Trade policy, quality and environment: an application to the European Union-Mercosur trade negotiations

Maria Priscila Ramos

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THESE

Pour obtenir le grade de

Docteur

de

l'Institut des Sciences et Industries du Vivant et de l'Environnement (Agro Paris Tech)

Spécialité : Sciences Economiques

présentée et soutenue publiquement par

Maria Priscila RAMOS

le 24 septembre 2007

Politique Commerciale, Qualité et Environnement: une Application aux Négociations Commerciales entre l'Union Européenne et le Mercosur.

Directeur de thèse : **Pr. Jean-Christophe BUREAU**

Travail réalisé : INRA, UMR210, Economie Publique, F-75005, Paris

Devant le jury :

Pr. David BLANDFORD	Penn State University, Rapporteur
Pr. Antoine BOUET	Université de Pau, Rapporteur
Pr. Jean-Chritophe BUREAU	AgroParisTech, Examinateur
Pr. Lionel FONTAGNE	Université Paris I Sorbonne-Panthéon, Examinateur
Pr. Luca SALVATICI	Université de Molise, Examinateur

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Remerciements

Je tiens tout d'abord à remercier le directeur de cette thèse, M. Jean-Christophe Bureau, pour m'avoir fait confiance pendant ces quatre ans de travail au sein de l'UMR Economie Publique et plus récemment au CEPII, puis pour m'avoir encouragé dans ce travail et partagé d'autres, pour son conseil parfois critique mais toujours pertinant, pour m'avoir guidé dans des décisions à prendre par rapport à cette thèse tout en me laissant une grande liberté, pour m'avoir donné la possibilité de beaucoup voyager pour de conférences, colloques, journées des jeunes chercheurs et d'autres réunions de travail des projets européens, et finalement en me faisant l'honneur de me déléguer plusieurs responsabilités dont j'espère avoir été à la hauteur.

Je remercie fortement les commentaires de rapporteurs, David Blandford et Antoine Bouët, qui m'ont permis d'améliorer la version finale de cette thèse pour une meilleiure clarté de la présentation des résultats les plus marquants de ce travail.

Mes remerciements vont également à Luca Salvatici pour la gentillesse et la patience qu'il a manifesté à mon égard durant plusieures années de travail ensemble, pour tous ses conseils et aussi pour m'avoir fait l'honneur de participer au Jury de soutenance. Je remercie également Yvan Decreux et David Laborde pour ses conseils, relectures pendant des 'nuits blanches' de travail, pour leur confiance dans le travail qui m'a été confié dans le cadre de l'équipe MIRAGE au CEPII.

Je ne trouve pas le mots pour exprimer ma sincère gratitude à ces deux personnes qui, à part leurs brillantes connaissances en économie et en informatique, ont un grand coeur et une grande générosité, Estelle Gozlan et Stéphane De Cara. Le fait de travailler à leur côté m'a permis de m'enrichir profesionnellement d'une part, et musicalement et culturellement en général de l'autre. Ma manière de leur remercier est de leur promettre d'agir comme eux avec des étudiants dans ma situation, si un jour l'occasion m'en est donnée.

Je remercie aussi à la direction de l'UMR Economie Publique de l'INRA / AgroParisTech et le CEPII, pour m'avoir accueilli très cordialement et pour les conseils stimulants et l'aide de toutes les personnes qu'y travaillent (personnel administratif, informatique, de la documentations, économistes et chercheurs) que j'ai eu l'honneur de recevoir.

Je remercie tous ceux sans qui cette thèse ne serait pas ce qu'elle est : aussi bien par les discussions que j'ai eu la chance d'avoir avec eux, leurs suggestions ou contributions. Je pense ici à Sophie Drogué pour aide dans la définition de ce sujet de thèse, pour m'avoir aidé à obtenir mon allocation de recherche et pour les années d'un travail cordial qu'on a pu partager; à tout l'equipe Mirage, Cristina, Hugo, Christophe, Houssein pour des relectures, pour leur soutien dans des moments difficiles et pour nos “pauses thé” qui ont été toujours enrichissantes de tout point de vue; à Karine Rezel pour être toujours disponible quand j’ai eu besoin d’elle.

Le professeur Lionel Fontagné m’a fait l’honneur de participer au Jury de soutenance; je lui en remercie profondément.

Pour leurs encouragements et leur assistance aussi bien matérielle que morale qui m’ont permis de faire cette thèse dans de bonnes conditions, je remercie chaleureusement à mes amis à Paris, Cecilia, Mariela, Ramiro, Bérénice, Juan, Candela, Olivia, Isabelle, François, Lisa, Emmanuelle; à mes amis de la chorale, Flora, Chlöé et Jerôme; et mes amies d’Argentine, Victoria, Agustina, Veronica x 2, Cecilia, Lujan, Guillermina y Lorena.

Je passe ensuite une dédicace spéciale à Pablo et à ma famille pour leur amour.

Preamble

This dissertation was written during my work experience at the French Institut National de la Recherche Agronomique / AgroParisTech (Joint Unit in Public Economics, UMR INRA 210) and the Centre d' Etudes Prospectives et d' Informations Internationales (CEPII). During this experience, I have worked on trade modeling, in particular (but not only) on the European Union and Mercosur. I have carried out a variety of studies on this topic, for the French government, for the European Commission, and for non-governmental organizations. I have been particularly involved in the work of the team in charge of the development of the MIRAGE model at CEPII, a Computable General Equilibrium (CGE) model, and I have participated to the development and the improvement of some of the features of the model, in particular the modeling of tariff-rate quotas. I have also participated to the development of large scale datasets on international trade, on the EU-Mercosur negotiations, including data on tariffs and tariff-rate quotas, on Sanitary and phytosanitary measures, and on environmental indicators.

During this work, and especially when working on EU-Mercosur trade negotiations, I ran into some empirical problems that required to develop some particular instruments or methodologies. In this dissertation, I chose to focus on empirical problems that have given me the opportunity of tackling more conceptual issues.

The thesis is organized in four different chapters. The reader should not expect a fully coherent set of work on the EU-Mercosur negotiation, in the sense that not all aspects of the negotiations are covered. Instead, the four chapters should be seen as an illustration of some developments that seemed useful, and sometimes necessary, to address a particular issue that was raised during a larger program of work. In the dissertation, I will not focus on the policy oriented work done for the negotiators, for example. Nor will I address the extensive work on data done for that purpose. While I have worked and helped developing some specifications of the MIRAGE model, here I will only focus on particular points. One is how to use a CGE model for assessing the relative benefits of multilateral and regional negotiation (Chapter 1). Another one, developed in the second chapter, is a particular extension of the model to tackle the challenge of modeling Tariff-Rate Quotas, which are central in the EU-Mercosur negotiations. The other chapters also provide an illustration of conceptual work that was developed to address a particular empirical issue. For example, a particular sector, beef, appears to be one of the main obstacles to the conclusion of a regional agreement. Empirical analysis showed that the fast growing imports of beef from Mercosur were heavily driven towards particular qualities and that the bias could be significant is one did not accounted for the composition of imports effect when assessing trade liberalization. I therefore attempted to address this topic, so as to develop a framework that could be integrated in large scale models. This work is presented in the third chapter. Sugar is another product that appears to be a major obstacle to a EU-Mercosur agreement. Because of the willingness of some EU member states to develop the use of renewable fuels, a selective liberalization of ethanol could make an agreement easier while benefiting to the EU. The latter and trade of organic products led me to explore further the trade-and-environment literature and to analyze the rationale of trade liberalization conditional to the environmental characteristics of the production process, from a welfare point of view, an issue which I focus on in the fourth chapter of this dissertation.

In brief, the trade relations between the EU and Mercosur countries is a thread that links the different chapters of this thesis. The organization of the dissertation in four independent chapters corresponds to a set of empirical issues that required some more conceptual work. That is, these chapters should be seen as snapshots illustrating the different faces of the work I have been doing in a more general framework. I believe that they provide a good image of the different techniques that I have learnt to use during my stay at INRA and CEPII.

Résumé

L'Union Européenne et le Mercosur ont commencé les négociations bilatérales en 1995 au moment de la signature de l'Accord Cadre Inter-Regional de Coopération. Malgré seize rondes de négociations et un contexte propice aux les relations commerciales (complémentarité intra et intersectorielle, liens historiques, langüistiques, culturelles et des préférences communes), ils ne sont pas parvenus à signer un accord commercial, et seulement les relations politiques et de coopération ont réellement avancé. Plusieurs raisons, telles que l'interdépendance entre les négociations bilatérales et multilatérales ou les sujets les plus controversés dans la libéralisation agricole, peuvent expliquer le retour à la case de départ.

Chaque chapitre de cette thèse répond à une question cruciale liée aux négociations UE-Mercosur. Le premier chapitre étudie les conséquences d'un accord UE-Mercosur sous différentes situations de référence (entrée du Venezuela dans le Mercosur et possibles résultats pour Doha) en utilisant le modèle MIRAGE. Le second chapitre est une contribution méthodologique à la modélisation des contingents tarifaires dans le cadre d'un modèle CGE, et souligne les possibles biais liés à l'absence de mécanismes de fonctionnement des contingents. Le chapitre 3 pose la question de l'effet Alchian-Allen dans le cadre d'une structure de protection complexe (contingents, tarifs composés) correspondant à la protection agricole en Europe. Le dernier chapitre étudie l'intérêt des grands pays importateur et exportateur à une négociation commerciale sélective en faveur des biens environnementalement préférables (EPPs), lesquels peuvent représenter une niche de marché à exploiter pour les exportateurs mercosulins.

Mots clés: Union Européenne, Mercosur, Accord Préférentiel de Commerce, Contingents tarifaires, Amélioration de qualité, Biens environnementalement préférables.

Abstract

The European Union and Mercosur have started negotiations in 1995 with the signature of the "EU-Mercosur Interregional Framework Co-operation Agreement". In spite of sixteen round of negotiations and a propitious textbook for trade relationships (complementary intra and inter-sectoral, historical links, common culture, languages and tastes), they have not managed to achieve a successful bilateral trade agreement, and only political and co-operation chapters have experienced major progresses. Many reasons, such as the interdependence between the bilateral and multilateral negotiations or their conflict-laden issues in agricultural liberalization, may explain why these negotiations have been stalled.

Each chapter of this dissertation addresses one important question linked to the EU-Mercosur negotiations. The first chapter analyzes the consequences of a EU-Mercosur agreement under different baselines (Venezuela accession to Mercosur and plausible outcomes of the Doha Round) using the MIRAGE CGE dynamic model. The second chapter presents a methodological contribution for tariff-rate quotas (TRQs) modeling in a CGE framework and highlights the possible biases linked to the lack of TRQ mechanisms. Chapter 3 addresses the question of the typical Alchian-Allen effect by introducing complex policy instruments (TRQs, composite tariffs) used in European agricultural protection. The last chapter analyze the rationale for large importing and exporting countries (environmental and welfare impacts) to negotiate a selective liberalization for Environmentally Preferable Products (EPPs), which could represent a rewarding niche market for exporters in the Mercosur.

Keywords: European Union, Mercosur, Preferential Trade Agreement, Tariff-rate quotas, Quality upgrading, Environmentally Preferable Products.

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GENERAL INTRODUCTION

Context

The Mercosur and the European Union (EU) countries seem to be a textbook case for a harmonious trade relationship. The geography is such that productions are highly complementary. Europe lacks raw materials and large surfaces, and has a more capital-intensive, high-tech economy. Even in the agricultural sector, the seasonality of production between the two hemispheres creates some complementarity. In addition, because of their historical links, the EU and Mercosur share culture, languages and tastes, and all the gravity based literature has shown that these factors were important trade enhancers. Indeed, some of the Ricardian effects take place in practice including the food sector where Mercosur and European countries share relatively similar consumption habits. Mercosur is a significant market for European spirits for example, while producing crops with a seasonal complementarity (fruits) as well as a climatic one (coffee, soybean).

However, there are a few sectors where the productive structure of the two parties compete more than they complement each other. It is particularly interesting to see that a limited number of sectors, such as beef, sugar and to a minor extent pork and poultry on the one hand, and a rather limited number of services on the other hand, end up creating a real gridlock in the negotiation towards a free trade area.

In 1995, the EU and Mercosur countries did indeed sign the "EU-Mercosur Interregional Framework Co-operation Agreement". While major progress has been experienced on the political and co-operation chapters of the agreement, the negotiations aiming at creating a free trade area by removing trade barriers have largely stalled. The EU proposal on agriculture is seen as being too restrictive by Mercosur, while the one on non-agricultural sectors and services is seen as too limited by the EU.

The prospect of freer trade between the EU and Mercosur is one of the major challenge for both sides of the Atlantic and it is important to understand the issues at stake and to help progressing towards an agreement. For a long time, the EU has given priority to the multilateral negotiations (together with developing tight relations with those countries that would eventually join the EU and granting preferential tariffs to its former colonies). Bilateral or regional agreements were not a priority. However, the memorandum on bilateral talks ended with the Commission Prodi and the EU is now much more open to such negotiations. It is possible that multilateral trade negotiations under the World Trade Organization (WTO) keep lasting for years, or even collapse. In such a case the EU will have little alternative to conclude regional agreements with large countries as a second best. While an agreement with Russia, sometimes seen as the best alternative to a WTO agreement for the EU, faces growing diplomatic concerns, the one with Mercosur appears as a feasible alternative. Interestingly, this prospect has led Mercosur countries, such as Brazil, which are aware that the EU would be left with few alternatives for a large scale deal, to raise the bar in the bilateral talks with the EU.

The EU-Mercosur negotiations are intimately linked to the multilateral negotiations. In the WTO arena, the stakes and the difficulties to reach a multilateral trade agreement (MTA) for both regions are similar to those under the EU-Mercosur negotiations. For the EU, it is difficult to define concessions to the Mercosur countries without knowing what would be the general tariff cuts faced in the multilateral framework. According to the WTO fora, an agreement between the EU and Mercosur on market access concessions could play, to a minor extent, a role such as the one played by the bilateral Blair House agreement during the Uruguay Round. The interaction between both negotiations is important to understand the present situation of the EU-Mercosur talks and the implications in terms of trade and welfare gains for each partner.

For these reasons, the relationship between the EU and Mercosur in the agricultural trade area is a far-fetching issue that deserves thorough investigation. Throughout the dissertation, one of our objectives will be to assess the potential gains resulting from a EU-Mercosur agreement (under different reference scenarios, i.e. the success or failure of the Doha Round). The issue nevertheless raises some technical difficulties.

Major technical challenges

The negotiations can be seen as a trade-off game between the different parties, seeking concessions in one sector to offset what they see as losses in others. For this reason, and in particular because the negotiations involve both agricultural and non-agricultural market access talks, a global approach such as one provided by a Computable General Equilibrium (CGE) model is especially attractive. However, most CGE models run into the problem of aggregation. That is, they can only include a limited number of countries and aggregated goods (typically less that 30 or 40 sectors) without running into computational problems. This creates a serious challenge, since, in the case of EU-Mercosur negotiations, most of the obstacles focus on particular products that must be analyzed at a very detailed level. Typically, CGE models, by treating large aggregates, are likely to introduce some bias in the analysis.

An accurate representation of trade and tariffs is crucial for reaching policy relevant conclusions. Indeed, we observed that, for many modelers, a trade liberalization between the EU and Mercosur would have little impact, including in the agricultural sector. An in-depth analysis shows that this is partly caused by what we think is an underestimation caused by misspecification of the model and data issues.

One cannot simply assess the impact of trade liberalization by cutting the (easily available) bound tariffs, i.e. the ones that countries negotiate on under the WTO. The use of standard models and commercially available datasets could lead to questionable conclusions if one does not acknowledge some specifications and data issues that are particular to the EU-Mercosur case. Mercosur countries have a considerable degree of binding overhang in their tariffs. Cutting bound tariffs by a large percentage might only dent the actual applied protection. Conversely, the EU applies tariffs to Mercosur exports that are not the bound ones either. Mercosur countries are eligible for the European Generalized System of Preferences (GSP). However, for some particular products, they are subject to graduation. That is, their preferential access is waived. For all these reasons, it is necessary to characterize the tariffs in a very detailed way, but also the non-tariff barriers facing by each party. An illustration of this issue is given in our first chapter.

Many authors only find a limited increase in EU imports of sugar and beef. One reason can be the specification of the model. For example, given that there is basically no import of sugar, it is easy, when using a model based on elasticities, to find that even a large increase in percentage term leads to limited absolute quantities. The Armington assumption may also exaggerate the differentiation of a product like sugar according to the origin. In the case of beef, most CGE modelers use the readily available database from the Global Trade Analysis Project (GTAP). Because these data are calibrated for the year 2001, before the very large surge in the EU beef imports from Brazil, the results might also be affected. These are also issues addressed in the first chapter, in particular by re-calibrating the model for a more recent year and developing detailed tariff data for that particular year.

In the bilateral negotiation, but also under a multilateral liberalization, the EU fears that a liberalization of the beef sector would lead to flood its internal market by imports from Brazil and Argentina.[1] Beef is a politically sensitive issue, the production involving a large number of small farmers in the EU. Sugar is also a sensitive issue, less because of its social implications than because EU producers are the well-organized pressure group. In such cases, the EU insists

[1]For example, at the end of 2005, the European Commission released some simulation where Brazilian imports would increase be multiplied by more than ten and reach 6 million tons, i.e. nearly half of the EU consumption, see Agra-Europe November 11 EP/3.

on a "managed trade" liberalization, i.e. on imposing ceilings to the quantities subject to a lower tariff. In the EU-Mercosur negotiation, the EU offer relies mainly on Tariff-Rate Quotas (TRQs).[2] TRQs are also central in the multilateral trade negotiations, given the large number of TRQs opened by the EU under the commitments of current access and minimum access during the Uruguay Round. However, CGE models are ill-equipped for representing such instruments, which are particularly complex given that the tariff varies in a non-linear way with the level of imports. This is an issue addressed in the second chapter of the thesis.

Using a CGE model, with the constraint on the limited number of product aggregates that are implied, causes particular questions when trade focuses on particular goods. The case of beef, where trade that takes place is limited to particular market segments, is an illustration. If one considers beef as an aggregate commodity, it is likely that the simulations with a CGE model will miss an important point, which is the composition of trade. In order to assess how the combination of instruments (TRQs, but also specific tariffs) introduce a bias towards importing higher quality, it is necessary to rely on a particular specification of import demand functions that allow to distinguish several components of the welfare variation, including a quality downgrading effect that may follow trade liberalization. All these issues are addressed in the third chapter.

Agricultural trade liberalization between the EU and Mercosur might have important environmental implications, because of the increase in pollution-intensive productions in exporting countries. In particular, the use of fertilizers and pesticides in large agricultural countries is an increasing concern, because of inappropriate environmental regulations aimed at internalizing the damage - both in Northern and Southern countries. Consumers in developed countries have become more worried about the environmental characteristics of the production processes of goods they purchase, and some of them are willing to pay higher prices for Environmentally Preferable Products like organic products. This is generally

[2] "Tariff-rate quotas (TRQs) are two-level tariffs, with a limited volume of imports permitted at the lower *in-quota* tariff and all subsequent imports charged the (often much) higher *out-of-quota* tariff" (Ingco, 1996; Diakosavvas, 2001; De Gorter and Kliauga, 2006).

considered as a rewarding niche market for exporters in developing countries, as the EU has recently become a net importer of organic products. At the same time, WTO members have launched negotiations aimed at liberalizing trade in Environmental Goods and Services, with the idea to promote free trade in a way that is consistent with sustainable development. Focusing on bilateral trade between the EU and Mercosur in both conventional agricultural commodities and their Environmentally Preferable substitutes (organic products), I have tried to compare the environmental and terms-of-trade implications of selective (only for the organic products) and unselective (for both varieties) cuts in tariffs, and to investigate how these changes in trade policy affect trade and the environment compared to an environmental policy. This fourth chapter is mainly conceptual, but the developments should prove useful in understanding the gains that Mercosur countries can expect under the present negotiations at the WTO Committee on Trade and the Environment.

Four distinct chapters

The rest of this dissertation consists of four chapters and a conclusion. The overall objectives in this dissertation are to:

1. Simulate and compare the welfare and trade implications of a multilateral trade negotiations on the EU and Mercosur preferential trade agreement (Chapter 1).

2. Improve the modeling of agricultural trade liberalization with regard to TRQs and to highlight its consequences (Chapter 2).

3. Address the impacts of trade liberalization on the composition of trade, in particular in the presence of TRQs and specific tariffs, which characterize the EU tariff structure (Chapter 3).

4. Address the comparison of different trade liberalization patterns and foreign environmental policy by decomposing welfare impacts (Chapter 4).

Chapter 1 aims at showing why, after twelve years agreeing on the framework of negotiations and eight after the beginning of the market access talks, the EU and Mercosur have not achieved significant progresses in the bilateral negotiations. First, the latter are held at the conclusion of the Doha Round. Second, agricultural trade liberalization is a key issue of this Preferential Trade Agreement (PTA) as agricultural sectors are the core of Mercosur's comparative advantages and their protection is still a major element of EU trade policy.

We use the MIRAGE CGE dynamic model (Bchir et al., 2002; Decreux and Valin, 2007) from CEPII to assess the consequences of this PTA. The fact that Venezuela has joined Mercosur is explicitly taken into account in the dynamic baseline. Simulations are run by considering plausible outcomes of the Doha Round, including its failure. Indeed, major concessions on agriculture in the Doha Development Agenda (DDA) will have negative effects on what will be offered in the bilateral talks, and vice versa. Between 2001[3] and 2004,[4] trade patterns between Mercosur and the EU have undergone important changes. In order to retain a realistic reference situation for the negotiations, we update the trade flows that will be used in our simulations. Liberalization scenarios (multilateral and regional) are defined at the most detailed level available using the MAcMap-HS6 database (Bouët et al., 2004), which was jointly developed by the ITC (UNCTAD, WTO, Gevena) and the CEPII, to take into account preferential tariff and quotas for the year 2004. This particularity allows us to pay especial attention to the sensitive products and exceptions issues.

Chapter 2 addresses the question of the importance of TRQ modeling in a CGE framework. We focus on avoiding TRQ aggregation biases. Since the Uruguay Round Agricultural Agreement (URAA) entered into force in 1994, TRQs have become a widely used trade policy instrument to improve agricultural market access while controlling import volumes at the same time (i.e. the beef and sugar markets in the European Union or in the United States). So far, CGE models, such as MIRAGE, have only taken into account the quota

[3]We consider GTAP 6.x data described by Dimaranan, ed (2006)

[4]Trade data is taken from BACI database described in Gaulier and Zignago (2004)

rents, assuming most of time that they are kept by exporters. Unfortunately, this methodology does not authorise any change in the TRQ regime when trade policy changes (i.e. a quota-volume increase for very sensitive agricultural products or a tariff reduction). In order to improve the treatment of TRQs in MIRAGE we model them as bilateral TRQs at the HS6 level. Assuming a simple scenario of bilateral trade agreement between the European Union and Mercosur, we compare our approach to the standard one, using the same CGE model for identical scenarios. A comparison of the results gives us an idea of the biases introduced by the negligence of TRQ modeling.

Chapter 3 addresses the question of quality-upgrade in trade due to complex trade policy instruments. The European Union tariff schedule includes a large number of specific and composite tariffs as well as many TRQs, which affect the composition of imports. By altering price ratios between products with different unit values, both can generate the typical Alchian-Allen *shipping the good apples out* effect in foreign countries' exports to the EU. Different patterns of trade liberalization, either through tariff reduction or an expansion in preferential-access quotas, might have different consequences for producers and consumers because of changes in the composition of trade. We illustrate the issues at stake in the beef sector, focusing on Mercosur exports to the EU. We model import demand for different qualities in the presence of a TRQ and we derive comparative statics results for changes in various policy variables.

Chapter 4 addresses the question of selective tariff cuts for Environmentally Preferable Products (EPPs) that could represent a rewarding niche market for exporters in the Mercosur. The conceptual issues that we developed could be useful for empirical analysis of the EU-Mercosur trade in biofuels and organic products.[5] Current negotiations at the WTO's Committee on Trade and the Environment have brought up debates on selective tariff cuts for such products. This raises

[5] Argentina is one of the few countries with an equivalence agreement with the EU with respect to the certification of organic products, so that -unlike many developing countries where NTBs are likely to be an issue- tariff cuts may result in significant improvements in terms of market access.

questions on the environmental and welfare implications of trade policy when a close substitute ("environmentally worse") exists. Building on the theoretical trade-and-environment literature, we analyze the rationale for large importing and exporting countries to negotiate tariff cuts upon environmental characteristics of the production process, focusing on environmental and terms-of-trade effects.

Main results show that if consumers in the importing country value the 'Green' product, selective tariff cuts always result in lower pollution levels in both countries, due to substitutions in consumption patterns. Other policies (full liberalization / unilateral environmental tax) allow a more dramatic reduction of the externality in one country, but an increase of pollution in the trading partner.

Chapter 1

Will Regionalism Survive Multilateralism? The EU-MERCOSUR Example

[1]

[1] This works has benefited from the cooperation of David LABORDE CEPII, Paris and Université de Pau.

1.1 INTRODUCTION

Twelve years after the agreement on the framework of negotiations, eight years after the beginning of market access talks, the European Union (EU) and Mercosur (Argentina, Brazil, Paraguay, Uruguay and, since 2006, Venezuela) negotiations have not managed to achieved significant progress for several reasons.

First, progress in the bilateral negotiations is subject to the evolution of the Doha Round. Indeed, interest in reaching a bilateral agreement in the future would decrease depending on whether the multilateral negotiations succeeded, leading to the opening of markets, or failed. At the same time, concluding an agreement right now would make no sense; most of the preferences granted could be changed and even revoked by multilateral talks. Moreover, a conflict between the EU and G20[2] leaders, such as Brazil and Argentina, on the WTO stage would make any bilateral agreement more difficult. Nevertheless, a failure in the Doha Round will increase the motivation to reach a Preferential Trade Agreement (PTA).

Second, agricultural trade liberalization is one of the most conflict-laden issues in both bilateral and multilateral negotiations. For the EU, trade liberalization under the Doha Round and/or under the EU-Mercosur PTA would be a severe blow to the EU farm sector. The "single pocket" approach links both kinds of liberalization. If more tariff reduction is given in the Doha Development Agenda (DDA) talks, less will be given in the EU-Mercosur PTA, and vice versa. Moreover, bargaining on Tariff-Rate Quotas (TRQ), the most favored tool of EU policymakers for warranting market access while retaining control of the volume of imports, is difficult. Not only the size of the quotas but also the way TRQs are administered are both controversial issues in negotiations.

Finally, Venezuela has recently signed a protocol to become a full Mercosur

[2]The G20 (or group of 20) is a bloc of developing countries which emerged at the 5th Ministerial WTO Conference in Cancun (September 2003). They oppose the protectionist measures of some developed countries on agricultural markets and focus on particular issues of agricultural trade liberalization at the Doha Round. Chine, India, South Africa and Brazil appear as the leaders of the group.

member. An exhaustive schedule has been set in order to take into account trade sensitivity aspects of each member. This new Mercosur member could change the conditions of bilateral negotiations with the European Union.

We use the MIRAGE model, the CEPII's CGE model aimed at studying the impact of trade liberalization, in order to provide a detailed analysis of the negotiations. MIRAGE is a dynamic multi-sector multi-country model, based on the last release of the GTAP (version 6.2) database. Our contribution is that we re-calibrated the model using trade variation from the BACI database between 2001 and 2004 to capture major changes in trade pattern during the last few years. For instance, that analysis with a 2001 representation of the economy could not capture the large increase in exports of beef production originating in Mercosur to the EU.

Venezuela's joining Mercosur is explicitly taken into account in the baseline. Because it is the first net food importer country in the custom union, it is crucial to assess the consequence of its integration. It is noteworthy that nowadays, no such assessment has been done in a CGE framework.

Even if our main focus is on the agricultural part of the agreement, we also give attention to liberalization in manufacturing sectors. Liberalization scenarios (multilateral and preferential) are defined at the most detailed level available (HS6), which allows us to make realistic assumptions on the products that the EU might classify as sensitive. Indeed, it is likely that the EU list will be fine tuned and target only for some tariff lines based on political reasons, within a given product category. We assess the consequence of a EU-Mercosur PTA scenario under different baselines, according to the different possibilities resulting from Venezuela's integration into Mercosur and the success or failure of the Doha Round. This scenario corresponds to what we believe to be the center of gravity between the EU proposal and the Mercosur proposal.

We focus on a detailed analysis of trade flows and welfare under a EU-Mercosur PTA scenario.

The paper is organized as follows: Section 1.2 shortly discusses the theoretical and empirical background on the EU-Mercosur PTA. Section 1.3 describes the bilateral trade relations and protection between both blocs. Section 1.4 presents the specifications of the MIRAGE model and scenarios. Finally, in Section 1.5 we discuss the results and conclude.

1.2 The EU-Mercosur PTA: a survey

The new regionalism theory may be considered the most pertinent theoretical framework to study the EU-Mercosur preferential trade agreement because of its main assumptions, such as the linkage between trade-productivity and endogenous growth, international factor mobility assumption, the role of imperfect competition, and political economy consideration,[3] i.e. the compatibility degree between a preferential and a multilateral trade agreement (Ethier, 1998a,b). The relation between Preferential Trade Agreements (PTAs) and Multilateral Trade Agreements (MTAs) has stimulated rich discussions.

A static analysis of this question goes back to Viner (1950) who characterized PTAs as *good* or *bad* according to trade creation (shift of imports from an inefficient to an efficient source) and trade diversion (vice versa) consequences. However, this seminal contribution did not consider previous dynamic aspects between PTAs and MTAs, such as between the EU-Mercosur and Doha negotiations.

Bhagwati (1991) analyzes, in a dynamic sense, whether PTAs contribute to MTAs either by adding new members or by accelerating free trade. Panagariya (1999) formulates the time-path question according to the independence (or not) of the PTA's and the MTA's time-path. In the case of the EU-Mercosur and the Doha negotiation, it is more adequate to assume both time-path are embraced simultaneously, and thus their interaction is essential for the final impact towards freer trade.

More recently, the analysis of the dynamic question moved to political-economy-theoretic modeling. In an oligopoly model where governments follow the interest of lobbying firms (Bhagwati, 1990; Krishna, 1994), two countries with a bilateral

[3]All the assumptions related to the new regionalism are considered in the MIRAGE model.

agreement do not have incentives to sign a multilateral agreement with non-members. However, median-voter models under monopolistic competition (Levy, 1997) show that bilateral PTAs may be a political support for MTAs. The sequential bargaining argument was introduced by Bhagwati et al. (1994). They stated that for non-hegemonic countries, simultaneous (PTA and MTA) bargaining is profitable, but for hegemonic countries, the sequential bargaining is preferred by picking the most vulnerable countries first, and then moving towards the rest. In the presence of lobbying when the final goal is multilateral free trade, non-hegemonic countries would abandon PTAs for MTAs, while hegemonic countries would move in both directions at the same time. Both multilateral and bilateral negotiations are very close, and the success or failure in the first ones could either open new perspectives for the second ones or impose the same restrictions as at the multilateral talks.

Many empirical works using CGE models, such as GTAP (Hertel, 1999), MIRAGE (Bchir et al., 2002; Decreux and Valin, 2007) and AMIDA (Flores, 2006), have analyzed the impacts of the EU-Mercosur Free Trade Agreement (FTA). Their simulations display similar results, with some slight differences according to each model's hypotheses (static vs. dynamics, perfect vs. imperfect competition on industrial sectors, number of factors, FDI, externalities and labor market rigidities).

A PTA between the EU and Mercosur countries would generate economic gains (welfare, GDP, trade and employment) for both regions. Monteagudo and Watanuki (2001) simulate a EU-Mercosur FTA scenario and find a substantial GDP and trade increase for Mercosur (2.94% for GDP, 7.9% for exports and 6.4% for imports), while those of the EU only increases slightly (0.06% for GDP and 0.4% for imports and exports). According to these authors most of GDP and trade variations for Mercosur are explained by export externality gains (between 10 and 13% of Mercosur's exports increase) and the scale effect of a larger economy has only a minor influence (6% of Mercosur's exports increase). Flores (2006)'s results using the AMIDA model show the same trend as Monteagudo and Watanuki (2001)'s; however, trade variations are greater than Monteagudo and

Watanuki (2001)'s (19.4% and 18.57% for total Mercosur's exports and imports), particularly due to the transaction costs modeling introduced in this paper (transportation, bureaucracy, distribution margins, etc.). Bouët et al. (2003)'s results are also close to those of Monteagudo and Watanuki (2001) but display a smaller trade creation effect between the EU and Mercosur (5.8% and 6.4% for Mercosur exports and imports and only 0.8% and 0.4% for those of the EU). Both papers use static CGE models considering imperfect competition in the manufacturing sectors, but the standard version of the model used by Bouët et al. (2003) is compared with the rules of origin modeling version, showing that the rules of origin have a strong restrictive impact on trade flows. Other papers, such as Laens and Terra (2006), which use a basic GTAP model (static, perfect competition in all sectors, no externality effects, etc.) display smaller welfare and trade gains for both regions than previous works. Conversely, Bchir et al. (2003) using the MIRAGE model show that dynamic gains are important when compared to the previous static models. A full liberalization scenario between the EU and the Mercosur displays higher trade gains for both regions than in the previous static models (22.6% and 19% for Mercosur's exports and imports respectively, while those of the EU gain 2.4% and 2.3%). The imperfect competition hypothesis in industrialized sectors also leads to greater welfare gains than under other standard models with perfect competition in these sectors.

Summarizing the previous results, we can say that all these papers show that the primary source of gains for Mercosur comes from agricultural liberalization, and that trade diversion effects are always non-negligible as a consequence of this FTA. However, none of them have considered Venezuela as a full Mercosur member. The recent work of Coelho et al. (2007) compare different scenarios for Venezuela's accession to Mercosur by assuming different hypotheses about the implementation of the Common External Tariff (CET) and free trade between partners. Trade results for Venezuela show that imports would increase more quickly than exports, and Brazilian exports would benefit the most from this process of integration due to bilateral trade composition.

1.3 EU-Mercosur bilateral relations

1.3.1 Historical and Prospective relations

Bilateral trade talks between the EU and Mercosur began in 1995 when negotiators set the structure, the methodology and the calendar for negotiations. The first phase concluded with the political and co-operation dialogue, and in 2001, the two blocs exchanged the first texts on goods, services and government procurement in order to improve market access between the regions. In the Presidential Summit in Madrid in 2002 the countries reiterated their political commitments to reach the largest bi-regional trade agreement in history. Several rounds of negotiations followed the previous commitments, and in the 9th round, the first list of most sensitive products under negotiation was exchanged. The latter has also constrained the progress in recent negotiations because Mercosur countries insist on a much larger access to the EU market. In the most recent proposals (October 2004), the EU made some concessions through several TRQs for these sensitive products. The TRQ scheme was preferred because of fears that a more generous European proposal on agriculture would allow Mercosur countries to capture an extremely large market share (Bureau et al., 2006). However, for Mercosur countries the latter was considered as a too limited proposal on market access issues. At the same time, the EU also rejected the Mercosur concessions in services and government procurement as too limited. After this disagreement on proposals, dialogue was interrupted until the Ministerial Meeting in Brussels on September 2005 when it was formally restarted (Ramos et al., 2006). Despite the strong majority vote in the European Parliament in favor of a EU-Mercosur FTA and recent discussions between representatives from both regions (November 2006 and April 2007), no agreement seems forthcoming if concessions are not improved.

The EU-Mercosur negotiations have shown long slow progress and even some backward steps, because of their protectionist attitudes. EU-Mercosur bilateral negotiations seem to reject the classical thesis that postulates that PTAs are much easier to attain than multilateral trade agreements because of the restriction of the WTO non-discrimination clause on the one hand, and because of the predictability of trade impact on the other hand(Johnson, 1965). The conditions for a EU-Mercosur PTA are that trade would be partly liberalized in a gradual and reciprocal way, substantially covering most bilateral trade flows without excluding any sector according to the WTO rules. This insures that a regional integration process achieves a sufficient degree of compatibility with the multilateral trading system (Giordano, 2003). Moreover, the demands and concessions of each region under bilateral talks are subject to the evolution and outcomes of WTO negotiations.

The ongoing integration in South America conditions the future of the EU-Mercosur negotiations. Within Latin America, Mercosur countries have signed different agreements with their neighbors. The trade agreements with Chile and Bolivia (format "4+1") have created two separate FTAs, leading these two countries to become Mercosur Associated Members. Such was the beginning of the Mercosur "expansion" in Latin America. Trade negotiations between Mercosur and the Andean Community would have been the first "bloc-to-bloc" trade agreement in the region, but it failed many times due to the discrepancy between members' interests. Finally, on July, 1th 2004, a PTA was implemented between Mercosur and the Andean Community according to the Economic Agreement (ACE 59) at the Latin America Integration Association.[4] One year later, Mercosur countries became associated members of the Andean Community, and in April 2006 Venezuela left its Andean partners to become a full member of Mercosur. This step in Mercosur expansion will likely lead to future Latin America integration.

The enlargement of Mercosur and the possibility to become a power region in trade negotiation may have a considerable impact on the EU-Mercosur bi-regional trade negotiations.

[4]The ALADI or LAIA is composed by all Latin-American countries and looks forward to the establishment of a common market, alongside with social and economic development of the region.

1.3.2 Bilateral trade relation

The period from 1998-2004 shows important changes in the Mercosur economies, including currency devaluation, social and macroeconomic crises and recent economic recovery. These facts have affected their trade relations with the rest of the world, and especially with the European Union.

Since 1997, Mercosur exports to the rest of the world (ROW excluding the EU) have been fluctuating by following the crisis in the region. Agricultural exports have obviously suffered more than the manufacturing sector (agricultural exports fell 21% while manufactured exports rose 5% between 1997 and 1998). In 2001 the situation was similar: agricultural exports fell 13% while manufactured exports rose 1%. The variation in agricultural exports to the EU is not only related to the local macroeconomic situation but also linked to sanitary crises, especially ground exports of beef (foot and mouth disease) and poultry (avian influenza). Between 2003 and 2004, Mercosur countries have improved their international competitiveness through currency devaluation as a consequence of the financial crisis in the region, but animal diseases limited animal product exports to the EU especially because of extra sanitary controls (while 2003 saw a 34% increase, 2004 saw a -12% decrease in agricultural and food exports).

[INSERT Figure 1.1 and 1.2]

European Union (agricultural and industrial) exports to the ROW have grown steadily during this period. However, their exports to the Mercosur countries have been strongly linked to the macroeconomic situation in Latin America. European exports to Mercosur have been falling since 1998, a phenomenon that can be explained by the recession period in South America and the first devaluation of the Brazilian Real. Industrial exports remained steady at the beginning of 1997, but after the Real devaluation they suffered from a strong negative variation (-8%). European exports recovered in the two following years (1999 and 2000) until the next crisis in 2001 (-6% of industrial exports). At the end of 2001, the economic crisis in Mercosur, and thus the devaluations of the Mercosur countries currencies in 2002, resulted in a collapse of European exports to the region. Since then, and until 2004, a "healthier" Mercosur economy led to a steady increase in European exports (between 30% and 40% per year even for agricultural and food products).

[INSERT Figure 1.3 and 1.4]

Even if Mercosur is a minor EU world partner, it is the EU's most important partner in Latin America, because Mercosur is the destination of close to 50% of the EU exports to the Latin region. At the same time, the EU is an important partner of Mercosur countries especially in the domain of agricultural and food exports (more than 30% of total non-Mercosur exports).

Figure 1.5 gives an idea of the patterns of trade of these two regions as well as the dynamic bilateral trade balance. Mercosur countries are net exporters of agricultural and food products (not only to the EU but also to the ROW), while the EU exports to Mercosur are mostly manufactured products and services. Bilateral trade was characterized by a deficit for the Mercosur region until 2001. Since 2002, because of the boom in their agricultural exports, the Mercosur countries have reversed the negative trade balance with the EU.

[INSERT Figure 1.5]

European imports from Mercosur never stopped rising even during the crises. Since 2002 European agricultural imports from Mercosur have shown a rapid increase with a peak in 2003. Depreciation of Mercosur currencies had reinforced the competitiveness of Mercosur exports and the appreciation of the Euro with respect to the US dollar then contributed to the widening of the trade surplus between Mercosur and the EU.

Bilateral trade between the European Union and Mercosur seems to be complementary according to the previously presented trade patterns. Mercosur exports to the EU are concentrated in a few chapters, of which most are agricultural: animal products (high-quality beef, poultry, pork and fish), cereals and seeds (wheat, rice and corn), fruits and vegetables, and some foods and beverages.

European Union exports to Mercosur mainly concern manufactured products, such as chemicals, pharmaceuticals, plastic, paper, iron and steel products and machinery, domestic electrical and electronic devices and vehicles, as we can see in the composition by chapter in Figure 1.7.

However, bilateral trade in some chapters also display the complementarity in their trade patterns. For instance, in the bilateral trade of papers and articles of paper sector (chapter 48), Mercosur exports raw materials belonging to the paper sector, while the EU exports final products of the same sector.

[INSERT Figure 1.6]

[INSERT Figure 1.7]

The complementarity between the trade patterns of both economic blocs, leads us to predict important gains of this regional agreement. Moreover, adjustment costs of this agreement would be negligible compared to the gains, due to the high initial tariff level, especially on the European side (De Melo and Panagariya, 1993; DeRosa, 1998).

Bilateral trade is only a part of bilateral business relations between the two regions. During the 1990's, the Mercosur region has received more than 50% of the Foreign Direct Investment (FDI) in Latin America and most of the capital came from European transnational groups (telecommunication, energy services and agribusiness). With a EU-Mercosur agreement, the EU is looking to consolidate its presence in the Mercosur market through FDI. To ensure FDI, European companies demand a stable regulatory framework of direct investment and intellectual property rights in order to reduce risks and avoid future problems (Giordano, 2003).

In short, Mercosur and the EU have complementary trade patterns, but we will see in the next subsection that potential trade flows are concentrated in politically sensitive sectors that are now characterized by a high level of protection. The latter and the insecure regulatory framework for FDI, both make this regional trade agreement difficult to conclude.

1.3.3 Reciprocal level of protection

1.3.3.1 Structure of protection in the European Union

Since the Mercosur countries are developing countries, they are eligible for the EU Generalized System of Preferences (GSP). Venezuela benefited from the GSP Drug before 2007, and now benefits from the GSP+. Because of the broader coverage of the GSP+, 85% of its exports to the EU are duty free. Other Mercosur countries are only eligible to the "standard" GSP, which has limited coverage for agricultural sectors. Only a few products among their main exports are covered by the GSP (fats, seafood, some fruits). In addition, the GSP seldom grants duty free access but more often only waives a small component of the tariff. Moreover, for products in which Mercosur countries are competitive, they face graduation (designed to spread the benefits of the GSP to a large number of countries and to avoid that a single exporter takes a very large market share).

The dispersion between agricultural and non-agricultural protection rates in the European market explains the difference in average applied tariffs across Latin American countries. For Uruguay and Paraguay, the average applied tariff in agriculture is ten times higher than in non-agricultural sectors. However, for agricultural products, Argentina is less harmed by the EU protection (14%) than Brazil, Uruguay and Paraguay. Brazil is affected by an average tariff in agricultural products that is twice as big as Argentina, and Uruguay faces tariff barriers five times greater than Argentina, even if the EU protection against meat exports remains significant for Argentina. In contract, for non-agricultural goods, Brazil only faces an average protection of 1.6%, while the Rest of Mercosur is affected by an average tariff of 2.6%.

[INSERT Figure 1.8]

The EU tariff structure shows some tariff escalation, and effective protection is higher for processed products. This is particularly true for meat, cocoa, semi-processed products of the wood sector, flours, tobacco and leather and apparel goods. While preferences granted under the GSP+ and agreements with other countries, such as Caribbean and Pacific countries, have largely eliminated tariff escalation, it remains an issue for Mercosur exports to the EU. A PTA with EU, will allow Mercosur countries to improve the degree of processing of their exports.

[INSERT Figure 1.9]

[INSERT Figure 1.10]

Tariff-rate quotas defined under the Uruguay Round Agriculture Agreement (URAA) allow Mercosur countries to benefit from preferential tariffs for some of their agricultural exports. These are either current access TRQs, opened so as to ensure persistence of historical preferential trade flows, or minimum access TRQs, given in order to open 5% of the EU consumption market to international competition (all WTO members).

Most TRQs in the European Union are administered according to License-on-demand (meat TRQs), Historical trade (animal products TRQs) and First-come/First-serve (fruits and vegetables TRQs) methods which not only affect the distribution of rights to imports but also the TRQ-rents between importers and exporters (Skully, 1999).[5]

[INSERT Table 1.1]

[5]However, the capture of the rent is explained sometimes by the presence of importer (or exporter)'s market power (Olarreaga and Ozden, 2005). Others explanations for the rent allocation between countries under the same preferential agreement are the difference in the quality composition of exports, the changes in world prices (or import prices) after the agreement or the differentiation of imports across origins.

European TRQs for Mercosur countries

The EU has opened more than 80 TRQs for agricultural products, some are granted for the current access and others introduced under the Uruguay Round minimum access.
Mercosur countries benefit both from a preferential market access through TRQs for cereals (maize, wheat, rice), meats (beef, pork and poultry), some fruits (peaches) and vegetables (garlic), dairy products (milk powder, butter and cheeses), sugar and other food products.
Argentina and Brazil benefit especially from meat TRQs. The first one particularly uses beef (fresh, frozen and processed) TRQs, and Brazil diversifies its meat exports, not only by exporting inside the Hilton TRQ and frozen beef but also using poultry (minimum-access TRQs) and pork TRQs. Most of WTO poultry TRQs are filled by Brazil who, in spite of the very high tariffs in the EU, manages to ship large quantities of poultry outside the quota. Brazil also exports frozen beef out of quota (80,000 tons in 2003).
Uruguay also benefits from beef TRQs but especially from the sheep and goat (current-access) TRQs as well as Argentina because of the specific licenses allocation to these countries.
Particularly concerning the “Hilton” high-quality beef, Mercosur countries benefit from 40,300 tons per year, which is allocated differently across them: a 28,000-ton quota for Argentina, 6,300 tons for Uruguay, 5,000 tons for Brazil and 1,000 tons for Paraguay. The only country which does not fulfill its quota is Paraguay due to sanitary problems. The Hilton in-quota tariff is 20% and the out-of-quota tariff is a composite tariff (*ad valorem* tariff of 12.8% plus specific tariff between 140 and 300 euros per 100kg). In spite of the high out-of-quota tariff, Mercosur countries manage to fulfill their quotas and even to export small volumes out-of-quota. For instance, in 2003 Brazil exported 41,000 tons of Hilton beef exceeding five times his quota.
Most part of meat TRQs are administered according to the License-on-demand methods. Nevertheless, in some TRQs, such as the “Hilton” beef TRQ, Mercosur countries manage their own licenses and capture most of the quota rent. This aspect explains the interests for some Mercosur producers in keeping TRQs instead of negotiating MFN tariff reductions.
Other interesting cases, such as sugar TRQ for which Brazil is the main exporter, and some cereals TRQs (durum wheat and corn for Argentina and Brazil), are also detailed in Table 1.1.

1.3.3.2 Structure of Protection of Mercosur

Since 1995, all Mercosur members have been applying a Common External Tariff (CET) to all imports coming from outside Mercosur. At the beginning, the CET covered about 85% of imports but since 2001 Argentina and Brazil have strongly increased the percentage of coverage, while Paraguay and Uruguay have more recently done the same (2006). Nevertheless, there exist some exceptions, such as for capital goods, telecommunication and electronics devices, sugar, automobiles and the list of exceptions defined by each particular country.

The CET varies between 0 and 23%, in which the highest level of protection is concentrated in manufactured products such as textiles, wood, machinery and equipment, food and other manufactured goods and the lowest level of protection is applied to animals, seeds, some chemical products, etc. The general criterion is that tariffs increase with the share of the added value of goods; however, other criteria have been also considered, such as the protection of production coming from a particular region or country. Indeed, Mercosur applies the highest tariffs on consumption goods and the lowest on agricultural raw materials. However, the protection structure is much more homogeneous than the EU one. Due to the trade structure, average protection is between 14% in agriculture and 10% in industry, and falls to 2% for primary products.

[INSERT Figure 1.11]

[INSERT Figure 1.12]

The EU has no preferential access to the Mercosur market. European countries face the CET from Mercosur in all products, which is higher for consumption and non-agricultural products than it is for other products. Some Mercosur countries, such as Brazil and the new member, Venezuela, have opened WTO TRQs on agricultural products. Brazil has opened two TRQs, one on pears and apples and the other on wheat. The former is not effective because the CET is lower than the in-quota tariff, but the latter is always effective, used and has been opened to all WTO members. Venezuela is the other Mercosur country which has opened TRQs (more than 60) on many different agricultural products. These TRQs are not Mercosur TRQs because they were individually opened by Brazil and Venezuela. The rest of Mercosur does not use them because intra-Mercosur trade is duty free (except for some exports, such as vehicles and vehicle parts exports, which are also sensitive products between Mercosur countries).

1.4 Modeling the EU-Mercosur bilateral agreement

1.4.1 The MIRAGE model

The model we use is the multi-region, multi-sector computable general equilibrium (CGE) model from CEPII, named MIRAGE, which was particularly developed for trade policy analysis.

The main hypotheses of this model are imperfect competition (oligopolistic framework "à la Cournot"), vertical and horizontal product differentiation in a sequential dynamic set-up, where the adjustment is linked to the capital reallocation.

The demand side is modeled in each region through the representative-agent assumption. Domestic products are assumed to benefit from a specific status for consumers, making them less substitutable for foreign products than foreign products between each other. In the absence of systematic information suitable for the incorporation of vertical differentiation in a worldwide modeling exercise, such as the one undertaken here, vertical differentiation is modeled in an *ad hoc* way: products originating in developing countries and in developed countries are assumed to belong to different quality ranges. This assumption is motivated by the fact that several empirical works have shown that unit value differences are able to reveal quality differences even at the most detailed level of product classification. This hypothesis about quality differentiation is likely to have direct consequence on the transmission of liberalization shocks since the elasticity of substitution is lower between different qualities than between products of a given quality.

Regarding the supply side of the model, producers use five factors: capital, labor (skilled and unskilled), land and natural resources. The structure of the value added is intended to take into account the well-documented relative skill-capital complementarity. These two factors are thus bundled separately, with a lower elasticity of substitution, while a higher substitutability is assumed between this bundle and other factors.

The production function assumes perfect complementarity between value added and intermediate consumption. The sectoral composition of the intermediate consumption aggregate stems from a CES function. For each sector of origin, the nesting is the same as for final consumption, meaning that the sector bundle has the same structure for final and intermediate consumption.

Constant returns to scale and perfect competition are assumed to prevail in agricultural and transport sectors. In contrast, firms are assumed to feature increasing returns to scale in other sectors. Each firm produces its own variety facing constant marginal costs and fixed cost per year and not affecting the production choices of its competitors through its own decision of production (Cournot-Nash). However, its market power affects the price at the sector level. The calibration of parameters and the adjustment in the number of firms are linked to the zero-profit condition.

Capital goods are immobile across sectors and thus have the same composition regardless of the sector. This assumption introduces a rigidity in the economy suggested by empirical evidence. Capital is accumulated every year as the result of investments in the most profitable sectors. Natural resources are considered to be perfectly immobile and may not be accumulated. Both types of labor are assumed to be perfectly mobile across sectors, whereas imperfect land mobility is modeled with a constant elasticity of transformation function. Production factors are assumed to be fully employed; accordingly, negative shocks are absorbed by changes in prices (factor rewards) rather than in quantities. All production factors are internationally immobile.

With respect to macroeconomic closure, the current balance is assumed to be exogenous (and equal to its initial value in real terms), while real exchange rates are endogenous.

The calculation of the dynamic baseline has been recently improved in order to introduce a variable total factor productivity (TFP). This improvement is based on a more elaborate demographic and macroeconomic forecast in which the labor and GDP growth rates are provided until 2015 by the World Bank. In the baseline, the TFP is determined endogenously but under the simulation scenarios it becomes fixed and thus the endogenous variables are the GDP and labor.

Some particular changes have been done for this paper.

First, we have defined a specific aggregation between regions (13) and sectors (30). All agricultural products are kept at GTAP original sector definitions because we are especially interested on the trade liberalization consequences in agriculture; however, due to vertical integration in some agricultural sectors in large countries such as Brazil, we have decided to gather raw and processed goods for rice, meat and sugar sectors. The rest of sectors have been disaggregated by considering important trade between partners, e.g. motor and vehicles, textile, paper, energy products. For instance, natural resources play an important role in Venezuelan economy and to observe how trade agreements can help or hinder the diversification processes around these assets, chemicals and energy products have been splitted. Since we do not study liberalization in services, most of them are aggregated. However, we do not aggregate services activities which are directly (transport and communication) or indirectly (business services) correlated to trade. For regional aggregation we considered the most recent configuration for the EU with all her new members (EU27) and also Mercosur countries are kept separately except for the smaller on, Uruguay and Paraguay, which are joint in the Rest of Mercosur in order to equilibrate the regional decomposition. For the rest of regions we have chosen an aggregation which consider close competitions of the EU-Mercosur PTA partners which would be harm by this agreement, e.g. NAFTA, Sub-Saharan Africa, Mediterranean countries (see Table 1.2).

[INSERT Table 1.2]

Second, particular treatment to recalibrate the model has been considered to mimic recent changes in trade flows between 2001 and 2004 using the BACI database (Gaulier and Zignago, 2004).

[INSERT Table 1.4]

[INSERT Table 1.5]

Comparing GTAP and BACI trade databases, we found that trade flows between these two regions have known major changes in the last years. Crises and currency devaluations in Mercosur economies have led to important changes in their patterns of trade. Mercosur bilateral trade with the EU has strongly increased for cereals, meat and other traditional agricultural exports. Moreover, the "mad cow" crisis has strongly weakened the meat sector in Europe and has allowed new export possibilities to the European market. In contrast, EU exports to Mercosur have decreased in the domain of traditional exports (chemicals, machines, vehicles, etc.) due to the different crises and currency devaluations in the region.

Simulating the EU-Mercosur PTA scenario on the basis of 2001 trade data, would result in a very distorted picture of the reality and would compromise any utility that this exercise could have for policymakers.

Trying to reproduce the evolution of trade flows of these regions, we have to adapt the dynamic path of the model between 2001 and 2004. After using the standard dynamic calibration of MIRAGE, we compare the evolution of the model's trade flows and the one existing in BACI database for the each year from 2001 to 2004.

Thus starting from GTAP trade of this two regions (also including Chile and Venezuela), we update them by reproducing the growth rate of trade flows, drawn from BACI database, between 2001 and 2004. Indeed, for some sectors and some small countries, such as "Other manufactures products" and "Rest of Mercosur", COMTRADE and consequently BACI display extreme variations of trade (in volume), and in many cases they are inconsistent with the base year data in GTAP. Taking into account relative changes instead of absolute ones allows us to avoid modifying the Social Accounting Matrices (SAMs) in 2001 but recalibrate the model for 2004.

Since the changes in trade policies during the period are already taken into account in the model, we have to explain trade differences through alternative explanations. Three main mecanisms are considered:

1. Sectoral technical progress for some countries

2. Foreign Direct Investments

3. Changes in transaction/transport costs

Each of these channels has a differentiate impacts.

Growth in the total sectoral trade for these regions are assumed to be explained by a productivity improvement in some sectors and investment in the other sectors. Changes in sectoral productivity will increase the sectoral exports of one country on global market. More technically, the sectoral productivity will become endogenous to reproduce growth rate of sectoral exports for Mercosur countries and European Union on global markets. The Genetic Modification technology in soja beans is a good illustration of this case.

Moreover, for some manufacturing sectors, such as paper industry, trade has not initially taken place in the model because of very small values. However, investment and particularly FDI have recently lead to increase trade and production. For these sectors the investment function in MIRAGE is not able to reproduce this new behaviour, and thus we decided to introduce exogenously new investments in these activities.[6]

Finally, bilateral trade between the EU and these Latin American countries increases also due to a reduction in transaction costs (20% per year from 2001 and 2004) in all sectors. More technically, given the new sectoral productivity and investments, bilateral sectoral transaction costs are shocked to complete changes in the bilateral trade flows between the EU and Mercosur countries. The changes in trasaction costs reflect not only transport costs reduction but also the improvement in business networks and the reduction in non-tariff barriers to trade.

[6]To maintain general equilibrium constraints, exogenous invest flows are taken from existing capital in other sectors from other regions in the model. The lack of data on bilateral sectoral FDI forbids us to achieve a better outcome.

The sequential dynamic set-up of the model leads us to implement the three previous mechanisms through which sectoral trade (total and bilateral) increases for Mercosur and the EU in this particular study.

The model uses the GTAP database 6.2. However, instead of relying on modeling tariff cuts at the sector level, we use a detailed database (MAcMapHS6) at the HS6 level (5,113 products);[7] this permits a better handling of the tariff dispersion (which matters as far as the gains of tariff removal will depend on such dispersion) as well as introducing sensitive products. TRQ data (in and out-of-quota tariffs, quota levels, quota primes and imports under TRQs) are also provided at the HS6 level, leading to state realistic scenarios about very sensitive products. This data also allows the analysis to be based on actual applied tariffs, including preferential provisions (e.g. GSP, FTAs, etc.).

1.4.2 Pre-experiment and reference baseline

Before the simulation of any scenario, several elements are included in the reference situation in order to have a realistic baseline: the end of the Multi-Fibers Agreement (2005), the United States' 2002 Farm Bill and the end of the implementation period of China commitments as a new WTO member (2005). All the tariff simulations are applied at the HS6 level taking into account all relevant information (Bound tariffs, MFN applied tariffs and preferential applied tariffs), then aggregated to the model nomenclature (Table 1.2) using the reference group weighting scheme in order to avoid biased tariffs due to tariff aggregation (Bouët et al., 2002).[8] Starting from the 2001 protection data provided by MAcMapHS6-v1 (used in GTAP6), we move to the 2004 level of protection (MAcMapHS6-v2),

[7]Regarding border protection, the database used to construct the scenarios of trade liberalization at the product level is MAcMapHS6 (Bouët et al., 2004). The base year for the first version of MAcMapHS6 (v1) is 2001 and for it second version the base year is 2004.

[8]The reference group weighting scheme used to aggregate MAcMaps' tariffs was developed by Bouët et al. (2002). For that purpose, authors have defined 5 groups of countries according to their GDP per capita, imports per capita and also exports per capita. Trade of these five groups of reference is used as weight to aggregate tariffs in order to avoid biased tariff due to other aggregation schemes.

and then we apply realistic trade policy changes.

Starting from this common ground, different baselines, used later as counterfactual, are built:

- (R1): the "business as usual" situation, with a Mercosur without Venezuela.
- (R2): (R1) + a successful DDA
- (R3): (R1) + the Venezuela accession
- (R4): the Venezuela accession plus a successful DDA (R1) + (R2) + (R3)

The accession of Venezuela to Mercosur has two main aspects: Venezuela adopting the Mercosur Common External Tariff (CET), and a trade liberalization between Venezuela and its new Mercosur partners. However, we keep the current preferences between Venezuela and the Andean Community constant. This regional integration is implemented during the seven years between 2007 and 2014. Argentina and Brazil will eliminate their tariffs by 2010, and Uruguay and Paraguay will do the same by 2013. Venezuela will start its tariff elimination by 2012 (tariff cut for non-sensitive products) and will finish it by 2014 eliminating tariff for sensitive products (chemical and petrochemical products, paper products, automobile, etc.) at the full completion of the agreement.

The Doha scenario considered here is similar to Lamy's 20-20-20 proposal.[9] This expected compromise can be described as following: a Swiss formula with a coefficient 10 for developed countries and 20 for developing ones in Non-Agricultural Market Access (NAMA). The G20 proposal in agriculture: a tiered formula for tariffs,[10] a new ceiling for domestic support in the North, and the phasing out of

[9]**G-20**, **Swiss 20** and **below USD 20 billion overall trade-distorting supports**. G-20 refers the cut into farms tariffs proposed by this group, a Swiss formula with a coefficient of 20 for reducing developing country industrial tariffs, and reducing the ceiling for the US overall trade-distorting supports to below USD 20 billion (Bridges, 2006)

[10]A tiered formula with inflexion points at 20, 50 and 75 percent, using average tariff cuts of 45, 55, 65 and 75 percent. For developing countries, the inflexion points are placed at 30, 80 and 130 percent and the average cuts at 25, 30, 35 and 40 percent. Final tariffs are capped at 100% for developed countries and 150% for developing countries.

export subsidies at the 2013 horizon; a Special and Differential Treatment making LDCs exempted from any tariff cuts and asking them to just continue the binding process (Fontagné et al., 2007). Other exclusions and flexibilities are introduced: a series of developing countries will not liberalize their manufacturing sectors due to a low initial binding rate (the so-called "Paragraph 6" countries of the NAMA framework); small and vulnerable economies (including Paraguay and Bolivia) are conceded zero liberalization. A final exception is that South Korea is treated as a developing country for agriculture and as a developed country for the NAMA.

Next, we address the issue of special and sensitive products, in order to examine the "variations" around the central scenario. "Sensitive products" and "special products" have to be defined for each country.

For both the agricultural and manufacturing sectors, sensitive products are defined following a political criteria in line with that proposed by Jean et al. (2005). We make the assumption that tariffs are currently higher where political sensitivity is the highest, and that governments take into account the effective impact on the formula of the applied tariffs and the price impact for domestic producers and consumers. In agriculture, sensitive products can appointed by all countries and are subject to a smaller liberalization than ordinary products. In NAMA, sensitive products are totally excluded from liberalization but this option is restricted to developing countries. In agriculture, developing countries are entitled to have some special products related to food-safety issues that will also be excluded from liberalization. More precisely, to define these products we compare situations in which normal rules and specific treatments are applied. As special products are concerned, we exclude 10% of the HS6 positions from liberalization, giving priority to the list of positions selected on the basis of their caloric contributions.[11] Thus sensitive products are defined as 4% of the HS

[11] 5% of agricultural HS6 lines are chosen according to the caloric contribution of their trade. Using the FAO data about caloric contribution per unit per product, we match with bilateral trade (volume) at the HS6 level from BACI database. These products are ranked following this indicator and 5% of their tariff lines are consider in prority to choose special products. Finally, the choice of special and sensitive products is done following their political relevance (Jean et al., 2005). The difference between special and sensitive products in the Doha scenario is that

headings with the highest sensitivity indicator.[12] For these products, we apply half of the formula effect on bound rates. When HS6 positions entail TRQs, we apply 2/3 of the formula (mimicking an increase in the quota). For NAMA, the sensitive products of developing countries can cover 10% of their HS6 positions and up to 10% of their trade. For sensitive and special products, no capping at the HS6 level is considered.

The DDA commitments are fully implemented after four years for developed countries (2008-2012) and seven years for developing countries (2008-2014).

1.4.3 Scenario

The accomplishment of the EU-Mercosur trade agreement is subordinate to the multilateral negotiations at the WTO for two reasons: the 'single pocket' constraint for the EU, and the value of preferences on both markets. Indeed, if an ambitious Doha Round succeeds, why making efforts to obtain a preferential access in a market that is already largely open to other competitors? Because of this uncertainty, our pre-experiment scenarios assume both possibilities, success and failure of the multilateral trade agreement before the signature of the bilateral EU-Mercosur agreement. The fact that we consider a WTO trade agreement before the EU-Mercosur PTA also affects our choice of sensitive products for the bilateral negotiation, leading thus to the second justification of our scenario and pre-experiments. Moreover, Venezuela as a new Mercosur member also may change the future of the EU-Mercosur PTA.

The current horizon of the EU-Mercosur agreement is seven years. Both scenarios start in 2008.

Because in October 2004 there were no new proposals exchanged, we simulate an average agreement between EU and Mercosur proposals (October 2004), also

the first 10% of tariff lines will not be liberalized (special products) and the following 4% of agricultural tariff lines are considered as sensitive with a minor liberalization.

[12]This indicator was developed by Jean et al. (2005); it means that a product will be more or less sensitive depending on value of its imports and the square proportional reduction in its import price due to the bound rate cut.

including some new TRQs opened by the EU for some particular products.

Trade liberalization for this bilateral trade agreement is total and reciprocal for all products except for sensitive and very sensitive products. The former tariff lines have been chosen following the same approach as for the DDA scenario. For Mercosur, 10% of tariff lines are sensitive products in general. Very sensitive products concern the first 5% of tariff lines and the former 5% of HS6 lines are only sensitive products. In the case of the EU, very sensitive products are HS6 lines under WTO TRQs such as meats, cereals and some dairy products and also other products for which the EU has the intention to open new bilateral TRQs for Mercosur (ethanol, sugar, cocoa and tobacco).

This distinction between sensitive and very sensitive products leads us to introduce different patterns of trade liberalization. Sensitive products of both regions will be liberalized in five years, while very sensitive products will not be liberalized in the case of Mercosur and liberalized only through TRQs in the case of the EU.

EU sensitive products are almost equally shared between agricultural and manufactured chapters; however sensitive and very sensitive products for Mercosur are essentially located in the industry.

[INSERT Figure 1.13]

[INSERT Figure 1.14]

In terms of trade, sensitive products represent 21% of EU imports and very sensitive products 18%. Conversely, with just 5% of lines on both categories, the Mercosur may classify 14% of its imports as sensitive and 44% as very sensitive. This last share of unliberalized products is extremely high and a stronger discipline on the number of lines should be considered (see Figure 1.14 and 1.13).

Since the sensitive product list is endogenous to the initial tariffs and trade flows, the lists of sensitive products are baseline dependent. For the EU, without the Venezuela into Mercosur, the sensitive product list related to the agreement is not affected by the conclusion of the DDA. Indeed, most of the sensitive products in agriculture in the EU-Mercosur relation are also sensitive for the WTO talks and the DDA will not change the pattern of protection, i.e. the ranking of sensitivity, on goods exported by Mercosur countries. However, Venezuela's accession has a more significant impacts. Nearly 20% of the list will be modified: agricultural products as well as clothings and footwear will be replaced by chemicals (organic and inorganic), aluminum, metals, plastics and glass products. In this case, the DDA will bring a marginal change to the list (10 products) adding aluminum, fisheries and organic chemicals. Indeed, without flexibility in the DDA for the EU and with the application of a swiss formula, the structure of tariff in non-agricultural goods will be more affected by the WTO Round. As for Mercosur, sensitive and very sensitive product lists are impacted by the positive outcome of the DDA. 10% of the products, among them chemical products, tanning or dyeing extracts, textiles and vehicles, are replaced by machinery, organic chemicals, photography and optics. The Venezuela accession has similar effects in magnitude but in this case, the number of sensitive products in agriculture, vehicles, wearing and apparel increased (see Figures 1.15 and 1.16).

[INSERT Figure 1.15]
[INSERT Figure 1.16]

The initial average rates of protection is positively related to the degree of sensitivity, is a direct consequence of the criteria chosen. In the case of the Mercosur, the selection criterion identifies industrial products as very sensitive (14.3% to 17%), while for the EU very sensitive products are concentrated in the tariff peaks in agricultural products.

Considering the very sensitive products, we made two assumptions for the scenario concerning agricultural products. For products under WTO TRQs we simulate a quota enlargement without any change in tariffs (inside and outside). The quota enlargement for these products is based on the comparison of the present utilization of the WTO TRQs by the Mercosur countries and the new quota volume (average between EU and Mercosur proposals, See Table 1.3). Since in the version of MIRAGE used here there is no explicit modeling of TRQs,[13] the

[13] In Chapter 2 we will present a TRQ modeling for MIRAGE.

quota enlargement does not affect the TRQ regimes (in, at or out-of-quota). The quota enlargement simulated in the MAcMapHS6 database only leads to a larger quota rent. For Mercosur very sensitive products, no liberalization takes place.

[INSERT Table 1.3]

For the new bilateral TRQs (ethanol, sugar, cocoa and tobacco) opened to Mercosur countries we consider some special tariff lines at 8 and 4 digits level.[14] The new TRQs will be set at 1.5 of traditional bilateral trade.

[INSERT Figure 1.17]
[INSERT Figure 1.18]
[INSERT Figure 1.19]
[INSERT Figure 1.20]

Due to the very sensitive products, this PTA is far from being a total liberalization scenario. In practice, the non-agricultural protection of the Mercosur regarding EU exports is cut by 50% (Argentina) to 60% (Brazil); conversely, agriculture protection is reduced by more than 80%. For the EU, even if during the implementation period sensitive products are excluded from liberalization, tariffs will eventually be eliminated. Non-agricultural goods from Mercosur countries gain free access to the EU, while the EU agricultural protection will be reduced by 65% (for Argentina) to 95% (Uruguay and Paraguay). The different baselines bring some significant changes. The accession of Venezuela to Mercosur will affect the choice of sensitive lines by the enlarged trade bloc towards agricultural products. The market access gains for the EU will be slightly reduced (to nine tenth of the basic cut). As expected, the main changes are driven by the DDA. The DDA will already achieve one fifth of the opening of Mercosur non-agricultural markets to EU exporters, and half of the market access improvement as regards

[14]The new quota for Ethanol would concern only 4 product lines (22071000, 22072000, 22089091, 22089099), for Sugar only 7 products (17025050, ex17499099 -17499080-, 18061090, ex18062080 -18069080-, ex18062095 -18069080-, ex18069090 -18061980-, ex18069090 -18069980-), for cocoa and Tobacco all products under the following HS4 codes: 1803, 1804, 1805 for cocoa and 2402, 2403 for Tobacco.

to Mercosur agricultural exports to the EU. It seems that the gains of the EU-Mercosur agreement could be significantly impacted by a successful DDA: the direct gains will be reduced, and the value of the granted preferences will be reduced by increasing competition of third countries. To check the consequences of this limited agreement, we also assess a 100% liberalization (FTA).

1.5 Simulations Results

The EU-Mercosur PTA scenario is simulated under four different baselines (R1, R2, R3 and R4) described in the previous sections. All results are presented in terms of percentage variations compared to baseline R1 in order to become all results comparable.

We firstly present the results of the EU-Mercosur PTA under our reference scenario (baseline R1 without the Doha agreement nor the Venezuela accession to Mercosur). Second, we show the results of this PTA under the rest of baselines (R2, R3 and R4) by comparing them with those of the reference scenario (R1). Finally, we discuss about the most profitable scenario for trade and welfare of each partner.

1.5.1 EU-Mercosur PTA: the reference scenario (R1)

Venezuela has officially entered Mercosur in July 2006. However, Brazil and Paraguay still need to ratify this decision. Furthermore, this implies a trade liberalization between existing Mercosur countries and Venezuela that is still to be undertaken. Obstacles may emerge at any time so that it was useful to consider the possibility of Venezuela not to complete the entry process. It is also useful as a way of comparing our results to those in the literature that do not consider Venezuela as a Mercosur member.

The Doha agreement should has initially to be concluded in 2006 but the disagreement in agricultural market access (subsidies and trade protection) truncates the end of this round. Conversely, other many improvements have been done during these years of negotiations but at the same time in last Ministerial

Meetings some countries set the possibility of the collapse of trade liberalization talks. For our EU-Mercosur PTA simulation is thus necessary to assume both the success and the failure of the DDA.

- Trade Impact:

  The EU-Mercosur agreement displays asymmetric consequences for trade in both Mercosur and European regions. For example, Brazil total exports increase by 8.7%, while those of the EU27 only increase by 0.8% (Table 1.21).

  Concerning European bilateral trade, we find that the European exports to Mercosur do not compensate its imports from the latter, and thus the real exchange rate depreciates in the EU in order to preserve the current account balance. The same situation is observed in the case of Venezuela which suffers from a real depreciation. For the Mercosur countries, bilateral trade with the EU leads to an appreciation of the real exchange rate (Table 1.23).

  [See Table 1.21 for scenario R1]

  [See Table 1.22 for scenario R1]

  [See Table 1.23 for scenario R1]

  Trade creation effects are strong in the EU and Mercosur trade relation, since European exports to Mercosur increase more than 20% (21% to Argentina, 26% to Brazil and 27% to te resto of Mercosur) and her imports from this Latin American region also increases (16% from Argentina, 59% from Brazil and 55% from the rest of Mercosur) (Tables 1.25 and 1.24). Argentina and EU27 trade gains are equally shared between industrial (4.16% and 1.52% respectively) and agricultural (3.95% and 1.5% respectively) sectors. Most of agricultural trade increase in Argentina are concentrated in a few sectors (MeatCattle 28% and Dairy products 50%), while those in the EU27 are equally distributed among all sectors (Tables 1.26 and 1.28).

In the case of the EU, all sectors benefit from an increase in exports, even critical sectors, such as Sugar (7.4%) and Rice (3.4%). Brazil and the rest of Mercosur only benefit from an incerase in agricultural sectors (5.8% and 4.9% respectvely), particularly for MeatCattle, Dairy products, Sugar, Rice and Cereals sectors (Tables 1.27 and 1.29). All these sectors are initially very protected in the EU and thus even an small tariff cut lead to these crountries to benefit from this PTA with the EU. Moreover, the choice in the sensitive products have an important impact in this agreement, an smaller tariff cuts in agrocultural sensitive products lead to improve market access for Mercosur countries in the EU, while protect (TRQs and lower tariff cuts) some controversial sectors in the EU.

In spite of important trade creation effects, this PTA also generate some important trade diversion consequences are also non-negligible under this scenario. First of all, Venezuela is harmed by the fact that not to be considered as a Mercosur member at the moment of the EU-Mercosur PTA signature, and thus its bilateral trade with the European Union decreases (-1.5% in Table 1.25). The regions which suffer from trade diversion effects are the rest of the Cairns group (developed and developing countries), the rest of South American countries (-0.11% on its total exports), Sub-Saharan African countries (-0.23% of their total exports) and some develped countries such as the NAFTA (-0.08% of total exports). Their bilateral trade with the European Union are especially harmed as a consequence of the improvement in trade relations with Mercosur (Table 1.25).

[See Table 1.25 for scenario R1]

[See Table 1.24 for scenario R1]

- Macroeconomic impact:

Assuming that the Doha agreement is not achieved nor the Venezuela accession to Mercosur, we find that the EU-Mercosur PTA is a welfare-improving scenario for Mercosur (Argentina 0.12%; Brazil 0.47%, and Uruguay and

Paraguay 1.23%) and the EU27 (0.1%). However, Venezuela shows a small negative impact on its welfare (-0.01%). Decomposing welfare impact, we observe that most welfare gains for Mercosur are due to capital accumulation and terms of trade gains (especially for Brazil, Uruguay and Paraguay in Table 1.12).[15] Terms of trade improve especially for Uruguay and Paraguay because they initially suffer from highest protection compared to their Mercosur partners (see Subsection 1.3.3). Very sensitive products represent an important share of initial imports, and since they are not liberalized, allocative efficiency gains are very weak in this PTA scenario.

[See Table 1.6 for scenario R1]

GDP increases in all Mercosur countries (Argentina 0.11%; Brazil 0.34%; Uruguay and Paraguay 1%) and the EU (0.11%) as a consequence of this bilateral agreement, whereas in Venezuela it slightly decreases (-0.08%) because this country does not benefit from the EU-Mercosur PTA under this scenario.

[See Table 1.13 for scenario R1]

Even if sensitive products for the European Union are mainly concentrated in agricultural products, their slight trade liberalization through this PTA harms European agricultural employment (-0.64%in Table 1.14). The same impact is observe in the case of non-agricultural employment in Mercosur countries (Argentina -0.07%; Brazil -0.16%, and the Rest of Mercosur[16] -1%) for whom most sensitive products are in manufactured sectors (Table 1.15). Moreover, capital returns decrease only in Argentina, and land returns only do in Venezuela and the EU27 as it was expected (Tables 1.16, 1.17 and 1.18). However, skilled and unskilled labor wages increase for all partners of the EU-Mercosur PTA (Tables 1.19 and 1.20).

[15] Note that TRQ gains may be overestimated since TRQ mechanisms are not modeled in this version of MIRAGE. Only exogenous TRQ-rents have been introduced.

[16] Uruguay and Paraguay

1.5.2 EU-Mercosur PTA: with and without DDA (R2 vs. R1)

We next compare the trade and welfare results of the EU-Mercosur PTA after the Doha agreement (R2) with those of the reference scenario (R1) presented above.

- Trade Impact:

  The assumption of a successful Doha agreement in the baseline intensifies asymmetries of this preferential agreement. Mercosur countries (and even Venezuela) display a greater increase in total trade, while the European trade increases less than under the scenario described above (see Tables 1.21 and 1.22 to compared scenarios R1 and R2). For instance, Brazil's exports increase by 10%, while EU exports only do by 0.3%. This scenario is most profitable for Brazil than for the EU compared to R1.

  Nevertheless, consequences on the real exchange rate shows that its depreciation (appreciation) in the European Union (Brazil and Argentina) would not be as big as if Doha agreement did not happen. This results infer that bilateral trade for the EU (Brazil and Argentina) is less (more) disfavorable than under the previous scenario (Table 1.23 for scenario R2).

  Looking at bilateral trade between the European Union and different regions of the world, we find that Doha in the baseline (R2 reference situation) leads to trade gains with Mercosur countries, which are then intensified due to the EU-Mercosur PTA (Tables 1.24 and 1.25). Bilateral trade between this two regions more than the previous scenario, where most trade gains come from the EU-Mercosur PTA and not from the Doha agreement, even if the latter leads to an important increase in market access improvements. This scenario is one of the most propitious one for Mercosur agricultural exports. Compared to the previous scenario, Argentina only increase its agricultural exports, benefiting the same sectors (MeatCattle 31% and Dairy products 40%) but also Rice (22%) and Wheat (25%) ones (Table 1.26). For Mercosur, Doha in the baselines oblige the EU to reduce even more the protection level especially for meat, rice and wheat, leading to greater trade increases for Mercosur countries than under the scenario R1 (Tables 1.26, 1.29, 1.27). For Brazilian exporting sectors and for the EU imports (by sector) there is also slight trade increases; however no important difference between the two first scenarios is observed (Tables 1.27 and 1.28).

Moreover, Doha agreement also leads to trade gains for other regions in bilateral trade with the EU, such as with others Cainrs group countries (8.7% for developed and 0.3% for developing countries) and other Latin American countries (4.4% except for Chile which loses -2.6%) and NAFTA (0.9%) but the EU-Mercosur PTA reduces the initial gains in Doha.[17] However, trade diversion effects intensify for Mediterranean (-2.3%) and Sub-Saharan African countries (-2.6%), which are traditional trade partners of the EU (Table 1.25 for R2). In short, a Doha agreement in the baseline not only leads to trade creation effects between the EU and Mercosur but also reduces trade diversion effects for some other regions compared to the R1 scenario.

[See Table 1.25 for scenario R2]

- <u>Macroeconomic impact:</u>

  In terms of welfare, this scenario is less favorable than the previous one (R1). The welfare in the EU27 (-0.5%) and in the larger Mercosur countries[18] decreases, while for the smaller Mercosur countries (0.75%) the EU-Mercosur PTA is always a welfare-improving scenario due to their terms of trade improvement. This result is also explained by smaller allocation efficiency gains in these countries, because the EU-Mercosur PTA (after a multilateral trade agreement) leads to a less efficient factor allocation (Tables 1.6 and 1.7).[19] Real GDP results follow the same trend as welfare, with

[17]These results come from the comparison between baselines situations R1(Ref) and R2(Ref) not available in Tables but under request.

[18]For Argentina -0.12% and for Brazil -0.8%

[19]Capital accumulation and land supply gains are also smaller but the differences compared

a decrease for the EU, Argentina and Brazil and an increase for Uruguay and Paraguay. For all countries, GDP variations are greater under R1 than under this scenario.

[See Table 1.6 for scenario R2]

[See Table 1.13 for scenario R2]

Employment consequence of this scenario also differs from scenario R1. Agricultural employment increases for all partners regions, even for the EU (1%) especially due to the increase in food trade (Beverages 1.3%, CattleMeat 12.8%, Dairy products 4.8% and Fats 2.3%), while the employment in non-agricultural sectors decrease also in all regions (i.e -0.4% in the EU due to exports reduction in the Autombile and Textile sectors explained by the Doha agreement in the baseline) (Tables 1.14 and 1.15 for scenario R2).

Factor returns also change due to the Doha agreement hypothesis in the baseline. Real land returns increase in Mercosur countries and natural resources returns also do in Venezuela as it was excepted after an important trade liberalization scenario (Doha + EU-Mercosur PTA), while capital returns decrease for all EU-Mercosur PTA partners (Tables 1.16, 1.17 and 1.18). Real skilled and unskilled labor wages also decrease for all partners, except in Uruguay and Paraguay where they increase by 0.8% and 1.5% respectively (Tables 1.19 and 1.20). These changes in factor returns also contribute to a less efficient factor allocation due to the EU-Mercosur PTA.

1.5.3 EU-Mercosur PTA: with and without Venezuela into Mercosur (R3 vs. R1)

We now analyze the consequences of the EU-Mercosur PTA depending on whether Venezuela becomes a full Mercosur member or not.

to results in the scenario R1 are less dramatic (Tables 1.8 and 1.9). TRQ gains also decrease except for the rest of Mercosur (Table 1.10) but, once again, this precise point in the results is not fully reliable because the true TRQ mechanism is not represented in this version of MIRAGE.

- <u>Trade Impact:</u>

  The asymmetry of the EU-Mercosur agreement persists for trade results by considering Venezuela as a full Mercosur member. Total trade variations for all partners are greater but quite similar to those of scenario R1, and thus this baseline assumption slightly affects EU and Mercosur trade (excluding Venezuela). However, the fact that Venezuela becomes a Mercosur member is a crucial hypothesis for trade of this country, because its exports and imports increase by 2.7% and 3.3% respectively (Tables 1.21 and 1.22 for R3). The increase in Venezuela's total trade comes basically from the EU-Mercosur PTA, because the accession to Mercosur only represennts less than 1/4 of this effect (0.4% for exports and 0.5% for imports), while the PTA strongly intensifies this effect.

  [See Table 1.21 for scenario R3]

  [See Table 1.22 for scenario R3]

  [See Table 1.23 for scenario R3]

  Depreciation of the real exchange rate in the European Union does not differ from the results of scenario R1; however, it intensifies in the case of Venezuela (-0.16%). Venezuela as a new partner of the EU-Mercosur PTA does not lead its exports to increase enough in order to compensate its imports from the EU, and thus the real exchange rate depreciates even more by comparing them to scenario R1. By contrast, the equilibrium condition of the current account balance leads to a greater appreciation of the real exchange rate in the case of Mercosur countries compared to scenario R1 (Table 1.23 for R3).

  [See Table 1.25 for scenario R3]

  [See Table 1.24 for scenario R3]

  Bilateral trade results show that the Venezuela accession to Mercosur does not reduce trade diversion effects, except for this country. Moreover, bilateral trade between the EU and Mercosur countries displays smaller trade variations because of the new Mercosur member. European imports from Venezuela increase by 15%, while its exports to the Venezuela increase by 23% (Table 1.25 and 1.24). Venezuelan exports to the EU mainly concern agricultural sectors (26%), even if his manufactures and services exports are not harmed by this preferential agreement (0.6% and 3% respectively in Table 1.30). Agricultural sectors which benefits the most from this PTA agreement are Diary products, which in terms of trade volumes remains small, and Vegetables and Fruits which is the representative sector of the agricultural trade of this country.[20]

[See Table 1.30 for scenario R3]

- Macroeconomic impact:

  The EU-Mercosur PTA under this baseline scenario (Venezuela accession to Mercosur) leads to greater welfare gains for Mercosur (excluding Venezuela) and the EU. In terms of welfare consequence, this scenario does not seems to be a great opportunity for Venezuela because of the deterioration in its terms of trade (Table 1.6 and 1.12 for R3). However, looking at the decomposition of welfare for this country, allocation efficiency gains increase as well as land supply gains (Tables 1.7 and 1.9).[21] GDP results displays the same evolution as welfare in this scenario and their variations are greater than under R1 (Table 1.13).

  Agricultural employment does not differ much from the results presented in scenario R1; however, the Uruguay and Paraguay employment in agricultural sectors increases by more than 3%, which is normal since only

[20]The increase in Venezuela's agricultural export to the EU may be explained by a problem in the update of the MAcMap database. The last release of this database is for year 2004 and thus it does not completely consider the Venezuela's preferences under the European GSP+.

[21]Note that most welfare losses in the case of Venezuela is explained by capital accumulation losses and other sources of losses (residual calculation). The welfare gains linked to TRQ-rents may be a source of distortion in welfare decomposition as we will see in Chapter 2. Nevertheless an improvement in welfare decomposition of this model should be done in order to reduce residual gains/losses.

agricultural trade and production increase (Table 1.14). Conversely, the employment in non-agricultural sectors slightly increases in Argentina (0.06%), Brazil (0.05%) and the EU (0.06%), while it decreases in the smaller Mercosur countries (-0.9%) and Venezuela (-1%) because the latter moves to agricultural sectors (Vegetables and Fruits in Venezuela, and MeatCattle, Rice, Sugar and Dairy products in the rest of Mercosur). The Venezuela accession to Mercosur lead to Mercosur countries, especially to Argentina and Brazil, to increase their non-agricultural trade and thus their non-agricultural employment; however, the EU-Mercosur PTA introduces a trade diversion effects for harming Mercosur industrial trade in favor to European one (Table 1.15). Factors returns follow the same trend as in scenario R1 for most of regions; however, the returns for Venezuela's natural resources and land increase (1.5% and 1.2% respectively) while capital returns decrease (-0.75%) since agriculture and primary products benefits especially from this agreement (Tables 1.16, 1.17 and 1.18 for R3). Skilled and unskilled labor wages also decrease in Venezuela (1.8% and 0.9% respectively in Tables 1.19 and 1.20 for scenario R3).

1.5.4 EU-Mercosur PTA: with a successful DDA and the Venezuela accession into Mercosur

We consider here the most optimistic future situation for all trade agreements. We compare the results of the EU-Mercosur PTA under the R4 baseline to the previous scenarios highlighting the main differences introduced by each baseline assumption.

- Trade Impact:

  The baseline scenario R4 (a successful DDA and the Venezuela accession to Mercosur) combines the results shown for scenarios R2 and R3. In terms of trade gains, this scenario leads to a greater total trade gains for all partners of the EU-Mercosur PTA (also including Venezuela). This is the scenario that leads us to infer that a PTA would survive a multilateral trade agreement, and even also to the Mercosur enlargement.

The equilibrium condition of the current account balance leads to lower real depreciation (appreciation) in the EU (Brazil, Argentina, Uruguay and Paraguay) than under the three scenarios presented above, while in Venezuela the increase in exports does not compensate that in imports and thus leads to a greater real depreciation under this scenario (Tables 1.21, 1.22 and 1.23 for scenario 4).

[See Table 1.21 for scenario R4]

[See Table 1.22 for scenario R4]

[See Table 1.23 for scenario R4]

Total an bilateral trade shows that trade creation effects not only benefit the partners of this PTA but also other developed and developing countries (Cairns group, NAFTA, other South American countries) as well as under scenario R2. For all EU-Mercosur PTA partners, this is the scenario preferred in terms of trade creation, except for Venezuela for which the better scenario for trade is its accession to Mercosur (baseline scenario).

Moreover, trade diversion effects are lower than in the previous scenarios, and countries like Chile would be even less harmed than under scenario R2. However, trade diversion consequences persist and intensify in the case of the bilateral trade relation between the EU for the Sub-Saharan African and Mediterranean countries (-2.6% and -2.3% respecively in Table 1.25).

[See Table 1.25 for scenario R3]

[See Table 1.24 for scenario R3]

Looking at sectoral trade, Mercosur exports and EU imports increase mainly for the most controversial products, sugar and meat, harming European production. The smaller Mercosur countries (Uruguay and Paraguay) benefit the most from this last scenario; however, this analysis does not take into account all non-tariff barriers that presently constrain their exports from in the EU market, especially for meat exports.[22] In the case of Venezuela, vegetables and fruits and some dairy products would benefit the most from this PTA.

[See Table 1.29 for scenario R4]

[See Table 1.28 for scenario R4]

[See Table 1.30 for scenario R4]

- Macroeconomic impact:

  This scenario is also welfare-improving for all original Mercosur countries (Argentina 0.02%, Brazil 0.13% and 0.9% for the rest of Mercosur), but not for the EU (-0.5%) and Venezuela (-1.6%) mainly because of the deterioration in their terms of trade. Looking at Table 1.6 and comparing results for R3 and R4, we can infer that adding the Doha agreement to the Venezuela accession to Mercosur in the baseline, deteriores welfare gains of the EU-Mercosur PTA for all partners. GDP also follows the same trend as welfare for all PTA partners (Tables 1.13 for R4).

  [See Table 1.6 for scenario R4]

  Employment in agriculture increases in Mercosur (3% in Argentina, 5.5% in Brazil, 3.8 in the rest of Mercosur and except in Venezuela -0.6%) and the EU (1%) as a consequence of this PTA, while non-agricultural employment decreases in all the EU-Mercosur PTA partners (-1.3 in the resto of Mercosur and -1.8% in Venezuela). Mercosur employment is oriented to agricultural sectors as a consequence of this PTA, and European one also does because the agricultural production increases in all sectors except for cereals, crops, fishing, sugar and rice, and her agricultural exports also increase, especially for Dairy products (19%), MeatCattle (16%), MeatOther (14%) and even for

[22] For instance, nowadays Paraguay cannot export beef to the EU due to sanitary problems.

Sugar (36%). The existence of sensitive products, which are less liberalized, lead European agriculture to be less harmed than under an FTA with the Mercosur. From a political point of view, and particularly for Mercosur, we may say that the EU-Mercosur PTA would lead to recover agricultural employment after the negative consequence of the DDA, even if we know that it is a less efficient result (Tables 1.14 and 1.15 for R4). Real returns for factors have also changed under this scenario. Capital real returns decrease for all partners, while land returns increase in the Mercosur (excluding Venezuela) and natural resources returns also increase in Venezuela (0.8%) as it was expected (Tables 1.16, 1.17 and 1.18 for R4). Table 1.20 and 1.19 shows that skilled and unskilled labor wages increase only in Uruguay and Paraguay (0.25% and 1.2% respectively), and unskilled wages also hold in Argentina (0.08%).

1.6 DISCUSSION AND CONCLUSION

The asymmetrical agreement between the EU and Mercosur simulated in this paper leads to asymmetric welfare and trade results for the two blocs. Under all scenarios, total trade increases more for Mercosur than for the EU, and European bilateral trade particularly shows an increase for meat and sugar imports from Mercosur countries, which are the most controversial sectors in these negotiations. Moreover, extra simulations of the EU-Mercosur free trade agreement under the same baselines leads us to infer that TRQs constrain bilateral trade for these sectors and thus a FTA between these regions would harm even more their production in the EU. However, results for sectors under TRQs are not reliable because of the simplified treatment of TRQs in this version of the MIRAGE model.[23]

Assuming the failure of the Doha agreement and the non-accession of Venezuela into Mercosur, the EU-Mercosur PTA leads to stronger trade diversion effects, while a successful Doha agreement in the baseline (reference situations R2 and

[23] This aspect is improved in Chapter 2.

R4) leads to increase slightly trade with other non-PTA partners (Cairns group, NAFTA and other South American countries). However, trade diversion consequences persist in bilateral trade relations between the EU and its traditional partners (Sub-Saharan Africa, Mediterranean countries and Chile). As expected, DDA in the baseline reduces negative impacts of this PTA for th rest of the world.

The Venezuelan accession to Mercosur is a crucial assumption for bilateral trade between this country and the EU. It leads to eliminate trade diversion effects suffered by Venezuela in the first baseline. Even if Venezuela exports to European countries increase, they do not compensate the greater augmentation in its imports coming from the EU. Moreover, for Mercosur this scenario is always welfare-improving and leads to trade gains, introducing slight differences compared to the reference situation without Venezuela into Mercosur.

Baseline assumption are crucial to analyze not only the global impact of the PTA in terms of trade but they also help to explain the interest of each partner to attain to this PTA

Facing bilateral and multilateral negotiations, policymakers are mainly interesting on welfare consequences for partners. For Mercosur countries there is strong incentive to achieve this PTA with the EU before Doha. On one side, Doha reduces their welfare gains and thus the incitation to sign the PTA after Doha. On the other side, if the EU-Mercosur PTA is signed, Mercosur have less incentives to continue to negotiate Doha. The main explanation is that for Mercosur countries the trade liberalization issue on stake is agriculture. Their trade gains are presently constrained by US agricultural supports and EU agricultural tariff protection. Since in our scenarios no US support cut is simulated, only tariff reduction would improve market access for Mercosur exports. For that reason a EU-Mercosur PTA is the best scenario, since under Doha more competition is introduced due to the non-preferential tariff cuts. Coming back to the title question: Will regionalism survive multilateralism? the answer would be again affirmative, because even after Doha, Mercosur countries may always increase their welfare due to the EU-Mercosur PTA. In the particular case of Venezuela, there is no real economic incentive to sign the EU-Mercosur agreement (welfare losses), and eventually it would accept it for the political reasons. Presently, the Venezuela benefits from the GSP+ and thus there is no real market access to improve. Moreover, Venezuela should reduce its tariff unilaterally to the EU which would be the explanation of its welfare losses. Venezuela as partners of the EU-Mercosur agreement has no important implications for the rest of partners, except for Brazil which would improve its welfare with this assumption.[24]

Since income distribution issues and inequality in Latin America is a structural problem of these economies, policymakers would ask about the gain distribution between unskilled labor, and capital and land owners. In all Mercosur countries, and particularly in Uruguay, Paraguay and Brazil, even after a Doha agreement these countries are motivated to sign a PTA with the EU because it lead to increase unskilled labor wages. If Doha is signed after the PTA agreement with the EU, unskilled labor will be the most affected production factors (even in the case of the EU). Capital and Land returns are not really affected by the interdependence of the multilateral agreement with EU-Mercosur PTA.

Finally, the welfare analysis and the distribution of the PTA gains between labor and other factors, lead us to conclude that the EU-Mercosur PTA will survive a multilateral trade agreement at the Doha Round. Moreover, the inclusion of a new partner in the PTA (Venezuela) does not harmed initial motivations of the original partners (Argentina, Brazil, Uruguay, Paraguay and the EU27). However, welfare consequences for the new Mercosur member are not encouraging and thus would become an extra obstacle to a future EU-Mercosur PTA.

[24] The Venezuela accession to Mercosur would mainly benefit Brazil because of the market access improvement for non-agricultural trade.

Figures and Tables

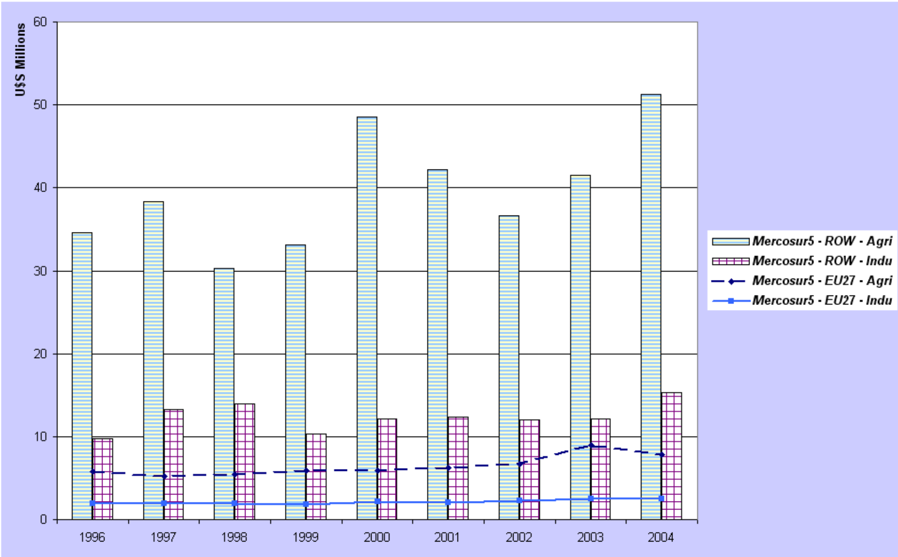

Figure 1.1: Mercosur (including Venezeula) total exports (in million dollar)

Source: BACI database - CEPII

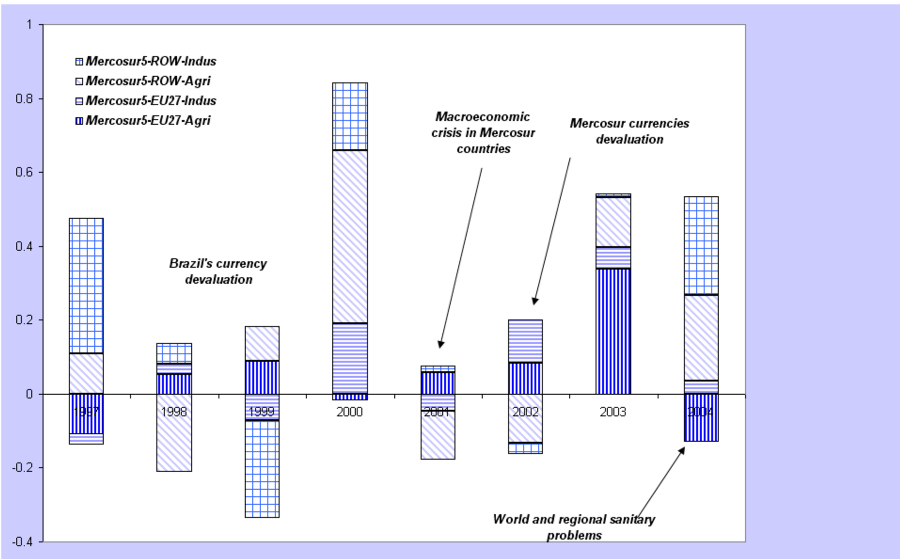

Figure 1.2: Mercosur (including Venezuela) total exports (in % variation)

Source: BACI database - CEPII

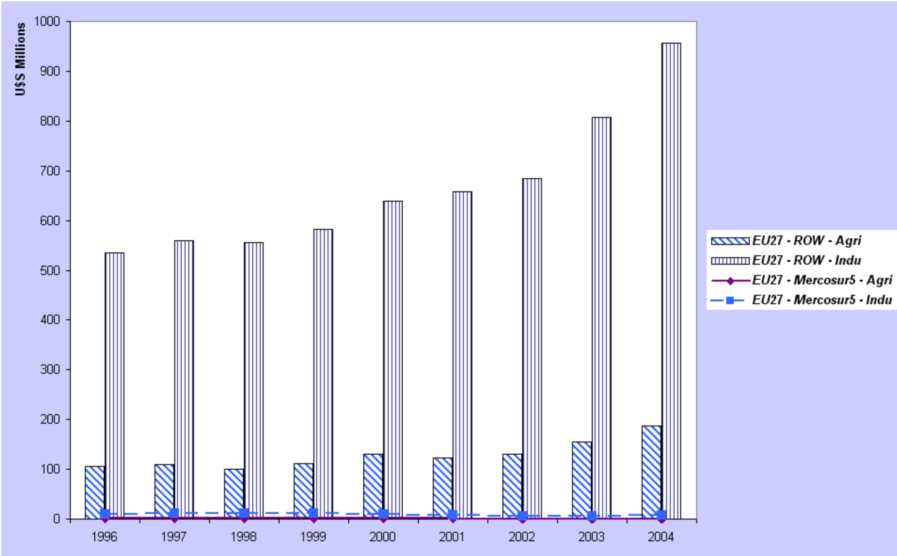

Figure 1.3: European Union (27) total exports (in million dollar)

Source: BACI database - CEPII

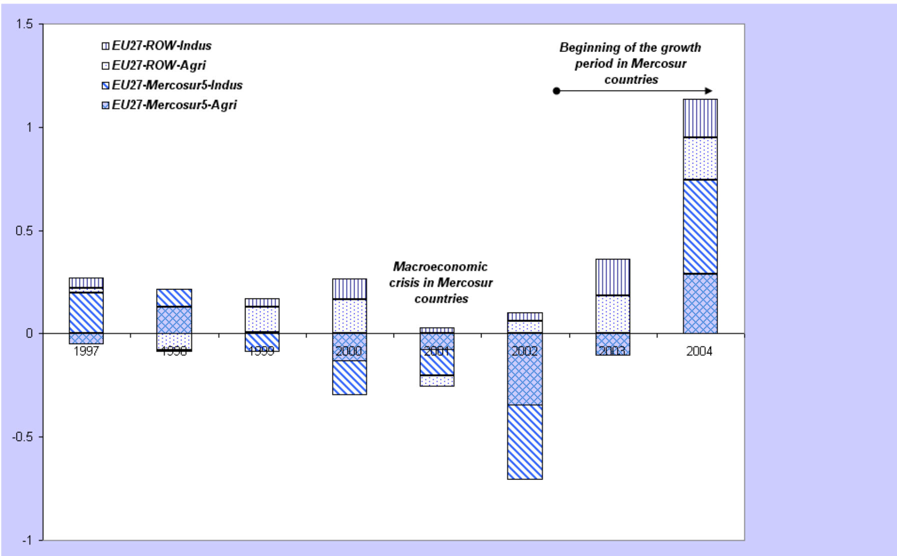

Figure 1.4: European Union (27) total exports (in % variation)

Source: BACI database - CEPII

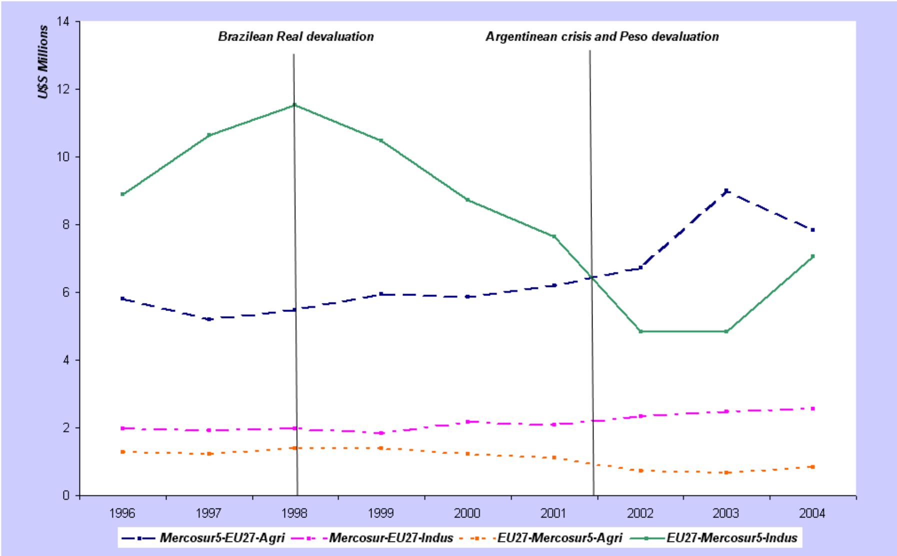

Figure 1.5: European Union - Mercosur bilateral trade (exports in million dollar)

Source: BACI database - CEPII

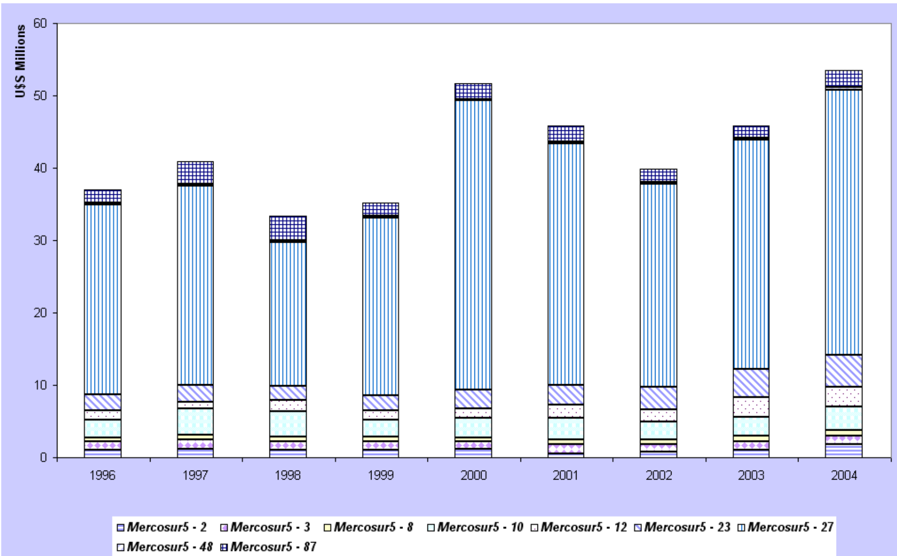

Figure 1.6: Mercosur exports to the European Union by HS2 level (in million dollar)

Source: BACI database - CEPII

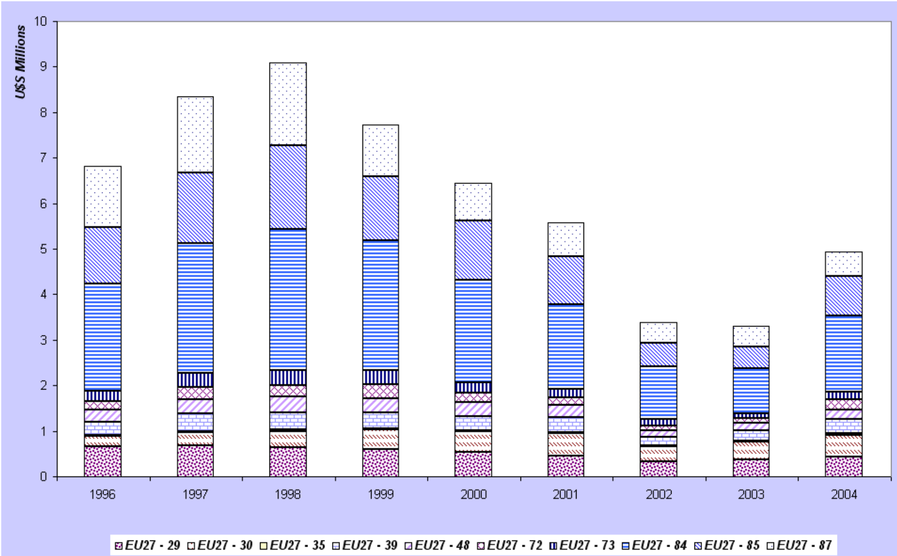

Figure 1.7: European Union exports to Mercosur by HS2 level (in million dollar)

Source: BACI database - CEPII

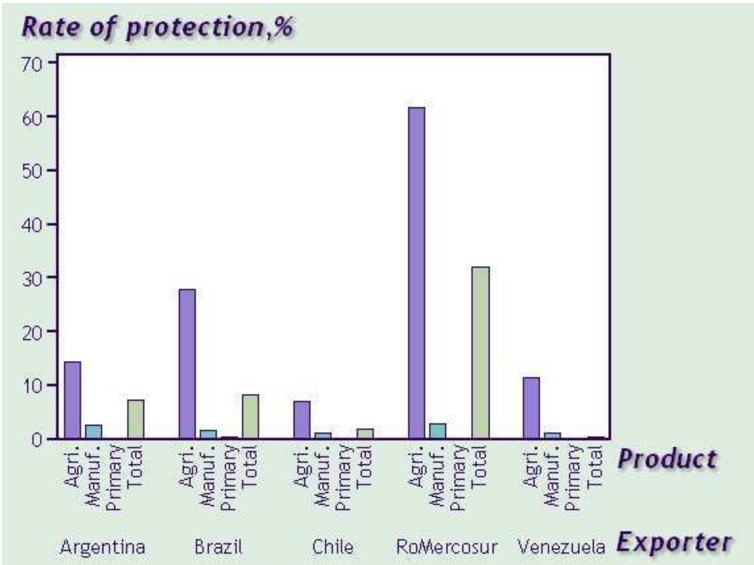

Figure 1.8: European Union average protection

Note: Authors' calculations using MacMapV2.03 (Base year 2004, Reference Group weighted average) - CEPII

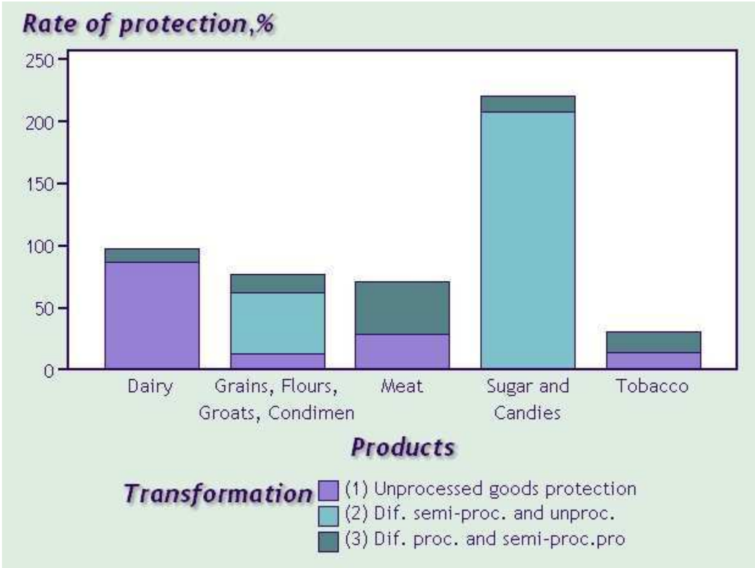

Figure 1.9: Highest European average rate of protection by added value

Note: Authors' calculations using MacMapV2.03 (Base year 2004, Reference Group weighted average) - CEPII

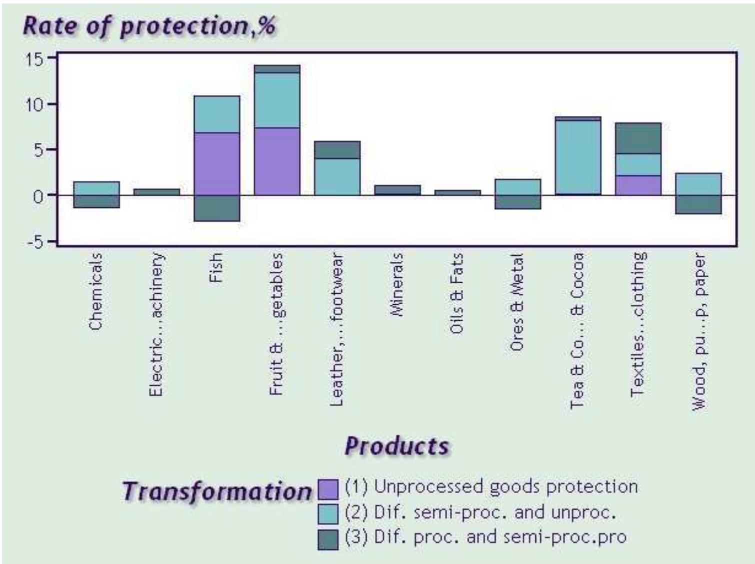

Figure 1.10: Lowest European average rate of protection by added value

Note: Authors' calculations using MacMapV2.03 (Base year 2004, Reference Group weighted average) - CEPII

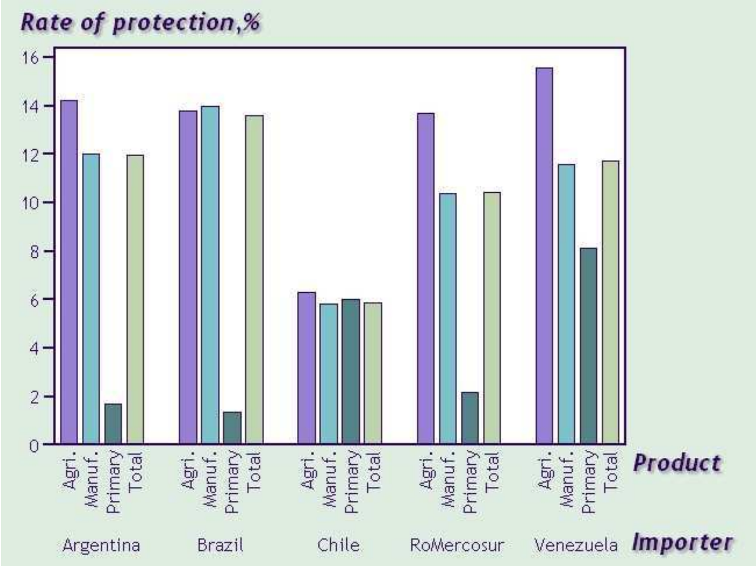

Figure 1.11: Mercosur Bilateral Protection applied on EU products

Note: Authors' calculations using MacMapV2.03 (Base year 2004, Reference Group weighted average) - CEPII

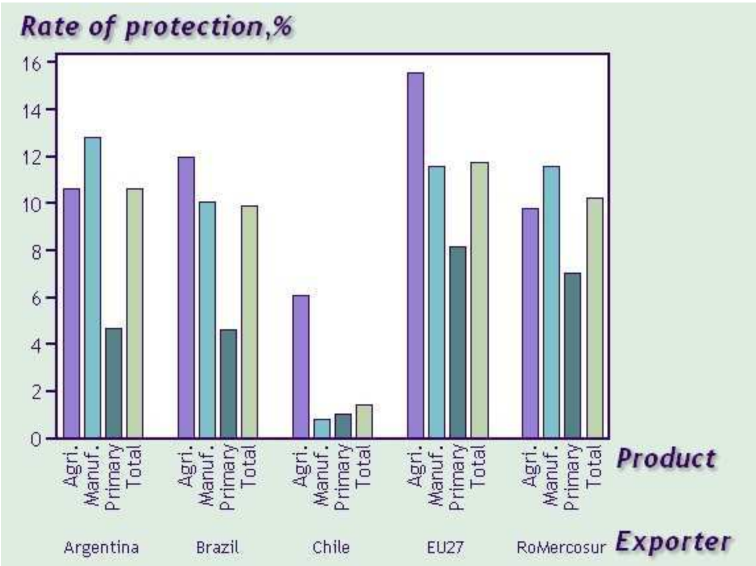

Figure 1.12: Venezuela Bilateral Protection applied on Mercosur and EU products

Note: Authors' calculations using MacMapV2.03 (Base year 2004, Reference Group weighted average) - CEPII

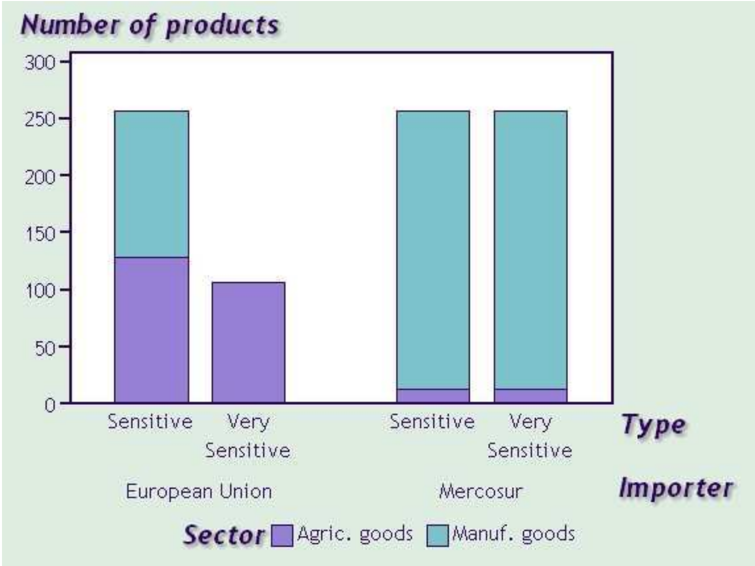

Figure 1.13: Number of sensitive products (without Venezuela accession nor DDA)

Source: Authors' calculations using MAcMaps database - CEPII

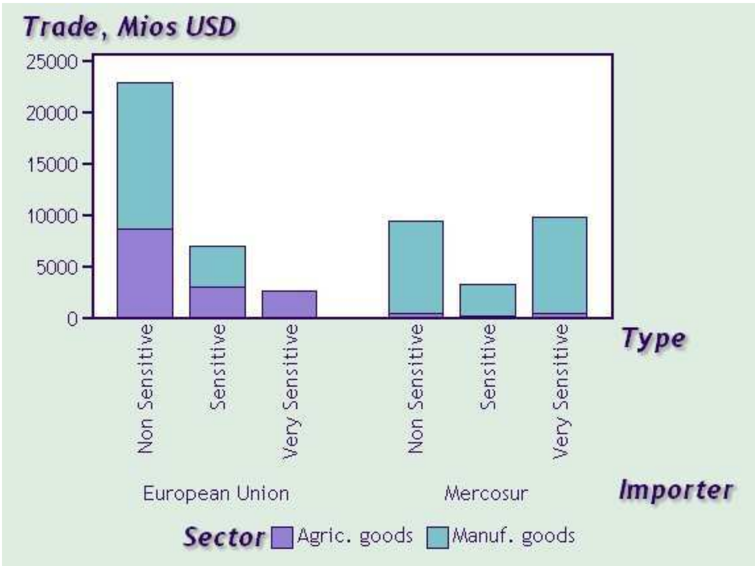

Figure 1.14: Trade volume of sensitive products (without Venezuela accession nor DDA)

Note: Authors' calculations using MacMapV2.03 (Base year 2004, Reference Group weighted average) - CEPII

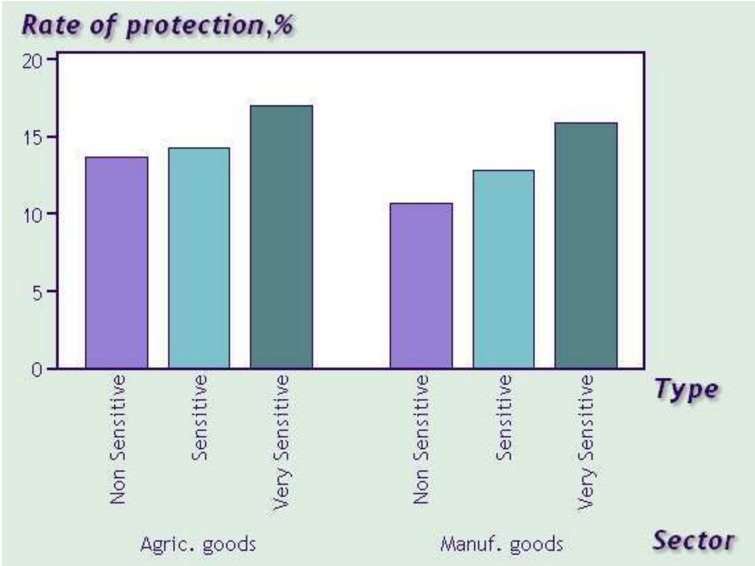

Figure 1.15: Protection applied by Mercosur on EU imports

Note: Authors' calculations using MacMapV2.03 (Base year 2004, Reference Group weighted average) - CEPII

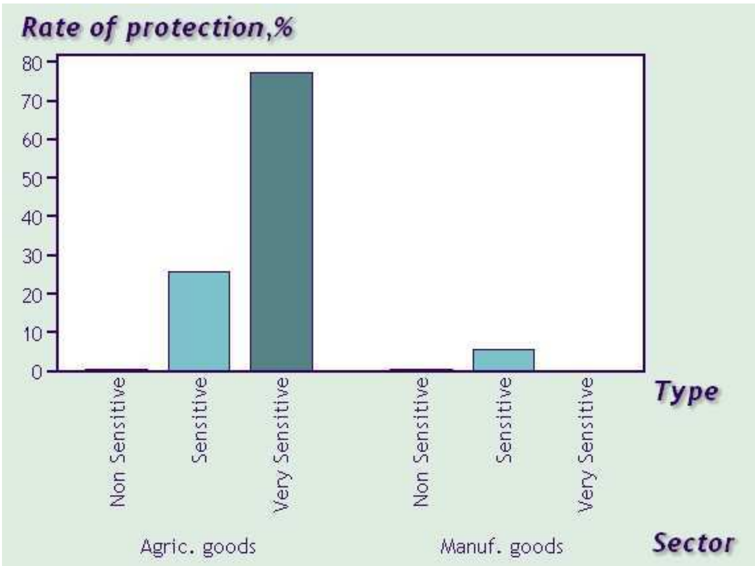

Figure 1.16: Protection applied by EU on Mercosur imports

Note: Authors' calculations using MacMapV2.03 (Base year 2004, Reference Group weighted average) - CEPII

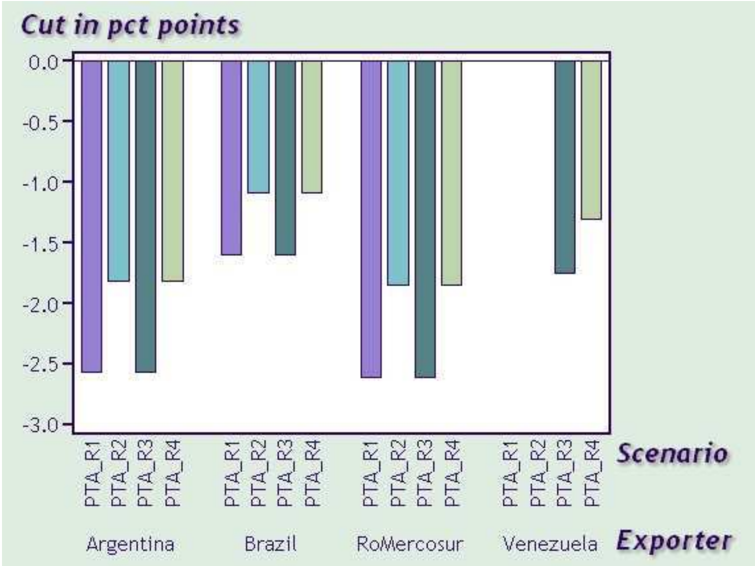

Figure 1.17: EU Bilateral Protection to Mercosur Manufactured Exports

Note: Authors' calculations using MacMapV2.03 (End of the implementation period, Difference computed from the relevant baseline tariffs, Reference Group weighted average) - CEPII

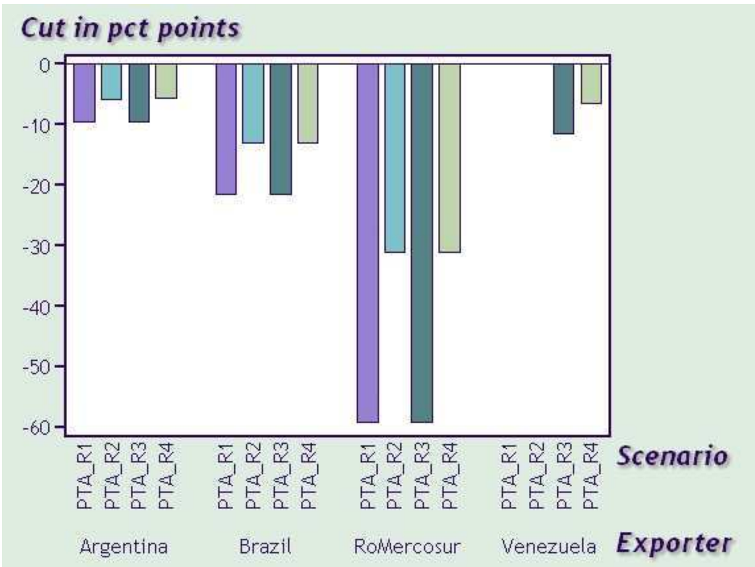

Figure 1.18: EU Bilateral Protection to Mercosur Agricultural Exports

Note: Authors' calculations using MacMapV2.03 (End of the implementation period, Difference computed from the relevant baseline tariffs, Reference Group weighted average) - CEPII

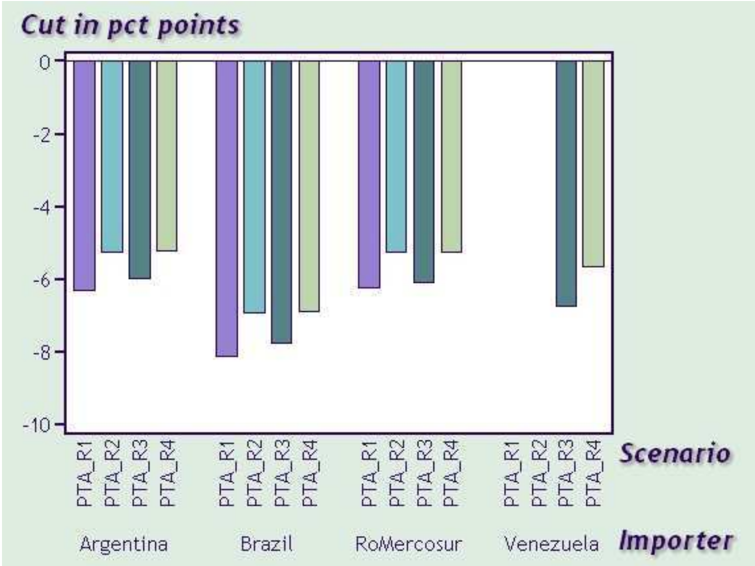

Figure 1.19: Mercosur Bilateral Protection to EU Manufactured Exports

Note: Authors' calculations using MacMapV2.03 (End of the implementation period, Difference computed from the relevant baseline tariffs, Reference Group weighted average) - CEPII

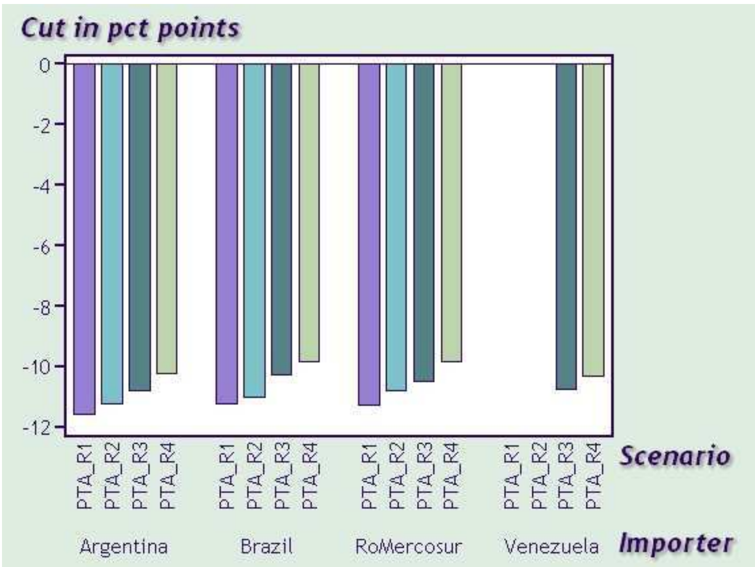

Figure 1.20: Mercosur Bilateral Protection to EU Agricultural Exports

Note: Authors' calculations using MacMapV2.03 (End of the implementation period, Difference computed from the relevant baseline tariffs, Reference Group weighted average) - CEPII

Table 1.1: Geographical and sectoral aggregation

CEREALS	Maize	247074
	Wheat	2721600
	Rice	236647
MEAT	Beef	149503
	Pork	60867
	Sheep and Goats	29000
	Poultry	32510
VEGETABLES	Garlic	25170
DAIRY PRODUCTS	Milk powder	68000
	Butter	10000
	Cheese	83400
SUGAR		241348

Table 1.2: Geographical and sectoral aggregation

Sector		Regions
Rice	Primary	CairnsDvped
Wheat	Fats	RestDvping
Cereals	Dairy	RestDvpd
VegFruits	Food	CairnsDvg
OilSeeds	Beverages	NAFTA
Sugar	Textile	SthAm
Crops	Paper	Venezuela
MeatCattle	Chemicals	Argentina
MeatOther	Metal	Brazil
Milk	MotorVeh	Chile
Wool	TrspEqNec	RoMercosur
Forestry	Electronic	EU27
Fishing	Machinery	Meditera
EnergyPdts	OtherManuf	SSA
OthSer	TrT	
BusServ		

Table 1.3: TRQ enlargement scenario for the EU-Mercosur agreement

Products	EU proposal	MERCOSUR proposal	Average Scenario (TN)
Bovine meat	160	315	237.5
Poultry meat	27.5	250	138.75
Swine meat	15	40	27.5
Wheat	200	1,000	600
Corn	200	4,000	2,100
Cheese	20	60	40
Milk	13	34	23.5
Butter	4	10	7

Table 1.4: Total trade variation (%) between GTAP-2001 and BACI-2004

	Venezuela	Argentina	Brazil	Chile	RoMercosur	EU27
Rice		7%	22%	36%	5%	
Wheat	5%	15%	60%	5898%	16%	5%
Cereals		10%	8%	70%	5%	
VegFruits	15%	1%	6%	11%	4%	
OilSeeds	39%	11%	4%	14%		
Sugar	49%	11%		305%		
Crops	68%	10%	8%	81%	5%	13%
MeatCattle	368%	78%	44%	30%	14%	24%
MeatOther	28%			7%		4%
Wool		64%	418%	45%	76%	24%
Forestry	50%	14%	12%	17%	45%	5%
Fishing			23%		1%	
Primary	62%	18%	14%	6%	2%	6%
Dairy	14%	3%	28%	3%		
Food	5%	139%	69%		117%	
Beverages	8%			8%		
Textile	18%	2%		7%		
Paper		6%	6%			2%
Chemicals		2%			9%	
Metal				3%		
TrspEqNec	4%			4%	2%	
Electronic	5%		2%		21%	
Machinery	20%	49%	11%	32%	9%	4%
OtherManuf	122%	102%	150%	42%	660%	67%
OthSer	250%		174%		46%	1931%

Table 1.5: Bilateral trade variation (%) between GTAP-2001 and BACI-2004

		Venezuela	Argentina	Brazil	Chile	RoMercosur	EU27
Rice	Argentina					16%	
	Brazil		86%			12%	91%
	Chile			289%			
Wheat	Brazil					32%	
	Chile		117%				
	RoMercosur		14%				
	EU27		47%				
Cereals	Venezuela				219%		856%
	Argentina			468%	103%		
	Brazil					22%	351%
	RoMercosur		83%	249%			65%
	EU27		38%	89%	51%		
VegFruits	Argentina					120%	
	Brazil	467%				142%	
	Chile		89%	52%			
	RoMercosur			10%			
	EU27	103%	13%	88%	43%	19%	
OilSeeds	Argentina			2086%	6%	1892%	18%
	Brazil						84%
	Chile		92%	14%		301%	801%
	RoMercosur		113%	141%			96%
	EU27			55%	339%	160%	
Sugar	Venezuela			1394%			
	Argentina			401%			
	Chile		62%	6241%			
	RoMercosur			19%			
	EU27			3%		128%	
Crops	Venezuela					9%	
	Argentina	29%		70%		35%	
	Brazil					53%	
	Chile			27%			5%
	EU27		15%	32%	2%		

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Table 1.5 – continued from previous page

		Venezuela	Argentina	Brazil	Chile	RoMercosur	EU27
MeatCattle	Venezuela		23253%	2014%			
	Argentina				27%		
	Brazil		21%			23%	
	Chile		224%	100%			
	RoMercosur		22%	33%	262%		
	EU27		151%	33%	64%	18%	
MeatOther	Venezuela			1478%		169%	
	Argentina					161%	
	Brazil	11%			142%	192%	
	Chile		106%	189%			17%
	RoMercosur				291%		119%
	EU27		337%	119%	106%	200%	
Wool	Argentina				132%		1018%
	Brazil		24457579%				366%
	Chile						522%
	RoMercosur		107%	1%	154%		
Forestry	Venezuela		15%				
	Brazil		129%				
	Chile	25%	434%	135%			2%
	RoMercosur		25%				
	EU27			68%	31%		
Fishing	Argentina			170%			
	Brazil				59%		
	Chile					1587%	
	RoMercosur		112%	2607%			
	EU27	36%	172%	168%	123%		
EnergyPdts	Venezuela		1011981%	17942%	1174%		34832%
	Argentina	6390%		65%	908%	228%	1153%
	Brazil		78%			174%	505%
	Chile	122%	52%	489%			1429%
	RoMercosur		203%	789%			
	EU27	16%	118%	426%			
Primary	Venezuela			5%			
	Argentina	296%		7%	38%		

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Table 1.5 – continued from previous page

		Venezuela	Argentina	Brazil	Chile	RoMercosur	EU27
	Brazil		15%		128%	133%	
	Chile		48%	22%		87%	
	RoMercosur				96%		
	EU27		125%	40%	268%		
Fats	Venezuela		492%	159323%	685%	339%	32%
	Argentina			285%	13375%	804%	60%
	Brazil				153%	335%	86%
	Chile		4877%	43632%		15577%	142%
	RoMercosur		85%	166%	409%		
	EU27		3340%	10895%	42%	376%	
Dairy	Venezuela		804%	4794%	1%	54%	
	Chile		3%	1122%		123%	5%
	EU27		29%			83%	
Food	Venezuela		17%		10%		
	Brazil		73%		99%		
	Chile						22%
	RoMercosur			11%			
	EU27	21%			99%	79%	
Beverages	Venezuela		260%	1174%		72%	16%
	Argentina			13%			
	Brazil		973%		96%	836%	33%
	Chile	213%	87%	60%		9%	43%
	EU27		25%	349%	35%		
Textile	Venezuela		37%		35%		
	Argentina			4%			
	Brazil	40%					4%
	Chile		73%	34%			
	RoMercosur	40%			76%		
	EU27	11%	36%	38%		77%	
Paper	Venezuela			60%			
	Chile		63%	29%		9%	18%
	EU27		23%	68%	53%	39%	
Chemicals	Venezuela		40%	55%	60%		18%
	Argentina			57%		1%	10%

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Table 1.5 – continued from previous page

		Venezuela	Argentina	Brazil	Chile	RoMercosur	EU27
	Brazil		50%		45%	31%	42%
	Chile	38%	62%	60%		76%	37%
	RoMercosur	140%		42%			
	EU27		32%	87%	79%	43%	
Metal	Venezuela			34%	55%	311%	2%
	Argentina	24%		37%	1%	80%	12%
	Brazil	1%	4%		76%	47%	15%
	Chile		76%	173%		122%	61%
	RoMercosur	62%		12%			
	EU27	104%	13%	72%	55%	13%	
MotorVeh	Venezuela		50%		196%	1258%	
	Argentina			203%	38%		
	Brazil				2%		
	Chile	286%	340%	181%		1290%	21%
	RoMercosur	31%	29%	44%	49%		
	EU27		14%	55%	23%	60%	
TrspEqNec	Venezuela		465%	23%	13%		61%
	Argentina						204%
	Brazil		18%			15%	
	Chile	210%		509%			
	RoMercosur		107%		2131%		
	EU27	8%		140%	469%		
Electronic	Venezuela			25%			
	Argentina	305%		31%		477%	6%
	Brazil		8%		109%		
	Chile	50%	10%	63%		513%	21%
	RoMercosur	46%	34%				33%
	EU27	27%		116%			
Machinery	Venezuela			56%		67%	
	Argentina			26%			
	Chile	80%	12%	9%		131%	17%
	RoMercosur	62%		20%			
	EU27			95%	99%	50%	
OtherManuf	Argentina	1647%					

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Table 1.5 – continued from previous page

		Venezuela	Argentina	Brazil	Chile	RoMercosur	EU27
	Brazil	66%					
	Chile	93%					
OthSer	Argentina			460%			
	Brazil	181%					
	Chile		1353%				
	RoMercosur		3450%				

Table 1.6: Welfare results compared to Ref-R1 (in % variation)

	R1(Ref)	R1(Sim)	R2(Sim)	R3(Sim)	R4(Sim)
Argentina	499,197	0,12%	-0,12%	0,22%	0,02%
Brazil	936,423	0,47%	-0,08%	0,66%	0,14%
EU27	14983,149	0,1%	-0,51%	0,10%	-0,47%
RoMercosur	41,294	1,23%	0,75%	1,32%	0,89%
Venezuela	140,552	-0,01%	-0,77%	-0,75%	-1,6%

Table 1.7: Welfare decomposition: Allocation efficiency gains (compared to Ref-R1)

	ResSR1	ResSR2	ResSR3	ResSR4
Argentina	0,0116	0,00%	0,00%	-0,00%
Brazil	-0,3551	-0,33%	-0,35%	-0,35%
EU27	0,1433	0,09%	0,14%	0,09%
RoMercosur	0,1269	0,1%	0,12%	0,1%
Venezuela	-0,0044	-0,00%	0,05%	0,03%

Table 1.8: Welfare decomposition: Capital Accumulation gains (compared to Ref-R1)

	R1(Sim)	R2(Sim)	R3(Sim)	R4(Sim)
Argentina	0,0478	0,04%	0,04%	0,03%
Brazil	0,1532	0,12%	0,15%	0,12%
EU27	0,0066	0,00%	0,01%	0,00%
RoMercosur	0,4856	0,43%	0,46%	0,42%
Venezuela	-0,0064	-0,00%	-0,00%	-0,01%

Table 1.9: Welfare decomposition: Land Supply gains (compared to Ref-R1)

	R1(Sim)	R2(Sim)	R3(Sim)	R4(Sim)
Argentina	0,0142	0,01%	0,01%	0,01%
Brazil	0,0470	0,04%	0,05%	0,04%
EU27	-0,0009	-0,01%	-0,00%	-0,00%
RoMercosur	0,1298	0,11%	0,13%	0,11%
Venezuela	-0,0007	-0,00%	0,02%	0,02%

Table 1.10: Welfare decomposition: TRQ gains (compared to Ref-R1)

	R1(Sim)	R2(Sim)	R3(Sim)	R4(Sim)
Argentina	0,0116	0,02%	0,01%	0,02%
Brazil	0,1185	0,08%	0,12%	0,08%
EU27	-0,0081	-0,01%	-0,01%	-0,01%
RoMercosur	0,0638	0,07%	0,06%	0,07%
Venezuela	0,0000	0,00%	0,00%	0,00%

Table 1.11: Welfare decomposition: Terms of Trade gains (compared to Ref-R1)

	R1(Sim)	R2(Sim)	R3(Sim)	R4(Sim)
Argentina	0,0158	0,01%	0,02%	0,01%
Brazil	0,2221	0,19%	0,22%	0,19%
EU27	-0,0122	-0,01%	-0,01%	-0,01%
RoMercosur	0,3764	0,34%	0,37%	0,33%
Venezuela	-0,0028	-0,00%	-0,03%	-0,03%

Table 1.12: Terms of trade effects compared to Ref-R1 (% variation)

	R1(Ref)	R1(Sim)	R2(Sim)	R3(Sim)	R4(Sim)
Argentina	1	0,1%	0,04%	0,11%	0,04%
Brazil	1	1,54%	1,32%	1,55%	1,31%
EU27	1	-0,08%	-0,06%	-0,07%	-0,06%
RoMercosur	1	1,4%	1,23%	1,39%	1,22%
Venezuela	1	-0,05%	-0,05%	-0,22%	-0,21%

Table 1.13: GDP results compared to Ref-R1 (% variation)

	R1(Ref)	R1(Sim)	R2(Sim)	R3(Sim)	R4(Sim)
Argentina	593,5414	0,11%	-0,13%	0,21%	0,01%
Brazil	1173,7731	0,34%	-0,19%	0,52%	0,03%
EU27	18886,7067	0,11%	-0,51%	0,11%	-0,47%
RoMercosur	47,2558	1%	0,54%	1,1%	0,68%
Venezuela	181,2192	-0,01%	-0,75%	-0,68%	-1,51%

Table 1.14: Agricultural Employment results compared to Ref-R1 (% variation)

	R1(Ref)	R1(Sim)	R2(Sim)	R3(Sim)	R4(Sim)
Argentina	21,9436	0,52%	2,92%	0,58%	3,05%
Brazil	20,8618	2,7%	5,23%	2,63%	5,45%
EU27	497,8910	-0,65%	1,04%	-0,64%	1,04%
RoMercosur	3,4127	2,86%	3,66%	3,06%	3,84%
Venezuela	7,1982	-0,1%	-0,22%	-0,11%	-0,62%

Table 1.15: Non-agricultural Employment results compared to Ref-R1 (% variation)

	R1(Ref)	R1(Sim)	R2(Sim)	R3(Sim)	R4(Sim)
Argentina	164,9737	-0,07%	-0,5%	0,06%	-0,35%
Brazil	349,7492	-0,16%	-0,74%	0,05%	-0,53%
EU27	5412,3151	0,06%	-0,48%	0,07%	-0,44%
RoMercosur	9,8131	-1,01%	-1,45%	-0,87%	-1,3%
Venezuela	44,3551	0,02%	-0,85%	-0,97%	-1,78%

Table 1.16: Real Capital Return results compared to Ref-R1 (% variation)

	R1(Ref)	R1(Sim)	R2(Sim)	R3(Sim)	R4(Sim)
Argentina	0,2299	-0,08%	-0,52%	0,023%	-0,37%
Brazil	0,1592	0,17%	-0,32%	0,32%	-0,1%
EU27	0,0629	0,01%	-0,55%	0,02%	-0,5%
RoMercosur	0,2504	0,08%	-0,5%	0,13%	-0,35%
Venezuela	0,1953	0,01%	-0,83%	-0,75%	-1,59%

Table 1.17: Real Land Return results compared to Ref-R1 (% variation)

	R1(Ref)	R1(Sim)	R2(Sim)	R3(Sim)	R4(Sim)
Argentina	2,0589	0,19%	1,41%	0,21%	1,47%
Brazil	2,0110	3,03%	4,07%	2,97%	4,18%
EU27	1,8883	-0,73%	-0,36%	-0,74%	-0,37%
RoMercosur	1,5792	1,86%	1,97%	1,92%	2,06%
Venezuela	1,2935	-0,12%	-0,32%	0,27%	-0,28%

Table 1.18: Real Natural Resources Return results compared to Ref-R1 (% variation)

	R1(Ref)	R1(Sim)	R2(Sim)	R3(Sim)	R4(Sim)
Argentina	2,3589	-0,63%	-0,96%	-0,89%	-1,15%
Brazil	2,2894	-3,57%	-3,62%	-3,81%	-3,77%
EU27	2,9646	0,18%	-0,6%	0,17%	-0,57%
RoMercosur	2,4971	-1,8%	-2,36%	-1,55%	-2,06%
Venezuela	1,3135	-0,08%	0,24%	0,51%	0,81%

Table 1.19: Real Skilled Labor Wages compared to Ref-R1 (% variation)

	R1(Ref)	R1(Sim)	R2(Sim)	R3(Sim)	R4(Sim)
Argentina	1,9036	0,16%	-0,32%	0,29%	-0,16%
Brazil	2,1001	0,18%	-0,55%	0,41%	-0,33%
EU27	4,0598	0,19%	-0,54%	0,19%	-0,5%
RoMercosur	1,7908	0,76%	0,1%	0,88%	0,25%
Venezuela	0,8419	0,02%	-1,02%	-1,19%	-2,29%

Table 1.20: Real Unskilled Labor Wages compared to Ref-R1 (% variation)

	R1(Ref)	R1(Sim)	R2(Sim)	R3(Sim)	R4(Sim)
Argentina	1,8879	0,17%	-0,08%	0,29%	0,08%
Brazil	1,9120	0,29%	-0,33%	0,5%	-0,11%
EU27	2,6366	0,10%	-0,52%	0,11%	-0,48%
RoMercosur	1,6244	1,53%	1,04%	1,64%	1,19%
Venezuela	0,9576	0,01%	-0,92%	-0,91%	-1,95%

Table 1.21: Total Exports results compared to Ref-R1 (% variation)

	R1(Ref)	R1(Sim)	R2(Sim)	R3(Sim)	R4(Sim)
Argentina	72,1520	3,19%	4,61%	3,35%	4,78%
Brazil	152,9236	8,69%	10,23%	9,06%	10,65%
EU27	5525,3331	0,36%	0,30%	0,37%	0,35%
RoMercosur	11,1173	6,91%	7,38%	7,1%	7,59%
Venezuela	33,0780	-0,09%	1,36%	2,75%	3,95%

Table 1.22: Total Imports results compared to Ref-R1 (% variation)

	R1(Ref)	R1(Sim)	R2(Sim)	R3(Sim)	R4(Sim)
Argentina	62,0254	3,83%	5,5%	4%	5,69%
Brazil	162,9034	9,03%	10,10%	9,39%	10,5%
EU27	5744,1483	0,33%	0,33%	0,35%	0,38%
RoMercosur	13,2191	6,0677	6,36%	6,23%	6,54%
Venezuela	27,3668	-0,10%	1,72%	3,33%	4,84%

Table 1.23: Real Exchange Rate compared to Ref-R1 (% variation)

	R1(Ref)	R1(Sim)	R2(Sim)	R3(Sim)	R4(Sim)
Argentina	1	0,10%	0,05%	0,12%	0,05%
Brazil	1	1,59%	1,36%	1,6%	1,36%
EU27	1	-0,09%	-0,06%	-0,08%	-0,056%
RoMercosur	1	1,29%	1,13%	1,28%	1,13%
Venezuela	1	-0,01%	-0,01%	-0,16%	-0,18%

Table 1.24: EU27 bilateral exports to Mercosur countries in FOB values (% variation compared to Ref-R1)

	R1(Ref)	R1(Sim)	R2(Sim)	R3(Sim)	R4(Sim)
Argentina	16,6602	21,22%	23,18%	20,93%	23,2%
Brazil	47,5740	25,53%	27,09%	25,18%	27,21%
EU27	3281,4675	-0,03%	-1,19%	-0,03%	-1,15%
RoMercosur	2,5311	26,8%	26,55%	26,84%	26,55%
Venezuela	5,9471	0,44%	2,31%	23,26%	22,87%

Table 1.25: EU27 bilateral imports from Mercosur countries in CIF values (% variation compared to Ref-R1)

	R1(Ref)	R1(Sim)	R2(Sim)	R3(Sim)	R4(Sim)
Argentina	13,1256	16,12%	17,22%	15,62%	17,05%
Brazil	38,5540	58,58%	61,82%	57,82%	61,93%
CairnsDvg	182,3771	-0,38%	0,34%	-0,37%	0,39%
CairnsDvped	30,8362	-0,28%	8,74%	-0,28%	7,66%
Chile	14,0448	-1%	-2,64%	-0,63%	-2,11%
EU27	3351,0388	-0,03%	-1,19%	-0,04%	-1,15%
Meditera	136,5151	-0,32%	-2,31%	-0,29%	-2,39%
NAFTA	621,9022	-0,14%	0,94%	-0,11%	1,04%
RestDvpd	526,1486	-0,11%	2,57%	-0,1%	2,6%
RestDvping	710,9155	-0,19%	1,66%	-0,18%	1,69%
RoMercosur	2,2942	55,49%	53,45%	54,58%	53,02%
SSA	63,7901	-1,28%	-2,58%	-1,24%	-2,62%
SthAm	48,1938	-1,4%	4,89%	-1,3%	4,89%
Venezuela	4,4122	-1,47%	1,06%	15,42%	14,79%

Table 1.26: Argentina exports by sector (% variation compared to Ref-R1)

	R1(Ref)	R1(Sim)	R2(Sim)	R3(Sim)	R4(Sim)
Agro	45,3596	3,95%	7,74%	4,04%	7,9%
Cereals	3,7608	8,07%	7,07%	8,23%	7,32%
Dairy	0,5907	50,28%	39,25%	50,22%	40,86%
Fishing	0,0273	6,22%	5,01%	6,47%	5,31%
Food	10,4637	9,2%	13,12%	9,7%	13,62%
IND	14,4794	4,16%	-0,35%	5,03%	0,31%
MeatCattle	0,4540	28,51%	31,42%	28,71%	31,59%
Rice	0,2990	0,96%	22,38%	0,89%	22,83%
Ser	5,8899	-0,73%	-1,05%	-0,87%	-1,1%
Sugar	0,1451	9,33%	3,27%	10,01%	4,49%
Wheat	5,6356	3,13%	25,2%	2,99%	25,08%

Table 1.27: Brazil exports by sector (% variation compared to Ref-R1)

	R1(Ref)	R1(Sim)	R2(Sim)	R3(Sim)	R4(Sim)
Agro	74,5185	24,76%	28,27%	24,39%	28,33%
Beverages	0,1588	28,73%	28,23%	29,32%	28,47%
Cereals	2,4709	13,55%	13,02%	13,41%	12,95%
Dairy	0,1042	358,57%	274,28%	335,01%	268,72%
IND	53,1219	-7,62%	-8,38%	-5,81%	-7,12%
MeatCattle	2,3204	214,65%	222,37%	213,64%	221,66%
MeatOther	16,0112	10,29%	17,33%	9,66%	16,67%
Rice	0,0390	130,34%	118,86%	128,58%	115,25%
Ser	9,4891	-4,49%	-3,88%	-5,08%	-4,32%
Sugar	5,6669	208,82%	203,2%	208,17%	202,99%
VegFruits	1,8329	3,99%	2,06%	3,49%	1,68%

Table 1.28: EU27 imports by sector (% variation compared to Ref-R1)

	R1(Ref)	R1(Sim)	R2(Sim)	R3(Sim)	R4(Sim)
Agro	520,6417	3,63%	6,01%	3,68%	6,06%
Cereals	8,5860	6%	9,25%	6,01%	8,94%
Dairy	41,9161	1,1%	7,55%	1,26%	6,52%
IND	3776,9606	0,01%	-0,11%	0,02%	-0,06%
MeatCattle	21,2538	24,84%	29,28%	24,76%	29,26%
MeatOther	56,3062	2,75%	5,13%	2,76%	5,16%
Rice	3,0256	5,83%	17,1%	5,86%	17,03%
Ser	863,8724	-0,03%	-0,76%	-0,02%	-0,7%
Sugar	4,5490	250,53%	251,33%	249,95%	251,1%
VegFruits	79,5769	-0,18%	1,93%	0,03%	2,14%

Table 1.29: Rest of Mercosur (Uruguay and Paraguay) exports by sector (% variation compared to Ref-R1)

	R1(Ref)	R1(Sim)	R2(Sim)	R3(Sim)	R4(Sim)
Agro	4,8577	21,01%	22,91%	21,34%	23,25%
Beverages	0,1542	2,22%	1,97%	2,35%	2,14%
Cereals	0,1554	28,51%	28,84%	28,5%	28,98%
Dairy	0,1669	77,26%	66,22%	81,99%	69,58%
IND	1,3892	-6,25%	-9,35%	-5,68%	-8,81%
MeatCattle	0,8645	65,3%	69,76%	65,15%	69,59%
Rice	0,6343	36,4%	43,07%	36,21%	43,14%
Ser	4,3560	-3,01%	-2,97%	-3,16%	-3,08%
Sugar	0,0157	976,62%	1033,51%	980,99%	1037,82%
Wheat	0,0214	24,46%	41,03%	23,78%	40,55%

Table 1.30: Venezuela exports by sector (% variation compared to Ref-R1)

	R1(Ref)	R1(Sim)	R2(Sim)	R3(Sim)	R4(Sim)
Agro	1,8628	-2,29%	3,15%	26,12%	25,37%
Dairy	0,0113	-7,28%	162,75%	1228,65%	987,24%
EnergyPdts	19,2023	-0,04%	0,92%	1,47%	2,4%
IND	6,9394	0,45%	2,65%	0,61%	3,17%
Primary	2,4242	-0,27%	0,33%	0,78%	1,6
Ser	2,5693	-0,09%	0,91%	3,13%	4,5%
VegFruits	0,1328	-0,46%	46,82%	274,77%	266,2%
Wheat	0,0003	-1,24%	25,1%	13,16%	44,6%
Wool	0,0000	-0,19%	26,14%	13,33%	45,14%

Appendix

The MIRAGE Model

The following equations are detailed and commented in Decreux and Valin (2007).

Notations

The i and j indices refer to sectors, r and s refer to regions, t to periods.
Superscripts for prices P refer to the related variable.
$U(s)$ is the subset of countries in the same development level as region s and $V(s)$ is the subset of countries with a different level of development.
$Agri(i)$ is the subset of sectors from agriculture.
i_{TrT} refers to transport sectors and r_{EU} refers to the European Union regions.
The reference year is indexed with t_0.

Parameters definition

$\sigma_{ARM_i}, \sigma_{IMP_i}, \sigma_{VAR_i}, \sigma_{VA_j}, \sigma_{CAP_j}, \sigma_C, \sigma_{IC}, \sigma_{KG}, \sigma_{GEO_i},$	Substitution elasticities of factors and goods demand
$cmin_{i,r}$	Minimal consumption of good i in the final demand of region r
epa_r	Saving rate in region r
$\mu_{i,r,s}$	Transport demand per volume of good
θ_r	Value share of region r transport sector in the world production of transport
$DD_{i,r,s,t}$	*Ad-valorem* tariff rate applied by regions s on its imports from region r
$MaxExpSub_{i,r,t}$	Maximum level of subsidized exports authorized by WTO
$taxp_{i,r}, taxcc_{i,s}, taxicc_{i,s}, taxkgc_{i,s}$	Tax rate applied on production, final consumption, intermediate consumption and capital good

$taxAMF_{i,r,s}$	Export tax rate equivalent to the Multifiber Arrangement
$TsubK_{i,r}$	Subsidy rate on capital
$TsubTE_{i,r}$	Subsidy rate on land
$cf_{j,r}$	Fixed cost per unit of output in imperfectly competitive sectors
$mmoy_{i,r}$	Mark-up average
$Quota_{i,r,t}$	Maximum production in sectors where quotas hold
α	Elasticity of investment to capital return rate
$\gamma_{i,r}^{L}, \gamma_{i,r}^{Q}, \gamma_{i,r}^{TE}, \gamma_{i,r}^{RN}$	Value share of factors in value added (Cobb-douglas)
δ	Depreciation of capital
$\rho_{r,t}$	Population growth rate of region r (World Bank data)
a_{XXX}	Various share and scale coefficients in CES or Cobb-Douglas functions
$PGF_{r,t}$	Total factor productivity

Variables definition

Production

$Y_{i,r,t}$	Output of sector i firms
$VA_{i,r,t}$	Value added
$CNTER_{i,r,t}$	Aggregate intermediate consumption

Factors

$Q_{i,r,t}$	Aggregate of human capital and physical capital
$L_{i,r,t}$	Unskilled labor
$L^{Agri_{i,r,t}}$	Total Unskilled labor in agriculture
$L_{i,r,t}^{notAgri}$	Total Unskilled labor in sectors other than agriculture
$TE_{i,r,t}$	Land
$RN_{i,r,t}$	Natural resources
$H_{i,r,t}$	Skilled labor

$K_{i,r,s,t}$	Capital stock from region r to region s in sector i
$KTOT_{i,r,t}$	Total capital stock in sector i and region r
$\overline{L}_{r,t}$	Total supply of unskilled labor
$\overline{TE}_{r,t}$	Total supply of land
$\overline{H}_{r,t}$	Total supply of skilled labor
$\overline{K}_{r,t}$	Total supply of capital

Demand

$BUDC_{r,t}$	Budget allocated to consumption
$UT_{r,t}$	Utility
$P_{r,t}$	Price of utility
$C_{i,r,t}$	Aggregated consumption
$IC_{i,j,r,t}$	Intermediate consumption of good i used in the production of sector j
$INVTOT_{r,t}$	Total investment in region r
$INV_{i,r,s,t}$	Investment from region r to sector i in region s
$B_{r,t}$	Investment scale coefficient
$KG_{i,r,t}$	Capital good demand of sector i in region r
$DEMTOT_{i,r,t}$	Total demand
$DEMU_{i,r,t}$	Total demand, in region r, of good originating from regions with the same development level than region r (including local demand in region r)
$DEMV_{i,r,t}$	Total demand, in region r, of good originating from regions with a different development level than region r
$D_{i,r,t}$	Domestic demand of good i
$DVAR_{i,r,t}$	Domestic demand of good i produced by each firm of region r
$M_{i,r,t}$	Total demand, in region r, of good i originating from regions with the same development level than region r other than region r
$DEM_{i,r,s,t}$	Demand, in region s, of good i originating from region r

$DEMVAR_{i,r,s,t}$	Demand of good i produced by each firm of region r

Transportation sector

$TRADE_{i,r,s,t}$	Exports to region s of industry i in region r
$TR_{i,r,s,t}$	Transport demand
$MONDTR_t$	Transport aggregate
P_t^T	Transport of commodities price
$TRM_{i,r,t}$	Supply of international transportation sector i in region r

Monopolistic competition

$EP_{i,r,s,t}$	Perceived price elasticity of total demand
$EPD_{i,r,t}$	Perceived price elasticity of domestic demand
$NB_{i,r,t}$	Number of varieties in imperfectly competitive sectors
$SDU_{i,s,t}$	Market share of domestic demand in demand of regions with the same level of development than region r
$SDT_{i,s,t}$	Market share of domestic demand in total demand
$SE_{i,r,s,t}$	Market share of imports from region r in imports of region s originating from regions with the same level of development
$SU_{i,r,s,t}$	Market share of imports from region r in demand of region s for goods from regions with the same level of development
$SV_{i,r,s,t}$	Market share of imports from region r in imports of region s originating from regions with a different level of development
$ST_{i,r,s,t}$	Market share of imports from region r in demand of region s

Tax revenue	
$RECPROD_{i,r,t}$	Revenue of production tax
$RECDD_{i,r,t}$	Revenue of tariff
$RECCONS_{i,r,t}$	Revenue of consumption tax
$RECEXP_{i,r,t}$	Revenue of exports tax
$RECTAX_{r,t}$	Total tax revenue
$RQUOTA_{i,r,s,t}$	Implicit transfers due to quotas
$REV_{r,t}$	Regional revenue
$SOLD_{r,t}$	Current account balance
$PIBMVAL_t$	Total GDP in value
$GDPVOL_{r,t}$	Regional GDP

Prices and taxes	
P^{XXX}	Generic notation to indicate the price of the variable *XXX*
$P^{CIF}_{i,r,s,t}$	CIF price
$P^{Int}_{i,t}$	Intervention price (European Union only)
$W^{\overline{K}}_{r,t}$	Capital return rate in region r
$W^{K}_{i,r,t}$	Capital return paid to the investor
$W^{\overline{TE}}_{r,t}$	Land return rate in region r
$W^{TE}_{i,r,t}$	Land return rate paid to the owner
$TAXEXP_{i,r,s,t}$	Export tax rate
$TAXREF_{i,r,s,t}$	Auxiliary variable to adjust TAXMOY to its proper level while keeping unchanged the distribution across destinations
$TAXMOY_{i,r,t}$	Average export tax rate across the various destinations

Equations of the model

Supply

Determination of supply results from the following optimization programs:

Leontieff relation between value added and intermediate consumption:

Imperfect competition

$$\min NB_{i,r,t} P^{Y}_{i,r,t}(Y_{i,r,t} + cf_{i,r}) = P^{VA}_{i,r,t} VA_{i,r,t} + P^{CNTER}_{i,r,t} CNTER_{i,r,t} \tag{1.1}$$

$$\text{s.t.} \quad NB_{i,r,t}(Y_{i,r,t} + cf_{i,r}) = a^{VA}_{i,r} VA_{i,r,t} = a^{CNTER}_{i,r} CNTER_{i,r,t} \tag{1.2}$$

Perfect competition

$$\min P^{Y}_{i,r,t} Y_{i,r,t} = P^{VA}_{i,r,t} VA_{i,r,t} + P^{CNTER}_{i,r,t} CNTER_{i,r,t} + P^{Quota}_{i,r,t} Quota_{i,r,t} \tag{1.3}$$

$$\text{s.t.} \quad Y_{i,r,t} = a^{VA}_{i,r} VA_{i,r,t} = a^{CNTER}_{i,r} CNTER_{i,r,t} \tag{1.4}$$

For sectors where quotas hold (perfect competition only):

$$Y_{i,r,t} = Quota_{i,r,t} \tag{1.5}$$

Factor demand

$$\min P^{VA}_{i,r,t} VA_{i,r,t} = P^{L}_{i,r,t} L_{i,r,t} + P^{Q}_{i,r,t} Q_{i,r,t} + P^{TE}_{i,r,t} TE_{i,r,t} + P^{RN}_{i,r,t} RN_{i,r,t} \tag{1.6}$$

s.t. (CES option)

$$\left(\frac{VA_{i,r,t}}{PGF_{r,t}}\right)^{1-\frac{1}{\sigma_{VA_i}}} = a^{L}_{i,r} L_{i,r,t}^{1-\frac{1}{\sigma_{VA_i}}} + a^{Q}_{i,r} Q_{i,r,t}^{1-\frac{1}{\sigma_{VA_i}}} + a^{RN}_{i,r} RN_{i,r,t}^{1-\frac{1}{\sigma_{VA_i}}} + a^{TE}_{i,r} TE_{i,r,t}^{1-\frac{1}{\sigma_{VA_i}}} \tag{1.7}$$

or s.t. (Cobb-Douglas option)

$$VA_{i,r,t} = A_{i,r} PGF_{r,t} L_{i,r,t}^{\gamma^{L}_{i,r}} Q_{i,r,t}^{\gamma^{Q}_{i,r}} TE_{i,r,t}^{\gamma^{TE}_{i,r}} RN_{i,r,t}^{\gamma^{RN}_{i,r}} \tag{7'}$$

and

$$\min P^Q_{i,r,t} Q_{i,r,t} = P^K_{i,r,t} KTOT_{i,r,t} + P^H_{i,r,t} H_{i,r,t} \tag{1.8}$$

$$\text{s.t.} \qquad Q_{i,r,t}^{1-\frac{1}{\sigma_{CAP_i}}} = a^K_{i,r} KTOT_{i,r,t}^{1-\frac{1}{\sigma_{CAP_i}}} + a^H_{i,r} H_{i,r,t}^{1-\frac{1}{\sigma_{CAP_i}}} \tag{1.9}$$

The capital stock in region s is described by:

$$KTOT_{i,s,t} = \sum_r K_{i,r,s,t} \tag{1.10}$$

Comment: in this model, production quotas have been introduced. For the associated sectors, production is equal to the quota and an additional income, equal to $P^{Quota}_{i,r,t} Quota_{i,r,t}$, is drawn from the quota.

Demand

Determination of demand results from the following optimization programs:

LES-CES (first stage)

$$\min P_{r,t} UT_{r,t} = \sum_i P^C_{i,r,t}(C_{i,r,t} - cmin_{i,r}) \tag{1.11}$$

$$\text{s.t.} \quad {UT_{r,t}}^{1-\frac{1}{\sigma_C}} = \sum_i a^C_{i,r}(C_{i,r,t} - cmin_{i,r})^{1-\frac{1}{\sigma_C}} \tag{1.12}$$

$$BUDC_{r,t} = \sum_i P^C_{i,r,t} C_{i,r,t} \tag{1.13}$$

$$P^C_{i,r,t} = P^{DEMTOT}_{i,r,t}(1 + taxcc_{i,r}) \tag{1.14}$$

$$P^{KG}_{i,r,t} = P^{DEMTOT}_{i,r,t}(1 + taxkgc_{i,r}) \tag{1.15}$$

$$DEMTOT_{i,r,t} = C_{i,r,t} + \sum_j IC_{i,j,r,t} + KG_{i,r,t} \tag{1.16}$$

Groups of regions (second stage)

$$\min P^{DEMTOT}_{i,r,t} DEMTOT_{i,r,t} = P^{DEMU}_{i,r,t} DEMU_{i,r,t} + P^{DEMV}_{i,r,t} DEMV_{i,r,t} \tag{1.17}$$

$$\text{s.t.} \quad DEMTOT_{i,r,t}^{1-\frac{1}{\sigma_{GEO_i}}} = a^{DEMU}_{i,r} DEMU_{i,r,t}^{1-\frac{1}{\sigma_{GEO_i}}} + a^{DEMV}_{i,r} DEMV_{i,r,t}^{1-\frac{1}{\sigma_{GEO_i}}} \tag{1.18}$$

Armington (third stage)

$$\min P^{DEMU}_{i,r,t} DEMU_{i,r,t} = P^{D}_{i,r,t} D_{i,r,t} + P^{M}_{i,r,t} M_{i,r,t} \tag{1.19}$$

$$\text{s.t.} \quad DEMU_{i,r,t}^{1-\frac{1}{\sigma_{ARM_i}}} = a^{DEM}_{i,r} D_{i,r,t}^{1-\frac{1}{\sigma_{ARM_i}}} + a^{M}_{i,r} M_{i,r,t}^{1-\frac{1}{\sigma_{ARM_i}}} \tag{1.20}$$

Regions (fourth stage)

For foreign regions with the same level of development:

$$\min P^{M}_{i,s,t} M_{i,s,t} = \sum_{r \in U(s)} P^{DEM}_{i,r,s,t} DEM_{i,r,s,t} \tag{1.21}$$

$$\text{s.t.} \quad M_{i,s,t}^{1-\frac{1}{\sigma_{IMP_i}}} = \sum_{r \in U(s)} a^{IMP}_{i,r,s} DEM_{i,r,s,t}^{1-\frac{1}{\sigma_{IMP_i}}} \tag{1.22}$$

For foreign regions with different levels of development:

$$\min P^{DEMV}_{i,s,t} DEMV_{i,s,t} = \sum_{r \in V(s)} P^{DEM}_{i,r,s,t} DEM_{i,r,s,t} \tag{1.23}$$

$$\text{s.t.} \quad DEMV_{i,s,t}^{1-\frac{1}{\sigma_{IMP_i}}} = \sum_{r \in V(s)} a^{IMP}_{i,r,s} DEM_{i,r,s,t}^{1-\frac{1}{\sigma_{IMP_i}}} \tag{1.24}$$

Varieties (fifth stage)

$$DEMVAR_{i,r,s,t} = DEM_{i,r,s,t} NB_{i,r,t}^{1-\frac{1}{\sigma_{VAR_i}}} \tag{1.25}$$

$$P^{DEM}_{i,r,s,t} = P^{DEMVAR}_{i,r,s,t} NB_{i,r,t}^{1-\frac{1}{\sigma_{VAR_i}}} \tag{1.26}$$

$$DVAR_{i,s,t} = D_{i,s,t} NB_{i,s,t}^{1-\frac{1}{\sigma_{VAR_i}}} \tag{1.27}$$

$$P^{D}_{i,s,t} = P^{DVAR}_{i,r,t} NB_{i,s,t}^{1-\frac{1}{\sigma_{VAR_i}}} \tag{1.28}$$

Intermediate consumption

$$P^{IC}_{i,j,r,t} = P^{DEMTOT}_{i,r,t}(1 + taxicc_{i,j,r}) \tag{1.29}$$

$$\min P^{CNTER}_{j,r,t} CNTER_{j,r,t} = \sum_{i} P^{IC}_{i,j,r,t} IC_{i,j,r,t} \tag{1.30}$$

$$\text{s.t.} \quad CNTER_{j,r,t}^{1-\frac{1}{\sigma_{IC}}} = \sum_{i} a^{IC}_{i,j,r} IC_{i,j,r,t}^{1-\frac{1}{\sigma_{IC}}} \tag{1.31}$$

Capital good

$$\min P^{INVTOT}_{r,t} INVTOT_{r,t} = \sum_{i} P^{KG}_{i,r,t} KG_{i,r,t} \tag{1.32}$$

$$\text{s.t.} \quad INVTOT_{r,t}^{1-\frac{1}{\sigma_{KG}}} = \sum_{i} a^{KG}_{i,r} KG_{i,r,t}^{1-\frac{1}{\sigma_{KG}}} \tag{1.33}$$

Commodity market equilibrium

Imperfect competition

$$Y_{i,r,t} = DVAR_{i,r,t} + \sum_s DEMVAR_{i,r,s,t} \tag{1.34}$$

$$TRADE_{i,r,s,t} = NB_{i,r,t} DEMVAR_{i,r,s,t} \tag{1.35}$$

Perfect competition

$$Y_{i,r,t} = D_{i,r,t} + \sum_s DEM_{i,r,s,t} \quad (i \notin TrT) \tag{1.36}$$

$$Y_{i_{TrT},r,t} = D_{i_{TrT},r,t} + \sum_s DEM_{i_{TrT},r,s,t} + TRM_{i_{TrT},r,t} \tag{1.37}$$

$$TRADE_{i,r,s,t} = DEM_{i,r,s,t} \tag{1.38}$$

Transport sector

Transport demand

$$TR_{i,r,s,t} = \mu_{i,r,s} TRADE_{i,r,s,t} \tag{1.39}$$

$$MONDTR_t = \sum_{i,r,s} TR_{i,r,s,t} \tag{1.40}$$

Transport supply

$$P^Y_{i_{TrT},r,t}(1 + taxp_{i_{TrT},r}) TRM_{i_{TrT},r,t} = \theta_{i_{TrT},r} P^T_t MONDTR_t \tag{1.41}$$

$$MONDTR_t = a^T \prod_r TRM_{i_{TrT},r,t}{}^{\theta_{i_{TrT},r}} \tag{1.42}$$

Factor market

[25]

[25]In this paper we consider the standard version of the MIRAGE model; however in its agricultural version:

- we distinguish between two types of unskilled labor: agricultural labor and non agricultural labor. A partial mobility between these two types of labors is allowed through a

Land market

$$W^{TE}_{i,r,t} = P^{TE}_{r,t} + P_{r,t}\, TsubTE_{i,r,t} \tag{1.43}$$

Land supply

$$W^{\overline{TE}}_{r,t}\overline{TE}_{r,t} = \sum_i W^{TE}_{i,r,t} TE_{i,r,t} \tag{1.44}$$

$$\overline{TE}_{r,t} = \overline{TE}_{r,t_0}\left(W^{\overline{TE}}_{r,t}\right)^{\sigma_{\overline{TE}}} \quad (\mathrm{NB}: W^{\overline{TE}}_{r,t_0} = 1) \tag{1.45}$$

Land allocation

$$TE_{i,r,t} = b^{TE}_{i,r}\overline{TE}_{r,t}\left(\frac{W^{TE}_{i,r,t}}{W^{\overline{TE}}_{r,t}}\right)^{\sigma_{TE}} \tag{1.46}$$

Full use of factor endowments

$$L_{r,t} = \sum_j L_{j,r,t} \tag{1.47}$$

$$\overline{TE}_{r,t} = \sum_j TE_{j,r,t} \tag{1.48}$$

$$\overline{H}_{r,t} = \sum_j H_{j,r,t} \tag{1.49}$$

Constant Elasticity of Transformation supply function. Within each category, labor is perfectly mobile.

- a duality of labor has been assumed in developing countries: an efficiency wage scheme determines the level of wages in non agricultural sectors and the corresponding labor demand, and labor supply in agricultural sectors is computed as a residual. The efficiency wage is set such that the purchasing power of non agricultural wages, including tax receipts so that fiscal policy do not affect the results, remains unchanged after the shock.

Revenues

For imperfectly competitive sectors:

$$0 = P^{Y}_{i,r,t}\left(NB_{i,r,t}\sum_{s}\frac{DEMVAR_{i,r,s,t}}{1+EP_{i,r,s,t}}+\frac{NB_{i,r,t}DVAR_{i,r,t}}{1+EPD_{i,r,t}}\right) - (P^{VA}_{i,r,t}VA_{i,r,t}+P^{CNTER}_{i,r,t}CNTER_{i,r,t}) \tag{1.50}$$

Comment: this corresponds to the zero profit condition allowing to compute the number of firms.

Tax revenue from imperfectly competitive sectors

$$RECPROD_{i,r,t} = taxp_{i,r}P^{Y}_{i,r,t}\left(NB_{i,r,t}\sum_{s}\frac{DEMVAR_{i,r,s,t}}{1+EP_{i,r,s,t}}+\frac{NB_{i,r,t}DVAR_{i,r,t}}{1+EPD_{i,r,t}}\right)$$

$$RECEXP_{i,r,t} = (1+taxp_{i,r})P^{Y}_{i,r,t}NB_{i,r,t} \tag{1.51}$$

$$* \sum_{s}(TAXEXP_{i,r,s,t}+taxAMF_{i,r,s,t})\frac{DEMVAR_{i,r,s,t}}{1+EP_{i,r,s,t}} \tag{1.52}$$

Tax revenue from perfectly competitive sectors

$$RECPROD_{i,r,t} = taxp_{i,r}P^{Y}_{i,r,t}Y_{i,r,t} \tag{1.53}$$

$$RECEXP_{i,r,t} = (1+taxp_{i,r})P^{Y}_{i,r,t} * \sum_{s}(TAXEXP_{i,r,s,t}+taxAMF_{i,r,s,t})TRADE_{i,r,s,t} \tag{1.54}$$

For both sectors

$$RECDD_{i,r,t} = \sum_{r} DD_{i,r,s,t}P^{CIF}_{i,r,s,t}TRADE_{i,r,s,t} \tag{1.55}$$

$$RQUOTA_{r,s,t} = \sum_{i\in TQUOTAO} TQUOTA_{i,r,s,t}P^{CIF}_{i,r,s,t}TRADE_{i,r,s,t} \tag{1.56}$$

$$RECCONS_{i,s,t} = P^{DEMTOT}_{i,s,t}(taxcc_{i,s}C_{i,s,t}+taxkgc_{i,s}KG_{i,s,t} + \sum_{j} taxicc_{i,j,s,t}IC_{i,j,s,t}) \tag{1.57}$$

$$RECTAX_{r,t} = \sum_{i} RECPROD_{i,r,t}+RECEXP_{i,r,t} + RECDD_{i,r,t}+RECCONS_{i,r,t} \tag{1.58}$$

Savings

$$BUDC_{r,t} = (1 - epa_r)REV_{r,t} \tag{1.59}$$

Factor mobility

$$P^{L}_{i,r,t} = P^{\overline{L}}_{r,t} \tag{1.60}$$

$$P^{TE}_{i,r,t} = P^{\overline{TE}}_{r,t} \tag{1.61}$$

$$P^{H}_{i,r,t} = P^{\overline{H}}_{r,t} \tag{1.62}$$

Prices definition

Sale price (imperfect competition)

$$P^{DEMVAR}_{i,r,s,t} = P^{CIF}_{i,r,s,t}(1 + DD_{i,r,s,t}) \tag{1.63}$$

$$P^{DVAR}_{i,r,t} = \frac{P^{Y}_{i,r,t}(1 + taxp_{i,r})}{1 + EPD_{i,r,t}} \tag{1.64}$$

CIF price (imperfect competition)

$$P^{CIF}_{i,r,s,t} = (1 + taxp_{i,r})(1 + TAXEXP_{i,r,s,t} + taxAMF_{i,r,s,t})\frac{P^{Y}_{i,r,t}}{1 + EP_{i,r,s,t}} + \mu_{i,r,s}P^{T}_{t} \tag{1.65}$$

Sale price (perfect competition)

$$P^{DEM}_{i,r,s,t} = P^{CIF}_{i,r,s,t}(1 + DD_{i,r,s,t}) \tag{1.66}$$

$$P^{D}_{i,r,t} = P^{Y}_{i,r,t}(1 + taxp_{i,r}) \tag{1.67}$$

CIF price (perfect competition)

$$P^{CIF}_{i,r,s,t} = (1 + taxp_{i,r})(1 + TAXEXP_{i,r,s,t} + taxAMF_{i,r,s,t})P^{Y}_{i,r,t} + \mu_{i,r,s}P^{T}_{t} \tag{1.68}$$

Imperfect competition

Determination of market shares

$$SDU_{i,s,t} = \frac{P^{D}_{i,s,t} D_{i,s,t}}{P^{DEMU}_{i,s,t} DEMU_{i,s,t}} \tag{1.69}$$

$$SDT_{i,s,t} = \frac{P^{D}_{i,s,t} D_{i,s,t}}{P^{DEMTOT}_{i,s,t} DEMTOT_{i,s,t}} \tag{1.70}$$

$$SE_{i,r,s,t} = \frac{P^{DEM}_{i,r,s,t} DEM_{i,r,s,t}}{P^{M}_{i,s,t} M_{i,s,t}} \tag{1.71}$$

$$SU_{i,r,s,t} = \frac{P^{DEM}_{i,r,s,t} DEM_{i,r,s,t}}{P^{DEMU}_{i,s,t} DEMU_{i,s,t}} \tag{1.72}$$

$$SV_{i,r,s,t} = \frac{P^{DEM}_{i,r,s,t} DEM_{i,r,s,t}}{P^{DEMV}_{i,s,t} DEMV_{i,s,t}} \tag{1.73}$$

$$Sh_{i,r,s,t} = \frac{P^{DEM}_{i,r,s,t} DEM_{i,r,s,t}}{P^{DEMTOT}_{i,s,t} DEMTOT_{i,s,t}} \tag{1.74}$$

Mark-up in domestic markets

$$NB_{i,r,t}(EPD_{i,r,t} + \frac{1}{\sigma_{VAR_i}}) = \left[\frac{1}{\sigma_{VAR_i}} - \frac{1}{\sigma_{ARM_i}}\right] + \left[\frac{1}{\sigma_{ARM_i}} - \frac{1}{\sigma_{GEO_i}}\right] SDU_{i,r,t} + \left[\frac{1}{\sigma_{GEO_i}} - \frac{1}{\sigma_{C_i}}\right] SDT_{i,r,t} \tag{1.75}$$

Mark-up in foreign markets in countries with the same level of development

$$NB_{i,r,t}(EP_{i,r,s,t} + \frac{1}{\sigma_{VAR_i}}) = \left[\frac{1}{\sigma_{VAR_i}} - \frac{1}{\sigma_{ARM_i}}\right] + \left[\frac{1}{\sigma_{IMP_i}} - \frac{1}{\sigma_{ARM_i}}\right] SE_{i,r,s,t} + \left[\frac{1}{\sigma_{ARM_i}} - \frac{1}{\sigma_{GEO_i}}\right] SU_{i,r,s,t} + \left[\frac{1}{\sigma_{GEO_i}} - \frac{1}{\sigma_{C_i}}\right] Sh_{i,r,s,t} \tag{1.76}$$

Mark-up in foreign markets in countries with different levels of development

$$NB_{i,r,t}(EP_{i,r,s,t} + \frac{1}{\sigma_{VAR_i}}) = \left[\frac{1}{\sigma_{VAR_i}} - \frac{1}{\sigma_{ARM_i}}\right] + \left[\frac{1}{\sigma_{IMP_i}} - \frac{1}{\sigma_{GEO_i}}\right] SV_{i,r,s,t} + \left[\frac{1}{\sigma_{GEO_i}} - \frac{1}{\sigma_{C_i}}\right] Sh_{i,r,s,t} \tag{1.77}$$

In the agricultural version of the MIRAGE model we also consider an intervention price scheme for the European Union.[26]

[26] The intervention price scheme in the EU is modeled as follows: as soon as the internal price becomes lower than the intervention price, the EU subsidies exports so as to raise the internal

Investment

$$INV_{i,r,s,t} = a_{i,r,s} B_{r,t} KTOT_{i,s,t} \, e^{\alpha W^K_{i,s,t}} \tag{1.78}$$

$$W^K_{i,r,t} = P^K_{i,r,t} + P_{r,t} TsubK_{i,r,t} \tag{1.79}$$

$$INVTOT_{s,t} = \sum_{i,r} INV_{i,r,s,t} \tag{1.80}$$

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price to the level of the intervention price. In actual facts, the EU also increases inventories but inventories are not accounted for Mirage.

In practice, the price scheme is divided into 4 possible modes:

- For countries other than the EU or sectors not concerned by intervention prices, the subsidy rate is exogenous.
- When the intervention price is lower than the internal price, there is no export subsidy.
- When the intervention price would be higher than the internal price, the export subsidy rate is endogenous. The distribution across importers is the same as in the baseline. If there was no subsidy in the baseline, this distribution is homogenous.
- The subsidization of exports is limited by a maximum of subsidized exports from the WTO. If this limit is reached, then this constraint replaces the price constraint.

When a simulation is complete, the model checks if the constraints defining a mode still hold. If they do not, then the mode is changed automatically until there is no more necessary change.

Regional equilibrium

$$GDPVOL_{r,t} * P^{CIndex}_{r,t} = REV_{r,t} + PIBMVAL_t * SOLD_{r,t} \tag{1.81}$$

$$\text{with} \quad P^{CIndex}_{r,t} = \prod_i \left(\frac{P^C_{i,r,t}}{P^C_{i,r,t_0}} \right)^{\frac{P^C_{i,r,t_0} C_{i,r,t_0}}{\sum_j P^C_{j,r,t_0} C_{j,r,t_0}}} \tag{1.82}$$

$$\begin{aligned} GDPVOL_{r,t} * P^{CIndex}_{r,t} = & \sum_s (RQUOTA_{r,s,t} - RQUOTA_{s,r,t}) \\ & + RECTAX_{r,t} + \sum_i P^{RN}_{i,r,t} RN_{i,r,t} + \sum_{i,s} (P^K_{i,r,s,t} K_{i,r,s,t}) \\ & + \overline{L}_{r,t} P^{\overline{L}_{r,t}} + \overline{TE}_{r,t} P^{\overline{TE}}_{r,t} + \overline{H}_{r,t} P^{\overline{H}}_{r,t} \end{aligned} \tag{1.83}$$

$$epa_r REV_{r,t} = \sum_{i,s} P^{INVTOT}_{s,t} INV_{i,r,s,t} \tag{1.84}$$

$$PIBMVAL_t = \sum_{i,r} PVA_{i,r,t} VA_{i,r,t} \tag{1.85}$$

Dynamics

$$K_{i,r,s,t} = K_{i,r,s,t-1}(1-\delta) + INV_{i,r,s,t} \tag{1.86}$$

$$\overline{L}_{r,t} = \rho_r \overline{L}_{r,t-1} \tag{1.87}$$

$$\overline{H}_{r,t} = \rho_r \overline{H}_{r,t-1} \tag{1.88}$$

Chapter 2

How does Tariff-rate quota modeling affect CGE results? an application for MIRAGE

[1]

[1]This work has benefited from Yvan Decreux cooperation from CEPII and the World Bank.

2.1 INTRODUCTION

The Uruguay Round Agreement on Agriculture (URAA) introduces tariff-rate quotas (TRQs) in order to improve market access of commodities that were subject to prohibite tariffs or Non-Tariff Barriers (NTBs) such as simple quotas. The purpose of implementing TRQs on highly protected agricultural products was to guarantee a minimum level of market access (established first at 3% of domestic consumption, then expanded to 5%), to safeguard current levels of access ("current-access quotas"). In addition, another reason for implementing TRQs was to maintain existing market access conditions, in particular those granted to developing by developed countries, such as the European Union, Japan and the United States, for historical reasons.

This policy instrument is defined as followed: "Tariff-rate quotas are two-level tariffs, with a limited volume of imports permitted at the lower *in-quota* tariff and all subsequent imports charged the (often much) higher *out-of-quota* tariff" (Ingco, 1996; Diakosavvas, 2001; De Gorter and Kliauga, 2006). This instrument combines tariff (tariffs in and over the quota) and non-tariff (quota volume) measures which determines three possibles regimes: the *in-quota* regime (quota unfilled and the in-quota tariff applied to imports), the *at-quota* regime (quota just filled and the equilibrium price includes a prime over the in-quota tariff) and the *out-of-quota* regime (imports exceed the quota and the applied tariff is the out-of-quota tariff). Most bilateral TRQs display "in-quota" and "at-quota" regimes because most out-of-quota tariffs are prohibitive. Nevertheless, some exceptions appear according to the economic conjuncture (i.e. beef TRQs allocated to Mercosur countries have been consistently exceeded over the last period in spite of the very high specific component of the out-of-quota tariff). The TRQ equilibrium regime depends on tariff and quota levels as well as import demand and export supply functions, but also on the TRQ administration methods, which affect the volume of trade and the distribution of the TRQ rent between importers and exporters. De Gorter and Kliauga (2006) introduce other intermediate TRQ regimes that may appear in the case of WTO TRQs. However, these regimes are not considered in this paper because we focus here on bilateral TRQs based on data from the MAcMapHS6 database.

Most Computable General Equilibrium (CGE) models have tried to introduce TRQ modeling, but they remain far from the true market behavior when markets are affected by TRQs. The standard version of the MIRAGE model only considers exogenous TRQ rents and their reduction under different liberalization scenarios (Decreux and Valin, 2007). Even if the TRQ rents are defined at the HS6 level, this way of modeling is quite limited, because it does not give the possibility to shift from one TRQ regime to another as a consequence of an external shock. Moreover, the assumption that the whole TRQ rent is allocated to exporters is not always accurate as such allocation depends on the TRQ administration method, the market power of traders, etc. The GTAP model (Elbehri and Pearson, 2000; Berrettoni and Cicowiez, 2002) and the LINKAGE model (van der Mensbrugghe, 2001; Van der Mensbrugghe et al., 2003) also introduce TRQ modeling at an aggregate level. The advantage of their modeling is a distribution of quota-rents between importers and exporters, based on information about quota allocation or TRQ administration methods. However, they still have some limitations as TRQs are assumed to concern entire GTAP sectors, adding up imports under TRQ regimes and imports under ordinary tariffs (introducing a possible bias due to data aggregation). Furthermore, no distinction is made between multilateral TRQs (where allocation is not always explicit) and preferential TRQs granted under preferential trade agreements (PTA) (where allocation is known); all of them are treated as bilateral TRQs. This paper does not provide any improvement on this second point.

The purpose of this paper is to examine the implications of different TRQ modelings for macroeconomic and trade indicators. We compare different versions of the MIRAGE model:

(i) without any consideration of TRQs,

(ii) with exogenous TRQ rent and

(iii) with explicit TRQ modeling at a very detailed level.

Section 2.2 discusses the literature about the economics of TRQs and TRQ modeling in partial and general equilibrium frameworks. Section 2.3 presents the new specification of TRQ modeling in the MIRAGE model. Section 2.4 presents an application case (EU-Mercosur PTA) in order to compare the results of the different MIRAGE versions. The EU-Mercosur PTA example has been chosen because TRQs are the most useful and controversial trade policy instrument in agriculture liberalization between these economic blocs. The final Section concludes about the relevance of TRQ modeling in a CGE framework and also some forthcoming extensions in TRQ modeling.

2.2 Tariff-Rate Quotas: Economics and modeling

The impact of a quota-volume expansion critically depends on the initial effective protection, the import elasticity and the TRQ administration methods. First, the TRQ equilibrium regime determines the TRQ component (tariff or quota) that constrains imports. In this model we distinguish three basic regimes: the *in-quota regime* (the quota is not filled and the tariff is the in-quota tariff, τ_{in}); the *at-quota regime* (the quota is binding and the applied tariff-equivalent, τ_m, is endogenously determined, with $\tau_{in} \leq \tau_m \leq \tau_{out}$); and the *out-of-quota regime* (imports exceed the quota level and the out-of-quota tariff, τ_{out}, is the effective trade policy instrument).

Second, the import elasticity determines how quickly one regime shifts to another when trade policy changes.

Finally, TRQ administration methods also affect the quota fill. They not only affect the volume and distribution of trade between partners, but they also have a considerable impact on the distribution of TRQ rents. The WTO identifies seven methods of TRQ administration: *Applied-tariff*, *License-on-demand*, *First-come/First-serve*, *Historical*, *Auction*, *State-trader/Producer-group* and a combination of the six previous methods. The *Applied-tariff method* is the most common form and is applied on almost half of TRQs, but the *License-on-demand* (allowing the possibility to resale licenses) and *Auction* methods are the most efficient ones because they reduce allocative inefficiencies in products markets and political discretion (and thus rents) in trade allocation (Abbott, 2002; Bureau and Tangermann, 2000; Skully, 1999).

The capture of the TRQ rent is also explained by the presence of an importer (or exporter)'s market power (Olarreaga and Ozden, 2005). The quality composition of exports, the changes in world prices (or import prices) after the agreement, and the differentiation of imports across origins also explain who captures the TRQ rent. This aspect of TRQs is an important question by its welfare and trade implications, and it deserves to be addressed in detail; however, it is not the purpose of this paper.

The modeling of TRQs in a CGE framework has been implemented by several authors. Elbehri and Pearson (2000) have introduced them in the GTAP model (Hertel, 1997) using the GEMPACK code from Harrison and Pearson (1996) and they use it to study bilateral TRQs in the sugar sector. Berrettoni and Cicowiez (2002) from the Centro de Economia International (CEI) run the GTAP model to simulate the EU-Mercosur PTA by comparing two different scenarios: a quota enlargement and a reduction in the out-of-quota tariff. All scenarios are welfare-improving for both regions but gains come from different sources depending on the scenario (i.e. in the case of Argentina, a quota enlargement leads to a greater quota rent while an out-of-quota tariff reduction increases trade, therefore reducing quota rents.)

The LINKAGE CGE model from the World Bank relies on the Mixed Complementarity Problem (MPC) methodology to implement TRQs (van der Mensbrugghe, 2001). MCP is based on orthogonality conditions. The first one states that in-quota imports cannot exceed the quota level. It is associated with a constraint on the quota premium-rate, which lower bound is zero. Two regimes, in-quota and at-quota, may be deduced from this condition. The second orthogonality condition states that the quota premium-rate is capped at the difference between the out-of-quota and the in-quota tariffs and it is associated with a lower bound for the out-of-quota imports (also equal to zero). Van der Mensbrugghe et al. (2003) test the LINKAGE TRQ modeling in the case of TRQ reforms in the sugar market by the most important OECD countries, such as the EU, the Unites States and Japan. Their conclusions highlight the trade-diversion effects induced by TRQs as well as welfare gains for countries benefiting from TRQ bilateral allocations (least-developed countries).

The originality of these previous models is the consideration of the TRQ rent-sharing between importers (government) and exporters,[2] which is crucial for welfare implications and export incentives. Their disadvantage lies in the fact that entire sectors, such as Meat or Sugar (identified in the GTAP database), are assumed to be under TRQ regimes which is not necessarily true.[3] Using aggregated data at the GTAP sector level may lead to biased results. Our proposed TRQ modeling aims at minimizing these aggregation biases.

When all individual quotas are aggregated into large quotas at the sector level, several possibilities appear to compute their parameters and to define the equilibrium regimes. Van der Mensbrugghe et al. (2003) assume that the aggregate sector is in an at-quota regime as soon as some individual quotas are binding. Therefore the size of the quota has to be equal to actual trade, while the premium is computed based on individual rents. By contrast, Lips and Rieder (2002) assume that a sector is in an out-of-quota regime as soon as one product exceeds its quota. It allows them to keep the actual size of the quota, but then, several options appear to compute inside and outside tariffs. They analyze two different methods for the GTAP model. The first method is based on the aggregation of in and out-of-quota tariffs using trade as a weighting scheme (the second one being provided by the GTAP database); the second method starts from the actual quota rent as the sum of all individual rents and from a trade-weighted outside tariff, which leads to the endogenous determination of the inside average tariff. When

[2]Van der Mensbrugghe et al. (2003) assume that the quota rents are shared in exogenous proportions that depend on importers and exporters, while Elbehri and Pearson (2000) and Berrettoni and Cicowiez (2002) assume them to be allocated equally between importers and exporters.

[3]Elbehri and Pearson (2000) and Berrettoni and Cicowiez (2002) aggregate in-quota and out-of-quota tariffs, weighting them by trade, and the fill-rate helps to determine the initial TRQ regime for each GTAP sector.

the sector is in-quota and out-of-quota regime but some individual quotas are not, tariff aggregation leads to an overestimation of the quota rent at the GTAP sector level, while keeping the actual rent as the base for the tariff gap leads to an overestimation of the inside tariff. They use both methods as a sensitivity analysis for their estimations.

2.3 Modeling Tariff-Rate Quotas in MIRAGE

2.3.1 The MIRAGE model

The MIRAGE model from CEPII is multi-sectoral and multi-regional CGE model (Bchir et al., 2002). It is a dynamic model fitted with imperfect competition in the manufacturing and service sectors, in order to give a more realistic representation of the world economy. MIRAGE describes imperfect competition in an oligopolistic framework "à la Cournot".

The demand side is modeled in each region through the representative agent assumption. Firstly, domestic products are assumed to be less substitutable to foreign products than foreign products are to each other. Secondly, products originating in developing countries and in developed countries are assumed to belong to different quality ranges. This assumption is based on empirical evidence of quality differences even at the most detailed level of product classification, and on the idea that the composition of identical aggregate sectors may be actually quite different between a developing country and an industrialized one. This assumption is likely to have direct consequences on the transmission of liberalization shocks, as the elasticity of substitution is lower across different qualities than across products within a given quality. Hence, the competition between products of different qualities is less substantial than between products of a similar quality. In the absence of systematic information suitable for the incorporation of vertical differentiation in a worldwide modeling exercise, such as the one undertaken here, differentiation is modeled in an *ad hoc* fashion: developed countries and developing countries are assumed to produce goods belonging to two different quality ranges; substitutability is assumed to be weaker across these two quality ranges than between products belonging to the same quality range.

Regarding the supply side of the model, producers use five factors: capital, labour (skilled and unskilled), land and natural resources. The structure of the value-added production function is intended to take into account the well-documented relative skill-capital complementarity. These two factors are thus bundled separately, with a lower elasticity of substitution, while a higher substitutability is assumed between this bundle and other factors.

The production function assumes perfect complementarity between value-added and intermediate consumption. The sectoral composition of the intermediate consumption aggregate stems from a CES function. For each sector of origin, the nesting is the same as for final consumption, meaning that the sector-bundle has the same structure for final and intermediate consumption.

Constant returns to scale and perfect competition are assumed to prevail in agricultural sectors. In contrast, firms are assumed to face increasing returns to scale in the industrial and service sectors (through a constant marginal cost and a fixed cost, expressed in output units). In those sectors, competition is imperfect. This modeling allows the pro-competitive effect of trade liberalization to be captured.

Capital good has the same composition regardless of the sector; it cannot change its sector affectation once it has been installed, thus introducing a rigidity in the economy suggested by empirical evidence. Capital is accumulated every year as the result of investments in the most profitable sectors. Natural resources are considered to be perfectly immobile and may not be accumulated. Both types of labor (skilled and unskilled) are assumed to be perfectly mobile across sectors, whereas imperfect land mobility is modeled with a constant elasticity of transformation function. Production factors are assumed to be fully employed; accordingly, negative shocks are absorbed by changes in prices (factor rewards) rather than in quantities. All production factors are internationally immobile. With respect to macroeconomic closure, the current balance is assumed to be exogenous (and equal to its initial value in real terms), while real exchange rates are endogenous.

The calculation of the dynamic baseline has been recently improved in order to have an endogenous total factor productivity (TFP). This improvement is based on a more elaborate demographic and macroeconomic forecast in which the labor and GDP growth rates until 2015 are taken from the World Bank database. In the baseline, TFP is determined endogenously but under the simulation scenarios it becomes fixed, while GDP is calculated endogenously.

The model uses the GTAP database 6.1. However, instead of relying on modeling tariff cuts at the sector level, we use a detailed database (MAcMapHS6) at the HS6 level (5,113 products) for border protection. TRQ data (in, at and out-of-quota tariffs, quota levels and imports under TRQs) are also provided at the HS6 level. This allows analysis to be based on actual applied tariffs, including preferential provisions (e.g. GSP, FTAs, etc.), and to build scenarios based on the sensitivity of products as revealed by actual trade policy. In the simulation presented later, tariff databases used to describe the initial situation and construct scenarios of trade liberalization are MAcMapHS6-v2, corresponding to year 2004, for TRQs applied by the EU to Mercosur, and MAcMapHS6-v1, which describes market access in 2001, for the remaining information (Bouët et al., 2004).

2.3.2 TRQ modeling in MIRAGE

Our improvement of TRQ modeling for MIRAGE aims at avoiding aggregation biases discussed above, and thus TRQs are introduced at a more detailed level (bilateral TRQs at the HS6 level) than GTAP data. This implies to modify the demand tree and include new branches (see Figure 2.1). A further CES nesting level is added to the sub-utility function in order to distinguish between imports under TRQs and imports under ordinary tariffs.

[INSERT Figure 2.1]

For imports under TRQs the information is disaggregated (bilateral TRQs at the HS6 level) and each GTAP sector may contain one or more TRQs (Equations 2.1 and 2.3); however, for non-TRQ imports, data remains aggregated at the GTAP-sector level (Equations 2.2 and 2.4).

$$TRQ_{id,i,r,s,,t,sim} = \alpha^{TRQ}_{id,i,r,s} DEM_{i,r,s,t,sim} \left(\frac{PDEM_{i,r,s,t,sim}}{P^{TRQ}_{id,i,r,s,t,sim}} \right)^{\sigma}_{IMP} \tag{2.1}$$

$$NTRQ_{i,r,s,t,sim} = \alpha^{NTRQ}_{i,r,s} DEM_{i,r,s,t,sim} \left(\frac{PDEM_{i,r,s,t,sim}}{P^{NTRQ}_{i,r,s,t,sim}} \right)^{\sigma}_{IMP} \tag{2.2}$$

$$P^{TRQ}_{id,i,r,s,t,sim} = PCIF_{i,r,s,t,sim} \left(1 + \tau^{TRQ}_{id,i,r,s,,t,sim} \right) \tag{2.3}$$

$$P^{NTRQ}_{i,r,s,t,sim} = PCIF_{i,r,s,t,sim} \left(1 + \tau^{NTRQ}_{i,r,s,t,sim} \right) \tag{2.4}$$

Within a sector containing TRQs, individual products are assumed to be imperfectly substitutable to each other. The elasticity has been assumed to be the same as the elasticity between products originating from different countries belonging to the same quality group.

The import price for GTAP sectors containing TRQs is a CES index price composed by TRQ and Non-TRQ prices (Equation 2.5). It depends on non-TRQ tariffs and TRQ-regimes changes.

$$\begin{aligned} PDEM_{i,r,s,t,sim} DEM_{i,r,s,t,sim} = & \sum_{id\$(id,i,r,s)} P^{TRQ}_{id,i,r,s,t,sim} TRQ_{id,i,r,s,t,sim} + \\ & + P^{NTRQ}_{i,r,s,t,sim} NTRQ_{i,r,s,t,sim} \end{aligned} \tag{2.5}$$

In order to model the possibility of TRQ-regime changes, we need to introduce some extra conditions. We define three TRQ-regimes: *in-quota*, *at-quota* and *out-of-quota regimes.*

In-quota regime	if $TRQ_{id,i,r,s,t,sim} < \bar{Q}_{id,i,r,s,t,sim}$	$\tau^{TRQ}_{id,i,r,s,t,sim} = \tau^{in}_{id,i,r,s,t,sim}$
At-quota regime	if $TRQ_{id,i,r,s,t,sim} = \bar{Q}_{id,i,r,s,t,sim}$	$\tau^{in}_{id,i,r,s,t,sim} < \tau^{TRQ}_{id,i,r,s,t,sim} < \tau^{out}_{id,i,r,s,t,sim}$
Out-of-quota regime	if $TRQ_{id,i,r,s,t,sim} > \bar{Q}_{id,i,r,s,t,sim}$	$\tau^{TRQ}_{id,i,r,s,t,sim} = \tau^{out}_{id,i,r,s,t,sim}$

The equilibrium under the first regime is characterized by imports lower than the quota level, the in-quota tariff being the effective protection. Under the second regime, the quota is binding and the prime over the in-quota tariff is endogenously determined. The out-of-quota regime considers an equilibrium in which the out-of-quota tariff is the effective protection because imports exceed the quota level.

[INSERT Figure 2.2]

The conditions which lead to TRQ-regime shifting (Table 2.1) are the following: if a TRQ is initially under the in-quota regime but imports exceed the quota level, then the TRQ-regime shifts to the at-quota regime. Conversely, if a TRQ is under an at-quota regime and the endogenous tariff-equivalent is lower than the in-quota tariff, then the TRQ-regime shifts to the in-quota regime. For all other TRQ-regime changes the mechanisms are similar.

[INSERT Table 2.1]

TRQ rents depend on the premium-rate over the in-quota tariff and the quota volume, as described in Equation 2.6. All TRQ rents at the detailed level are added to obtain the rent at the GTAP sector level. These rents increase exporters' revenues and may become an important source of welfare gain, as it is assumed in the standard version of MIRAGE: the full rent is captured by exporters.

$$QR_{id,i,r,s,t,sim} = (\tau^{TRQ}_{id,i,r,s,t,sim} - \tau^{in}_{id,i,r,s,t,sim})\bar{Q}_{id,i,r,s,t,sim} \tag{2.6}$$

In order to match TRQ information at the HS6 level and GTAP data, a multi-dimension mapping has been defined to show which TRQ (bilateral and at the HS6 level) belongs to each particular import demand (bilateral trade and at GTAP-sector aggregation).

As we have seen in the TRQ literature this way of modeling is supposed to avoid some aggregation biases affecting welfare and trade results; however, computational difficulties are likely to emerge at high levels of region and sector disaggregation. Forthcoming researches about TRQ modeling in MIRAGE will examine an aggregated TRQ model (minimizing aggregation biases) to address this difficulty.

2.4 The EU-Mercosur PTA: an example of TRQ modeling

Mercosur (Argentina, Brazil, Paraguay, Uruguay and Venezuela) is the most important EU partner in Latin America (50% of EU exports to the region) and inversely the EU is the destination market of more than 30% of Mercosur agricultural and food exports.

Mercosur countries are developing countries, which are therefore eligible for the EU Generalized System of Preferences (GSP), and some of them, such as Venezuela, benefit from the GSP+ with a duty exemption over approximately 85% of their exports. However, their access to the EU market is constrained by the limited GSP coverage for agricultural products and by the GSP graduation for the largest Mercosur countries (Argentina and Brazil).

TRQs defined under the Uruguay Round Agriculture Agreement (URAA) allow Mercosur countries to benefit from preferential tariffs for some of their agricultural exports. These are either current-access TRQs, opened to ensure persistence of historical preferential trade flows, or minimum-access TRQs, granted to open 5% of the domestic consumption to international competition (all WTO members).

The EU has opened more than 80 TRQs on agricultural products under either current or minimum access. Most of them are administered according to the License-on-Demand, Historical-trade and First-come/First-served methods. Mercosur benefits from a preferential market access through TRQs for cereals (corn, wheat), meats (beef, swine and poultry), fruits and vegetables, rice, dairy products and other food products. Argentina and Brazil benefit from large quotas of food (Argentina) and meat (Brazil and Argentina), and fruits and vegetables (Brazil), while Uruguay and Paraguay only have a smaller (bovine) meat quota and a tiny quota for dairy products (Uruguay). Venezuela does not use TRQs because it faces more duty free tariff lines given by the GSP+.

Under the EU current-access TRQs, Argentina and Uruguay benefit from a preferential access with a limit of 23,000 tons and 5,800 tons for sheep and goat respectively, and under minimum access these counties benefit from TRQs for beef and nutritional remainders (Argentina). Argentina also benefits from a WTO quota for garlic, which is not fulfilled as is the case for beef TRQs (Bureau et al., 2006).

Mercosur countries also benefit from the "Hilton" TRQ for (fresh) meat (28,000 tons for Argentina, 6,300 tons for Uruguay, 5,000 tons for Brazil and 1,000 tons for Paraguay), whose licenses are managed by the exporter countries. This aspect explains Mercosur's producers interests in keeping TRQs instead of negotiating MFN tariff reductions. The only country that does not fulfill its quota is Paraguay due to sanitary problems. The Hilton in-quota tariff is 20% and the out-of-quota tariff is a mixed tariff (12.8% plus a specific tariff between 140 and 300 €per 100kg depending to the HS tariff line). In spite of the high out-of-quota tariff, Mercosur countries manage to fulfill their quotas and even to export small volumes out-of-quota. In the beef case, there is also a 66,000-ton frozen beef WTO TRQ (for the meat industry) of which Brazil is the main beneficiary (as it is not allocated to any specific country). For instance in 2003, Brazil exported out of quota some 80,000 tons of frozen meat and 41,000 tons of Hilton meat. In this last case, outside exports represented eight times Brazil's quota. Brazil also benefits from the TRQs opened under minimum-access for poultry (not allocated to a particular country) and fills half of the 15,500-ton poultry TRQ. Despite EU tariffs, Brazil manages to ship large quantities of poultry to the EU outside quotas (Bureau et al., 2006; Ramos et al., 2006).

The accession of some EU members also leads to improve Mercosur access to the European market. Since the adhesion of Spain and Portugal to the EU, Mercosur countries have also benefited from a corn TRQ (2,5 million tons). This quota no longer exist because the tariff for seeds is duty-free and non-tariff barriers (OGM restrictions) protect the EU market from Mercosur's maize. Since 2006 and for a few tariff lines, the EU has opened a 244,000-ton WTO TRQ for flint maize from which Argentina and Brazil benefit. Brazil also benefited from a 82,000-ton sugar TRQ granted by Finland before it became an EU member, but recently Brazil's possibilities to export sugar to the EU have been enlarged (see

Table 1.1 in Chapter 1).

In order to improve the EU-Mercosur relations, in 1995 both regions agreed on the negotiations' take-off; however, after more than 10 years and several negotiation rounds, no agreement was signed. According to the proposals exchanged, the EU would only open its agricultural market to Mercosur through the enlargement of the present TRQs and the opening of some new quotas for specific products (sugar, tobacco and ethanol).

The predominance of TRQs as proposed measures in the EU-Mercosur negotiation has motivated our decision to take it as an illustration of some different TRQ modeling possibilities in a CGE framework.

2.4.1 TRQ Data description

According to the new TRQ database from MAcMapHS6-v2, 32 countries have opened TRQs under the rules of the WTO as well as under some PTAs. All WTO members benefit from these TRQs but they are not equally allocated between partners. The allocation is sometimes determined by importers. Agricultural products are most affected by this trade policy instrument, since more than 450 agricultural products and only 24 non-agricultural products are constrained by TRQs. Among agricultural products, bovine meat (chapter 02), roots and tubers (chapter 07), animal and vegetable oils (chapter 15) and some preparation from fruits and vegetables (chapter 20) are more frequently limited by TRQs. Countries such as Japan, the United States, Korea and the EU generate the greatest rents with their TRQs, while the most concerned products are meat (chapter 02), cereals (chapter 10), oilseeds (chapter 12) and beverages and tobacco (chapter 24). Because most of these TRQs are allocated to a few partners and TRQ rents are assumed to be entirely captured by exporters (MIRAGE model assumption), rents would be concentrated on a few countries (i.e. the United States, Brazil, Australia, Argentina and the European Union). This geographical distribution of quota rents is also the consequence of the choice of sensitive products by major importers, combined to the sectoral specialization of major exporters.

For the EU-Mercosur PTA example, we only consider EU TRQs. Large number of TRQs have been opened by the EU for particular sectors, such as Food products, Dairy products, Meat and Meat products, and Vegetables and Fruits. For some of these sectors (Dairy products, Meat, Cattle, and Fruits and Vegetables) more than 20% of EU imports enters under TRQ regimes, this is particularly true for imports originating in Mercosur. For instance, more than 60% of dairy imported products and almost 30% of imported meat coming from Argentina enter in th European market under TRQ regimes (Figure 2.3).

[INSERT Figure 2.3]

Concerning this model and the GTAP data, we have defined a specific aggregation in 7 regions and 25 sectors, using all the sectoral detail available in the GTAP database for agricultural products (see Table 2.2). For sectoral aggregation we have decided to keep all agricultural sectors in their original GTAP nomenclature because we are especially interested on the TRQ impact in these particular sectors, and to aggregate manufactures, services and primary products. Since our application focuses on the EU-Mercosur preferential trade agreement, we disaggregate all partners of this PTA (EU27, Argentina, Brazil, Uruguay and Venezuela) and in order to differentiate the effects according to the developing degree of the rest of the world, we differentiate developing and developed countries.

[INSERT Table 2.2]

2.4.2 Pre-experiment

Before simulating the bi-regional agreement scenario, we carried out a traditional pre-experiment in MIRAGE which takes into account the end of the Multi-Fibers agreement, the United States' farm bill and China as a WTO member. In addition, we added some assumptions specific to this paper.

For this particular simulation, we consider Venezuela as a Mercosur member since 2006, and thus we have replaced Venezuela's tariff by those of Argentina. In order to modify Venezuela's tariffs, we distinguish two cases: if

Venezuela's tariffs are higher than those of Argentina, they are replaced by the latter, but if Venezuela's tariffs are lower than Argentina's tariffs, we keep the original Venezuela's tariff to acknowledge the bilateral trade agreements between Venezuela and other countries or regions. For instance, as a preferential partner of the Andean Community, Venezuela applies lower (generally zero) tariffs to the members of this customs union than the Mercosur Common External Tariffs (CET).

In computing the baseline, we assume that the Doha Round will be successful. Therefore industrialized countries will reduce agricultural products' tariffs according to the following schedule based on the initial level of the Bound *ad valorem* Tariff Equivalent (BTE).

- BTE $\leq$ 20% => 40% reduction
- 20% < BTE $\leq$ 50% => 45% reduction
- 50% < BTE $\leq$ 75% => 50% reduction
- BTE > 75% => 60% reduction, with a tariff cap at 100%

The BTE is reduced by a Swiss formula with a coefficient of 10 in non-agricultural products.

For developing countries tariffs in agricultural sectors are cut according to the following schedule based on the initial level of the BTE:

- BTE $\leq$ 30% => 25% reduction
- 30% < BTE $\leq$ 80% => 30% reduction
- 80% < BTE $\leq$ 130% => 35% reduction
- BTE > 130% => 40% reduction, with a tariff cap at 150%

For non-agricultural products, bound tariffs are reduced according to a Swiss formula with a coefficient of 18. We also consider the possibility of non-agricultural sensitive products for developing countries by allowing them to implement a tariff cut corresponding to only half of what it should be according to the formula, for 10% of the total number of HS6 lines in industrial sectors. The tariff lines are chosen within some specific sectors. The automobile sector is considered totally sensitive for all countries. The remaining HS6 sensitive lines are spread among some sensitive sectors so as to represent an identical share of each of them. The list of sensitive sectors varies with developing country.

For industrialized and developing countries we also consider sensitive products with reduction rates halved, cap unchanged, accounting for 5% of the tariff lines spread equally among the tiers (except if the highest ones are empty; unused sensitive lines are then used in the next tier), and selected so as to reduce tariff rates as little as possible. This pre-experiment also considers a linear dismantling of export subsidies between 2007 and 2013.

The horizon of tariff cuts for industrialized countries is 3 years while it is 6 years for developing countries.

No commitment is taken into account for the least-developed countries.

Multilateral liberalization at the WTO is computed based on bound tariffs, whereas the bilateral agreement described later in the paper, will cut bilateral applied tariffs.

2.4.3 Bilateral liberalization scenario

The accomplishment of the EU-Mercosur trade agreement is subordinated to the multilateral negotiations at the WTO. This is the reason why in our pre-experiment scenario, we assume a successful multilateral trade agreement before the signature of the bi-regional EU-Mercosur agreement. This assumption also affects the choice of sensitive products for the bilateral negotiation, this is the second reason which justifies our scenario and pre-experiments.

The criterion to determine sensitive products for both regions is the level of protection. For the EU, sensitive products concern tariff lines for which applied tariffs exceed 40% as well as tariff lines where TRQs have been opened. In the case of Mercosur sensitive products, we consider all tariff lines which level of applied protection exceeds 15%. Otherwise, products are not sensitive and they will be immediately liberalized. EU sensitive-products' list is mainly composed by agricultural and food products while Mercosur sensitive products are mostly manufactured goods. Since October 2004 there has been no new proposal exchanged. Therefore we simulate an agreement that correspond to the average between EU and Mercosur October 2004 proposals, also including some new EU TRQs for some particular products. For Mercosur sensitive products, tariffs are cut 5 years after the beginning of the agreement whereas for the EU sensitive products, no tariff cut is assumed but quotas will be expanded (i.e. meat, cereals, dairy products and food) and some new TRQs will be created (i.e. some sugar products, ethanol, cacao and tobacco).

For products under WTO TRQs we simulate a quota enlargement without any change in tariffs (in-quota and out-of-quota). From the initial volume as measured by the present utilization of the WTO TRQs by Mercosur countries, an increase of the TRQ volumes is implemented based on the average between the EU and Mercosur proposals (see Table 2.3).

[INSERT Table 2.3]

As for new bilateral TRQs opened for Mercosur countries, we consider two cases. For some products we follow the EU proposal in which new quotas are only opened for some particular tariff lines at the 6-digit and 8-digit levels. The new TRQ for Ethanol would concern only 4 product lines (22071000, 22072000, 22089091, 22089099), for Sugar only 7 products (17025050, ex17499099 -17499080-, 18061090, ex18062080 -18069080-, ex18062095 -18069080-, ex18069090 -18061980-, ex18069090 -18069980-), for Cocoa and Tobacco all products under the following HS4 codes: 1803, 1804, 1805 for Cocoa, and 2402, 2403 for Tobacco. For the other sensitive products, new TRQ volumes correspond to 150% of the current observed imports of the EU from Mercosur countries.

All scenarios of trade liberalization (the WTO agreement in the baseline and the EU-Mercosur agreement in the simulation) were constructed using the MAcMapHS6 database at the product level (HS6 level) before aggregating the data toward the sectors used in the CGE model. The advantage of such a strategy is to take into account exceptions and the non-linearity of the applied tariff reduction formula, such as the Swiss formula for the pre-experiment scenario.

The EU-Mercosur agreement assumed in the liberalization scenario starts after the beginning of the implementation of the WTO agreement (most ambitious proposal) in 2007, and is assumed to be completely achieved by 2014.

This EU-Mercosur PTA scenario is run under different TRQ modeling hypotheses. The first version (V1) of the model does not consider any TRQ treatment so that only tariff reductions are implemented. The second version (V2) of MIRAGE introduces exogenous TRQ-rents, calculated according to the PTA scenario using the MAcMapHS6-v2 database. The third version (V3) of the model displays an explicit modeling of TRQ (HS6, partner, reporter) allowing TRQ-regimes shifting. Finally, we use the same disaggregated variant of Mirage as the one used for V3 but without any TRQ changes (V3nq standing for V3 no quota).

The aim of this example is to highlight modeling biases linked to data aggregation and the lack of TRQ modeling with TRQ-regime shifting. In order to isolate data aggregation biases, we will compare V1 and V3nq. No TRQ shocks are assumed in these versions and they only differ in terms of the degree of data aggregation (V1 at GTAP sectors/regions aggregation and V3nq at the HS6 level for some trade and protection data). As tariffs may vary strongly within those sensitive sectors, the aggregation bias may be not negligible, and should not be confused with the impact of modeling quotas at the detailed level with the possibility of regime changes. Therefore, what matters is the difference brought by V2 as compared to V1, which is compared to the difference of V3 as compared to V3nq. The first difference tells what quota changes imply in an aggregated framework with no regime change, while the second difference tells us the same thing in the disaggregated version with regime changes. All results are detailed in the following subsection.

2.4.4 Simulation results

- *Welfare, welfare decomposition and other macroeconomic impacts:*

In this subsection we will analyze the impact of the EU-Mercosur PTA in terms of welfare and other macroeconomic indicators. The idea is to elucidate the relevance of the TRQ modeling in welfare and macroeconomic results, isolating them from data aggregation biases.

Looking at welfare and GDP at world level, we find that data aggregation (V1 vs. V3nq) does not introduce any bias in the results; however, major differences appear when we compare V2 to V3. TRQ modeling in V3 permits a market access improvement, leading to a greater GDP and thus a greater welfare at the world level. By contrast, the simplification of just increasing rents based on exogenous TRQ rents from MAcMapHS6-v2 in V2 does not lead to these gains and thus underestimates welfare improvement at the world level.

Focusing on countries' welfare and their welfare decomposition gains, we also find that there is no bias explained by data aggregation. Welfare variations between V1 and V3nq do not differ for any country; however, welfare decomposition shows that allocation efficiency gains are greater when using disaggregated data (V3nq) rather than using all data at the GTAP level (V1). Protection data at a more detailed level leads to attribute an important part of welfare gains to the improvement of resource allocation.

The biases in countries' welfare are, however, explained by TRQ modeling. We find that the TRQ simplification through exogenous TRQ rents overestimates welfare gains, because no TRQ regime change is allowed. The lack of TRQ modeling do not consider the possibility that a quota expansion may reduce the marginal tariff leading to smaller (or even zero) rents. This fact is observed in the case of Argentina, Brazil and Uruguay welfare. Conversely, for the other regions, V2 displays welfare losses that are not confirmed by V3 results. Liberalizing trade through TRQs also lead to increased welfare for the rest of the world and for the EU25 according to V3, as compared to the baseline scenario. The EU benefits from a better allocation of resources since market access has been improved instead of just creating rents for Mercosur countries as in V2. As for the rest of the world, they actually benefit from the increase in agricultural exports by Mercosur countries, which leads them into specializing more in industrialized sectors, characterized by increasing returns to scale at the industry level through the imperfect competition mechanism. By contrast, welfare loss for the rest of the World in the V2 simulation is the logical consequence of the trade diversion implied by the bilateral agreement between Mercosur and the EU, without any positive mechanism to compensate it like the one mentioned. The overestimation of Mercosur gains under V2 is due to the opposite mechanism. While Mercosur countries benefit from rent increases, they still do not export more agricultural products, so that they continue to benefit from economies of scale in the industrial sectors.

Welfare gain composition is also affected by the TRQ modeling. Under V3, most welfare gains are explained by mechanisms other than TRQ rent increases (more efficient allocation of resources, capital accumulation and terms of trade improvement), while unsurprisingly under V2 they are mainly composed by capital accumulation and the exogenous strong increase of TRQ rents.

Regarding other macroeconomic indicators at the country level, such as employment (agricultural and non-agricultural), real wages and GDP, the consequences on most of them (especially on GDP) does not differ between V1 and V3nq. However, taking into account only exogenous TRQ-rents leads to some biases. Argentina, Brazil and Uruguay GDP growths are overestimated, while GDP is reduced in the rest of the world.

Employment and reals wages display the same trend. Agricultural employment is slightly affected by data aggregation (only for Argentina and Brazil) but TRQ modeling is more relevant to explain differences in results. TRQ modeling leads to greater variations in agricultural employment for most developing countries (Argentina, Brazil, Uruguay, Dping) but at the same time, it shows that the rest of the world, especially the EU25, would be more affected by the agricultural unemployment. For non-agricultural employment, data aggregation does not seems to have any consequence as dramatic as those which result from the specification of TRQs into the model. Unemployment is greater for developing counties while employment increases for developed countries under V3. However, their differences under V2 and V3 are not as large as for agricultural employment.

Variations in real returns for factors are also mainly affected by the TRQ modeling. Variation between the results of V1 and V3nq is negligible but differences between V2 and V3 are crucial. The increase in real wages is underestimated for unskilled agricultural labor when we consider exogenous TRQ-rents, and vice versa for unskilled non-agricultural labor. In the case of capital and land returns, the TRQ-regime shifting leads to higher returns in some countries, such as Argentina and Brazil, but to more dramatic decreases in their returns for the rest of the world.

In short, we can say that data aggregation marginally affects macroeconomic results compared to the influence of TRQ modeling. The possibility to switch from one TRQ regime to another allows to greater welfare gains, mainly explained by other sources than TRQ gains (overestimated in V2), such as allocative efficiencies, terms of trade or capital accumulation. All other macroeconomic indicators, such as GDP, employment and factor's returns follow the same trend as countries' welfare.

- *Trade impact:*

  Trade indicators are sensitive to both data aggregation and TRQ modeling; however, the latter always remains more significant to explain differences between results. World trade displays slight differences between V1 and V3nq while the largest part of world trade increase is due to the TRQ modeling. The simplification assumption of using exogenous TRQ-rents, instead of modeling TRQ mechanisms, does not allow to improve market access for sensitive products, and thus trade gains are lower. When quotas are expanded, TRQ-regimes may shift, and thus the effective protection decreases leading to an increase for trade.

The previous result is confirmed when we consider individual countries' trade. Total trade variations do not differ much from V1 to V3nq; however, TRQ modeling becomes crucial for trade results. The consideration of V3 to simulate the EU-Mercosur PTA allows to increase the overall trade of Mercosur countries and the EU25.

At a more detailed level, such as bilateral trade, data aggregation matters more than in the previous cases. Nevertheless, once more TRQ modeling is the source of results' differences between versions. More dramatic bilateral trade variations are observed under V3. This result is clearer for bilateral trade between Mercosur countries and the EU25, in which TRQs are really important. Looking at the scenario impact, the bilateral trade between the EU25 and each Mercosur country increases much more under V3, especially for Brazilian (27.7% under V3, 5.5% under V2 and 7% under V3nq) and Uruguayan (20.6% under V3, 4.4% under V2 and 5.4% under V3nq) exports to the EU, than under V2.

Decomposing trade in agricultural and non-agricultural trade, we find that the largest part of trade gains for Mercosur countries is found in agricultural sectors. As we explained in the scenario description, most of this products are sensitive and liberalized only through TRQs. By comparing V1 and V3nq, there is small differences due to data aggregation and thus the increase in agricultural trade is mostly explained by TRQ modeling. Looking at V3 results, the increase in exports for Argentina is mainly explained by Meat (37%) and Paddyrice (2.6%) exports, remembering that both sectors are under TRQs. In the case of Brazil 10% of the agricultural exports increase is also explained by Meat (121%) exports.[4] The explanation of the increase in the Uruguay agricultural exports (7.9%) is deversified among the following sectors: Cattle (7.9%), Cereals (1.4%), Diary products (8.6%) and Meat (19.8%) exports. European imports also increase for agricultural

[4]For other sensitive sectors, like Sugar, a small quota expansion is not enough to increase trade and an out-of-quota tariff reduction would be surely preferred.

products, especially for Meat (217%) and Meat products (2.2%) which are both under TRQs.

In short, we can say that TRQ modeling matters more than data aggregation to explain biases in trade results. In addition, TRQ modeling leads to more dramatic trade variations (negative and positive) compared to the use of exogenous TRQ-rents, which does not allow to trade increases. TRQs are the source of agricultural market access improvement, especially for sectors which benefit from larger quota increase (Meat). However, in other sectors, for which out-of-quota tariffs remain prohibitive, a small quota increase is not enough to change the TRQ-regime, and thus protection (out of quota) remains unchanged.

2.5 CONCLUSION and EXTENSIONS

Tariff-rate quotas have become a very significant trade policy instrument in agricultural liberalization, especially in sensitive sectors where industrialized countries want to keep a close control on trade. In these sectors, TRQs are presently the main way offered to developing countries like Mercosur to increase their exports to developed countries (notably the EU).

In this paper, we highlight the need for a proper TRQ modeling in a CGE framework. To do so we compare three versions of the Mirage GCE model (without TRQs, with exogenous TRQ-rents and with TRQ modeling). By isolating an aggregation biases from bias induced by a lack of actual TRQ modeling, we find that data aggregation is not the most important part; on the contrary, most differences between results come from the TRQ modeling.

The simple assumption to use exogenous TRQ-rents[5] distort welfare and trade gains. The impossibility to shift from one TRQ-regime to another explains these results by two non-negligible reasons. The first important aspect, which affects essentially welfare results, is the overestimation of TRQ rents because under this assumption any quota expansion automatically increases rents. In fact, actual

[5]Exogenous TRQ-rents are pre-calculated using MAcMapHS6-v2 for each scenario

TRQs do not necessarily lead to greater rents when quota volumes are expanded (except when the initial equilibrium is out of quota and remains out-of-quota after the expansion). The second reason is that the protection level for products under TRQs is not reduced when only rents are accounted for. This suppresses the possibility for a market access improvement, and thus for trade volume increases. Concerning welfare composition, a market access improvement also affects terms of trade, becoming one of the most important sources of welfare gain (along with allocative efficiency gains) in our example.

Using what we consider as the best specification, the V3 model, we obtain that the EU-Mercosur PTA simulated in this paper would be welfare-improving for all concerned partners; secondly, trade gains for Mercosur countries occur in agro-food sectors (particularly in the Meat sector); and finally, the openness of the European agricultural markets through TRQs lead to welfare gains for other countries as a result of their eviction from the European agricultural market, with a reallocation of their resources towards industrial sectors. For some poor developing countries, this mechanism remains unsure however, as their capacity to reallocate resources is questionable.

The literature on TRQ modeling in a CGE framework is quite recent, and a lot of modeling improvements have to be done.

The next extension to this work is to find the way of modeling TRQs in an aggregate way (at GTAP sectors and regions levels) while minimizing data aggregation biases. Working with TRQ modeling at an aggregate level is necessary when models become too large (many sectors and many regions). Several ways of doing it have already been proposed in the literature for some specific sectors, which have relied on a single quota for each sector containing quotas.

Another possible extension to this work is the distinction of multilateral and preferential TRQs. Licenses allocation is different in multilateral TRQs, and the possibility of a reallocation between partners should be explicitly modeled. Another interesting question would be to model each TRQ by taking into account its TRQ administration method, and eventually by considering importer or exporter market powers and their consequences.

De Gorter and Kliauga (2006) have introduced intermediate TRQ regimes in the case of multilateral TRQs. For instance, when one of the importers fills its quota-part of the multilateral quota, but the rest of partners do not without any possibility to resale licenses, the prime over the in-quota tariff could be positive even if the quota is unfilled. The empirical evidence also highlights the possibility that TRQs remain unfilled when they are restricted to some particular HS6 products.

Some of previous TRQ specifications merit to be addressed in detail in order to improve the modeling of agricultural markets' behavior.

Figures and Tables

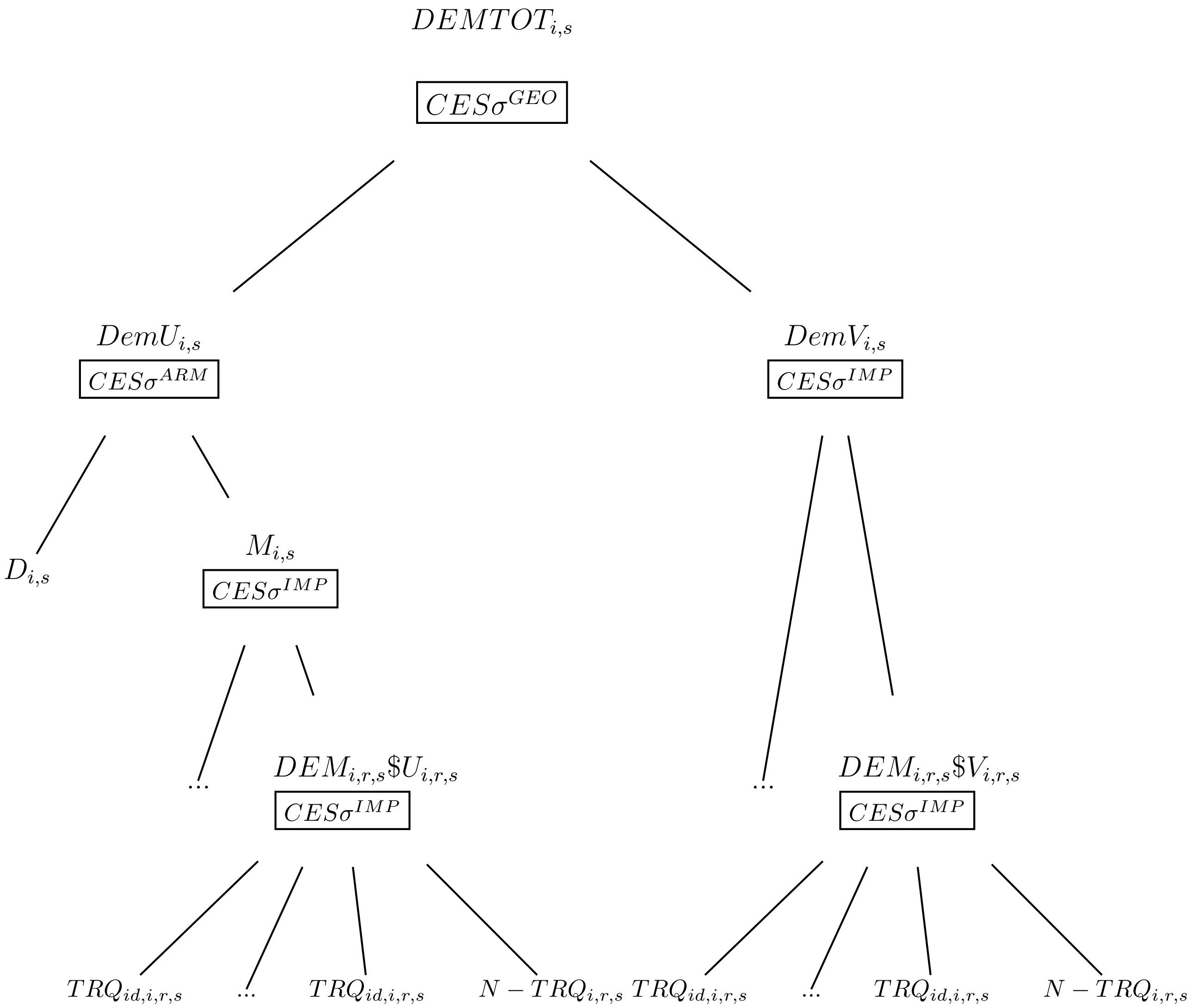

Figure 2.1: Demand tree with TRQ and non-TRQ imports

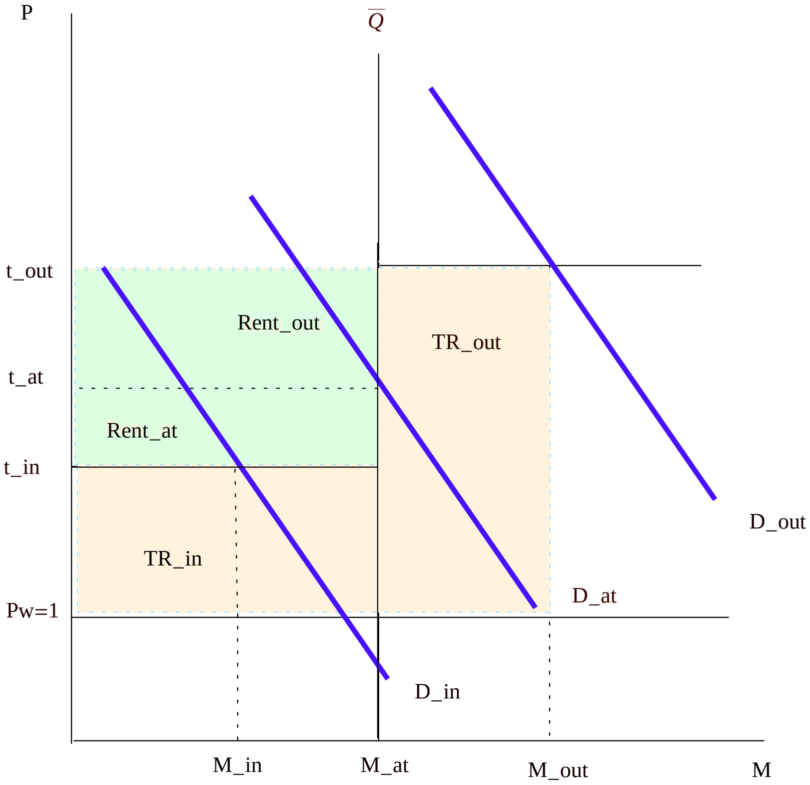

Figure 2.2: TRQ equilibria

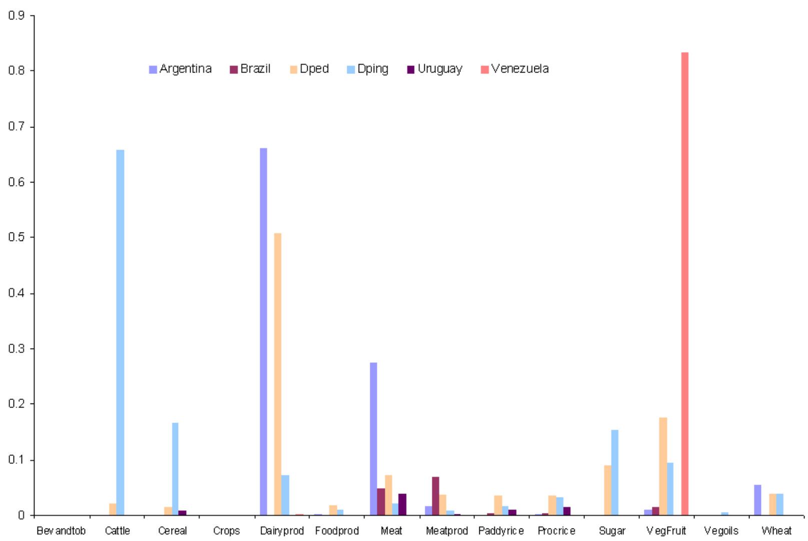

Figure 2.3: TRQ-imports' shares for agricultural sectors in the EU25

Source: MAcMapHS6-v2 database, CEPII

Table 2.1: TRQ-regime shifting

IF	AND	THEN
in-quota regime	$TRQ > \bar{Q}$	at-quota regime
at-quota regime	$\tau^{TRQ} > \tau^{out}$	out-of-quota regime
out-of-quota regime	$\tau^{TRQ} < \tau^{out}$	at-quota regime
at-quota regime	$TRQ < \bar{Q}$	in-quota regime

Table 2.2: Sectoral and geographical data aggregation

Regions	Sectors	
EU25	Animalprod	Plantsbf
Argentina	Bevandtob	Procrice
Brazil	Cattle	Rawmilk
Uruguay	Cereal	Sugar
Venezuela	Crops	Sugarcb
Dped	Dairyprod	VegFruit
Dping	Fishing	Vegoils
	Foodprod	Wheat
	Forestry	Woolsilk
	Meat	Primary
	Meatprod	Manuf
	Oilseeds	Services
	Paddyrice	

Table 2.3: TRQ enlargement scenario for the EU-Mercosur agreement

Products	EU proposal (TN)	Mercosur proposal (TN)	Average Scenario (TN)
Bovine meat	160000	315000	237500
Poultry meat	27500	250000	138750
Swine meat	15000	40000	27500
Wheat	200000	1000000	600000
Corn	200000	4000000	2100000
Cheese	20000	60000	40000
Milk	13000	34000	23500
Butter	4000	10000	7000

Table 2.4: World Results (% variation)

Variable	V1	V2	V3	V3nq
Exports (val)	0.06	0.05	0.20	0.06
Exports (vol)	0.05	0.05	0.20	0.06
Imports (val)	0.06	0.06	0.20	0.06
Imports (vol)	0.05	0.06	0.21	0.06
World GDP (volume)	0.00	0.00	0.02	0.00
World Welfare	0.00	0.00	0.02	0.00

Table 2.5: Welfare Results by Region (% variation)

Region	V1	V2	V3	V3nq
Argentina	0.05	0.19	0.08	0.05
Brazil	-0.00	0.39	0.08	0.00
Dped	-0.00	-0.00	0.01	-0.00
Dping	-0.01	-0.00	0.04	-0.01
EU25	0.01	-0.02	0.02	0.01
Uruguay	-0.01	0.84	0.12	-0.01
Venezuela	-0.10	-0.07	-0.08	-0.10

Table 2.6: Welfare decomposition for large Mercosur countries (% variation)

	Argentina				Brazil			
Variable	V1	V2	V3	V3nq	V1	V2	V3	V3nq
Allocation efficiency gains	-0.03	-0.03	0.02	0.01	-0.00	-0.02	0.04	0.02
Capital accumulation gains	0.02	0.05	0.03	0.02	0.01	0.11	0.04	0.01
Land supply gains	0.01	0.01	0.02	0.01	0.00	0.00	0.02	0.00
Other gains	0.02	0.04	-0.02	-0.02	-0.00	0.05	-0.10	-0.02
Tariff-quota gains	0.00	0.08	-0.01	0.00	0.00	0.24	-0.03	0.00
Terms of trade gains	0.03	0.04	0.04	0.03	-0.01	0.02	0.10	-0.01
Welfare	0.05	0.19	0.08	0.05	-0.00	0.39	0.08	0.00

Table 2.7: Welfare decomposition for small Mercosur countries (% variation)

	Uruguay				Venezuela			
Variable	V1	V2	V3	V3nq	V1	V2	V3	V3nq
Allocation efficiency gains	0.01	0.03	0.05	0.02	0.01	0.01	0.01	0.01
Capital accumulation gains	0.01	0.26	0.07	0.01	-0.03	-0.02	-0.02	-0.03
Land supply gains	0.01	0.02	0.04	0.01	-0.00	-0.00	-0.00	-0.00
Other gains	-0.01	0.05	-0.08	-0.02	-0.04	-0.04	-0.04	-0.04
Tariff-quota gains	0.00	0.44	-0.05	0.00	0.00	0.02	0.00	0.00
Terms of trade gains	-0.02	0.04	0.09	-0.02	-0.04	-0.03	-0.03	-0.04
Welfare	-0.01	0.84	0.12	-0.01	-0.10	-0.07	-0.08	-0.10

Table 2.8: Welfare decomposition for the EU (% variation)

Variable	V1	V2	V3	V3nq
Allocation efficiency gains	0.00	0.00	0.02	0.00
Capital accumulation gains	0.00	-0.01	-0.00	0.00
Land supply gains	-0.00	-0.00	-0.00	-0.00
Other gains	0.00	0.00	0.02	0.01
Tariff-quota gains	0.00	-0.02	0.00	0.00
Terms of trade gains	0.01	0.00	-0.01	0.01
Welfare	0.01	-0.02	0.02	0.01

Table 2.9: GDP results in % variation

Region	V1	V2	V3	V3nq
Argentina	0.04	0.16	0.05	0.04
Brazil	0.03	0.40	0.03	0.03
Dped	-0.00	-0.00	0.01	-0.00
Dping	-0.00	-0.00	0.03	-0.00
EU25	0.01	-0.03	0.02	0.01
Uruguay	0.02	0.88	0.10	0.02
Venezuela	-0.04	-0.01	-0.02	-0.04

Table 2.10: Agricultural Employment (% variation)

Region	V1	V2	V3	V3nq
Argentina	0.78	0.68	0.96	0.79
Brazil	0.46	0.25	2.86	0.58
Dped	-0.01	-0.00	-0.01	-0.01
Dping	-0.01	-0.00	0.10	-0.01
EU25	-0.12	-0.11	-0.89	-0.13
Uruguay	0.33	0.25	1.27	0.33
Venezuela	-0.02	-0.01	-0.02	-0.02

Table 2.11: Non-Agricultural Employment (% variation)

Region	V1	V2	V3	V3nq
Argentina	-0.13	-0.11	-0.16	-0.13
Brazil	-0.04	-0.02	-0.26	-0.05
Dped	0.00	0.00	0.00	0.00
Dping	0.00	0.00	-0.03	0.00
EU25	0.01	0.01	0.07	0.01
Uruguay	-0.15	-0.11	-0.56	-0.15
Venezuela	0.00	0.00	0.00	0.00

Table 2.12: Unkilled Real Wages in Agriculture (% variation)

Region	V1	V2	V3	V3nq
Argentina	0.47	0.49	0.64	0.49
Brazil	0.19	0.27	1.44	0.25
Dped	-0.01	-0.00	0.00	-0.01
Dping	-0.01	-0.01	0.11	-0.01
EU25	-0.04	-0.05	-0.45	-0.05
Uruguay	0.19	0.58	1.09	0.19
Venezuela	-0.21	-0.18	-0.18	-0.21

Table 2.13: Unkilled Real Wages in Non-Agriculture (% variation)

Region	V1	V2	V3	V3nq
Argentina	0.02	0.10	0.08	0.02
Brazil	-0.06	0.13	-0.11	-0.06
Dped	-0.00	-0.00	0.01	-0.00
Dping	-0.01	-0.00	0.04	-0.01
EU25	0.02	0.01	0.03	0.02
Uruguay	-0.05	0.40	0.17	-0.05
Venezuela	-0.20	-0.18	-0.17	-0.20

Table 2.14: Imports Values (% variation)

Region	V1	V2	V3	V3nq
Argentina	3.12	3.55	3.48	3.16
Brazil	2.14	3.11	4.44	2.25
Dped	-0.04	-0.04	-0.05	-0.04
Dping	-0.03	-0.04	0.17	-0.04
EU25	0.24	0.17	0.75	0.25
Uruguay	0.69	1.87	1.88	0.69
Venezuela	1.64	1.70	1.67	1.64

Table 2.15: Exports Values (% variation)

Region	V1	V2	V3	V3nq
Argentina	2.70	2.41	3.13	2.74
Brazil	2.32	1.42	5.02	2.44
Dped	-0.05	-0.06	-0.08	-0.05
Dping	-0.03	-0.03	0.15	-0.04
EU25	0.24	0.32	0.73	0.25
Uruguay	0.99	-0.05	2.99	0.99
Venezuela	1.39	1.35	1.41	1.39

Table 2.16: EU25 Exports in volume (% variation)

Importer	V1	V2	V3	V3nq
Argentina	7.45	8.05	8.56	7.53
Brazil	12.14	13.25	14.81	12.26
Dped	-0.12	-0.07	0.21	-0.12
Dping	-0.10	-0.05	0.43	-0.10
EU25	-0.02	-0.03	-0.10	-0.02
Uruguay	9.90	11.36	11.84	9.94
Venezuela	26.94	27.12	27.54	26.94

Table 2.17: Argentina Exports in volume (% variation)

Importer	V1	V2	V3	V3nq
Argentina	-1.30	-1.25	-0.84	-1.01
Brazil	6.09	6.52	8.18	6.23
Dped	-0.95	-1.51	-1.74	-1.03
Dping	-0.93	-1.33	-1.31	-1.00
EU25	15.11	14.61	17.62	15.62
Uruguay	-1.80	-0.85	-0.50	-1.85
Venezuela	-3.35	-3.84	-4.03	-3.44

Table 2.18: Brazil Exports in volume (% variation)

Importer	V1	V2	V3	V3nq
Argentina	11.52	11.06	8.86	11.44
Brazil	-0.54	-0.60	0.12	-0.81
Dped	0.34	-0.81	-3.35	0.16
Dping	0.20	-0.61	-3.08	0.04
EU25	6.45	5.49	27.71	7.06
Uruguay	-0.74	-0.27	-2.14	-0.88
Venezuela	-1.95	-3.05	-5.49	-2.13

Table 2.19: Uruguay Exports in volume (% variation)

Importer	V1	V2	V3	V3nq
Argentina	-0.49	-1.27	-1.96	-0.38
Brazil	-1.70	-1.91	0.12	-1.47
Dped	0.26	-0.92	-1.97	0.25
Dping	0.19	-1.06	-2.10	0.16
EU25	5.57	4.38	20.64	5.43
Uruguay	-0.39	-0.44	-0.77	-0.46
Venezuela	-2.02	-3.36	-4.94	-2.05

Table 2.20: Venezuela Exports in volume (% variation)

Importer	V1	V2	V3	V3nq
Argentina	0.72	1.40	1.97	0.83
Brazil	0.05	1.02	2.50	0.17
Dped	1.36	1.28	1.27	1.36
Dping	1.32	1.26	1.36	1.32
EU25	2.38	2.28	2.15	2.32
Uruguay	-1.32	-0.75	-1.26	-1.29
Venezuela	-0.63	-0.59	-0.62	-0.74

Table 2.21: EU25 Imports by sector (% variation)

Sector	V1	V2	V3	V3nq
1 Agro-food	1.67	1.52	13.88	1.79
2 Oth	0.16	0.08	-0.19	0.15
Meat	0.14	-0.19	217.35	0.48
Meatprod	1.27	1.00	2.19	2.42
Paddyrice	0.01	-0.00	1.67	-0.02
Primary	0.18	0.18	0.23	0.18

Table 2.22: Argentina Exports by sector (% variation)

Sector	V1	V2	V3	V3nq
1 Agro-food	2.93	2.59	3.52	3.00
2 Oth	1.75	1.23	1.37	1.69
Meat	-1.70	-2.31	37.79	-0.08
Paddyrice	-1.84	-1.11	2.56	-1.34

Table 2.23: Brazil Exports by sector (% variation)

Sector	V1	V2	V3	V3nq
1 Agro-food	2.06	1.30	10.78	2.49
2 Oth	2.66	1.26	-1.24	2.47
Meat	0.32	-0.69	121.53	0.49

Table 2.24: Uruguay Exports by sector (% variation)

Sector	V1	V2	V3	V3nq
1 Agro-food	2.14	0.82	7.99	2.13
2 Oth	0.23	-1.15	-1.91	0.22
Cattle	0.44	-0.26	7.91	0.51
Cereal	0.48	-0.27	1.39	0.61
Dairyprod	0.11	-1.82	8.59	0.12
Meat	0.41	-1.37	19.79	0.53
Paddyrice	0.70	-0.40	1.39	1.27

Table 2.25: Venezuela Exports by sector (% variation)

Sector	V1	V2	V3	V3nq
1 Agro-food	2.42	2.39	2.54	2.33
2 Oth	1.61	1.55	1.60	1.62
Bevandtob	1.94	1.89	1.94	1.94
Cereal	3.34	3.29	3.48	3.32
Foodprod	2.81	2.83	3.01	2.76
Meatprod	5.50	5.55	8.51	6.80
Primary	1.25	1.19	1.12	1.25
Sugar	1.66	1.70	2.43	1.68
VegFruit	1.70	1.60	2.74	1.10

Chapter 3

Shipping The Good Beef Out: EU Trade Liberalization to Mercosur Exports

[1]

[1]This paper benefited from the cooperation of Luca Salvatici from Molise University, Italie and Jean-Christophe Bureau from UMR Economie Publique, INRA/AgroParisTech and Trinity College

3.1 INTRODUCTION

Most applied models used in trade analysis can only distinguish a small number of aggregated products. This is typically the case with computable general equilibrium models that have increasingly been used for policy-oriented analysis in recent trade negotiations. Products aggregates must be consistent with the level of aggregation required by social accounting matrices and consumption statistics. Data availability, computer limitations and numerical optimization constraints restrict the number of product categories.[2] As a result, quantitative assessments of the impact of a trade agreement can seldom take into account the trade composition effects within a particular product category. Such effects can nevertheless raise important issues, especially in the agricultural sector (Lavoie, 2005). This is the case of the beef sector.

Large scale multicountry models are commonly used to assess the effects of proposals for a agricultural agreement under the World Trade Organization (WTO). Most simulations lead to the conclusion that a large decrease in EU tariffs on beef would be required in order to result in significant imports, because of the existing binding overhang (i.e., the fact that bound tariffs exceed the actual gap between world and domestic prices). Market analysts are skeptical. They argue that imports of high unit-value products have been increasing rapidly since 2000 in spite of very high tariffs. They believe that even a small tariff cut would generate significant trade flows in this market segment, and that users of large

[2] Typical Computable General Equilibrium (CGE) models, such as the Global Trade Analysis Project (GTAP) model, the World Bank's LINKAGE model or the MIRAGE model developed by the Centre d'Etudes Prospectives et d'Informations Internationales, distinguish at best 30 agricultural and food products. The EU tariff schedules include some 2,200 products for these categories at the eight-digit level (the level at which the EU bound its tariffs under the WTO), and some 3,500 products at the ten-digit level (the level at which tariffs are actually set by EU customs). In spite of recent efforts to model the traded sector in a much more disaggregated way (Grant et al., 2006; Laborde and Gohin, 2006) and to investigate the bias caused by lack of product differentiation (Hertel et al., 2004; Martin et al., 2003; Hallak, 2006), most large scale models currently used for trade negotiation purposes still rely on rather aggregated product categories, in particular when their structure involves dynamics and endogenous firm entry.

scale models underestimate the future growth in imports by considering beef as a commodity (EC, 2006).

This debate has important consequences in the Doha trade negotiations. Agricultural liberalization has been a major obstacle to a WTO agreement. Beef is one of the main sectors blocking the negotiations as far as market access is concerned. European policymakers are not willing to commit to large tariff cuts without reliable evidence of the degree in which imports will increase. Because more than two thirds of EU beef consumption is supplied by the dairy herd and is therefore quite price inelastic, the adjustment in domestic production would be borne mainly by the suckling cow sector, of great social and political importance throughout the EU given the large number of farmers involved. A more detailed investigation of the effects of the present tariff structure, in particular on import composition, is needed to determine the consequences of a multilateral tariff cut in this sector.

The beef sector is also a major bone of contention in the EU-Mercosur negotiations that have been going on since 1995. No agreement has yet been reached on the issue of agricultural market access. The EU has offered to expand the present Tariff-Rate Quotas (TRQs) for beef products.[3] Mercosur countries have insisted on a decrease in tariffs. The consequences of the two options differ significantly. A cut in tariffs or an expansion of the TRQs are likely to result in imports of very different types of products, with different consequences for the stakeholders both in the EU and Mercosur countries. For example, Argentina is relatively more specialized in exporting high-quality products than Brazil. In the EU, some regions specialize in the production of young bulls in feedlots that are considered as lower quality than more extensive production of more mature animals. A change in relative price would also affect French and Italian consumers, who consume a larger proportion of grilled boneless cuts from the rear end of animals, in a way that would not be the same as British and German consumers, whose

[3]TRQs differ from regular quotas as the exporter has to pay the Most Favored Nation (MFN) tariff beyond a certain volume of exports. This introduces a three tier regime (in-quota, at-quota and out-of quota exports), depending on whether the quota is binding or not.

consumption is more oriented towards meat from the front end of the animal, not de-boned, because of cooking habits. The various options for liberalizing trade might also result in changes in the availability of a particular quality of variey for EU consumers, and it is well known that in such cases the welfare changes are complex.[4] In the case of both multilateral and EU-Mercosur negotiations, aggregate models that treat beef as a commodity and ignore the changes in import composition are unlikely to provide a good assessment of the consequences for the various types of producers.

Several features of the EU tariff structure suggest that the import composition effects of trade liberalization options are complex. First, there is a large dispersion of tariffs within the beef product category in the EU.[5] The *ad valorem* equivalents of the bound tariffs in the beef sector range between zero and 140 percent across the different tariff lines. Even a uniform cut in tariffs would lead to significant change in the relative (tariff inclusive) import price of, say, boneless cuts, carcasses and offals. Second, the largest component of EU protection in the beef sector is a specific tariff, i.e. a tariff per ton. There is also an *ad valorem* component that provides a much lower level of additional protection. Specific tariffs impose a proportionally higher protection on low unit value products. They give exporters an incentive to ship higher quality products. Specific tariffs therefore have a quality upgrading. A cut in such tariffs could significantly modify the relative price of the various types of meat. Third, the EU tariff structure includes a variety of TRQs. They were opened either to fulfill the minimum market access commitments of the 1994 Agricultural Agreement of the Uruguay Round, or to

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[4]Consider a prohibitive tariff on a particular variety or quality. In a horizontal differentiation framework, welfare changes would result from the change in the number of variety available. In a vertical differentiation framework, welfare changes would differ according to the segments of consumers with a different willingness to pay for quality. Note that we consider that 'quality' refers to a vertical differentiation framework and 'variety' to a horizontal one.

[5]The EU tariff structure for beef includes 34 products at the eight-digit level. The EU customs actually apply tariffs at an even more detailed level, i.e. ten-digit level and up to twelve-digit level if one considers all the additional codes in the Integrated Tariff of the European Communities.

maintain existing arrangements that resulted in preferential trade flows. TRQs, like standard quotas, also have an import composition effect. An exporter facing a quantity constraint ships higher unit value products. In the case of certain TRQs granted to Argentina, Brazil and the United States, this import composition effect is strengthened by the fact that only high-quality beef is eligible. Fourth, regulatory issues, such as complying to minimum quality standards, segregating hormone-treated and hormone-free animals and providing sanitary certificates also involve fixed costs, which also affect shift imports toward higher quality products.[6]

In the following sections we analyze the different components of EU trade policy that affect beef imports. We focus on imports from Mercosur countries, that are the main potential source of competition for EU producers, given the prospect of a regional agreement and of a reduction in tariffs under the WTO. Indeed, Mercosur countries are likely to be the main exporters to the EU in the case of multilateral trade liberalization, given the low production costs in these countries, the difficulty for US industry to segregate hormone free-beef, and the difficulty for African countries to meet EU sanitary and certification standards. Using a partial equilibrium model with different product qualities, we investigate how a set of trade policy instruments affect the composition of imports. These instruments include the *ad valorem* and specific tariffs applied to in-quota and to out-of-quota imports, and the quota level itself. We then draw policy lessons from numerical simulations under a simplified framework.

3.2 Trade Barriers and Import Composition

The theoretical literature has shown that trade policy may have important consequences on the composition of trade (both quality and variety).

It is well known that, under some particular assumptions (perfect competi-

[6]The EU bans imports of beef produced with hormonal growth activators. It also requires some traceability inspection and certification procedures, all of which involve significant fixed costs. These issues are not formally addressed in this paper.

tion, perfect information, homogeneous products and auction as license allocation mechanism), most classical trade policy instruments, such as *ad valorem* and import quotas, could become equivalent in terms of volume of trade and welfare. However, under more realistic hypotheses, such as product differentiation, the application of these simple policy instruments does not lead to the same consequences for trade, trade composition and welfare, because quotas are less efficient than *ad valorem* tariffs (Anderson, 1988).

The study of trade policy effects on import quality composition dates back to the 19th century, to the famous case of *shipping the good apples out*, whose analytical version later became known as the Alchian-Allen effect. This effect dictates that fixed per unit transport costs result in a bias towards the exports of more expensive goods (Alchian and Allen, 1983). Because such transport costs result in a higher relative price of the least expensive quality, they shift the composition of imports so as to raise the relative consumption of the higher priced product. The Alchian-Allen effect is intimately tied to microeconomic consumer theory and the quality-upgrade effect of exports is only warranted under certain conditions of substitutability when there are more than two goods.[7] A condition for the Alchian-Allen effect to hold is that high and low qualities from the same product are closer substitutes than those of other (different) products; that is it requires that low and high quality are not close complements. These conditions are usually met in practice and the Alchian-Allen proposition is supported by the empirical literature (Borcherding and Silberberg, 1978; Umbeck, 1980; Bauman, 2004). [8]

[7]The Alchian-Allen effect results from the properties of the Hessian matrix of the expenditure function; see Silberberg (1978:335). The Alchian-Allen effect is intuitive in a two-goods case where higher and lower quality goods are substitutes. With more than two goods, there are theoretical cases in which this effect is inverted (if the premium good is a close substitute for the third composite good, for example, and when the inferior good is a complement to the third good. However, these are rare phenomena.)

[8]There are potentially two distinct types of quality upgrading: changes in characteristics of given varieties, and a shift in demand towards higher-quality varieties. This study focus on the latter, and it is worth emphasizing that the quality change is purely a consequence of changes in consumption patterns, not changes in the quality of any individual goods within the category.

In addition to the well-known transport cost effect, trade policy instruments also cause a Alchian-Allen type affect on the composition of imports. In a small country, when world prices are fixed, if the only policy is an *ad valorem* tariff and if there is a radial move towards freer trade, there will be no change in the composition of imports. *Ad valorem* tariffs do not alter relative prices under normal conditions (Boorstein and Feenstra, 1991; Falvey, 1979). However, in the presence of a specific tariff (Borcherding and Silberberg, 1978; Hummels and Skiba, 2004), a quantitative restriction (Anderson, 1985, 1991; Aw and Roberts, 1986; Feenstra, 1987), or a quality control (Rodriguez, 1979), trade liberalization will lead to changes in import composition. In practice, the widespread use of specific tariffs and quantitative ceilings in the EU agricultural and food sectors is such that any trade liberalization scenario, either regional or multilateral, is likely to significantly affect the composition of trade.

Note that, in practice, the link between trade liberalization and import composition is not limited to the simple quality upgrade effect described by Alchian and Allen. For example, in the presence of more than one distortion, the introduction of an *ad valorem* tariff may reduce relative import demand for high-quality imports (Hummels and Skiba, 2004). In addition, in the real life situation of the EU, the widespread use of TRQs in agriculture introduces extra complexity. TRQs differ from regular quotas as the exporter has to pay the Most Favored Nation (MFN) tariff beyond a certain volume of exports. This kind of protection introduces three regimes (in-quota, at-quota and out-of-quota), depending on whether the quota is binding or not.

3.3 The Model

In order to investigate the import composition effects caused by the EU tariff structure, with TRQs and composite tariffs, we assume a representative consumer who maximizes his/her utility. It is well known that if the utility function is

However, both aforementioned quality-upgrade effects are complementary, so our measure of quality upgrading will be a lower bound.

homogeneously separable, commodities may be consistently aggregated in the sense that one may form composite commodities which may be treated as the same manner as the primary commodities. When focusing on the beef sector, we work with three types of goods: a domestic good (d) and two qualities of the imported goods (m_h, m_l) where the subscript h denotes higher quality, and l lower-quality imports throughout the paper. The domestic product is the *numeraire*. For clarity of exposition, in this section, we assume that consumer's preferences are represented with a Cobb-Douglas utility function U.[9] Under this assumption, and after a monotonic transformation, U can be written as a function built-up from subutility functions, u_d and u_m.

$$U(d, m) = \alpha_d log(u_d(d)) + \alpha_m log(u_m(m_h, m_l)). \tag{3.1}$$

Under these assumptions, the marginal sub-utility $u_m^{'}(m_h, m_l)$ is not affected by changes in consumption of d, the domestic goods. We assume that the consumer solves the utility maximization problem in two stages, first choosing between domestic and imported products, maximizing the overall utility function, and then choosing between the two imported qualities. Since we are interested in trade policy effects, we only focus on the second stage, considering that import expenditure is equal to $R = I - d$, where I denotes the total consumer income and d is the domestic goods expenditure. We assume that $u_m(m_h, m_l)$ can be represented by a CES function in equation (3.2). In the following sections we focus on the composition of imports and on the maximization of u_m:

$$u_m(m_l, m_h) = (\lambda_h(m_h)^\rho + \lambda_l(m_l)^\rho)^{1/\rho}, \tag{3.2}$$

where m_h denotes the demand for high-quality imports and m_l the demand for low-quality imports. All parameters are positive and $\rho \leq 1$. The share parameters of the CES function represent the consumer's relative preferences for the two qualities of imported products and as such that $\lambda_h > \lambda_l$.[10] We first consider this

[9]This assumption is highly restrictive and constrains the consumer's budget shares between imports and domestic production, but it makes it easier to explain the different effects at stake. This assumption will be relaxed in the simulations and a CES-LES function will be used for U.

[10]Here, we consider that the λ_i parameters represent the quality preferences as in Hummels

maximization problem under a free trade situation. We then introduce a TRQ on high-quality imports and a composite tariff on low-quality imports so as to match the actual EU policy.

3.3.1 Free Trade

In the absence of trade policies, and assuming exogenous world prices (p_{hw}, p_{lw}), the consumer's problem is:

$$\begin{aligned} Max \quad & u_m(m_l, m_h) \\ s.t. \quad & R = p_{lw}m_l + p_{hw}m_h \quad and \quad m_h, m_l \geq 0. \end{aligned} \tag{3.3}$$

The Marginal Rate of Substitution (MRS) between qualities and the Marshallian demand functions, m_h and m_l, are derived from the first-order conditions:

$$MRS = \left(\frac{m_h}{m_l}\right)^{(1/\sigma)} \frac{\lambda_l}{\lambda_h} = \frac{p_{lw}}{p_{hw}}, \tag{3.4}$$

$$m_h = \left(\frac{\lambda_h}{p_{hw}}\right)^{\sigma} \frac{R}{(\lambda_l^{\sigma} p_{lw}^{1-\sigma} + \lambda_h^{\sigma} p_{hw}^{1-\sigma})}, \tag{3.5}$$

$$m_l = \left(\frac{\lambda_l}{p_{lw}}\right)^{\sigma} \frac{R}{(\lambda_l^{\sigma} p_{lw}^{1-\sigma} + \lambda_h^{\sigma} p_{hw}^{1-\sigma})}. \tag{3.6}$$

From (3.5) and (3.6) we obtain the demand for the high-quality imports relative to the low-quality ones (3.7). This expression is used to analyze variations in the composition of imports due to relative price changes.

$$\frac{m_h}{m_l} = \left(\frac{\lambda_h p_{lw}}{\lambda_l p_{hw}}\right)^{\sigma}. \tag{3.7}$$

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and Skiba (2004). Note that it is possible to introduce an income effect through these parameters, as in Hallak (2006), who specifies a variable $\theta_i^{\nu_i^k}$ as our λ_i, where ν_i^k is the income parameter that varies across countries k (richer or poorer countries) and remains constant across all qualities i. In our paper, since we work with only one importing country, there is no need to detail the effect of the income parameters.

3.3.2 The EU Trade Policy, TRQ's and Composite Tariffs

We now introduce a stylized representation of the EU trade policy, which includes two main instruments that affect imports. The first instrument is a TRQ for high-quality imports. This TRQ includes a quantitative ceiling on imports ($\bar{q_h}$) under which the (in-quota) *ad valorem* tariff t_h is lower than the out-of-quota tariff. The EU out-of-quota tariff includes both an *ad valorem* component t and a specific component T. The low-quality product is not affected by quantity restrictions but faces the same out-of-quota tariff as the high-quality product. How complicated this policy may look, it corresponds to the present regime that countries like Brazil or Argentina face when they export into the EU. The TRQ leads to a nonlinear import possibility curve, given the budget constraint, with an inflexion point at $\bar{q_h}$.

Tariffs do not change the maximization problem (3.3) but the existence of a TRQ for high-quality imports introduces extra restrictions. The first restriction ($m_{hin} \leq \bar{q_h}$) refers to in-quota imports m_{hin}. It makes it possible to define a marginal tariff t_m, depending on whether the quota is filled or not. The second restriction ($t_m \leq \frac{T}{p_{hw}} + t - t_h$) refers t_m and leads to determine whether high-quality imports exceed the quota or not(m_{hout}). The new problem (3.8) can be solved as a mixed-complementarity problem or MCP (Rutherford, 1995).

$$\begin{aligned} & Max \quad u_m(m_l, m_h) \\ & s.t. \\ & \qquad R = p_l m_l + p_h m_h \\ & \qquad m_h = m_{hin} + m_{hout} \\ & \qquad m_{hin} \leq \bar{q_h} \\ & \qquad t_m \leq \frac{T}{p_{hw}} + t - t_h \\ & \qquad m_h, m_{hin}, m_{hout}, m_l, t_m \geq 0, \end{aligned} \tag{3.8}$$

where m_{hout} denotes the out-of-quota imports of high quality. We find the same expressions for the demands as in (3.5) and (3.6), except that domestic prices are no longer equal to world prices. The in-quota and out-of-quota prices for high-quality imports are determined by both the (exogenous) world prices and by the tariffs, but the at-quota price varies with the marginal tariff, t_m that is bounded by $0 \leq t_m \leq (t + \frac{T}{p_{hw}} - t_h)$, where the right hand side expression is the value of the quota rent in the out-of-quota equilibrium situation. The value of t_m determines the domestic price for high-quality goods when the quota is just binding, i.e., $p_h = p_{hw}(1 + t_h + t_m)$ where p_{hw} is the CIF high-quality price and t_m varies according to the TRQ regime:

In-quota regime	$t_m = 0$	if $m_h < \bar{q_h}$,
At-quota regime	$0 < t_m < \left(t + \frac{T}{p_{hw}} - t_h\right)$	if $m_h = \bar{q_h}$,
Out-of-quota regime	$t_m = t + \frac{T}{p_{hw}} - t_h$	if $m_h > \bar{q_h}$.

We now turn to the import composition effect of the specific and *ad valorem* components of the EU tariff. The introduction of a composite tariff affects low-quality imports and changes the domestic low-quality price so that $p_l = p_{lw}(1 + t) + T$ where p_{lw} is CIF price for low quality, i.e. including transportation cost to the EU border. We assume that the CIF high-quality price exceeds the CIF low-quality price. The TRQ introduces changes in relative prices and relative import volumes according to the three different possible outcomes, i.e. in-quota, at-quota or out-of-quota regimes for high-quality beef. In order to facilitate the use of MCP techniques, we add the complementarity conditions (3.9) and (3.10) to the problem (3.8):

$$m_{hin} \leq \bar{q_h} \quad and \quad t_m \geq 0; (m_{hin} - \bar{q_h})t_m = 0, \tag{3.9}$$

$$t_m \leq (t + \frac{T}{p_{hw}} - t_h) \quad and \quad m_{hout} \geq 0; \quad \left(t + \frac{T}{p_{hw}} - t_h - t_m\right)m_{hout} = 0. \tag{3.10}$$

We obtain an in-quota solution if the TRQs' constraints ($m_{hin} \leq \bar{q_h}$ and $t_m \leq (t + \frac{T}{p_{hw}} - t_h)$) are non-binding. In this case the marginal tariff t_m is equal to zero and $m_h \geq 0$, $m_h = m_{hin} \leq \bar{q_h}$ and $m_{hout} = 0$. With an at-quota solution, t_m is positive but smaller than the difference between the out-of-quota tariff and the in-quota tariff $(t + \frac{T}{p_{hw}} - t_h)$. Under this condition $m_h > 0$, $m_h = m_{hin} = \bar{q_h}$ and $m_{hout} = 0$. Finally, an out-of-quota solution exits when the TRQ conditions are binding and imports exceed $\bar{q_h}$. Under this regime, t_m is positive and equal to the difference between the out-of-quota tariff and the in-quota tariff $(t+\frac{T}{p_{hw}}-t_h)$. Moreover, m_{hout} is also positive with $m_h = m_{hin} + m_{hout}$.

To sum up, the introduction of a high-quality TRQ leads to three possible equilibria. If neither TRQ constraints are binding, high-quality imports face the in-quota tariff (t_h), so $t_m = 0$ and $m_{hout} = 0$. If $t_m > 0$ and $m_{hout} = 0$, the first constraint is binding and imports are set at the quota level. In this situation the domestic price is endogenous and there is a positive quota rent ($QR = \bar{q}_h t_m > 0$). Finally, $t_m > 0$ and $m_{hout} > 0$ lead to out-of-quota imports and the overall imports face a higher (composite) tariff. In this case the quota rent is maximum.

[INSERT Figure 2.2]

Overall, the complex nature of the EU tariff structure results in similarly complex demands for high and low-quality imports, given by (3.11) and (3.12). The quality composition indicator is given by the ratio between these two equations which result from the (3.8), (3.9) and (3.10).

$$m_h = \frac{\left(\frac{\lambda_h}{p_{hw}(1+t_h+t_m)}\right)^{\sigma} R}{\lambda_l^{\sigma}(p_{lw}(1+t)+T)^{1-\sigma} + \lambda_h^{\sigma}(p_{hw}(1+t_h+t_m))^{1-\sigma}}, \tag{3.11}$$

$$m_l = \frac{\left(\frac{\lambda_l}{p_{lw}(1+t)+T}\right)^{\sigma} R}{\lambda_l^{\sigma}(p_{lw}(1+t)+T)^{1-\sigma} + \lambda_h^{\sigma}(p_{hw}(1+t_h+t_m))^{1-\sigma}}. \tag{3.12}$$

3.3.3 Trade Quality effect

Comparative statics shed light on the consequences of changes in the policy variables on the composition of imports. The following section presents the impact of a change in the high-quality quota level and of changes in all tariffs components for both qualities: in-quota *ad valorem* tariff, out-of-quota *ad valorem* tariff and out-of-quota specific component.

- **If the specific tariff varies:**

Three distinct cases can occur depending on the fill-rate of the TRQ. First, when high-quality imports are below the quota level, a decrease in the specific tariff T affects only the price of low-quality imports. The consequence is an increase in the relative share of the low-quality imports.

$$\frac{\partial m_h/m_l}{\partial T} = \frac{\sigma\lambda_h\Big(\frac{(p_{lw}(1+t)+T)\lambda_h}{p_{hw}(1+t_h)\lambda_l}\Big)^{\sigma-1}}{p_h w(1+t_h)\lambda_l} > 0 \qquad if \quad m_h < \bar{q_h}. \tag{3.13}$$

When high-quality imports exceed the quota, a reduction in the specific tariff T also results in a quality downgrade due to the typical Alchian-Allen effect as shown in (3.14):

$$\frac{\partial m_h/m_l}{\partial T} = \sigma\Big(\frac{\lambda_h}{(p_{hw}(1+t)+T)\lambda_l} - \frac{(p_{lw}(1+t)+T)\lambda_h}{(p_{hw}(1+t)+T)^2\lambda_l}\Big) \Big(\frac{(p_{lw}(1+t)+T)\lambda_h}{(p_{hw}(1+t)+T)\lambda_l}\Big)^{\sigma-1} > 0 \qquad if \quad m_h > \bar{q_h}. \tag{3.14}$$

Finally, when high-quality imports are exactly at the quota level there are two possible effects, because T affects p_l but also affects the upper bound of t_m. The latter introduces a possible shift from an at-quota to an out-of-quota regime. If the variation of T leaves the TRQ regime unaffected (we remain in the at-quota regime), we have a quality downgrading due to the increase in m_l. But if the decrease in T switches the TRQ regime from at-quota to out-of-quota regime, not only does m_l increase but so does m_h. Even in that case a cut in the specific tariff results in quality downgrading, because a reduction in T has a greater impact on m_l than on m_h, according to the Alchian-Allen effect. The magnitude of this positive effect will vary between the two cases depicted in (3.13) and (3.14).

The partial derivatives of the relative functions for both the in-quota and the out-of-quota demands are positive. In brief, when the specific tariff decreases, consumers demand relatively less of the expensive high-quality product, in line with the traditional Alchian-Allen conjecture.

- **If the out-of-quota *ad valorem* tariff varies:**

The case is more complex when the *ad valorem* component of the EU tariff t varies, since t is imposed on imports of both qualities. The partial derivatives relative to t show opposite signs depending on the fill rate of the TRQ.

If high-quality imports are below the quota, a reduction in t affects only low-quality beef, and results in larger m_l imports (quality downgrading).

$$\frac{\partial m_h/m_l}{\partial t} = \frac{p_{lw}\sigma\lambda_h\left(\frac{(p_{lw}(1+t)+T)\lambda_h}{(1+t_h)p_{hw}\lambda_l}\right)^{\sigma-1}}{(1+t_h)p_{hw}\lambda_l} > 0 \qquad if \quad m_h < \bar{q}_h. \tag{3.15}$$

When high-quality imports exceed the quota, the left hand side of (3.15) is negative since p_{hw} is greater than p_{lw}. The reduction of an *ad valorem* component increases the relative quality of beef imports under our assumptions. This result seems to be at odds with Falvey (1979) and with Boorstein and Feenstra (1991). Both find that in a first-best setting, an *ad valorem* tariff has no effect on the quality composition of trade. In our case, however, the specific tariff plays a role similar to that of the per-unit cost in Hummels and Skiba (2004). The *ad valorem* tariff dampens the effect of the specific tariff on the relative demand for the high-quality product.

$$\begin{aligned}\frac{\partial m_h/m_l}{\partial t} &= \sigma\Big(\frac{p_{lw}\lambda_h}{(p_{hw}(1+t)+T)\lambda_l} - \frac{p_{hw}(p_{lw}(1+t)+T)\lambda_h}{(p_{hw}(1+t)+T)^2\lambda_l}\Big) \\ &\Big(\frac{(p_{lw}(1+t)+T)\lambda_h}{(p_{hw}(1+t)+T)\lambda_l}\Big)^{\sigma-1} < 0 \qquad if \quad m_h > \bar{q}_h.\end{aligned} \tag{3.16}$$

If the high-quality quota is just binding, a change in t affects not only p_l but also the upper bound of t_m. There is a possible shift from one regime to another. If t decreases and the regime remains unchanged, p_l also decreases and there is a quality-downgrading. However, in the case of a shift to the out-of-quota regime, the average quality of imports increases (quality upgrading). For the at-quota regime the effect of the *ad valorem* component of the out-of-quota tariff is ambiguous.

In brief, the consequences of a change in the *ad valorem* tariff on the composition of imports are ambiguous. When high-quality imports are below the quota a reduction in t has a quality downgrading. The opposite result holds true when imports exceed the quota. The effect on quality cannot be determined in a general case, under the at-quota regime.

- **If the *ad valorem* in-quota tariff varies:**

The *ad valorem* in-quota tariff t_h appears in the relative demand function only when high-quality imports are below the quota level. When the quota is not binding, a reduction of t_h has a quality upgrading.

$$\frac{\partial m_h/m_l}{\partial t_h} = -\frac{(p_{lw}(1+t)+T)\sigma\lambda_h\left(\frac{(p_{lw}(1+t)+T)\lambda_h}{(1+t_h)p_{hw}\lambda_l}\right)^{\sigma-1}}{(1+t_h)^2 p_{p_h w}\lambda_l} < 0 \qquad if \quad m_h < \bar{q}_h. \tag{3.17}$$

When the quota is binding (both when imports are at-quota and exceed the quota), the only effect is an increase in the quota rent. As a result, p_h and m_h remain unchanged and a change in the *ad valorem* in-quota tariff has no impact on the quality composition of imports.

- **If the high-quality quota level varies:**

When the equilibrium is in-quota, an increase in the high-quality quota level has no effect on the relative quality of imports. When the high-quality quota is binding, if the quota level increases, the high-quality imports increase as well. The expansion of $\bar{q}_h$ reduces t_m and then p_h since $\frac{\partial t_m}{\partial \bar{q}_h} < 0$. Provided that m_l and m_h are gross Marshallian substitutes ($\sigma > 1$), a reduction of p_h implies a reduction of m_l. So, when $\bar{q}_h$ increases, there is a quality upgrading:

$$\frac{\partial m_h/m_l}{\partial \bar{q}_h} = \frac{(p_{lw}(1+t)+T)^\sigma}{\lambda_l^\sigma R}$$
$$\Big((\lambda_h^\sigma(p_{hw}(1+t_h+t_m))^{1-\sigma} + \lambda_l^\sigma(p_{lw}(1+t)+T)^{1-\sigma})^2 +$$
$$(1-\sigma)\lambda_h^\sigma \frac{\bar{q}_h p_{hw}}{(p_{hw}(1+t_h+t_m))^\sigma}\frac{\partial t_m}{\partial \bar{q}_h}\Big) > 0 \qquad if \quad m_h = \bar{q}_h. \quad (3.18)$$

When high-quality imports exceed the quota there are two possible results. If the increase in the quota level is such that the quota is still lower than the high-quality equilibrium value, the result is merely a change in the allocation of high-quality imports in and out of quota, but the import mix is not affected. If the new quota level is larger than the initial high-quality equilibrium, the new equilibrium will be either at-quota or in-quota. In both cases m_h increases while p_h and m_l decrease, resulting in a quality upgrading through the same mechanisms as for the previous result (see (3.18)).

In brief, starting from an out-of-quota equilibrium, a quota increase can result in two possible outcomes: no quality effect if the equilibrium remains out of quota; or a quality upgrading if the new equilibrium shifts to either at-quota or in-quota equilibrium.

[INSERT TABLE 3.4.3]

3.3.4 Welfare variations

Under standard assumptions, any trade restriction imposes efficiency costs, at lest in a first best setting. In the case of specific tariffs and TRQs, however, there is an extra welfare effect caused by the composition of imports. The previous results confirm that binding quotas and/or specific tariffs lead to quality upgrading, i.e. a shift in the mix of traded products towards more expensive goods. Feenstra (1995, pg. 1578) shows that such quality upgrading results in an extra welfare cost. This extra cost tops the standard distortion that would result from *ad valorem* tariffs, for example. To isolate the welfare effect of the quality change, let us consider an *ad valorem* tariff that has the same effect on the aggregate import expenditure as the actual EU policy described before. The uniform *ad valorem* tariff (τ) satisfies the following condition:

$$E(t, t_h, T, \bar{q_h}, p_w, u_m) = E(\tau, p_w, u_m), \qquad (3.19)$$

where $E(t, t_h, T, \bar{q_h}, p_w, u_m)$ is the total expenditure in the beef sector with a TRQ. Note that p_w denotes the vector of world prices and m the quantity of imports as before. Variables u_m and τ are the free trade expenditure/utility level and the uniform *ad valorem* tariff respectively, calculated for each scenario.

If the actual policy mix of quotas and tariffs did not lead to a shift in demand towards higher-quality varieties, it would have the same deadweight loss as the uniform tariff. To evaluate the extra deadweight loss caused by the specific tariff and the TRQ we use the conventional deadweight loss definition, based on the difference between the rise in import costs due to the trade restrictions and the revenue or rents generated from it. More specifically, we compare the deadweight loss due to the actual trade policy mix (Lq) with the loss introduced by a uniform *ad valorem* price-equivalent tariff ($L\tau$) applied over all imports:

$$Lq = E(t, t_h, T, \bar{q_h}, p_w, u_m) - E(p_w, u_m) - TR(m, p_w, t, t_h, T) - QR(p_w, t, t_h, T, \bar{q_h}), \qquad (3.20)$$

$$L\tau = E(\tau, p_w, u_m) - E(p_w, u_m) - TR(m, p_w, \tau), \qquad (3.21)$$

where $E(p_w, u_m)$ is the total expenditure under free trade and $E(\tau, p_w, u_m)$ is the total expenditure when protection is provided through the uniform *ad valorem* tariff equivalent. $TR(m, p_w, t, t_h, T)$ denotes the tariff revenue and $QR(p_w, t, t_h, T, \bar{q_h})$ the quota rent which is assumed to be kept by importers.[11] In the results we also report the equivalent variation $EV(p_w, t^0, t_h^0, T^0, \bar{q_h}^0, u^0, u^i)$, which represents the

[11]This assumption is controversial, and there is some debate on who keeps the rent. In the particular case of the Mercosur exports of high-quality beef to the EU, there is evidence that at least some of the rent is kept by exporters. Accordingly, our estimates provide a lower bound of the real cost implied by the TRQ scheme for the EU.

amount of income to be given to the representative consumer to hold his new utility level after the trade policy shock (u^i) but at the original prices (p_u^0).

$$TR(m, p_w, t, t_h, T) = t_h m_{hin} + (t_h + t_m) m_{hout} + \left(t + \frac{T}{p_{lw}}\right) m_l, \tag{3.22}$$

$$QR(p_w, t, t_h, T, \bar{q_h}) = t_m \bar{q_h}. \tag{3.23}$$

$$EV(p_w, t^0, t_h^0, T^0, \bar{q_h}^0, u^0, u^i) = E(p_u^0, u^i) - E(p_u^0, u^0), \tag{3.24}$$

Following Boorstein and Feenstra (1991) we define the welfare cost of a quality upgrading due to both the TRQ components and the low-quality protection, as:

$$WCofQ = (Lq - L\tau). \tag{3.25}$$

The total welfare cost of any non-uniform *ad valorem* or specific tariff structure is equal to the conventional deadweight loss triangle because of a uniform price increase, plus the extra loss due to quality upgrading $WCofQ$.

3.4 Mercosur Exports to the EU

3.4.1 EU Trade Policy and the Mercosur

Mercosur countries are eligible for the EU Generalized System of Preferences (GSP), but most beef products are excluded from this scheme. Mercosur exporters can export under the minimum-access TRQs, normally open to all WTO members in 1995 to match the requirements of the Uruguay Round. Brazil, Argentina, Uruguay and Paraguay also export high-quality beef under a current-access TRQ allocated to each of the four countries. Recently, significant exports of beef originating mainly from Brazil have also taken place outside the TRQs, under the MFN regime, in spite of very high tariffs that exceed 80 percent in *ad valorem* equivalent (see figures 3.1 and 3.2).

[INSERT Figure 3.1]

[INSERT Figure 3.2]

In the ongoing WTO negotiations, the EU resists the large tariff cuts in beef imports, requested by Mercosur countries as member of either the "G20" group or the Cairns group. In regional negotiations, the EU favors a managed-trade scenario. The EU has offered Mercosur an increase in existing TRQs and the possible opening of new TRQs, rather than large tariff cuts that might open the door to unlimited imports.[12]

3.4.2 Data and Model Calibration

We use EU beef imports from Mercosur (in thousands of tons) and their CIF value (in millions of Euro) to be at the eight-digit level of the EU classification, a domestic subdivision of the International Harmonized System. The eight-digit level is that at which the EU has bound its tariffs under the 1994 WTO agreement. Rather than introducing a proxy variable to reflect unobservable quality as it is often done in the literature (Crozet and Erkel-Rousse, 2004), we classify the different types of beef imports as "high" or "low" quality according both conservation mode (fresh or chilled or frozen), the final use of the imports (final consumer or processing) and an *ad hoc* distinction for some particular cuts known as being offered in the highest quality segment of the market, relying on the classification used by the EU Commission.[13] Unit values of imports are used to approximate CIF prices. The high-quality beef quota, the in-quota and out-of-quota tariffs for high-quality beef and the import tariff for low-quality beef are found in the TARIC

[12]The EU-Mercosur Interregional Framework Cooperation Agreement was signed on December 15th, 1995. Since 1999, the two parties have been engaged in several rounds of negotiations. In the 9th round, agricultural products were grouped into 5 categories (A, B, C, D and E). Beef falls in the category E, which includes the most sensitive products under negotiation. Since then, Mercosur countries have requested much larger access to the EU market. In October 2004, the EU offered to open or expand several TRQs.

[13]Fresh and chilled are normally denoted high-quality and frozen low-quality beef. For high quality beef, we considered all the tariff lines at the ten-digit level included in the following codes of the Harmonized system of the United Nations: 020110, 020120 and 020130. For low quality beef, the lines under the codes 020220, 020220, 020230, 020230 and 020230.

database. Import figures come from Eurostat's COMEXT data. The European domestic beef expenditure (d) in Euro is obtained from the French marketing board OFIVAL. For elasticities of substitution we used the GTAP elasticity for bovine meat products. As usual with CES specifications, results are very sensitive to the elasticity chosen (Hertel et al., 2004). Here we therefore carried out a sensitivity analysis using alternative values for the elasticities. In Table 3.2 we present the calibration data, which correspond to the situation in 2005. The 2005 benchmark is characterized by an out-of-quota equilibrium, as the EU imports of beef far exceed the quantities under TRQs.

In the numerical simulations, we replace the Cobb-Douglas specification for $U(m, d)$ that was used to keep simple the comparative statics results, by a LES-CES one, that makes more realistic assumptions as far as the substitution between domestic production an imports are concerned. This utility specification introduces a subsistance quantity for which no utility is obtained. Given the subsistance expenditure, the rest of income is allocated between the domestic good and two imported beef qualities. The coefficients of the LES-CES function and other parameters of the model are calibrated to the initial values of the expenditure shares in the base data (Table 3.2) with the domestic price set to 1.

[INSERT TABLE 3.2]

3.4.3 Scenarios of trade liberalization

We now compare the 2005 situation to various trade liberalization scenarios. We focus on the impact of various forms of trade liberalization on the composition of EU beef imports from Mercosur. In the bilateral negotiations, it is proposed that market access be achieved through different channels, including a quota expansion and tariff cuts. In the Doha negotiation, tariff cuts are normally the standard way to liberalize trade, but the 2004 Framework Agreement states that a WTO member might declare some sensitive products. In such a case, tariffs might be cut less dramatically but TRQs would have to be expanded. This also allows some arbitration between tariffs and quotas and raises the issue of choosing one option or the other.

The first scenario considers the elimination of the in-quota *ad valorem* tariff (t_h) for high-quality beef. The second scenario consists of eliminating the *ad valorem* component of the out-of-quota tariff (t), a relatively minor component of the composite tariff. The third scenario eliminates the specific component of the out-of-quota tariff (T). Finally, the fourth scenario considers an increase in the TRQ for high-quality beef ($\bar{q_h}$). In practice, Mercosur countries have proposed an expansion of the high-quality beef quota by a factor of eight,[14] while the EU has offered to expand the existing TRQ to 100,000 tons, i.e. a factor of 2.5. These two cases are considered in Tables 3.3 and 3.4 as Scenario 4-A for the small quota expansion and Scenario 4-B for the large quota expansion.

Table 3.3 presents the effects of the four scenarios on prices and quantities traded, as well as on the quota rent (QR), export revenue (XR), tariff revenue (TR) and equivalent variation (EV). Results regarding the welfare effects of the change in import composition are provided in Table 3.4. The variable $WCofQ$ is defined in Equations (3.25) with the quality composition indicator ($QRatio$) given by the ratio between imports demands of both qualities. All scenarios results are compared to the initial situation shown in Table 3.2.

[INSERT TABLE 3.3]

[INSERT TABLE 3.4]

As expected, results for the first scenario show that the elimination of the in-quota tariff for high-quality beef has no effect on the composition of imports. Given that in the initial situation the TRQs are filled, only rents are affected. In a general case, there is a considerable controversy regarding who keeps the benefits of the rent, between exporters and importers (Skully, 1999; Olarreaga and Ozden, 2005; Abbott, 2002). Here we have assumed that rents were kept by

[14] Mercosur countries request a 315,000-ton quota, a quantity which represents 5% of EU beef consumption and is significantly larger than the present TRQ, 40,300 tons of “Hilton beef”, i.e. high-quality beef. Note that an extra 10,000-ton quota was exceptionally granted to Argentina in 2002 and 2003.

EU importers. In the case of the high-quality beef quotas allocated to Mercosur countries, there are reasons to believe that exporters keep a significant share of the quota rent, given the method used to allocate TRQ licenses and the rather competitive structure of the beef industry in the EU. This suggests that the elimination of tariffs within the TRQs is a policy that would be favored by those producers who currently export under the TRQs. Some producer groups have made it explicit that they favored this option, rather than a general decrease in EU out-of-quota tariffs, but this position has not been followed by their government. Typically, this scenario would be of particular interest to Argentinean producers, who specialize in high unit-value products exported under the current quotas. It would, however, bring little benefit to Brazilian producers who presently export outside the TRQs.

Because it is a small component of the out-of-quota protection, the elimination of the *ad valorem* tariff (second scenario) would only have a limited impact on the overall trade. It would nevertheless affect the composition of imports, since the high-quality imports would increase more than low-quality ones. Even though the *ad valorem* tariff is a distortion in itself, it helps reduce the bias due to the quality upgrading caused by the specific tariff, according to the effect described by Hummels and Skiba (2004). The welfare loss associated with the quality upgrading ($WCofQ$) appears slightly higher under scenario 2 than in the initial situation (Table 3.4). Overall, Mercosur countries would benefit from an increase in export revenue (Table 3.3) but the quota rent would be lower than that of the first scenario and the gain in welfare limited. Brazil could participate more in high-quality trade by expanding its recent out-of-quota exports to the EU. However, those producers who currently have access to the EU TRQ, e.g. producers of high-quality beef in Argentina in particular, are likely to benefit less under the second scenario than under the first one.

The third scenario, i.e. the elimination of the specific component of the out-of-quota tariff would reduce the present bias towards high-quality exports and this explains the drastic reduction of the deadweight loss caused by the bias in import composition (Table 3.4). The overall welfare gains would be large due to the large distortion imposed by the specific tariff, because of both the high level of this tariff and its effect on the import composition. The quota rent would decrease considerably (Table 3.3).[15] EU consumers would reap large gains through lower import prices. All exporting countries would benefit from a larger access to the EU market. Brazil would perhaps benefit more than Argentina, given that Brazilian producers are less specialized in high-quality cuts than Argentinean exporter.

Simulation results for the two cases under the fourth scenario are conditional to the fact that the present level of the TRQ is binding for high-quality beef and that the EU imports beef from Mercosur out of the quota. Under Scenario 4-A, the expansion of the TRQ level is limited and the quota is still binding. Because the initial situation is an out-of-quota equilibrium, a small quota increase has no effect on either trade creation or quality composition of imports. On the contrary, the only impact would be a reduction in the tariff revenue for the EU and an increase in the quota rent for exporters of high-quality beef. Scenario 4-B considers the result of a much larger increase in the TRQ for high-quality beef. The quota would no longer be binding. The EU domestic price for high-quality beef would fall (Table 3.3). High-quality imports would increase significantly, while low-quality imports would decrease, leading to a significant increase in the welfare loss due to the import composition bias. Under this scenario the quality upgrading would represent a large share (almost fifty percent) of the total deadweight loss. The reduction in price and the increase in imports would benefit EU consumers, even though EU tariff revenue would go down. High-quality producers, particularly those of Argentina, are likely to be the main beneficiaries of this scenario due to the trade creation in the high-quality segment of the market.

[15]In Table 3.3, the quota rent (QR) falls to zero as there is a complete elimination of the specific tariff, i.e. the in-quota and out-of-quota tariff become the same. This is obviously a particular case.

Conclusion

The EU has recently become a net importer of beef after being a major exporter during decades. Mercosur countries have now become the largest source of imports and have taken a significant share of the EU market. Changes in domestic policy, in particular the progressive decoupling of direct support since 1992 and the elimination of the intervention price in 2002, have certainly played a role in reducing the incentives to produce in the EU. However, the tariff cuts resulting from the 1994 Uruguay Round Agreement have allowed Brazilian exporters to penetrate significantly the EU market.[16] A cut in the EU tariffs as the one discussed in the Doha negotiations or an ambitious regional or bilateral agreement with a competitive supplier such as Brazil or Argentina could result in a very large increase in imports, given that the current MFN tariffs, albeit still very high, do not succeed in keeping these products out of the EU market. This scenario is particularly feared by EU producers, since it would involve a considerable adjustment in the EU beef sector. By-products of the dairy production supply two thirds of the EU beef consumption and this supply is rather inelastic in relation to beef prices, meaning that producers of suckling cows would have to bear most of the adjustment, making a large cut in tariff politically difficult.

The particular tariff structure for beef explain why imports have been highly biased towards high-quality products, namely fresh boneless cuts. Indeed, the combination of high specific tariffs, low *ad valorem* tariffs and TRQs, some of which are restricted to high-quality beef imports, together with a series of fixed costs in the transportation, inspection and certification sectors have resulted in a significant Alchian-Allen effect. The resulting bias in the composition of imports

[16]The tariff cuts of the Uruguay Round, that have taken place between 1995 and 2001, have left very high MFN tariffs for many beef products. However, the EU had cut most initial tariffs by 36 percent, which has clearly played a role in the subsequent surge in imports. It is noteworthy that beef has not been subject to the strategic allocation of tariff cuts, that most countries have used to minimize the consequences of the Uruguay Round agreement on market access (Bureau et al., 2000). Indeed, the minimal cut for a given tariff line was 15 percent, but the EU chose not to treat beef as a sensitive product and to apply a 36 percent cut to all tariff lines in this sector.

could be either reduced or increased with trade liberalization, depending on the way freer trade is achieved.

Under the bilateral negotiation between the EU and Mercosur, the proposals of the two parties differ on whether trade liberalization in the beef sector should rely on a tariff reduction or a quota expansion. In the WTO negotiations, trade liberalization is supposed to take place through reductions in MFN tariffs, but the proposed provisions on "sensitive products", as agreed upon in 2004, have also introduced some flexibility between tariff cuts and expansion of TRQs. A quota expansion might favor high-quality imports, while a cut in the current specific tariff reduces the present bias towards higher-quality imports. For Mercosur countries as a whole, there is a trade-off between larger rents in one case but larger possibility of expanding exports in the second case. Individual Mercosur countries, might prefer one approach or the other according to the composition mix of their exports. For the EU, managed trade through quantitative ceilings might provide some insurance that some domestic production will persist, in a sector that is important from a social standpoint. On the other hand, this would maintain high prices for consumers and the quota expansion would further increase the quality bias, contributing significantly to the overall welfare cost. These trade-offs could perhaps lead to designing a combination of instruments and to a compromise acceptable for the different parties.

In the Doha framework, the EU is tempted to classify beef products as 'sensitive' and to propose a low tariff cut and an expansion of the TRQs. The EU should nevertheless keep in mind that this would encourage an even more unbalanced structure of imports, which would affect the various producers and consumers in a different way. Quality upgrading of imports is responsible for an extra deadweight loss that must be accounted for, in addition to the standard distortions caused by tariffs.

Most large scale models used in empirical analyses of trade negotiations tend to overlook the import composition issue in cases such as agricultural imports. The analytical framework developed in this paper suggests that the overall effect of a trade agreement on EU beef imports may be different from what one might expect when looking at the traditional flows of frozen carcasses. The complexity of the EU tariff structure is such that trade liberalization scenarios might result in non linear effects. Even though we only address this issue under simplifying assumptions, without an explicit modeling of EU supply and of the complex interactions with the dairy production so as to focus on the comparative statics, we believe that the analytical framework developed in this paper could be adapted for simulation purposes in more global models.

Figures and Tables

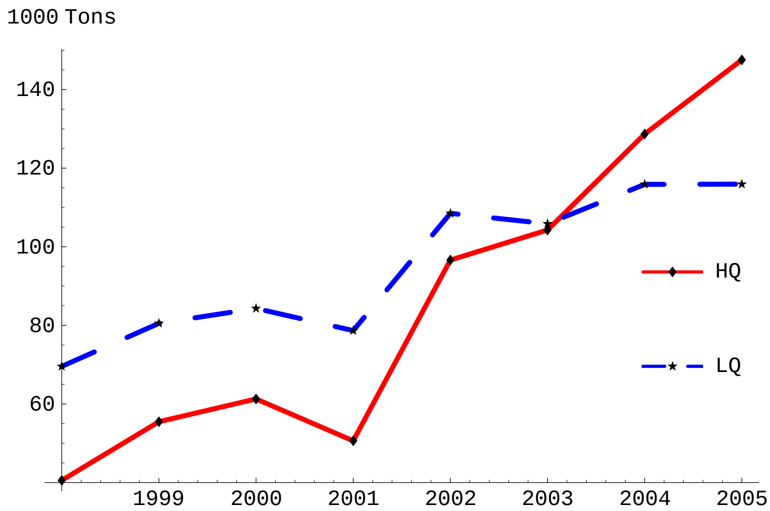

Figure 3.1: EU15 beef imports by quality from Mercosur in 1,000 tons
Source: COMEXT

Table 3.1: Alchian-Allen effect under TRQ and specific tariff: summary of comparative statics results

	In-quota	At-quota	Out-of-quota
t_h	-	0	0
t	+	+ or -	+
T	+	+	+
$\bar{q}_h$	0	+	0 or +

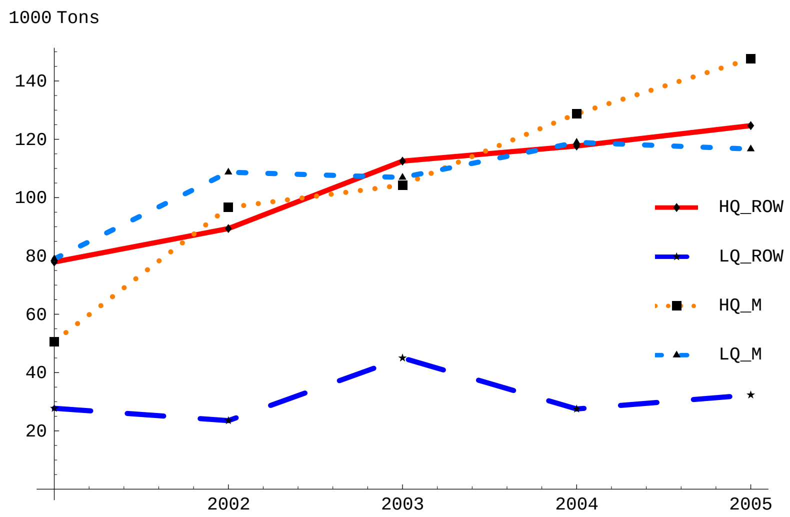

Figure 3.2: EU25 beef imports by quality from Mercosur and the Rest of the World in 1,000 tons

Source:COMEXT

Table 3.2: Calibration Data (2005)

Variables and Parameters	Initialization Values	Source
m_h	147.56 (1000 tons)	COMEXT
m_l	115.93 (1000 tons)	COMEXT
d	37.5 (million Euros)	INRA/OFIVAL
$\bar{I}$	39.5 (million Euros)	Appendix
p_{hw}	4.81 (Euro/kg)	COMEXT
p_{lw}	2.75 (Euro/kg)	COMEXT
t	12.8%	TARIC
t_h	20%	TARIC
T	3.02 (Euro/kg)	TARIC
$\bar{q_h}$	40.3 (1000 tons)	TARIC
p_h	8.43 (Euro/kg)	Appendix
p_l	6.11 (Euro/kg)	Appendix
p_d	1	Appendix
σ	4.4	GTAP

Table 3.3: Prices, Trade and Welfare results (in millions Euro and in tons)

Variables	Initial Sit.	Scenario 1	Scenario 2	Scenario 3	Scenario 4A	Scenario 4B
$\sigma = 4.4$						
p_h	8.43 (Euro/kg)	0%	-7%	-32%	0%	-23%
p_l	6.11 (Euros/kg)	0%	-6%	-46%	0%	0%
m_h	147.56 (1000 tons)	0%	20%	119%	0%	113%
m_l	115.93 (1000 tons)	0%	12%	521%	0%	-31%
d	37.5 (million Euro)	0%	0%	-6%	0%	-2%
EV	0 (1000 Euro)	0	142.92	1439.66	0	420.07
TR	817.77 (1000 Euro)	-5%	3%	-14%	-19%	-30%
QR	107.44 (1000 Euro)	36%	-23%	-100%	148%	119%
XR	1027.9 (1000 Euro)	0%	18%	243%	0%	69%
$\sigma = 2.5$						
p_h	8.43 (Euro/kg)	0%	-7%	-32%	0%	-32%
p_l	6.11 (Euro/kg)	0%	-6%	-46%	0%	0%
m_h	147.56 (1000 tons)	0%	12%	63%	0%	96%
m_l	115.93 (1000 tons)	0%	7%	195%	0%	-24%
d	37.5 (million Euro)	0%	0%	-1%	0%	-1%
EV	0 (1000 Euro)	0	138.41	1059.51	0	553.41
TR	817.77 (1000 Euro)	-5%	-4%	-49%	-19%	-30%
QR	107.44 (1000 Euro)	36%	-23%	-100%	148%	-100%
XR	1027.9 (1000 Euro)	0%	10%	104%	0%	59%
$\sigma = 6.5$						
p_h	8.43 (Euro/kg)	0%	-7%	-20%	0%	-16%
p_l	6.11 (euro/kg)	0%	-6%	-37%	0%	0%
m_h	147.56 (1000 tons)	0%	31%	59%	0%	113%
m_l	115.93 (1000 tons)	0%	17%	644%	0%	-34%
d	37.5 (million Euro)	0%	-1%	-8%	0%	-2%
EV	0 (1000 Euro)	0	148.22	1113.4	0	305.51
TR	817.77 (1000 Euro)	-5%	11%	67%	-19%	-31%
QR	107.44 (1000 Euro)	36%	-23%	-64%	148%	274%
XR	1027.9 (1000 Euro)	0%	27%	241%	0%	68%

Note: Author's calculations

Table 3.4: Welfare cost of quality change (in millions Euro)

Variables	Initial Sit.	Scenario 1	Scenario 2	Scenario 3	Scenario 4A	Scenario 4B
$\sigma = 4.4$						
L_q (1000 Euro)	2515.99	2515.99	2141.07	232.51	2515.99	2062.24
L_τ (1000 Euro)	2171.81	2171.81	1791.98	191.92	2171.81	1183.37
$WCofQ$ (1000 Euro)	344.18	344.18	349.09	40.59	344.18	878.87
$Qratio$	1.27	1.27	1.37	0.45	1.27	3.96
τ	0.9	0.9	0.77	0.17	0.9	0.57
$\sigma = 2.5$						
L_q (1000 Euro)	917.16	917.16	761	76.51	917.16	655.18
L_τ (1000 Euro)	824.31	824.31	665.7	69.06	824.31	280.16
$WCofQ$ (1000 Euro)	92.86	92.86	95.3	7.45	92.86	375.03
$Qratio$	1.27	1.27	1.33	0.7	1.27	3.29
τ	0.9	0.9	0.77	0.18	0.9	0.46
$\sigma = 6.5$						
L_q (1000 Euro)	5832.74	5832.74	5048.37	1654.17	5832.74	5266.03
L_τ (1000 Euro)	4820.75	4820.75	4027.65	1405.89	4820.75	3322.9
$WCofQ$ (1000 Euro)	1012	1012	1020.72	248.28	1012	1943.12
$Qratio$	1.27	1.27	1.42	0.27	1.27	4.1
τ	0.9	0.9	0.77	0.34	0.9	0.66

Note: Author's calculations

Appendix

MCP model

In order to model the TRQ problem in GAMS, we use the following equation system:

- Demand functions

  In order to avoid known limitations of the Cobb-Douglas function, for simulations we replace it by a LES-CES demand as following:

$$d - d_{min} = \alpha_d u \Big(\frac{P_u}{p_d}\Big)^{\sigma_u} \qquad [d]$$

$$m - m_{min} = \alpha_m u \Big(\frac{P_u}{p_m}\Big)^{\sigma_u} \qquad [m]$$

  where $\sigma_u = \frac{\sigma - 1}{\sqrt{2}} + 1$ as in the MIRAGE CGE model (Bchir et al., 2002; Decreux and Valin, 2007).

$$m_h = \lambda_h m (\frac{p_m}{p_h})^{\sigma} \qquad [m_h]$$

$$m_l = \lambda_l m (\frac{p_m}{p_l})^{\sigma} \qquad [m_l]$$

$$p_u u = p_d(d - d_{min}) + p_m(m - m_{min}) \qquad [u]$$

- Prices equations

$$p_d = 1 \qquad [pd]$$

$$mp_m = m_l p_l + m_h p_h \qquad [p_m]$$

$$p_h = p_{hw}(1 + t_h + t_m) \qquad [p_h]$$

$$p_l = p_{lw}(1 + t) + T \qquad [p_l]$$

where the budget constraint is:

$$\bar{I} = p_d d + p_m m \qquad [p_u, \bar{I}]$$

- TRQ constraints

$$m_h = m_{hin} + m_{hout} \qquad [m_{hin}]$$

$$m_{hin} \leq \bar{q_h} \qquad [t_m]$$

$$t_m \leq (t + \frac{T}{p_{hw}} - t_h) \qquad [m_{hout}]$$

$$mp_m = p_{hw}(1 + \tau)m_h + p_{lw}(1 + \tau)m_l \qquad [\tau]$$

Under a MCP program each inequality must refer to a particular variable which satisfies the complementary slackness Rutherford (1995).

EU-Mercosur bilateral trade relationship

Mercosur countries export large quantities of products that face no or little protection in the EU market, such as soybeans and coffee. However, the products in which Mercosur countries are particularly competitive, including sugar and beef, face a high protection in the EU. Mercosur exports to the EU are therefore limited.

The EU grants large tariff preferences to a variety of countries; as a result so that EU applied tariffs are in general much lower than the tariffs bound at the WTO. However, not all countries are eligible for EU preferential regimes. Mercosur countries, in particular, only have limited preferential access to the EU market, at least since the 1995 regional ongoing negotiations, have not yet resulted in an agreement. All Mercosur countries are eligible for the EU Generalized System of Preferences (GSP). However, the GSP does not cover all agricultural products, and the preferential margins are often small relative to the MFN tariffs. Most beef products are not covered by the GSP, and Mercosur exports must also face the MFN tariffs.

In compliance with WTO requirements, the EU has opened TRQs for some agricultural products. There are current-access quotas, related to historical trade that are therefore allocated to particular countries, and quotas under minimum access.

The EU has allocated an important "Hilton" beef quota to Mercosur. This quota has been expanding in 2002 when Argentina was granted a larger quota of 28,000 tons of high-quality beef,[17] Uruguay a 6,300-ton quota of high-quality

[17]CN codes: 0201 30 and 0206 10 95. "...Special or good-quality beef cuts obtained from exclusively pasture-grazed animals aged between 22 and 24 months, having two permanent incisors and presenting a slaughter live weight not exceeding 460 kilograms, referred to as "special boxed beef", cuts of which may bear the letters "sc" (special cuts)". Commission Regulation (EC) No.936/97.

beef,[18] Brazil a 5,000-ton quota.[19] Paraguay was added to the list of exporters with the grant of a 1,000-ton quota of high-quality beef since 2002.[20] Mercosur countries can also benefit from minimum-access quotas that are not allocated to a particular country and which are not limited to high-quality beef.

Each Mercosur country administrates the licenses for "Hilton" quotas. For example, in Argentina's case, the Secretary of Agriculture (SAGPyA) allocates the quota between exporters. In order to access in-quota tariffs for their products, exporters first need an authorization to export to the EU delivered by the EU Commission. They also have to fulfill all the tributary and sanitary obligations of their country. Then, licenses for the quotas are allocated to traditional exporters, considering their total beef export (except "Hilton" beef) during the last two years (FOB values) as proven by customs certifications. The new producers, who fulfill all sanitary conditions and have obtained EU authorization, benefit from 300-ton quota for the first year and 200 tons for the second year. Because it does not renew automatically, every year each exporter has to re-request the attribution of the "Hilton" quota-part from the SAGPyA (SAGPyA Resolutions 914/2001 and

[18]CN codes: 0201 30, 0202 30 90, 0206 10 95, 0206 29 91. "...Special or good-quality beef cuts obtained from exclusively pasture-grazed animals presenting a slaughter liveweight not exceeding 460 kilograms, referred to as "special boxed beef". These cuts may bear the letters "sc" (special cuts)".Commission Regulation (EC) No.936/97.

[19]CN codes: 0201 30, 0202 30 90, 0206 10 95, 0206 29 91. "Beef cuts obtained from steers (novilhos) or heifers (novilhas) aged between 20 and 24 months, which have been exclusively pasture-grazed, have lost their central temporary incisors but do not have more than four permanent incisor teeth, which are of good maturity and which meet the following beef-carcase classification requirements: meat from B or R class carcases of rounded to straight conformation and a fat-cover class of 2 or 3; the cuts, bearing the letters "sc" (special cuts) or an "sc" label as a sign of their high-quality are to be boxed in cartons bearing the words "high-quality beef". Commission Regulation (EC) No.936/97.

[20]CN codes: 0201 30 00 and 0202 30 90. "...fillet (lomito), striploin and/or Cube roll (lomo), rump (rabadilla), topside (carnaza negra) obtained from selected crossbred animals with less than 50% of breeds of the zebu type and having been exclusively fed with pasture grass or hay. The slaughter animals shall be steers or heifers falling under category V of VACUNO carcase-grading system producing carcases not exceeding 260 kg". Commission Regulation (EC) No.1524/2002.

186/2002).

For all these TRQs the tariff in-quota is an *ad valorem* tariff of 20% and the out-of-quota tariff a combination of an *ad valorem* tariff (12.8%) and a specific tariff (from 141.4 per 100kg to 304.1 per 100kg) which changes for each CN code.

EU-Mercosur trade negotiation

In December 1995 the finalization of the EU-Mercosur Interregional Framework Cooperation Agreement took place in Madrid. The agreement entered into force on July 1, 1999 and the two regions began negotiations in November of that same year.

The first round of negotiations (Buenos Aires, April 2000), established the general principles of current and future talks. These included the following provisions: free trade, no exclusion of any sector, conformity with WTO rules, the reinforcement of consultations on WTO matters, the single undertaking principle, intentions to aim at comprehensive negotiations and balances results, and conclusion at the earliest possible time,. The parties also set up technical groups[21] for trade and subgroups for co-operation areas. They also established a working program on the objectives, methodology, information exchange, modalities on non-tariff measures, and the schedule for progressive tariffs in goods and services.

During **the second** (Brussels, June 2000) **and third** (Brasilia, November 2000) **rounds** of negotiations the parties continued to exchange information and drafts about trade, non-tariff obstacles and trade, political and co-operation objectives for a future agreement.

In **the fourth round** (Brussels, March 2001) the parties presented their proposals and working documents about non-tariff issues and "Business Facilities" such as e-commerce were introduced as new subject in the negotiations.

The fifth round (Montevideo, July 2001) was the point of "takeoff" for tariff and service negotiations. The EU presented Mercosur the tariff and negotiation

[21]Subgroups of Technical groups:liberalization trade in goods and services, government procurement, investment, intellectual property rights, competition policies, trade defence instruments and dispute settlement mechanism.

texts for goods, services and government procurement. The objective of this offer was the progressive and reciprocal liberalization of almost all exchange, without exclusion of any sector and lasting for a ten-year period.

In **the sixth round** (Madrid, October 2001) Mercosur presented its tariff offer as well as negotiation texts on services and public markets. The point of contention with the EU proposal was the 33% reduction for EU import tariffs for a ten-year period. During this round and **the seventh round** (Buenos Aires, April 2002), the parties made substantial progress in the political and co-operation chapters (Science, Telecommunications, Energy, Transport). Moreover, the parties agreed on and finally adopted the Trade Facilitation Measures Package that had been discussed in Madrid.

The eighth round (Brasilia, November 2002) focused on the discussion of consolidated texts detailing for services, competition, market access for goods, technical barriers to trade, rules of origin, customs and dispute settlement. They also started discussions about trade of wine and spirits.

In **the ninth round** of negotiations (Brussels, March 2003) the discussion focused on reciprocal tariff proposals. Regarding agricultural tariffs, the parties distinguished several product categories (A, B, C, D, E) which were included in the tariff elimination agenda. The EU proposal included *ad valorem* tariff offers for all categories, except for category E[22] for which does not yet have defined methods of tariff reduction. However, the EU plans to propose TRQs rather than tariff elimination for E category products and not tariff elimination. The Mercosur proposal included the tariff elimination (over ten years) of 8042 tariff headings which account for 83,5% of Mercosur imports coming from the EU. For Mercosur, the majority of meat products (poultry, bovine, pork), fish and sugar are in category C, live animals are in categories A, B, C, while vegetables and fruits are in categories C and D along with cereals, oilseeds and vegetable oils. Mercosur does not consider agricultural imports to be sensitive under category E definition (only food and manufactures).

[22]The products of E category are: cereals, rice, olives, oils, bovine and pork meat, eggs, poultry meat, sugar and fruit and vegetables.

In **the tenth round** (Asuncion, June 2003) discussions focused again on agricultural products. The EU expressed concerns regarding the Mercosur proposal for an accelerated tariff reduction on agricultural imported products. In this round the EU made a proposal for tariffs on category E which had not been defined in the previous round. Discussions also took place on the SPS agreement, in particular on the issues of animal welfare, and wine and spirits.

The eleventh round (Brussels, December 2003) showed some progress on technical trade issues related to market access in goods, government procurement and investment, wines and spirits, business facilitation, intellectual property rights. They also agreed on the work-program for the 2004 rounds as well as the two Ministerial Meetings to conclude the EU-Mercosur Association Agreement.

The twelfth round (Buenos Aires, March 2004) saw progress on trade aspects for manufactured goods. The parties finalized the discussions about TBT, competition and customs procedures.

In **the thirteenth round** (Brussels, May 2004) the discussion about politics, co-operation and trade aspects went on but no important conclusions were reached.

After this final meeting of the Bi-regional Negotiations Committee, the parties continued to exchange of proposals and engage in informal discussions. The final proposals were exchanged in September 2004 in hopes of reaching an agreement at the end of October. However, no EU-Mercosur trade agreement was achieved because the two parties did not agree about crucial subjects such as agricultural trade liberalization and government procurement and investment. Nevertheless, dialogue between the EU and Mercosur has been recently renewed and future proposals are subject to the results of the WTO Doha Round.

Chapter 4

Not in Your Backyard ? Selective Tariff Cuts for Environmentally Preferable Products

[1]

[1]Estelle Gozlan, researcher at the UMR Economie Publique INRA/AgroParisTech is coauthor of this paper.

4.1 INTRODUCTION

In recent years, the WTO has become increasingly involved in trade-related environmental issues that have convinced its members of the need to promote free trade in a way that is consistent with sustainable development. In 2001, member countries agreed to negotiate *"the reduction, or as appropriate, elimination of tariff- and non-tariff barriers to environmental goods and services"* (EGS) in order to enhance the mutual supportiveness of trade and environment.[2] The idea is that an expansion of the market for environmental goods shall provide gains from trade and help countries to address some pollution / resource use issues. While no clear definition of environmental goods has been agreed upon yet, several countries have raised the possibility of broadening the definition to include Environmentally Preferable Products (EPP's), that is, goods with "*high environmental performance and/or low environmental impact*" or goods *"causing significantly less environmental harm at some stage of their life cycle than alternative products that serve the same purpose"* (WTO; ICTSD and IISD; UNCTAD). Such a definition could include goods produced with cleaner production processes and methods (PPMs, such as sustainably grown timber or organic products), in order to strengthen the "green" exporting capacities of developing countries.[3]

Economists are usually careful about the optimality of tariffs as an instrument of environmental policy, and there is widespread agreement that trade intervention can only be second best (Beghin et al., 1994; Whalley, 1998). Lawyers and international trade specialists are sometimes skeptical about the feasibility of lower "green tariffs" due to the impossibility to discriminate between environmentally preferable and conventional goods on the basis of the Harmonized System Custom classification. Moreover, as stated by Verbruggen (van den Bergh, ed, 1999), in the WTO circuit, the current understanding is that a country cannot

[2]Doha Ministerial Declaration, paragraph 31(iii).

[3]Although this position is supported by UNCTAD as a challenging opportunity for developing countries, the ICTSD (2005) recalls that developing countries fear production method distinctions could be misused for 'green protectionism' through the requirements of standards or eco-labels.

take trade measures against another country on the basis of PPM differences.[4] Such objections raise questions about both the practical feasibility and the optimality of implementing a new distortion in the tariff structure, and require an in-depth examination of its welfare implications. The two classes of environmental goods under discussion in current WTO negotiations (Hamwey, 2005) cover a wide range of environmental benefits, stemming from either Class A final-use (goods produced to provide environmental service, e.g. filters) or Class B higher environmental performance, - whether in consumption (e.g. energy-efficient light bulbs) or during the production process (e.g. organic agricultural products or chlorine-free paper). Moreover, because the reduced externality may be local, transboundary, or global, the distribution of environmental benefits from selective tariff cuts in EGS is not trivial.

The aim of this paper is to analyze the nature and distribution of welfare gains expected under the present negotiations, for the family of EPPs characterized by a reduced *local* pollution during the *production process*. We focus on EPPs because by definition, close substitutes ("Environmentally worse" products) exist, which can be valued differently by consumers, and the question of a substitution of green for conventional products has received little attention in the non-strategic trade-and-environment literature. Using a simple North-South trade partial-equilibrium model with two substitutable goods (resp. 'conventional' and 'environmentally preferable'), we seek to address the two following questions: first, what are the environmental and welfare consequences of selective tariff cuts for EPPs for large importing and exporting countries, and how does such a "green" liberalization scenario perform compared to a general, non-selective cut in tariffs? and second, should (large exporting) developing countries rely on such selective tariff cuts, or rather implement whenever feasible a strategic environmental policy aimed at improving their terms of trade while reducing local pollution?

Surveys and economic papers dealing with current Doha negotiations in environmental goods have focused on (i) the right definition for EGS/EPPs (Vikhlyaev, 2004; Howse and van Bork, 2005) and the various implications of negotiating tariff

[4]"In WTO jargon, unilateral measures with extraterritorial impact are not allowed."

cuts upon criteria (more flexible when technology changes) vs. a list of products (more realistic if an agreement has to be reached); (ii) whether extending the scope of environmental goods to include EPPs will provide new export opportunities for developing countries (Singh, 2004; Hamwey, 2005)- highlighting some non-tariff concerns;[5] (iii) the practical and legal feasibility of discriminating between otherwise similar products based on their PPM's within the WTO framework (Carpentier et al., 2005; Steenblik, 2005; Howse and van Bork, 2005): these contributions suggest that though complicated, the EGS preferential liberalization is not impossible (tariff cuts need not to rely on the HS custom classification), and that multilateral negotiations aimed at lowering tariffs, even upon PMM's, cannot be compared with (inadmissible) unilateral trade restrictions; (iv) the potential benefits or adverse impacts of early EGS liberalization (Hamwey, 2005; Carpentier et al., 2005; Howse and van Bork, 2005; Alavi, 2007): despite the many interesting arguments provided in these studies, they consider a range of products that is too wide to allow a sound assessment of economic mechanisms.

Theoretical literature on trade and the environment has extensively explored the links between trade and environmental policy with important contributions in both a strategic- and a non-strategic trade framework. Indeed, the presence of externalities modifies the optimality of policy instruments. The scale (global, transboundary or local pollution) and the source (consumption/ production) of the externality, and also the size (large/ small countries) and the status of trade partners (net exporting/ importing countries) constrain the optimal policy choice.

[5]Discussions at a recent meeting of the WTO Committee on Trade and the Environment (CTE) focused mainly on environmental requirements and market access issues, particularly standards in organic agriculture. During the brief meeting on 2 May, 2007, many Members said they saw organic standards as an opportunity, but also recognised the difficulties sometimes faced by developing countries in particular in achieving conformity with organic standards. Discussions, according to one trade source, took place in a 'solutions-oriented' mode. The WTO secretariat provided an informal document containing a list of environmental impact assessments of trade liberalization under multilateral, regional and bilateral initiatives being carried out in a number of developing countries. The document was submitted to Members for comments, and will be further discussed in the future.

When countries have no influence on world prices (small country assumption), free trade is always the first-best solution if paired with the appropriate environmental policy instrument (Krutilla, 1991). However, trade policy may become a second-best solution when it is not possible to implement an optimal regulation (e.g. a Pigouvian tax) aimed at internalizing environmental damages (Anderson, 1992; Krutilla, 1999; Gozlan and Ramos, 2006). For example, when a country is harmed by transboundary emissions generated by a trading partner, Copeland (1996) has demonstrated the optimality of a "pollution-content tariff" that taxes imports according to the pollution generated.

For large countries, the optimality of tariffs and environmental regulations is complicated by terms of trade effects (TOT), since their policies have an impact on world prices. Therefore, even when efficient environmental regulations are possible, a large importing country always has an incentive to set a non-zero tariff. Focusing on a bilateral production externality between two trading countries, Markusen (1975) has built on the idea that monopoly power in trade can influence foreign production. With a simple general equilibrium model, he compares a first-best policy menu (combining consumption taxes, production taxes, and import tariffs) with second-best policies (when one of the instruments is constrained): the optimal tariff differs under the first best and second best settings, reflecting the TOT consequences of the internalization of the domestic externality. However in both cases, the optimal tariff contains a positive term aimed at addressing foreign pollution, which does not depend upon the domestic environmental policy.

The TOT consequences of environmental policy have also been addressed in a partial equilibrium framework. In the absence of trade instruments (which can be constrained by multilateral negotiations), Krutilla (1991) shows that large countries have an incentive to distort their domestic environmental policy in order to improve their terms of trade: the optimal environmental tax is greater (lower) than the standard Pigouvian tax in the case of an exporting (importing) country. This strategic over-internalization (under-internalization) mechanism is used by Kraus (2000) as the very definition of "Not in my backyard" (NIMBY) and eco-dumping strategies: eco-dumping then refers to the "environmental policy whose level (...) is lower than the Pigouvian tax because of open economy reasons" and NIMBY to a more stringent environmental regulation than optimal under autarky. Such unilateral policies may degenerate into an "environmental race towards the bottom"[6] when countries retaliate, and thus reduce welfare for both partners (Rauscher, 1991, 1995).

Pigouvian taxes may not always be an available instrument for the domestic policy maker, due to political reasons or pressures. This is especially true when it comes to agriculture, where the strict implementation of the polluter-pays-principle should be translated e.g. into a tax on polluting inputs (fertilizers, pesticides...), while many European governments are reluctant to face farmers' hostile reactions.[7]

Most related to our framework are the contributions of Krutilla (1991) (partial equilibrium model with trade a single polluting good), Kraus (2000) on eco-tariffs, i.e. "import tariffs levied on the goods whose PPM pollutes the environment",[8] and LeClair and Franceschi (2006), analyzing the rationale behind differential tariffs as a means to address externalities embedded in traded goods. The originality of our approach relies on the explicit modeling of an environmentally preferable substitute to the traded polluting good, which is valued by at least a fraction of consumers.[9]

The remainder of the paper is structured as follows. Section 4.2 presents the model. Section 4.3 describes the equilibrium conditions in the world market. Section 4 is devoted to the consequences of trade liberalization with large countries and compares an unselective tariff cut for the conventional variety and its

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[6]"The outcome of inter-jurisdictional competition, when regulatory entities compete each other down to undesirably low levels of environmental regulation because some or all countries engage in eco-dumping" (Kraus, 2000)

[7]See Rauscher (1999) for a clear survey of economic mechanisms at stake on the interface between environmental and trade policies, including regulatory capture.

[8]Note that this possibility is not discussed under present EGS negotiations, even though this could be a way to discriminate among polluting and Environmentally preferable products

[9]Moreover, we focus on the cut in *ad valorem* tariffs, while Krutilla chose specific tariffs. Specific tariffs simplify the expression of tariff revenue, but complicate the expressions of the derivatives of other surpluses.

green substitute (subsection 4.1) with selective tariff cuts for the environmentally preferable product (4.4.2). Section 4.5 considers the environmental and terms-of-trade consequences of an environmental tax in the exporting country, and section 4.6 concludes.

4.2 The Model

Consider two countries (bloc of countries): a large Northern country, 'Home' (e.g. the European Union), and a large Southern country, 'Foreign' (e.g. the Mercosur), and assume away the rest of world. Given the initial prices of inputs, Home is a net importer and Foreign a net exporter. We denote variables pertaining to Foreign by an asterisk (*). The main features of our analysis are (1) a partial equilibrium model with two substitutable goods: a conventional variety whose production causes local pollution, and an environmentally preferable variety that is valued by consumers in the Northern country; (2) perfect competition among producers, but international trade between large countries allowing for terms-of-trade effects; (3) classical policy instruments: tariffs (homogeneous vs. differentiated upon PPMs) and environmental taxes.

Consumers are able to distinguish between green and conventional goods without ambiguity (perfect labeling). In Home (the Northern country), they display preferences for the green product. Traditional assumptions are made about the utility function: increasing in each of its arguments, quasilinear and concave, with parameters such that products are imperfect substitutes and G preferred to C for the same price.

Let $D_G(p_G, p_C)$ and $D_C(p_G, p_C)$ represent the demand for green and conventional goods in the Northern country. In the Southern country, we assume that there is no demand for the Environmentally Preferable Product: the green product is an export commodity.[10] Let $D^*(p_C^*)$ represent the Southern demand of conventional goods.

In each country, green and conventional goods are produced in two distinct

[10]This simplifying assumption will be discussed in the conclusion.

competitive sectors (hereafter G and C). Technologies do not differ from one country to another. Let $f(\mathbf{x}) = f(\mathbf{x}_p; \mathbf{x}_{-p})$ be a production function of $\mathbf{x}$, a vector of inputs priced $\mathbf{r}$, where $\mathbf{x}_p$ is the subset of polluting inputs and $\mathbf{x}_{-p}$ is the subset of other "clean" factors (labor, non-polluting capital). f displays decreasing returns to scale. To make things simple we limit $\mathbf{x}_p$ to one single polluting input x_p, priced r_p. The conventional production process is characterized by a local negative production externality $E(x_p)$, linked to the use of the dirty input. The environmental damage is an increasing function of the polluting input ($E'(x_p) > 0$). The green technology differs only by the additional constraint that the use of the polluting input x_p is exogenously set to zero.[11] Both sectors (in both countries) are competitive and producers are price-takers.[12]

Denoting y_C and y_G the output of, respectively, conventional and green products, the profit maximization program of a representative producer in each sector is given by

$$\begin{aligned} \max_{y_C} \quad & \pi_C = p_C.y_C - \mathbf{r}.\mathbf{x} \\ s.t. \quad & y_C = f(\mathbf{x}) \end{aligned} \tag{4.1}$$

$$\begin{aligned} \max_{y_G} \quad & \pi_G = p_G.y_G - \mathbf{r}_{-p}.\mathbf{x}_{-p} \\ s.t. \quad & y_G = f(\mathbf{x}_{-p}; x_p = 0) \end{aligned} \tag{4.2}$$

where p_C and p_G represent equilibrium prices of conventional and green outputs and $\mathbf{r}$ is the vector of input prices.

Due to the additional constraint that $x_p = 0$ in the Green cost minimization program, its marginal cost is higher than in the conventional sector and thus, its supply function $S_G(p_G)$ is more inelastic than the conventional one, $S_C(p_C)$.

[11] Similar results can be derived by assuming a simple threshold in the use of the polluting input (Gozlan and Ramos, 2006) for the green technology, but for expositional convenience we set x_p to zero. When looking for a specification of the production function -e.g. for simulations- the need to set the use of the x_p to zero may require a non-conventional form allowing the use of non-essential inputs (Just et al., 1982; Soloaga, 1999).

[12] The possibility that producers switch from conventional to green production processes is not addressed here, which could be the result of existing barriers to conversion in the short run (e.g. delay before a producer is entitled to use the "organic" label.)

Let T_E denote an environmental tax on the polluting input (initially set to zero). The dirty input demand schedule is determined by the equality of its private cost (including the environmental tax whenever implemented) and the value of its marginal product, that is, its marginal physical productivity valued at the world price. Therefore, producers will demand the polluting input in the domestic importing / foreign (*) exporting countries until the marginal revenue for an additional unit of this input $(p_C.\frac{\partial f(.)}{\partial x_p})$ equals its marginal cost, $(r_p + T_E)$.

Our initial assumption of $T_E = 0$ in the importing country is supported by the strategic underinternalization of the environmental damage when trade policy is constrained by negotiations. When the government cannot increase tariffs in order to improve its terms of trade, lowering environmental taxes is optimal.

4.3 Trade

Both countries (bloc of countries) are engaged into trade negotiations aimed at reducing tariffs. Following the empirical evidence, developed countries tend to have a high level of protection in agricultural products (tariff picks), while many developing countries protect relatively more industrialized products. According to this specification of their tariff structures, a trade liberalization will improve access conditions in developing markets for industrialized sectors in developed countries and vice-versa for agricultural sectors in developing countries. Considering a "green" tariff cut, developed countries will distort their patterns of trade, exporting 'clean' technologies to developing countries and importing relatively more 'sustainable' agricultural products from developing countries.

Although in this paper we focus on the consequences of a trade liberalization scenario in agricultural (conventional and organic) products only, we keep in mind that developed countries will also benefit from reciprocal export gains in the sector of industrialized products.

Selective tariff cuts for environmentally preferable products would result in a lower tariff τ_G for the green product compared to the conventional substitute (remaining with an unchanged tariff τ_C=τ). However, it is also possible to reduce tariffs in a non selective manner. Further, we assume that the exporting country does not retaliate against the importing country.

By convention, equilibrium prices are expressed as domestic prices $\mathbf{p} = (p_G, p_C)$, so the price received by foreign producers is $p_i/(1 + \tau_i)$ where $i = G, C$ and τ_i is the tariff rate applied by Home on imports of i. Let $X_i(p_i)$ denote the export supply of product $i = G, C$ defined as the difference between foreign supply and foreign demand at each price level, and $M_i(\mathbf{p})$ the import demand defined as the difference between the domestic demand and the domestic supply at each price level. The equilibrium in the world market is characterized by the two following conditions:

$$X_C(\frac{p_C}{1+\tau_C}) = M_C(\mathbf{p}) \quad (4.3)$$

$$X_G(\frac{p_G}{1+\tau_G}) = M_G(\mathbf{p}) \quad (4.4)$$

Note that the import demand functions depend on the vector of prices $\mathbf{p}$, where the substitution effect between varieties comes from the demand side in Home, while the export supply functions only depend on their own prices, due to our simplifying assumptions on demand in the Southern country.

The Southern country has an absolute advantage vis-à-vis the Northern country in the production of all varieties, and comparative advantage in the "green" product: this is because the green technology requires a substitution of capital (polluting inputs) to labour and wages are lower in the Southern country.

To analyze the implications of trade and environmental policies, we totally differentiate the equilibrium conditions (4.3) and (4) with respect to the relevant policy variable.

4.4 Trade liberalization: selective vs. unselective tariff cuts

We first consider the consequences on domestic and foreign equilibrium prices of a uniform reduction in the (undifferentiated) tariff rate τ, and then derive the environmental and welfare implications of such a 'full' liberalization scenario. This shall serve as a benchmark in order to discuss the opportunity for large countries to negotiate tariff cuts upon the environmental characteristics of the production process.

4.4.1 Unselective tariff cuts

Let $\varepsilon_i > 0$ $(i = C, G)$ represent the price elasticity of the export supply function of product i, $\eta_{ii} < 0$ represent the own-price elasticity of import demand functions $M_i(.)$, and η_{ij}, with $i \neq j$, the cross-price elasticity of import demands ($\eta_{ij} > 0$ since i and j are substitutes).

Lemma 1 *Let p^e_G (resp. p^{*e}_G) and p^e_C (resp. p^{*e}_G) represent the equilibrium prices in the importing (resp. exporting) country.*

- *A cut in τ results in a decrease in domestic equilibrium prices under the following condition:*

$$\frac{dp^e_G(\tau)}{d\tau} = \frac{p_G(\tau)}{(1+\tau)}\left[\frac{\varepsilon_G(\varepsilon_C - \eta_{CC}) + \varepsilon_C\eta_{GC}}{\Delta}\right] > 0 \tag{4.5}$$

$$\frac{dp^e_C(\tau)}{d\tau} = \frac{p_C(\tau)}{(1+\tau)}\left[\frac{\varepsilon_C(\varepsilon_G - \eta_{GG}) + \varepsilon_G\eta_{CG}}{\Delta}\right] > 0 \tag{4.6}$$

- *A cut in τ results in an increase in foreign equilibrium prices under the following condition:*

$$\frac{dp^{*e}_G(\tau)}{d\tau} = \frac{p_G}{(1+\tau)^2}\left[\frac{\varepsilon_C(\eta_{GC} + \eta_{GG}) + \eta_{CG}\eta_{GC}}{\Delta}\right] < 0 \tag{4.7}$$

$$\frac{dp^{*e}_C(\tau)}{d\tau} = \frac{p_C}{(1+\tau)^2}\left[\frac{\varepsilon_G(\eta_{CC} + \eta_{CG}) + \eta_{GC}\eta_{CG}}{\Delta}\right] < 0 \tag{4.8}$$

The sign of the own- and cross-price elasticities, and the fact that direct effects are greater than cross-price effects ($|\eta_{ii}| > |\eta_{ij}|$) ensure the validity of the signs derived above, where $\Delta = (\varepsilon_C - \eta_{CC})(\varepsilon_G - \eta_{GG}) - \eta_{CG}\eta_{GC} > 0$.

Fig.1 illustrates the impact of a unselective tariff cut in both markets (green and conventional equilibria expressed in terms of domestic prices).

[INSERT FIGURE 1 and 2]

The interpretation is straightforward: a cut in τ results (i) in a shift (increase) in both export supply curves, lowering equilibrium prices p_C and p_G. (ii) The decrease in p_i has a downward shifting effect on the import demand curve $M_j(p_G, p_C)$, which further decreases domestic prices. Conversely, the increase in foreign prices $p_i^{*e} = \frac{p_i}{(1+\tau)}$ is the expected terms-of-trade improvement resulting from a lower tariff in the large importing country. The shift in the import demand functions when equilibrium is derived in terms of world prices (Foreign markets for C and G) is depicted in fig.2.

In other words, variations in prices resulting from changes in the undifferentiated tariff have the same sign than in the single-product market treated in the literature, but the magnitude of price variations is greater due to the substitution effects from the demand functions.

Let's turn to the welfare implications of unselective tariff cuts. Let $W = V(p_G, p_C) + PS_C + PS_G - E(p_C) + TR$ represent the domestic welfare function, where $V(p_G, p_C)$ is the indirect utility function of consumers, $PS_i = \int_0^{p_i^e} S_i(p_i)dp_i$ represents the surplus of producers of good i ($i = G, C$), $E(p_C)$ is the externality and $TR = \frac{\tau}{1+\tau}[p_C M_C(p_G, p_C) + p_G M_G(p_G, p_C)]$ is the tariff revenue from the undifferentiated ad valorem tariff τ. Similarly, foreign welfare is $W^* = CS^*(p_C^*) + PS_C^* + PS_G^* - E^*(p_C^*)$ where the expression of consumer surplus is simply $CS^* = \int_{p_C^{*e}}^{\infty} D_C^*(p_C^*)dp_C^*$, because the green product is not consumed in the South. Let us start by totally differentiating each term in W and W^* with respect to τ.

Using Roy's Identity and the quasilinearity of the domestic utility function, gives the following variation in domestic consumers' surplus:

$$\frac{dV(p_G, p_C)}{d\tau} = -D_G(p_G, p_C).\frac{dp_G}{d\tau} - D_C(p_G, p_C).\frac{dp_C}{d\tau} \tag{4.9}$$

while for foreign consumers we have:

$$\frac{dCS^*(p_C^*)}{d\tau} = -D^*(p_C).\frac{dp_C^*}{d\tau} \tag{4.10}$$

The variation of domestic and foreign producer surplus in each market $i = C, G$ is:

$$\frac{dPS_i}{d\tau} = S_i(p_i).\frac{dp_i}{d\tau} \quad (4.11)$$
$$\frac{dPS_i^*}{d\tau} = S_i^*(p_i^*).\frac{dp_i^*}{d\tau} \quad (4.12)$$

The variation in domestic and foreign environmental costs can be decomposed as follows:

$$\frac{dE(p_C)}{d\tau} = \frac{\partial E}{\partial S_C}\frac{\partial S_C}{\partial p_C}\frac{dp_C}{d\tau} \quad (4.13)$$
$$\frac{dE^*(p_C^*)}{d\tau} = \frac{\partial E^*}{\partial S_C^*}\frac{\partial S_C^*}{\partial p_C^*}\frac{dp_C^*}{d\tau} \quad (4.14)$$

where $\frac{\partial E}{\partial S_C} = \frac{\partial E}{\partial x_p}\frac{\partial x_p}{\partial S_C} > 0$ is the marginal environmental damage. Finally, the tariff revenue in Home varies as follows:

$$\frac{dTR}{d\tau} = \frac{p_C M_C + p_G M_G}{(1+\tau)^2} + \frac{dp_C}{d\tau}\left[a_C M_C + \frac{\tau}{1+\tau} p_G \frac{\partial M_G}{\partial p_C}\right] + \frac{dp_G}{d\tau}\left[a_G M_G + \frac{\tau}{1+\tau} p_C \frac{\partial M_C}{\partial p_G}\right] \quad (4.15)$$

where $a_C = \frac{\tau}{(1+\tau)}(1+\eta_{CC})$ and $a_G = \frac{\tau}{(1+\tau)}(1+\eta_{GG})$.

From the sign of the price variations given in Lemma 1, it is easy to derive the following proposition:

Proposition 1 *Unselective tariff cuts for both conventional and green products result in:*

- *a decrease in domestic pollution and an increase in foreign pollution;*
- *a decrease in Home producers'/ an increase in Foreign producers' profits;*
- *an increase in domestic consumption of C and G and consumers surplus / a loss in foreign consumers' surplus;*
- *a loss in domestic tariff revenue.*[13]

[13]Provided that the initial tariff rate was not greater than the optimal tariff, which would be surprising for rational governments participating in multilateral trade negotiations.

Since a cut in τ results in a lower domestic price for the conventional product, the domestic polluting production decreases while imports and consumption of C increase. Domestic producers of C and G suffer from lower domestic prices, tariff revenues decrease, while consumers benefit.

The net effect on domestic welfare depends upon the initial level of protection. Rearranging the sum of the variations in surpluses derived above, it is possible to express the variation in welfare as follows:

$$\frac{dW}{d\tau} = \frac{dTR}{d\tau} - M_G(p_G, p_C)\frac{dp_G}{d\tau} - M_C(p_G, p_C)\frac{dp_C}{d\tau} - \frac{\partial E}{\partial p_C}\frac{dp_C}{d\tau} \tag{4.16}$$

where the first term is the change in tariff revenue, the second and the third terms reflect effects of the tariff variation on imports of both commodities, and the last term reflects its environmental consequences.

Substituting the change in tariff revenue given in eq. (4.15) and rearranging the expression of dW yields:

$$\begin{aligned}\frac{dW}{d\tau} = &\frac{p_C M_C + p_G M_G}{(1+\tau)^2} \\ &+\frac{dp_C}{d\tau}\Big[M_C(a_C - 1) - \frac{\partial E}{\partial p_C} + \frac{\tau}{1+\tau}p_G\frac{dM_G}{dp_C}\Big] \\ &+\frac{dp_G}{d\tau}\Big[M_G(a_G - 1) + \frac{\tau}{1+\tau}p_C\frac{dM_C}{dp_G}\Big]\end{aligned} \tag{4.17}$$

The first term in this expression is positive, as well as the derivatives of prices with respect to τ. The sign of the welfare variations varies with τ and the threshold value such that (4.17) is zero (optimal tariff) depends on the values of the terms between the brackets. It is easy to see that $(a_c - 1) < 0$ and $(a_G - 1) < 0$, $-\frac{\partial E}{\partial p_C} < 0$ while the cross-price derivatives of the import demand functions are positive. In the absence of externalities and without cross-price effects, this expression would reduce to

$$\begin{aligned}\frac{dW}{d\tau} = &\frac{p_C M_C + p_G M_G}{(1+\tau)^2} \\ &+\frac{dp_C}{d\tau}\Big[M_C(a_C - 1)\Big] \\ &+\frac{dp_G}{d\tau}\Big[M_G(a_G - 1)\Big]\end{aligned} \tag{4.18}$$

This shows that (i) the negative externality of the production process lowers the optimal tariff since there is a benefit to substitute polluting domestic production for imports while (ii) the existence of cross-price effects tend to increase the optimal tariff.[14]

In the Southern country (foreign), exporters of both varieties benefit from higher prices and supply increases, resulting in a higher pollution. Consumers suffer from the increase in p_C^* and still won't consume the 'green' variety since its price increases further. The net welfare effect of a full liberalization in Foreign simplifies to the following expression:

$$\frac{dW^*}{d\tau} = \frac{dp_G^*}{d\tau} X_G(p_G) + \frac{dp_C^*}{d\tau} \Big[X_C(p_C). - \frac{\partial E^*}{\partial p_C^*} \Big] \tag{4.19}$$

From Lemma 1, the derivatives of foreign prices with respect to τ are negative, while from our assumptions about the conventional technology, external costs increase with conventional prices. Equation (4.19) shows that the benefits from trade liberalization in Foreign are reduced due to the increase in the (uninternalized) local pollution.

The global impact of a full liberalization on the welfare of Home and Foreign depends on the relative magnitude of the effects described above (Equations 4.17 and 4.19), and shall be discussed later.

4.4.2 Selective tariff cuts for EPPs

We now turn the impact of a selective tariff cut for the green product, holding the tariff on the conventional product $\tau_C = \tau$ unchanged at its initial level. Totally differentiating the equilibrium conditions with respect to τ_G leads to the following lemma in the neighborhood of the equilibrium:

Lemma 2 • *A variation in τ_G affects the domestic prices p_G and p_c as follows:*

$$\frac{dp_G^e(\tau_G)}{d\tau_G} = \frac{p_G(\tau_G)}{(1+\tau_G)} \Big[\frac{\varepsilon_G(\varepsilon_C - \eta_{CC})}{\Delta} \Big] > 0 \tag{4.20}$$

[14] Although countries participating in multilateral negotiations do not set import tariffs such that their domestic welfare is maximized, the level of the optimal tariff is interesting for comparisons.

$$\frac{dp_C^e(\tau_G)}{d\tau_G} = \frac{p_C(\tau_G)}{(1+\tau_G)}\left[\frac{\varepsilon_G \eta_{CG}}{\Delta}\right] > 0 \tag{4.21}$$

- *A cut in τ_G affects foreign prices as follows:*

$$\frac{dp_G^{*e}(\tau_G)}{d\tau_G} = \frac{p_G}{(1+\tau_G)^2}\left[\frac{\eta_{GG}(\varepsilon_C - \eta_{CC}) + \eta_{CG}\eta_{GC}}{\Delta}\right] < 0 \tag{4.22}$$

$$\frac{dp_C^{*e}(\tau_G)}{d\tau_G} = \frac{p_C}{(1+\tau_C)(1+\tau_G)}\left[\frac{\varepsilon_G \eta_{CG}}{\Delta}\right] > 0 \tag{4.23}$$

In other words, a selective tariff cut for the Environmentally Preferable Product -holding constant the tariff on the polluting good- decreases the domestic prices for both varieties. The decrease in p_C comes from a substitution in the domestic consumption pattern.

World prices react differently to a cut in τ_G: while the foreign price for the EPPs increases, the foreign price of the conventional variety $p_C^* = \frac{p_C}{1+\tau_C}$ decreases, due to the reduction in the domestic price while holding τ_C constant.

Let's turn to the welfare implications of selective tariff cuts, and differentiate the surpluses with respect to τ_G.

The variation in domestic consumer surplus becomes:

$$\frac{dV(p_G, p_C)}{d\tau_G} = -D_G(p_G, p_C).\frac{dp_G}{d\tau_G} - D_C(p_G, p_C).\frac{dp_C}{d\tau_G} \tag{4.24}$$

while for foreign consumers we have:

$$\frac{dCS^*(p_C^*)}{d\tau_G} = -D^*(p_C).\frac{dp_C^*}{d\tau_G} \tag{4.25}$$

The variation of domestic and foreign producer surplus in each market writes:

$$\frac{dPS_i}{d\tau_G} = S_i(p_i).\frac{dp_i}{d\tau_G} \tag{4.26}$$

$$\frac{dPS_i^*}{d\tau_G} = S_i^*(p_i^*).\frac{dp_i^*}{d\tau_G} \tag{4.27}$$

Similarly, variations in domestic and foreign environmental costs are:

$$\frac{dE(p_C)}{d\tau_G} = \frac{\partial E}{\partial p_C}.\frac{dp_C}{d\tau_G} \tag{4.28}$$

$$\frac{dE^*(p_C^*)}{d\tau_G} = \frac{\partial E^*}{\partial p_C^*}.\frac{dp_C^*}{d\tau_G} \tag{4.29}$$

Finally, the tariff revenue in Home varies as follows:

$$\frac{dTR}{d\tau_G} = \frac{p_G M_G}{(1+\tau_G)^2} + \frac{dp_C}{d\tau_G}\left[\alpha_C M_C + \frac{\tau_G}{1+\tau_G} p_G \frac{dM_G}{dp_C}\right] + \frac{dp_G}{d\tau_G}\left[\alpha_G M_G + \frac{\tau_C}{1+\tau_C} p_C \frac{dM_C}{dp_G}\right] \quad (4.30)$$

where $\alpha_C = \frac{\tau_C}{1+\tau_C}(1+\eta_{CC})$ and $\alpha_G = \frac{\tau_G}{1+\tau_G}(1+\eta_{GG})$. From the sign of the price variations given in Lemma 2, it is easy to derive the following proposition:

Proposition 2 *Selective tariff cuts for green products result in:*

- *a decrease in pollution in Home and in Foreign;*
- *an increase in consumer surpluses in Home and in Foreign;*
- *a decrease in conventional producers' profits in Home and Foreign;*
- *a decrease in profits of green domestic producers / increase in profits of green foreign producers.*

[INSERT FIGURES 3 and 4]

In other words, a selective tariff cut for EPPs makes it possible to reduce the environmental damage in both countries, because the conventional production in both countries decreases through substitution effects from the demand side in Home (see fig.3). It lowers domestic profits in both sectors and conventional profits in Foreign. Profits, production and exports only increase in the green foreign sector. Consumers in both countries, according to their pattern of consumption,[15] benefit from the reduction in prices.

The net welfare impact on Home is found by summing up the previous surplus derivatives and reduces to $\frac{dW}{d\tau_G} = \frac{dTR}{d\tau_G} - \frac{dp_G}{d\tau_G} M_G(p_G,p_C) - \frac{dp_C}{d\tau_G}\left[M_C(p_G,p_C) + \frac{\partial E}{\partial p_C}\right]$. Substituting the expression of $\frac{dTR}{d\tau_G}$ given in (4.30) and rearranging:

[15] This is due to our assumption that there is no demand for green products in the southern country.

$$\begin{aligned}\frac{dW}{d\tau_G} &= \frac{p_G M_G}{(1+\tau_G)^2} \\ &\quad + \frac{dp_C}{d\tau_G}\Big[M_C(\alpha_C - 1) - \frac{\partial E}{\partial p_C} + \frac{\tau_G}{1+\tau_G} p_G \frac{dM_G}{dp_C}\Big] \\ &\quad + \frac{dp_G}{d\tau_G}\Big[M_G(\alpha_G - 1) + \frac{\tau_C}{1+\tau_C} p_C \frac{dM_C}{dp_G}\Big] \end{aligned} \tag{4.31}$$

leading to similar conclusions than previously, but with a different magnitude of price variations.

In the Southern country, the net welfare variation under selective tariff cuts writes:

$$\frac{dW^*}{d\tau_G} = \frac{dp_G^*}{d\tau_G} X_G(p_G) + \frac{dp_C^*}{d\tau_G}\Big[X_C(p_C). - \frac{\partial E^*}{\partial p_C^*}\Big] \tag{4.32}$$

From Proposition 2, exporters of the green variety benefit from higher prices and supply increases, consumers and the environment benefit from the decrease in p_C^*, while conventional producers lose. In other words, Foreign enjoys traditional gains from trade in the green market, while the net effects on the conventional market depend on the relative magnitude of producers' losses, consumers' gains and environmental benefits.

4.4.3 Discussion

Propositions 1 and 2 show that cutting tariffs upon the environmental characteristics of the PPMs has important implications in terms of the distribution of welfare gains and losses, as compared to unselective tariff cuts.

This results from differences in the sign and the magnitude of price variations under each liberalization scenario (Lemma 1 and 2), which can be resumed as follows:

1. p_C^* decreases under a "green" liberalization scenario, but increases under a "full" liberalization scenario (resulting in a different distribution of benefits);

2. Under both scenarios, p_G^* increases while domestic prices decrease;

3. The effect of unselective tariff cuts is unambiguously stronger on both domestic and foreign prices, as direct- and cross-price effects add up (amplifying the magnitude of gains and losses for those variable varying in the same directions under both scenarios).

The last point can be easily seen by comparing, for example, the variations in the green domestic price. The decrease in p_G under a full liberalization scenario consists of two terms (eq. 4.5), one accounting for the own-prices effects, the second accounting for the cross-price effect $\varepsilon_C \eta_{GC}$, that is, the further decrease in the green price resulting from the decrease in the price of its polluting substitute. Under a "green" liberalization scenario (eq. 4.20), this second effect vanishes.

The distribution of benefits from selective tariff cuts for the EPP is interesting, since it allows for an improvement in consumer surpluses and in the environment in both Home and Foreign. However, the gains to domestic consumers and the environment in Home would be greater under a full liberalization scenario, and whether these greater gains would more than offset foreign losses is ambiguous, depending on the own and cross-price elasticities of the demand functions and on the price elasticity of the demand for the polluting input in each country (comparative statics are provided in the appendix).

Conversely, a full trade liberalization leads to a greater terms-of-trade deterioration (improvement) for Home (Foreign).

Let's turn to the comparison of the variation in domestic welfare under selective (eq. 4.31) and unselective tariff cuts (eq.4.17). Starting from the same initial equilibrium (with $\tau_C = \tau_G = \tau$) and assuming that this initial tariff is not greater than the optimal tariff, we get:

$$\begin{aligned}\frac{dW}{d\tau} - \frac{dW}{d\tau_G} \mid_{\tau_G=\tau} &= \frac{p_C M_C}{(1+\tau)^2} \\ &+ \Big[\frac{dp_C}{d\tau} - \frac{dp_C}{d\tau_G}\Big]\Big[M_C(a_C - 1) - \frac{\partial E}{\partial p_C} + \frac{\tau}{1+\tau} p_G \frac{dM_G}{dp_C}\Big] \\ &+ \Big[\frac{dp_G}{d\tau} - \frac{dp_G}{d\tau_G}\Big]\Big[M_G(a_G - 1) + \frac{\tau}{1+\tau} p_C \frac{dM_C}{dp_G}\Big] \qquad (4.33)\end{aligned}$$

where the differences between price variations are positive. In other words, if the initial tariff was below the optimal tariff, the magnitude of the domestic welfare losses is likely to be greater under a full liberalization scenario, depending on whether the greater loss from the deterioration in terms of trade can be offset by the greater environmental benefits.

For the Southern country, the comparison of the net welfare variations under both liberalization scenarios is also ambiguous - unselective tariff cuts allowing higher traditional gains from trade, while green tariff cuts provide a different distribution of gains from trade and the environment.

4.5 Environmental Policy in the exporting country

In the previous section, we have assumed away the possibility that countries could address externalities and terms of trade issues by implementing an environmental policy. This was supported by the empirical evidence in many Northern countries that governments are reluctant to increase producers' production costs, and that environmental taxes are still unfrequent in Southern countries. Moreover, the theoretical arguments from the trade-and-environment literature suggest that large importing countries have an incentive to underinternalize environmental damages in order to improve their terms of trade. However, as large exporting countries have an incentive to overinternalize damages for strategic reasons, it is interesting to analyze the impacts of an environmental policy in the Southern country, in order to discuss the rationale for Foreign to rely on multilateral negotiations on environmental goods to improve its welfare, when environmental policy is an available tool.

Let $\varepsilon_{CT_E^*} < 0$ represent the elasticity of the foreign export supply function for conventional products with respect to the level of tax on the polluting input.

Lemma 3 • *A tax on the polluting input implemented if Foreign T_E^* results in an increase in domestic equilibrium prices. In the neighborhood of the equilibrium, caeteris paribus we get:*

$$\frac{dp^e_C(T^*_E)}{dT^*_E} = -\frac{p_C}{T^*_E}\Big[\frac{\varepsilon_{CT^*_E}(\varepsilon_G - \eta_{GG})}{\Delta}\Big] > 0 \quad (4.34)$$

$$\frac{dp^e_G(T^*_E)}{dT^*_E} = -\frac{p_G}{T^*_E}\Big[\frac{\eta_{GC}\varepsilon_{CT^*_E}}{\Delta}\Big] > 0 \quad (4.35)$$

- *A tax on the polluting input implemented in Foreign increases the foreign equilibrium prices as follows:*

$$\frac{dp^{*e}_C(T^*_E)}{dT^*_E} = -\frac{p_C}{(1+\tau)T^*_E}\Big[\frac{\varepsilon_{CT^*_E}(\varepsilon_G - \eta_{GG})}{\Delta}\Big] > 0 \quad (4.36)$$

$$\frac{dp^{*e}_G(T^*_E)}{dT^*_E} = -\frac{p_G}{(1+\tau)T^*_E}\Big[\frac{\varepsilon_{CT^*_E}\eta_{GC}}{\Delta}\Big] > 0 \quad (4.37)$$

The impact of a foreign tax on the polluting input on Home (for a given level of the import tariff τ) is depicted on figure 5. The environmental tax shifts the export supply of the conventional good downwards, resulting in an increase in its domestic price p_C, which in turn results in an upward shift of the demand function for the green substitute, resulting in an increase in p_G as well. Fig. 6 displays the mechanism on the foreign conventional market.

[INSERT FIGURES 5 and 6]

As the tariff remains unchanged, the foreign price p^*_G increases due to the increase in p_G.

The welfare implications are, again, highlighted by differentiating domestic and foreign surpluses with respect to T^*_E.

The variations in consumers surpluses, domestic producer surpluses and foreign 'green' producer surpluses remain formally similar to variations resulting from tariff changes, since the only impact on these agents is through variations in (domestic or world) prices:

$$\frac{dV(p_G, p_C)}{dT^*_E} = -D_G(p_G, p_C).\frac{dp_G}{dT^*_E} - D_C(p_G, p_C).\frac{dp_C}{dT^*_E} \quad (4.38)$$

and in Foreign:

$$\frac{dCS^*(p^*_C)}{dT^*_E} = -D^*(p_C).\frac{dp^*_C}{dT^*_E} \quad (4.39)$$

For domestic producers of both varieties and "green" producers in Foreign:

$$\frac{dPS_i}{dT_E^*} = S_i(p_i)\frac{dp_i}{dT_E^*} \tag{4.40}$$

$$\frac{dPS_G^*}{dT_E^*} = S_G^*(p_G^*)\frac{dp_G^*}{dT_E^*} \tag{4.41}$$

However the change in conventional producers surplus in Foreign results both from the increase in the price of the polluting input, and from the subsequent change in the price of the conventional output:

$$\frac{dPS_C^*}{dT_E^*} = S_C^*(p_C^*).\frac{dp_C^*}{dT_E^*} + \frac{\varepsilon_{CT_E^*}}{T_E^*}\int_0^{p_C^{*e}} S_C^*(p_C)dp_C \tag{4.42}$$

Similarly, while variations in domestic environmental costs result only from changes in prices, in Foreign it also depends upon the tax-elasticity of the supply function:

$$\frac{dE(p_C)}{dT_E^*} = \frac{\partial E}{\partial p_C}.\frac{dp_C}{dT_E^*} \tag{4.43}$$

$$\frac{dE^*(p_C^*)}{dT_E^*} = \frac{\partial E^*}{\partial p_C^*}.[\frac{dp_C^*}{dT_E^*} + S_C^*(p_C^*)\frac{\varepsilon_{CT_E^*}}{T_E^*}] \tag{4.44}$$

The tariff revenue in Home is influenced by the changes in prices resulting from the tax in Foreign:

$$\frac{dTR}{dT_E^*} = \frac{dp_C}{dT_E^*}\left[a_C M_C + \frac{\tau}{1+\tau}p_G\frac{dM_G}{dp_C}\right] + \frac{dp_G}{dT_E^*}\left[a_G M_G + \frac{\tau}{1+\tau}p_C\frac{dM_C}{dp_G}\right] \tag{4.45}$$

where a_C and a_G have been defined in section 4.4.1. Eventually, the Environmental tax revenues ETR collected in Foreign vary as follows with respect to the level of the tax:

$$\frac{dETR}{dT_E^*} = x_p^*(p_C^*) + T_E^*.\left[\frac{dx_p^*}{dT_E^*} + \frac{\partial x_p^*}{\partial p_C^*}.\frac{dp_C^*}{dT_E^*}\right] \tag{4.46}$$

where $x_p^*(p_C^*)$ represents the derived demand for the polluting input in Foreign. From lemma 3, we are able to derive the following proposition:

Proposition 3 *An foreign environmental tax on the polluting input results in:*

- *a decrease in pollution in Foreign but an increase in pollution in Home;*
- *a decrease in consumer surpluses in Home and in Foreign;*
- *a increase in green producers' profits in Home and Foreign;*
- *a increase in conventional producer's profits in Home / an ambiguous effect on foreign conventional producers.*

In other words, a positive environmental tax on the polluting input in the foreign country improves the environmental conditions in Foreign because of a shift in the conventional supply function, while the green supply increases (via the substitution effect on the domestic demand side). However, the environmental damage increases in the domestic country due to higher domestic prices. As a consequence of the increase in domestic and foreign prices, consumers surpluses decrease in both countries. Conventional consumption in Home and Foreign decreases, while the demand of green increases in Home because of the change in relative prices. This change in the relative prices leads to an increase in green trade while the conventional trade decreases. However, we have to highlight that the positive variation in green trade flows does not compensate the decrease in the conventional one.

4.5.1 Discussion

It is interesting to compare, from the Southern (exporting) country's viewpoint, the welfare implications of a domestic environmental policy with the consequences of trade liberalization scenarios. Indeed an environmental tax reduces its pollution while improving its terms of trade (because the shrinking of its conventional supply and exports results in an increase in both conventional and green world prices), reinforcing its "green exporting capacities". These objectives are precisely the point put forward in the debates on the opportunity to extend current EGS negotiations to EPPs of interest for developing countries (organic products).

Table 4.6 summarizes the magnitude and the direction of surplus variations under the three policy scenarios described in propositions.

[INSERT TABLE 4.6]

The comparison of the magnitude of price variations under trade- and environmental policy changes is not immediate as it depends on the respective levels of tariffs and taxes. Therefore whenever needed, we discuss price effects assuming an *ad valorem* tax-equivalent of T_E^* equal to τ.

1. The improvement in green exporting capacities of Foreign is greater under selective tariff cuts for the EPP than under an environmental policy, because the latter does only result from cross-price effects; however a full liberalization would perform even better.

2. The pollution in Foreign decreases under both selective tariff cuts and an environmental policy; the comparison of the net effect depends on the tax-elasticity of the demand for the polluting input. A full liberalization would result in a dramatic increase in environmental damages in Foreign.

3. Foreign consumers are hurt by the increase in p_C^* resulting either from a tax on the polluting input or from a full liberalization; this loss is likely to be greater under a full liberalization because direct and cross-price effects add up. This loss does not occur under a green liberalization scenario.

These results suggest that it could be rational for developing countries to insist on the inclusion of agricultural EPPs in the list of environmental goods eligible for selective tariff cuts under the present WTO negotiations, even when environmental policy is an available instrument.

Among the three policy scenarios considered in this paper, the "green" liberalization is the only one resulting in an improvement in environmental conditions and consumer surpluses in both countries. It also avoids a too harsh deterioration of the terms of trade for the importing country. However its net overall welfare implications are ambiguous: focusing on EU-Mercosur trade in organic and conventional products, it would be interesting to calibrate the model for a specific commodity in order to determine which effect would prevail.

4.6 CONCLUSION

In this paper we had two distinct objectives: (i) to model explicitly the consequences of trade and environmental policy in partial equilibrium when, in addition to the externality-generating good, there is an environmentally preferable substitute and (ii) to shed some light on the current WTO negotiations on environmental goods liberalization, focusing on the group of Environmentally Preferable Products for which developing countries could have a comparative advantage.

Many simplifying assumptions have been made necessary, among which the fact that there is no demand for green products in the Southern country. While this may be consistent with empirical observations, and allows to link the green and conventional markets in a simple manner -through the demand functions of the sole importing country, we ought to clarify under which conditions trade policy might modify the relative prices faced by foreign consumers in a way that would challenge this assumption.

The definition of an "environmentally preferable product" that we used -an exogenous constraint on the use of the polluting input- also deserves a deeper analysis. Indeed, this definition is an environmental standard and it could work as a non-tariff barrier for trade. Even if developing countries could benefit from selective tariff cuts for environmentally preferable products, our analysis overlooked an important issue about the mutual recognition of "environmentally preferable" production processes: in a large part, this is a traditional certification issue, which raises concerns about the ability of Northern countries to use green labels in a protectionist manner.

Figures and Tables

Table 4.1: Impacts of Trade and Environmental Policy changes

Variables	$\searrow \tau$	$\searrow \tau_G$	$\nearrow T_E^*$
p_C^e	$\searrow\searrow\searrow$	$\searrow$	$\nearrow\nearrow$
p_G^e	$\searrow\searrow\searrow$	$\searrow\searrow$	$\nearrow$
p_C^{*e}	$\nearrow\nearrow\nearrow$	$\searrow$	$\nearrow\nearrow$
p_G^{*e}	$\nearrow\nearrow\nearrow$	$\nearrow\nearrow$	$\nearrow$
S_C	$\searrow\searrow\searrow$	$\searrow$	$\nearrow\nearrow$
S_C^*	$\nearrow\nearrow\nearrow$	$\searrow$	? $\searrow$
E	$\searrow\searrow\searrow$	$\searrow$	$\nearrow\nearrow$
E^*	$\nearrow\nearrow\nearrow$	$\searrow$	? $\searrow$
S_G	$\searrow\searrow\searrow$	$\searrow\searrow$	$\nearrow$
S_G^*	$\nearrow\nearrow\nearrow$	$\nearrow\nearrow$	$\nearrow$
D_G	?	$\nearrow\nearrow$	?
D_C	?	$\searrow$	$\searrow\searrow$
D_C^*	$\searrow\searrow\searrow$	$\nearrow$	$\searrow\searrow$
M_C	$\nearrow\nearrow$	$\searrow$	$\searrow\searrow$
M_G	$\nearrow\nearrow$	$\nearrow\nearrow$	$\nearrow$
X_C	$\nearrow\nearrow$	$\searrow$	$\searrow\searrow$
X_G	$\nearrow\nearrow$	$\nearrow\nearrow$	$\nearrow$

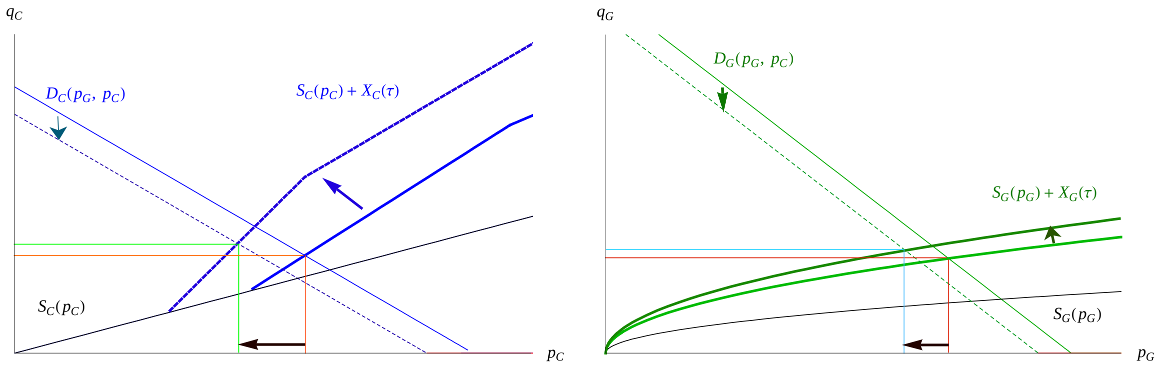

Figure 4.1: Home effects of unselective tariff cuts

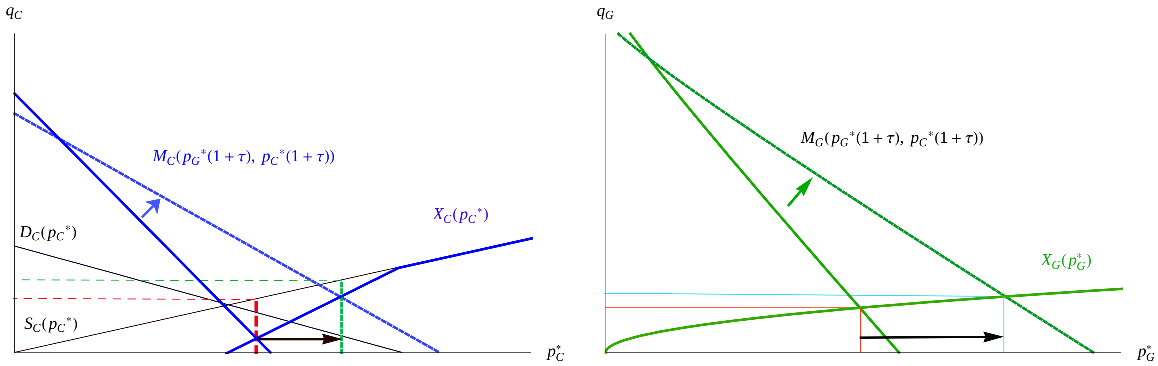

Figure 4.2: Foreign effects of unselective tariff cuts

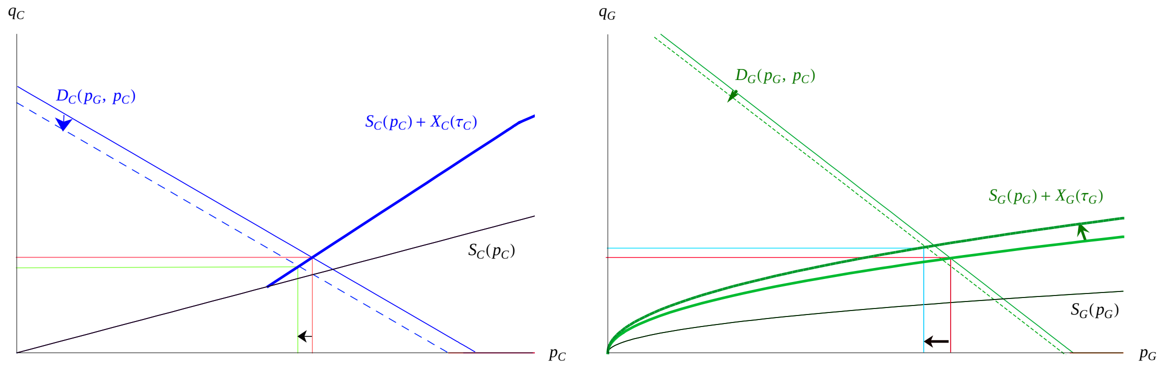

Figure 4.3: Home effects of 'green' tariff cuts

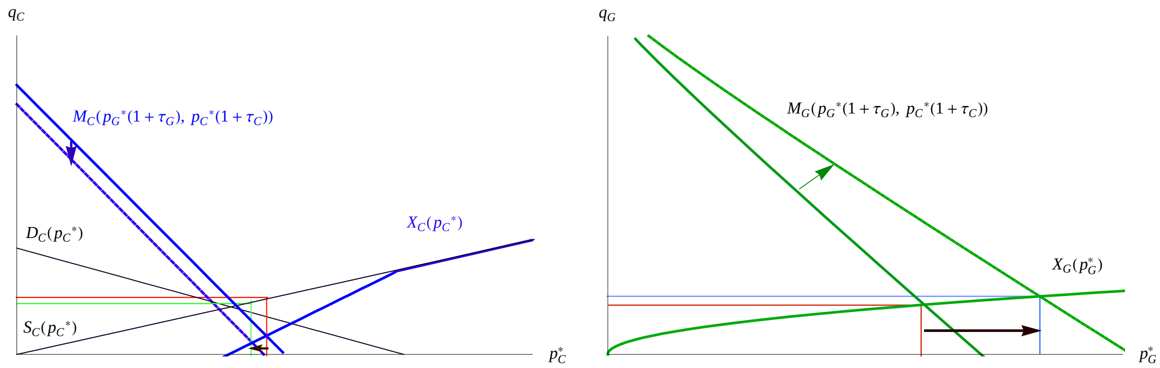

Figure 4.4: Foreign effects of 'green' tariff cuts

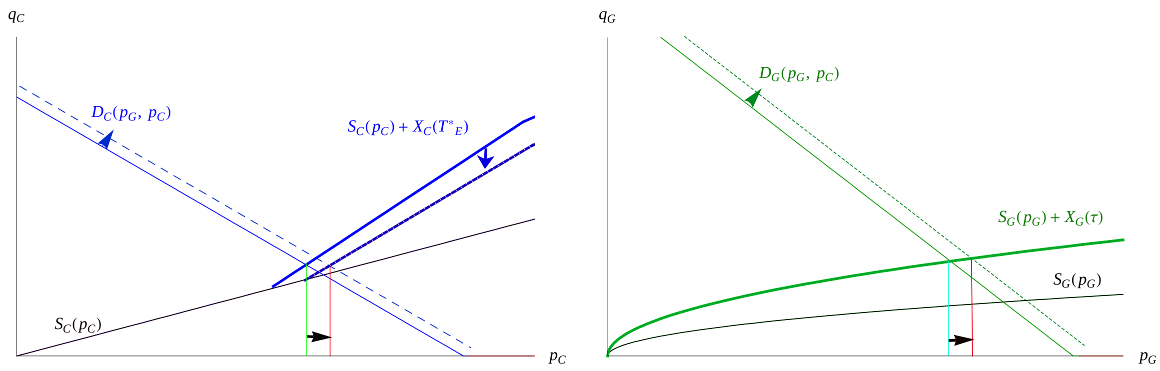

Figure 4.5: Home effects of a Foreign environmental tax

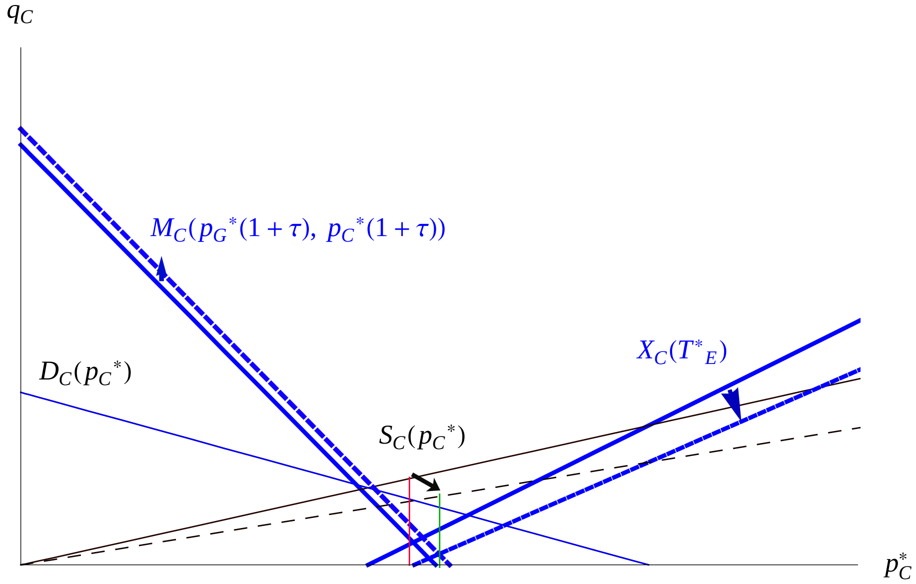

Figure 4.6: Unselective tariff cut: foreign prices

Appendix

Comparative statics

In order to express the variations in supply and demand functions in terms of elasticities, we totally differentiate them with respect to the relevant policy variable, and rearrange after substituting the values of price derivatives calculated in Lemma 1, 2, and 3.

Since these comparative statics require the introduction of new price elasticities for supply and demand functions, by convention we add a superscript denoting the function being derived (e.g. ε_C^X and $\varepsilon_C^{S^*}$ resp. for the conventional export supply and the foreign supply of C).

Unselective tariff cuts

- The transmission of changes in export prices to foreign supply functions depends on their own price elasticity of supply:

$$\frac{dS_C^*}{d\tau} = \frac{S_c^*(.)}{1+\tau}\varepsilon_C^{S^*}\left[\frac{\varepsilon_G^X(\eta_{CC}^M + \varepsilon_{CG}^M) + \eta_{CG}^M)\eta_{GC}^M}{\Delta}\right] < 0 \tag{4.47}$$

$$\frac{dS_G^*}{d\tau} = \frac{S_G^*(.)}{1+\tau}\varepsilon_G^{S^*}\left[\frac{\varepsilon_C^X(\eta_{GC}^M + \eta_{GG}^M) + \eta_{GC}^M\eta_{CG}^M}{\Delta}\right] < 0 \tag{4.48}$$

- The same is reciprocally true in the case of domestic supply functions:

$$\frac{dS_C}{d\tau} = \frac{S_c(.)}{1+\tau}\varepsilon_C^S\left[\frac{\varepsilon_C^X(\varepsilon_G^X - \eta_{GG}^M) + \varepsilon_G^X\eta_{CG}^M}{\Delta}\right] > 0 \tag{4.49}$$

$$\frac{dS_G}{d\tau} = \frac{S_G(.)}{1+\tau}\varepsilon_G^S\left[\frac{\varepsilon_G^X(\varepsilon_C^X - \eta_{CC}^M) + \varepsilon_C^X\eta_{GC}^M}{\Delta}\right] > 0 \tag{4.50}$$

- The impact of changes in export prices on foreign levels of consumption depends on the price elasticity of demand:

$$\frac{dD_C^*}{d\tau} = \frac{D_C^*(.)}{1+\tau}\eta_C^{D^*}\left[\frac{\varepsilon_G^X(\eta_{CC}^M + \eta_{CG}^M) + \eta_{GC}^M\eta_{CG}^M}{\Delta}\right] > 0 \tag{4.51}$$

- On the demand side in Home, own-price effects and cross-price effects add up:

$$\frac{dD_C}{d\tau} = \frac{D_C(.)}{1+\tau} \frac{\eta^D_{CC}[\varepsilon^X_C(\varepsilon^X_G - \eta^M_{GG}) + \varepsilon^X_G \eta^M_{CG}] + \eta^D_{CG}[\varepsilon^X_G(\varepsilon^X_C - \eta^M_{CC}) + \varepsilon^X_C \eta^M_{GC}]}{\Delta} < 0 \tag{4.52}$$

$$\frac{dD_G}{d\tau} = \frac{D_G(.)}{1+\tau} \frac{\eta^D_{GG}[\varepsilon^X_G(\varepsilon^X_C - \eta^M_{CC}) + \varepsilon^X_C \eta^M_{GC}] + \eta^D_{GC}[\varepsilon^X_C(\varepsilon^X_G - \eta^M_{GG}) + \varepsilon^X_G \eta^M_{CG}]}{\Delta} < 0 \tag{4.53}$$

- The effect on domestic demands and domestic supplies reflects the impact on the import demand function. An unselective cut in tariff results in an increase in both import demand functions:

$$\frac{dM_C(p_G, p_C)}{d\tau} = \frac{M_C(.)}{1+\tau}\varepsilon_C\left[\frac{\eta_{CC}(\varepsilon_G - \eta_{GG}) + \eta_{CG}(\varepsilon_G + \eta_{GC})}{\Delta}\right] < 0 \tag{4.54}$$

$$\frac{dM_G(p_G, p_C)}{d\tau} = \frac{M_G(.)}{1+\tau}\varepsilon_G\left[\frac{\eta_{GG}(\varepsilon_C - \eta_{CC}) + \eta_{GC}(\varepsilon_C + \eta_{CG})}{\Delta}\right] < 0 \tag{4.55}$$

- Variations in export supplies are found using comparative static for the foreign supply and demand functions.

  When the undifferentiated tariff reduces the export supply increases due to the positive effect on export prices, as we can see in the following comparative statics:

$$\frac{dX_C(\frac{p_C(\tau)}{(1+\tau)})}{d\tau} = \frac{X_C(\frac{p_C(\tau)}{(1+\tau)})}{1+\tau}\varepsilon_C\left[\frac{\varepsilon_G(\eta_{CC} + \eta_{CG}) + \eta_{GC}\eta_{CG}}{\Delta}\right] < 0 \tag{4.56}$$

$$\frac{dX_G(\frac{p_G(\tau)}{(1+\tau)})}{d\tau} = \frac{X_G(\frac{p_G(\tau)}{(1+\tau)})}{1+\tau}\varepsilon_G\left[\frac{\varepsilon_C(\eta_{GC} + \eta_{GG}) + \eta_{CG}\eta_{GC}}{\Delta}\right] < 0 \tag{4.57}$$

  Under an undifferentiated tariff reduction both import prices reduces and export prices increases. The effect on prices are transmitted to the demand and supply functions depending on their (own- and cross-) price elasticities.

Selective tariff cuts for EEPs

- When the importer country differentiates tariff according

to the PPMs, a preferential tariff reduction for EPPs leads to an increase (decrease) in *Green* (*Conventional*) trade.

- On the supply side

Under a selective tariff cut on EPPs the conventional supply reduces while the green supply increases.

$$\frac{dS_c^*}{d\tau_G} = \frac{S_C^*(.)}{1+\tau_G}\varepsilon_C^{S^*}\left[\frac{\varepsilon_G^X \eta_{CG}^M}{\Delta}\right] > 0 \tag{4.58}$$

$$\frac{dS_G^*}{d\tau_G} = \frac{S_G^*(.)}{1+\tau_G}\varepsilon_G^{S^*}\left[\frac{\eta_{GG}^M(\varepsilon_C^X - \eta_{CC}^M) + \eta_{GC}^M \eta_{CG}^M}{\Delta}\right] < 0 \tag{4.59}$$

In contrast, both conventional and green production increases in the domestic country as a consequence of the increase in their domestic prices.

$$\frac{dS_c}{d\tau_G} = \frac{S_C(.)}{1+\tau_G}\varepsilon_C^{S}\left[\frac{\varepsilon_G^X \eta_{CG}^M}{\Delta}\right] > 0 \tag{4.60}$$

$$\frac{dS_G}{d\tau_G} = \frac{S_G(.)}{1+\tau_G}\varepsilon_G^{S}\left[\frac{\varepsilon_G^X(\varepsilon_C^X - \eta_{CC}^M)}{\Delta}\right] > 0 \tag{4.61}$$

- On the demand side

Foreign demand of conventional product increases under a selective tariff cut on green commodities. This effect is possible though the cross-price effect in the international market.

$$\frac{dD_C^*}{d\tau_G} = \frac{D_C^*(.)}{1+\tau_G}\eta_C^{D^*}\left[\frac{\varepsilon_G^X \eta_{CG}^M}{\Delta}\right] < 0 \tag{4.62}$$

Domestic demand on the conventional product decrease as a consequences of a selective tariff cut on green products, through a simple substitution effect.

$$\frac{dD_C}{d\tau_G} = \frac{D_C(.)}{1+\tau_G}\varepsilon_G^X\Big[\frac{\eta_{CC}^D\eta_{CG}^M + \eta_{CG}^D(\varepsilon_C^X - \eta_{CC}^M)}{\Delta}\Big] > 0 \tag{4.63}$$

$$\frac{dD_G}{d\tau_G} = \frac{D_G(.)}{1+\tau_G}\varepsilon_G^X\Big[\frac{\eta_{GG}^D(\varepsilon_C^X - \eta_{CC}^M) + \eta_{GC}^D\eta_{CG}^M}{\Delta}\Big] < 0 \tag{4.64}$$

- The impact on trade is:

$$\frac{dM_G(p_G, p_C)}{d\tau_G} = \frac{M_G(.)}{p_G(\tau_G)}\varepsilon_G\Big[\frac{\eta_{GG}(\varepsilon_C - \eta_{CC}) + \eta_{CG}\eta_{GC}}{\Delta}\Big] < 0 \tag{4.65}$$

$$\frac{dM_C(p_G, p_C)}{d\tau_G} = \frac{M_C(.)}{(1+\tau_G)}\varepsilon_G\Big[\frac{\eta_{CG}(\varepsilon_C - \eta_{CC}) + \eta_{CC}\eta_{CG}}{\Delta}\Big] > 0 \tag{4.66}$$

$$\frac{dX_G(\frac{p_G(\tau_G)}{1+\tau_G})}{d\tau_G} = \frac{X_G(.)}{(1+\tau_G)}\varepsilon_G\Big[\frac{\eta_{GC}\eta_{CG} + (\varepsilon_C - \eta_{CC})\eta_{GG}}{\Delta}\Big] < 0 \tag{4.67}$$

$$\frac{dX_C(\frac{p_C(\tau_G)}{1+\tau_C})}{d\tau_G} = \frac{X_C(.)}{(1+\tau_G)}\varepsilon_C\Big[\frac{\varepsilon_G\eta_{CG}}{\Delta}\Big] > 0 \tag{4.68}$$

The impact of a "green" tariff reduction on its own-price is greater than the impact of this tariff cut on the conventional price, that is why in the neighborhood of the equilibrium a preferential tariff cut for EPPs increases (decreases) the "green" (conventional) trade.

Foreign Environmental Tax

Totally differentiating demand and supply functions and rearranging terms in order to express the results in terms of elasticities, we find that the following expressions for comparative statics when the foreign country punishes the conventional production with an environmental tax.

- impact on the international market (imports and exports)

  According to the the Lemmas the increase in the import prices makes conventional import demand reduces and "green" import demand slightly increases, because the environmental tax affect more the conventional import price than the "green" price. There are two effects: the first one is that the variation on the conventional price is greater than for the "green" price and the second one is that the own price effect is always greater than the cross-price effect. On the conventional demand both effects reinforce the decrease on the import demand but on the "green" demand both effect go in opposite directions

$$\frac{dM_C(p_G,p_C)}{dT_E^*} = -\frac{M_C}{T_E^*}\varepsilon^X_{CT_E^*}\left[\frac{(\eta^M_{CC}(\varepsilon^X_G - \eta^M_{GG}) + \eta_{CG}\eta_{GC})}{\Delta}\right] < 0 \quad (4.69)$$

$$\frac{dM_G(p_G,p_C)}{dT_E^*} = -\frac{M_G}{T_E^*}\varepsilon^X_{CT_E^*}\left[\frac{\eta^M_{GC}\varepsilon^X_G}{\Delta}\right] > 0 \quad (4.70)$$

  The impact of the environmental tax on the exporter price differs. This policy in the foreign country increases conventional export price and thus conventional exports; however ...

$$\frac{dX_C}{dT_E^*} = -\frac{X_C}{T_E^*}\varepsilon_{CT_E^*}\left[\frac{\eta_{CC}(\varepsilon_G - \eta_{GG}) - \eta_{CG}\eta_{GC}}{\Delta}\right] < 0 \quad (4.71)$$

$$\frac{dX_G}{dT_E^*} = -\frac{X_G}{T_E^*}\varepsilon_{CT_E^*}\left[\frac{\eta_{GC}\varepsilon_G}{\Delta}\right] > 0 \quad (4.72)$$

- the impact of the foreign environmental tax on the domestic country

  As the price increases the supply in the domestic country also does for both products; however the conventional production increases more than the "green" one. Demand for conventional product reduces but for "green" products increases due to the change in the relative price which favor the "green" demand.

$$\frac{dS_C}{dT_E^*} = -\frac{S_C}{T_E^*}\varepsilon_{CT_E^*}^{X}\Big[\frac{\varepsilon_C^S(\varepsilon_G^X - \eta_{GG}^M)}{\Delta}\Big] > 0 \tag{4.73}$$

$$\frac{dS_G}{dT_E^*} = -\frac{S_G}{T_E^*}\varepsilon_{CT_E^*}^{X}\Big[\frac{\varepsilon_G^S \eta_{GC}^M}{\Delta}\Big] > 0 \tag{4.74}$$

$$\frac{dD_C}{dT_E^*} = -\frac{D_C}{T_E^*}\varepsilon_{CT_E^*}^{X}\Big[\frac{\eta_{CC}^D(\varepsilon_G^X - \eta_{GG}^M) + \eta_{CG}^D \eta_{GC}^M}{\Delta}\Big] < 0 \tag{4.75}$$

$$\frac{dD_G}{dT_E^*} = -\frac{D_G}{T_E^*}\varepsilon_{CT_E^*}^{X}\Big[\frac{(\eta_{GC}^D(\varepsilon_G^X - \eta_{GG}^M) + \eta_{GG}^D \eta_{GC}^M)}{\Delta}\Big] > 0 \tag{4.76}$$

- impact on the foreign market

$$\frac{dS_C^*}{dT_E^*} = \frac{S_C^*}{T_E^*}\varepsilon_{CT_E^*}^{S^*}\Big[\frac{(\varepsilon_G^X - \eta_{GG}^M)(\varepsilon_C^X - \eta_{CC}^M - \varepsilon_C^{S*}) - \eta_{CG}\eta_{GC}}{\Delta}\Big] < 0 \tag{4.77}$$

$$\frac{dS_G^*}{dT_E^*} = -\frac{S_G^*}{T_E^*}\varepsilon_{CT_E^*}^{S^*}\Big[\frac{\eta_{GC}^M \varepsilon_G^{S^*}}{\Delta}\Big] > 0 \tag{4.78}$$

$$\frac{dD_C^*}{dT_E^*} = -\frac{D_C^*}{T_E^*}\varepsilon_{CT_E^*}^{S^*}\Big[\frac{\eta_{CC}^{D^*}(\varepsilon_G^X - \eta_{GG}^M)}{\Delta}\Big] < 0 \tag{4.79}$$

FINAL CONCLUSION

In this dissertation we have tried to address four important questions linked to the EU-Mercosur negotiations, with a special focus on agricultural trade liberalization.

Primarily, because the close relationships between multilateral and bilateral trade agreements condition welfare and trade gains for partners under a preferential trade agreement, our first objective was to simulate and compare the welfare and trade implications of a EU-Mercosur preferential trade agreement, when it is conditioned by the success or the failure of a multilateral trade agreement. The main idea was to investigate whether the success of WTO negotiations and the enlargement of a custom union (with the entry of Venezuela) would lead to welfare and trade gains for a subsequent preferential trade agreement.

Moreover, since the end of the Uruguay Round, agricultural trade liberalization has resulted in non-negligible improvements in terms of market access, but this has been made possible by the use of more complex trade policy instruments. These new tools, such as tariff-rate quotas, also lead to more complex effects on trade and welfare. Our second objective was to improve the modeling of agricultural protection, especially through the TRQ modeling in a CGE framework by avoiding aggregation biases.

Furthermore, the implementation of these new trade policy instruments in the agricultural sector may have important implications on the composition of trade when products are not homogeneous. This is the case in the segmented beef market, which displays different qualities for which the European Union applies different trade policy instruments. In the third chapter of this dissertation, we aimed at analyzing the complex effects of mixed tariffs and TRQs on trade, trade composition and welfare when commodities are vertically differentiated.

Finally, the increasing connection between trade and environmental objectives has recently pushed WTO members to negotiate alternative trade liberalization patterns (i.e. selective tariff cuts EPPs), which could provide new trade opportunities for developing countries in some particular niches like organic products or certified timber. Our last purpose, with regard to this empirical question, was to analyze the consequences of different patterns of trade liberalization in the case of high-added value commodities in the agricultural sector (EPPs and high-quality agricultural products).

Regarding the first empirical question ("Will Regionalism survive Multilateralism?"), we showed how a Doha output and the accession of Venezuela into the Mercosur will condition welfare and trade gains for a EU-Mercosur agreement. The main result of this paper is that even after the Doha conclusion, the EU-Mercosur PTA would improve market access for all partners. However, reaching a bilateral agreement after the DDA achievement and Venezuela's accession to Mercosur would only benefit Mercosur countries in terms of welfare, because the EU and Venezuela would suffer from a deterioration in their terms of trade.

The two main contributions of this paper, compared with other empirical works in a CGE framework, concern (1) the update and re-calibration of trade data through productivity improvement, transaction cost reduction and capital accumulation and (2) the enhancement of protection data (tariff-rate quota information, and bound and applied tariffs from MAcMapHS6-v2) following innovating papers (Jean et al., 2005) for the choice of sensitive products. However, several advances could be made in order to bring the simulated scenarios closer to the reality: the consideration of all other PTAs involving EU and Mercosur countries and the rest of the world (e.g. the EU-Chile PTA); the assumption of different hypotheses about TRQ-rent distribution between production factors (i.e. between land and capital). Further, these scenarios should be tested under the TRQ modeling introduced in the second chapter of this dissertation in order to shed light on the consequences on beef and sugar markets. This paper should not be considered as a contribution to the theoretical literature. However, for empirical literature, and especially for policymakers' decision, this work is one of most complete in its genre.

The second paper of this dissertation provides a methodological contribution to the TRQ modeling literature in a general-equilibrium framework. The literature on TRQ modeling is quite recent and makes strong TRQ aggregation hypotheses that lead to biased trade and welfare results. The originality of our contribution relies on the introduction of TRQ modeling at a detailed level, which would lead to non-biased results. Moreover, the comparison of different versions of the Mirage CGE model allows us to isolate data aggregation biases from those linked to the lack of TRQ modeling. Our results show that most part of biases due to simplifying assumptions (i.e. exogenous TRQ-rents) are explained by the impossibility to shift from one TRQ-regime to another. Our explicit TRQ modeling leads to greater welfare and trade gains when quantitative restrictions of TRQs are relaxed and the in-quota tariff becomes the effective protection. This methodological contribution helps to a better understanding of TRQ mechanisms, and of their trade and welfare consequences under an agricultural trade liberalization scenario. Many TRQ aspects could still be improved, such as the distinction between multilateral and bilateral TRQs due to their licenses allocation hypotheses, intermediate regimes for multilateral TRQs (De Gorter and Kliauga, 2006) and the impacts of TRQ administration methods and positive market power of traders. These and other aspect of TRQ modeling will be the source of motivation for future research.

In accordance with our two last objectives, focused on more specific trade issues, in chapters 3 and 4 we have developed two partial-equilibrium trade models. The third paper addresses the question of the typical Alchian-Allen effect when tariff structures are mainly composed by mixed tariff and tariff-rate quotas. The originality of this work is that it tackles with a classical question of the "shipping the good apples out" effect by introducing complex policy instruments largely used in agricultural protection. The results shows that different patterns of trade (*ad valorem* or specific tariffs reduction, and the quota volume expansion) lead to different consequences in terms of trade volume, welfare and especially on trade composition (quality upgrading or downgrading). These results confirm that the different components of complex tariff structures (quotas vs. tariffs) are not equivalent neither in terms of trade (and trade composition) nor in terms of welfare (Anderson, 1988; Hranaiova et al., 2006). Our results show that a quota expansion might favor high-quality trade and lead to greater TRQ-rents, while a cut in the specific component of a mixed tariff might reduce the bias towards high-quality trade increasing total trade. Moreover, in the importing country, the quota expansion guarantees the persistence of the domestic production, while leading to a lower equivalent variation. More generally, our results can provide interesting insights for the analysis of the possible consequences of the Doha and the bilateral EU-Mercosur proposals concerning the beef market liberalization. In the particular case of the EU-Mercosur negotiations, the EU has characterized beef as a "sensitive" product, leading to two possibilities of liberalization: a small (specific) tariff cut or a quota expansion; however she has to take into account the non-equivalence of these trade liberalization patterns. Finally, it would be interesting to find the combination (tariff cut plus quota expansion) that would lead to a convergence in trading partners' interests.

The fourth and last chapter analyzed the rationale for large trading partners to engage into preferential trade liberalization for environmentally preferably products. This work focuses on the comparison of environmental and terms-of-trade gains for one net importing and one net exporting countries. Compared to the trade-and-environment literature, the originality of this paper consists in the capture of cross effects between a polluting commodity and its environmentally preferable substitute. The main results that can be drawn from this paper is that, when the importing country displays preferences for EPPs, a selective tariff cut on these products improves the exporter's terms of trade and always results in lower pollution in both countries, due to the substitutions in the importing country's consumption pattern. Full trade liberalization and an unilateral environmental taxes in the exporting country may result in greater environmental and terms-of-trade benefits in one country, but it will always hurt its trading partner. This theoretical contribution gives an answer to the distribution of welfare gains of the multilateral liberalization in Environmental Goods and Services (EGS) at the WTO with regard to both trade and the environment.

Moreover, depending on the definition of EPPs used in current WTO negotiations, our results suggest that even developing countries could benefit from market access improvements, because some of them, such as Argentina, are net exporters of grown timber products or organic food. However, this work should be extended in order to address the problem of non-tariff barriers, which are likely to constrain the possibilities to improve market access for EPPs because of ”green” certification issues. This is the case when neither equivalence agreements nor mutual recognition procedures are established between trading partners.

Using different approaches and methodologies, theoretical and empirical frameworks, this dissertation sheds light on several important empirical questions at stake in multilateral and bilateral negotiations, especially in the case of the EU-Mercosur negotiations.

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