CEPII
CENTRE D'ÉTUDES PROSPECTIVES ET D'INFORMATIONS INTERNATIONALES

No 2009 – 22
September

DOCUMENT DE TRAVAIL

A Picture of Tariff Protection Across the World in 2004 MAcMap-HS6, Version 2

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NON-TECHNICAL SUMMARY

Trade negotiations increasingly rely on quantitative assessments. Accordingly there is a need for tariff information shedding light on applied protection at the detailed level. The purpose is not only to provide a measure of border protection, but also to pave the way for well-suited economic analysis of the consequences of trade liberalization, in particular through computable general equilibrium model analysis.

Based on a joint effort by ITC (UNCTAD-WTO, Geneva) and CEPII (Paris), a first version of a Market Access Maps data (MAcMapHS6-v1) was prepared (Bouët and ali, 2008),[1] mainly to furnish protection figures for the 6th release of the GTAP database (Bouët and ali, 2005). The first version of MAcMapHS6 represents an unprecedented effort to monitor border protection world-wide at the most detailed level, while accounting exhaustively for preferential trade agreements. It provides with a consistent, ad valorem equivalent measure of tariff duties and tariff rate quotas for 163 countries and 208 partners, at the six-digit level of the Harmonized System (HS) that includes 5,113 products.

Using 2004 data, an updated version of this database, MAcMapHS6-v2, has been built. This paper provides a detailed description of the methodology used for building the new database, providing evidence on the world applied protection in 2004. Moreover, since the dataset is the source of protection data for the GTAP7 (Narayanan and Walmsey, 2008) and the TASTE software (Horridge and Laborde, 2008), this documentation is an important reference for numerous researchers.

The methodology used for the construction of MAcMapHS6-v2 is closed to the previous. However, several key improvements have been made. To the core dataset provided by ITC, additional sources have been used to complete it and enhance the quality of the database. A new algorithm is utilized to deal with harmonized products nomenclature and code oddities. The method applied to process tariff rate quota information has been deeply improved. Finally, the way to compute reference group weights has been tuned.

On the overall, the relative low protection rate, 5.1% on average for the whole world, hides a high level of heterogeneity among countries and sectors. It is interesting to notice that trade policies preserve, since more than two centuries the same characteristics. The average level of protection decreases with the level of development: in 2004 high income countries have an average duty of 3.3%, against 9.6% for middle income countries and 12.2% for least developed countries. The agriculture is more protected (18.9%) than the manufacturing (4.4%) or extractive and energy products (1.9%); reflecting the particular role of the agriculture for all the countries.

[1] MAcMapHS6-v1 has been initially presented in Bouët et al. (2004) and the MAcMap approach has been introduced in Bouët et al. (2002).

Last but not least, final goods are more protected than intermediate goods. This aims to increase the effective protection of the locally produced value-added. In the same section we also investigate variations in tariffs occurred between 2001 and 2004. The decrease of 0.5 percentage points in the average world protection between 2001 and 2004 is mainly due to emerging economies.

ABSTRACT

MAcMap-HS6v2 is a comprehensive database providing detailed protection data at the 6 digit level of the harmonized system (HS6),i.e. more than 5000 products, for the year 2004. It includes ad valorem equivalents on MFN tariffs for 169 importing countries, as well as bilateral applied protection, together with preferential provisions for 220 partners. Specific and compound tariffs and tariff rate quotasdata are also provided, at the same level of detail.

In this paper we present the methodology used for building this new database, paying attention to the consequences from such choices. We then provide evidence on the world applied protection in 2004. Finally we investigate variations in tariffs occurred between 2001 and 2004.

JEL Classification: F13
Key Words: Trade policies, Tariffs, Database, Ad valorem equivalent

PANORAMA DE LA PROTECTION MONDIALE EN 2004
MACMAP-HS6, VERSION 2

RÉSUMÉ NON TECHNIQUE

Depuis le cycle de l'Uruguay, les négociations commerciales s'appuient sur des simulations faisant de plus en plus souvent appel à des modèles d'équilibre général calculable. Parmi les données nécessaires à ces simulations celles concernant la protection tarifaire au niveau détaillé requiert une attention toute particulière. Une mesure exhaustive de la protection est en effet nécessaire pour parvenir à des analyses robustes et cohérentes des conséquences des libéralisations commerciales.

Pour parvenir à la cohérence et à l'exhaustivité des données, une première version de la base MAcMap (Market Access Map data) a été construite en 2002 par le CCI (CNUCED-OMC, Genève) et le CEPII (Paris), révisée en 2004[2]. Son intégration à la sixième version de la base GTAP a permis une nette amélioration de la qualité des résultats fournis par les modèles. Ce travail représentait un effort sans précédent pour rassembler les données de protection à la frontière dans une nomenclature sectorielle détaillée. La base proposait ainsi un équivalent *ad valorem* des droits de douanes et des quotas tarifaires pour 163 pays et leurs 208 partenaires, dans une nomenclature à 6 chiffres du système harmonisé (SH6), incluant 5 113 produits.

Ce papier présente de façon détaillée la dernière version de la base MAcMap-HS6 dont la méthodologie est proche de celle de la version précédente et qui porte sur les données de 2004 ; il constitue une documentation de référence pour les nombreux chercheurs utilisant la base GTAP 7 ou TASTE software.

Nous présentons d'abord les sources des données. La principale source est constituée des données fournies par le CCI ; des sources additionnelles ou alternatives sont également utilisées (TARIC, US-ITC, données nationales indiennes…). Nous expliquons ensuite les améliorations méthodologiques apportées. Ainsi un nouvel algorithme est utilisé pour détecter et corriger les problèmes de nomenclature sectorielle ; le traitement des quotas tarifaires (QTRs) est amélioré ; enfin, le calcul des pondérations, nécessaire préalable à la méthode d'agrégation à partir des « groupes de référence », a été perfectionné.

Ce papier présente également une analyse détaillée des protections en 2004 et explique les changements survenus entre 2001 et 2004. Le taux agrégé de protection est relativement faible au niveau mondial : 5,1%, en 2004 (5,6% en 2001), mais cette moyenne cache une hétérogénéité importante, tant entre les pays qu'entre les secteurs. Les principaux faits stylisés ressortant d'une analyse des données de la base MAcMap-HS6v2 font ressortir des caractéristiques permanentes depuis plus de deux siècles. Le niveau moyen de protection décroît avec le niveau de développement : en 2004, les pays riches apposent sur leurs importations un droit de douane moyen de 3,3%, les pays en développement taxent les leurs à 9,6%, les pays les moins avancés à 12,2%. Sur le plan sectoriel, l'agriculture reste, de loin, le secteur le plus protégé, avec un droit

[2] MAcMapHS6-v1 est présentée dans dans Bouët et al. (2004). Une version préliminaire a été introduit dans Bouët et al. (2002).

de douane moyen de 18,9%, comparé à 4,4% pour l'industrie et 1,9% pour le secteur énergétique. Le rôle particulier qu'a l'activité agricole dans tous les pays explique cette différence et les difficultés rencontrées depuis l'introduction du secteur agricole dans les négociations commerciales. Enfin, dans un souci de renforcer la protection effective de la valeur ajoutée produite localement, les biens finaux demeurent plus protégés que les biens intermédiaires.

Le papier explore ensuite les effets à l'œuvre derrière la baisse de la protection effective depuis 2001. En effet, la méthodologie commune aux deux bases MAcMap-HS6 permet de mettre au jour les origines des différences entre 2001 et 2004, *via* une décomposition originale qui permet d'isoler les effets dus aux variations des taux de change, des valeurs unitaires, au système de pondération ou au traitement des QTRs. L'effet résiduel s'explique par une amélioration des données et/ou par un changement des politiques commerciales des pays. La baisse de 0,5 point de pourcentage observée entre 2001 et 2004 s'explique ainsi, pour une large part, par une baisse importante de la protection des économies émergentes.

RÉSUMÉ COURT

MAcMap-HS6v2 est une base de données proposant un équivalent *ad valorem* des droits de douanes appliqués et des quotas tarifaires pour 169 pays et leurs 220 partenaires, dans une nomenclature à 6 chiffres du système harmonisé (SH6), incluant 5 113 produits, pour l'année 2004. La base contient également les droits NPF (Nation la plus favorisée) ainsi que les droits consolidés déclarés à l'OMC. Les préférences bilatérales et régionales sont aussi prises en compte. Nous détaillons ici la construction d'une telle base ainsi que les conséquences de nos choix méthodologiques. Nous proposons également une description de la protection mondiale en 2004 et présentons les phénomènes à l'origine du changement de la protection depuis 2001.

Classification JEL : F13
Mots-clefs : Politiques commerciales, Droits de douane, Base de données, Equivalent ad valorem

ACKNOLEDGEMENTS

We thank Mondher Mimouni and Xavier Pichot and the International Trade Center in Geneva for their important contribution by providing us an extraction of the MAcMap database. We are grateful to Agnès Benassy-Quéré; Antoine Bouët, Yvan Decreux, Lionel Fontagné, Luca Salvatici and Priscila Ramos as well as one anonymous referee for detailed discussion and comments. Funding for this research from the European Commission through the AgFoodTradeFramework Project 7, Grant 212036, 2008 is gratefully acknowledged.

A PICTURE OF TARIFF PROTECTION ACROSS THE WORLD IN 2004 MACMAP-HS6, VERSION 2

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1. INTRODUCTION

Trade negotiations increasingly rely on quantitative assessments. Accordingly there is a need for detailed tariff information shedding light on applied protection across the world. The purpose of the present study is not only to provide a way to measure border protection, but also to pave the way for well-suited economic analysis of the consequences of trade liberalization, in particular through computable general equilibrium (CGE) models.

In a joint effort of the International Trade Center (ITC) (United Nations Conference on Trade and Development/World Trade Organization, Geneva) and CEPII (Paris), a first version of the Market Access Maps database (MAcMap-HS6v1) was prepared in 2003 Bouët et al. 2008),[3] mainly to furnish protection figures for the sixth release of the Global Trade Analysis Project (GTAP) database (Bouët et al. 2005). The first version of MAcMap-HS6 represented an unprecedented effort to monitor border protection worldwide at the most detailed level, while accounting exhaustively for preferential trade agreements (PTAs). It provided a consistent, ad valorem equivalent (AVE) measure of tariff duties and tariff rate quotas (TRQs) for 163 countries and 208 partners, at the six-digit level of the Harmonized System (HS), accounting for 5,113 products. Its main contributions were (i) an exhaustive coverage of PTAs across the world; (ii) the calculation of the AVE of specific duties, acknowledging the differentiated impact of such duties across exporters depending on their export unit values; (iii) the incorporation of TRQs both through the AVE of the resulting protection at the margin and through the calculation of involved rents; and (iv) an original aggregation methodology using a weighting scheme based on reference groups of countries and limiting the extent of the endogeneity bias inherent in the standard, import-weighted average protection.

Using 2004 data and following a similar approach, an updated version of this database, MAcMap-HS6v2, has been built. This paper describes in detail the methodology used to build the new database; it also provides evidence on applied protection around the world in 2004. Moreover, since this data set is the source of protection data for both the GTAP7 database (Narayanan and Walmsley 2008) and the TASTE software (Horridge and Laborde 2008), this documentation is an important reference for numerous researchers. This effort is a complement of the development of the online version of Macmap. ITC is providing a regularly updated picture of the world-wide protection mainly devoted to export promotion agencies or trade negotiators. A by-product of this joint effort of ITC, the WTO and UNCTAD is the publication of the "World Trade Profiles" annually.

[3] MAcMap-HS6v1 was first presented in Bouët et al. (2004); the MAcMap approach was introduced in Bouët et al. (2002).

We present the methodology used to construct MAcMap-HS6v2, a database devoted to analytical research, in section 2. Although this methodology is similar to that used previously, several key improvements have been made. Additional sources have been added to the core ITC data set to complete that data set and enhance the quality of the database. A new algorithm is used to deal with harmonized product nomenclature and code oddities. The method applied to process TRQ information has been vastly improved. Finally, the way reference group weights are computed has been fine-tuned.

Section 3 presents a general overview of tariff protection across the world in 2004. The relatively low protection rate, 5.1% on average for the whole world, hides a high level of heterogeneity among countries and sectors. The average level of protection decreases with the level of development: in 2004, high-income countries (HICs) have an average duty of 3.3%, against 9.6% for middle-income countries (MICs) and 12.2% for least-developed countries (LDCs). Agriculture as a sector is more protected (18.9%) than either manufacturing (4.4%) or extractive and energy products (1.9%), reflecting the fact that agriculture plays a specific role for almost all countries. Last but not least, final goods are more protected than intermediate goods, a practice that aims to increase the effective protection of the locally produced value-added. In the same section, we investigate variations in tariffs occurring between 2001 and 2004. The 0.5 percentage point drop in the average world protection between 2001 and 2004 is mainly due to MICs. For one thing, MICs achieved their Uruguay Round commitments in 2004, against 2001 for rich countries; and a number of emerging economies adopted more liberal trade policies (i.e., China and India). The total variation in protection between the two time periods has been decomposed into several effects: changes in the TRQ regime, the system of weights, the unit values, and exchange rates and residual changes from pure trade policies.

The increase in average agricultural protection in rich countries (+6% in relative terms) contrasts with the global decrease. It does not seem to come from a modification of trade policies; rather it is the result of two effects. One is the mechanical effect of the fall of the U.S. dollar on the European Union AVE, due to the conversion into U.S. dollars of the specific tariff (initially expressed in local currency per physical unit). Second, several tariff rate quotas previously unfilled (in quota) have been filled or even exceeded. The immediate consequence is thus an increase in the protection exporters face.

Section 4 concludes. Two appendices provide additional information on methodology and protection figures by country.

2. METHODOLOGY

In this section, we describe the data and the methodology used to build MAcMap-HS6v2. We also underscore the differences between the current version and the previous version (Bouët et al. 2008).

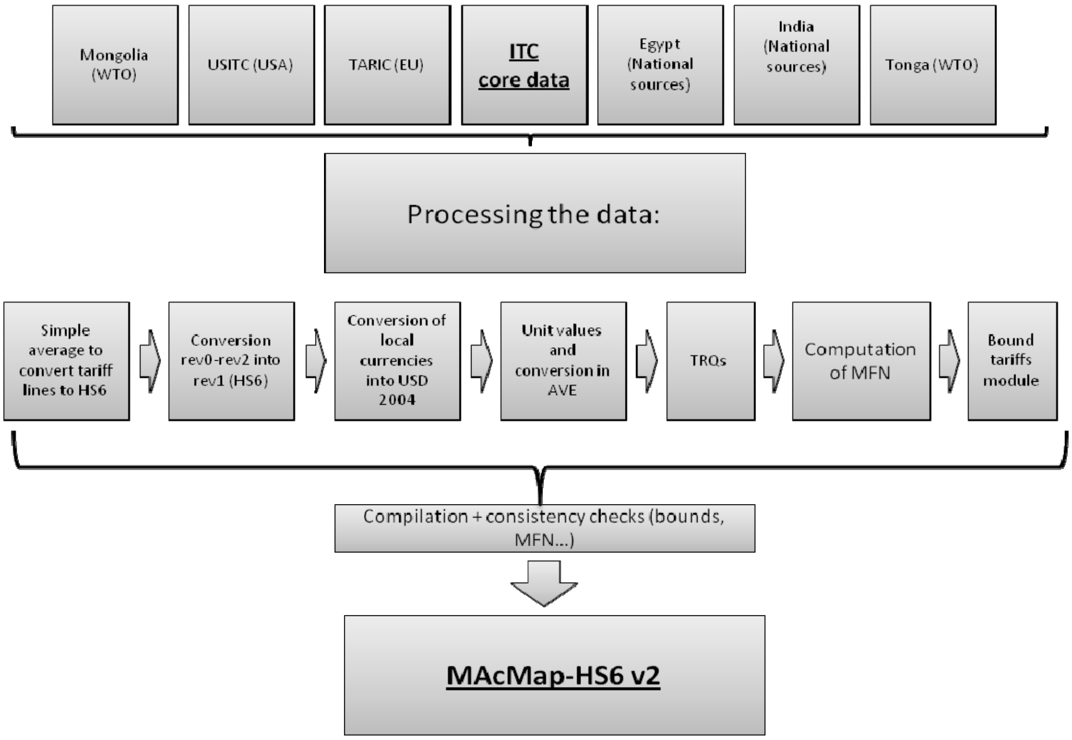
As data on applied protection are scattered and heterogeneous, the first step when tackling protection measurement is to collect and harmonize available information. Even at this early stage a number of choices must be made, since there is no unique or obvious way to handle the data. Once that has been done, the construction of the database mainly involves computing AVEs and proposing an appropriate aggregation procedure.

The first difference between the two versions of the MAcMap-HS6 database is the increased number of data sources considered: ITC's MAcMap data set is used as a primary source, but for several countries we rely directly on national sources to avoid any loss of information (see table 1). In addition, the bound tariff database (Bchir, Jean, and Laborde 2006) has been updated. The second difference concerns the technical side, where some improvements have been introduced. More efficient algorithms have been used to deal with data oddities. A special treatment is applied to tariff rate quotas. Finally, different concepts of unit value have been defined to answer alternative researchers' needs. Figure 1 shows the different steps of the procedure, which are further described in the following paragraphs. It is worth stressing that Macmap on line (and consequently the world Tariff Profiles) are using different methods to compute AVEs, taking benefit of the availability of tariff line information for a large series of countries. The data collected by ITC, the UNCTAD and the WTO and provided by ITC through Macmap is an unprecedented effort to release consistent tariff data on an exhaustive and detailed basis. Still, such huge database necessarily contains some problems at a given point in time, that would indeed be fixed in a further release but that need to be fixed all in a raw in a database such as MAcMap-HS6 devoted to academic exercises.

Table 1. Source of data for countries with complete replacement of data

Country	Source
United States	Harmonized Tariff Schedule of the United States (2004). USITC publication 3653 and http://www.usitc.gov/tata/hts/other/dataweb/
European Union	TARIC database (specific extraction)
India	http://commerce.nic.in/ and http://www.cbec.gov.in/customs/cst-0607/cst-main.htm
Egypt	Egyptian Tariff Schedule and collaboration with Peter Minor from Nathan Associates
Mongolia, Tonga	WTO notifications and tariff schedule (www.wto.org)

Figure 1. Processing steps of MAcMap-HS6v2



2.1. Data

MAcMap-HS6v2 is a large data set, providing duties for 171 importers and 209 exporters over 5,113 products for the year 2004. It is developed using the SAS® software.

2.1.1. ITC database

The main data source[4] is an extraction of ITC's MAcMap (www.macmap.org) database, which contains exhaustive information at the tariff line level. The ITC database includes the United Nations Conference on Trade and Development's (UNCTAD's) TRade Analysis and INformation System (TRAINS) database, to which ITC experts add their own data. The input file for MAcMap-HS6v2 contains applied tariffs at the bilateral level at the HS6 level, with an ad valorem component and two specific components (each associated to a given physical unit).

2.1.2. Complements to the core data

Although the ITC database constitutes an essential input to our work, we find it necessary to improve this primary source of data to fix a number of problems, such as the following (see Figure 2):

[4] We are grateful to Mondher Mimouni and Xavier Pichot for their collaboration and their kind support by providing the primary dataset.

1. Information can be outdated for some countries even if the data are labeled "2004." While this is not an issue for a database regularly updated like Macmap on line, this is much more a concern for a data base aiming at being fundamentally unchanged such as MAcMap-HS6. First, countries that have instituted important recent reforms (such as India or Egypt in 2004) may still be represented with outdated information. In addition, new free trade agreements (FTAs) may be imperfectly translated (e.g., the U.S.-Chile FTA): if country A and country B have signed an FTA and only country A has been updated, that creates asymmetric preferences in the database instead of the reciprocal preference scheme.
2. The ITC data may be incomplete in some specific cases for several reasons. First, some products are missing as a result of incomplete tariff schedule notifications. Second, due to complex tariff legislation, the relevant information, displayed as a footnote in the country tariff schedule, may have been discarded in an initial automatic treatment. Third, a tariff applied on a specific tariff line can be based on information related to other tariff lines: for example, the tariff for a fruit juice (generic tariff line) may refer explicitly to the tariff applied on the fresh fruit (specific tariff line), or the tariff applied on a set of goods (cloth suits, toolboxes) may represent the sum of the tariffs applied on the components. To compute a tariff for all these lines, instead of using a 0 as was done in the initial data set, we implement specific treatments (e.g., assumption on the average composition of a bundled good; cross-tariff lines procedure to retrieve the information). Information on entry prices and seasonal tariffs may be missing, as well. In MAcMap-HS6, the latter two problems are only partially covered. Only the EU case, based on the integrated tariff of the European Communities (TARIC) information, has benefited from a specific treatment: first, the yearly average[5] of monthly tariffs is used to take into account intra-year variation; and second, the entry-price tariff is selected based on the unit values used in the database[6] for the sake of consistency.
3. A few countries are missing in this extraction (e.g., Tonga and Mongolia, two World Trade Organization [WTO] members).
4. When countries use two tariff lines for managing in- and out-of-quota rates (e.g., the United States, Canada, Japan), these tariff lines are treated as two different products (instead of one) biasing downward the six-digit-level tariff provided by ITC.

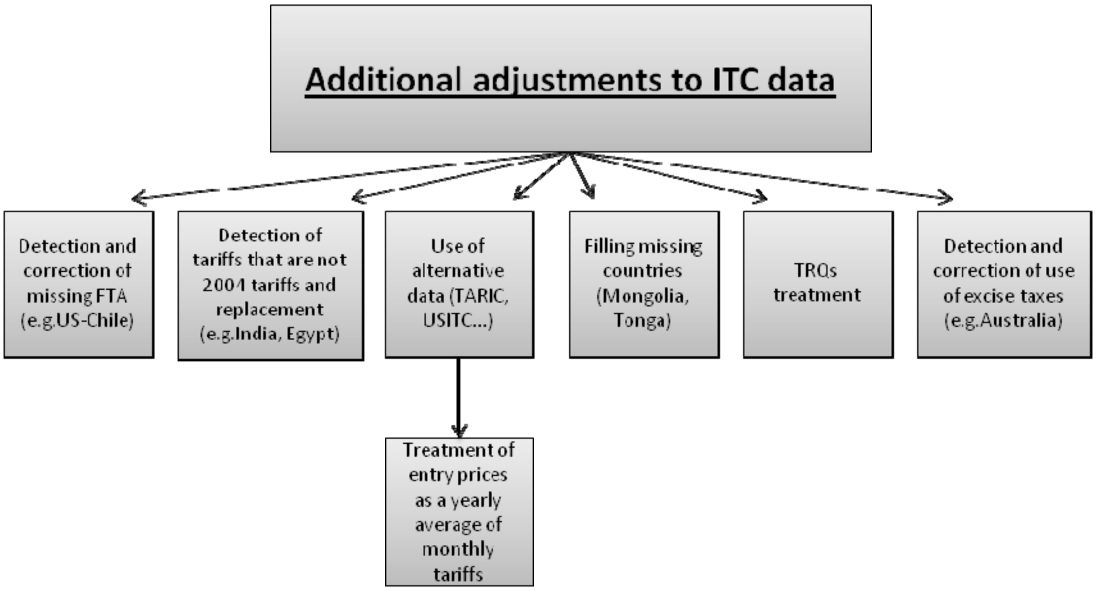
In a few cases, confusion exists between excise taxes (domestic taxation) and tariff duties (e.g., Australia and New Zealand on alcoholic beverages). To detect and correct such cases, we detect all non-zero bilateral tariffs for which an effective FTA or custom union (CU) is implemented and manually investigate the different cases. This may show that the remaining tax is not a tariff (as in the case of Australia).[7]

[5] It may be argued that taking the highest tariff over the year will be a better measurement of the protectionist barrier implemented. However, since there is no ideal solution, we rely on the simple average over the year.

[6] This procedure is implemented starting with the MAcMap-HS6v2.2 release.

[7] It is important to note that an "additional duty" has been included in the database even if it is not legally speaking a tariff: for example, the ethanol (HS6 220690) tax applied by the United States on ethanol imports.

Figure 2. Adjustments made on the ITC data set



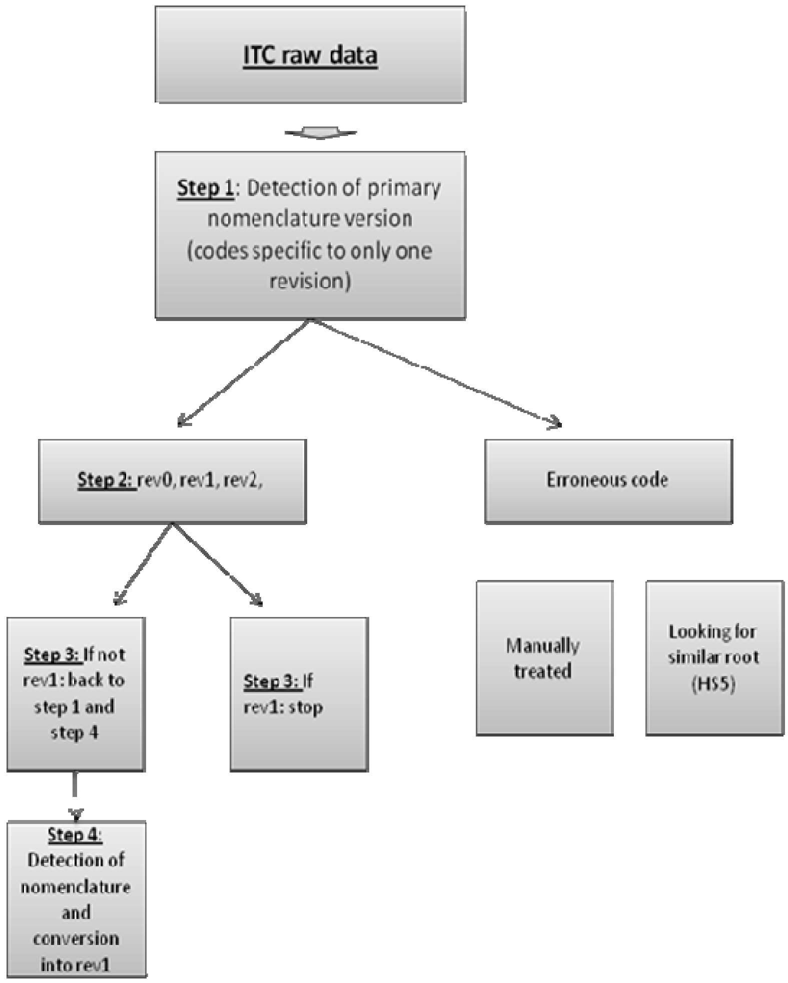
Thus, we completely replace the data for some countries (the United States, the European Union, India, Egypt see Table 1 for sources), partially replace the data for others (especially for all members of the Common Market for Eastern and Southern Africa [COMESA], the Association of Southeast Asian Nations [ASEAN], and the Southern African Customs Union [SACU]),and add the data for missing WTO countries. For all countries, we build an exhaustive data set that includes all preferential regimes, relying mainly on national administrative documents (official tariff schedules). The remaining problems are corrected by using targeted procedures as described previously.

2.1.3. Nomenclature

MAcMap-HS6 uses the HS6 nomenclature, which is the most detailed level of the international nomenclature for goods defined by the World Customs Organization (WCO). Several versions of this nomenclature exist, based on year (the most recent one is 2007).

For our purposes, we convert all codes from ITC into revision 1 (1996) to harmonize them using WCO official mapping tables following the procedure displayed in Figure 3. Raw data from ITC can belong to different versions of the HS6 nomenclature—0 (1988), 1 (1996), and 2 (2002)—whereas countries for which we use other data sources have adopted a more recent revision (2002). Besides, it happens that some countries mix different revisions at the same time. This is a real problem because one code can correspond to different products depending on the revision. Moreover, some codes in the original data set do not exist in any nomenclature or have been truncated.

Figure 3. Nomenclature adjustments



To avoid wasting information due to qualitative errors, we have developed an algorithm for dealing with aberrant codes. First, for each country we identify the "primary" nomenclature version. It is the revision (0, 1, or 2) for which the codes that exist in only one revision are the most represented. The same methodology is used to define the "secondary" nomenclature. We follow this hierarchy to convert each code into revision 1, each code being converted only one time. To illustrate this strategy, let's take two examples. First, let's assume that a code exists in both revision 1 and 2 but the revision 2 code covers a wider selection of products, meaning several revision 1 codes (for example, the revision 2 code 071190 vegetables and mixture of vegetables, which corresponds to 071110 and 071190 in the revision 1). If we assume that the primary nomenclature is revision 1, and since this code exists in revision 1, we do not need to proceed to a conversion. On the other hand, if we assume that the primary nomenclature is revision 2, we have to proceed to a conversion and use this tariff information for other lines. Second, the same code exists in revisions 0 and 2 but it does not map to the same HS6 revision 1 code depending on its origin. Once again, knowing the nomenclature of origin of the code is important since we can use the relevant correspondence table (from revision 0 to 1 or from revision 2 to 1).

This strategy enables us to deal with the conversion of codes that exist, but in some cases we have to go further. When an erroneous code -a code that does not exist in any official WCO nomenclature- is detected, the algorithm uses a sequential procedure to look for a similar code with missing information to fill the gap. First, codes that include non-numerical characters are extracted in order to pre-treat them manually.[8] Then, the algorithm looks for close HS6 products that belongs to the same HS5 position and that have no information in the tariff schedule and replaces missing information by the tariff associated to the erroneous code.

In addition, at a final stage, simple averages at the five- or four-digit HS level are used to provide tariffs for missing HS6 products.

It is noteworthy to check that methodologies used in both previous paragraphs deliver the same results for a frequent case when countries use a 0 (or 00) in the last position of the HS6 code to indicate that this tariff rate will apply to any products belonging to this position -that is, that the 0 can be replaced by any number for any HS6 code not elsewhere defined. Geographical nomenclature corresponds to the ISO codification of the United Nations.[9] Uninhabited territories (e.g., Bouvet Islands) and countries with a gross domestic product (GDP) of less than US$50 million (e.g., Montserrat) have been excluded from the data set. The EU25 is processed as a single entity but is disaggregated in a final stage.

2.1.4. Trade data

Trade data come from the BACI database (Base pour l'Analyse du Commerce International), developed at CEPII based on United Nation's COMTRADE database and fully documented in Gaulier, Paillacar, and Zignago (2008). It is a harmonized dataset using the COMTRADE data set as raw data, providing time series of bilateral trade at the HS6 level worldwide. A specific extraction is realized for MAcMap-HS6v2 to make trade data compatible with the revision 1 HS nomenclature, to get individual data for SACU members, and to split Benelux into two countries (Belgium and Luxembourg).

MAcMap-HS6v2 makes use of a simple average of three consecutive years (2002, 2003, and 2004) both for values and volumes, in order to reduce the volatility in trade data. In addition, the BACI data set generates a matrix (products by quantity units) that provides coefficients to convert Comtrade standard physical units[10] into tons for each HS6 product. The quantity data, totally expressed in tons, is used in our data set to compute both unit values and weighting schemes.

[8] This stage requires manual treatment since non-numerical characters can be related to aberrant information or a specific codification in some national tariff schedule nomenclature.

[9] http://unstats.un.org/unsd/methods/m49/m49alpha.htm. A few changes have been made: 842 instead of 840 for the United States, 490 for Taiwan, 579 instead of 578 for Norway, 699 instead of 356 for India, and 757 instead of 756 for Switzerland. Finally, the code for the EU25 entity is 918.

[10] Cubic meter for volume, square meter for area, and meter for length and unity.

2.2. Computing an Ad Valorem Equivalent at the Six-Digit Level

The lack of harmonized trade data at the tariff line level needed to compute unit values or weights for aggregation leads us to build a database at the six-digit level in order to supply international researchers with a uniform product nomenclature.

To provide an AVE at the six-digit level from the tariff line data set,[11] two main operations have to be performed:

1. Obtain at the six-digit level a simplified compound tariff with a single specific tariff expressed in dollars by ton that sums up with a single ad valorem component;[12] and
2. Define a unit value that will be used to convert the specific component previously defined into an AVE.

We prefer not to convert specific tariffs at the tariff line level for two reasons: first, trade data at such a level are not public information in all countries; and second, unit values are even far more volatile (see infra).

2.2.1. Getting a simplified compound tariff at the six-digit level

This first stage is performed by ITC under the following assumptions.

To move from the tariff line to the six-digit level, we compute a simple average across the different tariff lines. All mixed tariffs are converted into compound tariffs by giving the primacy to the pure ad valorem component of the duty rate; if such a term does not exist, the compound tariff is kept. In the case of a mixed tariff with two compound components, only the first one is retained.

We apply the same rule for the countries that we process separately from the ITC data set.

The important choice made at this stage[13] is the use of a simple average to compute the six-digit tariff from the tariff line level. Using a simple average has several advantages:

1. Aggregating tariff lines within an HS6 position is a more limited challenge than to aggregate tariffs over a large set of products. The number of lines is limited. A simple average reduces the risk associated with any aggregation and avoids the need of a complex aggregator.
2. It requires only information on tariffs.
3. At the detailed level, tariff peaks are more frequent and a trade-weighted average will be much more biased.

[11] At the tariff line level, tariffs can be expressed as ad valorem, specific, compound (the sum of ad valorem and specific components), or mixed (combinations of ad valorem, specific, and compound tariffs with a complex operator such as Max or Min).

[12] Each or both components may be equal to zero.

[13] In reality, this issue concerns all levels of aggregation and will be discussed in section 2.4.

2.2.2. Converting physical units

At this point, a compound rate may have one or two specific components associated with different physical units (ton, unit, cubic meter, square meter, and so on). Therefore, we convert every specific term into monetary units per ton and sum them to get only one term. The conversion rate between physical units is provided by the BACI data set. It is important to note that the same rate is used for computing unit values. At the end of this second stage, we have a compound tariff with two components: one ad valorem and one specific in domestic currency per ton, both at the bilateral level and at the HS6 revision 1 nomenclature.

2.2.3. Converting monetary units

The next step is to express all variables in the data sets in U.S. dollars, which implies converting the specific component into 2004 U.S. dollars. For this we rely on annual average exchange rates provided by the International Monetary Fund.

2.2.4. The choice of unit values

The last stage in commuting specific tariffs into AVEs involves the choice of unit values. Such values play a major role because any measurement error will have a proportional effect on the AVE of the specific tariff. For instance, using overestimated unit values will decrease the level of protection.

Using bilateral unit values at the product level is unsatisfactory given their high volatility, which is often caused by statistical errors (quantity badly notified, abusive rounding).[14] The volatility of unit values is illustrated in Figure 4, where we plot the distribution of the ratio between standard deviation and median of the unit values for 5,111 products, using different definitions: bilateral unit value, exporter unit value, exporter reference group unit value (ERGUV). This last concept was developed for the first version of MAcMap-HS6 at CEPII (see Bouët et al. 2004). All in all, to get a relevant AVE, we need unit values to match two features: stability and relevance compared with the price heterogeneity of different exporters. The ERGUV approach adequately responds to these requirements, as depicted in Figure 4. A cluster analysis is performed, grouping exporters into five groups, according to GDP per capita and trade openness. For each group, and for the whole world, a product unit value is computed using a weighted median of the trade data for the 2002–2004 period.[15] To ensure the stability of the AVE obtained, we apply an additional filter: ERGUVs are limited to an interval comprising between one-third and three times the world median unit value; extreme values are capped by the limits of this range.

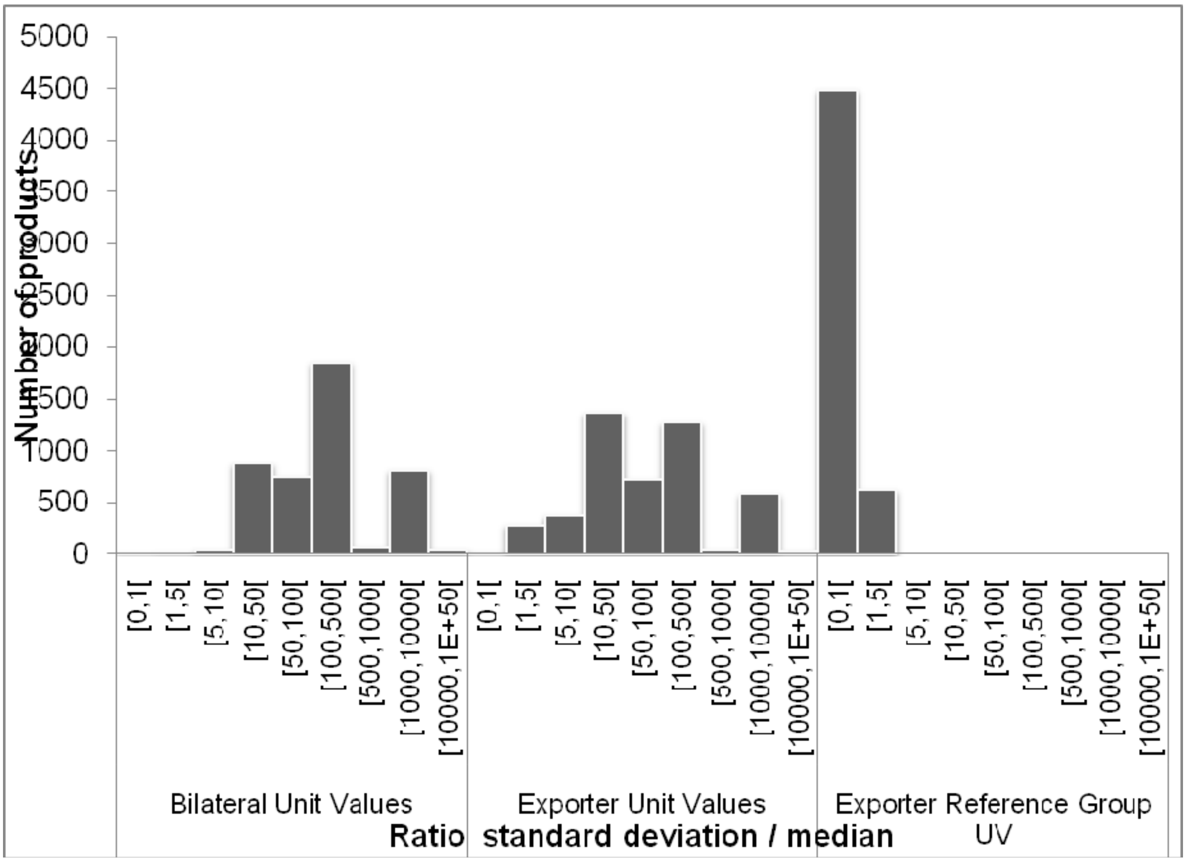
Let us note that it is not only a statistical matter. Different concepts of unit value are useful in studying tariff protection:

[14] For a relatively homogeneous product such as sugar, the nonweighted coefficient of variation of bilateral unit value is above 10,000%.

[15] A few nonmarket trade relations are discarded, such as food aid rice exports between Japan and North Korea valuated at Japanese domestic prices, because of a high level of bias in unit values.

- Focusing on the protection faced by a country, unit values should consider the exporter specificities and the heterogeneity of export prices. Low-cost exporters (e.g., LDCs) are more affected by specific tariffs than high-cost exporters. We still prefer to use the ERGUV as a default unit value to assess AVE.[16] However, in the complete database, we also provide the simple exporter unit value as an alternative.
- Concerning multilateral negotiations, or just to get a unique AVE for the most favored nation (MFN) tariff, we need to use a single unit value by product and by importer. Different unit values, all included in the database, meet this constraint: the world unit value, an importer unit value, and a unit value based on WTO recommendations (TN/AG/W/3 of July 12, 2006). See Appendix 1 for a discussion of the implementation of a tariff scenario in MAcMap-HS6.

Figure 4. Unit value heterogeneity



Note: The exporter reference group unit value (ERGUV) results are displayed before the implementation of the filter based on world unit value.

Source: MAcMap-HS6v2; Laborde (2008).

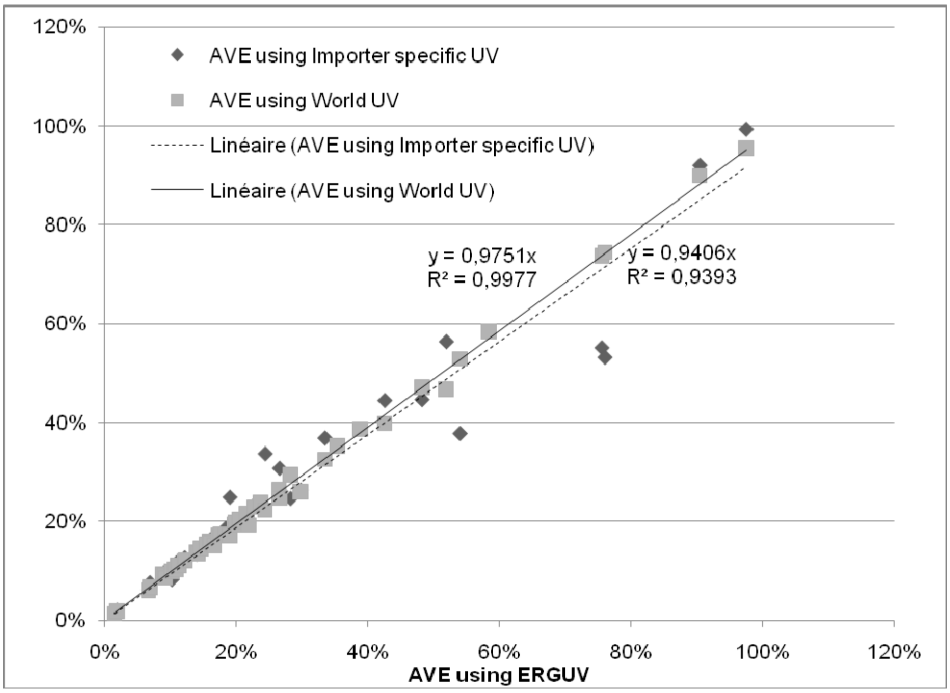
[16] In the case of LDCs, if the use of the ERGUV can "increase" their real unit values (assuming they are low-cost exporters) and reduce the AVE, using exporter-specific unit values can also lead to similar biases if the share of the preferential margins they benefit is included in their export prices.

Once we have calculated the unit values, we compute the AVE of a compound tariff as follows:

$$AVE = ad\ valorem + \frac{Specific}{unit\ value} \quad (1)$$

As we see in Figure 5, the differences in overall average agriculture protection using ERGUV and world unit value are small (correlation of 99%).[17] However, using importing country unit values decreases protection. For Norway, the gap is more than 20 points. Such a result is unsurprising since the importer's unit values include a share of quota rents and preferential margins.

Figure 5. Scatter plot of average agricultural protection using different unit values



Note: Each point represents one country.

Source: MAcMap-HS6v2; Laborde (2008).

2.2.5. Tariff rate quotas

Tariff rate quotas were introduced during the Uruguay Round (1986–1994) to replace simple quotas and have since been applied to agricultural trade. They improve market access conditions for some commodities protected with very high, sometimes prohibitive, tariffs. More precisely, TRQs combine a quantitative restriction and a two-tier tariff regime. Below the quota, imports under licenses face a preferential tariff (the *in-quota* tariff), and above the quota, the tariff applied equals or is very close to the MFN duty (the *out-of-quota* tariff). Taking this complex trade policy instrument into account when aiming to provide an AVE for a given tariff line is a

[17] As a matter of fact, the more disaggregated the figures, the wider the differences.

challenge. The MAcMap-HS6 methodology provides a relevant assessment of the marginal protection related to TRQs at the HS6 level.

Data Sources. A relevant treatment of TRQs requires a large set of good quality information, including tariff rates (in quota and out of quota),[18] the quota volume, the filling rate, and, sometimes, the quota allocation. Such information is usually poorly provided.

For this purpose, David Laborde and Priscila Ramos, with the help of Olivier Lecina,[19] have developed a specific data set. The starting point is version 1 of the MAcMap-HS6 TRQ data set, which displays 1,325 TRQs by reporter. Successively, we improve and update that data set with other sources. In particular, we rely on information contained in the 2005 Agricultural Market Access Database (AMAD), which has 1,393 TRQs, and the more complete De Gorter's data set (1,409 TRQs). All the information is controlled and updated with the WTO notifications. For several countries (China, the European Union, the United States), we have included preferential TRQs.

The comparison among different data sources helped us identify new and redundant TRQs, such as those offered by the new EU members (the Eastern European countries), and other TRQs, such as the Brazilian TRQs, which became irrelevant with the adoption of the MERCOSUR common external tariff. In addition, using different sources is crucial given the low level of information available in the core data set made by the WTO notifications. Indeed, out of the more than 1,434 TRQs registered at the WTO, only 450 have minimal information to be used in WTO secretariat calculations on TRQ fill rate in 2003 (see WTO 2005). In addition, nearly all of them are administrated based on the "applied tariff" approach, meaning that TRQs are not relevant per se. At the end, we provide robust information related to 784 TRQs for 32 reporting countries covering 493 HS6 products.

Allocating TRQs at the bilateral and six-digit level. Some TRQs are defined at the eight-digit level, while others cover a set of products at the six- or four-digit level. Moreover, in some cases they are open to all countries, and in others to a subset or even only one country. At the same time, one exporting country may be eligible for different TRQs (multilateral and/or preferential) when exporting one product to a specific country. Once the data have been collected, the next challenge is to bring the TRQ data set to the nomenclature used in MAcMap-HS6. Consequently, we split or aggregate all the information related to TRQs to obtain bilateral information at the six-digit level.

This procedure has been vastly improved compared with the previous version of MAcMap-HS6. In that version, we used a simple proportional rule—that is, if country A represents *X*% of effective imports of product *i* belonging to a TRQ offered by country B, we allocated *X*% of its TRQ to country A for the product *i*. That strategy had several limitations, the most obvious of which is to allocate a share of a MFN TRQ even to an exporter that benefit from a duty-free, quota-free preferential access. We have eliminated it with a new approach.

[18] Out-of-quota tariffs are provided by the tariff information in MAcMap-HS6. In-quota tariffs are extracted from the other sources quoted as well as the APEC tariffs database.

[19] The authors thank Harry de Gorter (see de Gorter and Kliauga 2006), Nicholas Grossman from the U.S. International Trade Commission, and Jacques Gallezot from the Institut National de la Recherche Agronomique for their contributions.

To define TRQs at the HS6 level, we developed an optimization program that aims to minimize tariff revenue collected by a country on imports related to TRQs.[20] It includes as constraints the TRQ specificities (products, country eligibility, size), the effective trade information, and the whole tariff structure (in-quota and out-of-quota rates but also other preferential and MFN schemes). Therefore, the preferential margin related to a TRQ will influence the allocation structure of the quota across partners and products. For instance, if a TRQ covers different HS6 products, exporters will mainly use it for products on which the TRQ preferences (in-quota rates) are the greatest, compared with non-TRQ tariff rates.

Applying the optimization program to each importing country *s* lets us define the allocated quantity q^{at} for each quota *TRQID* to each exporter *r*, as well as the quota q^{ef}, as follows:

$$Min \sum_{TRQID,r,hs6} \sqrt{RT_{s,TRQID,r,hs6}} \quad (2)$$

s.t.

$$\bar{Q}_{s,TRQID} \times share_{s,TRQID,group} = \sum_{r \in group, hs6 \in TRQID} q^{at}_{s,TRQID,r,hs6} \quad (3)$$

$$\bar{Q}_{s,TRQID} = \sum_{hs6 \in TRQID} q^{at-quota}_{s,TRQID,r,hs6} \quad (4)$$

$$q^{at}_{s,TRQID,r,hs6} \geq q^{ef}_{s,TRQID,r,hs6} \quad (5)$$

$$q_{r,s,hs6} = \sum_{TRQID} \left(q^{ef}_{s,TRQID,r,hs6} + q^{out}_{s,TRQID,r,hs6} \right) \quad (6)$$

$$TR_{s,TRQID,r,hs6} = \left(q^{ef}_{s,TRQID,r,hs6} \times AVE^{in-quota}_{s,TRQID,r,hs6} + q^{out}_{s,TRQID,r,hs6} \times AVE^{out-of-quota}_{s,TRQID,r,hs6} \right) \times UV_{hs6} \quad (7)$$

where $\bar{Q}_{s,TRQID}$ denotes the total quantity of quota *TRQID* applied by country *s;* $share_{s,TRQID,group}$ denotes the official share of quota *TRQID* allocated to the group of exporters, *"group"; * $q^{ef}_{s,TRQID,r,hs6}$ denotes the in-quota quantity used by exporter *r* in quota *TRQID;* $q^{at}_{s,TRQID,r,hs6}$ denotes the computed allocated quantity to exporter *r* in quota *TRQID;* $q^{out}_{s,TRQID,r,hs6}$ denotes the out-of-quota quantity; $q_{r,s,hs6}$ denotes the total quantity exported by *r* to *s; AVE* denotes the AVE of the in- or out-of-quota tariff; *TR* denotes the tariff revenue; and *UV* denotes the unit value.

[20] This behavior can have two justifications. Quotas can be allocated by a central planner on the side of exporters or by a perfectly competitive process between exporters that will lead to an optimal allocation process.

The objective function defined by equation 2 uses the square root of tariff revenue (*TR*) to obtain a nonlinear program (and a single solution)[21] and to represent the idea of economies of scale in the quota license management. Therefore, the cost of protection perceived by exporters (objective) of exporting *q* units from *n* exporters inside a TRQ is greater than the cost of exporting *nq* units from one country. This leads to a more concentrated structure of quota utilization.

The first constraint (equation 3) represents allocated quotas where a $share_{s,TRQID,group}$ of the quota *TRQID* is allocated to exporting countries *r* belonging to the eligible *group* of countries. One should keep in mind that several *hs6* products may belong to the same quota *TRQID.* The next constraint (equation 4) defines the total size of the quota. Equation 5 implies that no quantity under quota q^{ef} should be above the allocated quota quantity q^{at}. The fourth constraint (equation 6) defines that all trade quantities *q* should take place inside, q^{ef}, or outside, q^{out}, a quota. The last equation (equation 7) defines the tariff revenue collected on both the in-quota and out-of-quota quantities.

It is important to underscore the fact that this program is compatible with different solutions for $q^{out-quota}_{s,TRQID,r,hs6}$.. This is not a problem since we do not need to have information on the outside quantity by TRQID. Only the $q^{out}_{s,,r,hs6}$ is needed.

MAcMap-HS6 TRQ regimes

Based on the results of the previous optimization program that defined $q^{at}_{s,TRQID,r,hs6}$ *and* $q^{ef}_{s,TRQID,r,hs6}$), we compute the filling rate for each TRQ. It is defined at the TRQ level for a nonallocated TRQ and at the allocation level for an allocated TRQ.[22] The filling rates help to define three TRQ regimes, as in the previous version of MAcMap-HS6. The marginal tariff applied on imports under a TRQ will depend on the filling rate:

- When the fill rate is lower than 90%, the quota is not binding (in-quota regime or regime 0 in MAcMap-HS6 database), and the marginal tariff used in MAcMap-HS6, AVE^{MMHS6}, is the in-quota tariff ($AVE^{MMHS6} = AVE^{in-quota}$).
- If the fill rate is between 90% and 98%, we consider the quota to be binding (at-quota regime or regime 1 in MAcMap-HS6), and the marginal tariff is the simple average between the in-quota and out-of-quota tariffs ($AVE^{MMHS6} = \frac{AVE^{in-quota} + AVE^{out-of-quota}}{2}$).
- Finally, when the fill rate exceeds 98%, over-quota imports are allowed (out-of-quota regime or regime 2 in MAcMap-HS6), and the marginal tariff is the out-of-quota one ($AVE^{MMHS6} = AVE^{out-of-quota}$).

[21] With a linear objective, the optimization process will produce a set of solutions with an infinite number of potential permutations between different exporters inside each quota.

[22] In other words, a nonallocated TRQ will have only one fill rate (and regime) in the database. On the contrary, a TRQ with one share allocated to country A and another to country B will have two fill rates and potentially two different regimes.

The rule of simple average is used for the intermediate case because we do not have information about the effective domestic price and, thus, the effective marginal distortion.

In addition, a specific treatment is performed for South Korea for which MFN rates (and outside rates) are very high but where a discretionary treatment of the TRQ (annual TRQ creation) introduces significant market access. Therefore, we use new estimates of marginal protection rates for maize and soya based on U.S. Department of Agriculture analysis.

Assessing the impact of MAcMap-HS6 TRQ treatment

Table 2 displays the consequences of the TRQ treatment on the overall average agricultural protection for some countries. For Canada, a high fill rate leads to the use of the out-of-quota rate in most cases: the marginal rate is unaffected by the TRQ, but a rent is generated. On the other hand, for South Korea, TRQ management provides significant market access and reduces its average rate of protection by 20 points. Overall, the MAcMap-HS6 treatment provides an average protection (18.8%) at an intermediary level between the inside rate (14.7%) and the outside rate (22%).

Table 2. Average agricultural protection with and without TRQ treatment (percentage)

Country	In-quota rate always applied	MAcMap-HS6 treatment	Out-of-quota rate always applied
Canada	5.7	15.9	17.3
China	10.6	11.1	25.9
European Union	16.1	21.3	24.2
Japan	20.0	28.2	31.6
Panama	13.1	15.8	17.7
South Africa	12.6	15.1	18.0
South Korea	23.8	36.8	55.0
Switzerland	30.1	54	83.6
United States	3.8	8.9	9.9
All countries with TRQ	**14.7**	**18.8**	**22.0**

Note: Reference group weighting scheme. The average figures concern all agricultural products including those without TRQs.

Source: MAcMap-HS6v2; Laborde (2008).

Concerning the computation of TRQ rents, two alternatives are provided, depending on their attribution. Indeed, rents can be captured by exporters or importers depending on administration methods (see Skully 2001 for a discussion of the economics of administration methods) or market structures. Rent values may be included in the cost, insurance, and freight (CIF) trade values or not. So, under TRQ regimes 1 and 2, we have two potential formulas for rent values:

If the rents are captured by the importer, we have the following at the product and bilateral level:

$$TRQrents^{IMP} = share_{inside} \times Trade_{CIF} \times \left(AVE^{MMHS6} - AVE^{in-quota}\right) \qquad (8)$$

with $AVE^{MMHS6} = \begin{cases} \frac{AVE^{out-of-quota} + AVE^{in-quota}}{2} \; if\ regime\ 1 \\ AVE^{out-of-quota} \; if\ regime\ 2 \end{cases}$, denoting the marginal rate of protection, $Trade_{CIF}$ denoting the bilateral trade value, and $share_{inside} = \frac{q^{of}}{q} \begin{cases} \approx 1\ if\ regime\ 1 \\ < 1\ if\ regime\ 2 \end{cases}$ denoting the share of imports using the TRQ.

If rents are captured by the exporter, the CIF trade value includes the rents and we have the following at the product and bilateral level:

$$TRQrents^{EXP} = Trade_{CIF} \times share_{inside} \times \frac{AVE^{MMHS6} - AVE^{in-quota}}{1 + AVE^{in-quota} + share_{inside} \times \left(AVE^{MMHS6} - AVE^{in-quota}\right)} \qquad (9)$$

As shown in Table 3, the TRQ rents in MAcMap-HS6v2 total $7.7 billion if we assume that rents are captured by importers, or $3.9 billion if rents are captured by exporters (and included in the CIF trade value).

Table 3. TRQ rent values (in millions of USD)

	Imports* - CIF prices	AVE in MMHS6 x imports	*Assumption: Rents captured by the importer*			*Assumption: Rents captured by the exporter*		
			Rents	Tariff revenue	Imports at domestic prices	Rents	Tariff revenue	Imports at domestic prices
	[A]	[B]	[C]	[D]	[E]	[F]	[G]	[H]
Canada	1727	1027	364	663	2754	203	634	2847
China	5201	344	344	0	5544	249	0	5544
Japan	2974	2967	1907	1059	5941	794	948	6409
South Korea	3755	2121	428	1693	5876	192	1626	6925
Panama	26	10	5	5	36	3	5	40
Switzerland	1913	1686	960	726	3599	356	700	3836
United States	8595	2021	1547	475	10616	1050	465	11071
European Union	11636	6046	1693	4353	17682	871	4235	21137
All countries with TRQs	38387	17800	7679	10120	56187	3928	9710	63606

* Total imports (in and out of quota) for all products related to TRQs.

Source: Authors' calculations.

It is important to keep in mind that using the MAcMap-HS6 marginal rate of protection without using the associated rent values will lead to a bias in the cost of protection and tariff revenue measurement; symmetrically the gain of liberalization will be biased. Both approaches have different implications in terms of valuation of imports at domestic prices and tariff revenue.

Assuming that rents are captured by the importer, we can define different relations for each product and bilateral relation:

- $TariffRevenue = Trade_{CIF} \times [share_{inside} \times AVE^{in-quota} + (1 - share_{inside}) \times AVE^{out-of-quota}]$
- $TRQrents^{IMP} = share_{inside} \times Trade_{CIF} \times \left(AVE^{MMHS6} - AVE^{in-quota}\right)$
- Imports at domestic price:
  $Imports_{DP} = Trade_{CIF} + TariffRevenue + TRQrents^{IMP}$
- $Imports_{DP} = Trade_{CIF} \times \left(1 + AVE^{MMHS6}\right)$

In this case, using the AVE provided by MAcMap-HS6 and the CIF trade values allows us to derive the right domestic price values. However, the actual tariff revenue is $Trade_{CIF} \times AVE^{MMHS6} - TRQrents^{IMP}$.

Assuming that rents are captured by the exporter, the previous relations become the following:

- $TariffRevenue =$
  $(Trade_{CIF} \quad TRQrents^{EXP}) \times \left(AVE^{MMHS6} \quad share_{inside} \times \frac{AVE^{MMHS6} - AVE^{in-quota}}{1 + AVE^{in-quota}}\right)$
  $= Trade_{CIF} \times \frac{1 + AVE^{inside}}{1 + AVE^{in-quota} + share_{inside} \times \left(AVE^{MMHS6} - AVE^{in-quota}\right)} \times \left(AVE^{MMHS6} - share_{inside} \times \frac{AVE^{MMHS6} - AVE^{in-quota}}{1 + AVE^{in-quota}}\right)$
- $TRQrents^{EXP} = Trade_{CIF} \times share_{inside} \times \frac{AVE^{MMHS6} - AVE^{in-quota}}{1 + AVE^{in-quota} + share_{inside} \times \left(AVE^{MMHS6} - AVE^{in-quota}\right)}$
- Imports at domestic price:
  $Imports_{DP} = Trade_{CIF} + TariffRevenue$
  $Imports_{DP} = Trade_{CIF} \times \left(1 + AVE^{MMHS6}\right)\left(\frac{1 + AVE^{inside}}{1 + AVE^{in-quota} + share_{inside} \times \left(AVE^{MMHS6} - AVE^{in-quota}\right)}\right)$

In this case, using the AVE provided by MAcMap-HS6 and the CIF trade values does not allow us to derive the right domestic price values. We need to correct this to avoid a double-counting of the distortions on inside-quota quantity. Then, the actual tariff revenue becomes $Trade_{CIF} \times AVE^{MMHS6} - TRQrents^{EXP} \times \left(1 + AVE^{MMHS6}\right)$.

From Table 3, we can see that neglecting TRQ rents will lead to an overestimation of tariff revenue by 75% on average (the difference between columns G or D and B), and up to 325% for the U.S. case. The choice concerning rent allocation changes the valuation of imports at the domestic price by 13% (20% in the U.S. case). Therefore, users should consider carefully both issues when using MAcMap-HS6 marginal tariffs.

2.3. Additional treatments

After merging tariff data and the TRQ data set, we implement two additional steps.

2.3.1. Defining the MFN tariffs

We add the MFN applied rates to the initial database, containing bilateral applied rates. This step is not immediate since the MFN rate is not provided in the ITC source data. For the countries for which we have directly processed the tariff schedule, this information is available. However, for all the other countries (ITC data set), we recompute the MFN rate from the information contained in the database using the following search algorithm:

- AVEs are computed using importer-specific unit values (the same for all exporters).
- AVEs are ranked by decreasing values across WTO partners (other partners are discarded).
- The top five values are discarded to avoid oddities (such as WTO retaliation).
- We keep the tariff information (whole structure) for the first AVE that is repeated across three exporters.

The latter value is considered to be the MFN rate.

2.3.2. Merging with bound tariffs

We finally merge this applied tariff database with an updated version of the bound tariff database developed by Bchir, Jean, and Laborde (2006). Recently acceded members are included as are bound tariffs renegotiated through the General Agreement on Tariffs and Trade (GATT) article XXVIII procedure. Consistency checks are performed between bound MFN, applied MFN, and preferential rates. Applied rates are capped to their bound level if the commitments should have been enforced by 2004 and the trade relations belong to WTO. Only a few cases, such as the U.S.-Cuba trade relations, where the United States applies non-WTO tariffs against Cuba for political reasons, remain unchanged.

Adding bound tariffs allows for a quality control, but more important, it enables one to compute WTO tariff scenarios properly (see Appendix 1).

Last, as in the previous version of MacMap-HS6, we avoid the *water in tariff*[23] problem by capping all AVE tariffs at 1,000%, avoiding very high AVEs that may alter average figures without economic relevance.[24]

Comparing the final AVE at the six-digit level included in MAcMap-HS6v2 and the original data sources, we build Table 4. We decompose the distribution of the final AVE by source of the information: directly extracted from the MFN tariffs of TRAINS, MAcMap from ITC (primary extraction), MAcMap-HS6 (values generated/modified by the methodology described therein). First, we see that nearly two-thirds of the rows of the data set (66.58%) are directly based on TRAINS information; indeed, this share is mainly MFN relations and/or pure ad valorem tariffs. However, in terms of trade, this share is reduced (59.74%) since trade will be upward biased by preferential agreements. In addition to TRAINS inputs, the MAcMap-ITC data set is directly used for 20% (in average) of the MAcMapHS6 database. Finally, our specific treatments modify 19.61% of the AVE in terms of trade flows. This is particularly true for the agricultural products (26.95%), where both specific tariffs and TRQs play a very important role.

Table 4. Decomposition of the final data set by source

	Share of trade			Share of HS6 tariff lines		
	Nonag products	**Ag products**	**All products**	**Nonag Products**	**Ag products**	**All products**
MAcMap-HS6	18.98%	26.95%	19.61%	11.34%	18.87%	12.36%
MAcMap-ITC	20.88%	17.94%	20.65%	21.51%	18.20%	21.06%
TRAINS - MFN	60.14%	55.11%	59.74%	67.15%	62.93%	66.58%
Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Note: TRAINS data set refers here to a partial extraction of the TRAINS database limited to the MFN rates and the two main preferential agreements (EU and NAFTA).

Source: MAcMap-HS6v2 and initial data sets. Authors' computations.

2.4. Aggregating Tariffs

Even if MAcMap-HS6 provides disaggregated information, most applications (CGE analysis, econometrics matching tariff data and domestic production/consumption series) using protection data will require aggregated tariffs. The task is still a challenge for applied economists; none of the existing solutions is perfect.

[23] *Binding overhang* and *water in tariff* are two different notions. *Water in tariff* is a more general case where a tariff reduction will not lead to trade creation. Even without binding overhang, we can have a 3,000% tariff reduced to a 2,500% tariff with no trade creation -both being prohibitive.

[24] We assume that tariffs above 1,000% are prohibitive tariffs, but for some reason, such as a tariff exemption, trade flows take place.

2.4.1. Different Methods

The way tariffs are aggregated is crucial.[25] A simple average between tariffs, largely used by the WTO for consolidated duties, is an indicator a priori neutral. However, it has two major limitations. It depends on the degree of disaggregation of the tariff structure of a country (number of tariff lines); and, most important, it has a poor level of economic relevance because it gives the same weight to a highly important product as it does to a marginal one.

The trade-weighted average remains the most widespread method in applied research. It preserves the hierarchy between different products, but at the same time it suffers from the endogeneity problem between protection and trade: a prohibitive tariff forbids any import, which in turn means no weight. So when tariff peaks exist, this technique moves the protection level downward compared with the simple average, which puts relatively more weight on non-traded tariff lines.

Other weights, such as production or national consumption, may conceivably capture the distortions met by the producers or the consumers (see Bach and Martin 2001). In both cases the endogeneity problem is avoided, but another problem arises: data on consumption and production are not available at the same highly disaggregated level as trade data.

Let us note that the calculation of the average, whatever the method used, causes us to lose information about the distribution of the tariffs. Some sophisticated aggregators exist, such as the Trade Restrictiveness Index and the Mercantilist Trade Restrictiveness Index developed by Anderson and Neary (2005), which are uniform tariff equivalents that maintain the same value of trade or a welfare equivalent measure, whose variations can be related to changes in the generalized mean and variance of the tariff schedule.

These indicators lean on a theoretical justification; however, they rely on numerous assumptions about demand elasticities.[26] And more important, using a constant elasticity of substitution framework, they do not deal satisfactorily with the endogeneity problem between trade and tariff, especially for prohibitive tariffs.

The original approach proposed by CEPII (Bouët et al. 2004) aims to limit the endogeneity bias, preserving the specificities of the trade structures without requiring any assumptions on the demand parameters. The approach is designed to use an instrumental variable for bilateral trade that reduces the endogeneity bias. Following this “reference group” methodology, bilateral applied tariffs are aggregated using the exports of a given country toward a group of countries (the reference group) to which the import country belongs, instead of bilateral trade. Since different countries pertaining to the same reference group share common demand features but

[25] Since no good aggregation scheme exists, we should be cautious when using the terms “overestimate” or “underestimate.” The reference point is always subjective, and this assessment is always conducted by comparing one aggregator to another.

[26] Important recent research has provided new elasticity-of-import-demand estimates at the HS6 level (see Kee, Nicita, and Olarreaga 2008). But all products are not covered by these estimates, and for agricultural products past and present quantitative measures strongly hamper the validity of the results. Armington elasticities at the HS6 level are still poorly available (see Femenia and Gohin 2007).

different trade policies—due to a different political-economic equilibrium, for instance—the endogeneity bias is reduced.

World trade may appear to be a good weighting scheme, as it eliminates the endogeneity problem, but it also suppresses the specific features of trade patterns for exporters and importers.

The initial formula of the reference group weight was defined in Bouët et al. (2002) and updated in Bouët et al. (2008). We propose in this paper a slightly modified version:

$$wRG_{i,r,s} = M_{i,r,Grp(s)} \frac{M_{.,.,s}}{M_{.,.,Grp(s)} - intra_{r,Grp(s)}} \tag{10}$$

$$intra_{r,Grp(s)} = \begin{cases} M_{.,r,Grp(s)} \; if \; r \in Grp(s) \\ 0 \; else \end{cases} \tag{11}$$

where *r* is the exporter, *s* is the importer, *i* is the HS6 product, *Grp(s)* represents the reference group of country *s*, $M_{i,r,s}$ represents the imports of country *s* from *r* in product *i;* and the '.' index represents the sum over the related dimension.

It can be noted that the difference is in the denominator of $\frac{M_{.,.,s}}{M_{.,.,Grp(s)} - intra_{r,Grp(s)}}$. Here we subtract the $intra_{r,Grp(s)}$ that corresponds to the export of a country *r* to its reference group. The uncorrected version of this weighting scheme used in the previous version of MAcMap-HS6 created a virtual weight for an irrelevant relation: the trade between *r* and *r* when *r* exports to its reference group. The corrected version guarantees that the sum of $wRG_{i,r,s}$ matches the sum of trade flows ($M_{i,r,s}$). However, the term $\frac{M_{.,.,s}}{M_{.,.,Grp(s)} - intra_{r,Grp(s)}}$ is a scaling factor used to ensure relevant aggregation across importers, and its definition matters only in this case. Previous weights were underestimating the role of importing countries that belong to one group in which intragroup trade is important, when computing the average across groups (e.g., world average).

2.4.2. Comparing different weighting schemes

In this section, we compare how the world average protection varies when using different weights. Five different aggregating schemes are considered: bilateral trade, the reference group methodology (five different groups), the reference group world, the world trade, and the simple average. Remember that in the case of the world trade, all the exporter countries have the same structure of aggregation on each market. In the case of the reference group world, each exporter applies its own export structure (with the world as partner).

Table 5 clearly shows that the average world protection follows what the theory predicts. The simple average increases the measure of protection, while the bilateral trade reduces it. The measure decreases from 19.5% to 14.9% in agriculture and from 10.9% to 3.4% in the industrial sector, respectively.

The level of protection is particularly high in the agricultural sector when the world trade and the reference group world are used as aggregators, because of the concentration of protection on certain products in certain countries (e.g., rice).

Table 5. World average rate of protection using alternative weighting schemes

Weighting scheme	Agricultural goods	Non-agricultural goods
Bilateral imports	14.9	3.4
Reference groups (five)	18.9	4.1
"World" reference group	22.3	4.4
World trade	20.8	5.6
Simple average	19.5	10.9

Source: MAcMap-HS6v2; Laborde (2008).

In the industrial sector, the difference between the simple average and the weighted average is marked. This is due to raw materials, oil in particular, that are taxed lightly or not at all but at the same time represent an important part of world trade, covering a limited number of tariff lines. The reference group method yields intermediate figures, limiting the endogeneity bias.

3. PATTERN OF PROTECTION IN 2004

Using MAcMap-HS6v2, we develop a snapshot of the world's applied tariffs. We first present a general overview of protection in 2004. Next, we focus on the main characteristics of a select panel of countries. Finally, we concentrate on the sectoral issue.

Unless otherwise noted, comments in the text refer to tariffs calculated with the reference group methodology.

3.1. Overview of applied tariffs

The world average protection in 2004 is 5.1% (see Table 6), acknowledging the fact that 40% of world trade takes place under duty-free MFN rates. This relatively low AVE number hides a heterogeneous and complex pattern of protection, reflecting historical and political differences across countries and sectors. Here is a quick overview:

- The average level of protection decreases as the level of a country's development increases: in 2004, the average protection is 3.3% for high-income countries (HICs), 9.7% for middle-income countries, and 12.1% for least-developed countries.
- The agricultural sector is more protected (18.9%) than the manufactured goods sector (4.5%) or the extractive-energy products sector (1.3%). This gap naturally reflects the particular place of agriculture in the political economy of most countries as well as the mechanical consequences of agriculture's exclusion from previous cycles of GATT. Out of 170 countries

available in our base, only 11[27] have average applied rates for agriculture that are lower than their industrial applied rates.

- Final goods are more protected than intermediate goods. This progressivity aims to increase the effective protection of the locally produced value-added. All in all, the practice of tariff progressivity biases exports toward unprocessed resource-based commodities.

Table 6. World protection in 2004 by categories of countries and goods

Goods	World	HICs	MICs	LDCs
Agricultural goods	18.9	18.0	20.8	14.1
of which:				
Primary and semi-processed	*12.8*	*12.1*	*14.2*	*9.5*
Final	*22.8*	*21.7*	*25.4*	*16.8*
Industrial goods	4.4	2.7	8.9	11.7
of which:				
Primary and semi-processed	*2.8*	*1.2*	*6.2*	*10.9*
Final	*5.0*	*2.9*	*9.9*	*11.9*
Extraction and energy products	1.9	0.6	5.6	12.7
of which:				
Primary and semi-processed	*1.4*	*0.3*	*4.6*	*14.4*
Final	*3.3*	*1.4*	*7.6*	*11.2*
All products	**5.1**	**3.3**	**9.6**	**12.2**
of which:				
Primary and semi-processed	*3.3*	*1.8*	*6.8*	*11.4*
Final	*6.0*	*3.9*	*11.0*	*12.4*

Note: HICs stands for high-income countries, and MICs stands for middle-income countries. Both categories are defined by the World Bank. LDCs are the least-developed countries as defined by the United Nations. Differentiation by level of transformation follows the broad economic activities (BEC) United Nations nomenclature. Agricultural products are defined using the WTO classification.

The extraction and energy products category corresponds to chapters 25, 26, and 27 of the HS.

Source: Laborde (2008); MAcMap-HS6v2; reference group system of weights.

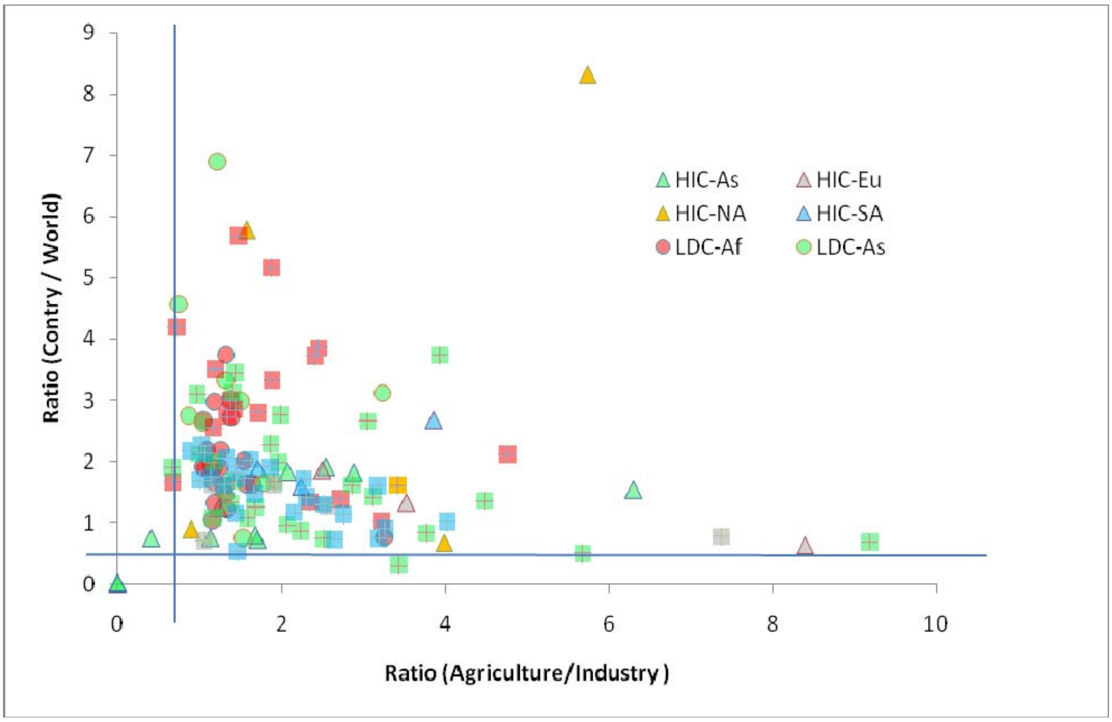
The protectionist bias in agriculture and on final products rises with the level of development of a country. Relative to their average level of protection, HICs give appreciably more protection to their agricultural sector. Indeed, rich countries tax their agricultural imports 6.7 times more than manufacturing goods. The ratio of agricultural protection to industrial protection decreases for MICs and LDCs: 2.3 and 1.2, respectively. MICs and LDCs, with scarce administrative resources, focus their trade policies on a few objectives (in primis, fiscal revenue collection).

Figure 6 represents the distribution of protection structure by plotting the average protection normalized by world protection versus the ratio of agricultural protection divided by industrial protection. It is clear that most countries are in the upper-right quarter of the space defined by the vertical line corresponding to even protection between agricultural and non-agricultural sectors and the horizontal line corresponding to the world average protection. Countries below the horizontal line are HICs or MICs from Asia and South America. Countries to the left of the

[27] Australia, Bahamas, Brazil, Belarus, Cambodia, Mayotte, Libyan Arab Jamahiriya, Maldives, Syrian Arab Republic, Uzbekistan, Yemen.

vertical line are the 11 countries listed previously (agricultural protection lower than non-agricultural protection). The lower-left quadrant contains only two countries: Hong Kong, at the origin of the axis,[28] and Singapore. The few HICs with protection levels above the world average are some Caribbean countries (South America [SA] group in the figure 6) e.g. Bahamas or Gulf countries (Asia). On the whole, Organisation for Economic Co-operation and Development (OECD) countries mainly differentiate themselves by moving along the horizontal axis. For LDCs (black-filled circles and diamonds), it is the reverse—they distribute themselves along the vertical axis. Middle-income African countries, whose average protection is the highest (more than 2.5 times the average world protection), tax industrial imports more than agricultural ones so as to increase their fiscal revenue.[29] Overall, they often adopt maybe more protectionist but simpler policies than the complex and the heterogeneous tariff schedules of HICs.

Figure 6. Applied protection by level of development



Source: Adapted from Laborde (2008); MAcMap-HS6v2; reference group weighting scheme.

As was said before, if average tariffs are relevant synthetic indicators, they often hide quite heterogeneous situations, among countries and sectors. The next two sections are devoted to looking at this heterogeneity.

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[28] The ratio of agricultural protection to industrial protection is set at 0 for Hong Kong even if it is undefined.

[29] Due to their diversity, it may be difficult to generalize for all African MICs. However, most of them are concentrated in Figure 3 between 1 and 2 for the agriculture: industry ratio and between 2.8 and 5 for the domestic protection:world average ratio.

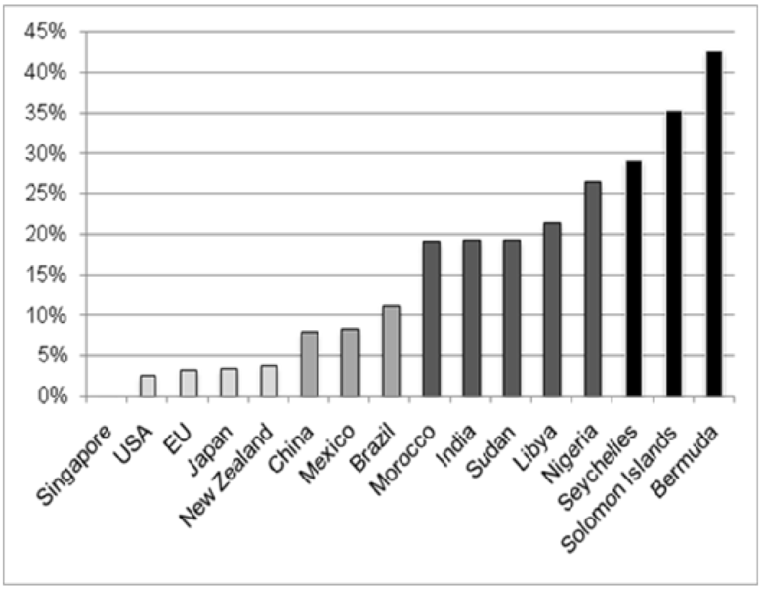
3.2. Country Results

Appendix 2 shows the average protection applied by each country, for all products and three disaggregated sectors (agricultural, non-agricultural, energy) calculated with two different weighting systems (reference group and trade weighted). The next subsection discusses this heterogeneity among countries. However, looking at average protection by country does not allow for capturing the strong dispersion of tariff rates in each country. Therefore, the following subsection investigates tariff dispersion with each country's tariff schedule.

3.2.1. Average Protection

Focusing on countries, the most protectionist importers (29% or more) are islands (Solomon Islands, Seychelles, Bermuda, Bahamas) for which duties are the main source of fiscal revenue (see Appendix 2 for a complete list and Figure 7 for selected countries).

Figure 7. Average applied protection in 2004, selected countries



Source: Authors' calculations; MAcMap-HS6v2; reference group weighting scheme.

A second group of 30 countries is essentially formed by some African countries (Nigeria, Burundi, Sudan, Libya, Morocco, Tunisia) whose global tariff rate is between 13% and 29%. India, with an average rate of 19%, twice the Russian Federation's rate (non–WTO member), is one of WTO's most protectionist members, at least among emerging economies.

A third group of 78 countries is composed of more liberal emerging economies with an average protection rate between 5% and 12%. For instance, China's protection rate is as high as South Korea's: 7.9%. This figure, however, considers neither the end of the implementation of China's WTO commitments, nor the fact that more than half of industrial Chinese imports benefit from a duty drawback system.

The last group of 28 countries -OECD countries, Gulf countries, several transition economies- is made up of those whose applied tariff is lower than 5%.

As we emphasized earlier in the section on methodology, the weighting system is crucial for countries with tariff peaks. For the European Union, the reference group methodology increases the average protection by 28% (2.5% for trade weighed and 3.2% for reference group weighted). The difference is even larger for the United States (+56%, from 1.6% to 2.5%) and Switzerland (+84%, from 2.5% to 4.6%). Inversely, differences are minor for countries with a more uniform tariff structure, even if highly protected, such as Pakistan or Bangladesh.

3.2.2. Tariff Dispersion

Thanks to a disaggregated database, we can assess the tariff dispersion for each country. This feature is important because it illustrates not only the role of political-economic forces and special interests in shaping tariff patterns but also the welfare cost of trade policies that increases with tariff heterogeneity. We see that high tariff heterogeneity is driven by both the difference between the average agricultural tariff and non-agricultural tariff and also a strong variance of tariffs within the agricultural sector.

In Table 7, we provide the coefficient of variation, the skewness, and the excess of kurtosis of the distributions of the power of tariff[30] for several countries. Countries that present the most extreme values for each indicator are selected. We compute these indicators not only for applied MFN tariffs (product heterogeneity) but also for applied bilateral tariffs (mix of product heterogeneity and preferential schemes). In the latter case, we compute unweighted indicators based on the whole database. We display detailed results for all products, agricultural products, and non-agricultural products aggregates. Indeed, it is relevant to see whether a distorted distribution is explained by a simple opposition between agricultural and non-agricultural products with a normal distribution within each category or by a globally distorted tariff structure.

Even if we must be careful when looking at world-level figures that result from both intercountry and within-country tariff heterogeneity, we can underscore some key figures of the power of tariff distribution pattern. First, the total coefficient of variation of the power of MFN tariff is equal to 82% for all products but equals 11% for non-agricultural products and 210% for agricultural products. So, at the global level, tariff heterogeneity is driven by the opposition between agricultural and non-agricultural products (as noted before) but even more by tariff heterogeneity across agricultural products. Unsurprisingly, the skewness is positive (764): the distribution is right-tailed. This is particularly true for the total distribution where relatively higher tariffs in agriculture lead to a very flat right tail. The skewness coefficient for nonagriculture is relatively low (3) and much stronger within agriculture (285). As for the kurtosis, its value, above 60,000, is strongly positive: the distribution is leptokurtic. This feature is correlated with the explanation that agricultural protection leads to a very flat tail on the right in opposition to a high concentration of tariffs in the middle of the distribution. Shifting from

[30] We use the power of tariff instead of the tariff value to get more meaningful results, especially when we want to compare indicators across countries. For instance, countries with average is close to 0 any tariff (even 3% or 4%) will lead to an infinite coefficient of variation.

MFN tariffs to bilateral applied tariffs does not change the global picture: indeed, at the world level, unweighted indicators are poorly affected by preferences that remain a minor issue.[31]

At the country level, the coefficient of variation of the power of tariff varies widely from 0% in Hong Kong and 1% in Chile to 606% in the Solomon Islands. Except for insular economies, Egypt has the largest value for developing countries (121%). Among rich countries, Iceland (117%), Norway (77%), and Switzerland (51%) have the most distorted trade policies. In general, intra-agriculture variation is stronger than intra-industry variation for developed countries and most developing countries. However, we can find the reverse situation for countries with comparative advantages in agriculture (Australia, Argentina, Georgia).[32] Whereas Australia and New Zealand have a coefficient of variation significantly higher in industry (respectively, 6% and 9%), other rich countries display the same level of dispersion (between 3% and 4%) in this sector. However, they differ strongly in their heterogeneity within the agricultural sector (2% for Australia, 206% for Iceland). In the case of LDCs, we see that the distortions are quite homogeneous across sectors (Bangladesh with a coefficient of variation of 9%, Senegal with 6%, Burundi with values between 10% and 12%).

We find a right-tailed distribution for nearly all countries except for a few developing ones—for instance, Bolivia and Georgia in both agricultural and non-agricultural products. The case of Chile is also interesting. Even if Chile applies a nearly homogeneous 6% MFN rate in 2004, it has some product exceptions. In non-agriculture, some goods can enter duty free (e.g., ships) and in agriculture some goods face a 25% tariff (e.g., frozen cuts of turkey). Therefore, the agricultural distribution is right-tailed (tariff "peaks" on poultry) and the non-agricultural goods distribution is left-tailed. For other countries, we check the global picture described before: the distribution of agricultural tariffs is more right-tailed than for non-agricultural goods (except for Norway, New Zealand, and Turkmenistan for countries presented in Table 7), and the overall distribution is more right-tailed than the subdistribution. This last result is driven by an average agricultural tariff higher than the non-agricultural tariff.

Most countries have a highly concentrated tariff distribution with a very high kurtosis coefficient; their variance is due more to infrequent extreme deviations than to frequent modestly sized deviations, especially for countries with very extreme trade policies such as New Zealand, Norway, and Singapore. Because of its nearly homogeneous structure, Chile also has a very leptokurtic distribution in agriculture, non-agriculture, and overall.

However, many developing countries have a platykurtic distribution overall with a coefficient close to 0: Argentina, Bangladesh, West Africa Economic and Monetary Union countries (Senegal, Côte d'Ivoire), Mauritania, Mauritius, Mongolia, Mozambique, and so on. Looking only at non-agricultural products presents a different picture: several countries, including the European Union and Canada but not the United States, have a low kurtosis value showing more even distribution.

[31] The global bilateral relations are a (171 - 24) x (209 - 24 - 1) bilateral matrix (the EU25 is considered to be only one region). Preferential agreements and unilateral preferences covered only a very small number of these relations.

[32] But not always. See the case of New Zealand.

Looking at bilateral rates modifies the previous picture for a few cases. If we compare the United States and the European Union, we see that the coefficient of variation slightly decreases for the European Union (14% to 11%) and slightly increases for the United States (8% to 10%). A similar evolution takes place for the overall kurtosis. The European Union preferential schemes are so numerous and have such a large product coverage that they drive a lot of tariffs to 0, close to the mean, in particular by weakening the agricultural MFN barriers. The European Union distribution is then more concentrated and less distorted (relatively less tariff peaks). On the contrary, for the United States preferences are still limited both in terms of partners and product coverage. In this case, introducing preferences, in particular since they avoid tariff peaks, just increases the variance of tariffs by introducing some exceptions.

Table 7. Coefficient of variation, skewness, and kurtosis of the power of tariff distribution

	MFN applied rates									**Bilateral applied rates**					
	Coef. of variation			**Skewness**			**Kurtosis**			**Coef. of variation**		**Skewness**		**Kurtosis**	
	All	N-agr	Agr	All	N-agr	Agr	All	N-agr	Agr	All	Agr	All	Agr	All	Agr
Argentina	6	7	4	0	0	0	-1	-1	0	6	5	0	0	-1	0
Australia	6	6	2	2	2	4	5	5	29	5	2	3	6	7	60
Bangladesh	9	9	9	0	0	-1	-1	-1	-1	9	9	0	-1	-1	-1
Bolivia	2	2	0	-4	-3	-21	11	9	459	2	1	-3	-6	7	37
Botswana	20	10	45	41	1	22	2E3	1	541	19	45	41	23	2E3	563
Burundi	12	12	10	0	1	-1	-2	-2	0	12	11	0	-1	-2	-1
Canada	17	5	40	11	2	4	136	2	17	10	24	9	4	100	15
Chile	1	0	1	22	-18	13	787	326	165	1	2	-1	4	27	50
Côte d'Ivoire	6	6	6	0	0	0	-2	-2	-2	6	6	0	0	-2	-2
Egypt	121	11	233	20	1	7	396	2	49	114	227	21	7	447	56
EU25	14	3	30	10	1	4	150	1	22	11	25	12	5	227	31
Georgia	3	3	1	-1	-1	-10	0	0	92	3	3	-1	-4	1	12
Hong Kong	0	0	0							0	0				
Iceland	117	4	206	45	2	17	2E3	1	315	117	215	47	17	2E3	330
Iran	22	22	23	2	1	4	10	0	44	22	23	2	4	10	44
Japan	47	3	93	16	2	6	343	7	45	26	56	17	7	468	65
Mauritania	7	7	7	0	0	0	-2	-2	-2	7	7	0	0	-2	-2
Mauritius	23	24	21	1	1	1	0	0	1	23	20	1	1	1	1

Table 7. Continued

	MFN applied rates									**Bilateral applied rates**					
	Coef. of variation			**Skewness**			**Kurtosis**			**Coef. of variation**		**Skewness**		**Kurtosis**	
	All	N-agr	Agr	All	N-agr	Agr	All	N-agr	Agr	All	Agr	All	Agr	All	Agr
Mongolia	5	5	4	-1	-1	5	3	0	57	5	4	-1	5	3	56
Mozambique	9	8	9	1	1	0	-2	-1	-2	9	9	1	0	-2	-2
New Zealand	14	9	30	35	28	21	2E3	1E3	489	11	25	49	25	3E3	704
Norway	77	5	125	44	38	18	3E3	2E3	402	72	125	46	18	3E3	417
Qatar	3	1	7	21	17	8	474	298	69	3	7	19	8	431	71
Russian Federation	6	5	8	2	0	5	20	-1	40	6	8	2	4	16	36
Senegal	6	6	6	0	0	0	-2	-2	-2	6	6	0	0	-2	-2
Singapore	1	0	3	61		22	4E3		513	1	3	64	23	4E3	558
Solomon Islands	606	20	1E3	71	1	26	5E3	16	677	606	1E3	71	26	5E3	672
South Africa	20	10	45	41	1	22	2E3	1	536	19	44	42	23	2E3	576
Switzerland	51	7	84	14	7	5	326	97	51	37	69	18	7	571	92
Turkmenistan	21	15	39	14	14	8	308	403	91	21	39	14	8	318	93
USA	8	4	17	10	2	5	147	6	32	10	17	194	6	1E5	37
Vanuatu	56	12	131	38	8	15	2E3	117	241	56	131	38	15	1681	239
World	82	11	209	764	3	285	6E5	39	8E4	82	210	773	289	6E5	**8E4**

Note: x E y should be read x . 10^y; for example, 1E3 = 1,000.

All = all products; N-agr = non-agricultural products; and Agr = agricultural products.

Source: Authors' calculations; MAcMap-HS6v2; unweighted computation based on the exhaustive data set.

3.3. Sectoral Results

As just demonstrated, tariff heterogeneity is quite important across products and tariff peaks are still numerous.

3.3.1. Average Protection and Tariff Progressivity

Beyond the general comments centered on Table 6 that have emphasized the strong difference between agricultural and non-agricultural protection,[33] we can attune the analysis based on Table 8.

The HS2 classification disaggregates international trade into almost 100 sectors, and thus, this decomposition offers a quick but exhaustive picture of world protection. As already seen, the overall agricultural sector is far more protected than industry. The same pattern applies when we look at the HS2 level.

Thereby, the 15 most protected categories belong to the agricultural sector. Sugar is a commodity that faces tariffs higher than 40% worldwide. Dairy products, tobacco, meat, cereals, and alcohol are close behind sugar and show average rates systematically higher than 20%. As previously explained, historical context explains a large part of this ranking: almost all countries in the world vigorously protect their agriculture. Fiscal policies may also explain the rank of tobacco or alcohol, as they have very low demand elasticities.

Among the highly ranked industrial categories in Table 8, one can distinguish very sensitive areas in trade negotiations such as apparel and textiles, with average tariffs around 10%. These categories occupy eight positions between ranks 16 to 23 of the most protected areas. Apparel is, however, more protected than textiles: the protection rate is 12.2% for knitted and crocheted fabrics and 11.7% for special woven fabrics, but only 8.8% for cotton and 8.2% for silk.

Beyond apparel and textiles, the car and truck industry is the most protected (9.1%), more so than ceramics (7.7%), plastics (6.2%), and glass products (5.9%). In this interval also lie fisheries (6.6%) and the residual agricultural categories like live trees and cut flowers (7.3%), coffee and tea (6.5%), vegetable products (5.8%), and oil seeds (5.6%). The least protected agricultural class is gums and resins (4.9%). Processed chemical products are more protected than other industrial sectors on average: these include explosives (7%), soaps and washing preparations (5.9%), tanning or dyeing extracts (5.6%), and fertilizers (5.5%). Iron and steel products also enjoy above average protection among non-agricultural goods (5.2% versus 4.4%).[34]

The least protected areas all belong to the manufacturing sector. Essential goods such as pharmaceutical products (1.8%) or cultural goods (1.4%) often benefit from specific national policies and low tariff protection. Last, trade in extraction sectors (HS27, HS26) is weakly taxed (2% and 1%, respectively).

[33] Differences that are mainly driven by the OECD trade policies.

[34] See Table 6.

Table 8. World average protection by HS2 chapter (in decreasing ranking)

HS2	*Label*	*AVE*	*HS2*	*Label*	*AVE*
17	Sugars and sugar confectionery	42.6	**53**	Other vegetable textile, paper yarn	5.8
04	Dairy produce, bird eggs, honey	37.8	**14**	Vegetable plaiting materials	5.8
02	Meat and edible meat offal	34.7	**43**	Fur skins and artificial fur	5.8
24	Tobacco and manufactured substitutes	28.3	**12**	Oil seeds and oleaginous fruits	5.6
11	Products of the milling industry	26.4	**32**	Tanning or dyeing extracts	5.5
10	Cereals	24.7	**31**	Fertilizers	5.5
22	Beverages, spirits, and vinegar	18.2	**40**	Rubber and articles thereof	5.2
15	Animal or vegetable fats and oils	17.5	**83**	Miscellaneous articles of base metal	5.2
21	Miscellaneous edible preparations	16.2	**05**	Products of animal origin *n.e.s.*	5.2
20	Preparations of vegetables, fruit, or nuts	16.2	**73**	Articles of iron or steel	5.2
16	Preparations of meat or fish	15.2		*All sectors average*	*5.1*
19	Preparations of cereals, flour, or milk	14.3	**65**	Headgear and parts thereof	5.0
07	Edible vegetables	13.7	**13**	Gums, resins	4.9
08	Edible fruit and nuts, peel of fruits	13.6	**82**	Cutlery, spoons, and forks	4.7
01	Live animals	12.6	**41**	Raw hides and skins	4.6
60	Knitted or crocheted fabrics	12.2	**76**	Aluminum and articles thereof	4.3
58	Special woven fabrics, tufted fabrics	11.7	**68**	Articles of plaster, cement, asbestos	4.3
64	Footwear, gaiters, and the like	11.7	**38**	Miscellaneous chemical products	4.1
23	Residues from the food industries	10.3	**92**	Musical instruments.	4.1
61	Apparel and clothing knitted	10.2	**91**	Clocks and watches and parts thereof	3.9
54	Man-made filaments	10.0	**48**	Paper and paperboard	3.6
62	Apparel and clothing accessories	9.9	**89**	Ships, boats, and floating structures	3.4
55	Man-made staple fibers	9.5	**72**	Iron and steel	3.4
63	Other made-up textile articles	9.5	**94**	Furniture, bedding, mattresses	3.4
87	Vehicles other than railway	9.1	**86**	Railway or tramway locomotives	3.4
18	Cocoa and cocoa preparations	9.0	**78**	Lead and articles thereof	3.4
52	Cotton	8.8	**25**	Salt, sulphur, earths and stone	3.2
50	Silk	8.2	**79**	Zinc and articles thereof	3.2
51	Wool, fine or coarse animal hair	7.9	**28**	Organic or inorganic compounds	3.1
57	Carpets	7.9	**81**	Other base metals, cermets	3.1
69	Ceramic products	7.7	**29**	Organic chemicals	3.1
35	Albuminoidal substances, glues	7.6	**46**	Manufactures of straw of esparto	3.0
59	Impregnated or coated textile	7.5	**74**	Copper and articles thereof	2.9

HS2	Label	AVE	HS2	Label	AVE
42	Articles of leather, saddlery, luggage	7.3	**85**	Electrical machinery and equipment	2.8
06	Live trees and plants, cut flowers	7.3	**95**	Toys, games, and sports requisites	2.8
96	Miscellaneous manufactured articles	7.0	**44**	Wood and articles of wood	2.6
36	Pyrotechnic products, matches	7.0	**71**	Natural or cultured pearls	2.5
66	Umbrellas, walking sticks	6.7	**84**	Boilers, machinery, and mechanical	2.3
37	Photographic goods	6.6	**90**	Optical measuring	2.3
	column continues on next page		**45**	Cork and articles of cork	2.0
03	Fish and crustaceans, molluscs	6.6	**27**	Mineral fuels, mineral oils	2.0
93	Ammunition	6.6	**80**	Tin and articles thereof	1.8
56	Wadding felt and nonwovens	6.6	**30**	Pharmaceutical products	1.7
09	Coffee, tea, maté, and spices	6.6	**88**	Aircraft, spacecraft, and parts thereof	1.4
33	Essential oils, perfumery, cosmetics	6.4	**49**	Printed books, newspapers, pictures	1.4
39	Plastics and articles thereof	6.2	**75**	Nickel and articles thereof	1.3
70	Glass and glassware	5.9	**47**	Pulp of wood	1.1
34	Soap, organic washing preparations	5.9	**26**	Ores, slag, and ash	1.0
67	Prepared feathers and down articles	5.9	**97**	Work of arts, antiques	0.5

Note: n.e.s. = not elsewhere specified.

Source: Authors' calculations; MAcMap-HS6v2; reference group weighted.

It is interesting to look at the issue of tariff progressivity[35] in more detail since on average tariffs applied to final goods are twice those applied to intermediate and raw products. Tariff escalation, allowed by tariff progressivity, is in fact a central issue in negotiations. Table 9 presents the average tariff by sector and degree of transformation, using the broad economic categories (BEC) classification. One can see that tariff progressivity is a widespread phenomenon, affecting almost all the sectors and the three country categories considered. A few exceptions are seeds and flour as well as sugar in HICs, tobacco and fishing products in MICs, and oil and dairy products in LDCs. Two points deserve attention. First, in the case of sugar in HICs, results are biased because of the European Union tax on the share of final goods that contain sugar (additional duty). Second, for semiprocessed goods, the rule is more the exception, stemming from the delicate task of classifying the products, considering their multiple uses.[36]

[35] Because dealing with tariff escalation requires one to compute the effective rate of protection, we limit our analysis to the tariff progressivity concept. Tariff progressivity means that tariffs increase with the level of transformation. Therefore, it is a necessary, but not sufficient, condition for tariff escalation.

[36] The same good (sugar) can be consumption good for final consumers and an intermediate consumption for firms.

Table 9. Average protection by sector and degree of transformation

Product	HICs			MICs			LDCs		
	Primary	Semi	Final	Primary	Semi	Final	Primary	Semi	Final
Fruits and vegetables	12.1	11.9	13.7	21.7	19.1	20.6	16.2	20.9	22.6
Meats and live animals	12.8		35.1	11.9		29	8.8		21.2
Dairy products	46		46.8	18.5		28.2	19.3		16.6
Vegetable oils and fats	5.5		6	6.4		21.3	8.2		15.9
Seeds, flour, and spices	31.6	36.7	15.1	17.6	16.8	19.5	7.8	14.5	17.1
Sugar		77.1	10.7		26.2	22.5		15.1	22.5
Tea, coffee, chocolate	1.2	1.9	13.8	20.2	14.2	24.2	17.3	19.5	21.1
Tobacco	22		22.8	44.3		41.4	15.2		30.3
Other agricultural products	4.8	3.9	17.4	6.7	9.1	9	6.4	11.4	8
Fishery	4.9	5.9	7.2	16.2	16.6	14.1	22.9	24.3	17.7
Paper and wood	0.3	1.2	1.1	2.9	8.7	12.1	7.9	12.6	15.1
Apparel and textile	3.4	6.1	8	9.6	15	19.8	13.1	18.3	22.7
Leather products	0.6	2.8	6.9	7.7	9.2	17.2	7.1	11	19.2
Metal and mines	0.2	1.4	2.7	2.5	7.3	12	6.2	11.1	15
Mineral products	0.4	0.7	3.1	6.3	8.2	14.3	12.4	8.5	18
Chemicals		2.8	1.9		7.9	10		8.8	11
Transports			5			16.3			12.1
Electric machinery		1.3	1.4		9	6.2		15.2	11
Other industrial products			1.7			8.5			12.9
Oil	0.7		2.4	3.8		8.4	16.7		11.7

Source: Laborde (2008); MAcMap-HS6v2; reference group weighting scheme.

3.3.2. Tariff Dispersion

In the previous section, we looked at tariff dispersion inside each country's tariff schedule; we can now investigate tariff dispersion at the product level across the world—in other words, which products face the most heterogeneous trade policies? This issue is relevant for exporting countries that specialize in such commodities: they may face narrow market opportunities and are exposed to asymmetric demand shocks.

Table 10 shows the 10 products that have the highest coefficient of variation of the power of the tariff in rich countries, middle- and low-income countries, and LDCs. We also indicate the 10 HS2 chapters for which the simple average across products of the coefficient of variation is the highest.[37]

Table 10. Products facing the most heterogeneous protection

HS6 products		Coef. var.	HS2 chapters		Coef. var.[a]
Across rich countries' markets					
060210	Unrooted cuttings and slips	145	10	Cereals	73
060491	Foliage branches and othr parts of plants	143	02	Meat and edible meat offal	66
230110	Flours, meals, and pellets of meat	143	06	Live trees and other plants	66
010391	Live purebred swine weighing inf 50 kg	132	01	Live animals	64
110820	Inulin	129	11	Products of the milling industry	62
060120	Bulbs, tubers, tuberous roots, corms	122	04	Dairy produce, bird eggs, honey	58
020622	Frozen edible bovine livers	119	07	Edible vegetables	49
010599	Live domestic ducks, geese, turkeys	116	23	Residues from the food industries	40
120740	Sesamum seeds, whether or not broken	115	12	Oil seeds and oleaginous fruits	33
100890	Cereals excl. wheat and meslin, rye, barley	115	16	Preparations of meat or fish	33
Across middle- and low-income countries' markets					
220290	Nonalcoholic beverages excl. water	108	22	Beverages, spirits, and vinegar	61
220710	Undenatured ethyl alcohol	92	24	Tobacco and manufactured substitutes	58
240391	Tobacco: homogenized or reconstituted	91	02	Meat and edible meat offal	27
240130	Tobacco refuse	91	06	Live trees and other plants	24
220430	Grape must partly fermented	80	04	Dairy produce, bird eggs, honey	22
330210	Mixtures of odoriferous substances	75	67	Prepared feathers and down articles	22
220429	Wine of fresh grapes incl. fortified wines	74	93	Ammunition.	21
220720	Denatured ethyl alcohol and othr spirit	72	43	Fur skins and artificial fur	20
220590	Vermouth and othr wine of fresh grapes	69	01	Live animals	19

[37] We compute a simple average of the coefficient of variation computed at the HS6 level and not the coefficient of variation at the chapter level because we want to focus on the variance across countries and not the variation across products within a chapter.

	HS6 products	Coef. var.		HS2 chapters	Coef. var.[a]
060410	Mosses and lichens for bouquets	69	07	Edible vegetables	19
		Across LDCs' markets			
240391	Tobacco: homogenized or reconstituted	113	24	Tobacco and manufactured substitutes	70
240130	Tobacco refuse	104	22	Beverages, spirits, and vinegar	33
220710	Undenatured ethyl	99	93	Ammunition.	21
240399	Chewing tobacco, snuff	97	44	Wood and articles of wood	18
220290	Nonalcoholic beverages	96	90	Optical measuring	15
240290	Cigars, cheroots, cigarillos, and cigarettes	94	81	Other base metals, cermets	13
240110	Tobacco: not stemmed or stripped	69	86	Railway or tramway locomotives	13
240120	Tobacco: partly or wholly stemmed or str	68	32	Tanning or dyeing extracts	13
220890	Ethyl alcohol	54	09	Coffee, tea, maté, and spices	13
440399	Wood in the rough whether or not stripped	46	87	Vehicles other than railway	13
		Across all markets			
220290	Nonalcoholic beverages	103	24	Tobacco and manufactured substitutes	61
240391	Tobacco: homogenized or reconstituted	96	22	Beverages, spirits, and vinegar	56
220710	Undenatured ethyl alcohol	95	10	Cereals	40
240130	Tobacco refuse	92	02	Meat and edible meat offal	37
060491	Foliage branches and othr parts of plants	78	06	Live trees and other plants	37
100610	Rice in the husk: paddy or rough	76	04	Dairy produce, bird eggs, honey	37
100640	Broken rice	75	11	Products of the milling industry	32
220430	Grape must partly fermented	73	01	Live animals	31
100630	Semimilled or wholly milled rice	69	07	Edible vegetables	25
220429	Wine of fresh grapes incl. fortified wines	69	23	Residues from the food industries	23

Note: The coef. var. is the coefficient of variation of the power of the tariff.

[a] Figures at the HS2 level are a simple average of the HS6 coefficient of variation.

Source: Authors' calculations; MAcMap-HS6v2; unweighted computation based on the exhaustive data set.

As expected, agricultural products dominate this ranking. Tobacco and alcohols have a very high level of dispersion across developing and least-developed countries: some have already adopted a domestic taxation policy for these products (high excise tax and low tariffs), whereas others still collect important amounts of duties on them. On the other hand, developed countries apply a similar level of tariffs on these products. For this latter group, the tariff dispersion depends strongly on their comparative advantages in each commodity. In particular, we see a different level of protection for some specific inputs or intermediate goods that may be imported freely in some countries but are taxed heavily in others (e.g., live animals for breeding, meals of meat products).

4. Understanding changes between 2001 and 2004

Using both MAcMap-HS6v1 (base year 2001) and MAcMap-HS6v2 (base year 2004), we can study the evolution of tariff protection between the two time periods. This comparison is particularly valuable since both data sets have been developed with the same methodology. Moreover, we propose an original method to decompose the changes observed at the aggregated level into different components (changes in the weighting scheme, the unit values, the exchange rates, the effective applied trade policies at the six-digit level).

4.1. Overview

Overall average protection has decreased by 0.5 percentage point, from 5.6% in 2001 to 5.1% in 2004 (see Table 11). This reduction is mainly due to MICs. Indeed, while developed countries had to achieve their Uruguay Round commitments in 2001, the MICs' schedule ended in 2004. Moreover, some MICs have unilaterally liberalized their economy—for example, India in 2004 for its industrial products, and China, in all sectors, to complete its WTO accession. Besides, several south-south preferential agreements (implementation of customs unions and free-trade areas) were translated into tariff reductions among member states or with third countries, whenever a common external tariff has been adopted. The share of world trade, in the framework of such agreements, is still growing: +26% in 2001 and +32% in 2004 (or from 16% to 20%, when excluding intra-EU), coming either from an increase of trade inside existing agreements or from a creation of new ones.

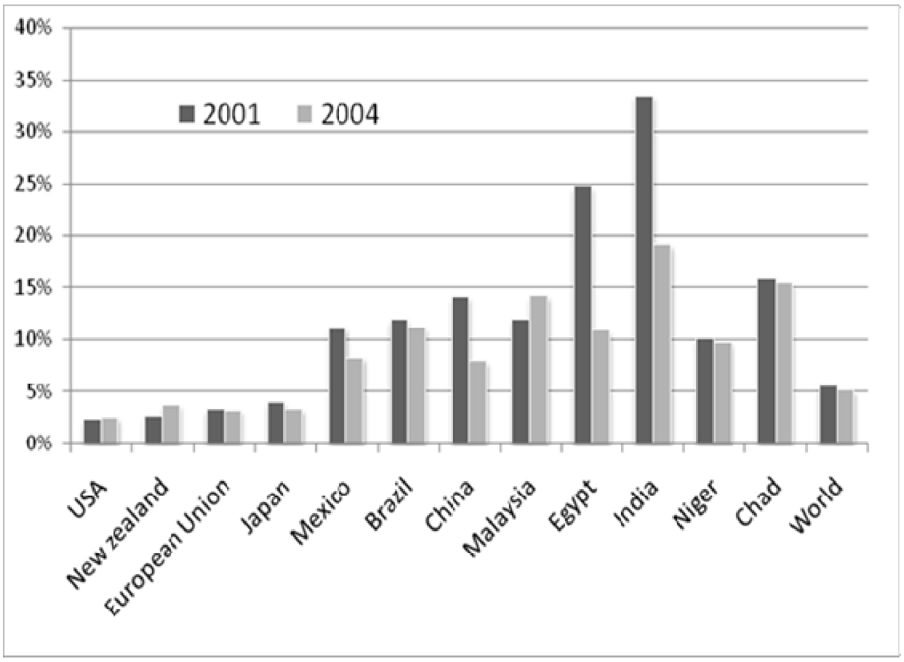
Table 11. Changes in applied protection between 2001 and 2004, group of countries

Sector	World			HICs			MICs			LDCs		
	Initial	**Point**	**Relative**	**Initial**	**Point**	**Relative**	**Initial**	**Point**	**Relative**	**Initial**	**Point**	**Relative**
Agriculture	19.2	-0.3	-2%	17.1	+1	+6%	24.1	-3.3	-14%	16.5	-2	-12%
Industry	5.0	-0.6	-12%	2.6	-0.1	-5%	11.5	-2.6	-22%	12.1	-0.4	-3%
Extraction	1.6	+0.3	+18%	0.7	+0.2	+25%	5.8	-0.2	-3%	12.9	-0.2	-2%
All	**5.6**	**-0.5**	**-9%**	**3.4**	**-0.1**	**-2%**	**12.3**	**-2.6**	**-21%**	**12.8**	**-0.7**	**-5%**

Note: Adding the initial value and the difference in points gives the 2004 tariff level. A few differences prevail with Table 5 figures since for the purpose of comparison, we have considered only the countries included in both databases.

Source: Authors' calculations; MAcMap-HS6v2 and v1; reference group weighting scheme.

Figure 8. Average protection in 2001 and 2004, selected countries



Source: Authors' calculations; MAcMap-HS6v2; reference group weighting scheme.

The increase in average agricultural protection in rich countries (+6% in relative terms) contrasts with the decrease in protection globally. This does not seem to come from a modification of trade policies, but rather is the result of two effects. First is the mechanical effect of the fall of the U.S. dollar on the European Union AVE, due to the conversion into U.S. dollars of the specific tariff (initially expressed in local currency per physical unit). Second, several tariff rate quotas previously unfilled (in quota) have been filled or even exceeded. The immediate consequence is thus an increase in the protection exporters face.

4.2. Focus on a few cases

Comparing average rates of protection across time can be misleading since several distinct effects interact. Following Laborde (2008), we identify the following effects:

1. The *real* change in trade policy, that is, evolution in the value of tariffs (ad valorem and/or specific)
2. The shift in TRQ regime (see supra) due to a change in the filling rate of a TRQ
3. The evolution in a trade pattern that will affect a related weighting scheme
4. The evolution of unit values that will modify the AVE of specific tariffs
5. A change in the exchange rates used to convert specific tariffs from the local currency unit to dollars

6. Other factors such as the effects of an improvement in the quality of data collection and data processing on trade policies

For researchers, real changes in trade policies are mainly related to effect 1 and to some extent to effect 2. However, other aspects deserve attention. The evolution in AVE, even with a fixed specific rate, may come as the consequence of the evolution of import prices in U.S. dollars (effect 4). In addition, for specific tariffs initially expressed in currencies other than U.S. dollars, the dynamic of the exchange rate matters: if the national currency appreciates compared with the U.S. dollar, the AVE will rise ceteris paribus.[38] Thus, the evolution of the AVE might be the combination of effects 4 and 5 (i.e., the evolution of unit value in local currency).

Using the reference group weighting scheme, we limit, but do not suppress, the modification in the weights matrix. Using import weights, more volatile and endogenously related to changes in tariffs, increases the problem. In particular, this introduces a strong downward movement in the aggregated protection. In fact, when a subset of tariff lines are liberalized, tariff rates go down and trade increases on those lines, overweighting them compared with the previous system of weights.

The difference between the aggregated protection in 2004 and 2001 for each country is given by $\sum_{i,r} w_{i,r,s}^{2004}\, tave_{i,r,s}^{2004} - \sum_{i,r} w_{i,r,s}^{2001}\, tave_{i,r,s}^{2001}$ with $w_{i,r,s}^{200x}$ being the weight in year *200x* applied to the AVE tariff in the same year *200x* ($tave_{i,r,s}^{200x}$) for product *i* and exporter *r*, *where* $\sum_{i,r} w_{i,r,s}^{200x} = 1$.

Let's also define $tave_{i,r,s}^{200x}$ as $tave_{i,r,s}^{200x} = tadv_{i,r,s}^{200x} + \frac{tspe_{i,r,s}^{200x}\, e_s^{200x}}{uv_{i,r}^{200x}}$ with $tadv_{i,r,s}^{200x}$ the ad valorem component of the tariff, $tspe_{i,r,s}^{200x}$ the specific component expressed in the local currency of country *s* by ton, $uv_{i,r}^{200x}$ the ERGUV in U.S. dollars per ton, and e_s^{200x} the exchange rate of local currency to U.S. dollars.

Then, we can rewrite the difference as follows, noting that the ^{FR0x} exponent indicates the year (0*x*) used for the filling rate of the TRQs:[39]

This equation decomposes total change as follows:

1. The E1 effect, related to the change in tariffs, which we derive by comparing 2001 and 2004 tariffs and using 2004 values for all other variables
2. The E2 TRQ effect, computed using 2001 tariffs to which we apply 2001 or 2004 TRQ filling rates. If no TRQ regime shift takes place, this component is equal to 0.

[38] When AVEs are computed using a world unit value, the evolution of one currency is not correlated to the changes in world prices for a subset of goods. When using importer-specific unit values, imperfect pass-through explains the divergence between world prices and import unit values.

[39] By default, and when it is not indicated, the year for the filling rate of the TRQ is the year of the tariff.

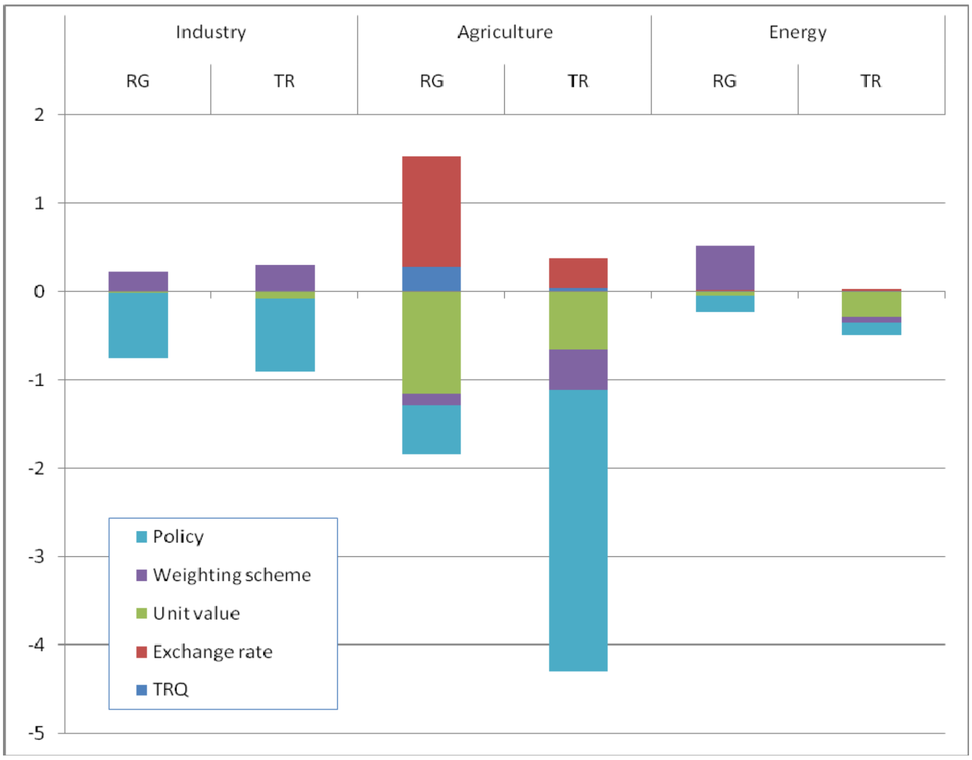
3. The E3 weighting scheme effect, computed by using 2001 tariffs (with 2004 exchange rate and unit values), looking at the difference in weights between 2001 and 2004.
4. The E4 unit value effect, computed at 2001 weights and tariffs when we look at the difference in AVE coming from the change in unit values, after controlling for the change in the exchange rate.
5. The E5 exchange rate effect, computed by using 2001 values for all variables and introducing the change in exchange rate.

This decomposition method is not path independent: however, we use an intuitive sequence. We start from 2001 tariffs, and we deal with non–trade policy parameters (exchange rate E5, unit value E4, trade E3). The changes in TRQ filling rate (E2) is at the margin between the evolution of trade and trade policy. After controlling for all external changes, we finally look at the shift in tariffs (E1).

$$
\begin{aligned}
&\underbrace{\sum_{i,r} w_{i,r,s}^{2004}\, tave_{i,r,s}^{2004} - \sum_{i,r} w_{i,r,s}^{2001}\, tave_{i,r,s}^{2001}}_{Total\ change} \\
&= \underbrace{\sum_{i,r} w_{i,r,s}^{2004}\left(\left(tadv_{i,r,s}^{2004} + \frac{tspe_{i,r,s}^{2004}\, e_s^{2004}}{uv_{i,r}^{2004}}\right) - \left({}^{FR04}tadv_{i,r,s}^{2001} + \frac{{}^{FR04}tspe_{i,r,s}^{2001}\, e_s^{2004}}{uv_{i,r}^{2004}}\right)\right)}_{E1:\ Shift\ in\ tariff\ effect} \\
&+ \underbrace{\sum_{i,r} w_{i,r,s}^{2004}\left(\left({}^{FR04}tadv_{i,r,s}^{2001} + \frac{{}^{FR04}tspe_{i,r,s}^{2001}\, e_s^{2004}}{uv_{i,r}^{2004}}\right) - \left(tadv_{i,r,s}^{2001} + \frac{tspe_{i,r,s}^{2001}\, e_s^{2004}}{uv_{i,r}^{2004}}\right)\right)}_{E2:\ TRQ\ effect} \\
&+ \underbrace{\sum_{i,r}\left(w_{i,r,s}^{2004} - w_{i,r,s}^{2001}\right)\left(tadv_{i,r,s}^{2001} + \frac{tspe_{i,r,s}^{2001}\, e_s^{2004}}{uv_{i,r}^{2004}}\right)}_{E3:\ Weighting\ scheme\ effect} \\
&+ \underbrace{\sum_{i,r} w_{i,r,s}^{2001}\left(\left(tadv_{i,r,s}^{2001} + \frac{tspe_{i,r,s}^{2001}\, e_s^{2004}}{uv_{i,r}^{2004}}\right) - \left(tadv_{i,r,s}^{2001} + \frac{tspe_{i,r,s}^{2001}\, e_s^{2004}}{uv_{i,r}^{2001}}\right)\right)}_{E4:\ Unit\ value\ effect} \\
&+ \underbrace{\sum_{i,r} w_{i,r,s}^{2001}\left(\left(tadv_{i,r,s}^{2001} + \frac{tspe_{i,r,s}^{2001}\, e_s^{2004}}{uv_{i,r}^{2001}}\right) - \left(tadv_{i,r,s}^{2001} + \frac{tspe_{i,r,s}^{2001}\, e_s^{2001}}{uv_{i,r}^{2001}}\right)\right)}_{E5:\ Exchange\ rate\ effect}
\end{aligned} \tag{12}
$$

Figure 9 shows the evolution of the aggregated tariff by sector, distinguishing between the reference group and the trade-weighted methodologies. The choice of a weighting system is not neutral. It seems that the trade-weighted system influences the aggregated protection downward.This is particularly true when tariffs decrease.

Figure 9. Decomposition of protection changes between 2001 and 2004 by sector



Source: Authors’ calculations; MAcMap-HS6v2.

Indeed, when a subset of tariff lines is liberalized, tariff rates go down and trade increases on those lines, overweighting them into the total weight system, compared with the reference group methodology.

At the sectoral level, the agricultural sector experiences the biggest changes, mainly imputable to an increase of the unit values (in U.S. dollars). We also observe that exchange rates exert a strong effect in the opposite direction. Finally, we check the important role of TRQs in the sector. When a country opens (or enlarges) a TRQ, the corresponding protection normally decreases while trade flows increase. Consequently, the level of protection will fall when aggregating protection data using bilateral imports.

With regard to the manufacturing sector, changes are rather similar with the two methodologies. The observed variations are mostly explained by pure policy changes (e.g., unilateral reform in Egypt and India).

In fact, the decomposition shows that no matter which aggregation scheme we use, the policy effect is the strongest. Trade policy reforms are thus the component that most affects the decrease of the applied protection. Table 12 displays selected countries that experienced important variations in their applied tariffs. It also gives us an interesting illustration of mechanisms taken into account in the decomposition methodology. Changes are provided for all goods and for the agricultural and non-agricultural sectors. The difference is given in percentage points (2004–2001) as well as in relative variation (with 2001 as the starting year). The evolution of the aggregate protection rate hides strong sectoral and country differences.

Table 12. Decomposition of changes in protection between 2001 and 2004

Country	Weighting scheme	Total change (pt)	Relative total change (%)	Exchange rate (E5)	Unit value (E4)	Weighting scheme (E3)	TRQ (E2)	Policy (E1)
All products								
Australia	RG	-1.32	-25.7%	0.53	-0.23	-0.05	0.02	-1.6
	TR	-1.67	-31.4%	0.59	-0.22	-0.08	0.01	-1.97
China	RG	-6.21	-44.0%	0.00	0	-0.2	0.04	-6.05
	TR	-6.27	-49.5%	0.00	0	0.2	0.09	-6.57
Egypt	RG	-13.86	-56.1%	-2.23	-0.88	-1.69	0	-9.06
	TR	-20.24	-68.3%	-3.02	-1.18	-6.89	0	-9.14
EU25	RG	-0.08	-2.5%	0.30	-0.15	-0.15	-0.01	-0.06
	TR	0.25	11.0%	0.17	-0.08	0.16	0.04	-0.04
India	RG	-14.37	-42.9%	0.00	-0.01	-2.12	0	-12.25
	TR	-13.49	-45.8%	0.00	-0.02	-1.35	0	-12.12
Japan	RG	-0.64	-16.3%	0.23	-0.3	0	-0.32	-0.25
	TR	-0.92	-19.2%	0.28	-0.32	-0.16	-0.3	-0.42
Korea	RG	-1.32	-14.4%	0	0	0.11	0.08	-1.51
	TR	-3.84	-38.6%	0	0	-0.03	0.06	-3.87
Niger	RG	-0.31	-3.1%	0	0	-0.36	0	0.04
	TR	-0.27	-2.6%	0	0	-0.31	0	0.04
Switzerland	RG	0.3	7.1%	0	-0.91	-0.05	-0.08	1.34
	TR	-4.63	-64.8%	0	-5.03	-0.35	-0.05	0.8
USA	RG	0.12	5.1%	0	-0.03	-0.04	0.14	0.05
	TR	0.03	1.9%	0	-0.01	0.03	0.05	-0.05
Non-agricultural products								
Australia	RG	-1.04	-18.8%	0.43	-0.16	0.04	0	-1.35
	TR	-1.51	-27.0%	0.47	-0.11	-0.06	0	-1.81
China	RG	-5.92	-41.2%	0	0	-0.09	0	-5.83
	TR	-5.56	-44.7%	0	0	0.25	0	-5.81

Egypt	RG	-19.33	-68.9%	-2.70	-1.08	-1.79	0	-13.76
	TR	-30.33	-77.7%	-3.81	-1.66	-10.73	0	-14.13
EU25	RG	-0.2	-7.3%	0	0	-0.09	0	-0.11
	TR	-0.08	-4.0%	0	0	-0.01	0	-0.07
India	RG	-15.76	-51.5%	0	0	-1.13	0	-14.63
	TR	-14.22	-52.2%	0	0	0.62	0	-14.85
Japan	RG	-0.15	-10.1%	0.01	-0.01	-0.07	0	-0.08
	TR	-0.24	-13.4%	0	0	-0.17	0	-0.07
Korea	RG	-0.12	-2.0%	0	0	0.05	0	-0.17
	TR	0.12	2.7%	0	0	0.28	0	-0.17
Niger	RG	0.24	2.5%	0	0	0.16	0	0.08
	TR	0.24	2.2%	0	0	0.16	0	0.08
Switzerland	RG	-0.51	-35.3%	0	-0.68	-0.04	0	0.21
	TR	-6.02	-97.3%	0	-5.86	-0.2	0	0.05
USA	RG	-0.17	-7.1%	0	0	-0.03	0	-0.14
	TR	-0.1	-5.8%	0	0	0.03	0	-0.13
Agricultural products								
Australia	RG	-0.92	-33.4%	0.54	0.02	0.04	0.33	-1.85
	TR	-1.06	-36.9%	0.38	0.09	0.23	0.14	-1.9
China	RG	-14.03	-55.8%	0.00	0	1.14	0.5	-15.68
	TR	-34.01	-80.4%	0.00	0	-2.42	1.98	-33.56
Egypt	RG	26.04	168.9%	-0.47	-0.01	-0.34	0	26.86
	TR	6.03	65.2%	-1.45	-0.15	0.59	0	7.04
EU25	RG	2.44	12.9%	5.36	-2.7	-0.21	-0.2	0.2
	TR	2.21	16.2%	3.85	-1.77	-0.64	0.6	0.17
India	RG	-0.77	-1.3%	0	-0.06	-0.27	0	-0.43
	TR	2.81	5.1%	0	-0.2	3.77	0	-0.76
Japan	RG	-7.37	-20.7%	2.99	-3.86	0.42	-4.31	-2.61
	TR	-6.17	-17.2%	2.77	-3.17	1.54	-3.26	-4.04
Korea	RG	-17.36	-32.0%	0	0	0.62	1.14	-19.12
	TR	-67.06	-65.3%	0	0	2.16	1.09	-70.3
Niger	RG	-1.54	-11.7%	0	0	-1.41	0	-0.14
	TR	-1.04	-10.1%	0	0	-0.96	0	-0.08
Switzerland	RG	10.14	23.1%	0	-4.93	-0.42	-1.15	16.64
	TR	8.5	27.0%	0	-3.27	-0.17	-0.84	12.79
USA	RG	3.73	72.8%	0	-0.47	0.11	1.99	2.1
	TR	2.28	90.3%	0	-0.16	0.28	1.2	0.96

Source: Authors' calculations; MAcMap-HS6v2.

China, Egypt, and India experienced the greatest variations (the average rate decreased by more than 40%). A large part of the decrease comes from unilateral reforms (e.g., Egypt and India in industry) as well as the completion of the last multilateral round (the Uruguay Round) in agriculture (e.g., India). Another important factor is accession to the WTO, which in the case of China means a significant decrease of its trade barriers in the agricultural sector (–14 percentage points). Finally, in the case of Egypt's agricultural protection, a large improvement in the quality of the data (see Table 1) partially explains the increase of the protection measure.

For Niger, a country that adopted no reforms during the considered period (the common external tariff was already effective when the West African Monetary Union was achieved in 2001), the variation in the applied tariff (–3.1% or –0.31 percentage point) is explained only by indirect effects, in particular by changes in weighting scheme (–0.36). However, in most of the remaining cases, changes linked to the system of weights represent less than a quarter (the maximal value is observed for the European Union) of the absolute value of the total changes.

Considering changes at the sectoral level, we can see that unit values as well as exchange rates play a central role in the evolution of agricultural sector protection, due to the existence of specific tariffs. Changes in unit values (a rise in agricultural prices from their low level in 2001) reduce the protection by 0.5 percentage point for the United States, 3.9 for Japan, and 2.7 for the European Union (with an initial level of 5.1%, 35.6%, and 18.9%, respectively). The variation in the exchange rate (U.S. dollar depreciation) has modified the value of the AVE, especially for the European Union whose average rate in agriculture increases by 5.4 points. This implies that the rise of world prices in U.S. dollars has been less important than the depreciation of the U.S. dollar against the euro. Specific duties concern mainly agriculture, except for Egypt, where these effects are negligible because the country had to face monetary phenomena coupled with a simultaneous duty reform.

For the United States, new bilateral agreements led to a lowering of industrial protection, as well as the reintegration of India into its GSP program. However, the largest changes occurred in agriculture. With monetary phenomena remaining neutral, we can see that the cause of the very high augmentation (+78%) in MAcMap-HS6v2 is the enhancement of the TRQ filling rate and a better description of U.S. protection with the use of national data instead of ITC data.

5. CONCLUSION

MAcMap-HS6v2 is an important tool for researchers aiming at monitoring border protection at the most detailed level. The exhaustive geographical coverage (171 importers and 209 exporters) and the important sectoral disaggregation (5,113 products, of the HS nomenclature) allow for extensive analysis. The data set contains a large set of information. It provides consolidated tariffs, ad valorem applied tariffs, the ad valorem equivalent of specific tariffs, tariff rate quotas, prohibitions and antidumping duties, as well as preferential rates for the year 2004. While relying mainly on ITC's raw data, the 2004 database also takes advantage of other sources (TARIC, USITC, and national sources as in the case of India and Egypt, for instance), which largely complete and enhance the quality of the data.

The methodology applied is similar to that used in the previous version of the database (MAcMAp-HS6v1 for the year 2001); however, some key improvements have been made. A new algorithm is used to deal with the harmonization of product nomenclatures as well as to handle code oddities. The method applied to process tariff rate quota information has been deeply improved. Finally, we have fine-tuned the way of aggregating tariffs.

Indeed, many applications that use protection data require aggregated protection data. That task is still a challenge for applied economists; none of the existing solutions is perfect. The way tariffs are aggregated can result in substantial differences in findings. The reference group methodology we propose aims at reducing the endogeneity problem between tariff and trade, while preserving the specificities of the trade structures.

In addition to thoroughly describing the methodology, the paper demonstrates how such a database can be employed. First, it can be used to describe the level of applied protection across the world in 2004. Of course, the relatively low average rate, 5.1 for the entire world, hides a high level of heterogeneity across countries and sectors. Even if the strong dispersion of tariff rates can be adequately observed only when remaining at a detailed level, some interesting patterns also appear at the aggregated level.

First, the average protection decreases with the level of development: in 2004, HICs have an average duty of 3.3%, against 9.6% for MICs and 12.2% for LDCs. Overall, even if poorer countries are more protectionist, they usually adopt simpler policies than the complex and heterogeneous tariff schedules of HICs.

Second, the agriculture sector is more protected (18.9%) than either manufacturing (4.4%) or extractive and energy products (1.9%), reflecting both the consequences of the exclusion of agriculture from the previous cycles of GATT as well as the particular political role of agriculture for all the countries considered. Last but not least, final goods are taxed more than intermediate goods, a practice that aims to increase the effective protection of the locally produced value-added.

The joint use of both databases, MAcMap-HS6v1 and MAcMap-HS6v2, can shed light on how and why protection evolved between 2001 and 2004. In particular, the fact that we are using a similar methodology enables us to distinguish different causes that might explain the variations observed: changes in exchange rates, in unit values, in weighting schemes, or in the effective applied trade policies.

That protection worldwide decreased by 0.5 percentage point can be attributed to MICs. Indeed, whereas developed countries had to achieve their Uruguay Round commitments in 2001, the MICs' schedule ended in 2004. Moreover, some MICs have unilaterally liberalized their economy (e.g., India), and, finally, China completed its WTO accession.

The elevation of the average agricultural protection in rich countries (+6% in relative terms) contrasts with the global decrease. It does not seem to come from a modification of trade policies; rather it is the result of two effects. On the one hand, the mechanical effect of the fall of the U.S. dollar on the European Union AVE, due to the conversion into U.S. dollars of the specific tariff (initially expressed in local currency per physical unit). On the other hand, several tariff rate quotas previously unfilled (in quota) have been filled or even exceeded. The immediate consequence is thus an increase in protection faced by exporters.

To conclude, it is worthwhile to note that one can use the MAcMap-HS6 database for purposes other than to describe trade policies. Indeed, numerous studies have already used the different versions of MAcMap-HS6. Researchers have used it as an input in CGE models to assess the impact of multilateral or bilateral agreements and as data in econometric studies.

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APPENDIX 1. UNIT VALUE CHOICE AND TARIFF-CUTTING FORMULA

1. NOTATIONS

Variable	Definition	Dimension
CTS_ADV	Bound rate—ad valorem component	hs6, reporter
CTS_SPE	Bound rate—specific component	hs6, reporter
MFN_ADV	MFN applied rate—ad valorem component	hs6, reporter
MFN_SPE	MFN applied rate—specific component	hs6, reporter
UT_ADV	Preferential rate—ad valorem component	hs6, reporter, partner
UT_SPE	Preferential rate—specific component	hs6, reporter, partner
uvm	World unit value (median, trade weighted, three-year average)	hs6
uv	Exporter reference group unit values	hs6, partner's RefGroup
uvr	Importer unit values (median, trade weighted, three-year average)	hs6, reporter
uve	Exporter unit values (median, trade weighted, three-year average)	hs6, partner
uvb	Bilateral unit values (median, trade weighted, three-year average)	hs6, reporter, partner
XXX_uv*	Ad valorem equivalent (AVE) of tariff XXX (= CTS/MFN/UT) using unit value uv* (= uvm/uv/uvr/...)	hs6, reporter,*

For modeling reasons, descriptive works, or to apply nonlinear tariff-cutting formulas, we need to compute the ad valorem equivalent (AVE) of a mixed or compound tariff. The major difficulty is choosing the right unit value to convert the specific component of the tariff. Taking too large of a *uv* will lead to overestimating the protection, and vice versa. Two principles should be kept in mind when dealing with unit values and AVEs.

First, unit values are noisy. Different methods can be used to solve this problem. Looking at bilateral unit values, even after taking a three-year average, a high volatility still appears. If it is legitimate to expect unit values to evolve with the partner, the quality of the traded good, the "pricing to market"behavior behavior, it seems unrealistic to accept a coefficient of variation of 10,000% for a homogeneous product like sugar. Since unit values are the ratio of the value of trade divided by the traded quantity and that quantity is badly registered, the unit values reflect the noise coming from low-quality data on quantity. So, we have a trade-off between keeping the maximum of information (i.e., bilateral unit value) and the needed robustness of unit value and AVE. To check the last objective, we have to discard some information or compute unit value on a larger set of values. The current solution used in MAcMap-HS6 is the exporter reference group unit values (ERGUVs). Unit values are computed by group of exporters (trade-weighted median). The ERGUVs are more robust than bilateral unit values or exporter-specific unit values but keep some specificities of the exporter based on its reference group (richest countries; very open, middle-income countries; less open, middle-income countries; very open, low-income countries; less open, low-income countries). Moreover, a filter is applied to bind the unit values into a range between 1/3 and 3 times the world (median) unit value.

Second, the relevance of unit value concepts depends on the issue under study:

- Looking at effective protection faced, unit values related to the exporter's specificities are required. Indeed, a specific tariff has more protectionist effects toward a low-price producer. So, a specific tariff's AVE should be dependent on the exporter. A choice among *uvb*, *uve*, or *uv* could be made.
- In a multilateral negotiations framework, we need to have a single AVE per MFN tariff. So, the choice of *uvr* or *uvm* seems relevant. It is noteworthy to see that WTO's principles to select *uvr* and not *uvm* will favor protectionist countries more since the unit value could be endogenous and positively correlated to the tariffs (quality effects, rents behavior).

Describing the current MAcMap methodology, we focus on *uv* for relevant applied AVE and on *uvm* for multilateral talks. To implement the WTO scenario, it is better to use *uv_wto* to stick with the existing WTO guidelines (*uv_wto* is a function of *uvr* and *uvm* but also of the gap on AVE resulting from the use of both unit value systems).

1.1. Applying tariff-cutting formula

If applying a tariff-cutting formula to an ad valorem tariff is straightforward, things become more complex when specific components are involved.

1.1.1. General principle

A tariff-cutting nonlinear formula *f(.)* will transform the base rate (the current bound rate if the product is bounded) into a new bound rate (*nbr*) that will cap the MFN rate (*final_MFN*). Moreover, no applied rate should be larger than this new MFN rate.

Related to the binding power of the commitment, we assume that none of the AVE applied tariffs computed with WTO's official unit values, whatever the structure, can be above the official WTO AVE. Following our notation, it implies that *UT_uvm* ≤ *CTS_uvm* for every WTO trade relation. However, we could still have *UT_uv* > *CTS_uvm*. Indeed, it seems that the unit values used for the official AVE computation are the most objective figures to determine whether a country respects its commitments or not.

Base rate br	New Bound rate $f(br)$
Initial MFN rate mfn	New MFN rate $Min(mfn, f(br))$
Initial Preferential rate $pref$	New Preferential rate $Min(pref, Min(mfn, f(br)))$

We assume that the structure of a tariff will not be changed by the liberalization process. If the tariff cut leads to a reduction of the MFN applied tariff, its structure (the size of the ad valorem component relative to the specific one) will be the same, meaning that each component is reduced proportionally by the same coefficient as the AVE:

$$\frac{Final\_MFN\_uvm}{MFN\_uvm} = k \Rightarrow \begin{cases} Final\_MFN\_ADV = k \times MFN\_ADV \\ Final\_MFN\_SPE = k \times MFN\_SPE \end{cases}$$
$$\forall k \leq 1$$

The constant MFN structure assumption is simplistic and neutral. However, it may be possible for some countries to reduce the ad valorem component more than the specific one, keeping the total AVE value equal to the new commitment. Indeed, specific tariffs have in reality more protectionist effects than ad valorem ones.

Preferential tariffs are sometimes correlated with the MFN tariffs. We should take this into consideration (preferential rates expressed as a percentage of the MFN, or just equal to the specific components or the ad valorem one) when applying a tariff-cutting formula. However, since the basic distribution of MAcMap-HS6 does not contain this kind of information, we assume that a cut in MFN applied tariff will not have systematic effect on preferential applied rates. The preferential AVE will be capped by the MFN AVE using the partner-specific unit value—that is, *Final_UT_uv ≤ MFN_UT_uv*. Indeed, in the other case, the exporter should prefer to ask for the MFN rate than the preferential one.

Finally, we avoid the case where the new WTO commitments will drive a change to the national tariff schedule, switching specific tariffs to mixed ones. For example,

Initial definition	*New definition*
$\$4/ton$	$\$4/ton\ MAX\ f(CTS\_uvm)$

1.1.2. The pure ad valorem case

Here, the situation is straightforward and the result is independent of the choice of *uv*.

Base rate $CTS\_uvm = CTS\_ADV$	New Bound rate $f(CTS\_uvm)$
Initial MFN rate $MFN\_uvm = MFN\_uv = MFN\_ADV$	New MFN rate $Min(MFN\_uvm, f(CTS\_uvm))$
Initial Preferential rate	New Preferential rate
$UT\_uvm = UT\_uv = UT\_ADV$	$Min(UT\_uvm, Min(MFN\_uvm, f(CTS\_uvm)))$

The final applied rate could be computed directly: *Min(UT_uvm, f(CTS_uvm))*.

1.1.3. The pure specific case

In this case, the value of the *uv* is important for computing the AVE of the bound tariff. The determination of the final applied tariff is not affected by the fact of using different unit values since the reduction rate of the bound tariff is applied to its specific, and single, component. This specific value will cap the MFN and preferential rates. There is no structural effect.

Base rate $CTS\_uvm = \frac{CTS\_SPE}{uvm}$	New Bound rate $f(CTS\_uvm)$
Initial MFN rate $MFN\_uvm = \frac{MFN\_SPE}{uvm}$ $MFN\_uv = \frac{MFN\_SPE}{uv}$	New MFN rate $Final\_MFN\_uvm = Min(MFN\_uvm, f(CTS\_uvm))$ $Final\_MFN\_uv = \frac{Final\_MFN\_uvm}{MFN\_uvm} \times MFN\_uv$ $Final\_MFN\_SPE = \frac{Final\_MFN\_uvm}{MFN\_uvm} \times MFN\_SPE$
Initial Preferential rate $UT\_uvm = \frac{UT\_SPE}{uvm}$ $UT\_uv = \frac{UT\_SPE}{uv}$	New Preferential rate $Final\_UT\_uv = Min(UT\_uv, Final\_MFN\_uv)$ $Final\_UT\_uv = Min(UT\_uv, MFN\_uv \times \frac{Min(MFN\_uvm, f(CTS\_uvm))}{MFN\_uvm})$ $Final\_UT\_uv = Min(UT\_uv, Min(MFN\_uvm, f(CTS\_uvm)) \times \frac{uvm}{uv})$ $Final\_UT\_SPE = Min(UT\_SPE, Min(MFN\_SPE, f(CTS\_uvm) \times \frac{CTS\_SPE}{CTS\_uvm}))$

1.1.4. The compound case

In this case, a structure effect appears given the fact that the weight of AVE of the specific component is not the same in the *MFN_uvm* and the *MFN_uv* tariffs.

Base rate $CTS\_uvm = CTS\_ADV + \frac{CTS\_SPE}{uvm}$	New Bound rate $f(CTS\_uvm)$
Initial MFN rate $MFN\_uvm = MFN\_ADV + \frac{MFN\_SPE}{uvm}$ $MFN\_uv = MFN\_ADV + \frac{MFN\_SPE}{uv}$	New MFN rate $Final\_MFN\_uvm = Min(MFN\_uvm, f(CTS\_uvm))$ $Final\_MFN\_uv = MFN\_uv \times \frac{Final\_MFN\_uvm}{MFN\_uvm}$
Initial Preferential rate $UT\_uvm = UT\_ADV + \frac{UT\_SPE}{uvm}$ $UT\_uv = UT\_ADV + \frac{UT\_SPE}{uv}$	New Preferential rate $Final\_UT\_uv = Min(UT\_uv, Final\_MFN\_uv)$ $Final\_UT\_uv = Min(UT\_uv, MFN\_uv \times \frac{Min(MFN\_uvm, f(CTS\_uvm))}{MFN\_uvm})$ $Final\_UT\_uv = Min(UT\_uv, Min(MFN\_uvm, f(CTS\_uvm) \times \underbrace{\frac{MFN\_ADV + \frac{MFN\_SPE}{uv}}{MFN\_ADV + \frac{MFN\_SPE}{uvm}}}_{\text{Structure effects}}))$

1.2. A numerical illustration

Starting from a bound tariff of 100% + \$1/ton, a MFN applied tariff of 75% + \$1/ton, and a preferential rate of 50% + \$1/ton, the following table displays the different operations made to determine the final applied tariffs given the *uvm*, *uv1,* and *uv2* unit values. In this case, we see that using a Swiss formula (i.e., α = 50%) will result in a cut of the bound tariff of 80%. The binding overhang reduces this cut to 77.14% for the AVE of the MFN tariff. Finally, the preferential rate will fall by 72.3% to 74.9% according to the *uv* used. Indeed, the share of the specific component in the AVE is not the same for the MFN and the preferential tariffs. Using a different *uv* might cause distortions due to the nonhomogeneous structure of the tariff. We can notice that even if for some *uv*s the preferential (bilateral) rate is above the bound AVE, it is not the case when using the official *uv*s. In this case, the importing country still respects its multilateral commitments.

			Base rate			Initial applied MFN rate			Initial bilateral applied rate		
		Initial tariff	**100%**	**$1.00**	**AVE**	**75%**	**$1.00**	**AVE**	**50%**	**$1.00**	**AVE**
uvm	$1.00		100%	*100%*	**200%**	75.0%	*100.0%*	**175.0%**	50.0%	*100.0%*	**150.0%**
uv1	$1.50					75.0%	*66.7%*	**141.7%**	50.0%	*66.7%*	**116.7%**
uv2	$0.50					75.0%	*200.0%*	**275.0%**	50.0%	*200.0%*	**250.0%**
			Final bound rate			**Final applied MFN rate**			**Final bilateral applied rate**		
		Final tariff	**20%**	**$0.20**	**AVE**	**17.1%**	**$0.23**	**AVE**			**AVE**
uvm	$1.00		20%	*20%*	**40%**	17.1%	*22.9%*	**40.0%**	13.3%	26.7%	**40.0%**
uv1	$1.50					17.1%	*15.2%*	**32.4%**	13.9%	*18.5%*	**32.4%**
uv2	$0.50					17.1%	*45.7%*	**62.9%**	12.6%	*50.3%*	**62.9%**

- Tariff formula cut [A]
- New MFN capped by new bound tariff [B]
- Ratio of reduction between initial and final applied MFN rates (*uvm*) [C]
- Proportional reduction of every initial component [D]
- AVE of the component using the *uv* of the row

1.3. Additional comments: Mixed tariffs

The MAcMap-HS6 methodology is aimed at limiting problems coming from the AVE conversion of the specific tariff. To achieve this goal, the ad valorem component of a mixed tariff is always preferred and kept. For example, a tariff defined as “3€/ton or 14%, whichever is higher (or lower)” will be transformed as a simple 14%. Even if we lose part of the available information, this approach allows us to discard the problem of applying highly volatile unit values.

APPENDIX 2. APPLIED PROTECTION IN 2004 - DETAILS BY COUNTRY

Country	Reference group				Trade weighted			
	All	***NAMA***	***Agri***	***Energy***	**All**	***NAMA***	***Agri***	***Energy***
Albania	8.3	8.1	9.4	8.9	11.1	11.4	11.6	7.5
Algeria	13.0	13.1	15.3	11.0	12.2	12.6	10.8	10.9
Antigua and Barbuda	9.6	9.4	16.2	2.4	8.8	9.1	10.6	6.1
Argentina	11.6	12.2	12.5	0.5	9.1	9.5	9.3	0.5
Armenia	1.5	1.4	4.9	0.0	1.9	1.3	5.5	0.0
Australia	3.8	4.5	1.8	0.0	3.7	4.1	1.8	0.0
Azerbaijan	6.4	6.3	10.6	4.1	6.1	6.6	6.2	1.8
Bahamas	29.6	29.8	26.5	29.9	18.8	14.9	22.6	30.6
Bahrain	9.3	9.2	19.2	4.1	7.1	8.8	16.5	0.4
Bangladesh	17.0	14.7	19.3	26.2	17.4	17.0	14.4	28.3
Barbados	13.7	12.3	47.4	3.4	12.5	11.1	30.5	0.7
Belarus	10.9	11.3	11.2	4.1	3.4	4.6	4.6	0.1
Belize	8.2	7.7	24.3	1.1	8.4	9.1	23.0	0.4
Benin	9.7	9.9	11.6	5.5	12.3	13.2	13.3	4.3
Bermuda	42.6	24.3	38.5	174.7	110.8	29.9	68.3	267.0
Bhutan	15.3	14.5	21.7	10.2	15.0	13.7	29.6	11.5
Bolivia	8.9	8.6	9.8	9.7	5.6	5.6	6.2	2.8
Bosnia and Herzegovina	3.6	3.9	4.1	1.6	3.6	3.6	4.9	1.5
Botswana	7.1	6.4	17.5	0.9	7.7	7.7	8.1	2.4
Brazil	11.1	12.7	11.3	0.5	8.9	10.7	10.9	0.2
Brunei Darussalam	9.3	8.5	24.4	0.9	9.1	7.4	28.5	0.5
Bulgaria	6.8	5.6	19.8	5.7	8.0	7.8	21.3	1.5
Burkina Faso	9.7	9.9	11.6	5.4	7.2	7.4	9.5	3.9
Cambodia	14.1	15.0	13.0	10.5	15.1	14.5	16.4	21.0
Cameroon	15.3	15.5	21.4	10.0	14.1	14.3	17.1	9.2
Canada	3.4	2.8	15.9	0.6	1.5	1.0	10.6	0.1
Central African Republic	15.2	15.5	21.4	9.9	15.1	14.1	19.0	7.3
Chad	15.4	14.9	20.6	9.9	12.6	12.3	19.6	1.6
Chile	2.7	2.5	3.7	4.1	2.0	2.0	1.7	1.9
China	7.9	8.4	11.1	2.3	6.4	6.9	8.3	1.8
Colombia	10.4	10.1	16.4	8.2	9.7	9.4	12.8	7.1
Congo	15.4	14.9	20.6	9.9	17.3	16.7	21.0	9.1
Costa Rica	5.2	4.1	16.4	3.3	4.0	3.4	7.6	6.9

Country	Reference group				Trade weighted			
	All	***NAMA***	***Agri***	***Energy***	**All**	***NAMA***	***Agri***	***Energy***
Croatia	4.0	2.3	16.7	3.2	1.2	0.6	6.3	0.6
Cuba	8.7	9.6	9.7	1.6	8.4	10.0	9.9	0.9
Côte d'Ivoire	8.2	8.8	11.4	3.4	9.2	11.0	10.2	1.3
Dominica	7.2	7.0	16.1	2.5	8.5	8.5	11.7	0.5
Dominican Republic	5.9	5.9	8.5	4.0	8.2	8.9	9.2	4.2
Ecuador	8.8	8.6	13.3	7.3	9.0	9.8	10.8	2.3
Egypt	10.8	8.7	41.5	3.7	9.4	8.7	15.3	3.5
El Salvador	3.8	3.2	10.2	3.4	4.7	4.5	5.4	5.3
Equatorial Guinea	14.0	14.1	18.8	9.9	12.9	12.3	23.3	7.3
Eritrea	6.3	6.7	6.9	2.1	5.2	5.7	4.4	1.9
Ethiopia	13.7	14.5	16.5	1.7	11.1	12.2	14.0	0.7
European Union (25)	3.2	2.5	21.3	0.3	2.5	1.9	15.9	0.2
FYMOR	8.3	7.7	14.8	8.0	7.1	5.8	14.2	5.3
Gabon	14.0	14.1	18.8	9.9	14.5	13.9	19.1	9.0
Georgia	8.6	8.1	11.4	10.3	7.0	7.4	8.1	3.2
Ghana	14.3	11.0	18.9	26.7	12.6	11.1	17.7	14.2
Grenada	9.8	9.3	17.3	5.7	8.4	8.6	9.8	1.4
Guatemala	3.7	3.3	8.6	3.5	5.4	4.9	6.5	7.2
Guinea Bissau	9.9	10.0	11.6	5.9	10.0	10.0	12.9	2.8
Guyana	8.8	8.2	18.6	6.0	7.8	7.6	11.0	5.4
Honduras	5.8	3.8	10.5	12.0	6.5	6.1	5.3	12.4
Hong Kong	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Iceland	5.5	1.3	63.8	0.0	2.6	0.7	29.1	0.0
India	19.1	14.8	58.4	13.3	16.0	13.0	58.1	13.5
Indonesia	5.5	5.7	9.1	1.6	4.3	4.6	7.5	1.0
Iran	17.6	18.5	26.5	5.2	16.0	16.6	17.1	5.1
Israel	5.0	3.2	33.4	0.4	3.3	1.6	26.8	0.3
Jamaica	4.6	4.3	13.9	0.6	7.0	7.3	12.9	0.1
Japan	3.3	1.3	28.2	1.1	3.9	1.6	29.8	0.4
Jordan	8.6	7.7	14.6	10.4	9.4	9.5	12.7	5.3
Kazakstan	4.4	4.0	8.9	4.0	3.1	3.4	4.1	0.4
Kenya	17.1	15.9	29.8	4.3	11.8	12.9	18.6	2.4
Korea	7.9	5.9	36.8	4.2	6.1	4.6	35.7	4.0
Kuwait	3.9	3.9	4.4	3.1	3.5	3.5	3.7	2.2
Kyrgyzstan	5.6	5.9	6.8	2.4	5.5	7.0	3.4	0.5
Lao People's Democratic	8.4	8.1	14.3	6.2	10.9	10.2	19.0	8.2
Lebanon	3.8	3.5	8.7	2.4	4.9	4.8	8.1	2.3

Country	Reference group				Trade weighted			
	All	***NAMA***	***Agri***	***Energy***	**All**	***NAMA***	***Agri***	***Energy***
Lesotho	5.4	4.8	15.7	1.1	13.9	15.0	4.3	2.4
Libyan Arab Jamahiriya	21.5	19.8	14.2	37.6	18.6	21.8	11.3	2.1
Madagascar	3.9	4.2	4.6	0.0	3.6	4.3	4.1	0.0
Malawi	11.2	11.6	12.3	6.7	8.8	9.0	8.4	7.6
Malaysia	14.2	13.5	26.9	3.8	5.7	5.1	17.9	2.2
Maldives	23.4	23.8	17.6	24.6	21.1	21.8	16.6	23.3
Mali	9.7	9.9	11.6	5.6	7.3	8.1	10.0	0.7
Mauritania	8.5	8.6	8.9	7.8	8.2	8.1	7.8	11.7
Mauritius	17.9	18.1	21.6	10.7	12.9	11.4	14.7	22.6
Mayotte	8.5	9.9	6.6	0.1	3.6	8.0	7.1	0.0
Mexico	8.3	6.6	22.6	8.5	3.1	3.1	3.9	1.9
Moldova, Rep.of	2.6	1.9	10.8	0.1	2.2	1.8	6.1	0.0
Morocco	19.0	16.9	40.8	18.4	18.3	17.3	38.4	8.7
Mozambique	9.8	9.8	12.2	5.9	9.1	9.2	10.8	5.1
Myanmar	3.9	3.9	6.0	1.9	3.8	3.4	8.6	1.7
Namibia	5.2	4.8	15.6	1.0	6.2	5.7	11.1	0.7
Nepal	13.5	13.7	14.2	11.7	15.9	17.1	10.6	16.0
New Zealand	3.7	3.7	6.3	1.8	3.2	3.4	4.4	0.7
Nicaragua	4.3	3.2	12.0	4.3	3.9	3.6	5.0	4.4
Niger	9.7	9.9	11.6	5.4	10.1	11.0	9.3	5.6
Nigeria	26.4	22.7	42.6	27.0	23.2	20.5	35.6	28.5
Norway	5.4	0.2	74.4	0.0	2.1	0.2	32.9	0.0
Oman	8.2	7.7	22.0	3.9	5.1	4.9	7.4	2.0
Pakistan	16.0	16.2	22.7	10.7	15.8	16.1	20.1	12.1
Panama	6.6	6.3	15.8	3.0	9.7	10.2	11.9	4.1
Papua – New Guinea	3.5	2.1	19.0	0.0	3.0	2.9	6.8	0.0
Paraguay	8.3	8.9	11.7	1.8	11.4	12.2	13.8	1.7
Peru	9.3	8.7	12.5	11.3	8.8	8.4	9.5	10.4
Philippines	5.0	4.7	9.8	3.1	3.2	2.7	9.1	2.8
Qatar	4.1	4.0	6.7	3.1	3.6	3.6	4.3	1.9
Romania	9.5	9.2	22.9	2.5	7.2	6.2	27.2	1.0
Russian Federation	10.2	10.3	12.1	4.7	9.8	9.6	12.1	1.5
Rwanda	6.8	6.4	10.5	6.1	6.4	7.0	7.3	0.6
Saint Kitts and Nevis	9.8	9.9	14.1	2.6	11.2	9.8	22.4	1.0
Saint Lucia	5.9	5.8	12.5	2.5	6.1	9.8	9.4	0.7
Saint Vincent	7.5	7.3	12.3	5.2	9.2	9.6	8.4	4.0
Saudi Arabia	6.3	6.2	7.7	5.3	6.2	5.8	8.2	4.8

Country	Reference group				Trade weighted			
	All	***NAMA***	***Agri***	***Energy***	**All**	***NAMA***	***Agri***	***Energy***
Senegal	8.4	8.9	11.7	3.7	8.4	9.7	9.7	3.5
Serbia-Montenegro	6.5	6.0	15.4	4.0	8.6	8.1	18.7	3.1
Seychelles	29.0	28.6	42.2	15.4	34.1	39.1	33.9	0.8
Singapore	0.1	0.0	1.5	0.0	0.0	0.0	0.5	0.0
Solomon Islands	35.3	38.4	46.7	21.8	44.3	43.6	69.0	34.2
South Africa	6.9	6.4	15.1	0.9	4.9	5.5	8.2	0.2
Sri Lanka	7.3	6.3	19.7	5.1	6.7	5.2	18.4	5.0
Sudan	19.1	19.4	24.4	7.5	16.8	17.0	17.7	5.0
Suriname	10.1	9.8	19.2	5.5	10.0	9.8	17.2	2.8
Swaziland	5.2	4.8	15.6	1.0	9.1	8.5	15.0	0.5
Switzerland	4.6	0.9	54.0	0.1	2.5	0.2	39.9	0.0
Syrian Arab Republic	15.8	17.0	16.5	7.7	16.4	17.0	15.2	9.3
Taiwan	9.8	9.3	23.7	4.4	5.1	3.4	19.0	7.5
Tajikistan	6.8	6.7	9.2	3.2	6.7	7.1	6.8	5.0
Tanzania	11.2	11.1	17.5	1.5	9.0	9.3	14.6	1.5
Thailand	13.6	12.7	38.8	0.8	9.3	10.1	20.4	0.2
Togo	8.4	8.9	11.7	3.7	11.8	13.1	10.6	7.8
Trinidad and Tobago	8.2	7.5	16.8	4.0	4.8	4.6	13.4	1.9
Tunisia	19.7	18.9	46.3	7.4	17.7	16.8	36.7	5.7
Turkey	4.9	2.5	35.3	0.2	1.9	1.4	13.3	0.1
Turkmenistan	3.0	1.8	18.2	0.9	5.6	1.6	53.4	4.2
USA	2.5	2.2	8.9	0.5	1.6	1.6	4.8	0.3
Uganda	7.4	6.4	9.8	10.7	4.9	5.1	6.5	1.6
Ukraine	6.9	5.9	26.3	1.2	7.1	7.2	32.0	0.3
United Arab Emirates	4.1	3.7	9.9	3.2	3.9	3.5	9.1	2.7
Uruguay	10.9	11.5	12.2	0.5	7.0	9.1	8.5	0.1
Uzbekistan	9.7	11.2	7.4	4.1	4.5	4.9	2.4	1.3
Vanuatu	15.9	14.1	45.6	8.2	19.0	11.2	62.5	27.6
Venezuela	10.5	10.5	14.0	8.2	11.4	11.1	13.5	7.5
Vietnam	11.7	10.6	19.8	11.3	13.3	11.6	25.2	17.1
Yemen	11.8	12.3	10.2	10.5	11.1	12.5	8.6	7.3
Zambia	10.2	9.0	13.3	14.9	7.9	7.8	8.0	8.8
Zimbabwe	14.6	14.3	20.5	11.6	15.1	15.2	19.5	7.8

Note: Agricultural products are defined using the WTO classification. NAMA covers non-agricultural products. Extraction and Energy products corresponds to chapters 25, 26 and 27 of the HS.

Source: Authors' calculations; MAcMap-HS6v2; reference group weighting scheme.

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ABBREVIATIONS AND ACRONYMS

Agr	Agricultural products
AMAD	Agricultural Market Access Database
APEC	Asia-Pacific Economic Cooperation
ASEAN	Association of South East Asian Nations
AVE	Ad Valorem Equivalent
BACI	Base pour l'Analyse du Commerce International
CGE	Computable General Equilibrium
CIF	Cost-Insurance-Freight
COMESA	Common Market for Eastern and Southern Africa
CU	Custom Unions
ERGUV	Exporter's Reference Group Unit Values
EU	European Union
FTA	Free Trade Areas
GATT	General Agreement on Trade and Tariffs
GTAP	Global Trade Analysis Project
HIC	High Income Countries
HS	Harmonized System
ITC	International Trade Center
LDC	Least Developed Countries
MFN	Most Favoured Nation
MIC	Middle Income Countries
N-Agr	Non-Agricultural products
OECD	Organisation for Economic Cooperation and Development
PTA	Preferential Trade Agreements
RG	Reference Group
SACU	South African Custom Union
TARIC	
TARIC	Integrated Tariffs of the European Communities
TR	Trade Weighted
TRQ	Tariff Rate Quotas
US	United States
US-ITC	United States International Trade Commission
UV	Unit Values
UVM	World Unit Value
WCO	World Custom Organization
WTO	World Trade Organization
MERCOSUR	*Mercado Comun del Sur*

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ISSN : 1293-2574