10.D

Tariff Data

David Laborde Debucquet

10.D.1 Introduction

Simple questions such as the comparison of the level of protection across countries and industries are hardly satisfactorily answered at the worldwide level. The growing complexity of trade policies has left negotiators, as well as economists and the public debate, without suitable information about the present state of trade policies. This chapter presents the applied protection data used in the GTAP 7 Data Base which originates from the MAcMapHS6v2[1] database.

In a joint effort of the International Trade Center (ITC)[2] (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) Data Base (Bouët et al. 2005). The International Food Policy Research Institute (IFPRI, Washington) has subsequently contributed to the development of the second version of the database used for the seventh release of the GTAP Data Base.[4] 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.

Indeed, building a exhaustive database on protection involves several challenges. The source information on border protection comes from national customs agencies. It is defined at the tariff-line level. The definition of tariff lines vary widely across countries but it is always

[1] The MAcMap acronym stands for Market Access Map.
[2] See International Trade Center, 2006.
[3] MAcMap-HS6v1 was first presented in Bouët et al. (2004); the MAcMap approach was introduced in Bouët et al. (2002).
[4] This project has been benefited from the financial support received by the 'AGFOODTRADE (New Issues in Agricultural, Food and Bioenergy Trade) a Collaborative Project financed by the European Commission within its VII Research Framework (see www.agfoodtrade.eu). Specific development for the GTAP Data Base have been funded by the World Bank.

based on the six-digit level of the Harmonized System classification (hereafter, HS-6 level). This non-harmonized information is not a suitable basis for a wide-ranging analysis of border protection across the world. UNCTAD's TRade Analysis and INformation System (TRAINS) has played a leading role in trying to gather the relevant information. As a result from the collection by UNCTAD of information from national custom schedules, it provides with data at the tariff-line level about applied tariffs (ad valorem and specific) and Tariff Rate Quotas (TRQs), as well as import flows by origin for more than 140 countries. However, at least until recently, TRAINS suffered from incomplete coverage of preferential agreements[4], and did not include ad valorem equivalent (AVE) calculations[5]. For years, TRAINS has been the main source of international information on applied border protection, and the only one allowing for a worldwide coverage. WTO's Integrated Database (IDB) is also an alternative source, although it only includes applied MFN tariffs, and does not reach a comparable coverage. Other efforts have been made to gather wide-ranging, harmonized data on border protection Some data bases have a more limited coverage in terms of products and/or countries (Agricultural Market Access Database (AMAD) or the Hemispheric Database). The Integrated Tariff Analysis System (ITAS) (see Fry et al., 2004) allows for a complete analysis of applied and bound tariffs and of the outcome of cutting bound protection, but for 17 countries and for industrial products only. The MAcMap project initiated by the International Trade Center (ITC, Geneva) was aimed to collect extensively tariffs information and provide them in a tractable way. The development of MAcMap also aimed at dealing with the main methodological hurdles encountered when trying to produce tariff data well-suited for large-scale analysis, in particular as far as the calculation of the AVEs of specific duties and the aggregation procedures are concerned. Basically, MAcMap is a set of files at the tariff-line level that can be used for several purposes, noticeably single-client studies and interactive web data bases for the business and policy makers community realized at the ITC.

Finally, the dataset used in GTAP derives largely from the MAcMap database. The dataset is harmonized and completed with additional sources to provide the most accurate description of protection at the world level for 2004. The resulting product is the MAcMap-HS6v2 is a comprehensive database providing detailed protection data at the 6 digit level of the harmonized system revision 1 (HS6), i.e. 5,113 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 quotas data are also provided, at the same level of detail. Information on bound tariffs is also included to cross-check information and allows the user to perform WTO tariff reduction scenarios. Even if the applied tariffs will be aggregated across products and countries, using trade weighted average, all detailed information is available for the users through the TASTE software (Horridge and Laborde, 2008) that allow browsing, aggregating and implementing tariff reduction scenarios with a user friend interface.

Detailed description of the database and changes between 2001 (MAcMapHS6 v1, GTAP6) and MAcMapHS6 v2, GTAP7) are provided in Boumellassa, Laborde and Mitaritonna (2009). Additional information, as well as the TASTE software, is available at http://www.ifpri.org/book-5078/ourwork/program/macmap-hs6

[4]This has been improved, though, in particular as a result of feedback from the development of MAcMap.

[5]Note, however, that such calculations have been proposed recently within TRAINS, although they are not documented in detail.

10.D.2 Collecting and Harmonizing Information

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.

Figure 10.D.1. Processing steps of MAcMap-HS6v2

Source: From Boumellassa, Laborde and Mitaritonna, 2009

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 10.D.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. 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.

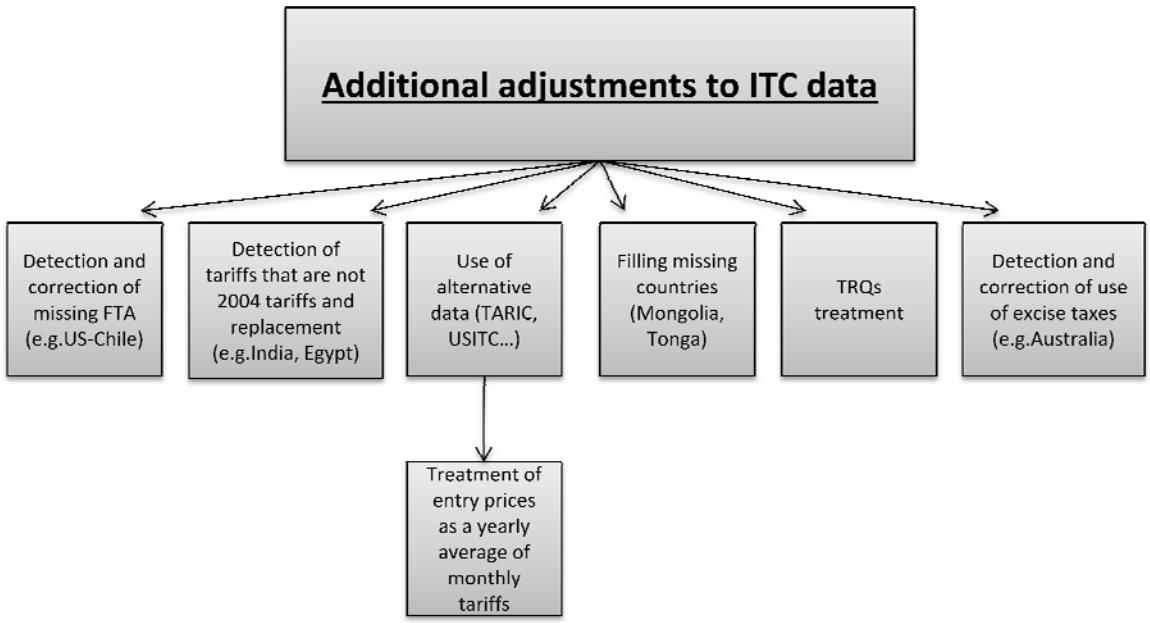
10.D.2.1 Protection Data set

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.

The main data source[6] 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).

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 (see Boumellassa, Laborde and Mitaritonna, 2009). Figure 2 summarizes the different adjustments perform on the ITC data.

Figure 2. Adjustments made on the ITC data set



Source: From Boumellassa, Laborde and Mitaritonna, 2009

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

Thus, we completely replace the data for some countries (the United States, the European Union, India, Egypt see Table 10.D.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.

Table 10.D.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)

10.D.2.2 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. To avoid wasting information due to qualitative errors, we have developed an algorithm for dealing with aberrant codes (see Boumellassa, Laborde and Mitaritonna, 2009, for details) . 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.

10.D.2.3 Trade Data set

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[7] 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.

10.D.3 Computing an Ad Valorem Equivalent at the HS6 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,[8] 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;[9] and

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).

10.D.3.1 General case

A 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.

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

[7] Cubic meter for volume, square meter for area, and meter for length and unity.
[8] 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).
[9] Each or both components may be equal to zero.

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.

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.

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).[10] The volatility of unit values is illustrated in Boumellassa, Laborde and Mitaritonna (2009). An alternative concept is the the Exporter Reference Group Unit Value (ERGUV) and 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. 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.[11] 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.

10.D.3.2 Tariff Rate Quotas

Tariff rate quotas (TRQ) 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 challenge. The MAcMap-HS6 methodology provides a relevant assessment of the marginal protection related to TRQs at the HS6 level.

A relevant treatment of TRQs requires a large set of good quality information, including tariff rates (in quota and out of quota),[12] the quota volume, the filling rate, and, sometimes, the

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

[11] 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.

[12] 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.

quota allocation. Such information is usually poorly provided. For this purpose, David Laborde and Priscila Ramos, with the help of Olivier Lecina,[13] 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 (e.g. 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.

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.

To define TRQs at the HS6 level, we develop an optimization program that aims to minimize tariff revenue collected by a country on imports related to TRQs.[15] 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.

[13] 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.

[15] 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.

Based on the results of the optimization program that defines allocated and used quota, we compute the filling rate for each TRQ. It is defined at the TRQ level for a non allocated TRQ and at the allocation level for an allocated TRQ.[16] 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 ($AVE^{MMHS6} = AVE^{out-of-quota}$).

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.

Table 10.D.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 10.D.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

[16] In other words, a non allocated 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.

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**

Source: MAcMap-HS6v2; Laborde (2008).

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

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, different formulas can be used (see Boumellassa, Laborde and Mitaritonna, 2009). The valuation of TRQ rents can be computed using MAcMap-HS6 dataset but are not used in the GTAP Data Base until now.

However, 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. As shown in Boumellassa, Laborde and Mitaritonna (2009), neglecting TRQ rents will lead to an overestimation of tariff revenue collected on agricultural products by 75% on average, 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 and finally, the GTAP protection figures.

10.D.3.3 Final treatments

After merging tariff data and the TRQ data set and computing AVE at the HS6 line, we implement two additional steps.

We merge the 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 and will be used in the TASTE software.

Last, as in the previous version of MAcMap-HS6, we avoid the *water in tariff*[17] problem by capping all AVE tariffs at 1,000%, avoiding very high AVEs that may alter average figures without economic relevance.[18]

Comparing the final AVE at the six-digit level included in MAcMap-HS6v2 and the original data sources, we build Table 10.D.5. 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 10.D.3. 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%

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

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).

10.D.4 Aggregation Procedures

While the corresponding questions have been already widely discussed (see e.g. Balassa, 1965; Laird, 1996), there is still no consensus about how to acknowledge the respective importance of products (as well as exporters and importers), without introducing very large biases. The way tariffs are aggregated is crucial.[19] 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

[17] *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.

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

[19] 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.

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 or aggregators have been discussed in the literature (see Bach and Martin 2001, Anderson and Neary 2005) but they rely on additional information that are not easily available at the HS6 level for a global database. An 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,[110] 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 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 GTAP protection dataset is computed using a trade-weighted average since it is the most frequent methodology used. However, due to the importance of the issue, we display in Table 10.D.4 results for 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 10.D.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).

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.

[110] See Boumellassa, Laborde and Mitaritonna for details.

Table 10.D.4. 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).

10.D.5 GTAP 7 vs. GTAP 6

Using respectively, MAcMapHS6 version 1 and version 2, GTAP 6 and GTAP 7 have protection datasets that have been built with very close methodologies and therefore, may be easily comparable. It is important for the user to be informed of potential changes. Following Laborde (2008), we can identify six mechanisms leading to change of protection level in an aggregated database as GTAP:

- The *real* change in trade policy, that is, evolution in the value of tariffs (ad valorem and/or specific)
- The shift in TRQ regime (see supra) due to a change in the filling rate of a TRQ
- The evolution in a trade pattern that will affect a related weighting scheme
- The evolution of unit values that will modify the AVE of specific tariffs
- A change in the exchange rates used to convert specific tariffs from the local currency unit to dollars
- Other factors such as the effects of an improvement in the quality of data collection and data processing on trade policies

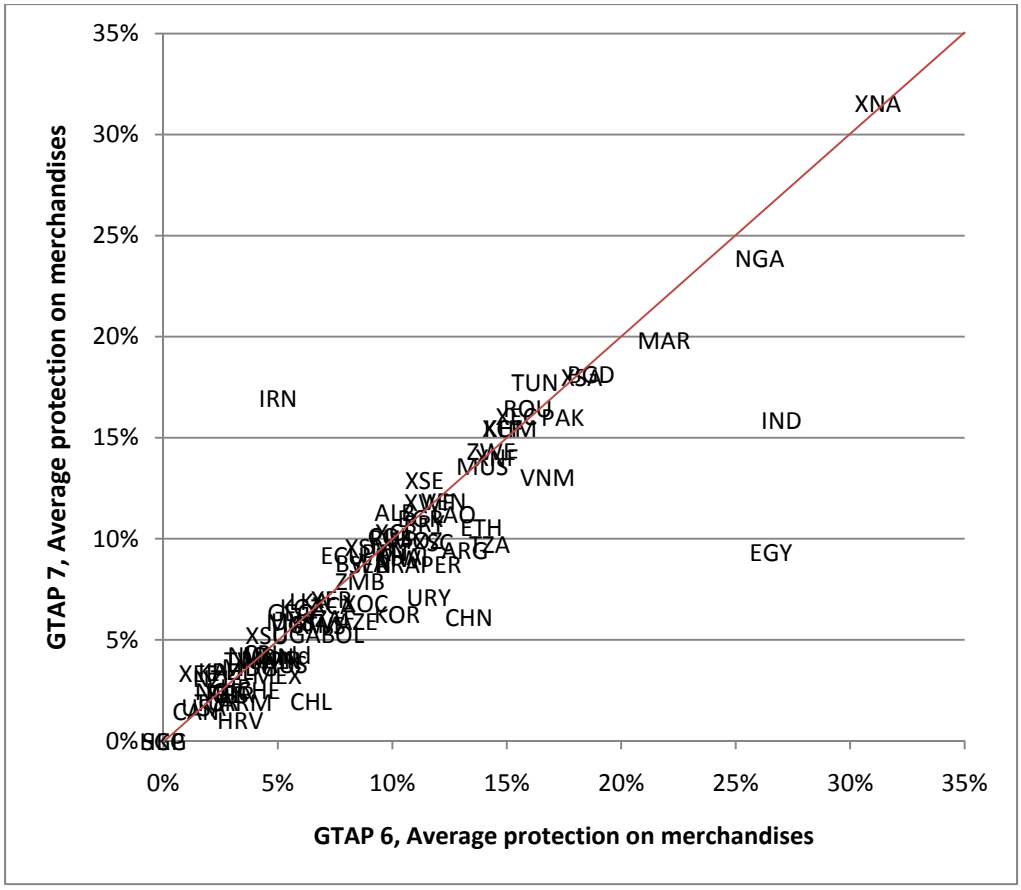
For researchers, real changes in trade policies are mainly related to effect 1 and to some extent to effect 2. However, other aspects deserve attention. The evolution in AVE, even with a fixed specific rate, may come as the consequence of the evolution of import prices in U.S. dollars (effect 4). In 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.[20] 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. Boumellassa, Laborde and Mitaritonna (2009) discuss in details the differences between 2001 and 2004

[20] 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.

providing a decomposition method for these different mechanisms. In this section, we will only focus on major changes.[21]

On the overall, world protection, excluding intra EU trade flows, has decreased by 15 percent from 5% to 4.3%. The decrease is relatively stronger in agriculture (17.5 % to 14.2%) than in non agricultural sectors (3.9% to 3.4%). In both cases, the changes are largely driven by policy changes. However, the evolution of the Euro/USD exchange rates have contributed to an increase of average agricultural protection by more than one percentage point, even if the net changes remain negative. Figure 3 provides a global overview of the changes on applied protection at the country level.

Figure 10.D.2. GTAP 6 vs GTAP7. Average AVE by region.



Note: the 25 members of the EU are aggregated into the EUR label.

Table 10.D.5 displays the countries for which tariff variation between GTAP 6 and 7 have been the strongest (more than 40% of variation). For non agricultural products, main tariff reductions are related to unilateral trade reform (India, Egypt), implementation of new bilateral agreements

[21] Readers can find differences between figures presented in this section and the trade weighted figures presented in the Boumellassa, Laborde and Mitaritonna working paper. This is due to the fact that in this section, the trade weights of MAcMapHS6 have been rescaled to reproduce the GTAP trade pattern.

(Chile with the EU and the US) or WTO commitments (China). However, changes in trade pattern plays a considerable role for some countries (Egypt, Armenia).[22] For Switzerland, which protection relies heavily on specific tariffs, the improvement on the unit values measurement of jewellery and precious metals has led to a strong reduction in the average AVE. Protection increases are driven by better measurement (Iran) or modification of the weighting scheme. The latter is particularly important for several Rest of regions where aggregation takes place both across products and countries. In agriculture a similar pattern appears however the role of TRQs may be quite substantial. Regimes shift in the US for instance have increased significantly the level of protection. In the case of Korea and China, we have strong reduction in protection due to a better representation of several trade policy tools. Even if they are related to TRQs, changes are not related to regime shifting but more to the way that these instruments are administrated and therefore we have attributed the changes to the last category (Policy changes).

[22] In the case of Egypt, we see the cumulative effects of the trade liberalization that reduces tariffs but also increase the weight (trade creation) of the liberalized products in the average.

Table 10.D.5. Average rate of protection by region. Main changes between GTAP6 and GTAP7

Region	GTAP6	GTAP7	Changes		Contribution				
	AVE	*AVE*	*Absolute*	*Relative*	*Exchange rate*	*Unit value*	*Weighting Scheme*	*TRQ filling rate c*	*Policy changes*
	percentage points				*percentage points*				
Non Agricultural products									
CHE	2.5	0.2	-2.4	-93.8	0.0	-2.4	0.0	0.0	0.0
CHL	6.4	2.0	-4.4	-68.4	0.0	0.0	0.3	0.0	-4.7
EGY	31.4	10.3	-21.1	-67.1	-2.8	-1.1	-1.7	0.0	-15.5
HRV	1.5	0.5	-1.0	-66.7	0.0	0.0	0.4	0.0	-1.4
ARM	3.1	1.3	-1.9	-59.9	0.0	0.0	-1.9	0.0	0.0
CHN	11.8	6.1	-5.7	-48.4	0.0	0.0	-0.6	0.0	-5.2
IND	24.7	12.8	-11.9	-48.2	0.0	0.0	0.2	0.0	-12.1
[… Other countries with changes with relative changes between -40% and + 40%…]									
XEF	0.7	1.0	0.3	46.8	0.0	0.0	0.0	0.0	0.3
KAZ	2.4	3.5	1.1	47.5	0.0	0.0	1.1	0.0	0.0
XSE	6.4	10.7	4.4	68.3	0.0	0.0	4.5	0.0	-0.2
IRN	5.1	16.9	11.8	232.5	0.0	0.0	0.3	0.0	11.6
Agricultural products									
CHN	37.9	6.6	-31.3	-82.6	0.0	0.0	2.6	1.2	-35.1
XSC	41.8	9.5	-32.3	-77.4	0.0	-0.2	-17.8	0.0	-14.3
CHL	6.9	1.6	-5.3	-77.3	0.0	0.0	0.0	0.0	-5.3
BWA	37.0	10.5	-26.5	-71.7	0.0	1.0	-4.8	0.0	-22.8
HRV	19.1	5.9	-13.3	-69.3	-3.6	-0.1	0.9	0.6	-11.1
MEX	11.0	4.0	-6.9	-63.2	0.0	0.0	-0.4	-5.1	-1.4
KOR	81.9	36.5	-45.3	-55.4	0.0	0.0	16.2	1.0	-62.5
AUS	3.2	1.6	-1.6	-50.2	0.6	0.4	-0.9	0.2	-1.9
AZE	10.5	5.6	-4.9	-46.8	0.0	-0.8	-4.2	0.0	0.0

					[… Other countries with changes with relative changes between -25% and + 25%…]				
XSU	13.4	19.6	6.3	47.0	0.0	0.0	6.7	0.0	-0.4
BLR	3.2	4.7	1.5	47.5	0.0	0.0	1.5	0.0	0.0
XSM	10.2	15.2	5.0	48.9	0.0	0.0	5.1	0.0	-0.1
USA	2.5	4.4	1.9	76.1	0.0	-0.1	0.1	1.1	0.9
NZL	1.8	4.3	2.5	134.3	0.7	0.1	-0.7	0.0	2.4
XEF	8.9	26.1	17.3	195.3	-1.5	0.0	0.7	9.0	9.0
SGP	0.2	0.5	0.3	207.2	0.0	0.0	0.4	0.0	-0.1
IRN	4.7	17.5	12.8	271.5	0.0	0.0	0.0	0.0	12.8

10.D.5 The TASTE Software

The GTAP project provides a coherent database to support CGE modelling of international trade and applied tariff changes at a 57-sector level of sectoral detail. Real-world tariff negotiations deal with bound rates, which form a ceiling on applied rates and (for a given exporter/ importer country pair) vary greatly within each of the GTAP sectors. Therefore, to compute applied tariff shocks for GTAP or similar models, we need much more detailed data on trade flows and on bound and applied rates. Such a dataset, MAcMapHS6 includes HS6 level trade data for all trading pairs, together with estimates of applied and bound rates for each trade. Trade data are internally consistent (exports=imports) and agrees with the GTAP dataset thanks to a rescaling procedure.

The MAcMapHS6 version 2 dataset is an impressive resource -- but presents barriers to entry. It consists of a huge (8 gigabyte) text file, too large to load into Excel or a text editor. To obtain or process this dataset raises technical problems which hitherto have been surmounted only by a few skilled teams from richer countries.

To lower these barriers, Laborde and Horridge (2008) have developed TASTE -- the Tariff Analytical and Simulation Tool for Economists -- which compresses the MAcMapHS6 dataset onto a single CD and allows the ordinary GTAP user to rapidly process the whole dataset. A set of rules about cuts in applied rates (as negotiated in Doha and similar processes) is specified by the user. Using an ordinary PC, TASTE takes 3 or 4 minutes to apply these rules to the 180 million trades described by MAcMapHS6. Resulting changes in applied rates are averaged to a user-specified level of sectoral and regional aggregation and are stored in a format which can be directly used by the standard GTAP Model. TASTE does not rely on any other software.

TASTE also facilitates other uses of the MAcMapHS6 data. For example, it is easy to make an extract of the data which includes all trades within a GTAP sector. This could be used to prepare a special version of the GTAP Model which modelled trade in one or a few GTAP sectors at the HS6 or HS4 level. The extra detail might be important if trade shares or import restrictions varied greatly amongst HS6 groups within a GTAP sector. Therefore, TASTE is a perfect complement to SPLITCOM (http://www.monash.edu.au/policy/splitcom.htm).

The latest version of TASTE and its documentation can be downloaded from http://www.ifpri.org/book-5080/ourwork/program/taste-tariff-analytical-and-simulation-tool-economists .

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