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A consistent, *ad-valorem* equivalent measure of
applied protection across the world:
The MAcMap-HS6 database

Antoine Bouët, Yvan Decreux, Lionel Fontagné,
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**A CONSISTENT, *AD-VALOREM* EQUIVALENT MEASURE OF APPLIED PROTECTION
ACROSS THE WORLD: THE MACMAP-HS6 DATABASE**

SUMMARY

At the time of "globalization", simple questions such as the comparison of the level of protection across countries and industries are still hardly satisfactorily answered at the worldwide level. Although a lot of information exists, no well-suited, comprehensive assessment of AVE applied protection across the world is available. This results, in particular, in most assessments of the impact of multilateral trade liberalization being carried out without taking into account specific tariffs, nor trade preferences. The growing complexity of trade policies has thus left negotiators, but also economists and the public debate, without well-suited information about the present state of trade policies, not to speak about their possible impact. This working paper endeavors to contribute filling this gap. Based on a joint effort devoted by the International Trade Centre –ITC– (United Nations Conference on Trade And Development –UNCTAD– & World Trade Organization –WTO–, Geneva) and the Centre d'Etudes Prospectives et d'Informations Internationales –CEPII– (Paris) to systematically collect detailed and exhaustive information on the level of applied trade barriers in the MACMap database, it proposes and uses a method to compute an exhaustive and consistent ad-valorem equivalent (AVE) measure of applied protection across the world, at the detailed product 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 CGE analysis. This results in the construction of MACMap-HS6 (version 1), a database providing at the six-digit level of the Harmonized System (HS-6 level, 5,111 products), a set of consistent and exhaustive AVEs of applied border protection across the world in 2001, suitable to analytical purposes. 166 reporting countries are covered, with 208 partners.

In so doing, the main original contributions of MACMap-HS6 are: (i) the exhaustive coverage of preferential trade arrangements (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 tariff-rate quotas (TRQs) both through the AVE of the resulting protection at the margin, and through the calculation of involved rents; (iv) an original aggregation methodology, using a weighting scheme based on reference groups of countries, and limiting the extent of the endogeneity bias inherent to the standard, import-weighted average protection.

This acknowledgement of the differentiated impact of specific duties, together with the bilateral allocation of TRQs, and most of all the emphasis put on trade preferences, entails a considerable increase in the complexity of the measurement of protection: it means that, even at the most detailed level (HS-6), protection is partner-specific. As opposed to the traditional approach in which protection used to be measured by importing country (reporter) and by product, this requires adding an additional dimension to the analysis, namely the exporting country (partner). For a worldwide database such as MACMap, this changes radically the complexity of the exercise.

This working paper also uses MACMap-HS6 to brush a broad picture of protection at the world level. Among a selected sample gathering most "important" countries in world trade, average protection ranges from 2.3% (USA) to 33.5% (India). Calculated according to MACMap's methodology, worldwide average level of protection is 5.6%. On average, protection is low in the richest countries, and does not exceed 4% in Quad countries.

It is well-known that agriculture is largely protected worldwide. This is confirmed by MACMap data. Average agricultural protection ranges from 2.7% in Australia to 59.6% in India in the sample displayed. The world average is 19.1%. Among Quad countries, the EU15 and Canadian agriculture are much more protected than the US one (resp. 17.9% and 14.9%, vs. 5.0%), but less than the Japanese one (35.3%).

The world distribution of tariffs is shown to exhibit a concentration of very high tariff peaks on a narrow range of agricultural products, especially pronounced in rich countries. This is consistent with the existence of a relatively small number of sensitive products excluded by rich countries from most liberalization agreements, whether multilateral or preferential.

MACMap-HS6 represents an unprecedented effort to monitor border protection world-wide at the most detailed level, while accounting exhaustively for preferential trade agreements. It has already been used in several assessments of the impact of liberalization agreements, and its use as an input for the upcoming GTAP 6 database paves the way for a large scale utilization. In negotiating future liberalization agreements, such as in particular those contemplated in the ongoing Doha Round, we believe that MACMap-HS6 can be a useful tool, and pave the way for better informed policy decisions.

ABSTRACT

Trade negotiations increasingly rely on quantitative assessments. Accordingly there is a need for tariff information shedding light on applied protection at the detailed level. MACMap-HS6 is a database providing 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 (5,111 products). Based on a joint effort by ITC (UNCTAD-WTO, Geneva) and CEPII (Paris) to systematically collect and harmonize the relevant information, we describe here the methodology used in MACMap-HS6 to compute and aggregate an *ad-valorem* equivalent of applied protection, well suited for analytical purposes (in particular computable general equilibrium analysis). Special emphasis is put in minimizing the endogeneity bias in the aggregation procedure, by making use of a weighting scheme based on groups of countries ("reference groups"). Structural differences in export specialization, as reflected in different unit values, are also acknowledged when computing *ad-valorem* equivalents, and tariff rate quota rents are computed. The resulting quantitative assessment is illustrated by giving an overview of *ad-valorem* equivalent, applied protection across the world, in terms of average as well as distribution.

JEL Classification: F13

Key Words: Tariff Duties; ad valorem equivalent; tariff rate quotas; aggregation method; preferential trade arrangements.

**UNE EVALUATION COHERENTE A L'ECHELLE MONDIALE DE L'EQUIVALENT AD
VALOREM DE LA PROTECTION TARIFAIRE APPLIQUEE :
LA BASE MACMAP-HS6**

RESUME

A l'heure de la « globalisation », des sujets simples comme la comparaison des niveaux de protection commerciale entre pays et industries sont toujours assez mal traités à un niveau mondial. Bien qu'une grande quantité d'information existe, aucune estimation convenable et complète des équivalents ad valorem de la protection appliquée dans le monde n'est disponible. Cela signifie, en particulier, que la plupart des estimations de l'impact d'une libéralisation multilatérale sont réalisées sans tenir compte des tarifs spécifiques ni des préférences commerciales. Les négociateurs, mais aussi les économistes et le débat public n'ont ainsi pas accès à une information satisfaisante sur la politique commerciale actuelle et sur ses effets, en raison de sa complexité croissante. Ce document de travail s'efforce de contribuer à combler cette lacune. Grâce à l'effort conjoint du Centre du Commerce International – CCI – (Conférence des Nations Unies sur le Commerce Et le Développement – CNUCED – & Organisation Mondiale du Commerce – OMC –, Genève) et du Centre d'Etudes Prospectives et d'Informations Internationales – CEPII – (Paris) pour collecter systématiquement au sein de la base MAcMap l'information détaillée et exhaustive sur le niveau des barrières commerciales appliquées, il propose et utilise une méthode pour calculer une mesure exhaustive et cohérente de l'équivalent ad valorem (EAV) de la protection appliquée à travers le monde, à un niveau détaillé de produits. L'objectif n'est pas seulement de fournir une mesure de la protection à la frontière, mais aussi de tracer la voie vers une analyse économique satisfaisante des conséquences d'une libéralisation commerciale, en particulier au moyen d'une analyse en équilibre général calculable. Cela conduit à la construction de MAcMap-HS6 (version 1), une base fournissant au niveau à six chiffres du Système Harmonisé (niveau SH-6, 5 111 produits), un ensemble d'EAV cohérent et exhaustif de la protection aux frontières dans le monde en 2001, adapté à un objectif analytique. 166 pays déclarant sont couverts, qui commercent avec 208 partenaires.

En procédant de la sorte, les principales contributions originales de MAcMap-HS6 sont : (i) la couverture exhaustive des accords commerciaux préférentiels (ACP) à travers le monde ; (ii) le calcul de l'EAV des droits spécifiques, par une méthode qui reconnaît que l'impact de ces droits est différent par exportateurs, selon la valeur unitaire de leurs exportations ; (iii) l'incorporation des contingents tarifaires (CT) à la fois à travers l'EAV de la protection marginale qui en résulte, et à travers le calcul des rentes induites ; (iv) une méthode d'agrégation originale, utilisant un système de pondération basés sur un groupe de référence pour chaque pays, et limitant l'étendue du biais d'endogénéité que présentent les moyennes pondérées par le commerce effectif.

Cette reconnaissance de l'impact différencié des droits spécifiques, ainsi que l'allocation bilatérale des contingents tarifaires, et surtout l'accent mis sur les préférences commerciales, occasionne une augmentation considérable de la complexité de la mesure de la protection : cela signifie que, même au niveau le plus détaillé (SH-6), la protection est spécifique au partenaire. Contrairement à l'approche traditionnelle dans laquelle la protection était mesurée par pays importateur (déclarant) et par produit, cela nécessite d'ajouter une dimension supplémentaire à l'analyse, sous la forme du pays exportateur (partenaire). Pour une base mondiale comme MAcMap, cela change complètement la complexité de l'exercice.

Le document de travail utilise aussi MAcMap-HS6 pour brosser un tableau général de la protection au niveau mondial. Au sein d'un échantillon sélectionné regroupant les pays les plus « important » dans le commerce mondial, la protection varie de 2,3 % (Etats-Unis) à 33,5 % (Inde). La protection mondiale moyenne calculée selon la méthodologie MAcMap est de 5,6 %. En moyenne, la protection est faible dans les pays les plus riches, et ne dépasse pas 4 % dans les pays de la Quad.

L'agriculture est connue pour être fortement protégée à travers le monde. Ceci est confirmé par les données de MAcMap. La protection moyenne dans l'agriculture varie de 2,7 % en Australie à 59,6 % en Inde au sein de l'échantillon présenté. La moyenne mondiale est de 19,1 %. Parmi les pays de la Quad, les agricultures de l'UE15 et du Canada sont beaucoup plus protégées que celle des Etats-Unis (resp. 17,9 % et 14,9 %, vs. 5,0 %), mais moins que celle du Japon (35,3 %).

On montre que la distribution mondiale des droits de douane présente une concentration de pics tarifaires très élevés sur un éventail réduit de produits agricoles, un phénomène particulièrement prononcé dans les pays riches. Cela concorde avec l'existence d'un nombre relativement petit de produits sensibles exclus par les pays riches de la plupart des accords de libéralisation, qu'ils soient multilatéraux ou préférentiels.

MAcMap-HS6 représente un effort sans précédent pour examiner la protection à la frontière au niveau mondial et au niveau le plus fin, en tenant compte de tous les accords commerciaux préférentiels. La base a déjà été utilisée dans plusieurs évaluations de l'impact d'accords de libéralisation, et son utilisation comme source pour la base GTAP 6 prépare le terrain pour une utilisation à grande échelle. Dans la négociation d'accords de libéralisation futurs, comme en particulier ceux envisagés dans le cadre du cycle de Doha en cours, nous sommes convaincus que MAcMap-HS6 pourra être un outil utile et permettra de prendre des décisions de politique économique mieux informées.

RESUME COURT

MAcMap-HS6 est une base qui fournit une mesure cohérente de l'équivalent ad valorem des droits de douane et des contingents tarifaires pour 163 pays et 208 partenaires, au niveau à six chiffres du Système Harmonisé (5,111 produits). Grâce à l'effort conjoint du CCI (CNUCED-OMC, Genève) et du CEPII (Paris) pour collecter systématiquement et harmoniser l'information pertinente, nous décrivons ici la méthodologie utilisée dans MAcMap-HS6 pour calculer et agréger un équivalent ad valorem de la protection appliquée, bien adapté à des objectifs analytiques (en particulier l'analyse en équilibre général calculable). Un accent particulier a été apporté à la minimisation du biais d'endogénéité au cours de la procédure d'agrégation, par l'utilisation d'un système de pondération basé sur des groupes de pays (« groupes de références »). Les différences structurelles de spécialisation à l'exportation, reflétées par des valeurs unitaires différentes, sont aussi prises en compte au moment de calculer les équivalents ad valorem, et les rentes induites par les contingents tarifaires sont calculées. L'estimation qui en résulte est illustrée par une vue d'ensemble des équivalents ad valorem dans le monde, en termes de moyenne et de distribution.

Classification *JEL* : F13

Mots-clefs : Droits de douane ; équivalent ad valorem ; contingent tarifaire ; méthode d'agrégation ; accords préférentiels de commerce.

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*Antoine Bouët, Yvan Decreux, Lionel Fontagné, Sébastien Jean & David Laborde*¹

1 INTRODUCTION

Negotiating on something that you do not know with precision, and even more modeling the outcome of this negotiation, are difficult tasks. Surprising as it is, though, this is what is happening in the ongoing Doha Round: at the time of "globalization", it is utterly difficult to measure accurately the magnitude of border protection around the world and consequently to give an accurate estimate of the economic impact of any trade liberalization. The Marrakech agreement admittedly brought some simplifications, in particular by abolishing quantitative trade restrictions. But it let specific tariffs (monetary amounts by physical quantities) still widespread in some sectors (agriculture) and some countries (Switzerland, Japan, Malaysia, Cyprus, European Union...). Worse, it gave birth to new protection instruments, known as tariff rate quotas (TRQs), through which a given amount of imports (allocated according to various possible modes of administration, and frequently on a bilateral basis) can benefit from a lowered tariff rate. At the same time, far from reducing the dispersion of tariff rate, dirty tariffication led to a very strong disparity of tariff levels, and to widespread tariff peaks. As it is well known, the distribution of tariffs matters a lot, both in terms of induced welfare and trade. Lastly, the number of preferential trade arrangements (PTAs) dramatically increased during the nineties.² And beside permanent regional agreements (free trade areas, customs unions...), non-reciprocal trade preferences were often granted by rich countries to developing ones, often for a limited period of time only.³

Against this background, 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, but also economists and the

¹ This article is part of the effort jointly devoted by ITC (UNCTAD-WTO) and CEPII (Paris) to build the MACMap database. The authors acknowledge helpful comments and suggestions made by Jaime de Melo on a previous version. They are also grateful to Mondher Mimouni and Xavier Pichot for contributing to MACMap at the ITC, as well as to Friedrich von Kirchbach, for his fruitful collaboration. They also like to thank Paul Gibson for providing them with the AMAD database on tariff rate quotas. They also benefited from valuable comments and suggestions from many researchers, in particular in the context of the GTAP consortium. Correspondence: sebastien.jean@cepii.fr. The present version of this paper is from September 2005, the first version of this working paper was released in December 2004.

² 216 enforced agreements had been notified to the WTO by January 2006.

³ Another difficulty is the stringency of rules attached to the latter agreements in order to be eligible to these preferences.

public debate, without well-suited information about the present state of trade policies. This article endeavors to contribute filling this gap. Based on a joint effort devoted by the International Trade Centre –ITC– (United Nations Conference on Trade And Development –UNCTAD– & World Trade Organization –WTO–, Geneva) and the Centre d’Etudes Prospectives et d’Informations Internationales –CEPII– (Paris) to systematically collect detailed and exhaustive information on the level of applied trade barriers in the MAcMap database, it proposes and uses a method to compute an exhaustive and consistent *ad-valorem* equivalent (AVE) measure of applied protection across the world. 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 CGE analysis.

The source information on border protection emanates from national customs. It is defined at the tariff line level. The definition of tariff lines varies widely across countries, but it is always based on the six-digit level of the Harmonized System classification (hereafter, HS-6 level). This non-harmonized information is hardly a well-suited basis for a wide-ranging analysis of border protection across the world. In trying to gather the relevant information, UNCTAD's TRade Analysis and INformation System (TRAINS) has played a leading role. 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 TRQs, as well as import flows by origin for more than 140 countries. However, at least until recently, TRAINS suffered from an incomplete coverage of preferential agreements⁴, and did not propose *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 now an alternative source, although it only concerns applied MFN tariffs, and does not reach a comparable coverage. Other efforts which have been made to gather wide-ranging, harmonized data on border protection are presented in Table 1: some databases 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 very complete analysis of applied and bound tariffs and of the outcome of cutting bound protection, but for only 17 countries and industrial products. Databases also differ from a methodological point of view (aggregation procedure, estimation of AVE).

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.

A consistent, ad-valorem equivalent measure of applied protection across the world

Table 1: Databases on market access

	AMAD	Hemispheric database	IDB	ITAS	MAcMap	OECD	Trains
<i>Source</i>	Agr. and AgriFood Canada, EU Commission, FAO, OECD, The World Bank, UNCTAD, USDA - ERS	Inter American Development Bank	World Trade Organization	Australian Government Productivity Commission	Centre d'Etudes Prospectives et d'Informations Internationales	OECD & UNCTAD	United Nations Conference on Trade And Development
<i>Time coverage</i>	From 1995 to 2001	From 1997 to 2001	From 2000 to 2004	1999	2001	1988, 1993 and 1996	From 1994 to 2001
<i>Country coverage</i>	50 countries	American hemisphere countries (33)	122 reporting countries	17 reporting countries	163 reporting countries/208 partners	14 OECD countries	163 reporting countries in 2001
<i>Product coverage</i>	Agricultural products (tariff lines level)	Tariff line or HS10, HS8 (HS6 for Canada)	Tariff line level	Industrial products	5,111 products (HS6)	5,111 products (HS6)	5,111 products (HS6)
<i>Ad-valorem duties</i>	Yes	Yes	Yes	Yes	Yes	yes	yes
<i>Specific duties</i>	Yes	Yes	Yes	Only 10% of specific duties included	Yes	yes	yes
<i>Tariff quotas</i>	Yes	No	Yes	No	Yes	Only for three countries (Canada, Iceland, USA)	yes
<i>Anti-dumping</i>	No	Yes	No	No	Yes	No	No
<i>Bound vs. applied MFN rates</i>	Bound and applied MFN duties	Bound and applied MFN duties	Bound and applied MFN duties	Bound and applied MFN duties	Applied duties	Bound and applied MFN duties	Applied duties
<i>Tariff regimes</i>	Multilateral (MFN)	MFN + all regional agreements + all preferences	Multilateral (MFN) partial inform. on trade preferences	MFN + all regional agreements + all preferences	MFN + all regional agreements + all preferences	Multilateral (MFN)	MFN + some regional agreements + some preferences
<i>Method of aggregation</i>	No average calculated	No average calculated	No average calculated	Simple average, trade-weighted average	Imports of the reporter's reference group from the partner	Simple mean	No average calculated
<i>Ad-valorem Equivalent (E) of specific duties</i>	No AVE calculated, but world prices and exchange rates included in the database	When provided by countries	When provided by WTO members	Use of IDB's AVE when available (10% of cases)	Specific duties divided by median unit value of trade flow originating from exporter's Reference Group	By price differentials, for some products only	No AVE calculated
<i>AVE of tariff quotas</i>	No AVE calculated	-	When provided by WTO members	-	OQTR, IQTR or weighted mean of IQTR and OQTR according to imports level	OQTR	No AVE calculated
<i>Possible simulation of tariff-cutting formula</i>	No	No	Yes (under WITS application)	Yes	No	No	Yes (under WITS application)

Thus, although a lot of information existed, no well-suited, comprehensive assessment of AVE applied protection across the world was available. This resulted, in particular, in most assessment of the impact of multilateral trade liberalization being carried out without taking into account specific tariffs, nor trade preferences, even if the GTAP network has done

considerable efforts in order to offering a consistent database.⁶ Gathering such information in a consistent and tractable way has been the first motivation of the MAcMap database. Beyond proper collection and harmonization of information, however, 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.

A first set of problems has to do with the calculation of the AVEs of specific duties. This requires harmonizing correctly trade and tariff data, and measuring in a robust way the corresponding unit values, both of which are difficult tasks. But the definition of the method itself is also controversial. AVEs based on a worldwide import average, as computed for instance by Gibson et al. (2001), has the advantage of robustness, but it is a strong simplification. Indeed, specific tariffs have a more restrictive impact on unprocessed or low quality goods (see e.g. Feenstra & Boorstein, 1991). This is not a secondary issue, given that vertical specialization of countries along the quality ladder has been shown to be widespread. In addition, poorer countries tend to specialize in lower quality goods (Fontagné & Freudenberg, 1997), so that the corresponding bias is likely to be systematically detrimental to developing countries. While no perfect solution is available, taking into account this peculiarity of specific tariffs is important if one is to gain an accurate understanding of their restrictive impact on trade flows.

It is worth emphasizing that this acknowledgement of the differentiated impact of specific duties, together with the bilateral allocation of TRQs, and most of all the emphasis put on trade preferences, entails a considerable increase in the complexity of the measurement of protection: it means that, even at the most detailed level (HS-6), protection is partner-specific. As opposed to the traditional approach in which protection used to be measured by importing country (reporter) and by product, this requires to add an additional dimension to the analysis, namely the exporting country (partner). For a worldwide database such as MAcMap, this changes radically the complexity of the exercise.

The aggregation procedure is another source of difficulties. 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 too large biases. The widely used trade-weighted average, in particular, suffers from a well-known endogeneity bias, leading to an understatement of the restrictive impact of tariff duties. While appealing theoretical work has been produced during the last decade on this topic (in particular following Anderson & Bannister, 1992 and Anderson, Bannister & Neary, 1995), including some empirical applications (see e.g. Anderson & Neary, 1999 or Bureau and Salvatici, 2004), they did not prove tractable for large-scale database. Hence, there is a need to propose a different aggregation procedure, likely to minimize this bias in an easily tractable way. An attempt is proposed here based on simple theoretical underpinnings.

⁶ None of these two aspects were accounted for in the tariff data included in the GTAP 5 database (see Dimaranan and McDougall, 2002), which has been the workhorse for founding empirically the assessments of the impact of multilateral liberalisation.

Basically, MAcMap is a set of files at the tariff line level⁷ that can be mobilized for several purposes, noticeably single client studies and interactive web databases for business community realized at ITC. This article deals with one specific application of MAcMap, MAcMapHS6v1, namely the construction of a database at the HS-6 level, intended to provide a set of consistent and exhaustive AVEs of applied border protection across the world (163 reporting countries are covered, for 5,111 products, with 208 partners) in 2001, suitable to analytical purposes. This specific database, is in particular the source for protection data in the 6th release of the GTAP database.⁸ This article intends to provide a complete description of the associated methodology and to use it to brush a broad picture of protection at the world level.

Section 2 proposes a detailed presentation of the methodology utilized in the last release, MAcMapHS6 version 1. Some major improvements have been introduced since the first presentation of MAcMap; this is why these changes are detailed throughout this section. Illustrative results about the worldwide structure of protection are provided in Section 3.

2 COMPUTING A CONSISTENT AND EXHAUSTIVE EQUIVALENT MEASURE OF APPLIED PROTECTION: METHODOLOGICAL CHOICES IN MACMAPHS6

As outlined above, the data about applied protection is scattered and heterogeneous. The first step when tackling protection measurement is thus to collect and harmonize information. In itself, this is a huge task, when one aims at characterizing protection for all reporting countries available, at the HS-6 level. It is even more so, as soon as protection is understood to be partner-specific, as already emphasized above. Noteworthy, even this early stage requires a number of choices, since there is no unique or obvious way to handle the data. Once this is done, the construction of the database mainly involves computing AVEs, and defining an appropriate aggregation procedure.⁹

⁷ Mondher Mimouni is in charge of co-ordinating the compilation of this primary data on behalf of ITC, UNCTAD and WTO.

⁸ The documentation of GTAP 6 is forthcoming. See Dimaranan and McDougall (2002) for the documentation of version 5. The GTAP version of the database is freely available on the CEPII website (<http://www.cepii.fr/francgraph/bdd/macmap.htm>) as well as alternative aggregations. More information is available on the website about the various versions of the database distribution and their updates.

⁹ For the sake of simplicity, we will refer in the following to MAcMap instead of MAcMapHS6v1.

2.1 Collecting and harmonizing information

For each importing country, information on the various instruments of protection at the border (*ad-valorem* tariffs, special tariffs, quotas, etc.) is maintained in the MAcMap database at the most disaggregated level possible: the tariff line level. In order to stick to the bilateral option, unilateral preferences and regional agreements are exhaustively documented. This is a rare feature among worldwide databases on border protection (see table 1).

Protection data in the MAcMap database originates from the source files of TRAINS, from countries notifications to the WTO, from AMAD, and from national custom information (reported to UNCTAD, or directly to ITC). Occasionally, this information is completed by other relevant sources: administrations, statistical institutes, international organisations, websites of regional agreements... Concerning antidumping duties, the information is drawn from notifications of member countries to the WTO. This combined information characterizes the trade policy applied by 165 countries to 208 exporting partners. It concerns tariffs (*ad-valorem*, specific, mixed, compound and antidumping duties), and tariff quotas.¹⁰

This protection data is generally available at the tariff line level, but no international harmonization of classifications exists beyond the HS6 level. Since HS6 is also, for most countries, the most detailed classification for which foreign trade statistics are available, this classification (more specifically, its revision 1, of 1996) has been adopted to put together all data into a database tractable for analytical purposes.

Trade data are sourced from BACI.¹¹ Based on COMTRADE, BACI includes a harmonization of classifications, a reconciliation of mirror declarations, and a treatment of unit values, in order to make them comparable and check their consistency. This results in a harmonized trade database at the HS6 level.

2.2 Calculating AVEs

The source information put together concerns various instruments, which cannot be directly compared or summed, and which are not all readily usable in large-scale modeling exercises. The natural solution to overcome these problems and to make the database fully operative for analytical purposes is to compute AVEs of each instrument.

¹⁰ *Ad valorem* equivalents of prohibitions were also taken into account in previous releases. Given their very limited number, however, this did not make significant changes.

¹¹ BACI is the French acronym for Base de données pour l'Analyse du Commerce International. For further details, see: <http://www.cepii.fr/anglaisgraph/bdd/baci/baci.pdf>

2.2.1 *Specific tariffs*

Specific tariffs were converted in AVE terms by dividing the duty by a unit value (UV).¹² The whole problem lies in the choice of the UV, and this raises important issues, both from a statistical and from a theoretical point of view.

Theoretically, specific tariffs have a more restrictive impact on unprocessed or low quality goods (see e.g. Feenstra and Boorstein, 1991). Arguably, the HS6 level already offers a significant product breakdown, allowing product heterogeneity to be relatively limited within each classification item. Still, large quality differences remain. As a matter of fact, following Abd-El-Rahman (1991), several empirical works have shown that, even at a far more detailed level of classification (Combined Nomenclature, 10 digits, including more than 10,000 products), unit values differences are able to reveal quality differences. Large-scale, systematic analyses have even shown that the corresponding vertical specialization is among the most salient features of trade between European countries (Fontagné, Freudenberg & Péridy, 1997; Greenaway and Torstensson, 2001). Also based on a very detailed analysis of US imports, Schott (2004) emphasizes the importance of "within-product" specialization, i.e. vertical differentiation along the quality ladder, as revealed by UV differences. Schott shows that "UVs within products vary systematically with exporter relative factor endowments and exporter production techniques" (*ibid.*, p. 647.)

This is not a secondary issue, given that vertical specialization of countries along the quality ladder has been shown to be widespread, and that poorer countries tend to specialise in lower quality goods. It means that the restrictive impact of specific tariffs may vary substantially across trade partners, depending on their quality specialization, and that their impact is likely to be systematically stronger on imports from developing countries.

From a statistical point of view, using bilateral UVs might seem appealing because it is fully consistent with the amount of tariff receipts collected, and because it allows the quality specialization of the corresponding trade flow to be taken into account. However, it is flawed with lack of robustness, thus introducing significant variance across AVE protection faced by different partners in the same market, often to a surprising extent.¹³ It is due in many instances to measurement errors, or even reporting errors (errors in the physical units reported, for instance). It also stems from the fact that small bilateral flows are not always representative, and are more prone to exhibit out-of-range UVs. In addition, it can only be implemented as such when imports did take place.¹⁴

¹² Alternative methods include an estimation based on price wedges, that is hardly tractable at the level of detail and coverage of this database. The "revenue" method, consisting in dividing tariff revenues by the value of imports, in addition to being difficult to implement, is clearly unfitted in the presence of preferential agreements (see e.g. WTO, 2003, for a discussion).

¹³ This method has been used in previous releases of MAcMap, and its use for analytical purposes proved to suffer from insufficient robustness.

¹⁴ Although this does not prevent from choosing an alternative rule when no imports took place.

Computing AVEs based on a worldwide import average, as for instance Gibson et al. (2001), is appealing in terms of robustness, but it completely disregards the question of quality differences.

Hence the choice of UVs must fulfil two purposes: reflecting the different restrictive impact of specific tariff according to the vertical specialization of the trade partners, exhibiting not excessive volatility. This need for an intermediate approach has led to base AVE calculations in MAcMap, on the median unit value of world-wide exports originating from a reference group the exporter belongs to. Each reporting country is affected to a reference group of similar countries. Reference groups are not only mobilized for the calculation of AVE of specific tariffs, but also for the purpose of aggregating tariffs (see section 2.3). These groups are defined on the basis of a hierarchical clustering analysis based on GDP per capita (in terms of PPP) and trade openness¹⁵. The five groups constituted as a result of this procedure can be loosely labeled as follows: (1) richest countries; (2) high openness, middle income countries; (3) low openness, middle income countries; (4) high openness, low income countries; (5) low openness, low income countries. The full set of countries and reference groups is provided in Appendix A1.

More specifically, this ERGUV (Exporter's Reference Group Unit Value) is calculated using "weighted" medians, obtained by assuming that each UV is repeated as many times as the underlying trade flow contains dollars.¹⁶ For the sake of robustness, UVs are computed based on three-year-average trade flows (across the 2000-2002 period). In addition, a filter rule is used. Any ratio of ERGUVs to the world median unit value outside the bracket $[1/3 ; 3]$ is truncated to the top or bottom limit.¹⁷ Moreover, a sequential procedure is used to fill missing values for reference groups: any blank is substituted by the value of the closer reference group.

Using this ERGUV offers four advantages:

- (i) the differences in unit values across countries, linked in particular to different products quality, is accounted for;
- (ii) the endogeneity bias (there is an incentive to alter product quality in response to a specific tariff) is lessened compared to a bilateral unit value, since the value is calculated based on worldwide exports;

¹⁵ It is a major change from the first release of MAcMap, in which reference groups were based on an arbitrary classification (GDP PPP per capita).

¹⁶ Using traded quantities as weights instead of trade flows could appear more consistent, but from a statistical point of view, the distribution of trade flows is more robust and less sensitive to measurement errors.

¹⁷ This is different from the method of filtering UVs used in previous releases, in which the unit value of the reference group was used instead.

(iii) more importantly, ERGUVs are more robust to measurement errors than BUVs: due to the use of median, outliers do not influence strongly the result, in contrast to a calculation based on the average.

On the one hand, one drawback with the use of ERGUV is that some information is lost relative to differences in product quality at the bilateral level. On the other hand, this quality information is only useful insofar as it is structural in nature, in which case we would expect it to remain relatively constant across reference groups (if not, it is likely that these differences are endogenous to protection). In particular, if unit values differ because of an exporter's cost-competitiveness, and not because of quality-related factors, then there is no point in computing a different AVE.

2.2.2 Mixed and compound tariffs

Mixed tariffs, i.e. tariffs involving a choice (a maximum or a minimum operator) between various terms raise the question of the term to be chosen. This choice is made without any calculation, using the following rules:

(a) when the tariff is defined as an *ad-valorem* base tariff, with in addition a cap and a floor (which are defined in specific terms), the base tariff is retained. If the base tariff is in specific terms and the cap and the floor are *ad-valorem*, a simple average of the two bounds is retained. This prevents from adding any additional noise through AVE calculation;

(b) when the tariff involves choosing between two terms, priority is given to *ad-valorem* tariffs¹⁸ for the same reason as previously;

(c) when the tariff is a choice between two compound tariffs, the second one is ignored. Additional elements are ignored.

2.2.3 Tariff rate quotas

When trying to summarize and harmonize the information about border protection, TRQs originate a number of problems. Due to their intrinsic nature, they cannot be perfectly summarized through an AVE, hence the question about the right way to handle them in multi-country, multi-product databases and models (see e.g. IATRC, 2001, Liapis and Blitz, 2001). Since TRQs are defined at very different levels of aggregation (from HS-4 to tariff line), their treatment must include a consistent (dis-)aggregation procedure. Keeping the basic information about IQTR, OQTR and quota as such, for instance, is not consistent with aggregation: the average IQTR and OQTR, combined with the sum of quotas, do not describe consistently the aggregate impact of various TRQs. Finally, another requirement is that the information produced could be conveniently combined with the tariff data, both for descriptive and statistical matters, as well as for incorporation in CGE analyses.

¹⁸ This means that if the tariff is the maximum between a compound tariff (the sum of a specific and an *ad valorem* tariff) and an *ad valorem* tariff, only the second term, i.e. the *ad valorem* tariff, is taken into account.

The methodology has been radically changed in MACMap-HS6v1, based on the idea that the calculation should reflect the marginal level of protection, as well as the rents involved, on a bilateral basis.¹⁹

Data on tariff quotas mainly comes from the AMAD database²⁰. The available information is: reporter, quota identification, product coverage, quota, imports, allocation of quotas, inside tariff, outside tariff²¹.

A fill rate is first computed for each TRQ, as the ratio of imports to the size of the quota itself.²² As soon as a quota involves a specified bilateral allocation, this fill rate is computed separately for each (group of) partner(s) which is allocated a separate quota. The shadow tariff is then defined as the *ad-valorem* tariff that would lead to the same level of imports as is observed under the tariff rate quota. Three market regimes are considered, depending on the level of the fill rate:

- 0 – If the fill rate is less than 90% (quota not binding), the inside quota tariff rate is chosen as the shadow rate.
- 1 – In the (90%,99%) range (quota assumed to be binding²³, OQTR prohibitive), a simple arithmetic average is used (except in a few cases where external information allows a better guess to be made).
- 2 – If it is higher than 99% (quota binding, OQTR not prohibitive), the shadow rate is equal to the outside quota tariff rate (OQTR).²⁴

¹⁹ In previous releases of MACMap, the AVE of tariff rate quotas (TRQs) was calculated as a trade-weighted average of inside- and outside-quota tariff rates. This method proved to understate significantly the real level of protection implied by TRQs. When out-of-quota imports are limited, in particular, it results in an AVE close to the inside-quota tariff rate (IQTR), while in fact this reflects the very high protection resulting from a high outside-quota tariff rate (OQTR).

²⁰ Thanks to Paul Gibson, for giving us these data.

²¹ Ad valorem equivalents of specific tariffs and of mixed tariffs (inside or outside the quotas) are calculated according to the same methodology as tariff barriers.

²² This fill rate is thus *not* restricted to being inferior or equal to one.

²³ The quota is assumed to be binding as soon as the fill rate exceeds 90%, since administration methods or other reasons might well prevent a small share of the quota from being used, even though the quota is actually binding.

²⁴ An apparently more logical approach would lead to chose the minimum of the outside rate and the applied rate. Nevertheless, due to the occurrence of tariff rate quotas on lines with tariff peaks within the HS6 position for which the applied tariff is defined, the difference between the inside rate and the minimum of the applied rate (at HS6 level) and the outside rate will poorly reflect the tariff gap that generates the rents. As outside rates and inside ones are defined at the same level, the chosen solution appears to be better.

In the case of missing data about the quota level and its fill rate, regime 2 is assumed but the rent is set to zero²⁵.

In the AMAD database, tariff quotas are sometimes defined at the HS4 level (about 30% of cases). In this situation, the applied rate, as defined by MACMap, is used at the HS6 level.

Finally the tariff quota database contains ten variables:

- 1) HS6
- 2) Reporter
- 3) Partner
- 4) IQTR (*ad-valorem* and specific components)
- 5) OQTR (*ad-valorem* and specific components)
- 6) Quantity allocated to the trading partner by the reporter (actual or estimated if the quota is defined at the HS4 level or if the quota is not country specific)
- 7) Market regime (0,1,2)
- 8) Unit value
- 9) Trade flows

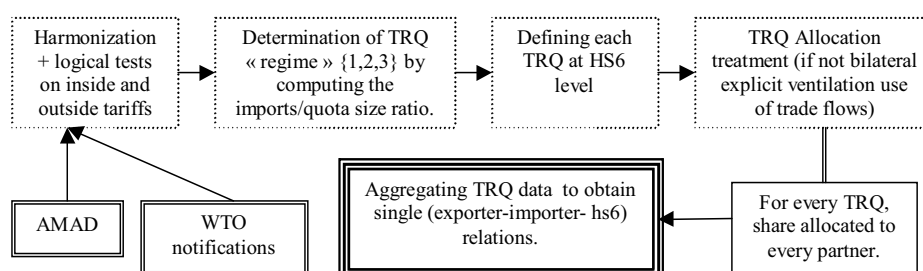
This database is then merged with MACMap, keeping information on AVE of tariff quota (*ad-valorem* and specific components), IQTR, market regime and allocated quota (for every reporter-partner-hs6 relation). Figure 1 sums up the whole procedure.

The quota rent is computed as follows:

$$rent = \text{Min} \left(uv \times q \times \frac{SR - IQTR}{1 + IQTR}, tradev \times \frac{SR - IQTR}{1 + SR} \right)$$

Where *uv* refers to the unit value, *q* to the quota allocated to the line, *tradev* to the trade value, *SR* to the shadow tariff rate, and *IQTR* to the inside quota tariff rate.

Figure 1: Tariff rate quotas treatment procedure



²⁵ In a few cases, like the Japanese tariff rate quotas on rice, a special treatment is made for dealing with “water in tariffs” and with the capture of the rents by national agents: regime 1 is assumed and rents are set to zero.

2.2.4 Prohibitive duties and “water in the tariff”

The presence of prohibitive tariffs is problematic when calculating AVEs with a view of using them for a CGE analysis. Indeed, prohibitive tariffs are seldom exactly equal to the lowest tariff that would drive import demand down to zero. Generally, there is “*water in the tariff*”, meaning that actual tariffs exceed this lowest level. This implies that a small tariff cut would not lead to any change in the corresponding trade flow. This is misleading for analytical purposes, since the study of the consequences of trade liberalization generally relies on the assumption that cutting tariffs systematically increases import demand. When the tariff is really prohibitive (*i.e.*, initial imports are zero), the problem is of a specific nature, in the sense that a standard CGE model cannot give any insight about the impact of liberalization: it needs to use initial imports as a basis for calibrating the import demand function (or the share coefficient of imports in the utility function.)

But initial demand is generally not zero in such analysis, for two reasons. Firstly, while in theory, by definition, there is no import for a product protected by a prohibitive tariff, in practice, non-zero trade flows are frequently recorded, even in presence of a tariff set at a prohibitive level. It results from the existence of very specific niches (within a given tariff line), or of the behavior of very specific consumers. However, these imports are generally very limited, they are not representative of the whole demand for the product, and their price responsiveness is almost zero (otherwise, this demand would not exist, given the initial level of the tariff.)

Secondly, CGE analysis does not use to be carried out at a very detailed level. Every sector aggregates a number of products. If one product is protected by a prohibitive tariff, then it will probably be aggregated with other products, with lower protection and significant initial imports. The AVE tariff duty calculated for the prohibitive tariff will then enter the average tariff computed for the sector if, as it is the case in MAcMap, this average is not import-weighted.

In both cases, this means that the presence of “*water in the tariff*” would lead to overstate the impact of a tariff cut. Correcting properly this bias would require removing the water in the tariff, *i.e.* replacing any prohibitive tariff by the lowest prohibitive tariff duty for the product concerned. This is far beyond the scope of this database. Therefore, we take the approach of establishing an upper limit to the AVE in the model starting at the HS6 level. This upper limit is set to 1,000% for the sum of all instruments. Practically, this upper bound is not applied in the source database, but it is used as a preliminary stage for any aggregation intended to feed a CGE model. In particular, it is applied when building the MAcMap for GTAP database.

2.3 Aggregation methodology

The most widespread methodology to aggregate tariffs is the import-weighted average. While easily calculated, this method suffers from well-known flaws, in particular because, everything being equal, the higher the tariff, the lower the import flow (in a proportion depending on the price-elasticity of import demand).

There is no obvious solution to address this issue. Simple averages are attractive in terms of ease of computation, but do not rest on any convincing foundation.. Using instead world imports as a weighting scheme, as proposed by Leamer (1974), avoids this endogeneity bias, but this measure fails to account for each economy's specificity. Other weighting schemes, like production or consumption shares, are not applicable at a detailed level, due to lack of data.

To sum up, existing aggregation methods include on the one hand atheoretical measures, largely recognized as significantly flawed and potentially misleading. On the other hand, theoretically based measures exist, but they are not applicable for a large-scale database such as MAcMap. Feenstra's approximation is an exception, but it relies on a hardly satisfactory assumption about import demand function. In addition, it is contingent on estimated Hicksian elasticities, which raises question as to the robustness of the aggregate measure computed. Finally, Feenstra's approximation concerns the TRI, a welfare-equivalent measure, while Anderson and Neary (2001) convincingly argue that an import-equivalent measure fits more closely the concerns of trade policy makers.

Against this background, our approach in choosing the aggregation methodology to be used as a tool for a systematic and large-scale analysis of protection is pragmatic. The methodology should avoid or minimize the endogeneity bias, while taking into account each economy's specificity and relying on available data at the detailed level of the nomenclature. For the sake of robustness, we would also like to avoid using estimated parameters in the aggregation. Finally, the methodology should be applicable on a large scale basis.

Based on these pre-requirements, the premise of our methodology is that an average weighted by free-trade imports is a suitable proxy for the Mercantilist Trade Restrictiveness Index (MTRI) proposed by Anderson and Neary (2001): see a simple theoretical justification in appendix 1.

However there is no possibility to infer the true free-trade imports from actual imports. Hypothesis could be made, like a constant elasticity of imports, but it is questionable that such assumptions allow to compute free-trade imports when protection is very high. Furthermore, the protection system is too complex to be summarized by a single measure. Some product may face a high *marginal* protection whereas a large quantity of goods is traded. It is therefore more cautious to base the weighting scheme on actual data. A compromise between the Leamer proposal to use world imports as a weighting scheme and using actual trade is to use imports from a reference group (RG) of similar countries. This is not a perfect solution since some products may be more protected than others in numerous countries. However it allows to account for prohibitive levels of protection.

A clustering based on PPP GDP per capita and trade openness allowed to identify 5 groups of similar countries (the list of countries is provided in appendix 2). Total imports by a group has to be normalized to account for the size of each country.

Practically, for each product–partner–reporter triplet, the following weight is used:²⁶

$$Weight_{i, partner, reporter} = M_{i, partner, RefGrp(reporter)} \frac{M_{\dots, reporter}}{M_{\dots, RefGrp(reporter)}}$$

Where $M_{i, partner, reporter}$ refers to the value of product i (defined at the HS6 level) imported by country "reporter" from country "partner", "RefGroup(reporter)" refers to the reference group the country "reporter" belongs to, and "." refers to the total, so that $M_{\dots, reporter}$ refers to the total value of "reporter"'s imports.

The last term, $\frac{M_{\dots, reporter}}{M_{\dots, RefGrp(reporter)}}$, only matters as long as data are aggregated among reporters. This normalization factor accounts for the fact that reporters as well as reference groups may differ in sizes. It means that, when aggregating across reporters (*i.e.*, importers) for a given partner (*i.e.*, exporter) and a given product, weights are normalized by the share of total imports from this reporter in total imports of its reference group, so that the size of the reference groups do not have any influence on the weights affected to the reporters, and thus properly proxy what would be free-trade imports.

It is noteworthy that, in using this weighting scheme to aggregate not only across products, but also across partners, we assume each partner to export a specific good, different from the ones exported by other partners. And we assume zero cross-price elasticities across these products.

In order to illustrate our methodology, we will compare our results with the aggregate protection level obtained as a result of the calculation of a MTRI based on the standard assumption of constant price-elasticity demand functions. Neglecting general equilibrium effects and ignoring cross-product substitution, imports are then $M_i = M_i^0 (1+t_i)^{-\sigma}$, where σ denotes the price elasticity of import demand, assumed to be equal across products. In this case, the MTRI τ^{CES} across a given set of products can be written as (see annex 1):

$$(1) \quad \tau^{CES} = \left(\frac{\sum_i M_i^0 (1+t_i)^{\sigma}}{\sum_i M_i^0} \right)^{1/\sigma} - 1$$

²⁶ The aggregation SAS program can be provided to the interested reader. The present methodology is a slight evolution of the methodology presented in Bouët *et al.* (2001, 2002), and used in previous releases of MAcMap.

This calculation overlooks product differences in terms of price-elasticity of import demand, but this is necessary in order to keep large-scale calculations tractable. The value of σ to be used in calculations is debatable. For the sake of illustration, in addition to unity (in this case, τ^{CES} is actually the import-weighted average), we will display the results of calculations for $\sigma=3$ and $\sigma=6$.

3 AN OVERVIEW OF PROTECTION PATTERNS ACROSS THE WORLD

The above-described database makes it possible to measure border protection across the world in consistent terms, accounting for *ad-valorem* and specific tariffs, as well as TRQs, and taking exhaustively into account preferential trade arrangements (PTAs). This section aims at brushing a broad picture of applied protection. General features of worldwide applied protection are first described. Differences between applied and MFN tariffs, and the importance of each type of instrument are then detailed. MAcMap figures are compared to the GTAP5 database on market access. Finally, informative figures on cumulative distribution of tariffs are exposed.

3.1 General features of worldwide applied protection

The first column of Table 2 reports the aggregate level of protection across all products, as calculated with our Reference Group (RG) methodology, for selected GTAP6 importing regions.²⁷ Among these selected countries, protection ranges from 2.3% (USA) to 33.5% (India). Calculated according to RG methodology, worldwide average level of protection is 5.6%. On average, protection is low in the richest countries, and does not exceed 4% in Quad countries.

It is well-known that agriculture is largely protected worldwide. This is confirmed by MAcMap data, as highlighted in the second column of Table 2. Average agricultural protection ranges from 2.7% in Australia to 59.6% in India in the sample displayed. The world average is 19.1%. Among Quad countries, the EU15 and Canadian agriculture are much more protected than the US one (resp. 17.9% and 14.9% vs 5.0%), but less than the Japanese one (35.3%).

Columns 3 and 4 indicate average protection for manufactures (except textile/apparel) and for textile/apparel. Manufacturing products outside textile and apparel are the less protected sector in average (4.2%). The contrast with agricultural products is especially striking in rich countries, in particular in Canada, the European Union, Japan, Korea and Switzerland. Trade in textile and clothing goods remains significantly restricted in most importing regions. Market access is severely restricted even in countries known for their comparative advantage in this activity (Bangladesh, China, India, Morocco, Tunisia). Protection in textile and apparel also remains large in Northern America, as compared to the EU (Canada:10.8%; USA: 9.4%; EU15: 5.7%)

²⁷ Regions have been selected in order to have a representative and diversified set of situations. The corresponding information is available for all countries included in MAcMap on http://www.cepii.fr/anglaisgraph/bdd/detailed_tables.xls

Table 2: Protection applied by country (2001)

	Total	By sector			By exporter		
		Agric.	Manuf.	Tex-Wea	LdC	Dvping Co.	Dvped Co.
World	5.6%	19.1%	4.2%	10.5%	4.9%	5.3%	5.7%
Argentina	12.6%	12.0%	12.4%	18.3%	7.7%	10.8%	13.1%
Australia	5.1%	2.7%	4.9%	14.2%	7.9%	5.6%	4.9%
Bangladesh	16.9%	20.9%	15.2%	29.7%	16.7%	20.2%	14.8%
Brazil	11.8%	11.0%	11.4%	18.1%	2.4%	9.4%	12.8%
Canada	3.4%	14.9%	2.1%	10.8%	5.8%	3.1%	3.5%
China	14.1%	25.0%	12.7%	20.4%	3.6%	12.9%	14.7%
European Union (15)	3.1%	17.9%	2.0%	5.7%	0.8%	2.7%	3.5%
India	33.5%	59.6%	29.9%	29.5%	28.3%	35.4%	32.5%
Japan	3.9%	35.3%	0.9%	6.8%	1.6%	3.9%	3.9%
Korea	9.2%	53.8%	5.5%	10.3%	10.1%	9.9%	8.9%
Madagascar	4.4%	5.5%	4.1%	4.7%	2.2%	4.6%	4.4%
Mexico	11.0%	28.2%	8.9%	14.5%	15.9%	17.9%	8.9%
Morocco	20.9%	40.1%	17.9%	33.9%	17.4%	25.0%	19.3%
Mozambique	9.9%	13.4%	8.3%	21.6%	10.0%	11.4%	9.1%
South Africa	8.4%	19.2%	6.5%	22.5%	5.8%	10.7%	7.7%
Switzerland	4.3%	43.3%	1.3%	4.0%	0.6%	4.0%	4.5%
Thailand	12.6%	28.0%	10.7%	18.1%	4.4%	12.8%	12.6%
Tunisia	20.3%	53.3%	16.5%	26.0%	9.4%	24.2%	18.9%
Turkey	6.0%	38.0%	2.6%	8.9%	3.3%	9.1%	4.9%
United States of America	2.3%	5.0%	1.7%	9.4%	5.1%	2.4%	2.3%
Vietnam	14.4%	26.0%	11.1%	31.1%	15.0%	16.6%	13.0%

Source: MacMap.

Columns 5 to 7 of Table 2 point out aggregate levels of each zone's protection, by exporters' group (developed countries, intermediate countries, Least Developed Countries – LDCs.) Several countries are granting LDCs preferential regimes, and this is indeed reflected in freer market access for LDCs in the European Union, Japan, and Switzerland. On the contrary, LDCs face higher average duties than other exporters in the USA, in Canada and in Australia, despite the specific preferential schemes they offer to LDCs. This is due to the product composition of LDCs exports,²⁸ and/or to higher *ad-valorem* equivalents of specific tariffs (since LDCs generally exhibit low export unit values). In the case of USA, for 2001, AGOA is only conceded to a few LDCs²⁹.

The database can also be used in order to shed light on the average protection faced by a country's exports. This is illustrated in Table 3 for the same sample of countries. The corresponding figures are the result of the specialization of countries and of the preferential regimes they benefit from, if any. Argentina (13.5%) and Brazil (11.0%), as a result of their large specialization on agricultural products, do face the highest level of protection among

²⁸ Many LDCs are specialised in highly protected product worldwide, in particular in agriculture and in textile and clothing.

²⁹ A decomposition of applied protection by sectors and partners groups is available on the CEPII website (http://www.cepii.fr/anglaisgraph/bdd/detailed_tables.xls)

our sample. This situation contrasts with the one of Mexico (2.3%), benefiting from preferential access to the NAFTA (only 1.9% faced on developed economies markets).

Table 3: Protection faced by exporting country (2001)

	Total	By sector			By importer		
		Agric.	Manuf.	Tex-Wea	LdC	Dvping Co.	Dvped Co.
World	5.6%	19.1%	4.2%	10.5%	12.8%	11.5%	3.4%
Argentina	13.5%	18.6%	9.7%	11.4%	11.8%	17.1%	7.2%
Australia	8.9%	24.6%	4.0%	8.3%	8.7%	13.4%	7.0%
Bangladesh	5.3%	9.5%	5.2%	6.0%	13.0%	11.1%	4.8%
Brazil	11.0%	23.5%	6.0%	12.3%	13.8%	18.7%	6.4%
Canada	4.2%	16.4%	3.3%	6.0%	9.6%	9.9%	3.6%
China	5.8%	18.4%	4.2%	11.2%	16.1%	15.8%	4.2%
European Union (15)	6.1%	18.6%	4.6%	10.1%	12.4%	11.9%	4.0%
India	7.5%	19.7%	5.0%	10.3%	13.8%	13.6%	4.9%
Japan	6.1%	13.9%	5.9%	13.4%	12.4%	12.2%	3.5%
Korea	6.9%	16.0%	6.1%	14.0%	12.0%	12.9%	3.3%
Madagascar	4.3%	4.8%	3.5%	5.4%	15.1%	10.5%	3.6%
Mexico	2.6%	11.8%	2.1%	4.4%	16.2%	11.2%	1.9%
Morocco	5.4%	11.5%	4.5%	6.9%	12.9%	12.6%	4.0%
Mozambique	5.5%	25.1%	2.4%	7.4%	13.0%	16.9%	2.0%
South Africa	6.7%	19.6%	5.1%	10.3%	13.0%	16.1%	2.1%
Switzerland	3.2%	16.8%	2.7%	5.2%	8.2%	10.4%	1.4%
Thailand	8.2%	33.4%	4.7%	11.3%	14.4%	14.6%	6.1%
Tunisia	5.8%	23.4%	4.6%	6.0%	12.6%	14.2%	4.3%
Turkey	7.3%	12.7%	6.3%	7.3%	16.7%	17.5%	4.1%
United States of America	5.8%	19.3%	4.3%	11.7%	11.4%	9.0%	3.6%
Vietnam	7.3%	12.6%	4.9%	9.8%	9.7%	11.4%	6.2%

Source: MacMap.

The comparison of Tables 2 and 3 highlights a very specific pattern of world protection: LDCs impose an average 12.8% tariff on their imports, but do face an average 4.9% on their exports. In the same way, developing economies impose 11.5% and face 5.3%. In contrast, developed economies impose 3.4% but face 5.7% only. It means that on a worldwide basis, trade preferences are globally granted to lower-income countries, which are at the same time the most protected group of countries.

Even a broad picture as the one brushed above shows that countries are discriminating across products and across partners, in particular as a result of various preferential schemes and of tariff peaks. This is confirmed by a more detailed analysis. The first column of Table 4 shows the coefficient of variation in the power of the tariff ($1+t$) across partners for each importer of our sample.³⁰ Unsurprisingly, EU15 is among the most discriminating importer across partners. But Mexico, Korea and to a lesser extent China, Japan and the US are also significantly discriminating across partners. As far as differences across products are concerned, Japan exhibits the highest variation of protection, due to specific features of its agricultural protection (e.g.: rice). It is followed by Korea and the EU15. Some developing

³⁰ The power of the tariff is an appealing metric, since differences in the power of tariffs are proportionally reflected, ceteris paribus, in consumer prices.

countries, such as Mozambique or Madagascar have a rather “flat” protection scheme, hardly discriminating across products.

Table 4: Coefficient of variation in the power of the applied tariff (2001)

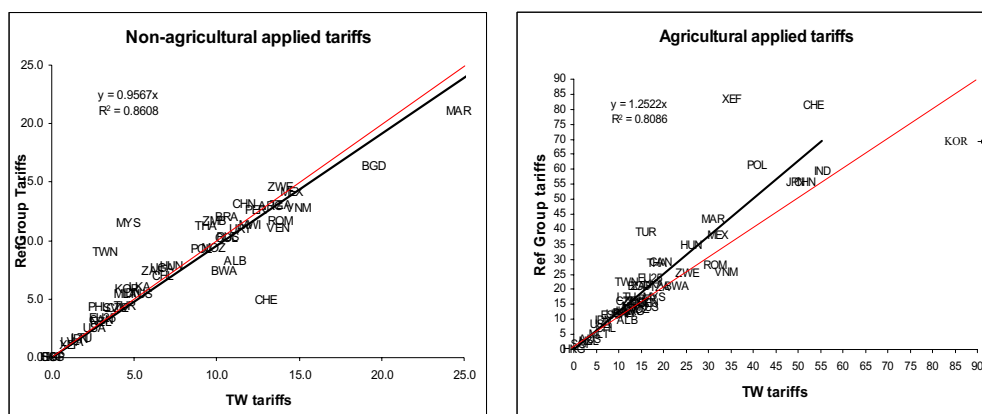
	Across Partner	Across Product
Argentina	21.01	9.60
Australia	35.76	23.97
Bangladesh	23.62	11.63
Brazil	44.66	19.88
Canada	68.65	63.03
China	119.95	89.28
European Union (15)	177.41	131.40
India	76.52	49.85
Japan	112.10	176.45
Korea	116.55	164.57
Madagascar	2.77	1.48
Mexico	190.21	67.26
Morocco	35.12	22.94
Mozambique	6.16	3.61
Norway	66.29	80.76
South africa	49.02	27.66
Switzerland	80.28	88.20
Thailand	55.23	40.20
Tunisia	41.78	22.49
Turkey	77.13	46.39
United states of america	102.96	56.84
Vietnam	35.36	24.57

Source: MAcMap

Note: Coefficients of variation across products is computed by first calculating the average applied tariff across partners for each product. Coefficients of variations across partners are computed within each product (as is done in a standard within-between decomposition of variance). All coefficients of variation are computed using MAcMap’s weighting scheme.

The distribution of tariffs for agricultural and non-agricultural products is provided in Appendices 3 and 4 for selected countries corresponding to differentiated protection patterns. This frequency is calculated using two alternative weighting schemes: RG and import shares. For instance, free agricultural imports account for 70.7% of Australian imports, much above the 62.9% for the Reference Group Australia belongs to. Accordingly, average protection within agriculture for Australia is slightly larger using RG weighting scheme. In the same way; 26.1% of Norwegian agricultural imports do face tariffs above 100% using the RG metric: this is 5% more than the share of the corresponding products in Norwegian imports.

Graph 1: Comparison between the Trade Weighted and the Reference Group Methodologies



Source: MAcMap

Note : Grey line : $x=y$

Black line : regression $y=a x$; R^2 and value of a is displayed on each plot

Following these remarks on the distribution of tariffs, Graph 1 displays the consequences of using these two weighting schemes (RG and bilateral trade flows) on the average tariffs for agricultural and non-agricultural tariffs. Agricultural protection is the most interesting case. Broadly speaking, the reference group weighting scheme leads to a higher protection rate, as it could be expected, especially for the EFTA countries and for the European Union due to the presence of tariff peaks, but also for Mexico where the trade weighted average understates real protection by overweighing intra-NAFTA trade relationships. Nevertheless, for some countries such as Korea, the existence of large, unfilled TRQs (under regime 1) allows to have simultaneously strong trade flows (that take place under the inside rate) and a high marginal protection rate. In this case, the trade weighted average overstates protection, while the reference group approach is more robust.

3.2 Applied versus MFN tariffs and decomposition by instrument

Up to recently, CGE simulation exercises tackling the impact of multilateral trade liberalization episodes have relied almost exclusively on MFN tariffs. MAcMap allows this approximation to be assessed, by making possible a systematic, worldwide analysis of the difference between applied and MFN tariffs to be carried out. This is done in Table 5 for agricultural products, while considering separately *ad-valorem* and specific tariffs (Appendix 5 reports similar results for non-agricultural products). MFN and applied duties often appear to be fairly similar, most of all in developing countries (see e.g. Bangladesh and Vietnam). But the difference turns out to be very large in several instances. In Switzerland, for instance, the average AVE MFN specific tariffs in agriculture is 81.1%, to be compared to an average AVE applied duty of 43.1%. Average AVE applied duties (summing *ad-valorem* and AVE specific duties) also amount to approximately half the MFN duties in the EU, Japan, and the US. The case of China is particular, since the rather

large gap between applied and MFN duties stems from unfilled TRQs,³¹ the AVE of which is assessed to be the IQTR for applied tariff, and the OQTR for MFN tariffs.

Table 5: Applied and multilateral protection for agricultural products, by instrument (2001)

	Applied Tariff		MFN Tariff		Trade (Mios USD)	Rents (Mios QTR)	Tariff Quotas
	Ad Valorem	Ad V. Eq. of Specific Comp.	Ad Valorem	Ad V. Eq. of Specific Comp.			
Argentina	12.0%	0.0%	12.7%	0.0%	960.2	0.0	N
Australia	1.4%	1.3%	1.5%	1.6%	2758.5	0.0	Y
Bangladesh	20.8%	0.0%	20.8%	0.0%	1092.8	0.0	N
Brazil	10.9%	0.0%	11.9%	0.0%	3488.6	0.3	Y
Canada	13.6%	1.2%	27.9%	1.0%	11650.0	366.7	Y
China	24.9%	0.0%	55.3%	0.0%	8803.8	0.0	Y
European Union (15)	4.9%	12.9%	6.5%	17.0%	52719.5	1602.8	Y
India	58.7%	0.3%	58.8%	0.3%	3626.4	0.0	N
Japan	8.7%	26.4%	10.2%	45.1%	30273.4	1132.0	Y
Korea	53.5%	0.0%	69.9%	0.0%	7601.3	1011.5	Y
Madagascar	5.5%	0.0%	6.1%	0.0%	96.1	0.0	N
Mexico	27.0%	1.2%	36.6%	1.2%	9680.0	696.8	Y
Morocco	39.9%	0.0%	43.2%	0.0%	1417.9	96.4	Y
Mozambique	13.4%	0.0%	13.5%	0.0%	288.9	0.0	N
Norway	8.7%	63.2%	4.0%	79.3%	2024.2	23.0	Y
South africa	7.8%	11.3%	8.6%	12.2%	1948.2	159.5	Y
Switzerland	0.0%	43.1%	0.0%	81.1%	4803.0	559.8	Y
Thailand	19.2%	8.7%	19.3%	9.0%	2699.9	101.1	Y
Tunisia	52.9%	0.0%	55.7%	0.0%	815.2	127.8	Y
Turkey	37.6%	0.1%	38.8%	0.1%	2786.8	0.0	N
United states of america	1.8%	3.3%	3.3%	5.0%	43384.4	408.0	Y
Vietnam	25.5%	0.0%	25.5%	0.0%	1101.0	0.0	N

Source: MAcMap

Table 5 also shows that *ad-valorem* duties are generally the main protective instrument in agriculture, but the impact of specific duties is greater in the European Union, Japan and Norway. In Switzerland, all tariffs are expressed in specific terms.

Another original contribution of MAcMap is to pave the way for a worldwide, systematic analysis of TRQs. 32 importing zones are found to be administrating tariff quotas in 2001, and our estimation of the value of TRQ rents in agriculture is reported in Table 5. TRQs rents are especially large in European Union, Japan and Korea. The worldwide amount of quota rents is about USD 6.79 bn, as calculated by MAcMap.

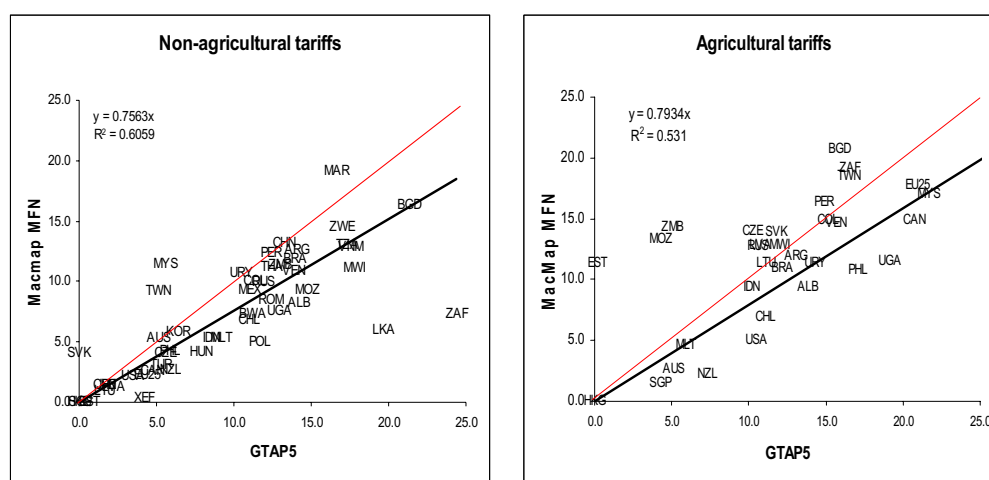
3.3 MAcMap vs. other databases

In assessing how the results found in MAcMap differ from other databases, the GTAP 5 dataset offers a useful point of comparison, since it also provides with a worldwide coverage for all products, and since this database has been used as a basis for virtually all recent CGE assessments of multilateral liberalization. GTAP 5 makes use of AMAD 1998

³¹ The Chinese TRQ for soybean is especially large, and accounts for a significant part of this difference.

data for agriculture, and of TRAINS³² 1997 data for non agricultural products. As outlined above (see in particular Table 1), and in addition to the difference in the period of reference, methodological differences between these datasets and MACMap abound. Still, it is interesting to make clear how GTAP 5 average duties differ from our assessment of average MFN AVE tariffs in MACMap, at the country level (Graph 1).

Graph 2: Comparison between MACMap MFN tariffs (RG aggregation) and GTAP5 data set (Trade Weighted average)



Source: MACMap and GTAP 5

Note : Grey line : $x=y$

Black line : regression $y=a x$; R^2 and value of a is displayed on each plot.

For agricultural tariffs, Norway, Switzerland and Romania have been excluded from the regression dataset to their extreme values. Some countries such as Japan and Korea are outside the range of the graph. Details are given in Table 5.

Comparing GTAP5 and MACMap average AVE duties by country does not highlight a systematic bias. Countries are equally located on the two sides of the $x=y$ line. Nevertheless, the assessment of sector protection may hugely differ between databases in a few cases, as illustrated for instance by agriculture in Estonia, Mozambique and Zimbabwe. More importantly, these two measures appear to be very poorly correlated across countries (the R-square of the bivariate regression is 57% for non-agricultural products, and only 16% for agricultural products). The change in protection between 1997 (or 1998 in agriculture) might explain this mismatch, but only for a small part. We argue that this poor

³² As available through WITS interface.

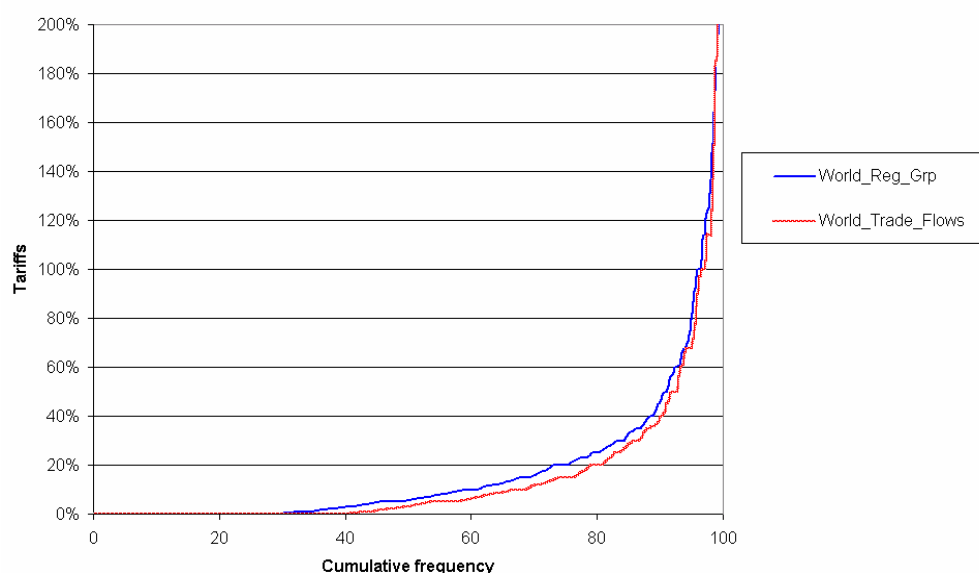
³³ The comparison with GTAP5 is made using MFN tariffs, since GTAP5 does not take into account preferential agreements, except the EU, the EU-EFTA agreement, ANZCERTA, SACU and NAFTA. On these two figures, GTAP 5 country codes are used.

correlation illustrates the value added brought about by the deep data and methodological improvements involved in constructing MAcMap.

3.4 Cumulative distribution of tariffs

A synthesis of the information contained in the database as well as an illustration of the peculiarities introduced by our assumptions can be proposed using the cumulative distribution of tariffs at the HS6 level. This is done in Graph 3 through 5.

Graph 3: Global cumulative frequency using alternative metrics (trade flows or reference group weights) for agricultural products, 2001



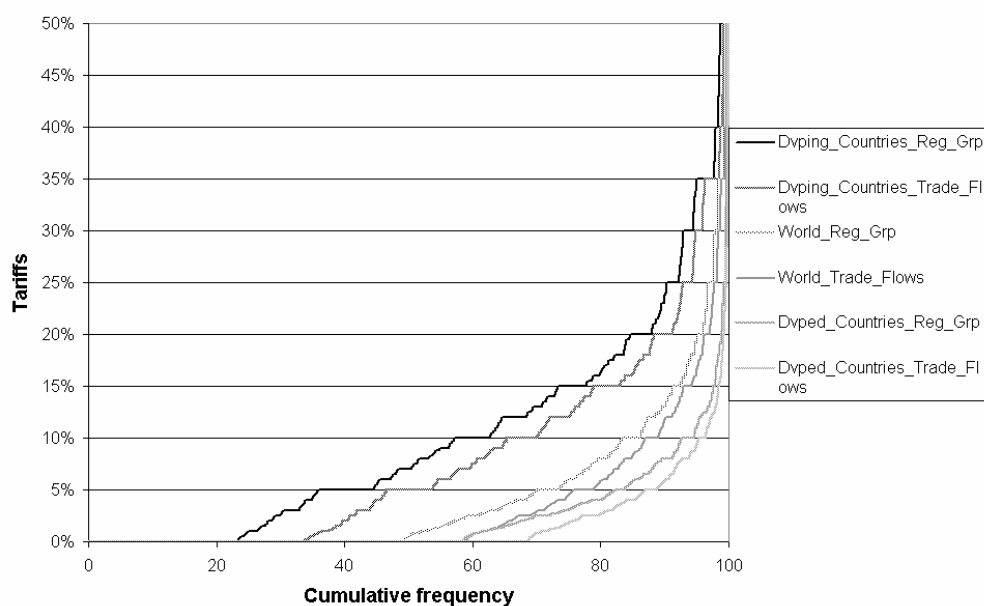
Source: MacMap.

Note: For the sake of readability, we do not include in this graph the distributions for developed and developing countries as in graph 4. Indeed, the curves are very close and follow the same order than in graph 4.

A specificity of MAcMap is to allow for a reference group weighting scheme. It is often asked whether this dramatically changes the brushed picture of protection. Graph 3 draws the distribution of world average tariffs for agricultural products, using two different metrics: MAcMap RG weights (World_Reg_Grp), and usual bilateral trade weights (World_Trade_Flows). Graph 3 draws the same distribution for manufacturing goods. These graphs illustrate the understatement of protection when using bilateral trade weights. The difference between these two curves is not large for agricultural products although, for instance, the share of duty-free imports is found to be approximately 30% using MAcMap's weighting scheme, as compared to around 40% when referring to bilateral imports. The difference is slightly higher for manufacturing goods. In both cases, however, and whatever

the metric used, these graphs also highlight the strong skewness of protection across the world, with a small proportion of world products and markets accounting for a large part of world average protection. This is especially clear in agriculture, and this finding suggests that granting even limited flexibility (as measured through the number of goods) can strongly undermine the impact of any liberalization agreement.

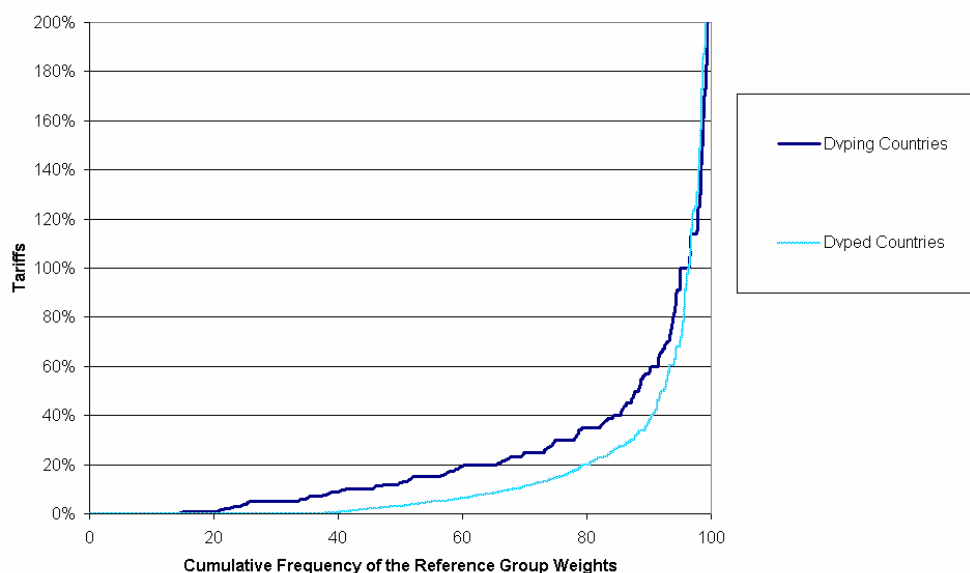
Graph 4: Cumulative frequency for manufacturing goods (2001)



Source: MacMap.

Graph 4 compares the cumulative frequency of tariffs on agricultural products for developing countries and developed countries. While the former countries impose higher import duties on a very large part of items, the cumulative frequency curve of developed countries is upper in the [95%;100%] area. The concentration of very high tariff peaks on a narrow range of agricultural products is thus especially pronounced in rich countries,. This is consistent with the existence of a relatively small number of sensitive products excluded by rich countries from most liberalization agreements, whether multilateral or preferential.

**Graph 5: Cumulative frequency for developing and developed countries
(Agricultural products, 2001)**



Source: MAcMap

4 CONCLUSION

The MAcMap database, developed jointly by ITC (UNCTAD-WTO, Geneva) and CEPII (Paris), represents an unprecedented effort to monitor border protection world-wide at the most detailed level, while accounting exhaustively for preferential trade agreements. Such a far-reaching effort to collect and process proper information also requires well-suited methodological choices, in order to be able to summarize it at a more aggregate level. This article endeavors to make clear what these choices are, by describing in detail the methodology used in MAcMapHS6 version 1 at the HS6 level. This methodology has been designed for analytical purposes, and in particular with the view of using it as a basis for CGE modeling. It is now used as an input for the GTAP 6 database.

A value added of this database is to provide *ad-valorem* equivalent computed at the detailed level. This proves to be of particular relevance in the agricultural sector where most of protection comes from specific tariffs. For instance, the average applied rate of Norway on agricultural products is 71.9% out of which 63.2 % comes from the *ad-valorem* equivalent of the specific components.

Another value added is to provide bilateral applied protection: this sheds light on the highly differentiated conditions of market access for developing economies. Preferential schemes conceded by certain importers strongly discriminate in favor of these countries. If the

overall protection of European Union is 3.1 %, least developed countries face an average rate of 0.8%..

Incidentally, the combination of the two previous elements can lead to unexpected results for instance a country supposed to be preferred on a given market suffers from the low unit value of its exports in a sector characterized by the presence of specific tariffs. Mozambique, a LDC supposed to be preferred, faces an average tariff of 25.1% for agricultural products, 6 % above the world average.

In addition to presenting a new database, this paper has proposed a new strategy of tariff aggregation. In order to minimize endogeneity biases, while taking into account the economic specificities as well as the lack of data at the detailed level, we have relied on a weighting scheme using reference groups. This method leads to a higher average rate of protection than a weighting scheme using imports.

In negotiating future liberalization agreements, such as in particular those contemplated in the ongoing Doha Round, we believe that MAcMap can be a useful tool, and pave the way for better informed policy decisions.

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6 APPENDICES

APPENDIX 1: A SIMPLE THEORETICAL JUSTIFICATION OF THE REFERENCE GROUP WEIGHTING SCHEME.

From a theoretical point of view, Anderson and Neary (1996, 2001) have shown how the aggregate level of protection should be defined, depending on the criterion chosen. The Trade Restrictiveness Index (TRI) is a general-equilibrium "welfare-equivalent" aggregate measure of protection, while the Mercantilist TRI is a general-equilibrium "import-equivalent" aggregate measure. We take the "Mercantilist preoccupation with the volume of trade" (Anderson and Neary, 2001) as decisive in policy formation and as consistent with the GATT-WTO framework: as emphasized by Anderson and Neary (2001), this approach is consistent with the WTO definition of retaliation measures, which is based on the equivalence of the volume of trade displaced. So our measure should be consistent with MTRI measure of aggregate protection.

Ignoring general equilibrium effects (that is, assuming constant production and revenue), we consider a "small" country, with import demand functions exhibit constant price semi-elasticity, and zero cross-price elasticities. γ_i is the price semi-elasticity of imports of good i :

$$(1) \quad \gamma_i = - \frac{(M_i - M_i^0)}{M_i^0 t_i}$$

where M_i refers to imports of good i , superscript 0 refers to free-trade, and t_i is the *ad valorem* tariff on i . From (1) imports of good i are: $M_i = M_i^0 (1 - \gamma_i t_i)$.

The MTRI is the level of uniform tariff τ , applied to all imports, which generates the same level of import volume as the real tariff structure (t_1, t_2, \dots, t_n) . As free-trade prices are normalized to unity, τ is defined as:

$$(2) \quad \tau : \sum_i M_i^0 (1 - \gamma_i t_i) = \sum_i M_i^0 (1 - \gamma_i \tau)$$

Hence:

$$(3) \quad \tau = \frac{\sum_i M_i^0 \gamma_i t_i}{\sum_i M_i^0 \gamma_i}$$

We finally suppose that the constant price semi-elasticity is equal across products: $\gamma_i \equiv \gamma$, so that this expression collapses to a very simple one: the MTRI is exactly equal to the free-trade import-weighted average.

Our second important assumption is that the sector structure of imports of a group of "similar" countries is an appropriate proxy for the free-trade sector structure of imports of a given country. As soon as protection patterns are not systematically related across countries, there ought not to be any systematic bias in the sector structure of imports for a large group of countries. Still, free-trade imports might differ due to differences in demand patterns. This is why the proxy for free-trade imports shall not be computed on a worldwide basis, but only for similar countries: hence the approach based on reference groups, previously defined by a statistical clustering based on GDP per capita and trade openness. We choose to use five reference groups. Using a higher number of groups would allow countries specificities to be better taken into account. But a small number of large groups allows the protection pattern of each country being diluted in a large set of countries, thus limiting the extent of the endogeneity of weights to the tariffs of each individual country.

APPENDIX 2: COUNTRIES IN MACMAP AND REFERENCE GROUPS
Group A

American samoa	Gibraltar	Northern mariana islands
Andorra	Greece	Norway
Anguilla	Greenland	Oman
Aruba	Guam	Palau
Australia	Hong kong	Poland
Austria	Hungary	Portugal
Bahamas	Iceland	Puerto rico
Bahrain	Ireland	Qatar
Barbados	Israel	San marino
Belgium	Italy	Singapore
Bermuda	Japan	Slovakia (slovak republic)
Canada	Korea	Slovenia
Cayman islands	Kuwait	Spain
Cook islands	Latvia	St. pierre and miquelon
Cyprus	Liechtenstein	Sweden
Czech republic	Lithuania	Switzerland
Denmark	Luxembourg	Taiwan
Estonia	Macau	Turks and caicos islands
Falkland islands	Malta	United arab emirates
Faroe islands	Marshall islands	United kingdom
Finland	Mayotte	United states of america
France	Micronesia	Virgin islands (british)
French guiana	Netherlands	Virgin islands (u.s.)
French polynesia	New caledonia	Wallis and futuna island
Germany	New zealand	

Group B

Antigua and barbuda	Croatia	Saint kitts and nevis
Argentina	Grenada	Saudi arabia
Belarus	Malaysia	Seychelles
Botswana	Mauritius	South africa
Brunei darussalam	Mexico	Trinidad and tobago
Chile	Netherland antilles	Uruguay
Costa rica	Russian federation	

A consistent, ad-valorem equivalent measure of applied protection across the world

Group C

Albania	Fiji	Panama
Algeria	Gabon	Paraguay
Angola	Georgia	Peru
Armenia	Guatemala	Philippines
Azerbaijan	Guyana	Romania
Belize	Indonesia	Saint lucia
Bosnia and herzegovina	Iran	Saint vincent and the grenade
Brazil	Jamaica	Samoa
Bulgaria	Jordan	Sri lanka
Cape verde	Kazakstan	Swaziland
China	Kyrgyzstan	Syrian arab republic
Colombia	Lebanon	Thailand
Cuba	Libyan arab jamahiriya	Tonga
Dominica	Macedonia	Tunisia
Dominican republic	Maldives	Turkey
East timor	Morocco	Turkmenistan
Ecuador	Myanmar	Ukraine
Egypt	Namibia	Vanuatu
El salvador	Nauru	Venezuela
Equatorial guinea	Palestinian territory	Yugoslavia

Group D

Afghanistan	Honduras	Papua new guinea
Bangladesh	India	Rwanda
Bolivia	Iraq	Sao tome and principe
Cambodia	Kiribati	Senegal
Cameroon	Korea, dem. people's re	Solomon islands
Central african republic	Lao people's democratic	Suriname
Comoros	Lesotho	Togo
Côte d'ivoire	Mauritania	Uganda
Djibouti	Moldova, rep.of	Uzbekistan
Gambia	Mongolia	Viet nam
Ghana	Nepal	Western sahara
Guinea	Nicaragua	Zimbabwe
Haiti	Pakistan	

Group E

Benin	Guinea-bissau	Sierra leone
Bhutan	Kenya	Somalia
Burkina faso	Liberia	Sudan
Burundi	Madagascar	Tajikistan
Chad	Malawi	Tanzania
Congo	Mali	Yemen
Congo (democratic republic)	Mozambique	Zambia
Eritrea	Niger	
Ethiopia	Nigeria	

APPENDIX 3: DISTRIBUTION OF TARIFFS FOR AGRICULTURAL PRODUCTS

	Frequency as a share in RG weighting scheme				Frequency (Share in trade)			
	Free	]0-30%]	30%-100%	]100%-+]	Free	]0-30%]	30%-100%	]100%-+]
Argentina	7.4	92.6	0.0	0.0	5.2	94.8	0.0	0.0
Australia	62.9	37.1	0.1	0.0	70.7	28.9	0.5	0.0
Bangladesh	11.1	50.4	38.6	0.0	10.8	41.8	47.4	0.0
Brazil	11.7	88.1	0.2	0.0	4.9	94.6	0.4	0.0
Canada	46.4	41.3	5.6	6.8	54.8	37.8	4.2	3.2
China	1.2	71.2	21.7	5.8	2.5	75.3	21.9	0.2
European Union (15)	34.7	48.3	13.7	3.3	47.0	42.3	8.8	2.0
India	0.7	6.8	88.2	4.3	3.9	4.8	87.7	3.6
Japan	23.4	53.8	14.2	8.7	30.8	53.9	8.0	7.3
Korea	1.0	69.0	21.7	8.3	2.5	73.4	15.6	8.6
Madagascar	34.8	65.2	0.0	0.0	30.1	69.9	0.0	0.0
Mexico	10.4	69.9	14.1	5.6	6.1	85.2	5.3	3.4
Morocco	2.3	45.4	43.5	8.8	2.6	28.7	63.8	4.9
Mozambique	2.6	97.4	0.0	0.0	4.8	95.2	0.0	0.0
Norway	29.2	29.4	15.3	26.1	31.9	30.7	16.4	20.9
South africa	22.8	60.2	12.6	4.3	36.6	56.8	5.7	1.0
Switzerland	17.6	47.6	20.8	13.9	30.3	40.6	18.8	10.3
Thailand	2.2	69.9	27.7	0.2	3.8	59.4	36.6	0.3
Tunisia	12.0	33.6	42.6	11.8	5.7	25.1	44.6	24.6
Turkey	20.3	44.7	22.7	12.3	13.9	47.4	30.3	8.3
United states of america	31.6	66.1	2.3	0.0	45.8	52.2	1.9	0.0
Vietnam	12.5	56.0	31.5	0.0	10.7	55.5	33.8	0.0

APPENDIX 4: DISTRIBUTION OF TARIFFS FOR NON-AGRICULTURAL PRODUCTS

	Frequency as a share in RG weighting scheme				Frequency (Share in trade)			
	Free	]0-15%]	15%-50%	]50%-+]	Free	]0-15%]	15%-50%	]50%-+]
Argentina	5.9	45.7	48.3	0.0	3.1	33.5	63.4	0.0
Australia	41.3	49.1	9.5	0.1	36.5	56.2	7.3	0.0
Bangladesh	9.9	51.4	38.7	0.0	5.5	44.8	49.7	0.0
Brazil	12.3	53.4	34.3	0.0	3.9	44.8	51.3	0.0
Canada	58.9	36.3	4.8	0.0	50.2	39.9	9.9	0.0
China	8.7	63.2	25.7	2.3	1.9	56.2	41.3	0.6
European Union (15)	57.1	42.0	0.9	0.0	73.5	25.8	0.7	0.0
India	1.8	15.9	79.4	2.8	0.9	5.2	93.2	0.7
Japan	74.3	24.8	0.9	0.0	63.8	35.4	0.8	0.0
Korea	18.6	80.7	0.7	0.0	7.3	91.1	1.5	0.0
Madagascar	32.5	65.7	1.8	0.0	37.6	58.4	4.0	0.0
Mexico	24.8	46.0	29.2	0.0	6.5	38.7	54.8	0.0
Morocco	10.6	35.1	54.3	0.0	6.4	27.2	66.4	0.0
Mozambique	6.1	73.5	20.4	0.0	4.6	65.7	29.7	0.0
Norway	96.9	2.8	0.3	0.0	94.6	4.3	1.1	0.0
South africa	51.5	31.0	17.5	0.0	47.0	27.9	25.1	0.0
Switzerland	74.5	24.7	0.6	0.1	66.4	31.1	2.3	0.1
Thailand	16.0	57.0	23.8	3.2	3.0	51.2	41.8	4.1
Tunisia	20.6	20.8	58.6	0.0	18.7	9.6	71.8	0.0
Turkey	52.0	44.3	3.2	0.5	42.4	52.6	3.2	1.8
United states of america	53.7	43.9	2.4	0.0	51.0	44.5	4.3	0.2
Vietnam	29.2	44.9	22.7	3.2	33.1	28.8	37.0	1.1

**APPENDIX 5: APPLIED AND MULTILATERAL PROTECTION
FOR NON-AGRICULTURAL PRODUCTS**

	GTAP5	Applied tariffs		MFN tariffs	
		Ref.Group	Trade Wei.	Ref.Group	Trade Wei.
WORLD		4.5%	3.6%	5.3%	5.1%
Argentina	14.0%	12.6%	10.0%	12.9%	13.2%
Australia	5.2%	5.3%	5.4%	5.4%	5.4%
Bangladesh	21.3%	16.3%	19.5%	16.3%	19.5%
Brazil	14.0%	11.9%	9.9%	11.9%	10.6%
Canada	4.7%	2.5%	0.8%	3.1%	3.0%
China	13.2%	13.1%	11.6%	13.1%	11.6%
European Union (15)	4.4%	2.3%	1.5%	3.3%	3.0%
India	22.0%	29.8%	27.4%	29.9%	27.5%
Japan	1.8%	1.4%	1.4%	1.6%	1.6%
Korea	6.4%	5.8%	4.5%	5.8%	4.5%
Madagascar	N.A.	4.2%	4.1%	4.3%	5.0%
Mexico	11.0%	9.3%	4.3%	14.1%	14.5%
Morocco	16.6%	19.1%	20.5%	21.1%	24.6%
Mozambique	14.7%	9.3%	9.3%	9.3%	9.8%
Norway	N.A.	0.3%	0.1%	1.0%	1.1%
South africa	24.4%	7.3%	5.7%	7.4%	6.1%
Switzerland	1.6%	1.4%	2.1%	4.9%	13.0%
Thailand	12.4%	11.2%	9.3%	11.2%	9.3%
Tunisia	N.A.	17.3%	12.6%	21.0%	23.7%
Turkey	5.3%	3.1%	1.4%	4.4%	4.4%
United states of america	3.5%	2.1%	1.6%	2.5%	2.6%
Vietnam	17.5%	12.8%	14.9%	12.8%	14.9%

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