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Competing Liberalizations: Tariffs and Trade in the 21st Century

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Competing Liberalizations: Tariffs and Trade in the 21st Century

Abstract

This paper proposes a unique overview of trade policies trends since the launch of the Doha Round, based on detailed data on tariffs and trade covering 130 countries. We show that regionalism has delivered limited effective liberalization so far, leading to only a 0.3 percentage point (p.p.) cut in the worldwide average applied tariff duty between 2001 and 2013. WTO commitments (1.0 p.p. average cut) and unilateral liberalizations on a most-favored-nation (MFN) basis (1.3 p.p.) mattered far more on average, with more uneven consequences. As a result, we reckon that trade policy changes between 2001 and 2013 more than halved the worldwide welfare gains to be expected from the tariff-cutting provisions of the hypothetical Doha Agreement. If all ongoing RTA negotiations were concluded, expected gains would fall to one-third of their 2001 level.

JEL-Codes: F100, F130, F140.

Keywords: regional trade agreements, unilateral liberalization, Doha Development Agenda, WTO.

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Highlights

• MFN tariffs were cut by one-third between 2001 and 2013, more than half of it as a result of countries' own initiatives.

• Regionalism cut marginally applied tariff duties worldwide by only 0.3 p.p. on average between 2001 and 2013.

• If concluded, ongoing RTA negotiations may lift the share of world trade between RTA partners beyond 50%.

• Trade policy changes between 2001 and 2013 more than halved the worldwide welfare gains to be expected from the tariff-cutting provisions of the hypothetical Doha Agreement. If all ongoing RTA negotiations were concluded, expected gains would fall to one-third of their 2001 level.

1. Introduction

Fifteen years after the launch of the Doha Development Agenda (DDA), the successive multilateral agreements reached in Bali (2013) and in Nairobi (2015) cover only a tiny share of the initial working program. Moreover, their formal implementation, after fraught discussions, remains complicated: Bali's package on trade facilitation has not yet been ratified by the required two-thirds majority. And prospects of reaching a wider agreement seem remote, to say the least. This stalemate is all the more striking given that there has been no shortage of trade policy reform during the last fifteen years. Either as a result of their own policy initiatives or of their commitments upon World Trade Organization (WTO) accession, a number of countries have significantly liberalized access to their market, China and India being cases in point. Regional Trade Agreements (RTAs) have multiplied, to the point where they are taking center stage in the trade policy arena. Meanwhile, the number of preferential agreements has quadrupled in twenty years, and ongoing negotiations between very large economic entities – the so-called mega-deals – could change dramatically the trade landscape. The varied nature of these crisscrossing policy changes (even the scope and depth of RTAs strongly differ from one another, as we document below) makes it difficult to understand how they redefined the trade policy landscape, and what the consequences may be in the near future, as illustrated by the differing interpretations offered: for instance, while Hufbauer and DeRosa (2007) emphasize that "global tariff-cutting over the past decade was dominated by preferential trade agreements", Krishna (2012) concludes instead that "the actual amount of liberalization that has been achieved through PTAs [Preferential Trade Agreements] is actually quite limited".

Against this background, this paper aims to address two questions: What do all these policy changes add up to? What are their consequences, for trade, welfare and multilateral negotiations?

Dealing with the first question requires providing a consistent overview encompassing the different policies at stake. To do this, we focus on tariff protection. Clearly, tariffs are not the only impediment to market access, and non-tariff measures are increasingly important. The growing emphasis on rules in trade agreements, already evident in the Marrakesh Agreement, is a consequence of this trend. However, the trade restrictiveness impact of non-tariff measures (NTMs) is not directly observable, and its assessment raises considerable methodological and data issues. Sophisticated analyses have been carried out to assess their trade impact, for instance through *ad valorem* equivalent (AVE) estimations (Kee et al., 2009 is an example), assessment of the NTM provisions in RTAs (e.g. Cadot and Gourdon, 2015), and by estimating the firm-level impact of NTMs on exports (Fontagné et al., 2015). While each of these approaches provides useful insights, none of them can yet be considered an undisputable basis for providing a robust, comparable and reliable assessment of the trade restrictiveness of NTMs worldwide, let alone of how they evolved over time or of how regional agreements influenced them. While restrictive, the focus on tariff protection allows us to rely upon an indisputable and consistent basis in measuring and comparing trade policy changes. Due to data limitations, our focus is also restricted to tariffs

applied on a permanent, as opposed to temporary, status. Contingent protection, well described in recent works (e.g. Bown, 2011) should also be taken into account to get the full picture of trade policy changes. While it is increasingly well documented,[1] available data did not make it possible to cover the period and countries considered here in an exhaustive and consistent way.

To carry out this broad assessment of the trade policy landscape through tariff protection, we put together an unparalleled database of product-level, consistent information about tariff protection worldwide, from 2001 up to the hypothetical situation where agreements now under negotiation would be signed and fully enforced. Country by country, partner by partner, the same method is used to compute bilateral *ad valorem* equivalent tariffs encompassing all protection components, across the different years considered. The different dimensions of tariff protection are taken into account, making it possible to disentangle commitments under the multilateral system, concessions in the context of reciprocal and non-reciprocal trade preferences, and countries' own trade policy choices. In addition to trade policies observed up to 2013, we also take into account ongoing negotiations and their possible outcome, if they were concluded. We also evaluate the tariff-cutting impact of a hypothetical multilateral agreement, based on a product-by-product application of the latest circulated modalities. This uniquely detailed historical dataset makes it possible to provide a comprehensive picture of multilateralism, regionalism and unilateralism[2] over a relatively long period.

Reflecting on the consequences of these policy changes reminds of the heated debates held in the 1990s about whether regional agreements would be "stepping stones" or "stumbling blocks" for multilateralism. Some, such as Bhagwati (1991) and Krugman (1991a), viewed regional agreements as potentially undermining the economic rationale for multilateral liberalization. Others, such as Bergsten (1991) and Summers (1991), considered every liberalization (every "ism"), whatever its form, to be a step forward, paving the way for worldwide trade liberalization. An extensive literature has developed, analyzing the multiple mechanisms through which regional agreements may erode opposition to further liberalization, but also undercut incentives to engage in further trade reform (see Baldwin and Freund, 2011, for a survey). Despite its elaboration, this sum of works is not fully conclusive regarding the way regionalism and multilateralism interact. The 1990s literature was mainly theoretical, spelling out a number of mechanisms and results, finally showing that the influence of regionalism on multilateralism could be mixed. More recently, applied investigations have been carried out, but they reached contrasting results, in accordance with the theoretical analysis showing the variety of possible mechanisms at stake. While several studies, in particular Estevadeordal et al. (2008), find that preferential agreements may favor multilateral liberalization, Limão (2006) and Karacaovali and Limão (2008) find the opposite for the EU and the US. The latter result is presumably linked to the different nature of the trade agreements sealed by these two blocs, which likely aim *inter alia* at extracting

[1] In particular, the World Bank's Temporary Trade Barriers database has vastly improved the quality and consistency of information available in this regard.

[2] "Unilateralism" refers here to liberalization at a country's own initiative.

non-trade benefits from their partners. Still, it remains difficult to reach a firm conclusion based on this literature, which in addition focuses on episodes differing significantly from the present predicament.

In the present context, the question of the consequences of unilateralism and regionalism for multilateralism thus remains essentially an empirical one. Addressing it requires first evaluating in-force and planned policies. An additional question, reminiscent of Krugman's (1991b) "Is Bilateralism Bad?", is about the welfare consequences of this accumulation of regional agreements. This question of welfare implications is also raised regarding unilateral liberalization, since it is difficult to infer a consistent appreciation of the global picture resulting from the accumulation of country-specific policy reforms.

General equilibrium model simulations are used to assess the impacts on trade and welfare of these various policy changes, as well as the consequences for the potential benefits to be drawn from a multilateral agreement. By doing so, we are able to evaluate to what extent the spread of regionalism may have eroded, or in some cases renewed, economic incentives to conclude the round.

The paper is organized as follows. Section 2 describes trade policies in the 21st century, through tariffs and trade, and disentangles regional and unilateral contributions to liberalization since the turn of the century. Section 3 quantitatively assesses the interaction between regionalism, unilateralism and multilateralism, using model-based simulations. The last section provides concluding remarks.

2. A quantified overview of trade policies in the 21st century

In order to build a quantified summary picture of the various trade policy changes that have occurred since the turn of the century, we focus on tariffs and trade worldwide, and build a detailed database (described below). Equipped with this unique tool, we successively review the main motives underlying trade policy changes: commitments in the multilateral arena, countries' own initiatives, and reciprocal trade agreements. A summary assessment of the consequences for world protection is then proposed.

2.1. Data, methodology and global preview

Our data work aims to document consistently tariff protection and trade at the six-digit level of the United Nation's harmonized system (hereafter HS6, in its 1996 revision, featuring 5,113 products), for 130 importing countries (the European Union being considered as a single entity), over the period 2001-2013. It includes in addition an evaluation of the likely outcome of trade agreements currently under negotiation. Yearly bilateral trade flows at the HS6 level are drawn from CEPII's BACI database (Gaulier and Zignago, 2010), which is itself based on the UN's Comtrade database.

Tariff protection is measured every third year. For each country and each product, we distinguish the following concepts of tariff duty, which we collectively refer to as the "tariff ladder":

(i) the bound duty, sometimes also called "bound MFN", or consolidated duty, i.e. the ceiling a country is committed not to exceed, under the WTO;

(ii) the "unilaterally applied" duty, the duty applied on an MFN basis, or as a result of non-reciprocal preferences[3] – it is unilateral, in the sense of being set as a result of each country's own initiative (even though commitments taken in multilateral agreements may restrict their room for maneuver), as opposed to reciprocal commitments taken in the context of an RTA;[4]

(iii) the preferential applied duty, additionally taking into account lower protection committed to under RTAs, i.e. reciprocal preferential agreements;

(iv) the post-DDA applied duty, referring to the level of applied duty that would result from applying a hypothetical Doha Round agreement, along the lines defined in the most detailed modalities circulated during the negotiations.[5]

For bound duties, the information is drawn from the WTO's Consolidated Tariff Schedules (CTS) database, based on the Bchir et al. (2006) treatment, updated as needed (in particular to account for recent accession protocols). WTO commitment schedules define a final bound duty and a phase-in period, sometimes with intermediate objectives.

To make comparisons meaningful across tariff protection concepts and over time, we need this database to be exhaustive. This requires filling it in two cases, where bound duties are not defined. First, some WTO members' non-agricultural products remain unbound. In the Doha Round negotiations, such cases were tackled by computing base rates, used as an equivalent of initial bound tariffs. In the rev. 4 modalities, base rates are computed adding 25 p.p. to the MFN applied duty. We adopt this convention to complete our database in such cases. The second case where bound duties are not defined is when the country is not a member of the WTO. In this case, product by product, the highest rate applied outside RTAs

[3] Partners that are not members of the WTO sometimes apply tariffs higher than the MFN. This non-MFN tariff is taken into account in this case.

[4] RTAs are reciprocal arrangements, whereby partner countries sign mutually binding commitments. By contrast, non-reciprocal preferential schemes, such as Generalized Systems of Preferences (GSPs) and their special schemes for least developed countries, are granted unilaterally and do not bind the countries granting them with respect to their partners. In this sense, they are not contractual in nature. They are set unilaterally and driven by development-oriented motivations.

[5] For post-DDA tariffs, we use as a reference the latest draft modalities circulated by the Trade Negotiations Committee chairman, namely revision 4 of the 2008 modalities for agricultural and non-agricultural market access (WTO 2008a, 2008b). For each HS6 product, the relevant tariff-cutting formula is applied to the existing bound tariff to compute the new bound. The new applied tariff is then the minimum between the formerly applied tariff and this new bound. This is done taking into account each country's status (developed, developing, LDCs, {very} recently acceded members, small and vulnerable economies, etc). In accordance with the modalities, 4% sensitive products (selected using the Jean et al. 2011 method) are entitled to more flexible treatment for developed countries, and a third more for developing countries. Special products are also taken into account in accordance with modalities. Quotas open in compensation for these sensitive of special products are not taken into consideration.

over the period is used as an equivalent of bound duty.[6] Indeed, such a non-preferential tariff can be viewed as an upper bound when considering the prospect of a hypothetical accession, since WTO accession protocols generally involve consolidating protection at a level inferior on average to the one previously applied. Taking the highest level over the period also means that these pseudo-bound duties are constant over time.

In the Marrakesh Agreement, the phase-in period for tariff schedules ended in 2000 for developed countries and in 2004 for developing countries. Beyond marginal changes linked to renegotiations, bound tariffs thus remained constant throughout the period studied here for developed countries that were founding members of the WTO. Although this is not the case for developing countries and newly acceded members, we do not have information about the yearly phase-in schedule of their commitments. For each product, we thus assume the bound duty in a given year to be the maximum between the MFN applied and the final bound rate. This assumption may entail some approximations about yearly changes (although not about the final level), but only in the sense of overstating the speed of enforcement of committed cuts in bound rates, and only in cases where the cut is not binding for applied MFN duties (in such cases, the final bound rate will be assumed to be implemented as of 2001, even when, in practice, its implementation is gradual). Given these conventions, the changes over time that we measure for bound tariffs are effectively binding for tariffs applied on an MFN basis.

In order to take preferential regimes into account, preferential applied duties must be measured not only at the product level for each country, but also separately for each partner (or at least each preferential regime). With 130 countries and more than 5,000 products, this is challenging. We mainly rely upon the source data of MAcMap-HS6 databases (ITC and CEPII) for the years 2001, 2004 and 2007 (Guimbard et al., 2012). Additional, comparable source data from ITC are used for the years 2010 and 2013.[7] Where a tariff-rate quota (TRQ) applies, we only consider the outside-quota tariff rate. Because many countries apply specific, compound or mixed tariffs (e.g. Switzerland, EU, Japan), ad-valorem equivalents (AVEs) of these tariffs were also computed at the product level. Following the Bouët et al. (2008) methodology, the conversion of specific duties into ad-valorem duties makes use of median unit values computed for exports of a reference group, instead of the exporting country itself. This approach minimizes the bias due to the so-called "shipping the good apples out" effect (Alchian and Allen, 1964), whereby a higher specific tariff leads to the export of higher-quality products. Similarly, when AVEs need to be aggregated up, the weights used are computed as shares in exports of a reference group instead of the exporting country itself, so as to limit the endogeneity bias ensuing from the observed inverse correlation between tariff levels and trade flows. To prevent changes in trade patterns from blurring our analysis of trade policies, the same unit values and weighting

[6] Even though countries that are not members of the WTO are not bound by the MFN principle, they usually apply the same duty rate to their partners, outside RTAs. If different rates are applied, we take into account the higher one applied to at least three different partners.

[7] We are indebted to Xavier Pichot and Mondher Mimouni (ITC) for making these data available to us.

schemes, computed using three-year average (2011-2013) statistics, are used for the sake of calculation and aggregation of AVEs, whichever the year concerned.[8]

Applied MFN rates are retrieved from this applied preferential duties database, as the highest rate applied to at least three partner members of the WTO.[9]

Given the large number of trade agreements under negotiation, some of them of prominent importance, we also wanted to shed light on the possible consequences of their conclusion. The exact content of these would-be agreements cannot be known yet, and we have emphasized above (and will illustrate below) that their scope and depth varies widely across agreements. In theory, Grossman and Helpman (1995) show that, for a given sector, the likeliness of being exempted from liberalization commitments within an agreement depends upon a weighted sum of the impacts that liberalization would entail on the sector's profits and on the economy's welfare. The relative weight of these two objectives depends upon the government's objective function. In practice, it also depends upon the capacity for a given sector to influence decision-makers. This theoretical analysis makes it difficult to devise the precise form that forthcoming agreements might take, but it suggests that potentially excluded sectors are those for which a fairly high initial protection level has a significant influence on profits. While the influence of bilateral liberalization on profits depends on the competitiveness of the partner country's producers in the sector concerned, it follows that a given country is likely to focus on the protection of a given subset of sectors in most of its agreements.

Put differently, the pattern of protection remaining within an RTA is likely to depend mainly upon the importing country, and its willingness to protect a small set of sensitive products. To check whether this presumption is borne out by the data, we analyzed the pattern of preferential tariff duties applied by countries with at least five RTAs in force.[10] For each country, we ran a regression including only product dummies as independent variables to assess to what extent their distribution can be explained by the product dimension only, irrespective of the partner (see Table A1 in Appendix). Countries for which the predictive power of the product dimension is low include small countries (with R-squared statistics equal to 13% for Chile, 16% for Albania, 43% for Guatemala, 47% for Tunisia), presumably because their low bargaining power makes them more flexible in setting concessions schedules; they also include larger developing countries such as China and India (respectively, 47% and 58%), which have tended so far to include an extensive list of sensitive products in their agreements, the definition of which was tailored to the ambition and specificity of each agreement. Still, the global picture remains supportive of the above-mentioned presumption, with only three countries for which the product dimension explains

[8] Using computations based on average statistics over the 2001-2013 period instead does not alter significantly the results.

[9] Stipulating that at least three different partners apply this same level allows preventing an exceptional regime from being considered as the MFN duty.

[10] Looking for any specific pattern would make little sense for countries with a very low number of RTAs.

less than 40% of the total variance, and 11 out of the 22 countries considered where it explains more than 90% of the total variance. This is particularly true for large, developed countries, with R-squared equal to 95% for the US, and more than 99% for the EU, Switzerland and Japan.

To evaluate the possible consequences of forthcoming trade agreements, we thus make the assumption that, for each product, each partner will apply in its future agreements the average of the preferential tariffs it is applying in its agreements in force for more than five years.[11]

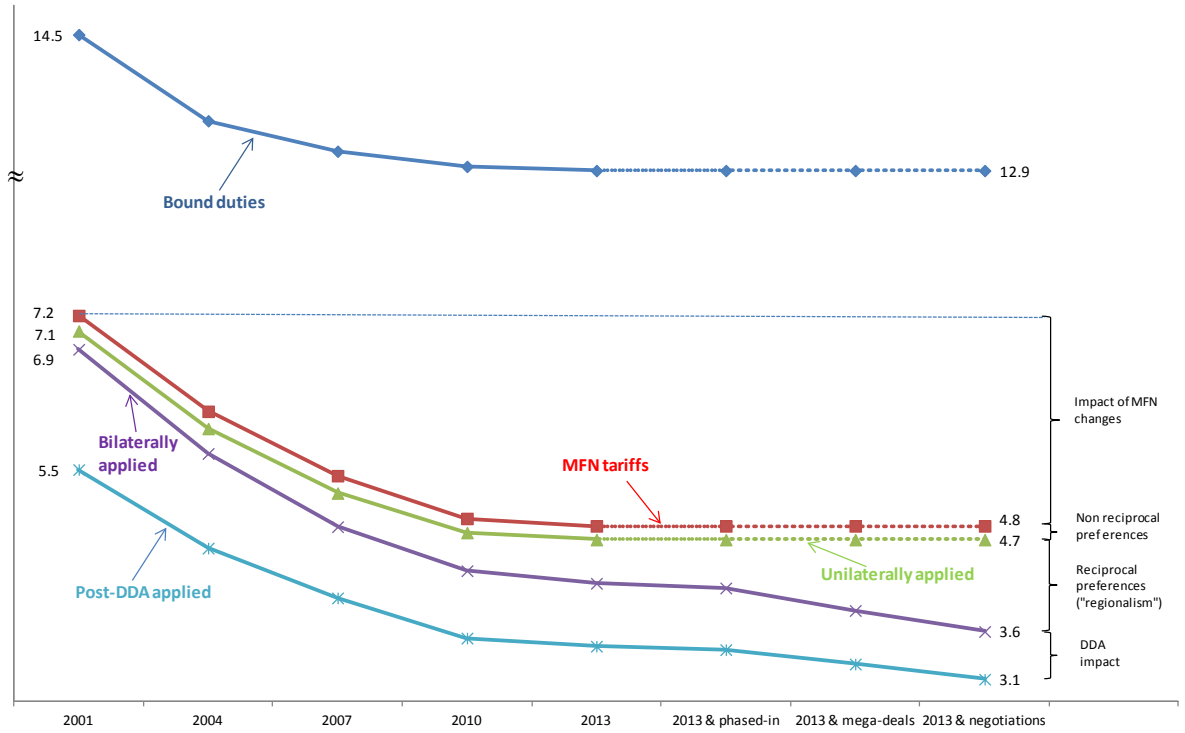
Equipped with this database, we can propose a quantified overview of how the trade policy landscape has changed since the turn of the century. A preview at the global level shows that the same downward trend is shared by all rungs of the tariff ladder, with a sharper slope between 2001 and 2007 (see Figure 1 and Appendix Figure 7 for results by country). However, closer examination shows that trends differed significantly across curves: while the worldwide average bound duty was cut by 1.6 percentage points (p.p.) between 2001 and 2013, this cut was 2.4 p.p. for the average MFN duty, and 2.7 p.p. for the average preferential applied duty. The contrast is starker in relative terms since, by 2013, the 2001 level was cut by 11% for bound duties, compared to 33% for MFN duties and 39% for applied preferential duties. If all ongoing negotiations were concluded, the cut in the average applied preferential duty would reach 3.3 p.p., almost half its 2001 level. It's worth noting that the gap between applied and post-DDA duties, equal to 1.4 p.p. in 2001, declined to 0.7 p.p. in 2013, and would fall to 0.5 p.p. if all ongoing negotiations were concluded. This trend illustrates strikingly how policy changes eroded the potential value of a multilateral agreement over the period.

This preview shows that non-trivial changes took place over the period considered. The underlying causes cannot be directly identified from these aggregate figures, because opposite product-level effects may compensate at the aggregate level.[12] Disentangling them requires more refined calculations and policy interpretation, to which we now turn.

[11] The five-year period is chosen so as to limit the influence of the phasing-in period, while keeping a large-enough number of agreements for each country.

[12] A parallel decline in average MFN and preferential duties is, for instance, consistent with two different changes: one would be a cut in MFN duties for products usually excluded from preferential agreements; another would be a cut in MFN duties for products usually included in RTAs, together with the enforcement of additional RTAs. In the former case, only unilateral liberalization is at stake; in the latter case, a combination of unilateral liberalization and regionalism caused the observed change.

Figure 1: The tariff ladder worldwide from 2001 onward (% AVE)



Source: Authors' calculations, MAcMap-HS6 database. Weighted averages computed using MAcMap-HS6 methodology (Bouët et al., 2008).

2.2. The rising tide of "regional" trade agreements

The most spectacular trade policy change since the turn of the century has probably been the multiplication of RTAs. From 123 in 1995, the number of RTAs notified to the WTO surpassed 200 in 2001 and reached as many as 625 in February 2016. A total of 419 agreements were in force at that time; avoiding double counting of agreements on services and goods, the total was still 265. This spectacular surge of RTAs is well documented (see WTO, 2011a, and Subramanian and Kessler, 2013, for detailed overviews). Its main causes can be traced back to a variety of factors: the competitive liberalization policy carried out under the Bush II administration as of 2001;[13] the build-up of Asian trade regionalism; the activism of a few countries engaged in a strategy of "additive liberalization", whereby the multiplication of RTAs was used to gain preferential access to as many partners as possible,

[13] As explicitly formulated, for example, in Robert B. Zoellick's statement to the Committee on Finance of the US Senate, Washington, DC, 21 June 2001.

in exchange for the opening of their own market,[14] and, finally, the competition between agreements, resulting from the increasingly entrenched fears – for both economic and political reasons – of being left on the sidelines of the agreements process.

A new wave of negotiations is under way with the so-called "mega-deals", the scope of which is far wider than that of previous agreements in terms of economic weight, with ambitious agenda announced by the parties involved: the Trans-Pacific Partnership (TPP, with formal agreement signed on 4 February 2016, but not yet ratified), the Transatlantic Trade and Investment Partnership (TTIP), and the EU-Japan FTA. The ASEAN+6 negotiation (Regional Comprehensive Economic Partnership) also covers a huge economic area by economic weight, but its ambition is far more limited (in what follows, we use the term "mega-deals" to refer to the first three above-mentioned agreements only). Should they all be concluded, these negotiations would potentially open a new era: it would be the first time trade agreements would be sealed between the world's top trading countries. Accordingly, the consequences of RTAs should be reconsidered.

This surge in RTAs has been accompanied by qualitative changes. Mainly at the initiative of the EU and the US, RTAs are increasingly used to promote common rules on investment, competition, trade in services, sanitary and phytosanitary measures, technical barriers to trade, public procurement, environment, and sometimes labor standards (Horn et al., 2010; WTO, 2011a). However, for reasons stated in the introduction, our quantitative analysis here focuses on tariffs and trade.

2.2.1. Does it matter for world trade and protection?

The extent to which this RTA tide did matter for world trade and protection patterns remains an open question. The WTO headcount of notified and enforced agreements is of little help to address it, because agreements vary widely by breadth and depth.

To illustrate more meaningfully the spread of regionalism, we measure instead the share of foreign trade taking place between partners linked by an RTA (Figure 2). This share hardly moved for North American countries, remaining at a high level (around 42%) between 2001 and 2013, chiefly reflecting the importance of the North American Free Trade Area. In all other regions, though, this "intra-RTA" share significantly increased over the period, with a spectacular increase in Asia (from 2.5% to 38.1%). In addition to the years 2001-2013, three situations are considered in our calculations, reflecting respectively the situation in which RTAs already signed (between 2013 and 2015) but still to be implemented are enforced ("2013 & phased-in"), the hypothetical situation where the three mega-deals actually under negotiation between rich countries would be signed and fully enforced ("2013 & mega-deals", acknowledging that TPP's implementation should start within the next two years), and the situation where all agreements under negotiation would be concluded and enforced ("2013 &

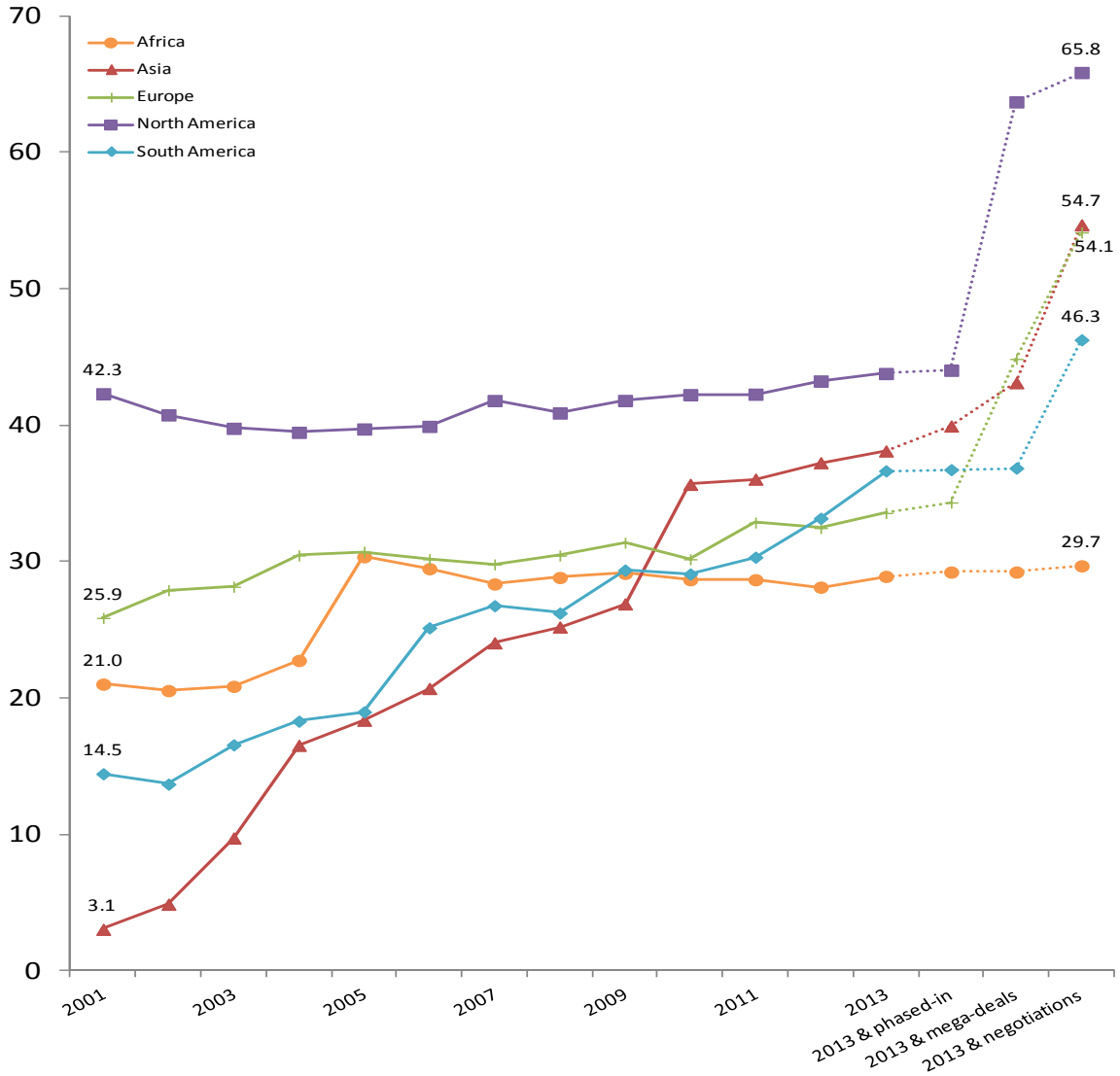
[14] Chile is the most extreme example of this strategy, with bilateral agreements covering 60 partners (EU member states are counted individually) and more than 90% of its imports. Mexico, Singapore and, to a lesser extent, Association of Southeast Asian Nations (ASEAN) countries can also be considered as having applied such a strategy.

negotiations”). Computations for these hypothetical situations are based on 2013 trade flows, updating their RTA status (within-RTA or not). Since RTAs are expected to increase trade between partners, the figures hence computed for the share of within-RTA imports should be considered as lower bounds. Completing the mega-deals would increase the share of within-RTA trade spectacularly in North America (by almost 20 p.p.), in Asia (+5 p.p.) and in Europe (+11.4 p.p.). Completing other ongoing negotiations would also make a significant difference, in particular in Asia (+17 p.p.), in Europe (+20 p.p.) and in South America (+17 p.p.). Strikingly, the African continent is the only one for which concluding ongoing negotiations would make little difference, and it thus features as being left aside from this tide of agreements. The recently announced (2015) Tripartite Agreement may make a significant difference for African countries. However, given the uncertainties surrounding its effective implementation at the time of writing, this agreement was not included in the present calculations.

These results can be summarized as follows:

Fact 1: Between 2001 and 2013, the share of foreign trade carried out with RTA partners increased strongly for Asian and Latin American countries, but only moderately for others. Concluding ongoing negotiations would greatly increase this share in Asia, Europe and North America.

Figure 2: Share of total foreign trade realized with RTA partners ("within an RTA"), by continent (%)



Note: For each region, the curve refers to the share of foreign trade (inside and outside the region) that the region's countries are carrying out with a partner country with which they have an RTA in force. For the sake of this figure and in what follows, Europe is defined as including, in addition to European countries *stricto sensu*, Community of Independent States – CIS countries, while Africa includes Middle Eastern countries and Asia includes Oceania. The calculations for the implementation of phased-in agreements and for the hypothetical situation where ongoing negotiations would be concluded ("2013 & mega-deals" and "2013 & negotiations") are made assuming unchanged trade flows, equal to their 2013 value.
Source: Author's calculations, BACI database.

RTAs do not imply free trade. Rather, they are often used to manage trade liberalization in a way that makes it possible to preserve some protection for sensitive sectors, while being more easily manageable than multilateral agreements. For example, while the US often excludes some sensitive agricultural sectors such as sugar from RTAs with efficient would-be exporters (e.g. its agreement with Australia), the EU restricts liberalization of the beef sector through tariff rate quotas or simple import ceilings. As a result, significant protection remains within RTAs, especially in the agricultural sector, even though some agreements contain provisions that explicitly phase out some of these tariffs after a long phase-in period, or a clause stating that the agreement will be revised in order to cut tariffs further.

To illustrate this fact, Table 1 reports the level of tariff duties applied between partners of RTAs in force for more than five years – a period after which most of the tariff-cutting commitments are usually applied for a sample of countries.[15]

The results uncover two striking contrasts. The first appears across countries, with average applied tariff duties driven down to close-to-zero by the majority of importers within their RTAs, but maintained to a significant proportion of MFN levels by China, South Africa and most of all India. The latter countries clearly appear as having applied so far a fairly cautious approach to RTAs, restraining market opening under their agreements to a limited scale, as witnessed by the significant share of products left with non-zero applied tariff duties. The second contrast is across sectors, with agriculture exhibiting far higher remaining protection within RTAs than other products, with the exception of Russia[16] and Brazil. For India and Japan, preferential duties under RTAs differ little from MFN tariffs, meaning that agriculture is essentially excluded from their agreements. This is not the case for other countries, but half or more of the MFN protection level is maintained within the agreement. Paradoxically, given that average MFN duties are far higher in agriculture than elsewhere, the ensuing average preference margin (i.e. the difference between the MFN and preferential duties) is larger for agricultural products in all countries considered here, except Brazil.

[15] For more details on phase-in periods of RTAs and the corresponding changes in applied tariffs, see Jean and Bureau (2016). In computing averages across products and countries, we use in what follows the Bouët et al. (2008) methodology, which relies on reference groups of importers to build a meaningful weighting scheme reflecting the importance of products and countries, while minimizing the endogeneity bias linked to the dependence of trade flows on tariffs.

[16] As regards Russia, most agreements referred to here are signed with other CIS countries.

Table 1: Remaining protection within RTAs for selected importers in 2013 (in %, except number of RTAs)

		All products			Agriculture		
		Within RTAs		Outside RTAs	Within RTAs		Outside RTAs
	Nb of RTAs	Mean AVE pref. duty	Import share of duty-free products	Mean AVE MFN duty	Mean AVE pref. duty	Import share of duty-free products	Mean AVE MFN duty
"Quad"							
Canada	4	1.1	97.4	2.5	13.3	71.7	15.4
European Union	23	0.8	94.3	3.3	14.2	20.5	14.5
Japan	8	1.2	86.9	2.1	15.1	28.1	18.2
USA	10	0.3	95.1	1.5	3.1	79.2	4.7
BRICS							
Brazil	1	0.3	94.5	12.3	0.5	75.3	8.2
China	7	3.9	63.1	6.6	12.8	36.2	18.5
India	6	8.8	17.9	9.5	39.5	26.2	42.9
Russia	3	0.0	100.0	9.1	0.0	99.8	17.3
South Africa	3	2.8	79.0	6.9	12.1	38.6	16.6

Scope: Only RTAs in force for five years or more are considered. Partial Scope Agreements are not taken into account.
Note: The number of RTAs refers to agreements, many of which include several partners. The various overlapping agreements of Russia with other CIS countries are not counted separately; only the CIS FTA is taken into account here.
Source: Authors' calculations using MAcMap-HS6 and BACI. Information on RTAs from WTO notifications and national sources.

2.2.1.1 Regionalism or "preferentialism"?

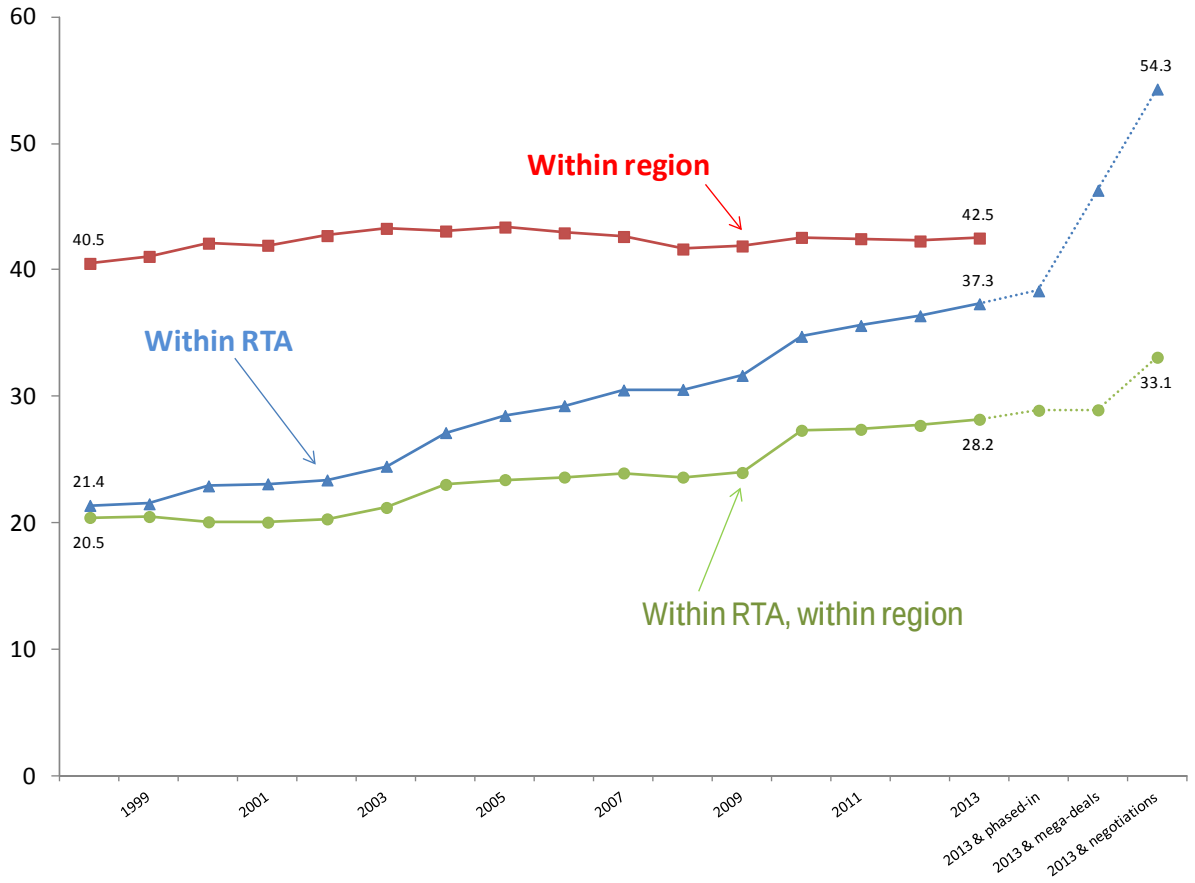
Another qualitative change concerns the geography of agreements. As their name suggests, RTAs used to be a synonym for regional integration. Noteworthy examples include the EU's successive enlargements and its agreements with its neighborhood; the North American Free Trade Area; the Mercosur agreement and the Andean Community in Latin America, and the agreement between ASEAN (Association of Southeast Asian Nations) countries and ASEAN agreements with neighboring countries in South-East Asia. Since the early 2000s, though, a growing number of bilateral trade agreements are being sealed with geographically

remote partners.[17] Whether the surge in RTAs observed since the turn of the century can be adequately termed a regionalist tide is thus questionable.

To illustrate the geography of agreements, Figure 3 parallels the world level share of trade realized within a RTA, with the share carried out within a region – where, for the sake of this calculation, a region is defined as one of the five continents, singled out in Figure 2. The results confirm the growing disconnect between RTAs and geography: While the share of trade within an RTA increases from 21% in 2001 to 37% in 2013, the share realized within a region hardly budges (40% in 2001, 42% in 2013). While trade within an RTA was almost entirely intra-regional in 2001, this was not the case anymore in 2013: Trade within an RTA, with partners in another region, accounted for 9% of world trade in 2013, compared to only 3% in 2001. Ongoing negotiations tend to exacerbate this trend, potentially lifting this within-RTA, extra-regional share of world trade up to 21% (17% if only mega-deals were enforced).

[17] Against this background, the term “Preferential Trade Agreement” (PTA), would seem more suitable to refer to the phenomenon. Since it is often used in WTO parlance to refer specifically to non-reciprocal preferential agreements, we stick to the term “RTA” while referring to reciprocal preferential agreements, even though they frequently do not deserve anymore the “regional” qualification.

Figure 3: Share of world trade realized within a region, within an RTA, and within an RTA within a region (%)



Note: "2013 & phased-in", "2013 & mega-deals" and "2013 & negotiations" refer to situation where, based on 2013 trade and tariffs, already signed agreements, mega-deals and all ongoing negotiations would be concluded and enforced. Changes in intra-RTA trade can be computed on this basis, reflecting the increased coverage of RTAs (and assuming unchanged trade flows). In contrast, changes in the share of trade realized within each region cannot be characterized in this hypothetical situation.

Source: Author's calculations, BACI database.

Referring to a surge in "regionalism" thus misleadingly suggests a movement toward regional integration. This is not what is actually going on, which would be more aptly termed a surge in "preferentialism". This issue goes beyond a semantic technicality. Regionalism can be thought of as an attempt to rationalize trade relationships between neighbors; it generally relies on strong political and cultural ties, with in many cases an integrative dimension, whereby rules and competition are streamlined in a geographically limited area. In contrast, purely mercantilist motives are dominant in the spread of preferentialism, which is mainly a way to seek commercial advantage, and increasingly to define new trade rules; being in

addition not restricted to given geographical areas, preferentialism is much more directly in competition with multilateralism.

We have thus established:

Fact 2: If all ongoing negotiations are concluded, RTAs would cover more than half of world trade. Their development since 2001 has mainly concerned partners not belonging to the same region.

2.3. Liberalization on an MFN basis and its causes

The surge in RTAs should not hide the fact that, since the turn of the century, many countries have considerably lowered the tariffs they apply on an MFN basis. To analyze this trend, changes in MFN tariff rates between t_0 and t_1 can be decomposed arithmetically as follows:

$$(1) \quad MFN_{t_1} - MFN_{t_0} = \underbrace{\left[MFN_{t_1} - \min\left(MFN_{t_0}, Bound_{t_1}\right)\right]}_{\text{Own initiative}} + \underbrace{\left[\min\left(MFN_{t_0}, Bound_{t_1}\right) - MFN_{t_0}\right]}_{\text{Commitment}}$$

where MFN stands for the MFN rate applied, and $Bound$ stands for the bound rate. The subscript refers to the year concerned. If the bound rate in t_1 falls below the initial MFN duty rate, MFN_{t_0}, then the country must lower its MFN level at most to this new bound level, in order to abide by its commitment. Accordingly, the term in the second square bracket corresponds to the change in MFN duty resulting from the country's commitments under the multilateral trading system. In contrast, further changes in the MFN duty (computed in the first square brackets) are the result of the country's own initiatives.

Putting this decomposition into practice shows that both phenomena played a role over the period under study (Table 2). Bound duties were themselves cut as a result of two kinds of newly implemented commitments: the end of the implementation of Uruguay Round commitments by developing countries, which had until 2004 to do so; and the implementation of accession protocols for the countries that acceded to the WTO after its creation.

In most cases, the impact of the ending implementation of the Marrakesh Agreement was limited, the main exceptions being Egypt (-6.1 p.p.), and to a lesser extent Malaysia (-2.5 p.p.), Ghana (-2.3 p.p.), Nigeria (-1.8 p.p.), Korea (-1.7 p.p.), India (-1.4 p.p.) and Bangladesh (-1.3 p.p.). Although fewer countries are involved, the changes ensuing from WTO accession are substantial. This is in particular the case for China (-8.4 p.p.), a change that is in itself of systemic importance, but also for Saudi Arabia (-4.7 p.p.), Vietnam (-3.5 p.p.) and Jordan (-1.9 p.p.).

Table 2: Decline in average (applied) MFN duty between 2001 and 2013, selected countries

	Av. MFN applied duty (AVE, %)		Change (p.p.)				Av. MFN applied duty (AVE, %)		Change (p.p.)		
	2001	2013	Total	Com-mitted	Lib. own Initiative		2001	2013	Total	Com-mitted	Lib. own Initiative
Libya	25.9	0.0	-25.9	0.0	-25.9	Vietnam	12.2	4.4	-6.5	-3.5	-3.0
India	30.0	9.7	-20.3	-1.4	-18.9	Malaysia	12.1	8.9	-3.2	-2.5	-0.7
Nigeria	28.0	10.8	-17.2	-1.8	-15.4	*Belarus*	10.9	7.7	-3.2	0.0	-3.2
Tunisia	22.8	8.5	-14.3	-0.2	-14.1	Russia	10.3	7.9	-2.4	-1.8	-0.6
Morocco	23.2	9.0	-14.2	-0.3	-13.9	Ukraine	5.5	3.1	-2.4	-0.9	-1.5
Peru	12.6	1.7	-11.0	0.0	-11.0	Ecuador	8.8	6.5	-2.3	0.0	-2.3
Egypt	19.9	10.1	-9.7	-6.1	-3.6	Thailand	11.1	8.9	-2.2	-0.5	-1.7
China	16.0	6.7	-9.3	-8.4	-0.9	Korea	10.4	8.2	-2.2	-1.7	-0.5
Bangladesh	19.3	10.4	-8.9	-1.3	-7.6	Panama	7.1	5.0	-2.1	-0.1	-2.0
Saudi Arabia	12.1	3.9	-8.2	-4.7	-3.5	Israel	6.4	4.7	-1.7	-0.4	-1.3
Kenya	17.3	11.5	-5.8	-0.1	-5.7	Australia	3.8	2.7	-1.1	-0.1	-1.0
Mexico	16.6	11.1	-5.5	0.0	-5.5	Brazil	10.4	9.4	-1.0	0.0	-1.0
Cambodia	13.0	7.9	-5.1	-0.2	-4.9	Canada	4.8	3.8	-0.9	0.0	-0.9
Colombia	10.3	5.5	-4.9	0.0	-4.9	Chile	6.9	5.9	-1.0	0.0	-1.0
Pakistan	14.1	9.4	-4.7	-0.5	-4.2	*Kazakhstan*	4.7	6.4	1.7	0.0	1.7
Jordan	11.3	6.7	-4.6	-1.9	-2.7	Norway	4.1	6.0	1.9	-0.1	2.0
Oman	8.1	4.0	-4.1	-1.1	-3.0	Switzerland	4.2	6.9	2.7	0.0	2.7
Ghana	13.4	9.4	-4.0	-2.3	-1.7	*Iran*	5.2	17.6	12.4	0.0	12.4
Taiwan	8.1	4.2	-3.9	-0.8	-3.1	**World**	7.2	4.8	-2.4	-1.1	-1.3

Note: The countries shown are those accounting for more than 0.1% of world percent in 2013, for which average MFN applied duties changed by more than 1 p.p. in absolute value between 2001 and 2013. Countries are ranked by increasing total change over the period. Non-members of the WTO in 2013 are featured in italics. Countries that acceded after the WTO's creation and no later than 2013 are underlined. "Committed change" refers to changes in MFN linked to commitments in the multilateral system, either in the Marrakesh Agreement or on WTO accession. "Lib. own initiative" refer to the rest of changes in MFN, made as a result of each country own initiative.
Source: Authors' calculations, MAcMap-HS6 database. Weighted averages computed using MAcMap-HS6 methodology (Bouët et al., 2008).

Beyond these changes linked to commitments in the multilateral system, a number of countries undertook significant unilateral liberalization, through their own initiative. At the world level, the corresponding cut in average MFN tariffs (-1.3 p.p.) was even stronger than the one ensuing from newly implemented multilateral commitments (-1.1 p.p.). In most cases, this reflects a reconsideration of the costs and benefits of protectionism by a number of developing countries. The Uruguay Round contributed to their integration in world trade,

pushing many of them to abandon rather outdated policies such as import substitution and the protection of "industrializing industries", of which the development record proved poor. Increasingly, trade openness is viewed as a way to import market discipline, thus helping to fight against rents and more generally against resource misallocation. India is probably the most outstanding example of such use of trade liberalization as a pro-growth policy. Following the already sweeping liberalization of the early 1990s, India embarked on another policy of across-the-board cuts in tariff protection, with its Foreign Trade Policy 2004-09 stating explicitly the objective "to double [India's] percentage share of global merchandise trade within the next five years".[18] As a matter of fact, India's average AVE MFN tariff was cut from 30% in 2001 to 9.7% in 2013, and our decomposition shows that 18.9 out of this 20.3 p.p. cut reflected the country's own initiative.

Interestingly, the Indian strategy explicitly aimed at "neutralizing incidence of all levies and duties on inputs used in export products", and targeted facilitation of "import of capital goods and equipment", pointing to a key aspect of this renewed use of trade liberalization as a development strategy: the need to adapt to the age of global value chains (GVCs), i.e., to a context where value chains are increasingly (finely) sliced up across countries, either globally or regionally. As pointed out by Baldwin (2011), this trend changes deeply the way developing countries approach development issues. Joining a global value chain, either by attracting foreign direct investment or just by being providers to multinational firms, makes it far easier to attract manufacturing activities, even though the consequences are not necessarily as far-reaching as they used to be. Against this background, the cost of protection must be reconsidered, recognizing that lower tariffs (and transaction costs) may help the country in finding its place in such chains, and that liberalization in intermediate inputs may substantially improve domestic firms' competitiveness (Goldberg et al., 2010; Topalova, 2010).

Many countries carried out reforms rooted in this pro-growth strategy. In Mexico, the October 2008 "Program to Promote Growth and Employment" included ambitious unilateral cuts in MFN tariffs. According to our calculations, the country's initiative resulted in a 5.5 p.p. cut in the average MFN tariff between 2001 and 2013. Peru reduced progressively its MFN tariffs between 2007 and 2013, as Chile did a decade before. Egypt put in place an ambitious trade liberalization strategy in 2004. Mauritius divided its MFN protection level by three, as part of a strategy aiming at turning the island into a trade hub. And Libya (admittedly a controversial example on other grounds) abolished duties on 3,500 products in 2005.

Unilateral liberalization can also be directly linked to RTAs. Nigeria is an interesting example of such a link, since it cut its MFN rate from 28% in 2003 to 10.8% in 2009, in a move to adopt Economic Community of West African States common external tariffs (WTO, 2011b, p. 28).

[18] See, e.g., http://dgft.gov.in/exim/2000/policy/contents.htm.

In summary:

Fact 3: MFN tariffs were cut by one-third between 2001 and 2013, more than half of this as a result of countries' own initiatives.

2.4. Consequences for applied tariff protection, and underlying factors

To ease analysis and interpretation, changes in applied rates (for a given triplet, importer-exporter-product) can be decomposed in the following way:

(2) $Applied_{t_1} - Applied_{t_0} = \left[Applied_{t_1} - MFN_{t_1}\right] + \left[MFN_{t_1} - MFN_{t_0}\right] - \left[Applied_{t_0} - MFN_{t_0}\right]$

where $Applied$ stands for the duty rate applied. For a given year t, the difference $MFN_t - Applied_t$ is the preferential margin granted in this specific case. Such a preferential margin may result from the application of either a reciprocal or non-reciprocal trade agreement. We distinguish these two cases because they do not reflect the same policy rationale. Indeed, a reciprocal trade agreement (hitherto referred to as an RTA, or regional trade agreement, as is usual in WTO parlance) reflects an exchange of commitments between two partner countries. In contrast, a non-reciprocal agreement, such as a country's Generalized System of Preferences, is a non-contractual scheme that a country decides to apply through its own initiative, usually to pursue development goals. As we want to shed light on the nature of policy changes, we distinguish these two cases, and note in what follows the corresponding preference margins as $RPref$ and $NRPref$ (for reciprocal and non-reciprocal preference margins). Accordingly, equation (2) can be rewritten as follows:

(3) $\Delta Applied = \Delta MFN - \Delta RPref - \Delta NRPref$

Having already analyzed changes in MFN duties, the interest of this decomposition lies in highlighting how changes in preferential schemes led to further changes in applied duties. The first learning from these calculations is that non-reciprocal preferential margins did not vary significantly over the period (Table 3:). As a matter of fact, as apparent from the global preview given above (Figure 1), non-reciprocal preferences only influence marginally average applied duty, so that their changes have a negligible influence at the worldwide level. In addition, unilateral liberalizations erode the value of non-reciprocal preferential margins, potentially cancelling out at the aggregate level the effects of new schemes entering into force.

Reciprocal preferences, in contrast, did contribute to cutting applied duties over and above what liberalization of MFN duties implied (their contribution to changes in applied duties is singled out in Table 3: under the column "Reciprocal Pref.", where the value of term $-\Delta RPref$ in equation (3), i.e. the decrease in the average preferential margin, is reported). This contribution is sometimes significant, as is the case for Chile (-4.2 p.p.), Mexico (-2.2 p.p.) and Vietnam (-1.3p.p.). On average, however, this contribution turns out to be limited, only removing 0.3 p.p. from world-applied duties. Despite all the talk about the

regionalist tide, the influence of RTAs on applied protection since the start of the century thus remained minimal at the global level. The main explanations for this result have already been mentioned: (i) RTAs have been spreading, but so far they have not been covering trade between key trading countries; (ii) tariff protection within RTAs is not zero, and sometimes far from it, and (iii) significant liberalization on an MFN basis eroded the preferential margin associated with RTAs. The latest point explains why changes in RTA preferential margins may tend to increase average applied duties, as is the case for instance for Libya (+1.9 p.p.) and Tunisia (+0.7 p.p.).

Table 3: Decomposition of changes in average applied tariff duty between 2001 and 2013 for selected countries (AVE in %, variation in p.p.)

	Changes 2001-2013						Changes 2001-2013				
	Total	MFN	Non Reciprocal Pref.	Reciprocal Pref.	Applied 2013		Total	MFN	Non Reciprocal Pref.	Reciprocal Pref.	Applied 2013
Libya	-24.1	-25.9	0.0	1.9	0.0	Ukraine	-2.9	-2.4	-0.5	-0.1	2.4
India	-20.5	-20.3	0.0	-0.1	9.4	*Algeria*	-2.8	-0.9	0.0	-2.0	10.4
Nigeria	-17.2	-17.2	0.0	0.0	10.8	Korea	-2.5	-2.2	0.0	-0.3	7.9
Morocco	-14.5	-14.2	0.0	-0.3	6.6	Ecuador	-2.5	-2.3	0.0	-0.2	6.2
Tunisia	-13.5	-14.3	0.0	0.7	6.2	Russia	-2.3	-2.4	0.4	-0.3	7.6
Peru	-11.0	-11.0	0.0	0.0	1.6	Thailand	-2.2	-2.2	0.0	0.0	8.9
Egypt	-10.6	-9.7	0.0	-0.9	8.9	Panama	-2.1	-2.1	0.0	0.0	4.9
China	-9.9	-9.3	0.0	-0.6	6.1	South Africa	-1.9	-0.9	0.0	-1.1	5.7
Bangladesh	-8.9	-8.9	0.0	0.0	10.4	Philippines	-1.4	-0.3	0.0	-1.0	3.7
Saudi Arabia	-8.0	-8.2	0.0	0.2	3.8	Australia	-1.3	-1.1	0.0	-0.2	2.4
Vietnam	-7.8	-6.5	0.0	-1.3	4.3	Brazil	-1.3	-1.0	0.0	-0.3	9.0
Mexico	-7.7	-5.5	0.0	-2.2	6.3	Argentina	-1.2	-0.9	0.0	-0.3	10.7
Cambodia	-7.1	-5.1	-0.1	-1.9	5.9	Croatia	-1.2	-0.8	0.7	-1.0	3.3
Jordan	-6.5	-4.6	0.0	-1.9	4.4	Guatemala	-1.1	-0.9	0.0	-0.3	3.0
Kenya	-5.9	-5.8	0.0	-0.1	10.8	Costa Rica	-1.1	0.1	0.0	-1.2	3.5
Chile	-5.1	-1.0	0.0	-4.2	1.7	Indonesia	-1.1	-0.2	0.0	-0.9	4.6
Colombia	-5.0	-4.9	0.0	-0.1	5.2	Israel	-1.0	-1.7	0.0	0.6	3.1
Pakistan	-5.0	-4.7	0.0	-0.2	9.2	Norway	1.7	1.9	0.1	-0.3	5.2
Oman	-4.4	-4.1	0.0	-0.3	3.4	Switzerland	1.9	2.7	-0.2	-0.7	5.1
Taiwan	-4.1	-3.9	-0.3	0.0	4.2	*Kazakhstan*	2.0	1.7	0.6	-0.3	6.5
Ghana	-4.0	-4.0	0.0	0.0	9.3	*Iran*	12.4	12.4	0.0	0.0	17.6
Malaysia	-4.0	-3.2	0.0	-0.8	8.0	**World**	-2.7	-2.4	0.0	-0.3	4.2
Belarus	-3.0	-3.2	0.4	-0.2	7.5						

Note: The countries shown are those accounting for more than 0.1% of world percent in 2013, for which average applied duties changed by more than 1 p.p. in absolute value between 2001 and 2013 (results for countries not meeting the latter condition are shown in Appendix Table 5). Countries are ranked by increasing total change in average applied protection between 2001 and 2013. "Total" refers to the total change in each country's average applied rate. Its components are the change in the average MFN rate ("MFN"), in the preferential margin granted through non reciprocal preferences ("Non Reciprocal Pref.) and though reciprocal preferences ("Reciprocal Pref."). The average level applied in 2013 is shown in the last column ("Applied 2013").

Source: Authors' calculations, MAcMap-HS6 database. Weighted average using MAcMap-HS6 methodology.

These findings can be summarized as follows:

Fact 4: Regionalism only marginally contributed to cutting tariffs applied across the world, by 0.3 p.p. on average.

2.5. The eroding tariff-cutting impact of a Doha agreement

The combination of liberalization on an MFN basis and RTAs has been eroding progressively the impact, hence the potential for gains, of a multilateral agreement. The average tariff-cutting impact of a Doha agreement, measured as the difference between applied and post-DDA duties, was 1.4 p.p. in 2001. This difference was reduced to 0.7 p.p. in 2013 and would fall to 0.5 p.p. if ongoing agreements are enforced.

In addition to being substantial on average, this erosion is very uneven across countries: applying the latest modalities used in DDA negotiations to the Indian tariff schedule in 2001 would have implied a 7.5 p.p. cut in applied tariffs; by 2013, this would-be cut would have shrunk to a mere 0.03 p.p., because India's applied duties are worth only one-quarter of its bound duties. India's situation may be extreme, but several other important countries stand out: for Egypt, the tariff-cutting impact of a Doha agreement would have been 6.4 p.p. based on its 2001 tariff schedule, but only 0.6 p.p. based on its 2013 schedule; for Mexico, the cut fell from 2.1 p.p. in 2001 to 0.5 p.p. in 2013; for Turkey, from 1.4 p.p. to 0.6 p.p. In addition, completing all agreements under negotiation would bring down further the expected cut ensuing from a DDA agreement: in the US, down to 0.3 p.p. (compared to 0.6 p.p. in 2013); in the EU, down to 0.7 p.p. (compared to 0.9 p.p. in 2013).

Among the countries accounting for at least 0.1% of world imports in 2013 (the EU being counted as a single country), 46 were members of the WTO before the Doha Ministerial Conference in 2001. Out of these, the cut implied by a hypothetical DDA agreement would have topped 1 p.p. in 16 countries in 2001; in 2013, only seven would have been in this situation; if all agreements under negotiation were enforced, this number would fall to six. In relative terms, a hypothetical DDA agreement would have cut protection by more than 5% in 19 of these 46 countries, based on 2001 trade policies; this number would have fallen to 10 based on 2013 policies, and to four with all ongoing negotiations concluded.

Put briefly:

Fact 5: Not only has the average cut resulting from a hypothetical conclusion of the Doha negotiations been eroding over time, it has also become increasingly concentrated on a handful of countries. This trend would worsen if all ongoing RTA negotiations were concluded.

3. How regionalism and multilateralism interact: moving across the tariff ladder's rungs

While the influence on average tariff protection is informative, it does not deal with the most pressing policy questions: How do these recent and would-be trade policy changes affect trade and welfare? To address this question, we use model-based simulations to assess various thought experiments corresponding to moves across the above-described tariff ladder.

3.1. Model

The model used is a multi-sectoral, multi-regional computable general equilibrium model of the world economy. Our purpose in using such a model is not theoretical elaboration, but rather consistency and transparency in assessing a variety of trade policy scenarios worldwide. Accordingly, the model's structure is fairly standard for such trade policy analysis. On the demand side, the representative consumer's utility function is an LES-CES (Linear Expenditure System – Constant Elasticity of Substitution) function of sector-level subutility functions. Within each sector, products are differentiated by country of origin, using a two-tier CES function – an elaboration on the so-called Armington assumption. Varieties within each of these bundles are horizontally differentiated. On the supply side, each sector is modeled using a representative firm, which combines value-added and intermediate consumption in fixed shares. Value-added is a CES bundle of imperfectly substitutable primary factors (capital, skilled and unskilled labor, land and natural resources). The model's macroeconomic closure assumes savings-driven investment for each economy, with exogenous dynamic saving propensity taken from Fouré et al. (2013), and exogenous current account imbalances (in real terms).

Simulations are carried out in a sequential dynamic framework where installed capital is immobile, with capital reallocation resulting from depreciation and investment.[19] In addition to the tariff data described above and in the Appendix, the simulations below rely on the GTAP 9PR1 database,[20] with base year 2011 (Narayanan et al., 2012). To take into account forthcoming structural changes in the world economy, a baseline for the world economy is simulated up to 2025, based on standard assumptions about changes in technology, demographics and education, as described in Fouré et al. (2013). We focus on the impact each policy shock (assumed to be enforced as of 2015) might have on the world economy in 2025; a counterfactual trajectory of the world economy is simulated, and the results reported here refer to deviations from the baseline in 2025.

3.2. Experiment design

For each base year (2001, 2004, 2007, 2010, 2013, "2013 & phased-in", "2013 & mega-deals", "2013 & all agreements under negotiation"), we successively consider the

[19] Details of the model can be found in the Appendix.

[20] The GTAP database provides social accounting matrixes for 140 regions, with 57 sectors. See https://www.gtap.agecon.purdue.edu/.

hypothetical situation where each country would apply tariff protection corresponding to a different level of this ladder, from bound duties down to zero. Each move corresponds to a hypothetical policy shock, which we name and interpret as follows:

- From bound to unilaterally applied duties, “standstill”: such a scenario can be thought of as the opposite of the maximum protection uplift that is possible for all WTO members without reneging on their commitments. An agreement whereby members would bind duties at their MFN level is sometimes referred to as a “standstill” agreement, and it would precisely aim at insuring against such move, hence the name given here to this shock.[21]
- From unilateral to applied duties, “regionalism”: this shock exactly corresponds to the joint enforcement of all RTAs, i.e. the phasing-in of regionalism.
- From applied to post-DDA, “multilateralism”: this scenario reflects the application of a would-be Doha agreement.
- From post-DDA to zero, “full liberalization”: this full liberalization scenario, applied once a DDA agreement is assumed to have been applied, illustrates the distance remaining between the possible end point of a multilateral agreement and free trade.

The shocks simulated below reflect these (hypothetical) trade policy changes, applied to different base years: for instance, “standstill, 2001” is a hypothetical trade policy shock whereby tariff duties applied would be cut from an initial level equal to 2001 bound tariffs to a final level equal to 2001 unilateral tariffs.

The simulations were run on an aggregation of countries in 22 regions, and 18 sectors, including five agricultural sectors (see Table 6 and Table 7 in the Appendix). For the sake of clarity and brevity, only aggregate results are presented below.

3.3. Results

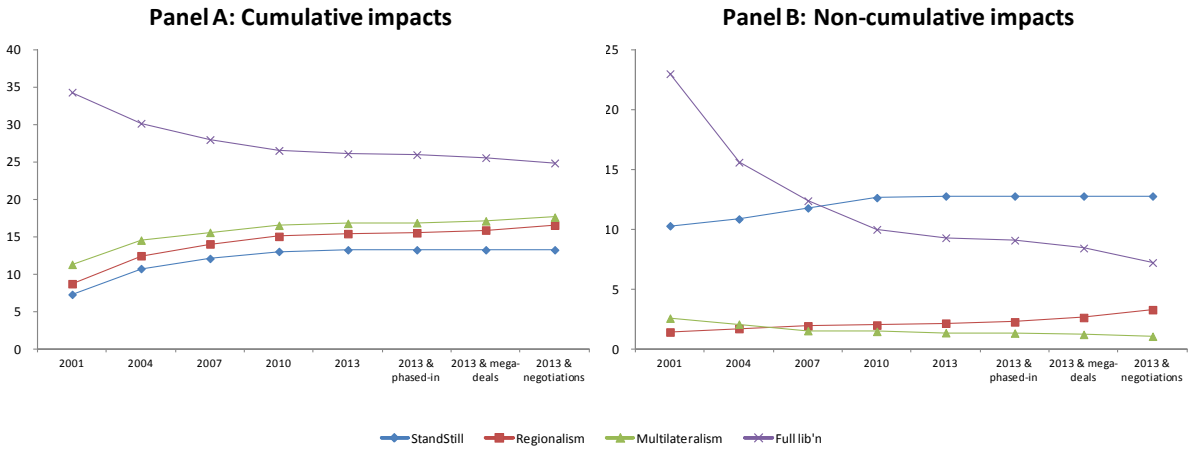
The impacts of the various shocks on world trade are presented in Figure 4, both in a cumulative (panel A) and non-cumulative way (panel B). The diamond blue line describes the export gains from cutting protection from bound to unilateral tariffs; the corresponding “standstill” impact is significant throughout the period, and it increases from 7.3% based on 2001 trade policies to 13.3% with 2013 trade policies. This strong increase illustrates how far-reaching unilateral changes in trade policies were during the 2000s. It also confirms that WTO disciplines are increasingly disconnected from applied protection, even disregarding RTAs.

By comparison, regionalism had a far lower impact on world trade, even though it increased regularly over the period: from 1.4% in 2001, it reached 2.2% in 2013, and would reach 3.3% if all agreements under negotiation were enforced. These are very low figures for such sweeping changes, showing that trade-creation effects resulting from RTAs’ tariff provisions, although positive, remain very limited compared to the spread of trade flows concerned.

[21] Note, however, that unilaterally applied duties also take non-reciprocal trade preferences into account.

According to our simulations, applying a Doha Agreement based on 2001 policies would have increased world trade by 2.6%. Even though this assessed impact is already pretty low, it is almost twice as large as the one obtained based on 2013 policies (1.4%), and more than twice the impact obtained based on a situation where all ongoing negotiations would be concluded (1.1%). Beyond their absolute level, these impacts are also small compared to the trade-creating impact of cutting post-DDA tariffs down to zero (see the "full liberalization" impact in Figure 4, panel B, equal to 23% in 2001, and 9.3% in 2013).

Figure 4: Assessed impact of liberalization components on world exports (%)



Note: All impacts are expressed as deviations from the baseline in 2025. Years do not correspond to the time when the impact is evaluated, but to the year that the trade policy shock refers to.
Source: Authors' simulations based on a perfect competition version of the Mirage model.

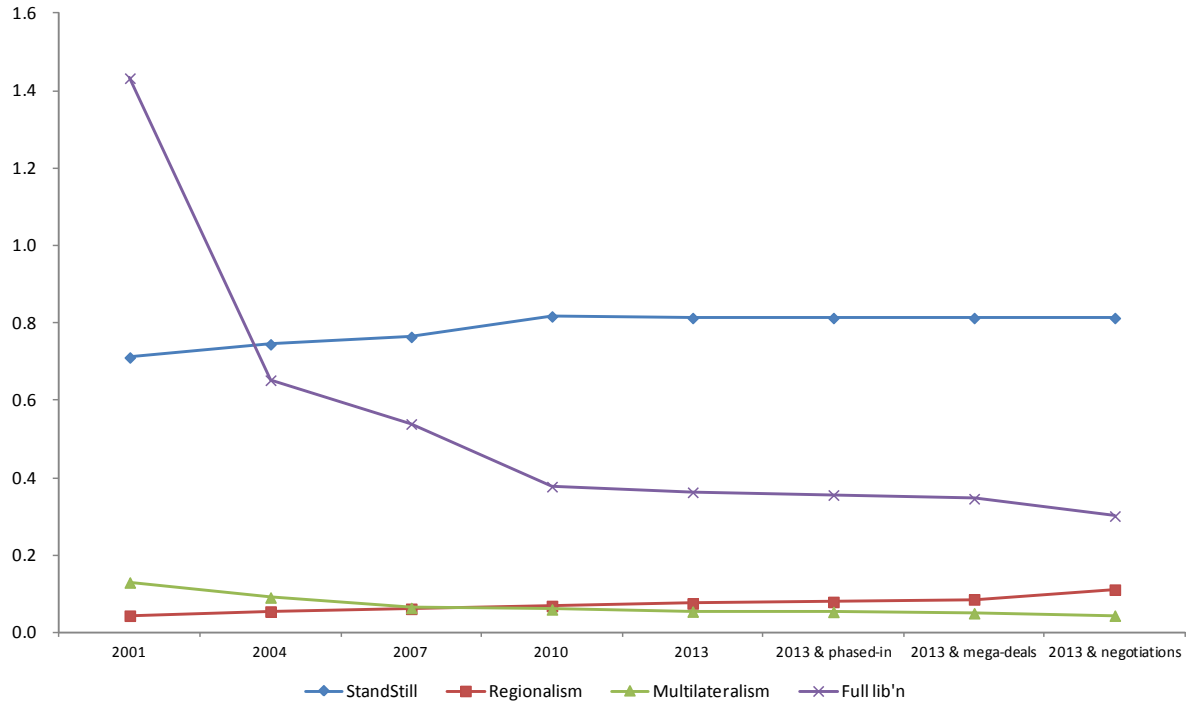
Assessed welfare impacts, measured here using equivalent variations, provide a similar picture. The positive global welfare gains found for regionalism suggest overall a negative answer to Krugman's (1991b) question: "Is Bilateralism Bad?". Still, it does not suggest that this is an efficient way to improve world welfare, with average gains (+0.04% with 2001 trade policies, +0.1% assuming all agreements under negotiation were enforced) fairly low given the widespread reach of RTAs.

These welfare results also confirm that, as regionalism and unilateralism spread, the value of multilateralism erodes. The welfare gains associated with a Doha Agreement, assessed as 0.13% in 2001, would be as small as 0.05% in 2013, and 0.04%, were all ongoing negotiations concluded. In this latter hypothetical situation, expected gains from multilateralism would thus be only one-quarter of what could have been expected in 2001, a result consistent with (and even a bit stronger than) those found based on tariffs and export creation. In sum:

Result 1: Trade policy changes between 2001 and 2013 have more than halved the worldwide welfare gains to be expected from the tariff-cutting provisions of a hypothetical Doha Agreement.

Were all ongoing RTA negotiations concluded, expected gains would fall to one-third of their 2001 level.

Figure 5: Assessed impact of liberalization components on world welfare (%, non-cumulative)



Note: All impacts are expressed as deviations from the baseline in 2025. Years do not correspond to the time when the impact is evaluated, but to the year that the trade policy shock refers to.
Source: Authors' simulations based on Mirage model.

3.4. The eroding incentives to conclude the Doha Round

These results suggest that the changes in the trade policy landscape witnessed since the launch of the Doha Round have radically altered the economic incentives for completing the negotiation. To gain further insights into this trend, we split the whole change into two sub-periods, 2001 to 2013, and 2013 to the hypothetical situation where all agreements under negotiation are enforced. For different geographical areas, Figure 6 shows how the welfare impact of multilateralism and regionalism changed over each sub-period.

Trade policy changes between 2001 and 2013 mostly increased the welfare gains from regionalism for ASEAN countries. To a lesser extent, regionalism gains also increased for Argentina, developed Asia, and Mexico. For other countries, changes in the welfare impact of regionalism remained minimal. Meanwhile, the welfare gains to be reaped from a multilateral agreement declined for almost all regions considered, with European Free Trade Agreement

(EFTA) members as the only significant exceptions. The decrease was especially strong for India and North Africa, in both cases due to significant unilateral liberalization, and for ASEAN countries and developed Asia, where it can be related to the numerous RTAs they enforced during this period. In general, though, the two phenomena do not appear to be systematically related.

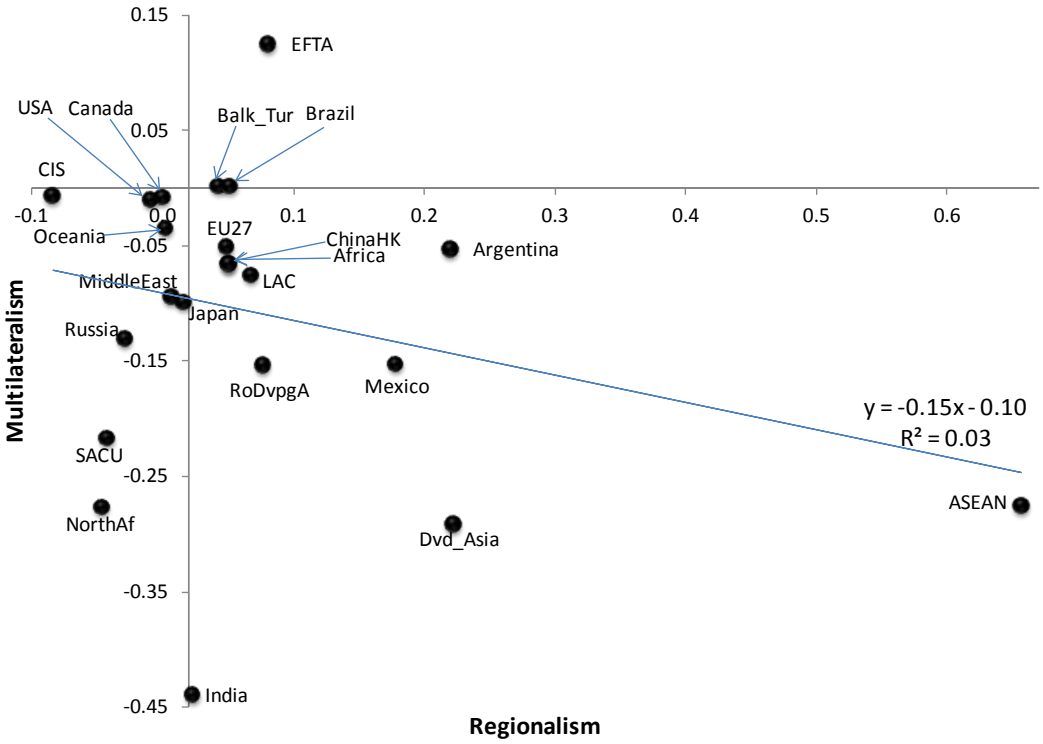
In contrast, between 2013 and the hypothetical situation where agreements under negotiation would be enforced, changes in the welfare impact of regionalism and multilateralism are strongly, negatively correlated (Figure 6, Panel B). Of course, we cannot anticipate possible future changes in unilateral protection over the coming years. Yet, this correlation shows the negative impact that regionalism may have for the economic incentives to reach a multilateral agreement. Importantly, these impacts are far from homogenous, and countries like Japan, India and the rest of developed Asia may benefit significantly from regionalism, with diminished gains from a possible multilateral agreement. This outcome may contribute to making an agreement even more difficult, given how asymmetric gains may hamper an agreement, as explained by Bagwell and Staiger (2013).

At the other extreme, some countries found themselves hurt by the diversion effects of regionalism, a situation that makes more attractive a multilateral agreement. According to our simulations, this is mainly the case here for Argentina and Brazil. This is unlikely to increase substantially the odds of a multilateral agreement being signed, though, for two reasons. First, because the countries in such a position might also consider more seriously engaging in regional agreement negotiations; secondly, because, apart from Brazil, none of the big players in world trade would see the value of a multilateral agreement significantly enhanced as a result of these regional agreements. In the case of China in particular, the agreements it is negotiating are enough to counterbalance the diversion effects born out of the megadeals surrounding it. In summary:

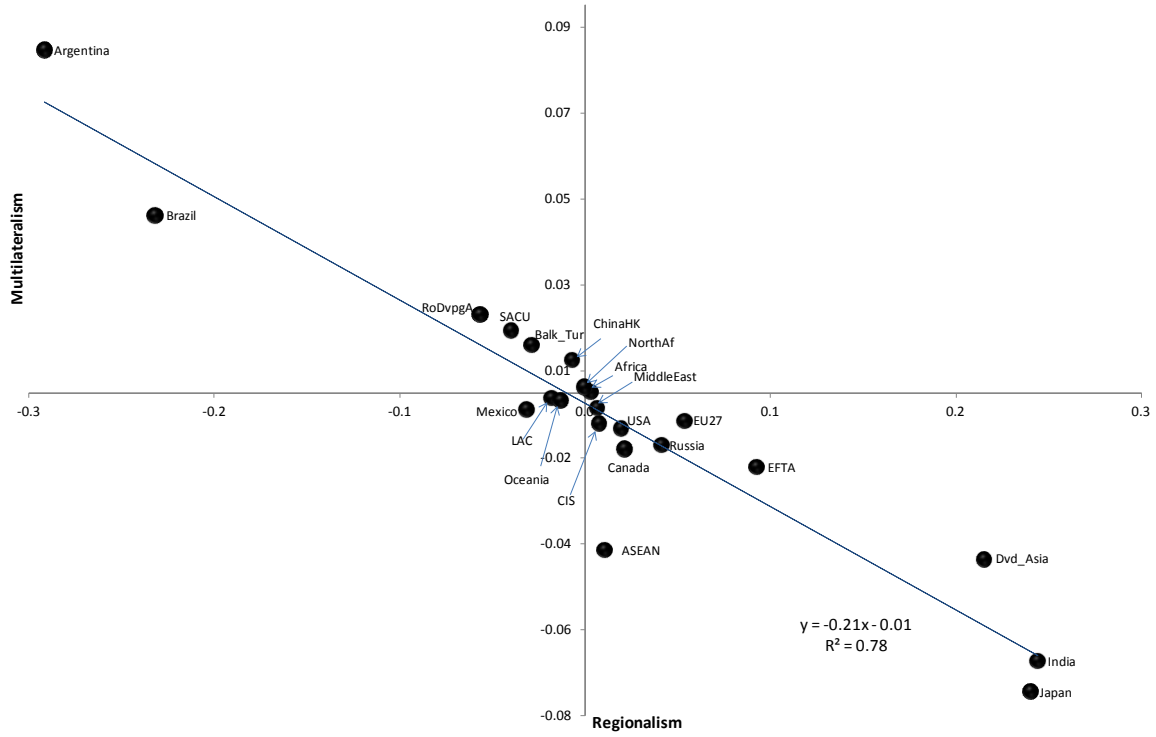
Result 2: Across countries, the declining value of multilateralism was not significantly correlated with the spread of multilateralism until now. Concluding ongoing FTA negotiations would increase the value of a multilateral agreement for Brazil, and decrease it for Japan. For the other big players in the trade arena, this value would not be significantly changed.

Figure 6: Changes in the welfare impact of multilateralism and regionalism (p.p.)

Panel A: changes from 2001 to 2013



Panel B: changes from 2013, ensuing from the enforcement of all agreements under negotiation



Note: All impacts are expressed as deviations from the baseline in 2025. Years do not correspond to the time when the impact is evaluated, but to the year to which the trade policy shock refers.
Source: Authors' simulations based on Mirage model.

4. Concluding remarks

This paper proposes a unique overview of trade policy trends since the launch of the Doha Round, based on detailed data on tariffs and trade. Not only does it cover all countries across the world in a consistent manner over the whole period, it also distinguishes, product by product, between bound, applied MFN, and applied preferential tariffs. In addition, the analysis takes into account the possible consequences of a DDA agreement as well as of the conclusion of all RTAs under negotiation. Beyond the pure statistical evaluation, the consequences for trade, welfare and terms of trade are assessed, using a computable general equilibrium model.

A considerable number of new RTAs have been signed and enforced since 2001, and many are being negotiated, some of them unparalleled in potential importance. Accordingly, regionalism is widely described as the major development in trade policies. However, our results suggest that regionalism has delivered limited effective liberalization so far. The situation may change if all ongoing negotiations are concluded (they might bring the share of world trade carried out between RTA partners beyond 50%, compared to 37% in 2013). Still,

we show that new RTAs led to just a 0.3 p.p. cut in the average applied tariff duty worldwide between 2001 and 2013. Commitments resulting from the ending implementation of the Marrakesh Agreement and from WTO accessions, including China's, mattered much more, resulting in a 1.1 p.p. cut in average applied protection over the same period. Even more important were unilateral liberalizations on an MFN basis, undertaken through governments' own initiatives, as was the case in India and many other emerging and developing countries; they cut average applied tariff protection by 1.3 p.p. between 2001 and 2013. While our results do not make it possible to assess whether unilateral tariff cuts have been accompanied by a reduction in NTMs, anecdotal evidence as well as the underlying policy rationale suggests that the two are correlated; motivations for such unilateral liberalization include easier insertion in global value chains, and cheaper imports as a corollary of export-oriented strategies, themselves being seen as a fast track to development.[22]

These sweeping changes deeply eroded the incentives for many countries to conclude ongoing multilateral negotiations. Based on the latest detailed modalities circulated during the negotiations, we show that the tariff-cutting impact of a Doha Agreement, assessed to 1.4 p.p. on average based on 2001 trade policy conditions, fell to 0.7 p.p. based on 2013 policies, and would fall to as little as 0.5 p.p. if all ongoing negotiations were concluded. For many countries, the combination of their own initiatives and RTAs (enforced or under negotiation) makes WTO disciplines increasingly irrelevant, meaning that any realistic multilateral agreement is unlikely to change significantly their applied protection. India is emblematic of this situation, but it is actually shared by many emerging countries. Our simulation-based evaluation of a hypothetical Doha Agreement suggests similar results for export creation and welfare: trade policy changes between 2001 and 2013 more than halved the worldwide welfare gains to be expected from the tariff-cutting provisions of a hypothetical Doha Agreement. Were all ongoing RTA negotiations to be concluded, expected gains would fall to one-third of their 2001 level.

Regarding the controversial issue of whether regionalism is "good" or "bad", our results suggest that regionalism did increase welfare, even though its gains were small and concentrated on those countries that engaged actively in RTAs. The consequences for incentives to conclude a multilateral agreement were limited until now, but they may become significantly negative, if all agreements under negotiation are concluded: our results suggest that the ongoing regionalist tide would be more discriminatory than liberalizing. In this sense, regionalism appears more as a stumbling block than a stepping stone, at least as far as tariff provisions are concerned. A number of large emerging countries benefited a lot from multilateralism when they joined the WTO; enjoyed the low MFN tariffs that OECD countries had implemented thanks to 50 years of GATT negotiations, and implemented export-led growth strategies. Over the last decade, they have been a magnet for regional agreements, their fast-growing domestic market proving attractive enough for OECD countries to move

[22] The correlation is less straightforward when tariffs are cut as a result of commitments to trading partners, in which case countries may be tempted to use other protection instruments instead, as evidenced by Bown and Crawley (2013) in the case of temporary trade barriers.

away from their historical commitments to the promotion of multilateralism. As a result, the world market is increasingly fragmented and multilateralism has stalled. At this point, emerging countries would reap little benefit from a further extension of regionalism. This may provide some incentive for them to put more weight behind the defense of multilateralism in the future, as they have often been called to do, but so far in vain (Mattoo et al., 2011).

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Appendix

A1. Results of ANOVA regressions

Importer	RSquare	Coeff. Of Variation	RootMSE	Number of RTAs
Japan	**1.00**	**23.89**	**0.01**	**5**
Switzerland	**1.00**	**31.03**	**0.02**	**15**
Iceland	**1.00**	**25.40**	**0.03**	**15**
South Korea	**0.99**	**37.41**	**0.04**	**5**
Norway	**0.99**	**18.16**	**0.11**	**15**
European Union	**0.99**	**47.11**	**0.01**	**21**
Israel	**0.98**	**68.18**	**0.05**	**6**
Turkey	**0.95**	**79.98**	**0.06**	**11**
USA	**0.95**	**178.90**	**0.01**	**10**
Mexico	**0.92**	**186.38**	**0.05**	**13**
Costa Rica	**0.92**	**189.01**	**0.02**	**5**
Morocco	**0.89**	**216.66**	**0.06**	**6**
El Salvador	0.70	245.70	0.03	5
Former Yugoslav Republic	0.67	244.60	0.04	6
Jordan	0.67	232.42	0.08	6
India	0.58	120.59	0.08	6
Tunisia	0.47	215.96	0.06	5
China	0.47	146.82	0.05	6
Guatemala	0.43	212.27	0.03	5
Egypt	0.27	833.36	0.26	5
Albania	0.16	225.69	0.04	5
Chile	0.13	226.06	0.02	12

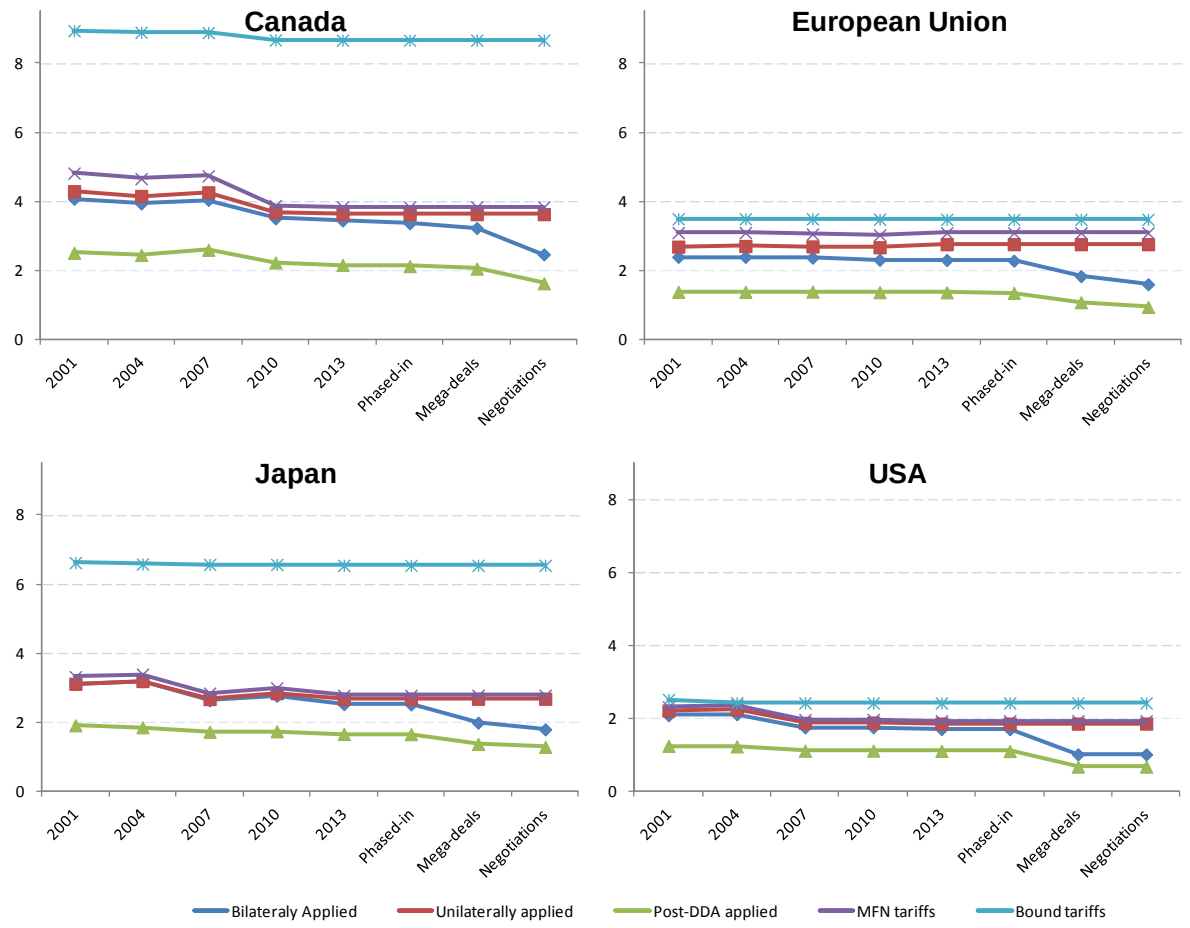
Note: These statistics refer to Least-Square Dummy Variable (LSDV) regressions carried out separately for each country. The dependent variable is the product-level preferential duty rate applied bilaterally to each partner with which the country has an RTA in force. In each regression, the only independent variables taken into account are product dummies. The R-square of such regression indicates to what extent the product dimension alone explains the structure of preferential tariffs applied by each country.

Source: Authors' calculations. MAcMap-HS6 database.

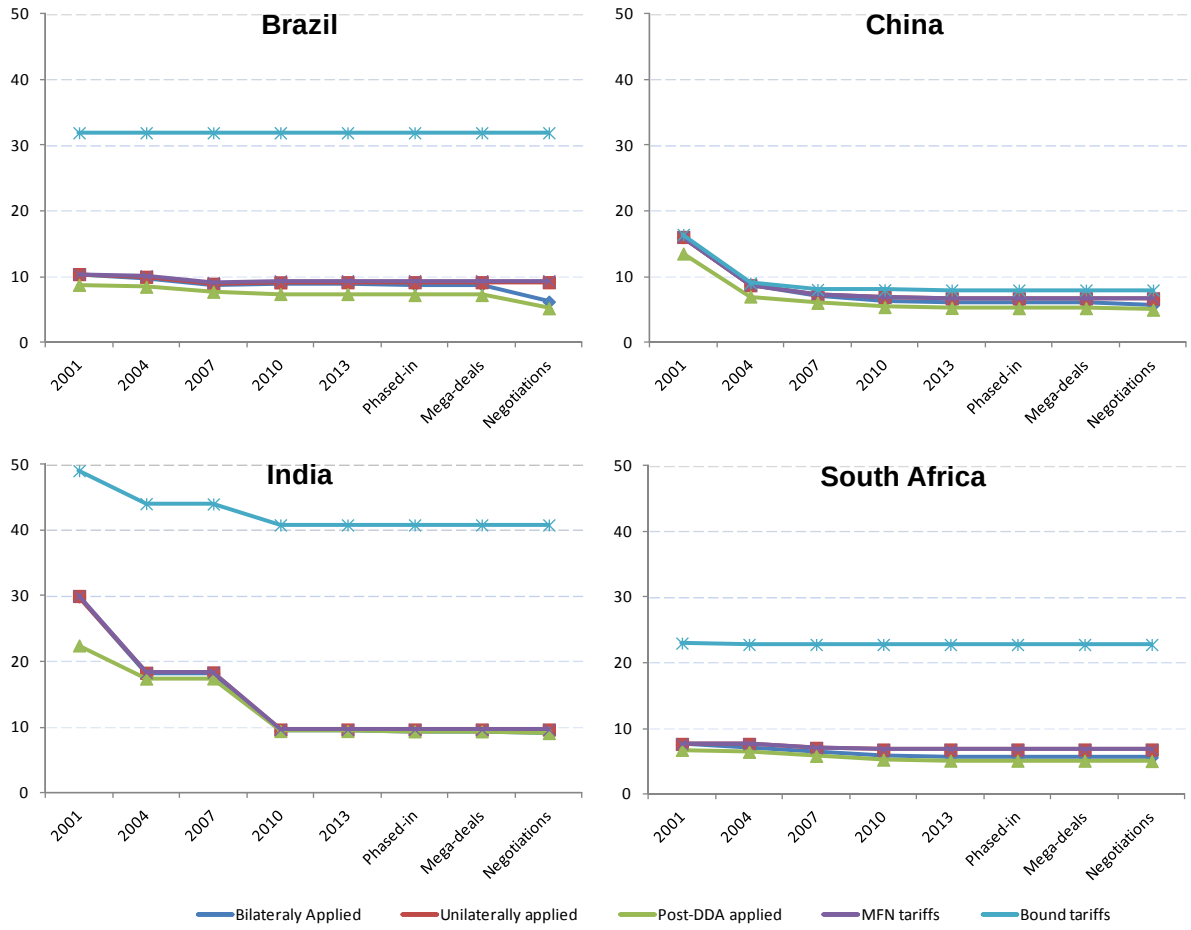
A2. The tariff ladder from 2001 onward for selected countries

Figure 7: The tariff ladder from 2001 onward for selected countries (AVE, world average)

Panel A: Rich countries



Panel B: Emerging countries



A3. Additional results on the decomposition of changes in average applied and MFN tariff duty between 2001 and 2013

Table 4: Decomposition of changes in average MFN tariff duty between 2001 and 2013, for selected countries (AVE in %, variation in p.p.)

	Av. MFN applied duty (AVE, %)		Change (p.p.)		
	2001	2013	Total	Com-mitted	Lib. own Initiative
Argentina	12.2	11.3	-0.9	0.0	-0.9
South Africa	7.7	6.8	-0.9	-0.1	-0.8
Algeria	13.3	12.4	-0.9	0.0	-0.9
Guatemala	4.2	3.3	-0.9	0.0	-0.9
Croatia	5.1	4.3	-0.8	-0.5	-0.4
Kuwait	4.8	4.0	-0.8	0.0	-0.8
Sri Lanka	7.4	6.9	-0.6	0.0	-0.6
Japan	3.3	2.8	-0.5	-0.1	-0.5
New Zealand	2.3	1.9	-0.4	0.0	-0.4
USA	2.3	1.9	-0.4	-0.1	-0.3
Philippines	5.2	4.9	-0.3	0.0	-0.3
Indonesia	5.8	5.6	-0.2	-0.1	-0.2
Qatar	4.2	4.0	-0.2	-0.1	-0.1
Lebanon	3.9	3.8	-0.2	0.0	-0.2
Azerbaijan	6.0	5.9	-0.1	0.0	-0.1
United Arab Emirates	4.0	4.0	0.0	0.0	0.0
European Union	3.1	3.1	0.0	0.0	0.0
Hong Kong	0.0	0.0	0.0	0.0	0.0
Costa Rica	4.6	4.7	0.1	0.0	0.1
Turkey	6.6	6.7	0.1	-0.2	0.3
Myanmar	4.0	4.4	0.4	0.0	0.4
Venezuela	11.0	11.7	0.6	0.0	0.6
Singapore	0.1	0.8	0.8	0.0	0.8

Note: To complement Table 2, the countries shown are those accounting for more than 0.1% of world percent in 2013, for which average applied duties changed by less than 1 p.p. in absolute value between 2001 and 2013. Countries are ranked by increasing total change over the period. Non-members of the WTO in 2013 are featured in italics. Countries that acceded after the WTO's creation and no later than 2013 are underlined. "Committed change" refers to changes in MFN linked to commitments in the multilateral system, either in the Marrakesh Agreement or on WTO accession. "Lib. own initiative" refer to the rest of changes in MFN, made as a result of each country own initiative.
Source: Authors' calculations, MAcMap-HS6 database. Weighted averages computed using MAcMap-HS6 methodology (Bouët et al., 2008).

Table 5: Decomposition of changes in average applied tariff duty between 2001 and 2013, for selected countries (AVE in %, variation in p.p.)

	Changes 2001-2013				
	Total	MFN	Non Reciprocal Pref.	Reciprocal Pref.	Applied 2013
Kuwait	-0.9	-0.8	0.0	-0.1	3.6
Lebanon	-0.8	-0.2	0.0	-0.6	3.0
New Zealand	-0.7	-0.4	0.1	-0.3	1.5
Canada	-0.6	-1.0	0.3	0.0	3.5
Sri Lanka	-0.6	-0.6	0.0	0.0	6.8
Japan	-0.6	-0.5	0.1	-0.1	2.5
USA	-0.4	-0.4	0.0	-0.0	1.7
Turkey	-0.4	0.1	-0.4	-0.1	5.2
Qatar	-0.3	-0.2	0.0	-0.1	3.6
United Arab Emirates	-0.1	0.0	0.0	-0.1	3.7
European Union	-0.1	0.0	0.1	-0.2	2.3
Azerbaijan	-0.1	-0.1	0.0	0.0	5.7
Hong Kong	0.0	0.0	0.0	0.0	0.0
Myanmar	0.3	0.4	0.0	-0.1	4.3
Venezuela	0.3	0.6	0.0	-0.3	11.2
Singapore	0.7	0.8	0.0	-0.1	0.8

Note: To complement Table 3:, the countries shown are those accounting for more than 0.1% of world percent in 2013, for which average applied duties changed by less than 1 p.p. in absolute value between 2001 and 2013. Countries are ranked by increasing total change in average applied protection between 2001 and 2013. "Total" refers to the total change in each country's average applied rate. Its components are the change in the average MFN rate ("MFN"), in the preferential margin granted through non reciprocal preferences ("Non Reciprocal Pref.) and though reciprocal preferences ("Reciprocal Pref."). The average level applied in 2013 is shown in the last column ("Applied 2013").
Source: Authors' calculations, MAcMap-HS6 database. Weighted average using MAcMap-HS6 methodology.

A4. Sectoral and geographical aggregation

Table 6: Sectoral decomposition used in the analysis

Sectoral aggregation	Code	List of GTAP sectors (long names)		
Cereals	Cereals	Paddy rice	Wheat	Cereal grains nec
Agriculture from Plant Origin	VegAgr	Vegetables. fruit. nuts	Oil seeds	Sugar cane. sugar beet
		Plant-based fibers	Crops nec	
Agriculture from Animal Origin	AnimAgr	Cattle.sheep.goats.horses	Animal products nec	Raw milk
		Wool. silk-worm cocoons		
Forestry	Forestry	Forestry		
Fishing	Fishing	Fishing		
Primary Energy	PrimEne	Coal	Oil	Gas
		Electricity	Gas manufacture. distribution	
Minerals	Minerals	Minerals nec	Mineral products nec	
Food industries	Food	Meat: cattle.sheep.goats.horse	Meat products nec	Vegetable oils and fats
		Dairy products	Processed rice	Sugar
		Food products nec	Beverages and tobacco products	
Clothing industries	Clothing	Textiles	Wearing apparel	Leather products
Other industries	OthManuf	Wood products	Paper products. publishing	Metal products
		Manufactures nec		
Energy Sector	SecEner	Petroleum. coal products		
Chemistry	Chemistry	Chemical.rubber.plastic prods		
Metals	Metals	Ferrous metals	Metals nec	
Vehicles	Vehicles	Motor vehicles and parts	Transport equipment nec	
Electronic	Electronic	Electronic equipment		
Equipment	Equipment	Machinery and equipment nec		
Transport	Transport	Transport nec	Sea transport	Air transport
Services sectors	Serv	Water	Construction	Trade
		Communication	Financial services nec	Insurance
		Business services nec	Recreation and other services	
		PubAdmin/Defence/Health/Education	Dwellings	

Table 7: Region aggregates used in counterfactual simulations

Geographical aggregation	Code	List of GTAP9 countries (140)									
Oceania	Oceania	AUS	NZL	XOC							
China and Hong Kong	ChinaHK	CHN	HKG								
Japan	Japan	JPN									
Developed Asian countries	Dvd_Asia	KOR	TWN								
ASEAN	ASEAN	KHM	IDN	LAO	MYS	PHL	SGP	THA	VNM	XSE	
India	India	IND									
Rest of Asian developing countries	RoDvpgA	BRN	MNG	XEA	BGD	NPL	PAK	LKA	XSA	XNA	XTW
Canada	Canada	CAN									
USA	USA	USA									
Mexico	Mexico	MEX									
Argentina	Argentina	ARG									
Brazil	Brazil	BRA									
		BOL	CHL	COL	ECU	PRY	PER	URY	VEN	XSM	CRI
Latin American Countries	LAC	GTM	HND	NIC	PAN	SLV	XCA	XCB	DOM	JAM	PRI
		TTO									
		AUT	BEL	CYP	CZE	DNK	EST	FIN	FRA	DEU	GRC
EU27	EU27	HUN	IRL	ITA	LVA	LTU	LUX	MLT	NLD	POL	PRT
		SVK	SVN	ESP	SWE	GBR	BGR	ROU			
EFTA	EFTA	CHE	NOR	XEF							
Russia	Russia	RUS									
Commonwealth of Independent States	CIS	BLR	UKR	XEE	XER	KAZ	KGZ	XSU	ARM	AZE	GEO
Turkey and Balkan countries	Balk_Tur	ALB	TUR	HRV							
Middle East countries	MiddleEast	BHR	IRN	ISR	JOR	KWT	OMN	QAT	SAU	ARE	XWS
North Africa	NorthAfr	EGY	MAR	TUN	XNF						
		BEN	BFA	CMR	CIV	GHA	GIN	NGA	SEN	TGO	XWF
Africa	Africa	XCF	XAC	ETH	KEN	MDG	MWI	MUS	MOZ	RWA	TZA
		UGA	ZMB	ZWE	XEC						
SACU	SACU	BWA	NAM	ZAF	XSC						

A5. The Model

As a complement to the short description given in the main text, the main elements of the model's structure are sketched below. The model used here is the perfect competition version of the Mirage model, as documented in Fontagné et al. (2013).[23]

Supply side

On the supply side, each sector in Mirage is modeled as a representative firm, which combines value-added and intermediate consumption in fixed shares. Value-added is a CES bundle of imperfectly substitutable primary factors (capital, skilled and unskilled labor, land and natural resources). Firms' demand for production factors is organized as a CES aggregation of land, natural resources, unskilled labor, and a bundle of the remaining factors. This bundle is a nested CES aggregate of skilled labor and capital (which are considered as relatively more complementary).

Mirage assumes full employment of primary factors, of which the growth rates are set exogenously, based on the macro projections on a yearly step, as detailed below. Population, participation in the labor market and human capital evolve in each country (or region of the world economy) according to the demographics embedded in the macro projections. This determines the labor force as well as its skill composition (skilled/unskilled). Skilled and unskilled labor is perfectly mobile across sectors, but immobile between countries. Natural resources are sector-specific, while land is mobile between agricultural sectors. Natural resources for the mining sector and land for agricultural sectors are set at their 2011 levels: prices adjust demand to this fixed supply. In the baseline, natural resources for fossil-fuel production sectors adjust to match the exogenous price target that is imposed (International Energy Agency, 2015) for coal, oil and gas, and according to the energy demand projected by the model. By contrast, in the simulations, changes in demand for fossil energy sources influence their price, while natural resources are fixed at their baseline level.

Installed capital is assumed to be immobile (sector-specific), while investments are allocated across sectors according to their rates of return. The overall stock of capital evolves by combining capital formation and a constant depreciation rate of capital of 6% that is the same as in the long-term growth models. Gross investment is determined by the combination of saving (the saving rate from the growth model, applied to the national income) and the current account. Finally, while total investment is savings-driven, its allocation is determined by the rate of return on investment in the various activities. For simplicity, and because we lack reliable data on foreign direct investment at country of origin, host and sectoral levels, international capital flows only appear through the current account imbalances, and are not explicitly modeled.

[23] The model is also documented in an interactive wiki-based website. See http://www.mirage-model.eu.

Demand side

On the demand side, a representative consumer from each country/region maximizes instantaneous utility under a budget constraint and saves a part of its income, determined by saving rates projected in our first-step exercise. Expenditure is allocated to commodities and services according to a LES-CES (Linear Expenditure System – Constant Elasticity of Substitution) function. This implies that, above a minimum consumption of goods produced by each sector, consumption choices among goods produced by different sectors are made according to a CES function. This representation of preferences is well suited to our purpose as it is flexible enough to deal with countries at different levels of development.

Within each sector, goods are differentiated by their origin. A nested CES function allows for a particular status for domestic products according to the usual Armington hypothesis (Armington, 1969): consumers' and firms' choices are biased towards domestic production, and therefore domestic and foreign goods are imperfectly substitutable, using a CES specification. We use Armington elasticities provided by the GTAP database (Global Trade Analysis Project) and estimated by Hertel et al. (2007). Total demand is built from final consumption, intermediate consumption and investment in capital goods.

Dynamics

Efficiency in the use of primary factors and intermediate inputs is based on the combination of four mechanisms. First, agricultural productivity is projected separately, as detailed in Fontagné et al. (2013). Second, energy efficiency computed from the aggregate growth models is imposed on Mirage. Third, a 2 p.p growth difference between TFP in manufactures and services is assumed (as in van den Mensbrugghe, 2005). Fourth, given the agricultural productivity and the relation between productivity in manufacturing and services, Mirage recovers endogenously country-specific TFP from the exogenous GDP and production factors. Notice that TFP thus recovered from the baseline projections is subsequently set as exogenous in the alternative scenarios. Therefore, GDP becomes endogenous in such scenarios.

Dynamics in Mirage is implemented in a sequentially recursive way. That is, the equilibrium can be solved successively for each period, given the exogenous variations of GDP, savings, current accounts, active population and skill level coming from the growth models, as described above. Simulations extend up to 2025. Finally, Mirage is calibrated on the GTAP dataset version 9PR1, with 2011 as a base year.