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IMPACTS OF THE PROPOSALS FOR TARIFF REDUCTIONS IN NON-AGRICULTURAL MARKET ACCESS (NAMA)

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IMPACTS OF THE PROPOSALS FOR TARIFF REDUCTIONS IN NON-AGRICULTURAL MARKET ACCESS (NAMA)[1]

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RESUMO

O estudo visa avaliar os impactos de propostas alternativas de redução da proteção tarifária de bens não-agrícolas sobre a economia brasileira usando um modelo de equilíbrio geral computável. Foram simulados os impactos da implementação de cortes tarifários de acordo com diferentes coeficientes para a fórmula Suíça. As simulações foram realizadas com o modelo GTAP e todos os choques tarifários foram calculados a partir de informações da base de dados MacMap. Além de analisar resultados macroeconômicos e setoriais, também foi testada a sensibilidade dos resultados em relação ao aumento das elasticidades de Armington e à ocorrência de uma simultânea liberalização de tarifas sobre bens agrícolas.

PALAVRAS CHAVES

Comércio Internacional, Equilíbrio Geral Computável, Organização Mundial de Comércio, Rodada de Doha, Acesso a Mercados Não-Agrícolas.

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F1, F13, F17, F5, F53, D58.

Abstract

The study aims at evaluating the impacts of alternative formula-based tariff reduction of non-agricultural goods on Brazilian economy using a computable general equilibrium model. It was simulated the implementation of Swiss formula tariff cut, considering different coefficients. The simulations were carried out with the GTAP model and all tariff shocks were calculated from MAcMap database. Besides analyzing macroeconomic and sectoral results, it also has tested the sensibility of the result regarding Armington elasticities increase and the implementation of a simultaneous agricultural tariff liberalization.

Key Words

International trade, Computable General Equilibrium, World Trade Organization, Doha Round, Non-Agricultural Market Access.

1 Introduction: Doha Round and NAMA negotiations

The World Trade Organization Uruguay Round can be said to have determined the elements that would comprise the Doha Round (2001-...), which was introduced as the Development Round, following the awareness that economic results promised by trade liberalization had not matched the expectations of most member nations, i.e., non-developed countries. Trade liberalization remained the key objective of the Round; yet the development issue and the situation of the developing countries (DCs) and of the least developed countries (LDCs) have become an essential element in the discussions, since members now admit that tariff reductions are necessary, but not enough to foster a trade liberalization process[2] and reduce the existing asymmetry between the nations.[3]

Regarding trade negotiations on market access for manufactured or industrial goods, also called Non-Agricultural Market Access (NAMA), the Doha Mandate, in its paragraph 16, sets forth its main objectives: (i) reduction or elimination of tariffs, including: high tariffs, tariff peaks and tariff escalations; (ii) reduction or elimination of non-tariff barriers (NTBs) mainly those applicable to goods of interest to DCs; (iii) tariff consolidation (coverage of all tariff lines). Moreover, trade negotiation asymmetry is admitted, i.e., the specific needs and interests of DCs and LDCs must be considered using the principle of "less than full reciprocity".[4]

In July 2004, following the collapse of the V Cancun Ministerial Conference, WTO members announced the Framework/04,[5] a basic structure to resume, guide and organize the Doha Round negotiations. In this document, the issue pertaining to NAMA negotiations is covered in its Annex B. The Framework/04 reiterates the positions of Doha Mandate's §16, regarding negotiation of non-agricultural goods. One could say that considerable attention is given to developing a non-linear formula to reduce tariffs applied line by line. According to this document, the formula's main objective would be to reduce or eliminate tariffs and, *a priori*, would not exclude any line.[6]

According to Framework/04, non-bound tariffs would have to be reduced [2] times the tariff of the most favored nation (MFN) applied, using base year 2001.[7] Moreover, negotiators

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[2] Proof of this fact is that negotiations of non-tariff barriers and rules are considered essential elements in actual trade liberalization.

[3] The least developed countries (LDCs) are the focus of special attention.

[4] Article XXVIII of GATT 1994 and §50 of the Doha Mandate.

[5] Doha Work Programme: Decision Adopted by the General Council on 1 August 2004 (WT/L/579) known as the frameword of the Doha Round negotiations.

[6] To comply with the principle of "less than full reciprocity", Annex B of the Framework/04 received the §8, which deals with possible flexibilities in implementing tariff reductions for DCs and LDCs.

[7] For calculation purposes, import data for the period 1999-2001.

would have to make a special effort to convert non ad valorem tariffs into equivalent ad valorem tariffs, using a methodology to be defined. Regarding the nomenclature, the document proposes that negotiations initially use the nomenclature of the 1996 Harmonized System (1996HS) or the 2002 Harmonized System (2002HS) but the final result would be based on the 2002HS. Additionally, it reiterates the Mandate's position on environmental non-agricultural goods, sets forth guidelines for negotiating sectoral initiatives,[8] and points towards elimination of low duties by DCs and other nations. The document also acknowledges the DCs' efforts towards unilateral tariff reduction.

In December 2005, the WTO launched a new document[9] in which, once again, it reiterated the commitments adopted by the Doha Mandate. Regarding the NAMA negotiations, the document incorporated the work of the Negotiating Group on Market Access (NGMA),[10] which can be summed up in the following themes: formulas for tariff reduction, consolidation of tariffs and flexibility for least developed countries.

Regarding the formula for tariff reduction, the document pointed out that members favored the Swiss formula and that discussions were centered on the number and the amounts of the coefficients to be agreed. There were basically two positions: (i) the adoption of a limited number [2] of coefficients: for developed countries this coefficient would be between 5 and 10; for the other countries, between 15 and 30; and (ii) the use of multiple coefficients, according to the average of the bound tariffs for each member. According to the document, the decision regarding the number and the amounts of the coefficients to be applied depended on the interpretation of the meaning of the principle "less than full reciprocity" for DCs and LDCs.

In addition, it was admitted that the NAMA negotiation would not be included in the Hong Kong Ministerial Conference. Yet some points had to advance to enable the Doha Round to be concluded at the end of 2006, namely: (i) definition of a non-linear formula to be adopted, as well as the number of coefficients and amounts to be applied; (ii) improvement in the understanding regarding the flexibilities to be permitted to DCs and LDCs; and (iii) progress in the discussion on the treatment to be given to non-bound tariffs.

The WTO's VI Ministerial Conference, held in Hong Kong in December 2005, saw very little progress in relation to the NAMA negotiations, mainly because of the priority given to the agricultural issue. The concluding text of the Hong Kong Conference, in regard to NAMA,

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[8] Sectoral initiatives include discussion of non-tariff, as well as, tariffs barriers. There is the need to establish a minimum number of participants per sector before discussions start for a given sector. This is called critical mass. Sectoral initiatives are: Automotive, Bicycle and Parts, Footwear, Electric and Electronic, Sports Equipment, Medical and Pharmaceutical Equipment, Precious Stones and Jewelry, Raw Materials, Fishing and Fishing Equipment, Wood Products, IT Products, Forest Products, and Chemical. Brazil's position is not to take part in sectoral initiatives.

[9] Doha Work Programme – Preparations for the Sixth Session of the Ministerial Conference. Available at http://www.wto.org/english/thewto_e/minist_e/min05_e/draft_text2_e.htm
[10] Negotiating Group on Market Access – Progress Report by the Chairman, Ambassador S. H. Jóhannesson, to the Trade Negotiations Committee (TN/MA/16 of 24/Nov/2005).

mentions the agreement of various member nations on the importance of adopting the Swiss Formula to reduce tariffs, of sectoral initiatives and of tariff consolidation.

In brief, the final statement of the Hong Kong Conference for NAMA pointed out the willingness of member nations to meet the goal of reducing or eliminating high tariffs, tariff peaks and tariff escalations. This should be achieved using the Swiss Formula. The document emphasized that the formula's structure and details would be agreed simultaneously with the negotiations on agricultural goods market access. Consequently, the success of the NAMA negotiations will depend on progress made by agricultural negotiations, and vice-versa.

2   Objective of the study

This study aims at assessing the impacts of tariff on non-agricultural goods reduction on the Brazilian economy by means of a multi-sector and multi-regional computable general equilibrium (CGE) model. The Swiss formula, used for the tariff reduction, associates the final tariff (T_f) to the initial tariff (T_i) in a non-linear manner, as shown in the expression

$$T_f = (B \cdot T_i)/(B + T_i)$$

in which *B* is the coefficient to be negotiated.

CGE models are widely used to estimate the economic impacts of tariff liberalization proposals. Recent studies that used CGE models for this purpose include those carried out at the Centre d'Études Prospectives et D'Informations Internationales (CEPII), such as Jean, Laborde and Martin (2005) and Bchir, Fonteagné and Jean (2005), which were published in Anderson and Martin (2006); regarding studies on Brazil, we can name Ferreira Filho and Horridge (2005), published in Hertel and Winters (2006).

We simulated the tariff cut implementation with three coefficients: B = 15 and B = 30 for all countries/regions, and B = 20–10, a combination of B = 20 for developing countries and B = 10 for least developed countries Henceforth, they will be referred as Swiss 15, Swiss 30 and Swiss 20–10.

The non-linear tariff reduction causes a sharper decrease of the highest tariffs, such as "tariff peaks" and "tariff escalation", resulting in a more balanced tariff structure. The chart in Figure 1 shows the non-linearity of the Swiss formula: the higher the initial tariff, the higher the reduction – in percentage terms – defined by the formula. It also helps us visualize the role of the coefficient B: the lower the coefficient B, the higher the impact of the formula. The coefficient also defines the tariff ceiling after the reduction. As the initial tariff approaches infinity, the final tariff converges to the coefficient value.

Figure 1: Relation between the initial and the final tariffs in the Swiss Formula (B = 15, 30).
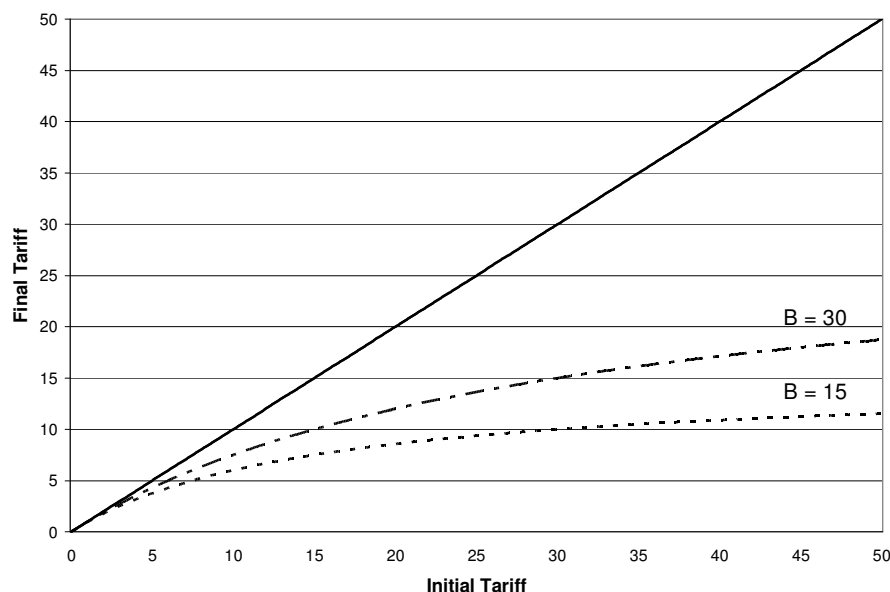
Source: Authors' own elaboration

This study brings the results of a set of simulations that are part of a wider research project, the aim of which is the assess, on a quantitative basis, the multiple scenarios resulting from the trade negotiation process defined by the mandate of the WTO's Doha Round.

3 Model, databases and simulation

The impacts of manufactured-products tariff reduction proposals on the Brazilian economy were evaluated by means of the GTAP (**G**lobal **T**rade **A**nalysis **P**roject) model and using information from two databases (GTAP and MacMap –Market Access Mapping).[11]

The sections below present details on the databases and the simulations, i.e., on the regional and sectoral specifications of the model and on the generation of implemented tariff shocks in it.

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[11] The proposals implementation were simulated with the version 6.2 of the GTAP model (September 2003) and using the GEMPACK (**G**eneral **E**quilibrium **M**odeling **P**ackage) source-code version, release 9.0 (April 2005), developed by the Centre of Policy Studies at Monash University, Australia. The CGE model database employed was the GTAP Database 6 (Spring 2005), the most recent version available during this research work, which corresponds to the world economy in 2001.

3.1 The GTAP model and the GTAP database

The GTAP simultaneously considers the sectoral interdependence relations of a whole economic system, including those in the domestic economy as well as those in the foreign economies. The GTAP model is a multi-region and multi-sector CGE model, with perfect competition and constant returns to scale, in which bilateral trade is formulated using the Armington approach. Among the model's original characteristics is the treatment of the families' preferences using non-homothetic functional forms of the constant differences in elasticity (CDE) type, explicit treatment of international trade and of transport margins, and a global banking industry, which intermediates global savings and consumption. A detailed description of the model can be found in Hertel (1997).

The GTAP database contains information from national accounts and input-output matrices of 57 economic sectors, Government, Families, two kinds of workers in each of the 87 regions presented in the database.

3.2 Market Access Mapping – MAcMap

The consolidated and applied tariffs were obtained or estimated from the data provided by MacMap, a database organized by the International Trade Centre (ITC), which combines data from the United Nations Conference on Trade and Development (Unctad), the World Trade Organization (WTO) and the Centre d'Études Prospectives et d'Informations Internationales (CEPII).

Among MAcMap's features are:

- Comprehensive coverage of the Preferential Trade Agreements;

- Estimation of ad-valorem equivalents of specific tariffs and tariff quotas; and

- An original methodology for aggregating tariffs. According to this methodology, importing countries are classified by their income (high, medium or low) and degree of liberalization of the economy (high or low). Next, the tariffs applied by a given importing country are weighted according to the imports of this country's reference group of HS6-level goods originating from a given exporting country.

Both the bound tariffs as well as the applied tariffs were aggregated into two digits of the Harmonized System (HS-2). In some cases, the bound tariffs and applied tariffs aggregated into two digits of the Harmonized System are already available in the MAcMap database. When they were not available (especially in the case of tariffs charged by the European Union), they were estimated based on the arithmetic mean of the information available at six digits of aggregation. However, we must point out that we *cannot* say that the estimation method of the tariffs whose aggregation was not available in the MAcMap system, i.e., the arithmetic mean based on the HS6, is consistent with the original method. It is merely an approximation.

3.3 Simulation specification

3.3.1 Model specification: regional and sectoral aggregation

From the regional perspective, the world economy is represented by the following countries or regions: Brazil, Argentina, the United States, the European Union, China and the "Rest of the World" (all other countries). Data from the Brazilian Ministry of Development, Industry and Trade, show that the European Union, the United States, Argentina and China, in that order, were Brazil's main trading partners in 2005, accounting for close to 60% of all Brazilian foreign trade.

Figure 2: Brazilian exports, 2005, according to destination, %.
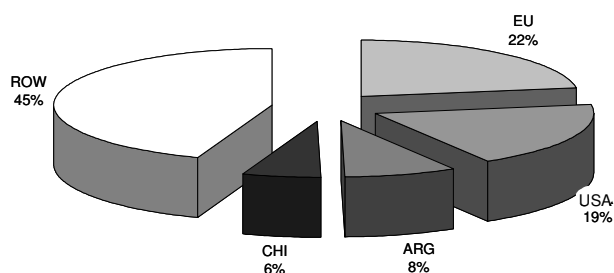
Source: Authors' own elaboration, based on Brazilian Ministry of Development, Industry and Trade data.

From the sectoral perspective, all the 57 economic sectors represented in the GTAP 6 database were considered.

3.3.2 Generation of tariff shocks

The simulation consisted in multilateral liberalization of trade in non-agricultural goods, by reducing bilateral tariffs involving the countries and regions represented in the model. Figure 3 and Figure 4 show averages and standard deviations of bound tariffs (Figure 3) and of applied tariffs (Figure 4) used in generating the shocks. In all, we considered 25 lists of bilateral tariffs (six countries or regions times five partners, less the tariffs of the "Rest of the World").

Figure 3: Average and standard deviation of bound tariffs used in generating the shocks

BOUND TARIFFS			
BRA	31.93%	EU	3.50%
	(5.84%)		(3.03%)
ARG	32.48%	CHI	9.78%
	(5.25%)		(4.66%)
USA	2.91%		
	(2.93%)		

Source: Authors' own elaboration, based on MAcMap data. Numbers in parentheses are standard deviations.

Figure 4: Average and standard deviation of applied bilateral tariffs

		AVERAGES AND STANDARD DEVIATION OF TARIFFS APPLIED BY				
		BRASIL	ARGENTINA	USA	EU	CHINA
ON GOODS IMPORTED FROM	BRASIL		0.00%	2.08%	2.19%	9.19%
			(0.00%)	(3.52%)	(3.58%)	(5.09%)
	ARGENTINA	0.11%		2.08%	2.20%	9.19%
		(0.9%)		(3.53%)	(3.59%)	(5.09%)
	USA	13.06%	12.64%		4.12%	9.19%
		(6.1%)	(6.72%)		(3.84%)	(5.09%)
	EU	13.06%	12.64%	3.19%		9.19%
		(6.1%)	(6.72%)	(3.53%)		(5.09%)
	CHINA	13.06%	12.64%	3.29%	2.19%	
		(6.1%)	(6.72%)	(3.48%)	(3.56%)	
	ROW (MFN)	13.06%	12.81%	2.09%	2.19%	9.19%
		(6.1%)	(6.59%)	(3.54%)	(3.56%)	(5.09%)

Source: Authors' own elaboration, based on MAcMap data. Numbers in parentheses are standard deviations.

Based on MAcMap data, we applied the Swiss Formula to the bound tariffs of countries or regions, covering 79 chapters of the Harmonized System, in three different situations:

- Coefficient B = 15, for all countries (Swiss 15);
- Combination of coefficients, B = 20 for Argentina, Brazil, China and the "Rest of the World", and B = 10 for the USA and for the EU – (Swiss 20–10);
- Coefficient B = 30, for all countries (Swiss 30).

The tariffs obtained in each exercise became the *new upper limits* for the tariffs *currently applied* per country or region to its partners. If the *tariff currently applied* was above the *new bound tariff*, the difference between the two tariffs would "perforate" the new upper limit established. Anytime this occurs, there is the need to reduce the applied tariff, adjusting it to the

new limit, which represents a "shock" in the tariff barrier of the respective sector, the impacts of which were simulated through a computable general equilibrium model.

To identify the Harmonized System (HS) chapters covered by the NAMA negotiation, we decided to exclude the first 24 chapters, which cover most of the farming sector and the so-called agribusiness sector, limiting the NAMA group to the chapters ranging from HS 25 (salt, sulfur, land and stones,...) to 97 (art objects,...)[12].

As an example of this procedure, Figure 5 shows the impact of the application of the Swiss Formula, with the coefficient B = 15, on the tariff protection of the Brazilian industrial sectors, classified into two digits according to the Harmonized System. The line with square markers corresponds to the current bound tariffs, per industrial sector; the line with triangles, to the applied tariffs; the line with lozenges, to the bound tariffs after the application of the Swiss Formula. The vertical bars show the perforations to which Brazilian industrial sectors would be subject, which correspond to the shocks that will be implemented in the CGE model.

Figure 5: Perforations resulting from the application of the Swiss Formula (B = 15)
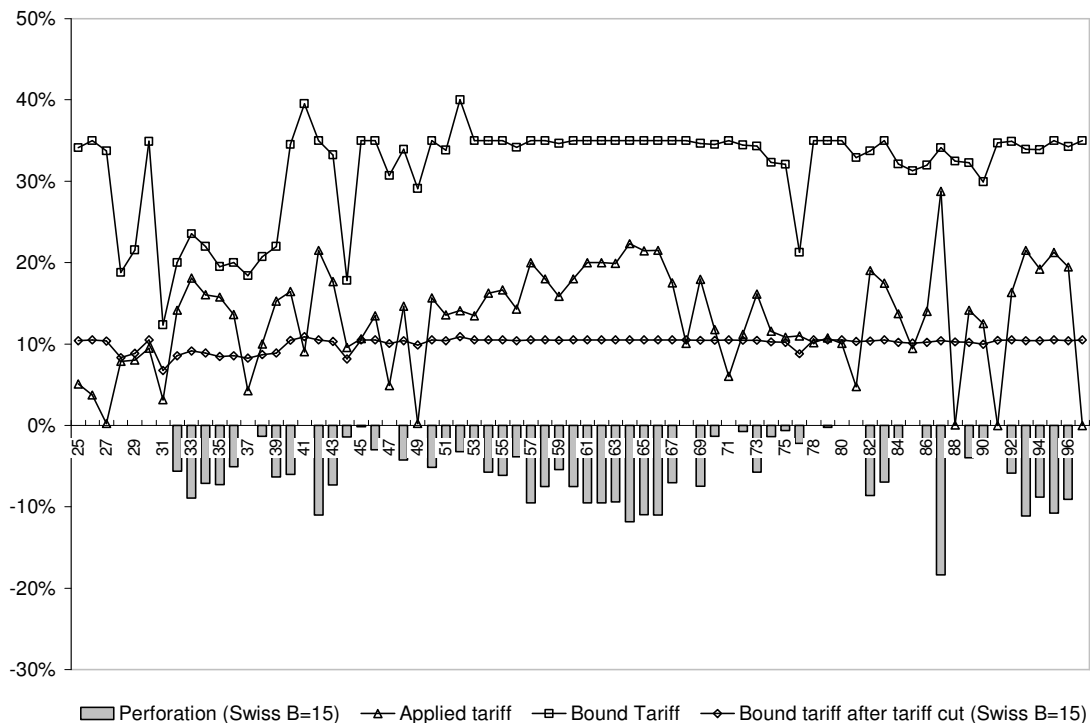
Source: Authors' own elaboration, based on MAcMap data.

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[12] A more detailed list of the HS positions and goods covered by the NAMA negotiations according to the Girard tariff reduction proposal can be found in Forbes et al. (2004, p. A.3)

For example, the bound tariff in chapter 87 of the Harmonized System (which corresponds to the automotive sector) is 34.14%, while the tariff currently applied is 28.78%. After the shock, following the Swiss Formula with a coefficient of B = 15, the new bound tariff for this sector would be 10.42%. Therefore, the perforation in the sector's tariff would be 18.36 percentage points (i.e., the difference between 28.78% and 10.42%).

Finally, the chapters of the HS-2 covered in the NAMA negotiations were associated to the available sectors in the GTAP model, as shown in the Annex table.

4 Results

The tables and the charts in this section show some selected results from the simulation of three proposals for tariff reduction: Swiss 15, Swiss 30 and Swiss 20–10. All results are shown in the form of percentage change from the initial situation.

Figure 6, below, shows a summary of the impacts of the three proposals on the selected macroeconomic variables of the regions included in the simulation.

Figure 6: Impacts on selected macroeconomic variables.

	BRA			ARG		
	Swiss 15	Swiss 30	Swiss 20-10	Swiss 15	Swiss 30	Swiss 20-10
Real GDP	0.06	0.02	0.04	0.02	0.01	0.02
GDP deflator	-0.90	-0.42	-0.66	-0.90	-0.42	-0.66
Investment	0.89	0.09	0.39	0.60	0.17	0.43
Total Exports	2.63	1.10	1.94	0.94	0.26	0.63
Total Imports	3.06	0.95	1.97	1.39	0.31	0.95
Exports price index	-0.63	-0.27	-0.46	-0.63	-0.29	-0.46
Imports price index	-0.07	-0.04	-0.07	-0.15	-0.07	-0.12
Consumer price index	-0.82	-0.42	-0.63	-0.82	-0.39	-0.60
Real consumption	-0.02	0.01	0.00	-0.04	-0.02	-0.03
Household income	-0.83	-0.41	-0.63	-0.86	-0.41	-0.63

	USA			EU		
	Swiss 15	Swiss 30	Swiss 20-10	Swiss 15	Swiss 30	Swiss 20-10
Real GDP	0.01	0.00	0.01	0.00	0.00	0.00
GDP deflator	-0.11	-0.06	-0.10	-0.03	-0.05	-0.11
Investment	0.00	0.01	0.01	-0.03	-0.02	-0.05
Total Exports	1.35	0.82	1.33	0.19	0.08	0.19
Total Imports	0.88	0.56	0.89	0.16	0.06	0.12
Exports price index	-0.07	-0.03	-0.06	-0.02	-0.04	-0.09
Imports price index	-0.01	-0.01	0.00	-0.02	-0.02	-0.04
Consumer price index	-0.11	-0.06	-0.11	-0.03	-0.04	-0.11
Real consumption	0.00	0.01	0.01	0.00	-0.01	0.00
Household income	-0.11	-0.05	-0.10	-0.02	-0.04	-0.11

	CHN			ROW		
	Swiss 15	Swiss 30	Swiss 20-10	Swiss 15	Swiss 30	Swiss 20-10
Real GDP	0.16	0.11	0.16	0.00	0.00	0.00
GDP deflator	-0.22	-0.10	-0.10	0.06	0.03	0.08
Investment	0.45	0.31	0.39	-0.03	-0.01	0.00
Total Exports	2.56	1.67	2.21	0.11	0.06	0.12
Total Imports	3.63	2.41	3.16	0.15	0.09	0.19
Exports price index	-0.25	-0.12	-0.14	0.04	0.02	0.06
Imports price index	0.01	0.00	0.01	-0.03	-0.02	-0.03
Consumer price index	-0.11	-0.02	-0.01	0.04	0.02	0.06
Real consumption	0.08	0.06	0.09	0.02	0.02	0.03
Household income	-0.04	0.03	0.07	0.06	0.04	0.09

Source: Authors' own elaboration.

Concerning the Brazilian economy, the results show that it would be expected:

– A very modest increase in the real GDP under three scenarios; the greater the liberalization, the higher the rise in the GDP. Although very modest, the results suggest that multilateral liberalization of the trade in industrial goods, taken individually, can benefit the Brazilian economy as a whole.

– This result is especially attributable to the sound performance of exports and investments.

– Regarding the trade result, the percentage increase in exports exceeds that of imports in the scenario of smooth liberalization (Swiss 30) and falls short in the scenario of radical liberalization (Swiss 15). In the scenario Swiss 20–10, the percentage increase in exports is close to that of imports.

– Total trade (exports plus imports) would increase more than 5% in the case of coefficient B = 15, 2.06% in the case of coefficient B = 30, and 3.9% in the third scenario. In comparison,

total world trade would increase 0.46% under scenario B = 15, and 0.27% under scenario B = 30.

– Real consumption of the families, a proxy for welfare, remains practically stable in all scenarios.

Similarly to what happens in Brazil, the impacts on the GDP in all other countries and regions are quite modest, perhaps with the exception of China, where the GDP increases 0.16% in both scenario B = 15 as well as scenario B = 20–10. The intensity of the impacts on foreign trade is especially noteworthy. Total trade in China increases 6.19% in the more radical scenario, and 4.08% in the smoother scenario. Applying the same intensity criterion, we see a decrease in the income of Argentine families in all three scenarios, at levels similar to those seen in Brazil.

Figure 7, below, shows the percentage impacts on production and employment of the sectors most harmed in the three scenarios.

Figure 7: Impacts on production of the most harmed sectors in Brazil (%).

Swiss 15	Code	Var% Production	Var% Employment
Motor vehicles and parts	mvh	-5.05	-4.93
Textiles	tex	-1.61	-1.50
Transport equipment nec	otn	-1.28	-1.21
Metal products	fmp	-1.26	-1.22
Chemical, rubber, plastic products	crp	-1.12	-1.01
Manufactures nec	omf	-1.12	-1.04

Swiss 30	Code	Var% Production	Var% Employment
Motor vehicles and parts	mvh	-4.21	-4.19
Transport equipment nec	otn	-0.53	-0.52
Manufactures nec	omf	-0.42	-0.41
Wearing apparel	wap	-0.41	-0.41
Chemical, rubber, plastic products	crp	-0.39	-0.37
Textiles	tex	-0.08	-0.06

Swiss 20-10	Code	Var% Production	Var% Employment
Motor vehicles and parts	mvh	-4.90	-4.84
Manufactures nec	omf	-0.88	-0.84
Transport equipment nec	otn	-0.83	-0.79
Chemical, rubber, plastic products	crp	-0.79	-0.74
Textiles	tex	-0.77	-0.71
Metal products	fmp	-0.73	-0.70

Source: Authors' own elaboration.

Among data found in the table, we have:

– The automotive sector (mvh) is the most harmed in all scenarios, with production falling 5.05% in the Swiss 15 scenario, 4.21% in the Swiss 30, and 4.90% in the Swiss 20–10. In the last two scenarios, in fact, this is the only sector with a negative impact on production above 1% in magnitude.

– In the scenario "Swiss 15", five sectors other than the automotive have a percentage decrease in production above 1%: Textiles (tex, -1.61%), Transport Equipment (otn, -1.28%), Metal Products (fmp, -1.26%), Chemical, Rubber and Plastic Products (crp, -1.12%) and Other Manufactured (omf, -1.12%).

– From the perspective of employment, the percentage changes are in line with those seen in production.

Production data refer to the percentage change in the amount produced, in physical units of the product. To have a better idea of the impact on real revenue, we must observe, in addition to the percentage changes of the amounts, the percentage changes in market prices in each sector, as well as the percentage change of the GDP deflator in each country and region. For instance, market prices in the "mvh" (motor vehicles and parts) sector in Brazil decreased 1.03% under scenario B = 15. Considering production had a percentage reduction of 5.05%, and that the Brazilian GDP had a deflator reduction of 0.9%, we arrive at the percentage reduction in actual revenues of 5.18%. That is, if we consider the *actual revenues* of the "motor vehicles and parts" sector rather than its *production* in physical units, the sector's situation is further deteriorated. Quite the contrary happens in other sectors. For example, the real revenues of the Metal Products (fmp) sector fell 1.03%, in contrast with a decrease in production of 1.26%.

Figure 8, below, shows the percentage impacts on production and employment of the sectors most benefited in the three scenarios.

Figure 8: Brazil, impact on production of the most benefited sectors following the application of the Swiss Formula at coefficients of B = 15, B = 30 e B = 20-10 (%).[13]

Swiss 15	Code	Var% Production	Var% Employment
Metals nec	nfm	1.27	1.41
Water transport	wtp	1.20	1.24
Meat products nec	omt	1.18	1.28
Wood products	lum	1.15	1.23
Electronic equipment	ele	1.14	1.28
Leather products	lea	1.08	1.16

Swiss 30	Code	Var% Production	Var% Employment
Metals nec	nfm	0.90	0.92
Machinery and equipment nec	ome	0.61	0.63
Meat products nec	omt	0.59	0.61
Water transport	wtp	0.59	0.59
Electronic equipment	ele	0.57	0.59
Wood products	lum	0.46	0.47

Swiss 20-10	Code	Var% Production	Var% Employment
Leather products	lea	1.31	1.34
Metals nec	nfm	1.24	1.31
Water transport	wtp	0.94	0.96
Meat products nec	omt	0.90	0.95
Electronic equipment	ele	0.84	0.91
Wood products	lum	0.81	0.85

Source: Authors' own elaboration.

We see that:

– In the radical liberalization scenario, six sectors had production increases above 1%: Other Metal Products (nfm, 1.27%); Sea Transport (1.2%); Other Meat Products (omt, 1.18%), Wood Products (lum, 1.15%), Electronic Equipment (1.14%), and Leather Products (1.08%).

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[13] The GTAP sector most benefited was "wol" (Wool), under which production increased 1.87% in scenario B = 15, and 1.09% in scenario B = 30. The GTAP "wol" sector would correspond to part of the HS chapters 50 (Silk) and 51 (Wool, Fine or Coarse Animal Hair, etc.), which were translated to the GTAP sector "tex" (Textiles). For this reason, and because this accounts for just a minimal fraction of the Brazilian economy, we preferred to exclude this sector from Figure 15.

- In the smooth liberalization scenario, in spite of changes in the order of the most benefited sectors, none of them had production increases above 1%.

- In the scenario of combined coefficients, the Leather and Footwear (lea, increase of 1.31%), and Other Metal Products (nfm, 1.24%) sectors stand out.

- Similarly to what happens in the previous table, employment percentage changes are in line with production changes.

4.1 4.1 Sensitivity analysis

This section analyzes the sensitivity of the macroeconomic results obtained in relation to liberalization parameters and amplitude. For this analysis, the application of the Swiss Formula with a coefficient of B = 15 was used as the basic scenario, and its results (such as those shown in Figure 6) were compared to the results obtained in two new situations:

a.   Duplication of the Armington elasticities, which regulate the substitution between demand for domestic and imported supplies, in all countries and regions, including the "Rest of the World".

b.   Application of an orderly tariff liberalization of agricultural goods (50% reduction in the tariffs shown in the model), at the same time of the tariff shock in industrial goods.[14]

The sensitivity of the GTAP results to changes in Armington elasticities is relatively well known and documented (please see Harrison et al, 1997). Specifically, we duplicated the parameter ρ of the function CES, which determines, in the Nested Technology Tree, the substitution between imported and domestic supplies.

The comparison between the macroeconomic results found under the basic scenario (Swiss Formula 15) and those found after duplication of the Armington elasticities are shown in Figure 9.

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[14] Agricultural liberalization is considered a sensitivity analysis because in the context of the Doha negotiations the theme covers issues beyond tariff liberalization, such as domestic support and export competition. Please see Section 1.2.3.

Figure 9: Macroeconomic results of the basic scenario vs. the duplication of the Armington elasticities

	Real GDP		GDP deflator		Investment	
	Basic Scenario	2*Armington	Basic Scenario	2*Armington	Basic Scenario	2*Armington
BRA	0.06	0.08	-0.90	-1.36	0.89	0.57
ARG	0.02	0.04	-0.90	-1.06	0.60	0.54
USA	0.01	0.01	-0.11	-0.17	0.00	-0.01
EU	0.00	0.01	-0.03	0.02	-0.03	-0.01
CHN	0.16	0.29	-0.22	-0.53	0.45	0.34
ROW	0.00	0.01	0.06	0.13	-0.03	0.03

	Total Exports		Total Imports	
	Basic Scenario	2*Armington	Basic Scenario	2*Armington
BRA	2.63	5.23	3.06	4.69
ARG	0.94	2.40	1.39	2.94
USA	1.35	2.10	0.88	1.32
EU	0.19	0.38	0.16	0.38
CHN	2.56	4.91	3.63	6.30
ROW	0.11	0.39	0.15	0.53

	Real consumption		Consumer price index	
	Basic Scenario	2*Armington	Basic Scenario	2*Armington
BRA	-0.02	-0.06	-0.82	-1.22
ARG	-0.04	-0.02	-0.82	-0.98
USA	0.00	-0.01	-0.11	-0.16
EU	0.00	0.02	-0.03	0.01
CHN	0.08	0.12	-0.11	-0.33
ROW	0.02	0.05	0.04	0.10

Source: Authors' own elaboration.

An examination of the tables shown in Figure 9 reveals that in comparison to the initial impacts we would have:

– The growth of real GDP increases a significant 33% in Brazil, 50% in Argentina and 81% in China, in spite of less investment in these three nations. For the other countries and regions, the increase in GDP does not appear significant, in spite of a considerable increase in investment in the "Rest of the World".

– Both imports as well as exports of all countries and regions increased significantly, in line with the duplication of the inputted Armington elasticities. Among the regions, the impact on exports is heterogeneous: relatively elastic in the "Rest of the World" and in Argentina (i.e.,

the growth in exports more than doubled in response to the duplication of the Armington elasticities); equivalent in Brazil, the European Union and China; and relatively inelastic in the United States (i.e., the growth in exports increased less than proportionally to the Armington elasticities).

– In Brazil and in the United States, a fall in real consumption (and, consequently, in well-being) is intensified, in spite of an increase in the GDP (which, in turn, can be justified by the increase in exports or in government expenditures). In the other countries, real consumption increases, especially in China, or decreases less (as in Argentina).

– In regard to the consumer price index (and also the GDP deflator), we see a sharper price decrease in all countries and regions, except in the European Union and the "Rest of the World", something which can be explained by an increase in the real consumption witnessed in these two markets.

The comparison between the macroeconomic results obtained under the basic scenario (Swiss Formula 15) and under the scenario that combines the tariff reduction suggested by NAMA and an orderly agricultural liberalization is shown in Figure 10. In this case we imposed a uniform 50% reduction on the agricultural tariffs listed in the database, in all countries and regions of the model, except the "Rest of the World".

Figure 10: Macroeconomic results of the basic scenario vs. orderly agricultural liberalization.

	Real GDP		GDP deflator		Investment	
	Basic Scenario	**Agric. Liberaliz.**	**Basic Scenario**	**Agric. Liberaliz.**	**Basic Scenario**	**Agric. Liberaliz.**
BRA	0.06	0.09	-0.90	0.43	0.89	2.04
ARG	0.02	0.04	-0.90	-0.29	0.60	0.79
USA	0.01	0.00	-0.11	-0.14	0.00	-0.01
EU	0.00	0.08	-0.03	-0.27	-0.03	-0.14
CHN	0.16	0.23	-0.22	-0.37	0.45	0.58
ROW	0.00	0.00	0.06	-0.11	-0.03	0.01

	Total Exports		Total Imports		Δ Trade Balance (US$)	
	Basic Scenario	**Agric. Liberaliz.**	**Basic Scenario**	**Agric. Liberaliz.**	**Basic Scenario**	**Agric. Liberaliz.**
BRA	2.63	1.85	3.06	5.05	-833.87	-1.914.47
ARG	0.94	0.87	1.39	2.07	-237.48	-262.30
USA	1.35	1.51	0.88	0.96	335.89	610.52
EU	0.19	0.49	0.16	0.31	647.62	2.257.00
CHN	2.56	2.79	3.63	4.17	-1.261.35	-2.171.12
ROW	0.11	0.14	0.15	0.23	1.349.20	1.477.81

	Real consumption		Consumer price index	
	Basic Scenario	Agric. Liberaliz.	Basic Scenario	Agric. Liberaliz.
BRA	-0.02	0.21	-0.82	-0.36
ARG	-0.04	0.05	-0.82	0.26
USA	0.00	0.00	-0.11	-0.14
EU	0.00	0.07	-0.03	-0.29
CHN	0.08	0.29	-0.11	0.45
ROW	0.02	0.03	0.04	-0.09

Source: Authors' own elaboration.

We see that:

– The intensity of the real growth of GDP increased for all countries and regions, especially China and the European Union, and except the United States and the "Rest of the World"; in Brazil, we see a combination of an increase in the GDP (50%), significant inflation (from a deflation of 0.9% to an inflation of 0.43%) and a surge in investment (approximately 130%).

– Contrary to what our intuition might suggest, the intensity of the growth in exports *decreased* in Brazil and Argentina, and increased significantly in all other countries and regions, including the European Union. Imports, in turn, increased in all countries. This resulted in a *deterioration* of the trade balance in Brazil and China (in special), and in Argentina (to a smaller degree). In all other countries, we see an *improvement* of the trade balance.

– Real consumption increased in all countries and regions, except in the USA. Consumer prices increased (or decreased less) in Brazil, Argentina and China; in all other countries and regions, consumer prices fell or remained relatively stable (as is the case of the European Union).

Among these results, those relative to foreign trade, especially Brazilian and Argentinean exports and imports, stand out. To get more details on these results, we prepared Figure 11, which shows changes in trade balance (US$) and in production (%) between the scenarios of "Simultaneous Orderly Agricultural Liberalization" and of "Standard" (B = 15), per good, in millions of US$, for Brazil.

We see that agricultural liberalization in fact encouraged specialization of the Brazilian production and export of farm and agribusiness products: production and export of goods in these sectors increased, while production and export of industrial products decreased. At the same time, industrial goods produced in Brazil had to compete with similar products produced more efficiently by developed industrial economies, which in the model are represented by the USA and the EU, countries or regions which benefit from the same specialization process, but the other way around.

This process *deteriorated* the Brazilian trade balance deficit, because the rise in the trade balance associated to the farm and agribusiness products was not enough to offset the drop in the trade balance associated to industrial products. In short, the agricultural liberalization implemented harmed industrial exports, and this loss was not offset by higher agricultural exports.

Figure 11: Brazil, changes in trade balance (US$) and production (%) between the scenarios of "Simultaneous Orderly Agricultural Liberalization" and of "Standard" (B = 15), main sectors affected, in millions of US$

Sectors	Code	Trade Balance Variation (US$ mi)	Production Variation (%)
Bovine meat products	cmt	2546.3	28.12
Food products nec	ofd	255	1.16
Meat products nec	omt	202.95	2.91
Sugar	sgr	26.86	0.15
Leather products	lea	-233.63	-6.38
Electronic equipment	ele	-236.27	-2.19
Business services nec	obs	-288.52	-0.32
Motor vehicles and parts	mvh	-333.74	-1.63
Transport equipment nec	otn	-347.51	-4.16
Chemical, rubber, plastic products	crp	-355.11	-1.82
Machinery and equipment nec	ome	-732.52	-3.14

Source: Authors' own elaboration.

From the perspective of production, we see the opposite. The increase in the production of farm and agribusiness products would largely offset the decrease in the production of industrial goods, which would justify the rise in the GDP and, consequently, the role of farming and agribusiness in the country's output.

5 Concluding remarks

Computable general equilibrium models are widely used by international organizations – the World Bank, World Trade Organization, United Nations and others – to simulate the expected effects of economic policies, especially in international trade. This report presented the results of a study that is part of a wider research project, whose purpose is to simulate the isolated effects on the Brazilian economy of the possible results of trade negotiations under the Doha Round by means of a computable general equilibrium model.

Among the possible limitations of the results obtained, in addition to the restrictions raised regarding the method (computable general equilibrium) and the model (GTAP), we must remember that some tariffs, especially those charged by the European Union, have been

aggregated in a different manner from that used by the MAcMap database (please see Section 3.2). The regional aggregation used (isolating Brazil's main trading partners, the EU, the USA, Argentina, China, and the "Rest of the World", in that order) and the translation of the GTAP sectors to the Harmonized System, shown in the Appendix, are the authors' methodological choices; other studies presenting other suggestions of regional aggregation and sectoral translation can obtain different results.

Among the results, a very modest increase in the Brazilian GDP in all three scenarios analyzed stands out. We also identified the sectors which most benefit and most suffer with such liberalization; chief among them is the automotive sector, the production of which can fall up to 5% in the scenario of greater liberalization.

Additionally, we tested the sensitivity of the results to changes in the Armington elasticities and a simultaneous liberalization of farm tariffs. In the first case, the increase in the GDP was quite sensitive to the increase in the Armington elasticities; in the second case, the agricultural liberalization implemented would harm the exports of the industrial sector, and this loss would not be offset by higher agricultural exports, all of which would result in a deteriorated trade balance.

From the perspective of production, we see the opposite. The increase in the production of farm and agribusiness products would largely offset the decrease in the production of industrial goods, which would justify the rise in the GDP and the role of farming and agribusiness in the country's output. Higher output would result in more investment, which in the end brings further growth, rises in real consumption and greater well-being.

The simulated agricultural liberalization (50% reduction in the agricultural tariffs listed in the GTAP database) is a simplification of the proposals under negotiation in the WTO's Doha Round. A more detailed simulation of the liberalization proposals actually discussed is beyond the scope of this paper and would require additional and deeper studies on this issue.

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7 Appendix: Association of non-agricultural HS-2 sectors to GTAP sectors.

HS-2 Code	HS-2 product description	GTAP Code	GTAP Code Description
25	Salt; sulphur; earths and stone;etc.	nmm	Mineral products nec
26	Ores, slag and ash.	omn	Minerals nec
27	Mineral fuels, mineral oils and products of their distillation; etc.	coa	Coal
28	Inorganic chemicals; organic or inorganic compounds etc.	crp	Chemical,rubber,plastic prods
29	Organic chemicals.		
30	Pharmaceutical products.		
31	Fertilisers.		
32	Tanning or dyeing extracts; tannins and their derivatives; etc.		
33	Essential oils and resinoids; perfumery, cosmetic etc.		
34	Soap, organic surface-active agents, washing preparations, etc.		
37	Photographic or cinematographic goods.		
38	Miscellaneous chemical products.		
39	Plastics and articles thereof.		
40	Rubber and articles thereof.		
41	Raw hides and skins (other than furskins) and leather.	lea	Leather products
42	Articles of leather; saddlery and harness; travel goods, etc.		
43	Furskins and artificial fur; manufactures thereof.		
44	Wood and articles of wood; wood charcoal.	lum	Wood products
45	Cork and articles of cork.		
46	Manufactures of straw, of esparto or of other plaiting materials;etc.		
47	Pulp of wood or of other fibrous cellulosic material; etc.	ppp	Paper products, publishing
48	Paper and paperboard; articles of paper pulp, etc.		
49	Printed books, newspapers, pictures and other products etc.		
50	Silk.	tex	Textiles
51	Wool, fine or coarse animal hair; horsehair yarn and woven fabric.		
52	Cotton.		
53	Other vegetable textile fibres; paper yarn and etc.		
54	Man-made filaments.		
55	Man-made staple fibres.		
56	Wadding, felt and nonwovens; special yarns; twine, etc.		
57	Carpets and other textile floor coverings.		
58	Special woven fabrics; tufted textile fabrics; lace; etc.		
59	Impregnated, coated, covered or laminated textile fabrics; etc.		
60	Knitted or crocheted fabrics.		
61	Articles of apparel and clothing accessories, knitted or crocheted.	wap	Wearing apparel
62	Articles of apparel and clothing accessories, not knitted or crocheted.		
63	Other made up textile articles; sets; worn etc.		
64	Footwear, gaiters and the like; parts of such articles.	lea	Leather products
65	Headgear and parts thereof.	wap	Wearing apparel
68	Articles of stone, plaster, cement, asbestos, mica or similar materials.	nmm	Mineral products nec
69	Ceramic products.		
70	Glass and glassware.		
71	Natural or cultured pearls, precious or semi-precious stones, etc.	omn	Minerals nec
72	Iron and steel.	i_s	Ferrous metals
73	Articles of iron or steel.	fmp	Metal products
74	Copper and articles thereof.	nfm	Metals nec
75	Nickel and articles thereof.		
76	Aluminium and articles thereof.		
78	Lead and articles thereof.		
79	Zinc and articles thereof.		
80	Tin and articles thereof.		
81	Other base metals; cermets; articles thereof.		
84	Nuclear reactors, boilers, machinery and mechanical etc.	ome	Machinery and equipment nec
85	Electrical machinery and equipment and parts thereof; sound etc.	ele	Electronic equipment
86	Railway or tramway locomotives, rolling-stock and parts thereof; etc.	otn	Transport equipment nec
87	Vehicles other than railway or tramway rolling-stock, and etc.	mvh	Motor vehicles and parts
88	Aircraft, spacecraft, and parts thereof.	otn	Transport equipment nec
89	Ships, boats and floating structures.		
90	Optical, photographic, cinematographic, measuring, etc.	ome	Machinery and equipment nec
91	Clocks and watches and parts thereof.	omf	Manufactures nec
92	Musical instruments; parts and accessories of such articles.		
93	Arms and ammunition; parts and accessories thereof.		
94	Furniture; bedding, mattresses, mattress supports, etc.		
95	Toys, games and sports requisites; parts and accessories thereof.		
96	Miscellaneous manufactured articles.		
97	Works of art, collectors' pieces and antiques.		