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IMPACTS OF DOHA ROUND ON THE AGRIBUSINESS OF BRAZIL, CHINA AND INDIA

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APRESENTAÇÃO ORAL

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GRUPO DE PESQUISA: 3

Abstract: The central themes to be addressed during the Doha Round of world trade negotiations are the reduction of the agricultural production and export subsidies, and improved market access for agricultural and non-agricultural goods. The G-20 group wields enough power to press negotiations at the Doha Round toward lower agricultural trade barriers and production and exports subsidies. The objective of this study is to determine the impacts of four possible Doha Round scenarios on the economies of Brazil, China, and India. The scenarios are examined using the Global Trade Analysis Project's (GTAP) general equilibrium model and database. Scenarios focusing on the reduction of agricultural production and export subsidies are studied. The scenarios are then analyzed taking into account implementation of the Harbinson approach and the Swiss formula to tariff reduction. The best results obtained by Brazil, China, and India are those from the Scenario 4. In this scenario, WTO recommendations for agricultural production and export subsidies reduction are simulated and, at the same time, the Girard formula is applied to reduce agricultural import tariff and an average tariff cut is applied to manufactured products. Changes in GDP growth rate, in the per capita utility, and in the equivalent variation are higher under this scenario for Brazil, China, and India. The losses, due to low competitivity, by the EU15 and the US in the agricultural products in all analyzed scenarios are making it difficult to reach an agreement at the Doha Round of negotiations.

Keywords: agricultural products; trade liberalization; Doha Round; G-20; GTAP.

Classification JEL: F13; F15; Q17.

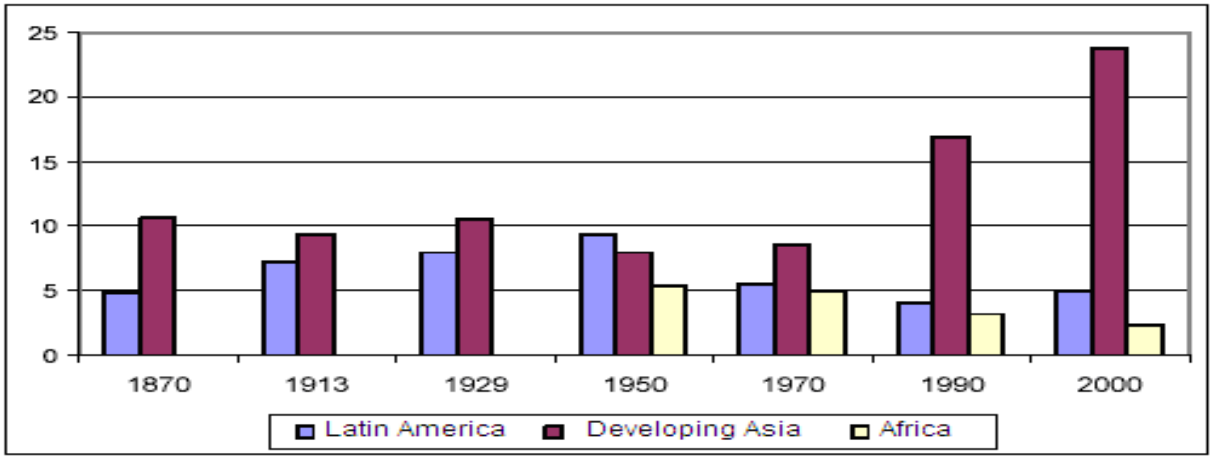
1 Introduction

In 1999, the World Trade Organization (WTO) initiated revision of the Uruguay Round Agreement aimed at discouraging trade-distorting domestic support, non-tariff barriers, and reducing direct export subsides, among other things. The revision meetings led to the Doha Round in Doha, Qatar, in 2001. One focus of the Doha Round was the easing of agricultural product access into the WTO market by reaching agreement regarding three controversial agricultural themes: the reduction of tariffs on imported agricultural goods, the reduction of subsidies for exported agricultural goods, and the reduction of subsidies for domestic agricultural goods.

Due to the nature of agribusiness, developing countries are burdened with high import tariffs. To make matters worse, the agricultural sector is the only sector still subsidized. These two facts are strong justifications for the improvement of the agricultural market and for the implementation of reduced subsidies within importing countries.

The G-20 currently plays an important role at the Doha Round. Created at the Cancun meeting in 2003 to serve as a trade bloc representing all developing countries, the G-20 now wields enough power to press negotiations at the Doha Round toward lower agricultural trade barriers and a decrease in agricultural production and export subsidies. There are currently 21 members in the G-20: 10 Latin American countries--Brazil, Mexico, Argentina, Uruguay, Paraguay, Venezuela, Chile, Bolivia, Guatemala and Cuba, 6 Asian countries--China, India, Philippines, Indonesia, Pakistan and Thailand, and 5 African members--South Africa, Egypt, Nigeria, Tanzania and Zimbabwe. The regions that make up the G-20 account for approximately 60% of the global population and have risen significantly in terms of exports over the past decades; especially the developing Asian countries, which accounted for almost 25% of all exports in 2000 (Figure 1). In terms of agriculture, the G-20 accounts for 70% of the world's agricultural population and 26% of total agricultural exports (G20, 2007).

Figure 1: Participation by Latin America, developing Asia, and Africa in global exports (%)



Source: IOS (2005)

The G-20's vast and balanced representation put it in a strong position when negotiating agriculture related issues. This strength was proved when the G-20 was able to negotiate a deal with the developed countries at the Sixth WTO Ministerial Conference (Hong Kong, 2005) fixing a deadline for the elimination of agricultural export subsidies. With this agreement, the G-20 was recognized as a necessary voice in agricultural negotiations. It had successfully communicated the developing countries' interests to the WTO, coordinated its member countries' actions, and forged stronger relations between its members and the WTO's other members.

Brazil, China and India have a special interest in the results reached at the Doha Round. They have achieved substantial growth in the international trade market and their agribusiness trade activities are concentrated on the export of soy, coffee, maize, meats, sugar and cotton (key products). These three countries path to growth is associated with the capacity and strength of the G-20 to format a multilateral agreement that will allow for the unrestricted access of agribusiness products into the world market.

China, India, and Brazil have vast agricultural resources and their economies rely on agriculture and agribusiness to a great extent. China is the fourth largest economy in the world. Its economy grew at an average rate of 10% between the periods of 1990 to 2005, and is among the world's largest producers of rice, corn, wheat, soybeans and vegetables. Half of its labor force is employed in agriculture. China's main crops are paddy rice, maize, sweet potatoes, wheat, and sugar cane; however, its major exports are electrical and mechanical machinery and equipment, apparel and apparel accessories, and consumer durables. In 2004, its total export was US$ billions 593.3.

India is the twelfth largest economy in the world and the third largest within Asia. It is also the world's fourth largest agricultural power, with 20% of its Gross Domestic Product (GDP) derived from agriculture, and is among the leaders in the export of milk, fruits, vegetables, wheat,

rice, tea, cotton and sugar. Its main crops are sugar cane, paddy rice, wheat, potatoes and bananas. Still, India's main exports are jewels, mineral fuels, clothing, textiles, and organic chemicals. Its total exports were US$ billions 75.6 in 2004.

Brazil has the tenth largest economy in the world. It is the world's leading producer of coffee, sugar cane and oranges. Brazil's main crops are sugar cane, soybeans, maize, manioc, and oranges. Just as China and India, Brazil's main exports are not related to agriculture; instead, they are vehicles, machinery, iron and steel, ores and meats. Even though agriculture is 10% of Brazil's GDP, 30% if counting agribusiness, out of its 96.5 US$ billions in total 2004 exports, only 4bn came from agricultural raw materials and 28.5bn from food products.

All three countries have much room to grow in terms of agricultural product exportation. The depreciation of the Brazilian *Real* since its inauguration has stimulated Brazilian exports and should benefit exportation of the vast amount of agricultural resources Brazil possesses. India has a high unemployment rate and 25% of its population lives under the poverty line. The reduction of international agricultural trade barriers could help India employ more citizens in agriculture and agribusiness. China already employs half of its inhabitants in agriculture related jobs; but this does not show up in its exports, demonstrating room for growth in the export of agricultural products. All three countries could benefit greatly from reforms made during the Doha Round.

There are many published works that address the potential reduction of agribusiness product trade barriers at the Doha Round. Some influential papers include those by Harrison et al. (2003), Conforti and Salvatici (2004), Buetri et al. (2004) and recently by Gurgel (2006) and Antimiani, et al. (2006); yet there is still the need for current information on the different economic impacts arising from implementation of Doha Round initiated multilateral trade agreements.

The objective of this study is to determine the impacts of possible Doha Round outcomes, focusing on the economies of Brazil, China, and India. Four scenarios that emphasize agribusiness products key to the Brazilian, Chinese and Indian economies are examined using the Global Trade Analysis Project's (GTAP) general equilibrium model and database. Each scenario implements a reduction of agricultural production and export subsidies taking into account implementation of either the Swiss formula or the Harbinson approach to tariff reduction. Simulations of the changes specified in each of the four scenarios are run and the results from these simulations are analyzed.

This paper is divided into five sections and organized in the following way: an introduction, to provide the history of the Doha Round and the importance of the G-20; Section 2, to describe and clarify the model employed and its database, Section 3, an exploration of the simulations and the aggregations used in the analysis; Section 4, to provide an analysis of the results from simulation of the four scenarios.

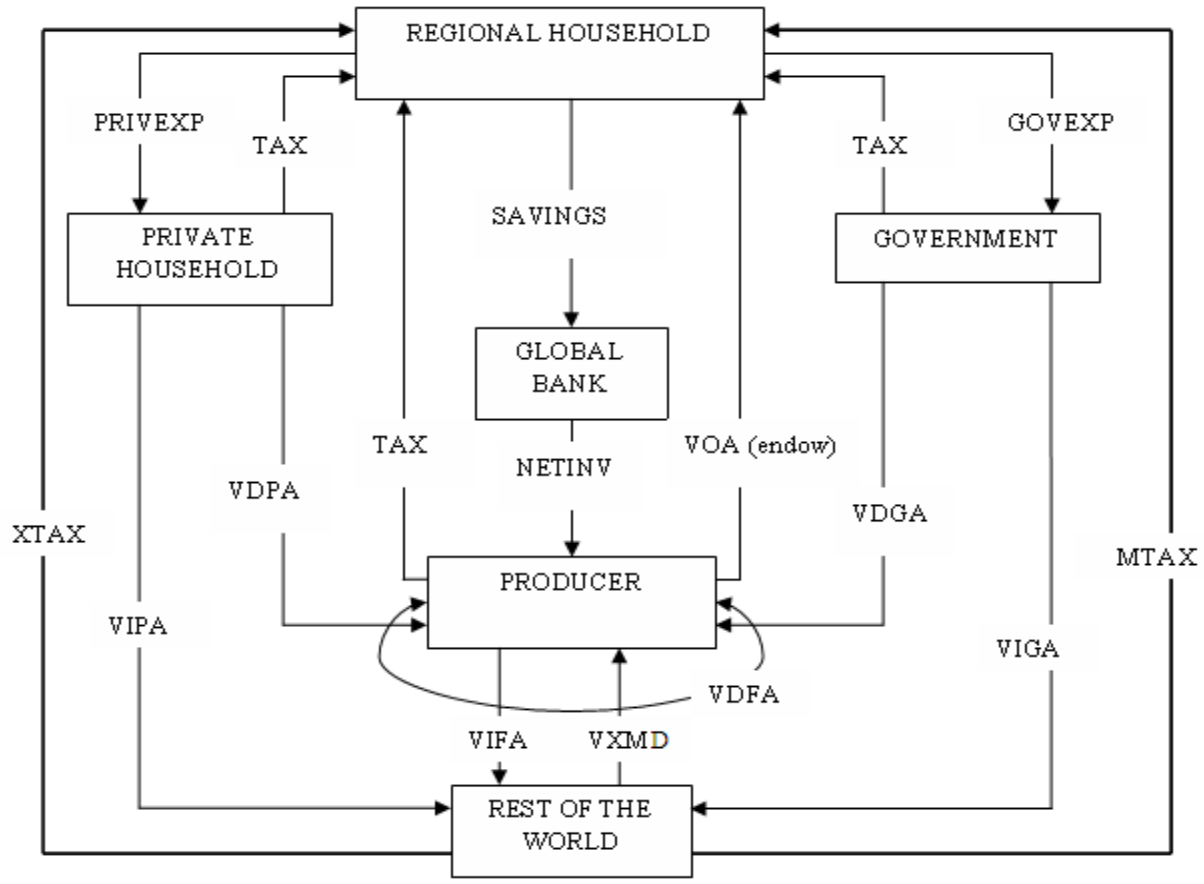
2 The model GTAP and its database

The Global Trade Analysis Project (GTAP) model of General Equilibrium is selected for development of this work. GTAP was set up at Purdue University's Centre for Global Trade Analysis by Hertel and Tsigas (1997) and is considered a reference in the analysis of regional integration. The GTAP model consists of a branch theory to analyze quantitative questions regarding the international economy, engaging diverse sectors and products with a global database and a software for data manipulation.

To facilitate the understanding of GTAP's structure, a model displaying the performance of an economy and its interaction with the Rest of the World while considering the presence of taxes and subsidies is provided (Figure 2). A glossary of terms is included with the figure. In this model, regional income is comes from payments by firms to purchase the primary factors of production, these being land, capital, labor and natural resources. This income corresponds to the flow of the Value of Output at Agents' Prices of Endowment Commodities (VOA), plus added taxes (TAX), and is allocated to four different categories: private consumption by regional households or families (PRIVEXP); consumption by the government (GOVEXP); the demand for savings (SAVINGS); and a bundle of income for the payment of taxes. Taxes in the model are defined by

the difference between the value of output at market price and at agent's price. This computation of income variance allows the model to calculate change in regional income that is then used as an indicator of regional well-being. (Hertel & Tsigas, 1997).

Figure 2 – A multiregional open economy without government intervention.



Where, VOA (endow): Value of Output at Agent's prices of endowment commodities
VDFA: Value of Domestic purchases by Firms at Agent's prices
PRIVEXP: Private expenditure
GOVEXP: Government expenditure
VDPA: Value of Domestic purchases by Private households at Agent's prices
VDGA: Value of Domestic purchases by Government household at Agent's prices
NETINV: The sale of investment goods to satisfy the regional household's demand for savings
VXMD: Value of Exports at Market prices by Destination
VIPA: Value of Import payments to Rest of the World from private households
VIGA: Value of Import payments to Rest of the World from government households
VIFA: Value of Import payments to Rest of the World from Firms
XTAX: Export tax, converts to fob values
MTAX: Import tax
Source: Hertel and Tsigas (1997).

The revenue the producers receive is spent on intermediate consumption (VDFA), since firms must combine commodities and intermediate goods to produce goods for the final demand, on payments for imports from the Rest of the World (VIFA), and on payment of taxes (TAXES) to

government. In this way, all generated revenue is spent on the purchase of intermediate factors and services from primary factors; therefore, satisfying the zero profit condition, an important assumption for the model's closure, as demonstrated in Figure 2.

To better understand the multiregional model in an open economy, two economies are considered. One of them represents a regional economy and the other the Rest of the World. An open economy gives all agents the opportunity to pursue commercialization, allowing the domestic economy to spend part of its income on an outside financial system (VIPA and VIGA). Tax is the source of income for both the exporting country (XTAX) and the importing country (MTAX). The production sector also interacts with the remaining portion of world economy, represented by the variables VIFA and VXMD

The current GTAP database, version 6.0, encompasses 87 regions and 57 sectors. The GTAP staff makes the database available to anyone who requests it, regularly updates it, leaves it open to additions by those who identify an area that may need improvement, and establishes that all data is replicable and documented.

2.1. Behavioral equations

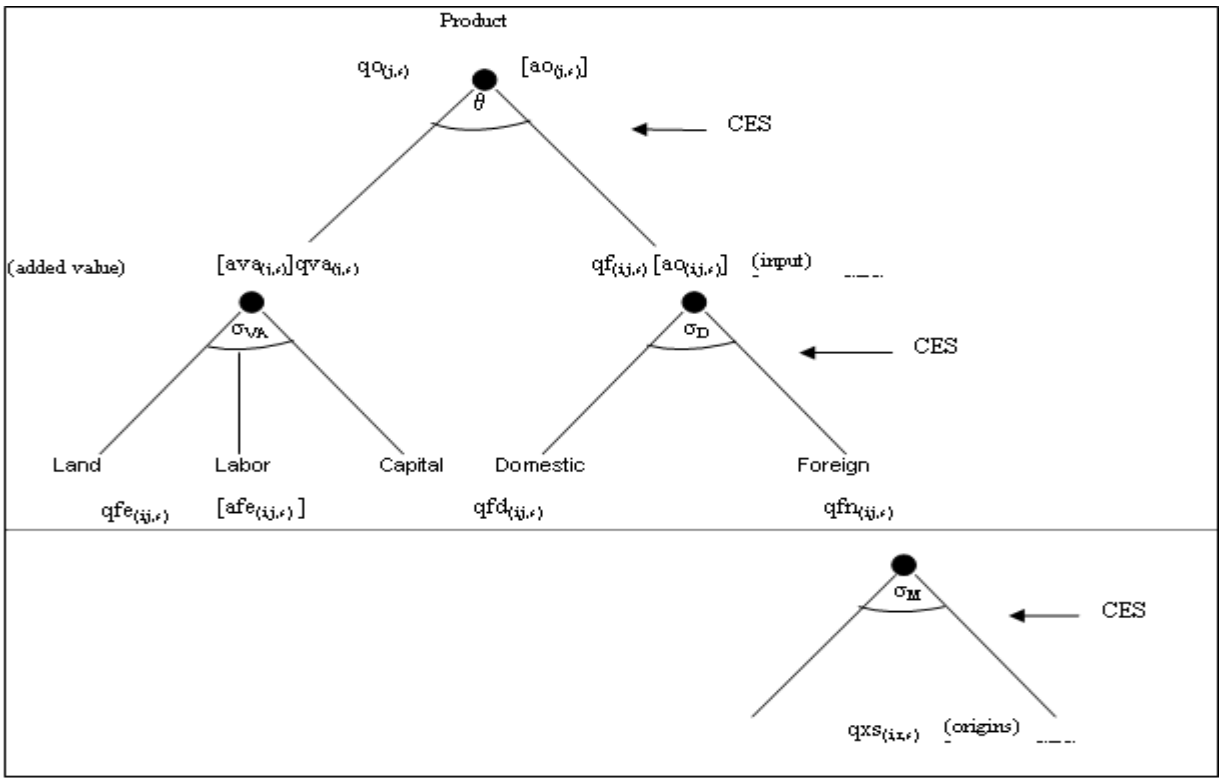
The "technology tree" shown in Figure 3 describes the assumed technologies that firms possess in the model. This production branch is a convenient way to represent separate firm technologies while permitting constant return to scale (Hertel & Tsigas, 1997).

The decisions taken by the firms are based on a Constant Elasticity of Substitution (CES) function, where the firms optimize their profit by choosing the factors of production and estimating constant returns to scale. The CES function assumes that each sector of the economy produces only one manufactured good, and the firm maximizes its profit with the use of primary factors without taking into account the price of intermediate factors. The CES function can be represented by the equation:

$$Q = A\left[\delta K^{-p} + (1-\delta)L^{-p}\right]^{-1/p}, \qquad (1)$$

where, Q is the quantity produced ; K is the capital factor; L is the labor factor; and A, p and δ are the given parameters, where, A represents the technological level, p the substitution parameter, and δ the distribution parameter. The restrictions for the parameters are as follows: A must be greater than 0, δ must be between 0 and 1, and p must be bigger than one. (CHIANG, 1982).

Figure 3- Production structure.



σ_{VA}: substitution elasticity enters the production factors that compose added value.
σ_D: elasticity of substitution between domestic and imported factors.
σ_M: elasticity of substitution between imported factors.
Source: Hertel & Tsigas (1997)

The distribution of income between the sectors is represented by a Cobb-Douglas per-capita utility function, where an increase or a reduction of income in each country reflects an increase or a reduction proportional to the change in income for each sector. The expenses of the government are represented by a Cobb-Douglas utility function with sub-utilities in the form:

$$U = K.CP^{\theta CP}.CG^{\theta CG}.S^{\theta S}, \tag{2}$$

where, U is the total utility in each region; CP is private consumption; CG is government consumption; S is savings in the economy; and K and θ are parameters representing the ratios of CP, CG and S, constant in the creation of total income.

Finally, consumer expenses are given by a Constant Difference of Elasticity (CDE) function, which assumes that variations in consumption do not appear as proportional variations in a consumer's utility. The private demand function is represented by the maximization of the expenditure function of CDE, while government demand is given by the representative fixed coefficients of the consumed amounts. The CDE function is given by:

$$\sum_i B_i * UP^{\gamma_i \beta_i} * Z_i^{\beta_i} \equiv 1, \tag{3}$$

where, Bi is a multiplicative variable; UP is private total utility; γ_i is the substitution parameter; β_i is the parameter of expansion in the CDE function; and Z_i, is the normalization of the vector price (PPi), represented in equation (4):

$$Z_i = f\left[\frac{PP_i}{E(PP_i)} * UP\right], \tag{4}$$

2.2 Macroeconomic closure and linearization of the equations

The neoclassic school of thought is applied in respect to macroeconomic closure of the model. The investment rate is determined by the savings rate. The difference between the investment rate and the savings rate is equal to the trade balance plus international transfers, represented by:

$$S - I = X + R - M \,, \tag{5}$$

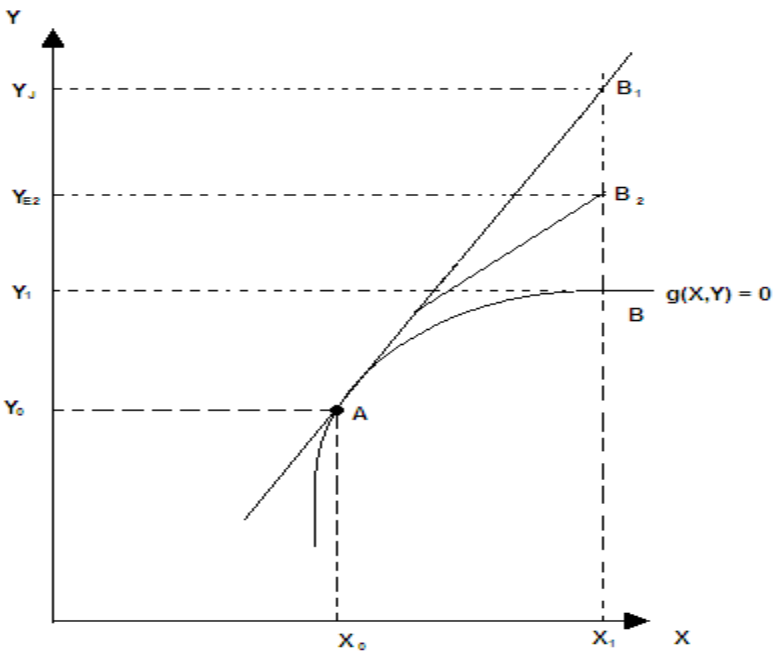
where, S is the savings rate; I is the investment rate; X is the rate of exportation; M is the rate of importation; and R is the rate of international transfers.

The model solves an equation by analyzing tax growth in prices and quantities. It uses a solution obtained from a non-linear model of general balance and then creates a linear solution to the function in a sequence of successive updates of the values. The values of the coefficients in the formula are:

$$\frac{dV}{V} = \frac{d(PQ)}{PQ} = p + q \,, \tag{6}$$

where, p denotes the growth of taxes on price P, and q denotes the growth of taxes on quantity Q (Figure 4).

Figure 4 – Solving a nonlinear model via its linearized representation.



Source: Hertel and Tsigas (1997)

Figure 4 shows function $g(X,Y)=0$, with an endogenous X value and an exogenous Y value, where the initial balance is (X_0 , Y_0). When the function is introduced to a shock in its X variable, and thus taken from X_0 to X_1, what tends to occur when using the linearized Johansen method is a result with a greater outcome than from the non-linear model, $Y_j \succ\succ Y_1$, which generates an error in

the result. However, the Euler method allows division of the shock into two different phases and brings up the value given after the first phase to the solution of Y_{E2}, which is between the values of Y_j and Y_1. It is noted that as the number of segments in the given shock are increased, the results obtained will be closer and closer to the non-linear function with value Y_1 (Gragg method). The GTAP model uses the Gragg method as its standard procedure; this consists of the extrapolation of different phases successively applied to the shock with only a small gap between each (Hertel and Tsigas, 1997).

3. Scenarios and model aggregation

Section 3 contains a discussion of the main WTO proposals, formalized since the Ministerial Conference of the Doha Round, in respect to subsidies for production and exportation and import tariffs (Harbinson and Girard approaches) and a restatement of the objectives declared at the Uruguay Round. The end of this section puts forward a synthesis of these proposals grouped into four scenarios and a table delineating the products, product aggregations, and geographic areas addressed in this study.

3.1 WTO proposal for agricultural production subsidies and export subsidies

Developed countries were not satisfied with results from the Uruguay Round regarding the reduction of agricultural production subsidies. For this reason, the WTO proposed the Doha Round to specifically address this issue through a more detailed examination of production subsidies. To facilitate this examination, production subsidies were subdivided into the following five categories, conforming to recognized characteristics: green box, S&D box, red box, amber box, and blue box.

Provided that they comply with all relevant criteria, green box production subsidies are not prohibited and therefore unlimited. This green box encompasses resources destined for government programs directed toward research and extension, infrastructure, control of plagues and diseases, and emergency support for agricultural producers. According to the WTO (2007), this type of subsidy is justified due to the intrinsic characteristics of agricultural activities, such as the exposure to environmental risks that generally provoke great harvest losses. These subsidies are considered non-distortionary in regards to international trade.

The S&D box encompasses production subsidies provided by governmental programs directed toward agricultural development and are also not prohibited. These subsidies are intended to give special assistance to agricultural activities in developing countries.

The production subsidies included in the red box are prohibited due to their strong capacity to distort commercial flow between countries.

The production subsidies included in the blue and amber boxes distort international trade and must be reduced. Blue box subsidies are those that are not in accord with multilateral agreements. According to WTO (2005), this type of subsidy is present in Japan and countries belonging to the European Union (EU), such as Slovenia, Iceland, Slovakia, and Norway, which have until 2010 to eliminate them. Some countries insist that blue box subsidies are an important tool for supporting and reforming local agriculture and argue that they must be kept. Amber box subsidies are those designed to maintain a particular market price, i.e., policies to achieve a particular price level and include payments directly to the producer. Subsidies in the amber box that total less than 5% of the product's production value are exempt from WTO mandated cuts.

The WTO presented a proposal for the reduction of global agricultural subsidies that divided world economies into three groups, determined by the total amount of subsidies provided. Group 1 consists of countries that provide a total agriculture subsidy of up to US$ 10 billions, and the WTO proposed subsidy cuts ranging from 31% to 70%. Group 2 is made up of countries with subsidy expenditures ranging from US$ 10 billions to US$ 60 billions, with proposed cuts varying from 53% to 75%. Group 3 contains countries with subsidy expenditures superior to US$ 60 billions, and proposed subsidy cuts ranging from 70% to 80%. The groups and proposed production subsidy reductions are shown in Table 1. The subsidy reductions listed are the minimums proposed by the WTO for each group.

Table 1- Proposal by the WTO for the reduction of global agricultural subsidy expenditure

Group	*Expenditure in US$ billions*	*Reduction*
1	0 – 10	31%
2	10 – 60	53%
3	> 60	70%

Source: WTO (2005)

The United States of America (USA) falls into Group 2, the EU falls into Group 3, and other countries providing agricultural subsidies fall into in Group 1.

Currently, Doha Round negotiations have put forward a ban on export subsidies. This proposal is more stringent than proposals made at the Uruguay Round, which advocated only a reduction in export subsidies.

3.2 Proposals for the reduction of border tariffs

There are two main proposals in regard to improved global market access through the reduction of tariff barriers. The first proposal repeats the formula used at the Uruguay Round, also known as the Harbinson approach, which employs an average reduction over all products, allowing some variations for individual products provided that a minimum total reduction is met. As shown by Antimiani et al. (2006), the fundamental problem with this approach is that it provides no reward for cutting a high tariff rather than a low one, allowing policymakers to avoid dealing with extra tariffs (tariff peaks) and with the gap between tariffs on finished products and raw materials (tariff escalation).

The other approach uses a Swiss formula to calculate "non-linear" reductions on higher tariffs. This method, known as the Girard approach, results in steeper cuts on higher tariffs and effectively establishes a maximum tariff level. In accordance with Antimiani et al. (2006), critics deem this model too complicated since it requires converting specific tariffs into *ad valorem* tariffs. Supporters of the model assert that the Swiss formula, or a model similar to it, is needed to deal with tariff peaks and to narrow tariff escalation.

According to the Harbinson approach, and from experience gained from the previous round of world trade negotiations, governments may reduce tariffs by a small percent on some high tariff commodities while reducing tariffs a large percent on products with small tariffs, diminishing the trade liberalizing intent of tariff reduction. As this is an arbitrary assumption, the scenarios created in our study impose a uniform tariff reduction on every country that falls within a particular tariff group. That is, the scenario employing the Harbinson approach implements a simple proportional cut, frequently described in policy discussions as a linear cut:

$$T_1 = cT_0 , \qquad (7)$$

where, T_0 is the initial bounded tariff, T_1 the rate after application of the formula, and c is the constant proportion tariffs are to be reduced from their original rate. Table 2 shows the tariff cuts for both developed and developing countries used in this study's Harbinson scenario.

Table 2- Scenarios for tariff reduction relative to the current tariff to imports (Harbinson approach)

Developed Countries	*Developing Countries*

Current Tariff Interval	Reduction	Current Tariff Interval	Reduction
0% - 15%	40%	0% - 20%	25%
15% - 90%	50%	20% - 60%	30%
> 90%	60%	60% -120%	35%
		> 120%	40%

Source: Adapted from Antimiani et al. (2006)

The Girard method, used in two of this study's scenarios, has been suggested as a reasonable approach to tariff reduction; although, according to its creator, it should be seen as a set of basic elements for possible modalities. This method applies the Swiss formula and would result in steeper reductions in higher tariffs than in lower tariffs, thereby obtaining final rates that fall within a smaller tariff range. The formula was put forward by the Chairman of the WTO Non-Agricultural Market Negotiating Group, Pierre-Louis Girard in an attempt to set targets for negotiation. According to the formula, all non-agricultural tariffs are to be reduced on a line-by-line basis using the following formula:

$$T_1 = \frac{t_a \cdot T_o}{t_a + T_o}, \tag{8}$$

where, t_1 is the final rate, to be bound in ad *valorem* terms, t_a is the national average of the bounded rates within each band, and T_0 is the initial rate. Table 3 contains stipulated WTO tariff reduction limits (2004; 2005), clearly stating permitted divergence. The advantage this methodology is that it harmonizes proposed reductions within each tariff grouping.

Table 3- Proposal by the WTO for the tariff reduction per product (Girard approach).

Group	*Current Tariffs*	*Reduction*
1	0% – 20/30%	20% -65%
2	20/30% – 40/60%	30% - 75%
3	40/60% - 60/90%	35 % - 85%
4	> 60/90%	42% - 90%

Source: WTO (2005)

To reflect Non-Agricultural Market Access (NAMA) negotiations, this study also employs an average of the Girard approach to tariff reduction to analyze the effect of reduced manufactured product tariffs, shown in Table 4 and simulated in Scenario 4. It is hoped that by reducing both agricultural and non-agricultural tariffs, potential negotiating friction between developing and developed countries will be diminished.

Table 4 – Proposal for the tariff reduction of manufactured products

Group	Current Tariff	Reduction
1	0%-20%	42.5%
2	20%-40%	52.%
3	40%-60%	60%
4	>60%	66%

Source: WTO (2005)

3.3 Repetition of the objectives of the Uruguay Round

Table 5 shows the agricultural tariff, export subsidy, and direct domestic production subsidy reductions agreed to at the Uruguay Round. The effects of these reductions are simulated in Scenario 3.

Table 5- General measures for the reduction of agricultural protection established in the Uruguay Round

TARIFFS AND INCIDENCE OF SUBSIDIES	Description of the cuts	Countries and chronology of the reduction for the protection of agricultural exchanges	
		Developed	Developing
		6 years: 1995 -2000	10 years: 1995 -2004
TARIFFS	General Mean	36%	24%
	Minimum cut per product	15%	10%
PRODUCTION	Total subsidies	20%	13%
EXPORTATION	Value of subsidies	36%	24%
	Quantity subsidized	21%	14%

Source: WTO (2005)

3.4 Scenarios and model aggregation

This study contains four scenarios. The scenarios are used to analyze the effects of possible Doha Round tariff and subsidy reductions. Box 1 gives an abbreviated breakdown of conditions implemented in the four scenarios.

Box 1- Review of the characteristics of the scenarios of accords proposed for the Doha Round

Issue		Scenarios			
		1	2	3	4
Production Subsidies	Proposal by the WTO	X	X		X*
	Repetition of the Uruguay Round	-	-	X	
Export Subsidies	Elimination	X	X	-	X
	Repetition of the Uruguay Round	-	-	X	
Tariff Reduction	Harbinson Approach	X	-	-	
	Girard Approach	-	X	-	X
	Repetition of the Uruguay Round	-	-	X	

*For scenario 4, proposal by the WTO is carried for all products except manufacturing. Manufacturing subsidies are eliminated.

** For scenario 4, tariffs for all goods except manufacturing are reduced using the WTO Girard approach. For manufactured goods, an average of the WTO Girard approach is used.

This study addresses 10 economic segments and eight geographic divisions, shown in Table 6.

Table 6 – Regions, countries, and commodity sectors considered by GTAP

Regions	Commodities
1- China (CHI)	1- Paddy rice and processed rice (RICE)
2- India (IND)	2- WHEAT
3- Brazil (BRA)	3-Cereal grains (MAIZE)
4- Rest of G-20 (RG20)	4- Oil Seed and vegetable oils (SOYBEAN)
5- United States of America (USA)	5- Sugar cane , sugar beat, and sugar (SUGAR)
6- European Union (EU15)	6- Row milk, milk derivatives (DAIRY)
7- Rest of developed countries (RDEVELOPED)	7- Meats, sheep, goats, horses, animal products and Meat products (MEAT)
8- Rest of the World (ROW)	
	8- Other foods (tobacco, fibers, coffee, orange juice, fruits, vegetables and others) (REAGRIBIS)
	9- Manufactures (metals in general, vehicles, chemical products, machines and equipments, petroleum, gas and others) (MNFCS)
	10- Services and public administration (SVCES)

Source: GTAP version 6.0.

4 Results and discussion

4.1 Impacts on production and market

4.1.1 Scenario 1

Scenario 1 simulates the implementation a Doha Round agreement by eliminating agriculture export subsidies, reducing agriculture production subsidies using figures shown in Table 1, and reducing import tariffs using the Harbinson formula. The Harbinson formula would reduce tariffs linearly, making tariff cuts by tariff interval, differentiated between developed and developing countries. Estimates have placed that tariff reduction to be between 40% to 60% for developed countries and 25% to 40% for developing countries. Table 7 presents the percent variations of production, exportation, and importation after running this scenario.

Table 7 – Percent variations in production and trade – Scenario 1

Percent variation of quantity produced								
	CHI	IND	BRA	RG20	USA	EU15	RDEVELOPED	ROW
RICE	2.36	-0.22	-0.1	4.62	6.65	-42.8	-27.22	-0.63
WHEAT	-2.01	-0.97	-1.87	-0.19	4.72	-2.94	-4.6	-0.75
MAIZE	2.91	-0.05	10.34	-0.02	-0.4	-7.13	-18.22	0.55
SOYBEAN	-10.46	-6.07	2.83	6.36	-2.8	-2.2	-9.55	2.05
SUGAR	-3.97	0.24	3.58	4.96	-1.51	-19.41	-5.65	2.52
DAIRY	-2.04	0.41	0.55	2.05	0.05	-5.61	6.29	2.05
MEAT	-1.43	-0.99	15.96	0.4	3.2	-5.02	-2.74	0.46
REAGRIBIS	-0.34	-1.26	-0.32	-0.44	0.14	0.69	2.92	-1.33
MNFCS	-0.61	1.15	-2.21	-0.62	1.15	-0.94	-1.39	1.06
SVCES	1.02	0.21	0	0.12	-0.28	0.42	0.42	-0.35
Percent variation of export quantity								
	CHI	IND	BRA	RG20	USA	EU15	RDEVELOPED	ROW
RICE	135.14	-2.72	-17.45	43.56	40.8	-68.89	69.88	9.07
WHEAT	-74.69	-24.45	-21.02	8.16	7.76	-6.16	20.04	12.11
MAIZE	39.07	-1.71	20.78	8.93	-4.71	-16.18	10.47	8.7
SOYBEAN	106.09	36.26	7.22	19	-5.68	-4.86	3.03	16.51
SUGAR	8.49	10.5	15.66	54.67	-21.31	-69.34	69.2	59.35
DAIRY	-0.29	29.48	29.43	50.98	16.27	-23.3	73.52	17.91
MEAT	-28.37	5.7	77.64	18.25	38.3	-18.12	20.74	11.51

REAGRIBIS	1.68	-5.8	-2.1	-0.21	6.17	3.09	18.96	-2.13
MNFCS	6.07	26.24	0.79	1.27	7.95	-0.32	-1.83	5.52
SVCES	-9.75	-3.78	-8.68	-1.87	3.4	4.62	-3.81	-3.15
Percent variation of import quantity								
	CHI	IND	BRA	RG20	USA	EU15	RDEVELOPED	ROW
RICE	5.27	56.76	-0.93	15.42	34.89	5	459.07	6.51
WHEAT	11.95	48.2	1.19	7.32	5.85	-0.71	36.8	5.25
MAIZE	8.52	7.62	6.7	5.99	-1.73	-0.17	-0.96	-0.61
SOYBEAN	18.58	47.44	7.8	1.82	20.94	1.11	8.54	4.32
SUGAR	12.1	16.85	4.43	8.74	23.92	52.83	52.2	12.67
DAIRY	13.42	4.77	-0.6	3.18	-15.59	0.63	60.17	-11.86
MEAT	22.47	31.23	13.91	7.4	-0.79	1.12	29.65	0.95
REAGRIBIS	14.24	18.43	7.35	5.43	1.3	-0.04	1.42	6.54
MNFCS	14.21	18.28	8.4	3.43	-1.35	0.59	4.85	4.13
SVCES	5.66	2.64	5	1.37	-1.88	-1.85	3.82	2.42

Source: Results from this study.

Changes made in this scenario resulted in a generalized fall in the production of agribusiness commodities in developed countries and a small rise in the production of these products in developing countries, with the exception of China.

Except for rice and corn, China demonstrated the worst agricultural product production results relative to the other developing countries in this scenario. On the positive side, Chinese market flow increased, as the country substantially augmented its exportation of rice, corn and soy and increased importation of all sectors' products. Results for India showed small variations in quantities produced, with small falls in the main products of agribusiness and a rise in the manufacturing sector. Indian international trade rose, prominently in manufacturing exports. Brazil experience general growth in the production of agribusiness products (corn, soy, sugar and meats) and a fall in manufactured products production, the Brazilian economy's most sensitive sector. There was strong elevation in Brazilian exportation of meats, dairy and its derivatives, sugar, soy and corn and a significant rise in the importation of manufactured products. For the rest of the G-20 countries (RG20), there were small increases in the production of agribusiness products and falls in the production of manufactured goods. These countries showed strong growth in the exportation of agribusiness products and lesser increases in the importation of all analyzed products, which demonstrates the G-20 countries' growth potential in the agricultural sector.

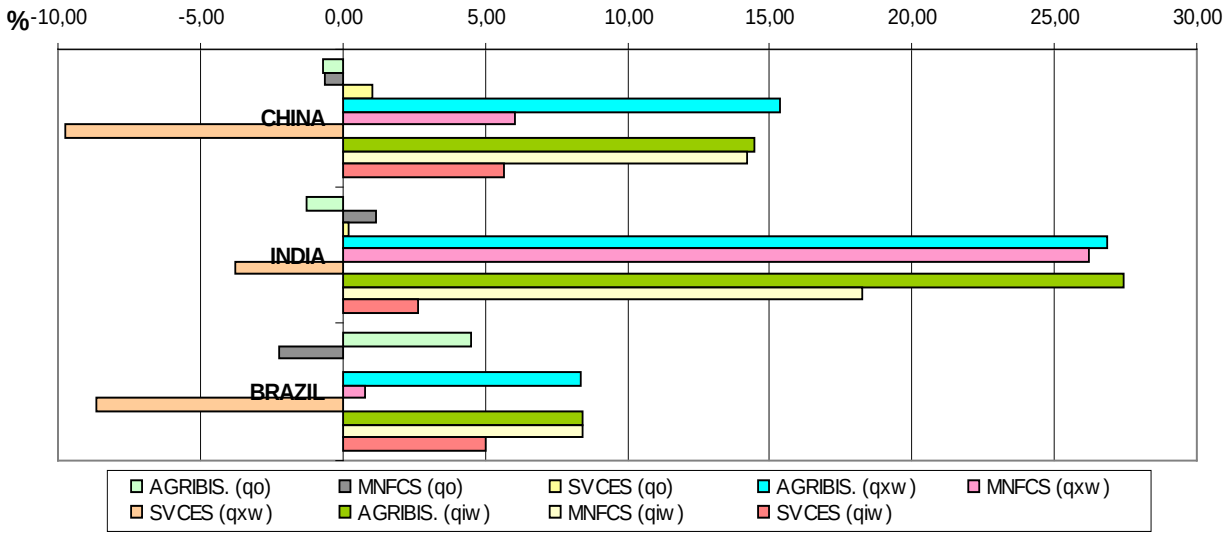
Among developed countries in Scenario 1, the USA showed small increases in quantities produced by some sectors, for example, rice, wheat, meat, and manufactures, and small falls in production from the other sectors. A strong increase occurred in the export of rice, dairy, meat, and manufactures and in the import of soy, and especially, sugar, a sector firmly protected by the United States. The scenario proved to be very negative for EU (EU15) production and trade flows, with a powerful descent in the production of agricultural goods, reflecting the EU's high subsidies. The EU manufacturing sector was also affected negatively, contrary to our expectations that the EU manufacturing sector would be able to take advantage of its assumed comparative advantage. Exports by the EU15 contracted strongly; however, the scenario's effect on imports was less accentuated, even showing an increase in sugar imports. As for other developed countries (RDEVELOPED), the scenario resulted in strong drops in the production of agricultural products, much the same as for the EU, but both exportation and importation increased, most notably for rice importation, up 459.07%, (Japan grants high rice subsidies).

For the rest of the world (ROW), simulation of Scenario 1 resulted in small variations in quantities produced and generalized increases in exportation and importation.

Figure 5 summarizes the changes elicited by Scenario 1 in the quantities produced (qo), exported (qxw), and imported (qiw) for the agribusiness (aggregated), manufacturing, and services sectors of China, India, and Brazil. In general, we observed only small changes in quantities produced, except for Brazilian agribusiness, a high rise in the export of agribusiness goods from

China, India, and Brazil, a rise in the export of Chinese and Indian manufactured goods, and large increases in quantities imported, especially agribusiness and manufactured goods by China and India.

Figure 5 – Changes in produced quantities, exported quantities, and imported quantities by China, India, and Brazil – Scenario 1



Source: Results from this study

4.1.2 Scenario 2

This scenario simulates the same conditions found in Scenario 1 except that the Girard approach is used to determine import tariff reductions. The Girard formula is a non-linear tariff reduction formula, in which the cuts vary in accordance with the current tariff. The formula defines higher cuts to higher tariffs and lower cuts on lower tariffs. In the Doha Round, this formula, known as the Swiss formula, is preferred by the G-20. The proposed WTO subsidy reduction calls for the elimination of export subsidies. Table 8 shows the percentage changes in production, export, and import from the simulation of Scenario 2.

Table 8 – Percent changes in production, import, and export – Scenario 2

Percent changes in quantity produced								
	CHI	IND	BRA	RG20	USA	EU15	RDEVELOPED	ROW
RICE	0.89	-0.03	-0.28	3.49	-1.82	-30.2	-14.09	-0.35
WHEAT	-1.63	-0.85	-1.79	-0.14	4.07	-2.87	-4.59	-0.32
MAIZE	0.63	-0.05	6.11	-0.36	0.86	-6.14	-12.31	0.57
SOYBEAN	-16.39	-7.62	4.76	7.29	-1.58	-1.76	-7.2	2.03
SUGAR	-3.2	0.33	3.58	2.96	-0.76	-12.92	-3.73	1.1
DAIRY	-1.55	0.41	0.54	2.4	0.15	-4.88	4.79	1.9
MEAT	-1.14	-1.15	12.2	0.11	2.4	-3.97	-1.71	0.4
REAGRIBIS	-0.57	-1.14	-0.8	-0.52	0.09	0.96	2.63	-1.35
MNFCS	-0.42	1.24	-1.62	-0.51	1.14	-1.05	-1.44	1.1
SVCES	1.02	0.24	-0.02	0.12	-0.27	0.4	0.37	-0.36
Percent changes in quantity exported								
	CHI	IND	BRA	RG20	USA	EU15	RDEVELOPED	ROW
RICE	59.21	3.14	-14	33.9	6.44	-54.44	21.79	10.6
WHEAT	-65.18	-20.48	-15.73	6.44	6.88	-6.82	12.92	10.17
MAIZE	18.73	-0.12	10.5	5.88	0.47	-14.85	9.01	7.44
SOYBEAN	29.26	28.1	12.4	21.2	-1.67	-3.68	-4.24	14.53
SUGAR	5.58	14.1	15.27	34.38	-12.81	-57.2	40.38	37.57

DAIRY	4.25	32.27	26.61	49.94	8.47	-21.43	51.94	8.9
MEAT	-22.44	6.93	59.21	10.88	27.72	-15.27	11.29	6.99
REAGRIBIS	-4.26	-4.16	-4.58	-1.02	5.01	3.26	14.13	-3.23
MNFCS	4.78	24.01	0.93	0.95	6.87	-0.75	-2.83	5.06
SVCES	-8.74	-2.98	-7.88	-1.75	2.86	4.26	-3.9	-3.14
Percent changes in quantity imported								
	CHI	IND	BRA	RG20	USA	EU15	RDEVELOPED	ROW
RICE	3.83	69.09	-0.99	12.54	30.39	0.37	201.81	3.98
WHEAT	7.87	56.17	0.53	5.28	2.95	-0.57	25.73	2.81
MAIZE	9.48	8.01	4.36	5.32	-2.24	-0.2	1.49	-1.3
SOYBEAN	19.97	58	7.22	1.01	18.31	0.63	5.25	2.84
SUGAR	9.57	17.57	1.19	7.21	10.13	26.78	28.65	11.37
DAIRY	9.45	1.91	-2.42	0.26	-25.94	-0.74	35.1	-14.06
MEAT	17.27	36.37	9.85	5.47	-3.13	-0.28	16.63	-0.78
REAGRIBIS	11.79	17.84	5.77	4.23	0.6	-0.64	-0.8	5.37
MNFCS	11.52	16.17	6.72	2.8	-1.9	0.34	3.51	3.55
SVCES	4.95	2.12	4.46	1.23	-1.62	-1.78	3.57	2.27

Source: Results from this study

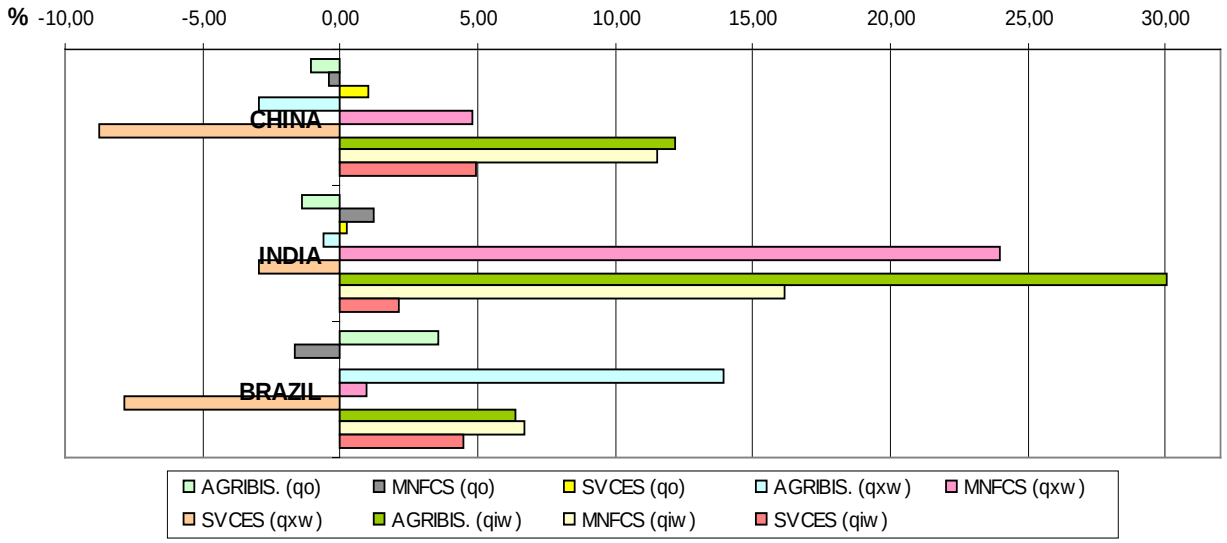
Production results from Scenario 2 were quite similar to those from Scenario 1. Because of this similarity, our comparative analysis will focus on the important differences between the two scenarios. In Scenario 2, we saw a stronger drop in Chinese soy production, -16.39%, and smaller production changes in India, Brazil, the RG20 and the ROW than in Scenario 1. Rice production in the United States decreased In Scenario 2 and increased in Scenario 1. The EU15 showed smaller production drops in Scenario 2 than Scenario 1, especially in the rice and sugar sectors (sensitive sectors in that region).

Quantities exported from China, RG20, USA, EU15, RDEVELOPED and ROW showed smaller changes in Scenario 2 than in Scenario 1. Indian rice and dairy product exportation was more elevated in Scenario 2 than Scenario 1, which is an important result since India is the world's second largest dairy producer. Brazilian meat and dairy exportation was less in Scenario 2 than in Scenario 1, which negated the Scenario 2 increase in Brazilian soy exportation.

With the exception of the soy and manufacturing sectors, the quantity of Chinese imports dropped in Scenario 2 relative to Scenario 1. Indian importation increased more across most sectors in Scenario 2 than in Scenario 1. The exceptions were in the dairy, manufacturing, and services sectors. The Scenario 2 results for Brazil, RG20, USA, RDEVELOPED and ROW are very similar to those from Scenario 1; although, the changes were smaller. For the EU15, the importation of meat and dairy products decreased in Scenario 2 while increasing in Scenario 1.

Figure 6 summarizes results from the simulation of Scenario 2 in quantities produced (qo), exported (qxw), and imported (qiw) for the agribusiness (aggregated), manufacturing, and services sectors of China, India, and Brazil. In Scenario 2, we observe only small changes in quantities produced by China, India, and Brazil and greater changes in their trade, similar to Scenario 1.

Figure 6 – Changes in quantity produced, quantity exported, and quantity imported by China, India, and Brazil – Scenario 2



Source: Results from this study

4.1.3 Scenario 3

Scenario 3, applies the stipulations contained in the tariff agreements negotiated during the Uruguay Round of GATT: Over six years, developed countries will cut tariffs a minimum of 15% per product line; over 10 years, underdeveloped countries will cut tariffs a minimum of 10% per product line. This scenario considers that agreements to be negotiated through the Doha Round will contain tariff and subsidy reductions at least as great as those obtained through the Uruguay Round, even knowing that the majority of these Uruguay Round compromises were not applied. Table 9 provides the results from simulating Scenario 3 in percent variations of products produced, exported, and imported.

Table 9 – Percent variations in production and trade – Scenario 3.

Percent variation in quantity produced								
	CHI	IND	BRA	RG20	USA	EU15	RDEVELOPED	ROW
RICE	0.15	0.02	0.06	1.01	-0.95	-10.64	-3.78	0.05
WHEAT	-0.68	-0.39	-0.05	0.14	2.36	-0.49	-3.95	-0.02
MAIZE	0.14	-0.03	1.9	-0.08	0.61	-2.46	-5.46	0.28
SOYBEAN	-3.78	-1.69	1.18	1.83	-1.09	-0.46	-3.13	0.74
SUGAR	-1.38	0.11	1.3	1.06	-0.26	-4.49	-1.48	0.39
DAIRY	-0.35	0.12	0.21	0.91	0.03	-2.07	1.22	1.1
MEAT	-0.47	-0.28	3.01	0.11	1.19	-1.46	-1.73	0.33
REAGRIBIS	-0.17	-0.44	0.03	-0.16	0.03	0.14	1.29	-0.42
MNFCS	-0.22	0.41	-0.39	-0.16	0.57	-0.07	-1.23	0.35
SVCES	0.42	0.04	-0.02	0.03	-0.14	0.07	0.31	-0.13
Percent variation in quantity exported								
	CHI	IND	BRA	RG20	USA	EU15	RDEVELOPED	ROW
RICE	13.25	2.34	-3.04	10.25	1.04	-21.05	-2	5.54
WHEAT	-34.54	-9.75	-5.73	2.61	3.83	-0.99	1.66	5.16
MAIZE	4.57	-0.23	3.62	2.33	0.91	-5.55	1.2	3.57
SOYBEAN	10.63	5.02	2.98	5.32	-2.58	-0.48	-3.68	6
SUGAR	1.31	5.17	5.17	11.97	0.62	-23.79	10.22	11.81
DAIRY	1.04	12.29	10.68	16.67	5.81	-8.58	15.21	10.81

MEAT	-8.92	2.36	14.59	5.92	13.3	-5.59	2.67	6.4
REAGRIBIS	-0.45	-2.33	0.15	0.02	2.12	0.83	7.13	-0.38
MNFCS	1.83	8.09	1.59	0.67	3.43	0.38	-2.62	1.84
SVCES	-3.38	-1.08	-2.67	-0.63	1.56	1.67	-2.83	-0.89
Percent variation in quantity imported								
	CHI	IND	BRA	RG20	USA	EU15	RDEVELOPED	ROW
RICE	2.01	14.86	-0.64	4.28	10.38	-0.95	45.62	0.46
WHEAT	1.71	11.22	0.28	1.76	-0.55	-0.53	9.09	1.15
MAIZE	1.77	2.4	1.26	1.76	-1.4	-0.19	0.96	-0.19
SOYBEAN	4.31	11.59	2.35	0.12	6.01	0.04	1.2	1.59
SUGAR	3.97	2.01	-0.4	2.21	4.99	5.66	8.82	3.29
DAIRY	1.26	-2.02	-1.66	-0.56	-8.38	-0.21	13.27	-6.08
MEAT	7.18	8.35	2.62	2.48	-2.06	-0.07	8.81	-0.12
REAGRIBIS	4.76	5.83	2.35	2.1	0.41	0.05	0.39	2.38
MNFCS	4.66	5.18	2.77	1.31	-0.93	0.04	2.53	1.3
SVCES	1.92	0.74	1.47	0.47	-0.88	-0.72	2.34	0.69

Source: Results of research.

Although the results from Scenario 3 are similar to those from scenarios 1 and 2, these results are much less statistically significant.

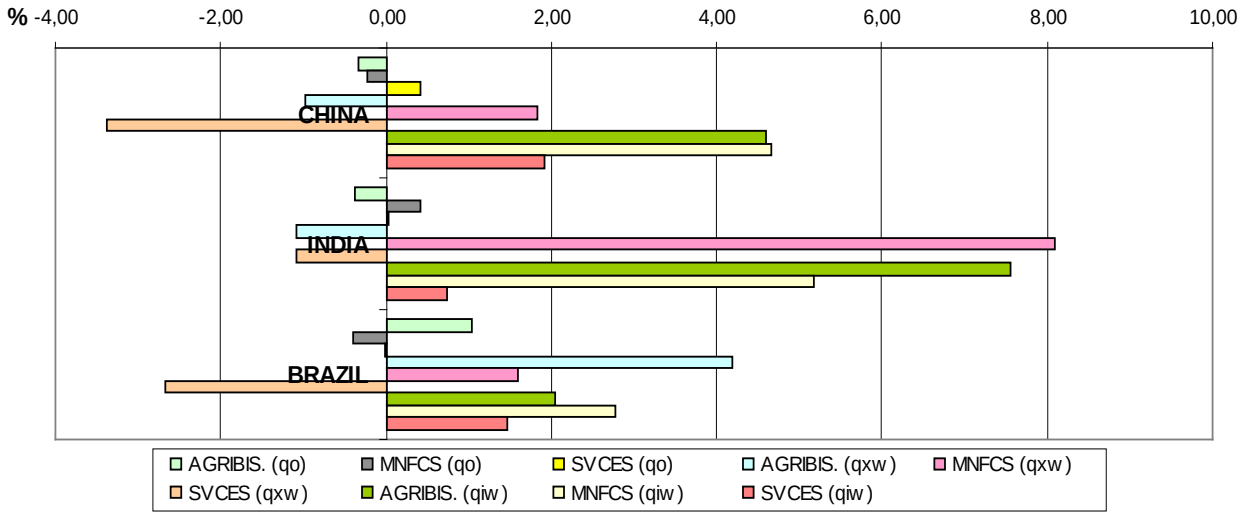
Under conditions imposed by Scenario 3, all Chinese economic sectors show approximately 1/3 the production variance found in Scenario 1. India, Brazil, RG20 and ROW show smaller variations in Scenario 3 than in scenarios 1 and 2, except for a small rise (1.18%) in the production of Brazilian soy. The production variation caused in the USA by simulation of Scenario 3 is similar that caused by scenarios 1 and 2 with the exception of rice production, which rose in Scenario 1 but fell in scenarios 2 and 3. Simulation of Scenario 3 elicited falls in all EU15 agricultural product production, although smaller and less pronounced than in scenarios 1 and 2.

Variations in exported quantities generated by simulation of Scenario 3 are significantly less than generated by scenarios 1 and 2. There were exceptions: a rise in the export of manufactured products by Brazil and EU15 and a notable rise in the exportation of corn and sugar by the USA. The corn and sugar sectors of the United States are less affected by this scenario since there are smaller subsidies involved.

Variations in imported quantities generated by Scenario 3 show the same tendencies as the variations generated by scenarios 1 and 2; although less accentuated. This reduced variation is particularly evident in the sugar sectors of the USA and EU15. The sugar sector is a highly protected sector in these regions, which may also be said about the rice sector in the rest of developed countries.

Figure 7 summarizes results from the simulation of Scenario 3 in the quantities produced (qo), exported (qxw), and imported (qiw) for the agribusiness (aggregated), manufacturing, and services sectors of China, India, and Brazil. In general, simulation of Scenario 3 only caused small variations in produced quantities and lower variations in trade relative to scenarios 1 and 2 for China, India, and Brazil.

Figure 7 – Variations in quantity produced, quantity exported, and quantity imported by China, India, and Brazil. – Scenario 3



Source: Results from this study

4.1.4 Scenario 4

Scenario 4 simulates a possible Doha Round compromise that goes beyond the reduction of agricultural tariffs and subsidies and uses the Swiss formula through the Girard model to also reduce tariffs on industrial goods (NAMA in WTO terminology), which may placate developed countries. Table 10 shows the results from simulation of Scenario 4 in percent change of production, exportation, and importation.

Similar to simulation of scenarios 1 and 2, simulation of Scenario 4 caused in a small general increase in the production of agribusiness goods by developing countries, with the exception of China, a drop in the production of these goods by developed countries, and an increase in trade between countries.

Results from Scenario 4 show negative production variations for all Chinese sectors other than services, with a big fall in Chinese soy production (-18.42%). There was great variation in the quantities of Chinese exports, with big increases in the export of rice, corn and soy and great reductions in the export of wheat and meat. Simulation of Scenario 4 caused Chinese importation to increase over all sectors, providing evidence of the strong impact the removal of Chinese trade barriers would have.

Table 10 – Percent changes in production and trade from simulation of Scenario 4

Percent changes in quantity produced								
	CHI	IND	BRA	RG20	USA	EU15	RDEVELOPED	ROW
RICE	-0.26	-0.26	-0.85	1.36	3.58	-25.9	-14.42	0.77
WHEAT	-3.3	-0.98	-2.8	-3.06	8.83	-0.97	-9.54	0.18
MAIZE	-1.54	-0.13	4.61	-1.47	2.24	-5.42	-13.91	0.91
SOYBEAN	-18.42	-8.13	-5.14	7.03	2.24	-0.46	-9.3	2
SUGAR	-5.9	-0.09	0.3	2.36	-0.14	-11.48	-4.83	1.84
DAIRY	-3.79	0.17	0.34	1.75	0.43	-4.36	2.45	2.38
MEAT	-2.62	-1.4	8.66	-0.82	4.26	-3.05	-5.21	0.71
REAGRIBIS	-1.95	-1.59	-1.98	-1.51	0.68	1.92	1.87	-1.25
MNFCS	-0.54	1.67	-0.43	0.64	1.18	-1.65	-0.92	1.61
SVCES	1.87	0.25	0.01	-0.17	-0.33	0.50	0.30	-0.61
Percent changes in quantity exported								

	CHI	IND	BRA	RG20	USA	EU15	RDEVELOPED	ROW
RICE	30.14	-1.47	-21.33	19.35	22.45	-48.59	21.7	12.32
WHEAT	-72.61	-22.05	-8.69	0.52	13.7	-4.3	5.57	-6.23
MAIZE	7.89	-2.35	9.88	3.54	2.87	-14.58	7.56	2.8
SOYBEAN	27.78	19.39	-12.35	22.28	9.62	0.77	-7.58	8.42
SUGAR	-9.35	0.7	2.02	32.94	-4.15	-54.48	33.67	26.84
DAIRY	-22.59	18.06	20.38	42.79	27.82	-19.81	35.93	3.07
MEAT	-45.17	3.6	42.6	1.71	44.74	-12.41	1.83	0.52
REAGRIBIS	-19.15	-8.67	-10.05	-5.22	9.68	5.97	7.31	-6.44
MNFCS	8.24	39.61	8.82	4.57	9.46	-1.04	-1.65	7.6
SVCES	-21.58	-7.44	-14.73	-8.07	8.73	8.74	-11.24	-5.56
Percent changes in quantity imported								
	CHI	IND	BRA	RG20	USA	EU15	RDEVELOPED	ROW
RICE	20.59	65.02	-0.31	13.4	20.81	0.06	214.94	-3.74
WHEAT	19.73	58.04	-0.99	4.95	-1.99	-0.77	25.34	-1.55
MAIZE	11.05	8.5	2.58	6.15	-3.91	0.33	2.16	-2.86
SOYBEAN	23.49	59.8	1.93	3.58	15.29	-1.16	5.93	-0.92
SUGAR	15.8	19.11	1.5	8.89	2.92	23.76	29.94	-2.35
DAIRY	26.18	3.9	-1	0.93	-32.35	-1.26	38.94	-20.02
MEAT	39.48	38.36	11.32	10.19	-10.85	-1.5	21.09	-6.58
REAGRIBIS	21.61	19.66	7.02	5.71	-3.33	-1.52	1.2	1.76
MNFCS	21.31	30.25	12.11	5.95	-1.87	0.15	6.67	6.04
SVCES	13.74	5	8.99	5.29	-4.66	-3.64	9.87	4.36

Source: Results from Scenario 4.

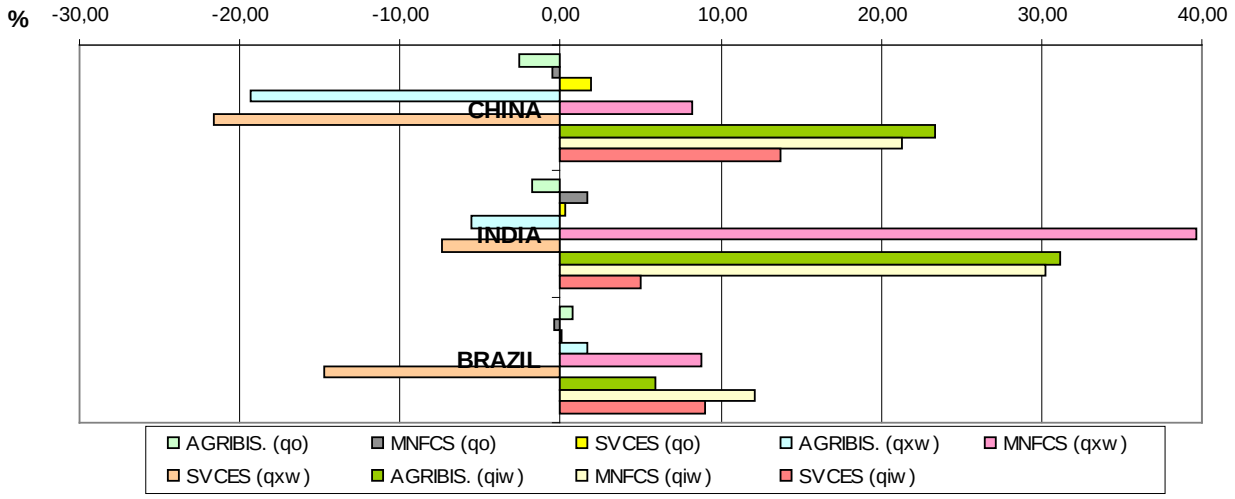
In this scenario, the Indian economy experienced small variations in the quantities produced with small drops in agribusiness production, except for dairy products, and an increase in output from the manufacturing and services sectors. Indian agricultural product exportation increased in this scenario, particularly the exportation of dairy products (18.06%) and manufactured goods (39.61%). There was an increase in Indian importation by all sectors, with extreme growth in rice, wheat and soy imports.

The production results for Brazil from simulation of Scenario 4 were generally in line with results from the other scenarios except for a fall in soy production (-5.14%), a fall which was unique among the scenarios. There was an increase in Brazilian exportation of milk and meat and an increase in the importation of manufactured goods; although, these results were much more modest than those presented in scenarios 1, 2, and 3. Another unique result from simulation of Scenario 4 was the fall in Brazilian soy exportation (-12.00%), a significant negative for the Brazilian economy. For the rest of the G-20 countries (RG20), simulation of Scenario 4 caused small increases and decreases in agribusiness product production, increases in all product importation, increases in all agribusiness product exportation except for "other foods," and a slight fall in manufactured goods exportation. There was a considerable increase in the RG20 countries exportation of rice, soy, sugar and dairy.

Simulation of Scenario 4 was quite positive for the economy of the United States, with increases in production from all sectors, especially soy. Exportation also increased greatly, especially by the rice, dairy, and meat sectors; and importation by the principal product sectors fell. For the European Union, Scenario 4 was negative. It brought about strong falls in the production of agricultural goods, with the exception of products from the "other foods" category. Production from the EU15's manufacturing sector was also negatively affected. In this scenario, EU15 exportation decreased considerably, and importation increased somewhat. For the rest of the developed countries (RDEVELOPED), results from Scenario 4 show a small drop in the production of all agricultural products; however, trade increased. Product exportation by the RDEVELOPED countries generally increased and product importation increased an even larger amount. Rice importation increased 214.94%.

Figure 8 summarizes results from simulation of Scenario 4 in quantities produced (qo), exported (qxw), and imported (qiw) for the agribusiness (aggregated), manufacturing, and services sectors of China, India, and Brazil. In general there were only small variations in the quantities produced, a large increase in the export of manufactured products by China, a drop in the exportation of agribusiness products and services by India, and an increase in the exportation of agribusiness products from Brazil. There were also large variations in imported quantities, with an increase of agribusiness product importation by China and India, and of manufactured goods by Brazil.

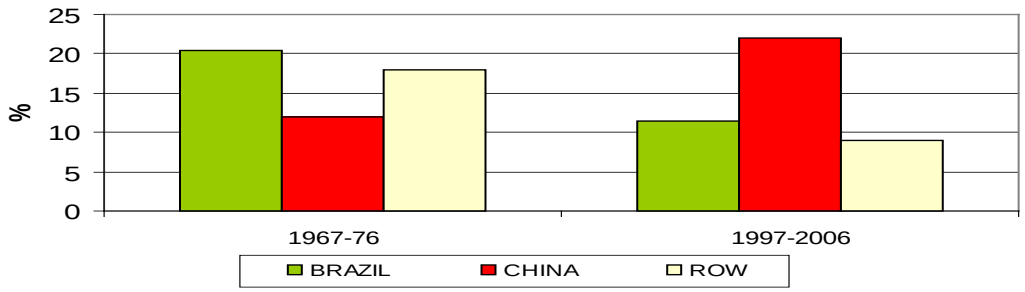
Figure 8 – Changes in produced, exported, and imported quantities for China, India, and Brazil – Scenario 4



Source: Results from this study

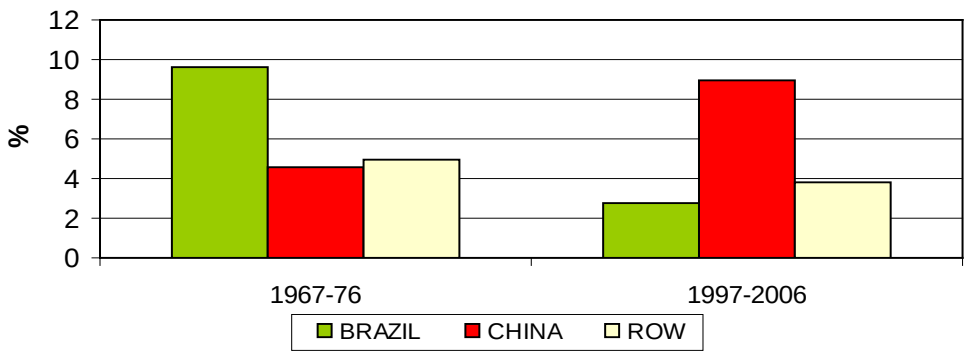
The expansion of Chinese global commerce over last decade (Figure 9) has brought substantial increases in the growth of its economy (Figure 10), as was the case with Brazil from 1968 to 1973. The tendency, given by the data presented in scenarios 1 and 4, is that the growth of Chinese trade will continue to generate significant increases in that country's Gross Domestic Product (GDP). The Brazilian economy can take advantage of the Doha Round to become a more important global exporter of agricultural products by increasing its participation in the flow of global commerce.

Figure 9 – Mean export growth: Brazil, China, and ROW



Source: Netto (2007)

Figure 10 – Mean GDP growth - Brazil, China, and ROW

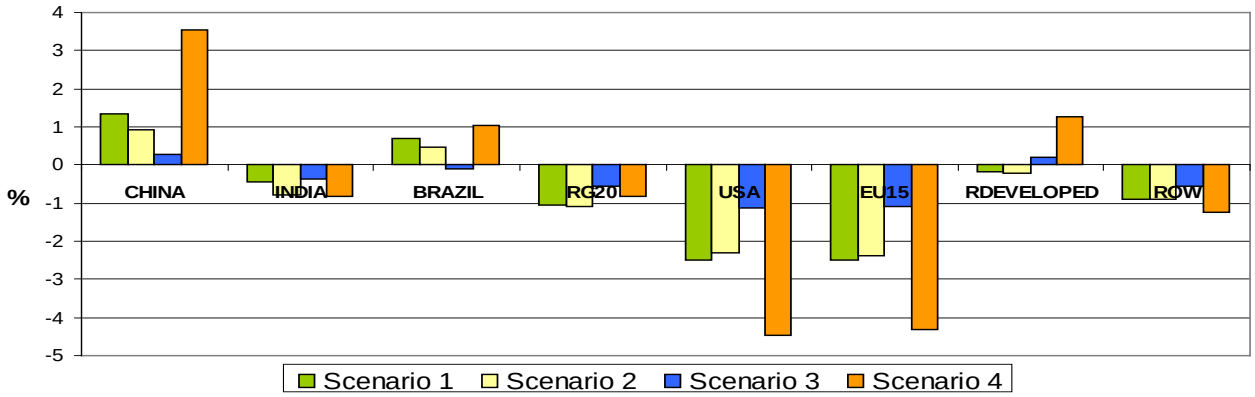


Source: Netto (2007)

4.2 Impacts on the indicators of growth and well-being

Figure 11 shows the percent GDP change in the studied countries and regions brought about by simulation of the four scenarios. Results from Scenario 1, the Harbinson formula, show small GDP increases in China, Brazil and RDEVELOPED, small GDP reductions in India, RG20, and ROW, and large GDP drops in the United States and the EU15. The results were similar from Scenario 2, the Girard formula; although the increases were not as large. Scenario 3's application of the accord signed at the end of the Uruguay Round resulted in similar but smaller GDP changes than from simulation of scenarios 1 and 2, with the exceptions of Brazil and the RDEVELOPED: rather than an increase, Brazil's GDP fell slightly; and rather than a decrease, the RDEVELOPED's GDP grew slightly. Simulation of Scenario 4 had the most pronounced results of all simulations, with large increases in the GDPs of China, Brazil, and the RDEVELOPED and large drops in the GDPs of the USA and EU15. These results are interesting, as this is the only scenario that simulates a reduction of NAMA tariffs.

Figure 11 – Percent changes in GDP

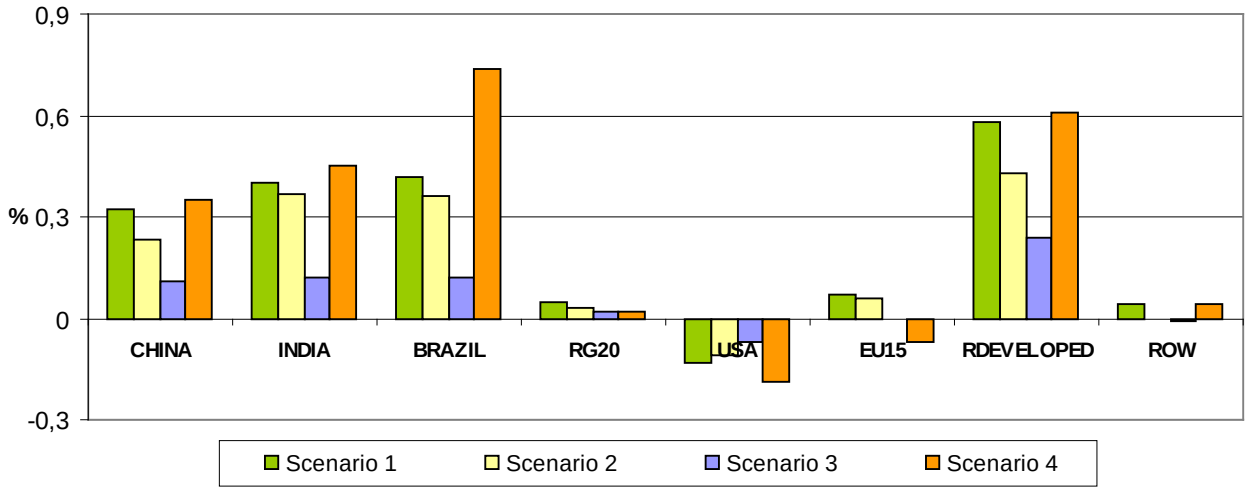


Source: Results from this study

It is worth noting that the GDP of the USA fell in all scenarios, most substantially in Scenario 4. Due to the importance of the USA to the global economy, representing 30% of the world's economy and 14% of its exports (IMF, 2007), if the USA were to enter a recessive business cycle, the international economy would likely follow. This must be taken into account by Doha Round negotiators.

Figure 12 shows variation in per capita utility derived from the scenarios' results. All countries but the United States and the EU15 showed increased per capita utility in all scenarios. The EU15 suffered a loss of utility in Scenario 4 and the United States realized negative utility in all scenarios. Scenario 4 has the largest percent variations in utility per capita.

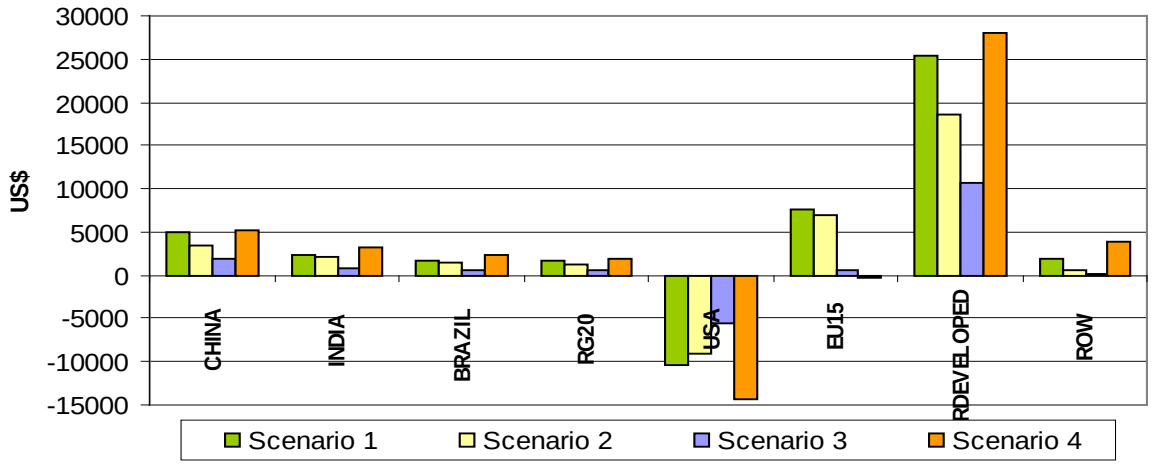
Figure 12 – Percent changes in per capita utility



Source: Results from this study

Equivalent variation (EV), expressed in millions of US$ and shown in Figure 13, is obtained by multiplying percent change in per capita utility by current GDP. This indicator takes into consideration the size of the geographic area's economy and the simulated change in its well-being.

Figure 13 – Equivalent Variation in US$ millions



Source: Results from this study

The economies of China, India, Brazil, RG20, RDEVELOPED and ROW showed profits in all four scenarios, obtaining the highest profits in Scenario 4. This behavior may be the effect of eliminating commercial barriers, which resulted in lower domestic prices, an increase in real revenue, and a consequent higher level of well-being. The United States shows losses in all scenarios, with the greatest losses in Scenario 4, explained by drops in GDP and utility per capita. The EU15 shows profits in all scenarios, with the greatest profits in Scenario 1, followed by scenarios 2, 3, and 4.

5 Conclusions

The results from simulating all scenarios were favorable for China, especially in trade and increased per capita utility. The Chinese agribusiness sector did not show much variation in any scenario. Similar results were arrived at for India; although, the increase in Indian dairy product and manufactured goods exports generated in all scenarios ought to be quite important for the Indian economy. Doha Round agreements should benefit the majority of agribusiness products from Brazil and the rest of the G-20 countries (RG20) by improving these products' access to the global marketplace.

The best results for China, India, and Brazil in regards to GDP growth, change in per capita utility, and change in EV came from Scenario 4's simulation, which included the reduction of agricultural tariffs utilizing the Swiss formula through the Girard mode and the reduction of NAMA product tariffs. For the other G-20 countries, Scenario 1 provided the best GDP, per capita utility, and EV results, followed respectively by scenarios 2, 4, and 3.

The hypothetical losses suffered by the economies of the EU15 and the United States through simulation of this study's various scenarios may make it difficult to reach a trade agreement using the group of parameters imposed by any of the scenarios. It may be that the G-20 could help avoid a impasse at the Doha Round if they were to advocate an increase in the number of sensitive products and negotiate a longer term for developing countries to make tariff and subsidy reductions.

Acknowledgements
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