looks similar to Figure 2, there are some remarkable differences. Although the EU generates limited trade spillovers, it is second in causing terms of trade effects. This seems to indicate that the EU has high tariffs in place in sectors in which large terms of trade gains could be realized.

Finally, Figure 4 displays the per capita spillover effects in terms of total welfare impacts in trading partners. The figure looks similar to Figure 3 with the Republic of Korea, the EU and

Figure 3: Terms of trade spillovers per capita: terms of trade losses by trading partners because of tariffs in country x

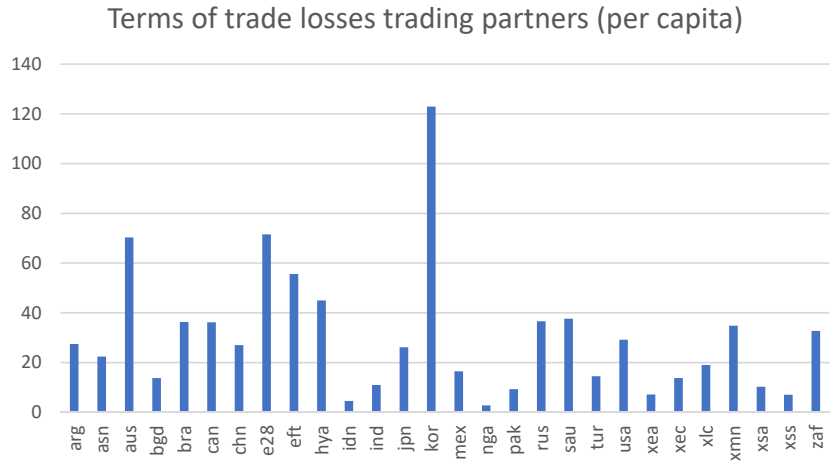


Figure 4: Welfare spillovers per capita: loss of welfare in trading partners because of tariffs in country x

Australia's tariffs exerting the largest negative welfare effects on trading partners.[9]

Next, we analyze econometrically the determinants of the spillover effects across all countries and sectors. Table 1 shows the results of the per capita spillover effects in terms of exports (first three columns), terms of trade (fourth column), and total welfare (fifth column). About 70% of the per capita impact on the export volumes and terms of trade of trading partners can be explained by a small set of variables. For welfare the explained variation is about 50% lower,

[9]Total spillover effects (and not per capita) for terms of trade and welfare are displayed in the Appendix, respectively in Figures A1 and A2. Note that welfare losses imposed on trading partners from tariffs in Nigeria, the Kingdom of Saudi Arabia, and the Russian Federation are negative (i.e. these tariffs are actually improving the welfare of other countries). In the applied modelling approach, this is due to the specific situation of predominantly oil-exporting nations with trade surpluses. Specifically, regions with a trade surplus see their welfare go down if the price of savings and investment rises. A rise in the price of investment goods (e.g. due to a tariff) raises nominal income on the one hand, but it also reduces the return on investments on the other. (More formally, in the model the utility from savings falls when its price rises since savings are one of the goods consumed by the representative agent). Due to the predominance of oil exports, these regions have sizeable trade surpluses and this investment channel dominates the other channels (changes in distortions and changes in terms of trade). See for further discussion Huff and Hertel (2000).

Table 1: Determinants of spillover effects onto trade partners

	(1) log(Exports)	(2) log(Exports)	(3) log(Exports)	(4) log(ToT)	(5) log(Real-Income)
Log(Initial tariffs)	0.899***	0.925***	0.931***	0.949***	0.769***
	(28.47)	(35.07)	(39.93)	(39.65)	(26.18)
Log(GDP per capita)	0.788***	0.0639	0.0702	0.130*	0.113
	(13.88)	(1.05)	(1.30)	(2.44)	(1.73)
Log(Population)	-0.0511	-0.807***	-0.805***	-0.781***	-0.654***
	(-0.89)	(-12.89)	(-14.56)	(-14.38)	(-9.48)
Log(Share in global imports)		0.819***	0.821***	0.875***	0.675***
		(18.83)	(21.36)	(23.11)	(13.37)
Log(Substitution elasticity)			1.698***	1.505***	1.407***
			(15.13)	(13.43)	(10.04)
Constant	-7.697***	6.162***	3.065***	1.275	0.609
	(-11.03)	(6.56)	(3.59)	(1.52)	(0.57)
Observations	815	815	815	805	717
R^2	0.504	0.655	0.731	0.739	0.568

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

which is related to the presence of outliers such as Nigeria and the Kingdom of Saudi Arabia whose spillover effects are very specific.

Five variables are included in the regression to explain the variation in spillover effects (all in logs allowing us to interpret the coefficients as elasticities). First, the coefficient on initial tariffs is close to one for the different specifications and spillover variables, thus corresponding to a roughly proportional effect. A one per cent increase in initial tariffs leads to a 0.9 per cent increase in the export losses of trading partners.[10]

Second, GDP per capita displays a positive coefficient of about 0.8 if the share in global imports is not included as a control variable. Once controlling for the share in global imports, GDP per capita becomes insignificant. This implies that the larger spillover effects in richer countries are driven by the fact that richer countries demand a large share of global imports.

Third, population is insignificant without controlling for the share in global imports. When controlling for the share in global imports, the coefficient on population becomes negative and significant, around -0.8 for trade and terms of trade spillovers and around -0.65 for welfare. This indicates that in per capita terms more populous regions generate less spillover effects. We do not have a straightforward explanation for this finding, but hypothesize that it could be due

[10]Spline regressions (not displayed) indicate that the coefficient is close to 1 for all tariff levels. This means that we do not find support for a stronger distortionary effect at higher tariff rates. Also, from the literature on optimal taxation it is known that the distortionary impact of tariffs on a country's own welfare rises more than proportionally in tariff rates. We have tested whether this is also the case for welfare effects imposed on other countries. Table A1 shows that the quadratic term is negative indicating that the welfare losses imposed on others do not rise more than proportionally with the tariff rate. For own welfare the squared tariff rate is positive but not significant.

to the fact that more populous regions tend to import a smaller share of their total demand, because larger regions tend to be less open (Ramondo (2016)).

Fourth, the share of imports in global imports is highly significant with a coefficient around 0.8 in all specifications. This indicates that a larger share in global imports increases trade, welfare and terms of trade losses imposed on other countries.

Fifth and finally, a larger sectoral trade elasticity leads to larger spillover effects, with a coefficient of around 1.5 for the different spillover metrics. This result is expected: a larger elasticity leads to a stronger reduction in import demand and thus trading partners' exports.[11]

Based on this empirical analysis, we design a fifth rule for tariff liberalization that reflects as much as possible the tenet of reducing international spillovers. Rather than taking total spillovers into account, we propose a rule based only on the explained variation in spillovers as a function of the small set of explanatory variables discussed in previous paragraphs. This has three advantages. First, it leads to a relatively simple rule for tariff liberalization that is nevertheless based on 70% of the explained variation in spillover effects. Second, by focusing on the explained variation we avoid taking into account the influence of accidental factors driven by modelling choices, such as the result for oil-exporting countries under a fixed trade balance. Third, the proposed rule does not depend on simulations of the size of spillover effects of different countries for a specific dataset and a specific year.

Under the proposed rule, tariffs are reduced in proportion to the explained variation in spillover effects. More specifically, the following specification is employed:

$$\frac{\Delta tar_{ik}}{tar_{ik}} = \left(\beta_{tar}^{metr} \frac{tar_{ik}}{\overline{tar}} + \beta_{gdppc}^{metr} \frac{gdppc_i}{\overline{gdppc}} + \beta_{pop}^{metr} \frac{pop_i}{\overline{pop}} + \beta_{impsh}^{metr} \frac{impsh_{ik}}{\overline{impsh}} + \beta_{\sigma}^{metr} \frac{\sigma_k}{\overline{\sigma}} \right) \quad (1)$$

The coefficients $\beta_{var}^{metr}; var = tar, gdppc, pop, impsh, \sigma$ are taken from Table 1 and can vary by spillover metric, $metr = trade; welfare; tot$.

4 The impact of tariff liberalization rules on trade and welfare

The tariff liberalization rule developed at the end of the previous section is based on the trade spillover effects of existing tariffs on other countries. The question is how this rule will perform when implemented by all countries simultaneously. In this section we explore the potential trade and welfare effects by implementing the spillover based rule (as well as the other rules) in the recursive dynamic version of the WTO Global Trade Model. First, we compare the tariff reductions under the different rules, then we look at the trade effects and finally we evaluate the real income and terms of trade effects.

4.1 Tariff changes

When implementing the various tariff liberalization rules for all countries/regions simultaneously, we obtain the average change in tariffs of the different countries/regions, as displayed in Table 2 in percentage points and in Table 3 as a percentage cut in initial tariff rates.

[11] In the model employed the trade elasticity is equal to the substitution elasticity (minus one) between varieties from different regions. A larger substitution elasticity leads to bigger shifts away from imports when tariffs increase.

Table 2: Change in tariff rates under different liberalization rules, in percentage points

Region	1. Cut tariffs to Minimum G20	1. Cut tariffs to Average G20	2. Equal % cut of initial bound tariff	3. Cut in proportion to import share	3. Cut in proportion to import share with threshold	4. Cut in proportion to total demand share	5. Tariff rule based on trade spillovers
Argentina	-9.70	-1.92	-1.45	-2.72	-0.22	-1.92	-10.97
ASEAN	-1.96	-0.34	-0.59	-1.23	-0.34	-0.64	-1.72
Australia	-3.69	-0.97	-0.99	-2.94	-0.81	-1.04	-2.72
Bangladesh	-11.23	-2.58	-5.38	-7.07	-2.81	-4.82	-11.58
Brazil	-9.44	-1.68	-1.47	-6.48	-0.82	-5.56	-10.36
Canada	-2.40	-0.36	-1.15	-2.20	-0.95	-1.18	-2.04
China	-3.61	-0.16	-1.67	-3.59	-1.66	-3.53	-2.16
EU	-0.87	-0.02	-0.41	-0.79	-0.40	-0.57	-0.86
EFTA	-0.65	-0.52	-0.16	-0.35	-0.09	-0.16	-0.67
High income Asia	-1.14	-0.03	-0.50	-0.65	-0.18	-0.34	-0.90
Indonesia	-2.14	-0.14	-0.39	-1.55	-0.19	-0.97	-1.67
India	-6.58	-1.42	-0.77	-4.91	-0.63	-5.07	-2.29
Japan	-3.16	-2.37	-1.54	-3.26	-1.72	-2.86	-3.15
Korea, Republic of	-5.04	-11.75	-1.81	-4.35	-1.43	-3.48	-4.70
Mexico	-2.38	-0.22	-0.31	-1.59	-0.37	-0.75	-2.41
Nigeria	-10.91	-1.89	-5.11	-6.47	-2.11	-3.89	-10.73
Pakistan	-8.54	-1.74	-1.70	-3.75	-0.44	-2.07	-7.58
Russian Federation	-7.22	-0.92	-3.47	-6.68	-2.94	-5.24	-7.06
Saudi Arabia, Kingdom of	-3.98	-13.01	-0.77	-3.27	-0.53	-1.92	-2.24
Türkiye	-1.52	-1.79	-0.53	-1.14	-0.30	-1.00	-1.21
USA	-1.87	-0.05	-0.90	-1.95	-0.90	-1.92	-1.64
Other East Asia	-2.12	-0.35	-0.67	-0.23	-0.03	-0.06	-2.01
Other Central Asia	-3.07	-0.30	-1.52	-1.01	-0.26	-0.52	-3.01
Other Latin America	-3.59	-0.46	-0.54	-0.67	-0.04	-0.35	-3.18
Other Middle East	-5.19	-1.45	-1.73	-2.66	-0.62	-1.52	-3.95
Other South Asia	-8.40	-1.76	-2.71	-2.33	-0.56	-1.20	-7.78
Other Sub-Saharan Africa	-8.97	-1.67	-3.21	-2.80	-0.73	-1.50	-8.93
South Africa	-5.85	-1.05	-1.44	-2.04	-0.45	-1.51	-5.77
Average	**-4.83**	**-1.82**	**-1.53**	**-2.81**	**-0.80**	**-1.99**	**-4.40**

Comparing tariff changes for our different tariff liberalization rules, we find that the largest (smallest) average reduction would occur for the "crudest" rules, i.e. the minimum (average) G20 tariff rule, as a percentage of initial tariffs. The picture is similar for reductions in percentage points, where however rule two based on initial bound tariffs and rule three based on import shares (with threshold) result in even smaller average tariff cuts than the average G20 rule. For individual countries/regions under the minimum G20 rule the largest reductions in terms of percentage points would occur for developing countries, such as Bangladesh, Nigeria, Pakistan, Other South Asia and Other Sub-Saharan Africa. Brazil and the Republic of Korea would also need to reduce their tariffs substantially. The smallest reductions would occur for the EFTA countries and the EU. For reductions as a percentage of initial tariffs, most regions would reduce their tariffs by more than 90% of the initial tariff rates under the minimum G20 rule. This result indicates that the variation in percentage points in the minimum G20 rule is almost entirely driven by differences in initial tariff rates.

More nuanced results are obtained for the economically more refined rules. Importantly, using the most sophisticated rule based on trade spillovers would make an important difference for many countries, in particular in the developing world, with some being required to make substantially larger reductions (both in per cent of initial tariffs and percentage points), such as Bangladesh, Brazil and Pakistan, and others lower reductions (e.g. China, India), when compared to some of the other rules, including those based on cuts in proportion to import or total demand shares.

Table 3: Change in tariff rates under different liberalization rules, in per cent

Region	1. Cut tariffs to		2. Equal % of	3. Cut in proportion to		4. Cut in	5. Tariff rule
	Minimum G20	Average G20	initial bound tariff	import share	import share with threshold	proportion to total demand share	based on trade spillovers
Argentina	-96	-14	-10	-22	-2	-13	-94
ASEAN	-90	-7	-19	-47	-11	-18	-57
Australia	-90	-6	-12	-69	-9	-31	-36
Bangladesh	-95	-18	-43	-52	-17	-32	-94
Brazil	-96	-13	-10	-66	-5	-57	-90
Canada	-96	-22	-40	-91	-35	-55	-66
China	-90	-5	-38	-86	-34	-84	-37
EU	-79	-19	-39	-29	-13	-20	-26
EFTA	-70	-14	-21	-24	-8	-11	-64
High income Asia	-86	-1	-36	-51	-13	-26	-58
Indonesia	-83	-9	-15	-51	-6	-27	-55
India	-96	-5	-19	-70	-9	-71	-28
Japan	-79	-16	-34	-77	-33	-69	-51
Korea, Republic of	-95	-21	-27	-83	-23	-61	-64
Mexico	-94	-4	-3	-69	-2	-25	-65
Nigeria	-94	-13	-44	-59	-18	-35	-87
Pakistan	-95	-10	-7	-37	-4	-19	-66
Russian Federation	-93	-7	-45	-85	-36	-67	-86
Saudi Arabia, Kingdom of	-92	-21	-20	-69	-13	-35	-45
Türkiye	-77	-17	-25	-55	-16	-37	-49
USA	-93	-1	-41	-98	-40	-95	-60
Other East Asia	-82	-9	-26	-8	-1	-1	-63
Other Central Asia	-89	-6	-45	-22	-5	-14	-79
Other Latin America	-86	-10	-11	-15	-1	-8	-69
Other Middle East	-87	-17	-26	-42	-8	-21	-58
Other South Asia	-91	-22	-32	-28	-9	-13	-83
Other Sub-Saharan Africa	-92	-15	-32	-25	-6	-14	-86
South Africa	-90	-8	-18	-31	-8	-16	-79
Average	**-89**	**-12**	**-26**	**-52**	**-14**	**-35**	**-64**

To evaluate the trade spillover rule more systematically we show scatter plots of the relationship between the reductions in tariff rates imposed as an importer, those faced as an exporter and GDP per capita. The left upper panel of Figure 5 shows that importer tariff reductions are larger in low income regions. However, there is a lot of residual variation, with the tariff reduction in, for example, Bangladesh being much larger than in India. The right upper panel shows that the tariff reductions faced as an exporter are also larger for low-income regions, although the correlation with income is weaker and there is also a large degree of residual variation. The middle panels of Figure 5 show the correlation of import tariff changes as a per cent of the initial tariffs with GDP per capita. Also in per cent, tariff changes by importers are larger in low-income regions. This is related to the fact that, according to the spillover rule, regions with larger initial tariffs should reduce tariffs relatively more (in per cent) and that low-income regions tend to have higher tariffs. Finally, the lower panels display the correlation between the changes in tariffs imposed as an importer and the changes in tariffs faced as an exporter. Both in terms of per cent and percentage point reductions, there is a positive correlation between the tariff changes, implying that regions reducing tariffs more also benefit from larger tariff reductions elsewhere. However, the correlation is much tighter for changes in per cent than for changes in percentage points and there is a set of countries, such as Pakistan, Bangladesh, Argentina, and Nigeria, which would reduce tariffs much more on their imports than the reductions they would see for their exports.

Figure 5: The relationship between changes in export and import tariffs, in percentage point (pp) and per cent (%), and GDP per capita

4.2 Projected trade changes

Reflecting the trade-weighted changes in own tariffs, we can also explore projected changes in real imports. Table 4 shows that real imports would increase most in emerging countries like Bangladesh, Brazil and China. Again, comparing between different tariff liberalization rules reveals subtle, but possibly important differences for individual countries/regions. For example, the more sophisticated spillovers rule would result in smaller increases in imports for China and India, but larger ones for Brazil than the (also economically sound, but somewhat simpler) rule based on domestic demand shares. Changes in tariffs cannot be mapped one-to-one into changes in imports. In other words, countries with the largest increases in imports are not always those with the largest reductions in tariffs. One underlying reason for this is the distribution of tariff reductions across sectors in combination with the size of trade elasticities. Of course, general equilibrium effects, such as rising incomes leading to more import demand,

Table 4: Change in real imports under different liberalization rules, in per cent

Region	1. Cut tariffs to Minimum G20	1. Cut tariffs to Average G20	2. Equal % of initial bound tariff	3. Cut in proportion to import share	3. Cut in proportion to import share with threshold	4. Cut in proportion to total demand share	5. Tariff rule based on trade spillovers
Argentina	5.90%	0.50%	1.06%	1.43%	0.32%	1.33%	5.57%
ASEAN	1.64%	0.19%	0.26%	0.64%	-0.05%	0.10%	1.84%
Australia	3.31%	0.04%	0.66%	2.65%	0.53%	1.39%	2.09%
Bangladesh	10.27%	2.82%	4.06%	6.45%	2.22%	5.03%	9.99%
Brazil	12.64%	1.61%	2.15%	9.26%	1.35%	8.15%	12.32%
Canada	0.94%	0.10%	0.40%	0.72%	0.35%	0.35%	0.84%
China	9.37%	0.62%	3.80%	8.11%	3.10%	7.53%	6.27%
EU	1.62%	0.04%	0.57%	1.43%	0.46%	0.97%	1.34%
EFTA	1.61%	0.29%	0.23%	0.55%	0.10%	1.29%	0.76%
High income Asia	2.12%	-0.03%	0.84%	1.47%	0.39%	0.68%	2.07%
Indonesia	3.39%	0.35%	0.15%	2.34%	0.10%	1.77%	2.21%
India	9.51%	1.12%	1.24%	6.95%	0.67%	5.99%	4.34%
Japan	5.06%	0.52%	2.09%	4.77%	1.89%	4.03%	3.91%
Korea, Republic of	5.80%	0.14%	1.42%	4.89%	1.04%	3.57%	4.65%
Mexico	1.59%	0.05%	-0.03%	0.58%	-0.11%	0.18%	1.71%
Nigeria	4.79%	0.36%	1.86%	2.79%	0.79%	1.99%	4.34%
Pakistan	6.52%	0.77%	0.62%	2.63%	0.32%	1.98%	6.26%
Russian Federation	5.88%	0.33%	2.44%	5.88%	2.24%	4.55%	5.57%
Saudi Arabia, Kingdom of	3.01%	-0.07%	0.65%	2.72%	0.60%	1.55%	1.35%
Türkiye	3.33%	0.85%	1.12%	1.20%	0.24%	1.29%	2.40%
USA	2.52%	0.00%	1.10%	2.41%	1.02%	2.40%	1.92%
Other East Asia	1.45%	0.06%	0.46%	0.46%	0.17%	0.56%	1.16%
Other Central Asia	3.83%	0.50%	1.41%	1.37%	0.32%	0.97%	4.10%
Other Latin America	3.61%	0.48%	0.40%	0.43%	-0.15%	0.21%	3.02%
Other Middle East	4.35%	0.95%	1.30%	2.15%	0.48%	1.40%	3.05%
Other South Asia	6.09%	0.67%	1.50%	2.73%	0.67%	2.27%	5.65%
Other Sub-Saharan Africa	4.71%	0.77%	1.36%	0.92%	0.07%	0.23%	4.72%
South Africa	5.11%	0.69%	0.72%	1.75%	0.21%	1.60%	4.80%
Average	**3.71%**	**0.29%**	**1.19%**	**2.81%**	**0.86%**	**2.31%**	**2.83%**

also play a role. This is illustrated in Figure 6, upper panel, showing that, although imports increase more in regions with larger tariff reductions, there is a lot of residual variation.

Projected changes in real exports can be found in Table 5. The countries benefiting most from improved market access are developing countries like Bangladesh and Pakistan. Again, the spillovers rule makes a substantial difference for individual countries/regions, with e.g. Brazil benefiting more strongly from increased exports than under most other rules, and countries, such as China and India, seeing slightly smaller increases than for e.g. the domestic demand-based rule. As expected, figure 6 shows that also on the export side regions facing larger tariff reductions are projected to see larger export increases.

4.3 Projected real income and terms of trade changes

Table 6 displays the projected changes in real income for different regions under the various rules. Although a large majority of countries/regions would gain under most of the rules and the global average change in real income is always positive, some countries face reductions in welfare under certain rules. The reason is that welfare effects are not only affected by the reduction in spillover effects of tariffs in trading partners but also by the reduction of own tariffs which can have both positive (improved efficiency) and negative effects (loss in terms of trade). Hence, the balance of the different effects is not necessarily positive for all regions.

We can abstract from efficiency effects on welfare and focus exclusively on terms of trade

Table 5: Change in real exports under different liberalization rules, in per cent

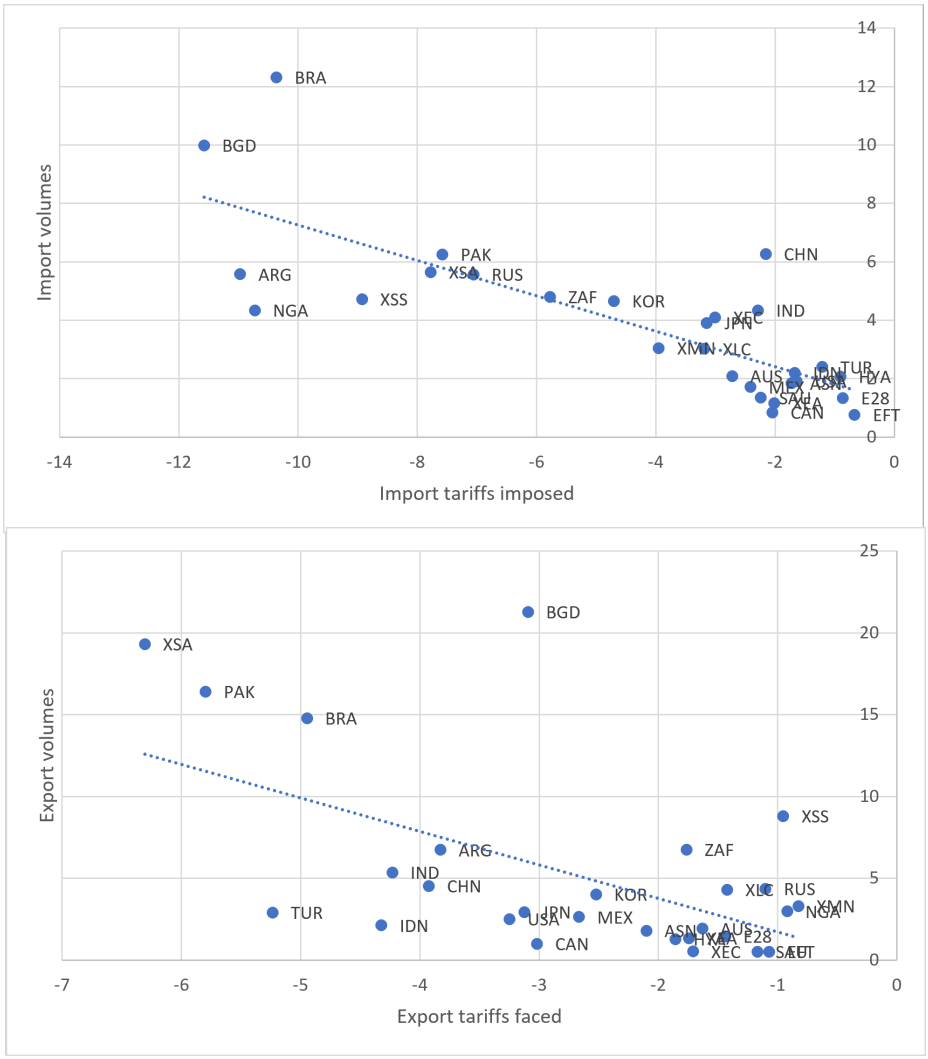
Region	1. Cut tariffs to		2. Equal % of	3. Cut in proportion to		4. Cut in	5. Tariff rule
	Minimum G20	Average G20	initial bound tariff	import share	import share with threshold	proportion to total demand share	based on trade spillovers
Argentina	6.81%	1.01%	0.96%	1.20%	0.02%	1.47%	6.73%
ASEAN	1.85%	0.18%	0.43%	0.64%	0.05%	0.13%	1.79%
Australia	2.86%	0.09%	0.58%	2.18%	0.43%	1.03%	1.92%
Bangladesh	21.54%	4.35%	8.61%	14.52%	5.00%	10.10%	21.28%
Brazil	15.18%	2.03%	2.23%	10.23%	1.24%	9.47%	14.79%
Canada	1.06%	0.13%	0.49%	0.77%	0.38%	0.33%	0.99%
China	7.40%	0.40%	3.05%	6.76%	2.63%	6.39%	4.54%
EU	1.63%	0.04%	0.59%	1.47%	0.47%	0.92%	1.46%
EFTA	1.04%	0.25%	0.11%	0.29%	0.03%	0.93%	0.51%
High income Asia	1.33%	-0.03%	0.59%	0.84%	0.21%	0.35%	1.28%
Indonesia	3.08%	0.23%	0.24%	1.91%	0.11%	1.29%	2.12%
India	12.76%	1.73%	1.49%	9.64%	0.82%	8.74%	5.36%
Japan	3.54%	0.42%	1.50%	3.45%	1.39%	3.00%	2.93%
Korea, Republic of	4.90%	-0.10%	1.17%	4.19%	0.89%	3.14%	4.02%
Mexico	2.58%	0.11%	0.14%	1.13%	0.00%	0.49%	2.63%
Nigeria	3.22%	0.26%	1.26%	1.77%	0.47%	1.21%	2.98%
Pakistan	17.58%	2.01%	1.51%	6.56%	0.54%	5.05%	16.41%
Russian Federation	4.45%	0.30%	1.86%	4.37%	1.68%	3.41%	4.37%
Saudi Arabia, Kingdom of	1.23%	-0.07%	0.24%	1.13%	0.22%	0.58%	0.52%
Türkiye	3.13%	0.37%	0.78%	1.84%	0.51%	1.70%	2.91%
USA	3.14%	0.01%	1.41%	3.14%	1.34%	3.12%	2.51%
Other East Asia	1.51%	0.17%	0.43%	0.34%	0.10%	0.33%	1.35%
Other Central Asia	0.85%	-0.05%	0.80%	-0.57%	-0.29%	-0.78%	0.53%
Other Latin America	4.98%	0.63%	0.60%	0.74%	-0.10%	0.40%	4.31%
Other Middle East	4.59%	1.08%	1.37%	2.10%	0.44%	1.22%	3.31%
Other South Asia	19.46%	2.60%	5.07%	6.01%	1.09%	3.05%	19.31%
Other Sub-Saharan Africa	8.60%	1.40%	2.58%	2.05%	0.34%	0.80%	8.81%
South Africa	6.82%	1.05%	1.31%	2.22%	0.33%	1.83%	6.75%
Average	**3.70%**	**0.29%**	**1.18%**	**2.79%**	**0.85%**	**2.29%**	**2.83%**

effects, which are affected both by the reduction in tariffs of trading partners and a country's own reduction in tariffs. The former leads to terms of trade improvements because of lower tariffs and therefore larger demand for a country's exports with higher export prices as a result. The latter leads to terms of trade losses, because import demand rises as a result of lower tariffs leading to higher import prices (exclusive of tariffs). The terms of trade effects are shown in Table 7. Since changes in terms of trade are a zero sum game, they should add up to zero. The GDP weighted average change in terms of trade is indeed close to zero. Terms of trade losses are substantial in some of the developing countries such as Bangladesh and Pakistan. However, also rich regions like the EU and the US would incur terms of trade losses under different liberalization rules. The last column on the trade spillovers rule shows that it is mainly East Asian and Southeast Asian countries, such as China, the Republic of Korea, Japan, Indonesia, and High-income Asia who would see improvements in their terms of trade.

This analysis also supports another well-known economic insight (sometimes less heeded to in politics): Comparing the real income results (Table 6) with the real export changes (Table 5) shows that export gains may not be a good indicator of gains in welfare for certain countries, notably when terms of trade losses are large (Table 7).

Finally, we can explore to what extent regions imposing larger spillover effects on other regions and thus being required to reduce tariffs more incur larger terms of trade losses and thus smaller real income gains when all regions implement tariff reform simultaneously. Figure 7 depicts both the projected per cent change in the terms of trade (lower panel) and the projected

Figure 6: The relationship between changes in imports and import tariffs imposed and exports and tariffs faced on exports



per cent change in real income (upper panel) on the vertical axis against the per cent change in import tariffs according to the tariff rule based on trade spillovers on the horizontal axis (Rule 5). The figure shows that there is a positive relation between the spillover effects and the real income effects (upper panel) and terms of trade effects (lower panel). Hence, regions generating larger adverse spillovers face a larger reduction in terms of trade and thus benefit less from trade liberalization in terms of real income. As expected, for the real income effects the relationship is not so tight, which is due to the fact that tariff reductions also generate efficiency gains for countries.

The outliers in the relationship between the reductions in spillovers and the projected real income effects of tariff liberalization suggest that flexibility, notably in terms of special and differential treatment, would be required also in the implementation of an economically-based approach, such as our fifth tariff liberalization rule.

Table 6: Change in welfare under different liberalization rules, in per cent

Region	1. Cut tariffs to		2. Equal % of	3. Cut in proportion to		4. Cut in	5. Tariff rule
	Minimum G20	Average G20	initial bound tariff	import share	import share with threshold	proportion to total demand share	based on trade spillovers
Argentina	-0.08%	-0.07%	0.05%	0.05%	0.06%	-0.02%	-0.12%
ASEAN	0.12%	0.13%	-0.06%	0.22%	-0.06%	0.11%	0.37%
Australia	0.21%	0.00%	0.06%	0.20%	0.06%	0.12%	0.15%
Bangladesh	-1.28%	0.01%	-0.46%	-1.01%	-0.31%	-0.54%	-1.31%
Brazil	0.12%	0.03%	0.11%	0.26%	0.09%	0.15%	0.11%
Canada	0.06%	0.00%	0.02%	0.04%	0.02%	0.03%	0.04%
China	0.61%	0.07%	0.26%	0.43%	0.18%	0.37%	0.56%
EU	0.21%	0.03%	0.10%	0.18%	0.08%	0.18%	0.14%
EFTA	0.30%	0.03%	0.07%	0.14%	0.04%	0.10%	0.15%
High income Asia	0.46%	0.01%	0.14%	0.37%	0.10%	0.20%	0.47%
Indonesia	0.27%	0.06%	-0.01%	0.24%	0.00%	0.20%	0.16%
India	0.06%	0.07%	0.03%	0.02%	0.01%	-0.04%	0.20%
Japan	0.67%	0.09%	0.27%	0.60%	0.24%	0.49%	0.49%
Korea, Republic of	0.78%	0.42%	0.38%	0.65%	0.30%	0.50%	0.64%
Mexico	0.01%	0.05%	-0.03%	0.04%	-0.03%	-0.06%	0.04%
Nigeria	0.23%	0.03%	0.12%	0.14%	0.06%	0.11%	0.20%
Pakistan	-0.37%	-0.01%	0.02%	-0.07%	0.03%	-0.06%	-0.31%
Russian Federation	0.25%	0.05%	0.15%	0.28%	0.16%	0.23%	0.24%
Saudi Arabia, Kingdom of	0.44%	0.03%	0.11%	0.37%	0.09%	0.30%	0.24%
Türkiye	0.56%	0.31%	0.27%	0.03%	-0.03%	0.14%	0.31%
USA	0.04%	0.00%	0.02%	0.02%	0.01%	0.02%	0.02%
Other East Asia	0.08%	-0.03%	0.07%	0.08%	0.04%	0.17%	0.04%
Other Central Asia	0.64%	0.13%	0.14%	0.36%	0.10%	0.34%	0.78%
Other Latin America	-0.16%	0.00%	-0.02%	-0.06%	-0.02%	-0.04%	-0.17%
Other Middle East	0.07%	0.08%	0.08%	0.11%	0.05%	0.16%	0.04%
Other South Asia	-0.47%	-0.10%	-0.15%	0.17%	0.10%	0.39%	-0.55%
Other Sub-Saharan Africa	-0.52%	-0.04%	-0.13%	-0.15%	-0.04%	-0.10%	-0.58%
South Africa	-0.54%	-0.03%	-0.15%	-0.08%	-0.04%	0.03%	-0.63%
Average	0.11%	0.05%	0.06%	0.12%	0.04%	0.11%	0.11%

5 Concluding remarks

Against the background of discussions on non-reciprocal tariffs, this paper has explored the spillover effects of countries' tariffs on their trading partners. Our analysis shows that about 70% of the per capita spillover effects can be explained with a small number of variables. We find that (i) higher tariffs lead to proportionally larger distortions (negative spillover effects); (ii) richer countries distort more and populous countries less; (iii) countries with larger shares in global imports distort more; (iv) and distortions are bigger in sectors with larger trade elasticities. The analysis of spillover effects of actual tariffs can provide insights into the design of possible tariff liberalization rules some of which are in line with proposals in earlier negotiations.

First, because spillovers are proportional to tariff rates, tariffs should be cut as a per cent of initial tariffs. The analysis with the Armington model does not find that the spillover effects on other countries rise more than proportionally with tariff rates. Of course, earlier work has demonstrated that the distortionary effects for countries imposing the tariffs rise more than proportionally with tariff rates, leading to calls to eliminate tariff peaks. Hence, even not directly supported by a trade spillover analysis, eliminating tariff peaks can still be a sound policy objective, and for political economy reasons, this might more easily be done in a multilateral context than unilaterally.

Second, the finding that richer countries generate larger spillover effects seems to provide support for the principle of special and differential treatment, since it implies that countries

Table 7: Change in terms of trade component of welfare under different liberalization rules, in per cent

Region	1. Cut tariffs to Minimum G20	1. Cut tariffs to Average G20	2. Equal % of initial bound tariff	3. Cut in proportion to import share	3. Cut in proportion to import share with threshold	4. Cut in proportion to total demand share	5. Tariff rule based on trade spillovers
Argentina	-7.02%	-1.74%	1.38%	1.98%	2.27%	1.22%	-7.85%
ASEAN	-10.16%	-0.90%	-4.00%	-8.29%	-3.23%	-5.80%	-7.44%
Australia	0.55%	-0.26%	-0.20%	1.22%	0.00%	1.67%	-2.84%
Bangladesh	-38.36%	-3.24%	-17.36%	-30.42%	-11.49%	-18.82%	-39.00%
Brazil	-0.81%	-1.06%	1.80%	4.11%	2.28%	1.60%	-2.89%
Canada	-2.62%	-0.16%	-1.27%	-3.06%	-1.25%	-2.98%	-2.53%
China	3.96%	0.17%	1.03%	-0.49%	-0.71%	-2.48%	9.43%
EU	-1.63%	0.09%	-0.95%	-1.42%	-0.54%	-0.28%	-2.19%
EFTA	5.54%	0.22%	1.94%	4.97%	1.50%	4.05%	2.66%
High income Asia	10.66%	-0.93%	3.77%	11.15%	3.80%	8.06%	9.78%
Indonesia	1.49%	-0.25%	-1.91%	2.49%	-1.16%	3.27%	-3.93%
India	-5.42%	-0.68%	-0.93%	-5.27%	-0.70%	-6.61%	3.51%
Japan	26.52%	1.90%	11.43%	24.93%	10.46%	20.30%	18.31%
Korea, Republic of	8.07%	3.06%	1.33%	7.92%	1.01%	4.39%	5.75%
Mexico	-16.11%	-0.39%	-5.10%	-14.63%	-4.58%	-12.52%	-10.85%
Nigeria	0.37%	-0.15%	0.60%	1.13%	1.24%	0.69%	-0.78%
Pakistan	-33.37%	-2.90%	-2.41%	-10.20%	-0.24%	-6.56%	-28.91%
Russian Federation	6.32%	-0.20%	1.98%	5.33%	1.45%	3.93%	0.64%
Saudi Arabia, Kingdom of	7.19%	0.01%	3.94%	6.98%	3.76%	6.09%	2.76%
Türkiye	-3.78%	2.83%	-0.46%	-7.94%	-3.28%	-4.94%	-2.44%
USA	-4.35%	-0.11%	-1.59%	-5.36%	-1.86%	-5.25%	-4.29%
Other East Asia	-3.47%	-0.78%	-0.34%	-0.54%	0.27%	0.35%	-3.60%
Other Central Asia	-2.46%	-0.31%	-0.88%	-0.83%	0.00%	0.04%	-3.70%
Other Latin America	-8.05%	-0.45%	-1.55%	-4.28%	-1.31%	-3.83%	-6.60%
Other Middle East	-1.91%	-1.07%	0.46%	1.13%	1.12%	2.77%	-1.73%
Other South Asia	-3.79%	-1.83%	-1.64%	3.56%	1.41%	6.79%	-6.66%
Other Sub-Saharan Africa	-9.69%	-1.57%	-3.47%	-3.74%	-1.00%	-2.42%	-10.97%
South Africa	-10.88%	-2.07%	-4.84%	-3.43%	-1.95%	-0.80%	-15.72%
Average (population weight)	-4.03%	-0.56%	-1.05%	-2.66%	-0.69%	-2.51%	-1.86%
Average (GDP weight)	-0.30%	-0.02%	0.01%	-0.58%	-0.16%	-0.82%	0.03%

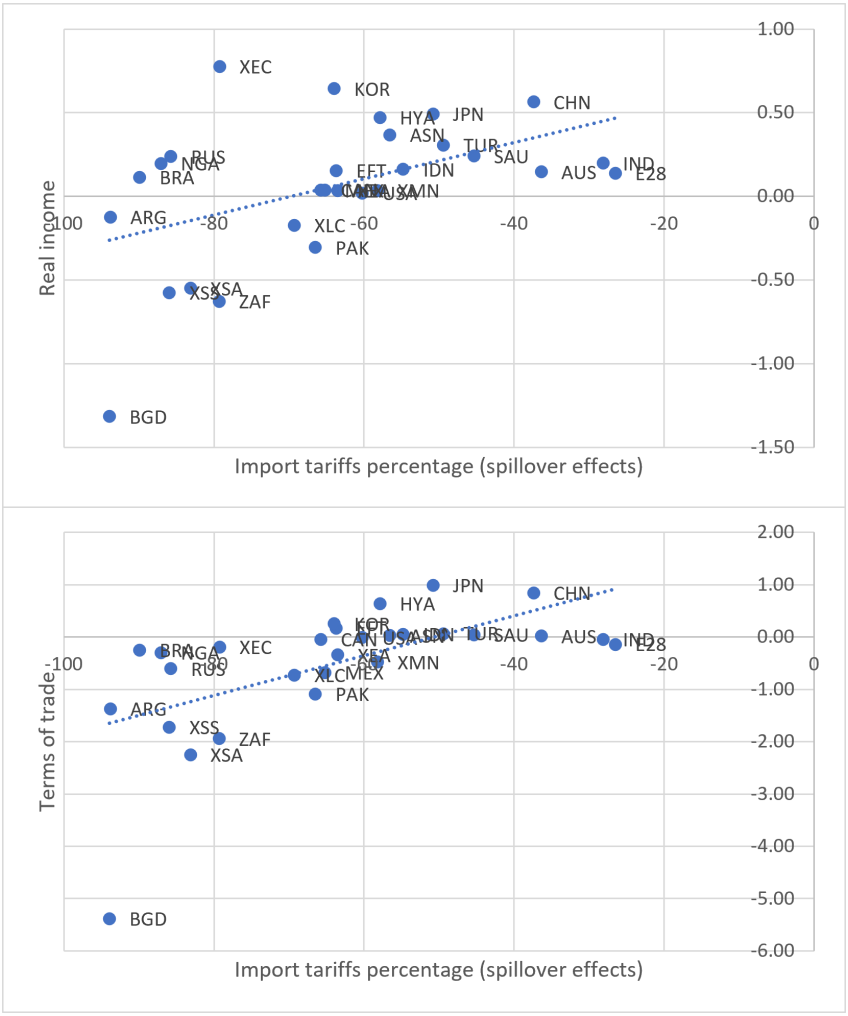
with lower levels of income (GDP per capita) can cut tariffs by less. However, the estimations show that a more precise criterion, the share in global exports, could be used instead of GDP per capita. This criterion is more precise because it can explain a larger share of the spillover effects.

Third, the analysis of spillover effects has implications for the importance of tariff reductions across sectors. Tariffs should be reduced most for products with large trade elasticities, i.e. for products which are highly substitutable. However, estimates of the variation in trade elasticities between products are not always consistent between different studies and methodologies. Therefore, this insight might be more difficult to implement in practice than the other two findings which can be based on publicly available statistics on existing tariff rates and trade shares.

Fourth, simulations implementing the spillover rule for all countries simultaneously show that the projected terms of trade and real income effects are in proportion with the spillover effects, i.e. regions generating larger adverse spillover effects benefit from smaller real income gains or incur larger real income losses. However, this relation is not perfect with some regions incurring larger real income and terms of trade losses than required by the reduction of spillovers from their own tariffs, suggesting that flexibility is needed in the implementation of the rule.

The results presented in this paper should be interpreted with caution for three main reasons

Figure 7: The relationship between projected real income changes and terms of trade changes and the per cent change in tariffs according to Tariff Rule 5 based on trade spillovers



(and more research is needed on these points): First, actual bound tariff rates are the result of negotiations about trade policies over multiple decades in which tariffs were not the only trade policy negotiated, but also other policies such as barriers to services trade and various other trade and trade-related measures. Hence, our analysis of spillovers cannot be used to evaluate the extent to which obligations of different countries in the multilateral trading system are uneven. Second, we do not take changes along the extensive margin into account, which could play an important role in the spillover effects of tariff peaks. Modelling the extensive margin, i.e. shifts from no trade to positive trade, could raise the negative spillover effects of high tariff rates and make the impact non-linear, thus calling for the elimination of tariff peaks, as emphasized in a range of previous studies. Third, it would be interesting to evaluate the spillover effects of other policies, in particular subsidies. The bottleneck in evaluating such policies is that there are no comprehensive data on the size of subsidies in manufacturing and services. Work by international organizations and other institutions is under way in that regard.

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Appendix A Additional simulation results

Figure A1: Terms of trade spillovers: terms of trade losses trading partners because of actual tariffs in comparison to zero tariffs

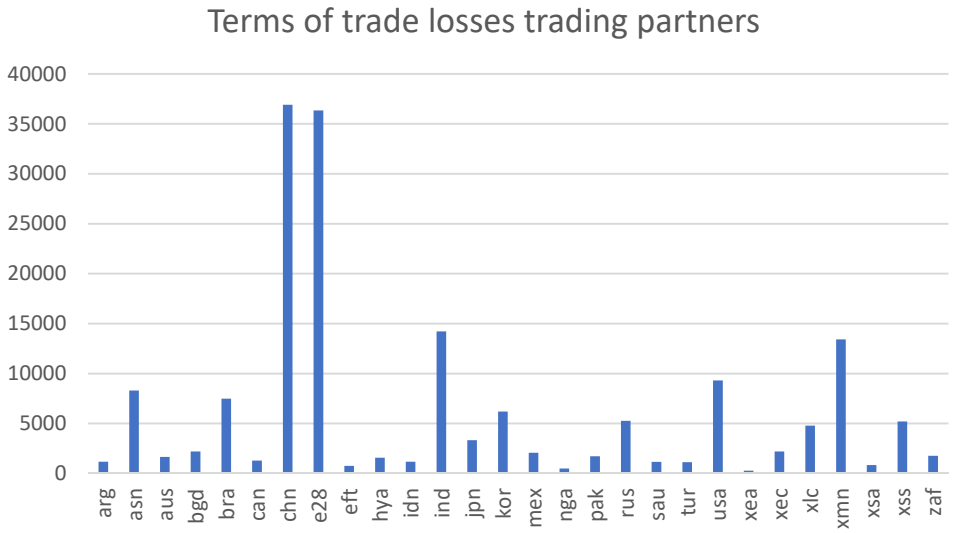

Figure A2: Welfare spillovers: loss of welfare trading partners because of actual tariffs in comparison to zero tariffs

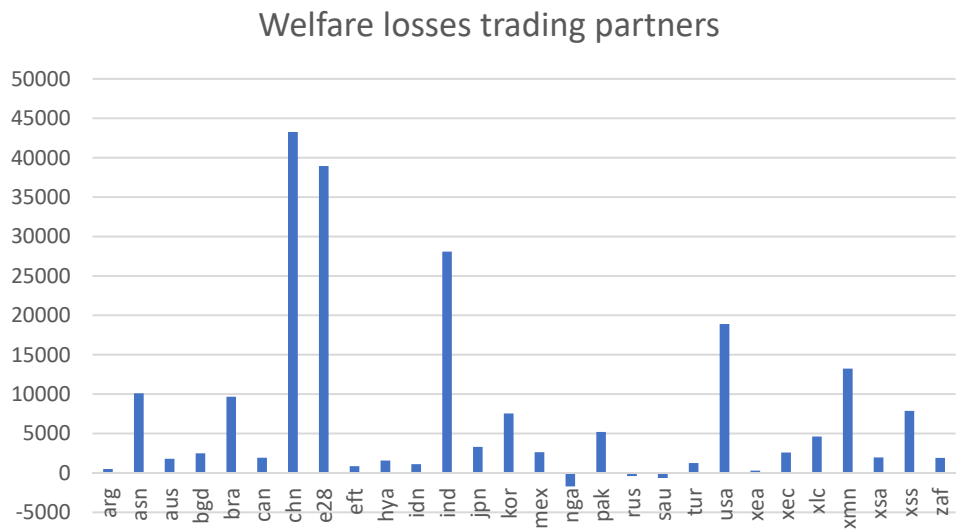

Table A1: Determinants of welfare distortions trade partners

	(1) lvfob_pc	(2) lvfob_pc	(3) lvfob_pc	(4) ltot_pc	(5) lev_pc
Log(Initial tariffs)	0.849***	0.893***	0.896***	0.921***	0.776***
	(23.84)	(29.90)	(34.01)	(34.41)	(23.77)
Log(In. tariffs squared)	-0.0218**	-0.0139*	-0.0150**	-0.0146*	0.00191
	(-2.94)	(-2.24)	(-2.73)	(-2.29)	(0.30)
Log(GDP per capita)	0.846	0.0846	0.124	0.0713	-1.514*
	(1.26)	(0.15)	(0.25)	(0.14)	(-2.54)
Log(GDP per capita squared)	-0.00426	-0.00146	-0.00330	0.00296	0.0904**
	(-0.11)	(-0.05)	(-0.12)	(0.11)	(2.75)
Log(Population)	-0.0505	-0.800***	-0.798***	-0.774***	-0.633***
	(-0.87)	(-12.70)	(-14.37)	(-14.17)	(-9.15)
Log(Share in global imports)		0.812***	0.813***	0.867***	0.678***
		(18.66)	(21.19)	(22.86)	(13.45)
Log(Substitution elasticity)			1.703***	1.499***	1.397***
			(15.22)	(13.39)	(10.00)
Constant	-7.718*	6.131*	2.887	1.593	7.698**
	(-2.57)	(2.34)	(1.24)	(0.69)	(2.75)
Observations	815	815	815	805	717
R^2	0.510	0.657	0.734	0.741	0.573

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A2: Change in tariff rates under different liberalization rules based on spillovers, in percentage points

Region	Tariff rule base on			
	trade spillovers		terms of trade	welfare
	extensive	parsimonious	spillovers	spillovers
Argentina	-10.97	-11.23	-10.92	-11.02
ASEAN	-1.72	-1.76	-1.71	-1.73
Australia	-2.72	-3.22	-2.71	-2.81
Bangladesh	-11.58	-11.64	-11.55	-11.59
Brazil	-10.36	-10.71	-10.32	-10.41
Canada	-2.04	-2.21	-2.05	-2.08
China	-2.16	-3.37	-2.19	-2.11
EU	-0.86	-0.90	-0.86	-0.87
EFTA	-0.67	-0.67	-0.67	-0.67
High income Asia	-0.90	-1.00	-0.90	-0.93
Indonesia	-1.67	-2.19	-1.65	-1.69
India	-2.29	-5.60	-2.30	-2.27
Japan	-3.15	-3.18	-3.15	-3.16
Korea, Republic of	-4.70	-4.71	-4.68	-4.78
Mexico	-2.41	-2.55	-2.39	-2.43
Nigeria	-10.73	-11.28	-10.69	-10.75
Pakistan	-7.58	-9.31	-7.45	-7.52
Russian Federation	-7.06	-7.32	-7.04	-7.10
Saudi Arabia, Kingdom of	-2.24	-3.15	-2.26	-2.42
Türkiye	-1.21	-1.29	-1.20	-1.23
USA	-1.64	-1.67	-1.67	-1.68
Other East Asia	-2.01	-2.06	-2.01	-2.01
Other Central Asia	-3.01	-3.05	-2.98	-3.02
Other Latin America	-3.18	-3.36	-3.16	-3.21
Other Middle East	-3.95	-4.53	-3.96	-4.03
Other South Asia	-7.78	-8.50	-7.73	-7.80
Other Sub-Saharan Africa	-8.93	-9.09	-8.89	-8.95
South Africa	-5.77	-5.84	-5.74	-5.80
Average	**-4.40**	**-4.84**	**-4.39**	**-4.43**
Coefficient variation	**-0.79**	**-0.74**	**-0.79**	**-0.79**