Agriculture in the Doha Development Agenda: An Opportunity for Latin America ?[1]

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Abstract

The Doha Development Agenda has been negotiated under the auspices of the World Trade Organization over the past years. Agriculture trade liberalization has proven to be a major stumbling block bringing the whole negotiation process to a deadlock. Diverging negotiation positions still persist between and within groups of industrialized and developing countries. Reaching an agreement on agriculture is key to conclude the Doha Round, particularly for Latin American countries that display comparative advantages in this sector.

Despite the existence of a burgeoning literature aimed at evaluating the global gains from the Doha Round, only few studies assess global agricultural trade reforms considering scenarios based on tariff reduction formulas. Moreover most of them do not explicitly consider the majority of Latin American countries. This study aims at filling this gap, developing a new multi-region static CGE model which incorporates several innovative features in scenario design, database and modeling.

The simulations suggest a number of important policy conclusions: i) Latin America as whole may reap large gains from agriculture trade liberalization as trade gains may be large for certain countries and commodities; ii) there is nevertheless a great heterogeneity among countries and liberalization scenarios, whereby national welfare gains may be asymmetric and even negative for certain countries; iii) the market access pillar of trade negotiations is the dominant factor driving trade and welfare effects, while the reduction of trade-distorting domestic support and export subsidies is likely to generate small or even negative effects in certain cases; iv) the trade and welfare effects of the simulated scenarios are very close suggesting that a successful conclusion of the Doha Round negotiations is at reach; v) nevertheless the inclusion of sensitive and special products into simulations scenarios alters significantly the results for individual countries and their treatment will probably drive the final outcome of multilateral trade negotiations for Latin America.

Key Words: Doha Round, Agricultural Reform, CGE Model, Latin America

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1. Introduction

The Doha Development Agenda has been negotiated under the auspices of the World Trade Organization (WTO) for more than five years, upon its launching in Doha, Qatar in November 2001. Following the December 2005 Hong Kong Ministerial Meetings, which ended with little progress, the last meeting in late July 2006 among the leading trading powers, the so-called G-6 (the United States, the European Union, Japan, Australia, Brazil and India) could not break the impasse over the negotiation modalities, which will define how tariffs and subsides are to be cut. Throughout the negotiations, trade issues on agriculture have proven a major stumbling block.

Important divergences on negotiation issues still persist between developed and developing countries, but also among industrialized countries as well as among developing countries. As WTO Director General, Mr. Pascal Lamy, put it: they are part of a negotiating triangle that needs to be squared in order to successfully seize a once in a generation opportunity for poverty reduction. Some movement is expected form the United States on trade-distorting agriculture domestic support, from the European Union on agriculture market access, and on non agriculture market access from developing countries. Among developing countries, there is also a serious disagreement over the special and differentiated treatment.

In any event, it is clear that agricultural liberalization is the key to a successful Doha Round. This is in fact the central objective of a number of developing countries and the most notable part of the unfinished business of half of a century of multilateral trade negotiations. Latin America and the Caribbean (LAC) have been advocating agriculture trade liberalization for a long time. It is therefore suitable to wonder in which extent a Doha Development Agenda that does not take into due account agriculture market opening would be a lost opportunity for the region.

The past several years have witnessed a burgeoning literature aimed at evaluating the global gains from trade liberalization commitments with the use of Computable General Equilibrium (CGE) models. Among others, the most recent studies include: Anderson et al. (2006a, b) using the dynamic LINKAGE model; Hertel and Keeney (2006) with the static GTAP-AGR model; Bouët, Movel and Orden (2005) and Bouët (2006) using the dynamic MIRAGE model, and Polasky (2006) with the static Carnegie model. All these studies are based on the GTAP database (version 6) benchmarked at 2001.

The great majority of the most recent studies measure the potential impact of the so-called full trade liberalization scenarios on global welfare. That is, they simulate the effects of trade liberalization under the assumption of a complete removal of trade-distorting instruments, very often *ad valorem* tariffs, across the board. Polasky (2006) goes one step forward and assesses sector-specific effects under a more elaborated set of scenarios, including the liberalization of agriculture and non-agriculture sectors separately. In turn, Bouët (2006) compares 16 studies of the global impact of full trade liberalization scenarios. He finds that the impact in terms of world welfare is generally small, that there are notable divergences across studies and that the magnitude of the welfare effects is on a downward trend. He correctly attributes these findings to discrepancies in the underlying datasets that have been refined over time, behavioral parameters, and theoretical specifications of the models. In any event, none of these studies focuses on Latin America and only in a handful of them the largest economies of the continent, such as Brazil, Argentina or Mexico, are identified.

Meanwhile, taken as a whole, the Latin American region is deemed to be a world-class competitive exporter of farm products and, as such, a potential strong winner of multilateral agriculture trade liberalization. However, a closer look at the issue reveals that net gains may be fairly asymmetric over countries, sectors and even households. In fact the region features a wide heterogeneity in resource endowments, production structures, farm productivity, trade specialization and net food trade position

(Falconi, Giordano and Sumpsi, 2005). In short, it is well known that when it comes to trade policy the devil lies in the details. It is therefore crucial to assess the potential effects of agriculture trade liberalization considering with a sufficient degree of accuracy the heterogeneous effects that each trade-distorting instrument may have on any single country of the region.

In this light, the objective of this study is two-fold:

(i) Assess the value of Doha Round examining the potential effects of realistic scenarios that are not based on the simplistic assumption of full liberalization of agricultural trade, but rather on actual formula-based liberalization commitments.

(ii) Single out the trade and welfare effects for all Latin American countries, in order to provide a clear snapshot of national interests, one that takes into account the existing heterogeneity among the countries of the region.

To meet these objectives, we apply a newly developed variant of the IDB-INT global static CGE model in which we incorporated several innovations in terms of scenario design and modeling.

The most salient feature of this study is that simulation scenarios are inspired by actual negotiation proposals submitted by major players in WTO negotiations (the G20, the European Union, and the United States) to which we added, for the sake of comparison, a scenario that replicates the outcome of the Uruguay Round and an application of the Swiss formula to the agriculture sector. Simulations scenarios are constructed considering the impact of banded-formula-based reductions commitments of bound tariffs and domestic support instruments on applied tariffs. Scenarios are built with a bottom-up approach that takes into account information at the tariff line level, including *ad valorem* equivalent tariffs measured following the methodology used in the WTO process and Producer Support Estimates (PSE) measured following a variation of the methodology used by the Organization for Economic Co-operation and Development (OECD).

On the modeling side, we incorporate as many agricultural sectors as possible (15 sectors) in order to accurately consider the peculiar socio-economic characteristics of Latin American economies. We also model a segmented market for unskilled labor, in order to reflect labor market rigidities that are prevalent in developing countries. In the tradable sectors, we consider endogenous trade-linked productivity effects, in order to capture the positive relation that exists between trade openness and factor productivity. Finally, the underlying dataset of the CGE model is built on the IDB-INT FTAA database, which includes tariff information on a numerous regional trade agreements and preferential trading arrangements in force in the Western Hemisphere and the European Union.

The simulations results suggest that Latin America as whole is a large potential winner from agriculture trade liberalization. Even though the absolute scale of welfare gains is modest, trade gains may be large for certain countries and commodities. There is nevertheless great heterogeneity among countries and liberalization scenarios. The increase in world prices of agricultural products following the trade reform affects the terms of trade of Latin American economies. The overall impact on terms of trade implies heterogeneous national welfare effects according to the initial net trade position in agricultural goods. Southern Cone countries will be the largest beneficiaries from global agricultural reform, Central America benefits to a lesser extent, whereas Andean countries experience modest or even negative welfare effects. Oilseeds and soybeans as well as bovine meat are the sectoral winners throughout Latin America, followed by processed sugar and cereal grains. On the contrary, the coffee and cocoa sector is losing in many countries. The comparison of liberalization scenarios reveals that the trade and welfare effects of the market access pillar of trade negotiations is the most important, while the reduction of trade-distorting domestic support and export subsidies is likely to generate either small or negative effects. In general

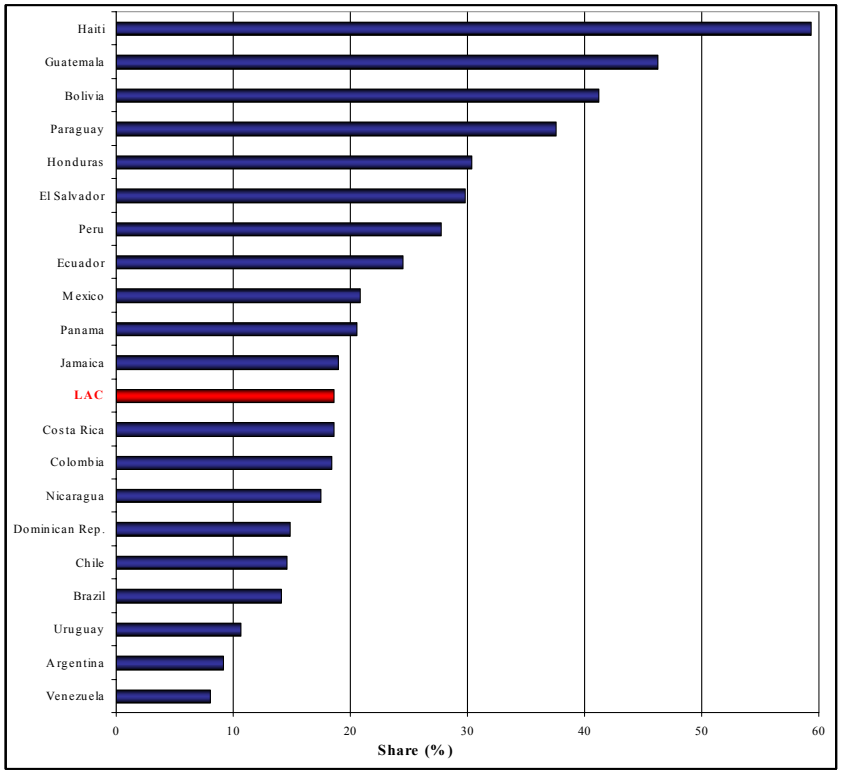
terms the trade and welfare effects of the simulated scenarios are very close, which suggests that a successful conclusion of the Doha Round negotiations is at reach. Nevertheless, the inclusion of sensitive and special products into the simulations scenarios alters significantly the results. Their treatment will probably drive the final outcome of multilateral trade negotiations for Latin America.

The rest of the paper is organized as follows. Section 2 presents some stylized facts describing the economic and social importance of agriculture trade for the region. Section 3 analyzes the current structure of trade barriers in agricultural trade, considering the three pillars of multilateral trade negotiations and a detailed assessment of the bound overhang in tariffs and subsidies. Section 4 describes the position of key players in agriculture trade negotiations and provides a rationale of the simulations scenarios adopted in this study. Section 5 describes the structure of the model as well as key extensions and innovations. Section 6 reports the simulation results on macro and key economic variables, placing emphasis on the sectoral trade impact in each Latin American economy.

2. The importance of Agriculture for Latin America

For Latin America, agriculture is extremely important in several respects, among which employment and trade stand out. The sector absorbs a considerable portion of the labor force. According to the Food and Agriculture Organization of the United Nations (FAO), 19 percent of the population (about 104 million individuals) depends from agriculture. But its relative relevance varies from country to country (Graph 1). Haiti is ranked at the top of the list with around 60 percent of the labor force depending form agriculture, followed by Guatemala and Bolivia, with more than a 40 percent share. It is worth noticing that even the largest countries rely substantially on agriculture: 21 percent for Mexico, 14 percent for Brazil and 9 percent for Argentina.

Graph 1: Agricultural Population Share in LAC Countries (2004)

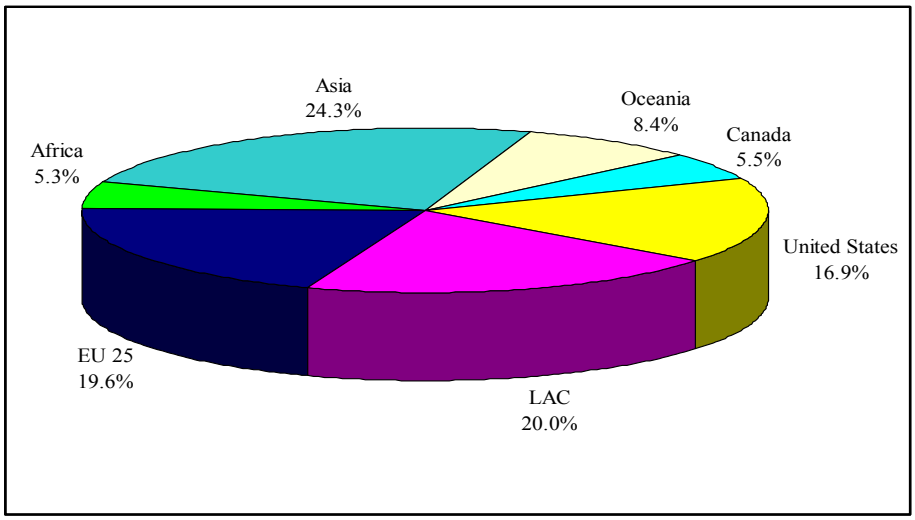


Source: FAOSTAT.

However, the above statistics may not necessarily report the real magnitude of the population that depends on agriculture. FAO's statistics only account for individuals depending directly for their livelihood on agriculture, namely, agricultural workers and their dependents. They do not include individuals employed in agriculture-related activities, such as workers whose main activity is not agriculture but produce goods and services indirectly related to agricultural activities. This wider universe may be approximated by the share of rural population over total population. Using this notion, it might be roughly inferred that 25 percent of the LAC population is dependent directly or indirectly on some kind of agriculture-related activity. Moreover, additional employment generated in agro-industries or processed food industries is not included either (see Falconi, Giordano and Sumpsi, 2005). It is important to note, however, that these activities are affected by the negotiations of the Agreement on Agriculture taking place in the WTO framework.

In trade terms, Latin America accounts for 20 percent of global agricultural exports valued at $US 377 billions in 2004, reflecting strong global competitiveness in a wide range of agricultural products. Within Latin America, Argentina and Brazil together account for 11 percent of global exports. Brazil is ranked in the third place after the EU25 and the United States in the world's largest agricultural exporters, and Argentina is the 7th position. Graph 2 shows the share of major agricultural exporters in the world by region.

Graph 2. Share of Global Agricultural Exports by Main Geographic Divisions (2004)



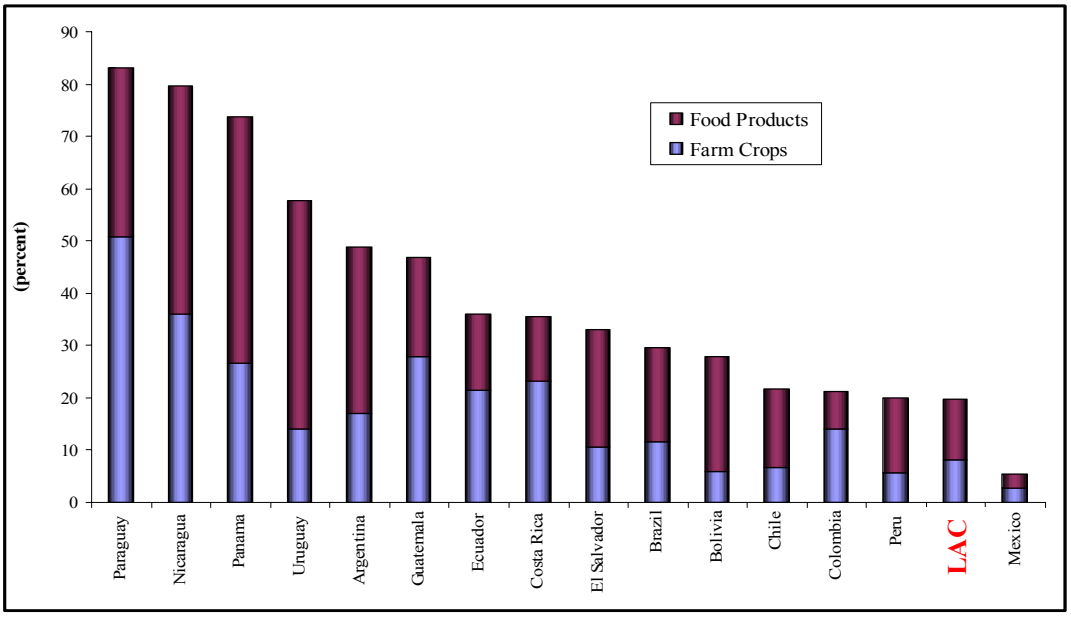
Source: COMTRADE.

In several countries of the region, agriculture accounts for a significant share of national exports. In aggregate regional terms, the sector accounts for around 20 percent of total exports, but its share vary tremendously from one country to another. The share of agriculture exports exceeds 70 percent in Paraguay, Nicaragua and Panama and 40-50 percent share in Uruguay, Guatemala and Argentina. Even in Brazil, whose exports are relatively highly diversified, agriculture represents around 30 percent of total exports. In sharp contrast, Mexico has only a 5 percent share of agricultural exports in its trade.[3] For large countries such as Argentina, Brazil, Mexico, but also in Chile, food products explain the bulk of the value of agricultural exports. On the contrary, farm crops are the main agricultural exports for mid- to small

[3] In Mexico, the share of agriculture could be significantly underestimated due to the presence of *Maquila*.

countries. In Paraguay, farm crops account for half of the country's total exports. Graph 3 presents the share of agricultural exports in total exports for Latin American countries.

Graph 3. Share of Agriculture in Total Exports for LAC Countries (2004)

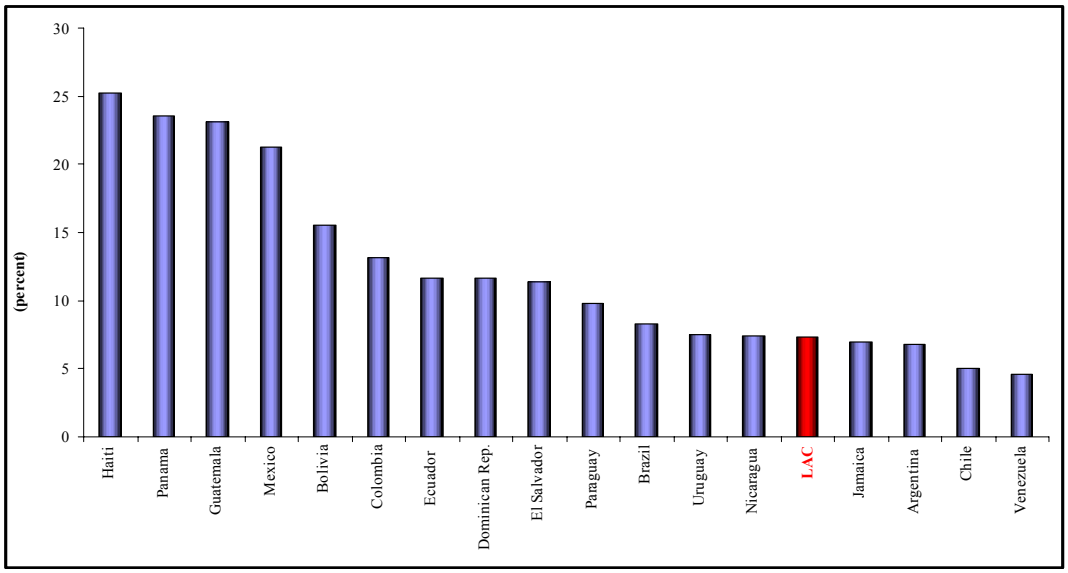


Source: COMTRADE.

Agriculture also plays an important role in national accounts. The average share of agriculture value added is around 9 percent for Latin America, with wide variations across countries (Graph 4). Haiti has the highest share of 25 percent, followed by Guatemala and Paraguay, whose shares exceed 20 percent. However, this index underestimates the real economic importance of agriculture because it does not include the downstream activities of agro-industries such as dairy, meat production, or processed foods.

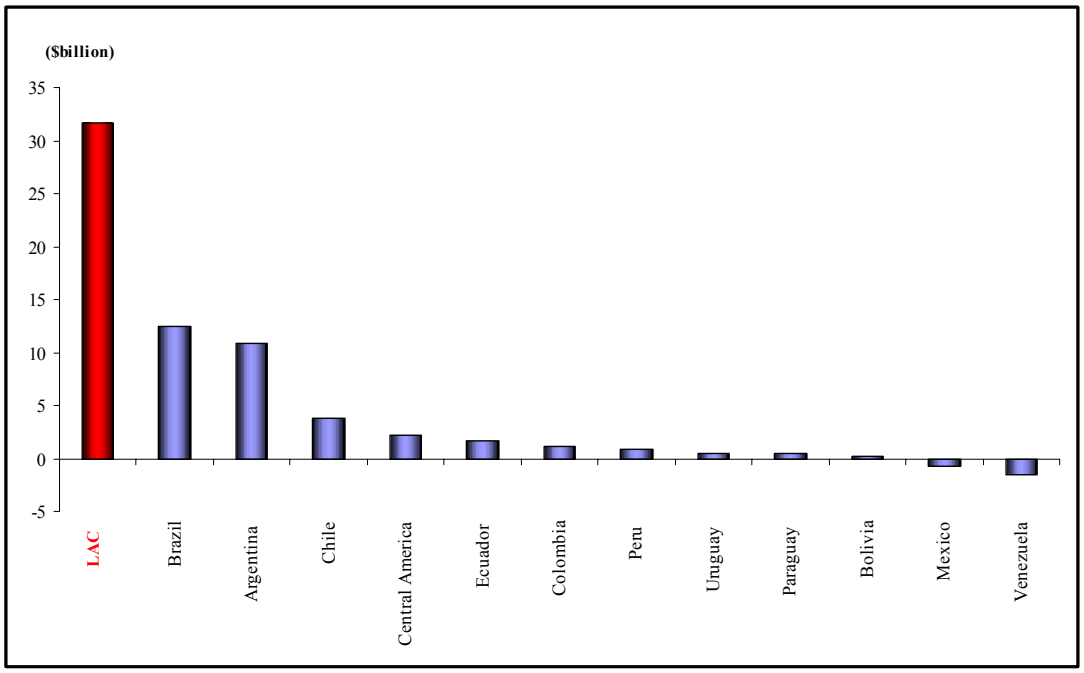
Last but not least, Graph 5 presents the external balance of agricultural trade for major countries in Latin America in 2001, which is the base year of this and other comparable CGE-based impact evaluation studies. Latin America as a whole displays a trade surplus of $32 billions in agriculture. Argentina and Brazil contribute to a large extent to the regional trade surplus, although Chile, Central America and the Andean counties also run a smaller surplus. In contrast, Venezuela runs the most acute trade deficit ($1.6 billions) followed by Mexico. The net trade position of any single economy is an important determinant of the trade and welfare impact of trade liberalization, and therefore explains to great extent the negotiation stance in multilateral trade talks.

Graph 4. Share of Agriculture in Total Value Added (2001)



Source: World Bank's World Development Indicators.

Graph 5. External Balance in Agricultural Trade (2001)



Source: COMTRADE.

3. Key Distortions and Barriers in Global Agricultural Trade

This section analyzes three pillars of impediments distorting agricultural trade in global market: market access, domestic support, and export subsidies. This overview gives a clear picture of the current levels of protection imposed by major agricultural players, and provides essential base in analyzing the simulation results reported later.

Market access refers to elements related to tariffs and other kinds of border protection, which includes tariff quotas, tariff quotas administration, special safeguards, importing state trading enterprises, and so on. Trade barriers in this form allow inefficient domestic producers in operation, hinder a more efficient domestic resource allocation, and lower demand of foreign goods, which would be otherwise competitive in the domestic market. As recent studies show, market access in the form of tariffs is the most trade-distorting measure of all, and this is why this pillar is the core in the negotiations particularly for developing countries including Latin America.

Domestic support constitutes different forms of production subsidies that distort the market conditions. This measure enhances an oversupply of agricultural products, and helps to retain domestic resources in agriculture, which could be otherwise mobilized for more efficient sectors. The oversupply of agricultural commodities leads to lowering commodity prices in both domestic and international markets, and leads to an increased competition in the global market. Domestic support is classified according to boxes: Green, which includes those subsidies with minimal distortional effects (non price support schemes, non product specific); Amber, which includes subsidies or direct payments with important effects on domestic markets such as price support schemes, payments by quantity of production, etc.; and, Blue box, which includes direct payments with some scheme of reduction in production or set aside programs.

Export subsidies includes any payments or fiscal outlays to producers, in order to sell domestic products in the world market. Under this pillar, there are also other kinds of distorting measures, such as export credits, food aid, exporting state trading enterprises, and so on. The direct payments or simply export subsidies, according to the WTO mandate, should be eliminated, since they are the most distortional scheme in this category.

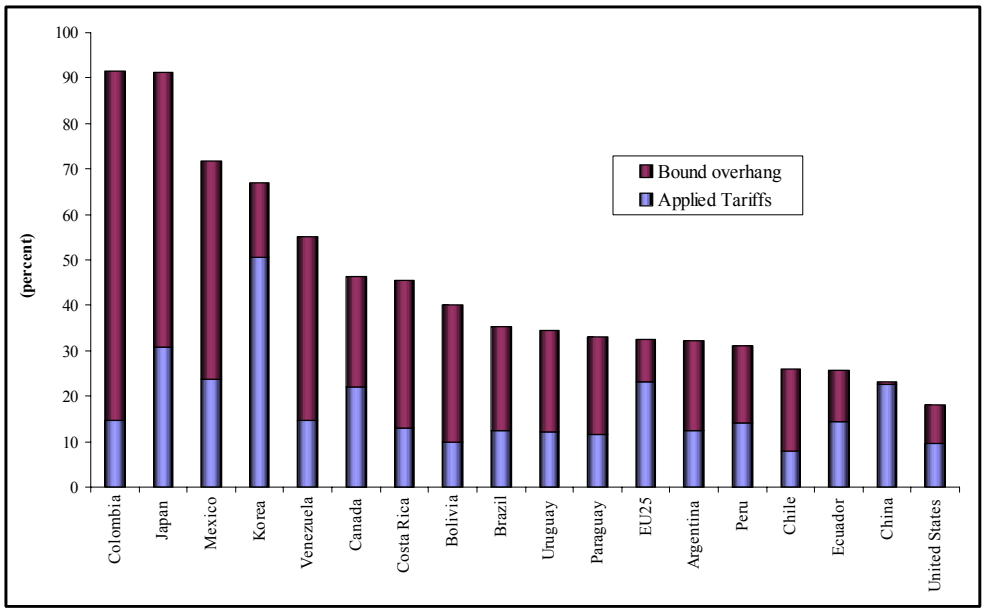
Graph 6 presents a clear picture of the average and bound tariff composition. There is an important level of bound overhang or sometimes called "water". As seen, there is no direct correlation between the level of the bound overhang and stages of development. Colombia and Mexico show high levels of bound overhang, together with Japan. This is a very important point in the negotiations, because the reduction commitment will be applied to the bound tariffs; the tangible reduction in the applied tariffs is only achieved by the effective reduction in the bound tariffs. For example, in order to reduce the average applied tariffs in Colombia, there should be an average reduction in the bound tariffs by 80 percent or more. That means that even a 50 percent reduction would no be enough to reduce the applied tariffs in Colombia.

Table 1 presents the main tariff-related statistics—average, standard deviation and maximum tariffs—for both bound and applied tariff categories for countries included in the model. These tariffs are measured from each tariff line schedule based on the Harmonized Tariff System (HTS), following the "Ad valorization" process of the Uruguay Round.[4] In general, developed countries have higher protection in both bound and applied tariffs than developing countries. Most developed countries apply higher maximum tariffs and large degree of standard deviation. This implies that these countries have a wide

[4] First, tariffs including *ad valorem* equivalents are evaluated at the HTS 8-digit level, whenever data is available. Second, they are converted into 6-digit, using simple average estimation. Finally, the sectoral tariffs are estimated as trade-weighed rates, following sectoral concordance between tariff lines and model sectors.

range of weak agricultural sectors, which would require prohibitive tariffs to protect domestic producers from strong foreign competition. Japan is the typical case, followed by the EU25.[5] Compared with other developed countries, the United States, the largest trade partner for most of the Latin American countries, has relatively modest average protection, but retaining high maximum tariffs. In this respect, Mexico is an exception; the country, among developing countries, maintains the highest protection on both applied and bound tariffs.

Graph 6. Tariff Composition for Latin America and Major Partners (2001)



Source: IDB-INT FTAA database and AMAD database.

Table 1. Statistics of Bound and Applied Tariffs for Latin America and Major Partners (2001)

(percent)

Country/Region	Bound Tariffs			Applied tariffs		
	Average	Standard deviation	Maximum tariff	Average	Standard deviation	Maximum tariff
Argentina	32.2	7.0	35.0	12.3	5.5	22.5
Bolivia	40.0	0.4	40.0	10.0	0.2	10.0
Brazil	35.4	10.2	55.0	12.5	6.2	22.5
Canada	46.4	86.5	538.0	21.9	62.4	538.0
Chile	26.0	5.5	98.0	8.0	0.0	8.0
China	23.1	19.5	121.6	22.5	19.9	121.6
Colombia	91.5	34.3	227.0	14.6	5.4	20.0
Costa Rica	45.5	24.4	233.1	12.9	17.2	154.0
Ecuador	25.8	10.4	85.5	14.4	5.7	20.0
EU25	32.4	54.1	817.3	23.1	49.0	817.3
Japan	91.2	180.2	2419.6	30.7	107.0	2419.6
Korea	67.0	142.4	907.1	50.6	133.4	907.1
Mexico	71.7	185.6	1404.0	23.8	38.1	260.0
Paraguay	33.0	5.7	35.0	11.6	5.4	32.0
Peru	31.2	6.0	68.0	14.0	4.9	20.0
Uruguay	34.5	7.7	55.0	12.1	5.4	35.0
United States	18.0	34.2	350.0	9.7	26.4	350.0
Venezuela	55.2	33.5	135.0	14.7	5.4	25.0

Source: IDB-INT FTAA database and AMAD database.

[5] In this study, the European Union and the EU25 are interchangeable, unless otherwise noted.

Table 2 reports domestic support and export subsidies for countries and regions included in the model. The former combines all the expenses actual allocated in the Amber and Blue boxes, estimated from the OECD Producer Support Estimate (PSE),[6] whereas the latter is taken from the WTO notifications. In the estimation, we take special care to avoid double-counting in protection, which occurs when tariff and subsidies are applied altogether to the same products, particularly to products with price support schemes (De Gorter and Ingco; 2002). The simple estimate of the support as the difference between the international price, called the reference price, and the intervention price could be misleading, if tariffs are present. In order not to double-count protection, we estimate the price support, as the difference between the reference price plus tariffs and the intervention price.

In 2001, the global domestic support amounts to $US 95 billion. The European Union is by far the single largest user, accounting for 40 percent of the global amount, followed by the United States.[7] In Latin America, Mexico and Brazil are the largest users, but their shares are small, below 2 percent of the global total. On export subsidies, the European Union is almost the only user, allocating $US 2.6 billion, and none of Latin American countries uses this type of trade-distorting measure.

Table 2. Domestic Support and Export Subsidies (2001)

Country/Region	Domestic Support*		Export Subsidies	
	Values ($US milion)	Share (%)	Values ($US milion)	Share (%)
EU25	38,733	40.7	2,622	96.4
United States	26,264	27.6	32	1.2
Japan	13,047	13.7		
Korea	7,451	7.8		
China	5,711	6.0		
Mexico	1,722	1.8		
Brazil	1,271	1.3		
Canada	807	0.8	66	2.4
Venezuela	145	0.2		
Argentina	62	0.1		
Colombia	48	0.1		
Uruguay	1	0.0		
World	95,262	100.0	2,720	100.0

Source: OECD PSE and WTO notifications.
Note: * in blue and amber boxes.

As with tariffs, the bound overhang also applies in the current levels of domestic support. Under the Uruguay Round, member countries committed themselves not to spend beyond the agreed levels of support measure by the Aggregate Measurement of Support (AMS).[8] Argentina is the only country that

[6] The PSE is an indicator of the annual monetary value of gross transfers from consumers and taxpayers to support agricultural producers, measured at farm gate level, arising from policy measures, regardless of their nature, objectives or impacts on farm production or income.

[7] Although the OECD PSE is the source for this estimation, Table 2 does not include several counties such as Norway, Switzerland, Australia, New Zealand, and Turkey, as these countries belong to the "rest of world" in the model. But the values in the Table account for more than 95 percent of the world, and the regional or country share does not change much, because countries excluded from the Table are not heavy users in domestic support.

[8] The Aggregate Measurement of Support (AMS) is an another indicator, on which the domestic support discipline for the Uruguay Round Agreement on Agriculture is based. It is determined by calculating a market price support estimate for each commodity receiving such support, plus non-exempt direct payments or any other subsidy not exempted from reduction commitments, less specific agricultural levies or fees paid by producers. It differs from the PSE in many respects. The most important difference is that price gaps in the AMS calculation are estimated by

almost spends the full amount of its allowed domestic support, although the country is not a big user. On the other hand, the United States and the EU25, the world's two largest users of domestic support, spend 70 percent and 55 percent of their authorized levels, respectively, whereas Japan applies only 15percent.

Following De Gorter and Ingco (2002), we estimate *ad valorem* equivalents of domestic support and export subsidies in 2001. Table 3 presents the estimated equivalents of domestic support on both Amber and Blue boxes. As with tariffs, the European Union and United States impose considerably high *ad valorem* equivalent rates mostly on farm crops, such as *paddy rice*, *wheat*, *cereal grains*, *oilseeds and soybeans*. However, there are clear distinctions between the two in the application of this trade-distorting scheme. While the former uses domestic support measure mostly in Blue box, the latter applies it in Amber box. In the EU market, *bovine meat* is also protected with high barriers in Blue box. In Latin America, Mexico and Brazil provide domestic support measures for a wide range of agricultural sectors. In farm crops, *wheat* is the most protected with more than 15 percent of *ad valorem* equivalent in both countries, followed by *cereal grains* and *paddy rice*. In Mexico, *other agricultural products* are also protected with hefty barriers beyond 16 percent. Across Asia, sensitive *paddy rice* is the most heavily protected farm crop: 35 percent protection in Asia 3, and 27 percent in Asia 7.[9] In Asia 3 region, *bovine meat* is also heavily protected from foreign competition, followed by *cereal grains and other agricultural products*.

Table 3. *Ad Valorem* Equivalents of Domestic Support (2001)

(percent)

	Canada	United States		Mexico	Colombia	Venezuela	Argentina	Brazil
		Amber	Blue					
Paddy rice		25.85	2.11	5.94	0.96			7.95
Wheat	5.67	16.99	8.77	15.15				15.18
Cereal grains	11.98	15.93	4.85	9.83		9.55		9.90
Oil seeds and Soybeans	7.90	23.50	4.59	6.88				3.94
Vegetables and fruits								
Sugar cane								
Coffee and cocoa					1.84		5.22	0.85
Livestock		0.23		0.48				
Other agricultural products	0.75	21.55		16.57	0.48			4.06
Bovine meat	1.70	1.27		1.45				1.91
Pork and poultry meat	0.81	1.39		0.73				2.49
Dairy products								
Processed sugar		3.40		1.22				1.92
Other food products								

	Uruguay	EU25		China	Asia 3		Asia 7	
		Amber	Blue		Amber	Blue	Amber	Blue
Paddy rice		1.47	20.67	2.00	34.88	1.10	27.60	2.50
Wheat		2.02	35.20	2.02				
Cereal grains		3.86	55.92	2.35	11.53	0.48	0.52	
Oil seeds and Soybeans		0.56	15.31	9.35			0.78	10.47
Vegetables and fruits	0.39			0.03				
Sugar cane								
Coffee and cocoa								
Livestock		0.04	0.04	0.13			0.15	
Other agricultural products		1.53	0.41	19.54	19.24		3.54	2.63
Bovine meat		1.11	8.87	2.76	25.46		1.75	
Pork and poultry meat		0.85	1.88	8.49	0.47		0.31	
Dairy products								
Processed sugar		2.50	0.10	7.99				
Other food products								

Source: OECD PSE.
Note: Data for countries other than the United States, EU25, Asia 3 and Asia 7 are on Amber box equivalents.

reference to domestic administered prices and not to actual producer. In addition, many budgetary transfers included in PSEs are excluded from the AMS.

[9] Asia 3 comprises Korea, Malaysia, and Thailand, and Asia 7 is made up from Hong Kong, Indonesia, Japan, Philippines, Singapore, Taiwan, and Vietnam. See Annex Table A.1 for regions and countries in the model.

Table 4 reports the *ad valorem* equivalents of export subsidies for Canada, the United States and the European Union—the single largest user in this form of trade-distorting measure. The European Union provides extensive subsidies on farm crops and food products in a wide range. The most protected product is processed sugar with 18 percent of *ad valorem* equivalent, followed by *paddy rice* (15 percent) and *dairy products* (7 percent). In North America, *dairy products* are the single recipients of export subsidy support. The sector is heavily protected in particular in Canada with 17 percent of *ad valorem* equivalent, and around 4 percent in the United States.

Table 4. *Ad Valorem* Equivalents of Export Subsidies (2001)

(percent)

	Canada	United States	EU25
Paddy rice			15.19
Wheat			3.29
Cereal grains			2.38
Oil seeds and Soybeans			0.11
Vegetables and fruits			
Sugar cane			
Coffee and cocoa			
Livestock			
Other agricultural products			
Bovine meat			3.89
Pork and poultry meat			0.59
Dairy products	17.00	3.71	6.92
Processed sugar			18.31
Other food products			0.12

Source: Authors' estimation based on WTO notifications.

4. The Doha Round of Trade Negotiations

4.1. Main Actors and Their Positions

In November 2001, the Doha Round was officially launched at the Fourth Ministerial Meeting in Doha, Qatar. The mandate for the negotiations is termed as the so-called "Doha Development Agenda (DDA)", which has since played a central role of the development perspective in the negotiations. Since the very beginning, member countries have reaffirmed their continued efforts to maintain the process of reform and to liberalize trade in promoting economic development, growth and alleviating poverty, governed in the multilateral trading system. In the declaration, the high ambition and enthusiasm, strongly ensuring the principles and objectives of the DDA, was particularly expressed:

"*Building on the work carried out to date and without prejudging the outcome of the negotiations we commit ourselves to comprehensive negotiations aimed at: substantial improvements in market access; reductions of, with a view to phasing out, all forms of export subsidies; and substantial reductions in trade-distorting domestic support. We agree that special and differential treatment for developing countries shall be an integral part of all elements of the negotiations and shall be embodied in the schedules of concessions and commitments and as appropriate in the rules and disciplines to be negotiated, so as to be operationally effective and to enable developing countries to effectively take account of their development needs, including food security and rural development*".

As the passage above states, member countries committed themselves to comprehensive negotiations, and agreed to initiate negotiations for continuing the agricultural trade reform process. In the negotiation

process, agriculture appears to be a central issue and sticking point particularly for developing countries, often stalling the process, as seen at the Cancun Ministerial Meeting in 2003, and Hong Kong Ministerial Meeting in 2005. The recent collapse of the Doha negotiations over disagreements particularly in agriculture put the global trading system at risk. Here we briefly review the positions of main actors in agriculture negotiated in three pillars.

The United States continuously offered and demanded an important market access for agricultural products. In this pillar, its position was aggressive and collided with the interests of the European Union. While retaining its position similar to some developing countries', the country often clashed with developing countries, regarding some of the items of the Doha mandate in food security and rural development. However, the pro-liberalization position in market access was counterbalanced by a more limited offer in domestic support. This was particularly the case with the launch of the so-called Farm Bill in 2002. The US position in this pillar is to keep the status quo of its current levels of support, and thereby collided with some developing countries, particularly the G20. It is important to remind, that all reductions in market access and domestic support will be made from the bound levels. In this respect, the US strategies would seek to reduce its current bound levels of support, without reducing applied levels effectively.

The European Union was in the opposite position with the United States. Due to weak competitiveness and political sensitivity particularly in large agricultural countries, it is extremely difficult for the bloc to make larger concessions. As a result, they request a large number of sensitive products, which will be treated under a special treatment in their reduction commitments. In terms of domestic support, the European Union continues to be by far the largest user. But after the Common Agricultural Policy (CAP) reform, the bloc switched their trade-distorting schemes from Amber box to Blue box that would require smaller levels of reduction, and to Green box, which calls for no reduction at all. After converting domestic support schemes in this way, the bloc's new position in this pillar was to offer greater and wider reduction without conceding much at home, demanding the United States to take a bold reduction commitment.

The G-20 was formed before the Cancun Ministerial Meeting by some developing countries, when they saw that the negotiation process was moving out of their interests.[10] The G-20 asked for an important reduction commitment in both market access and domestic support. Moreover, in viewing the disguised schemes in domestic support of the European Union, they have also demanded discipline in the Blue box. Because none of them is a big user of domestic support, their position in this pillar was common and radical. However, their position in market access was somewhat divided; some members with strong agriculture like Argentina and Brazil requested a large market access,, while others such as India and China preferred to be more cautions in this pillar. Despite these differences, they increased their bargaining power and showed a strong negotiating position. To make matters complicate, the European Union and the United States asked the G-20 more greater access in non-agricultural goods. This proposal was unacceptable for some of the G-20 members, particularly Argentina, Brazil and India, unless the European Union would make larger concessions in agricultural market access.

[10] The G20 (Group of 20) is a bloc of developing nations established on 20 August, 2003 that emerged at the 5th Ministerial WTO conference held in Cancún (Mexico) in September 2003. The group has pressed for a reduction of trade-distorting farm subsidies and for greater access to industrialized markets. Its official appearance occurred as a response to the text released by the EC and the US with a common proposal on agriculture for the Cancún Ministerial. The original group of signatories of the 20 August 2003 document went through many changes and the title G-20 was finally chosen in honor of the date of the group's establishment. In March 2006, the group consisted of 21 nations: Argentina, Bolivia, Brazil, Chile, China, Cuba, Egypt, Guatemala, India, Indonesia, Mexico, Nigeria, Pakistan, Paraguay, Philippines, South Africa, Tanzania, Thailand, Uruguay, Venezuela and Zimbabwe. Fluctuating members have included Colombia, Costa Rica, Ecuador, El Salvador, Peru and Turkey.

At the WTO agriculture negotiations in 2004, the G-33,[11] mainly smaller and food-importing developing countries, submitted their proposal on market access, particularly on special products (SP) and special safeguard mechanism (SSM). Their position was similar to that of the G-20, but they demanded a more flexible special treatment and asked to keep and extend the Special Safeguard. This measure allows a member to raise its tariffs above the bound levels, when the country would face a substantial decrease in the world prices or a surge in imports. They argue that this scheme permits them to isolate from the effects of trade and helps to promote rural development. In the negotiations, they look for an automatic and almost unlimited use of SSM. This proposal did not arouse a big issue for the united States and the European Union, but it was unacceptable for the G-20, because they believed that the offer would constitute a step back and could increase the volatility of international prices.

4.2. Doha Scenarios for Agricultural Liberalization

In recent year, a number of studies evaluate the effects of the current Doha Round, reflecting high expectations and ambitions expressed in the course of the negotiations. Among others, Polanski (2006) analyses the Doha impact in 9 scenarios, which also include liberalization for non-agricultural sectors. The moderate liberalization scenario in agricultural trade is called the "Doha Round for Agriculture". Her analysis assumes the reduction of tariffs by 36 percent for developed countries and 24 percent for Developing countries. Export subsidies are completely eliminated, whereas domestic support is reduced by one third. This scenario is similar to the reduction commitment under the Uruguay Round. But from the Latin American perspective, its country coverage is limited: only Argentina, Brazil and Mexico as a single country; and two broad regions—rest of Latin America, and Central America and the Caribbean.

Anderson et al (2006) take a different approach. They consider 8 hypothetical scenarios for agricultural liberalization, using the LINKAGE model. But their analysis largely focuses on country- or region-wide comparisons on selected macroeconomic and trade indicators, and mostly deals with full global merchandise trade liberalization. One of the important aspects is that they use a dynamic model, which captures capital accumulation effects and endogenous productivity gains. In terms of geographic coverage, their model identifies large LAC countries—Argentina, Brazil and Mexico—but aggregates other countries into a broad group (rest of Latin American and the Caribbean region).

Bouet et al (2006) evaluate the Doha Round, applying the dynamic MIRAGE model. One of the features is broader geographic coverage: 41 countries and regions in the world. In Latin America and the Caribbean, their model accommodates 8 countries—Argentina, Brazil, Chile, Colombia, Mexico, Peru, Uruguay and Venezuela, plus 3 aggregated regions: Caribbean economies, rest of America, and rest of South America. They analyze the impact for 2 Doha ambitious (based on US tariff formula on agriculture) and unambitious (EU tariff formula) scenarios, in comparison with full trade liberalization, which is used as a reference throughout the analysis. As with Anderson et al (2006), the Doha effects are evaluated largely in terms of macroeconomic variables for countries identified in the model. Their results, however, must be taken with care, because the impact presented in the study reflects the effects of liberalizing non-agricultural sectors that can influence substantially relative prices and factor remunerations.

[11] The G-33 comprises 42 developing countries, which are concerned about food security, livelihood security and rural development needs, and include: Antigua and Barbuda, Barbados, Belize, Benin, Botswana, China, Congo, Cote d'Ivoire, Cuba, Dominican Republic, Grenada, Guyana, Haiti, Honduras, India, Indonesia, Jamaica, Kenya, Korea, Mauritius, Madagascar, Mongolia, Mozambique, Nicaragua, Nigeria, Pakistan, Panama, Peru, Philippines, St Kitts and Nevis, St Lucia, St Vincent and the Grenadines, Senegal, Sri Lanka, Suriname, Tanzania, Trinidad and Tobago, Turkey, Uganda, Venezuela, Zambia, and Zimbabwe.

In designing the Doha agricultural liberalization scenarios, we work with real proposals presented by the main actors in the negotiations. Taking into account the bound overhang that exists in tariffs and domestic support, we estimate accurate reduction schedules for these measures at each tariff line. Thus, scenario design based on actual proposals is one of key features of our study, and clearly differentiates the work from other previous studies.

In order to estimate accurate reduction schedule for the sectors in the model, the following methodologies are taken. First, percentage reductions on the bound tariffs are evaluated based on the real proposals. Second, these reductions are used to estimate percentage perforation in the applied tariffs, considering tariff overhang. Third, these tasks are undertaken at each tariff line level, following the estimation. Finally, the estimated percentage reductions are aggregated into our sectors and countries, following the sectoral concordance. In estimating *ad valorem* (AVE) equivalents for bound tariffs, we follow the methodologies used by the WTO during the negotiation process, in order to make the reduction from the same points, where countries would eventually have done. The IDB-INT FTAA databases benchmarked in 2001 is used for MFN applied tariffs and the AMAD database to estimate the bound tariffs for each country.

Based on the last proposals submitted to the negotiation tables, We come up with 8 scenarios. In order to measure the impact of sensitive products, 3 key scenarios proposed by main actors (G20, European Union, and the United States) are split into two variants: with vs. without sensitive products. In addition, two additional scenarios are added to serve as a reference. One is the New Uruguay Round scenario, in which the reduction commitments of the previous Round are reproduced. This scenario specifically considers general reductions by 36 percent for developed countries and 24 percent for developing countries in market access. The other is concerned with the so-called "Swiss Formula" scenario with coefficients of 25/35 (developed/developing). This scenario is demanded by the ABI countries (Argentina, Brazil and India), in order to balance reduction commitment between agricultural and non-agricultural products.[12] In addition, departing from the original positions, we also consider one of the features of the July Framework,[13] which ask for the "fullest liberalization for tropical products". Although tropical products are not well defined, we apply the complete liberalization to the non-controversial list of tropical products (see Annex B). It is reminded that the simulation exercises only deal with liberalization in agriculture, without changing trade regime in non-agriculture.

One of the most important issues of the proposals is the treatment of sensitive products. These products would have a lower reduction according to the band they belong, but tariff quota access should be given as a compensation to these lines. Due primarily to the difficulties in estimating quota creation or expansion, however, we do not consider this issue. Moreover, we also assume 50 percent of deviation of tariff cuts for these products in each band.

Another important issue related to the sensitive products is the selection of these products, as countries have discretionary right to designate tariff lines as sensitive products. There is no formal criteria or effective constraints in choosing these products. To this end, it is assumed that countries will choose these products, whose perforations in the applied tariff are the greatest. In other words, after applying the tiered formula, tariff lines that have the largest reduction in the applied tariffs are selected as sensitive products.

With these treatments and assumptions, Table 5 lists the scenarios based on the actual proposals, and Annex B reports the main proposals for G-20, the European Union and the United States in terms of

[12] For non-agricultural products, the coefficients are 5/10. However, because the current levels of protection in agricultural and non agricultural products are different, applying the same coefficients would lead to extremely large reductions in agricultural products than in non-agricultural products.
[13] WT/L/579

modalities. Note that they are not exactly in the format of the proposals, but are designed to capture the essence of the respective positions of each group.

Table 5 Doha Scenarios for Agricultural Liberalization

Index	Scenarios
1-A	G20 proposal with sensitive products
1-B	G20 proposal without sensitive products
2-A	EU proposal with sensitive products
2-B	EU proposal without sensitive products
3-A	US proposal with sensitive products
3-B	US proposal without sensitive products
4	New Uruguay Round
5	Swiss formula for agriculture

5. The IDB Agricultural CGE Model

5.1. A Brief Description of the Model

We evaluate the Doha Round liberalization on agriculture, using a newly developed computable general equilibrium (CGE) model. The model is in the tradition of recent trade-focused multi-region CGE models, developed to analyze the impact of trade policy changes amid the proliferation of regional integration in the last decade and particularly the Doha Round trade negotiations

The model for this study is a global multi-region, multi-sector, static general equilibrium model. It is highly nonlinear, and simulates for a decentralized market economy. All regions are fully endogenized and linked only through trade. The model, thus, deals with the real side of the economy and does not consider the financial or monetary markets. The model incorporates 18 regions and countries, identifying key countries in Latin America (Table A.1 in Annex A). Each region or country consists of 30 sectors, which are aggregated into 7 macro-sectors (Table A.2 in Annex A). The base year of the model is 2001. The model is built on the individual Social Accounting Matrices (SAMs) for each region and country, at the base year. Table 6 summarizes the major modeling framework and assumptions, and Annex C presents the full technical specifications of the model.

Each region in the model traces the circular flows of income through factor payments from producers to institutions—households, firms and government—and capital market, and finally back to demand for goods in commodity markets. These institutions represent the economic agents whose behaviors and interactions are explicitly specified in the model. Consumption, intermediates, government consumption and investment are the four components of domestic demand. Households in each region choose the optimal levels of commodity bundles for consumption by maximizing their utility, subject to their budget constraint and given prices in commodity markets. Intermediate demand is determined by fixed input-output coefficients. Government receives income from a variety of taxes plus foreign borrowing, and allocates for pubic consumption, subsidies to domestic institutions, and foreign payments.

In addition to 30 sectors in each region (country), the model includes 4 types of factors: land, natural resources, labor and capital. Output is specified by a constant elasticity of substitution (CES) with a constant returns-to-scale technology among primary factors, while intermediate inputs are determined in fixed proportions. Each factor demand is derived from profit-maximizing behavior by producers, given

factor returns (labor wages, capital rent and land prices). However, factors do not necessarily receive a uniform returns across sectors. Instead, the model incorporates factor market rigidities or distortions, which exogenously fix the ratios of the relative sectoral returns to the economy-wide average return for that factor at benchmark.

The treatment of international trade follows the standard specifications in common with other CGE models. The model specifies a set of export-supply and import-demand equations for traded sectors, following the national product differentiation allowing that products produced in different regions are imperfect substitutes. Both exports and imports are modeled in a two-stage nested structure. Exports are modeled in a constant elasticity of transformation (CET). The optimal allocation of supply is determined by revenue-maximizating choice between domestic sales and aggregate export supply at the upper stage, and among exports destined to different markets at lower stage. At the lower stage, however, the specification of imperfect substitutes for some products in certain regions or countries can be partially or entirely turned off, permitting perfect substitutes. Imports are modeled by a constant elasticity of substitution (CES) function, following the "Armington" assumption. The optimal allocation of demand is determined by cost-minimization choice between domestic demand and aggregate import purchases at the upper level, and imports from different markets at lower stage.

Table 6. Main Framework and Assumptions of the IDB Agricultural Model

Items	Description
1. Production Sectors	All regions and counties produce 30 goods using primary factors of production and intermediate inputs with a CES production function under CRS technology.
2. Market Structure	All sectors face a perfectly competitive market structure.
3. Demand	Final demand is derived from the households' utility maximizing behavior subject to their budget constraint. Intermediate demand is determined by the fixed input-output coefficients.
4. Trade	Exports are specified by a CET function, while imports are modeled with a CES specification. Both exports and imports are constructed in a two-stage nested structure.
5. Factors of Production	
(i) Land	Sectorally fixed for developed regions and countries. For developing regions and countries, land is sectorally mobile, but total supply is fixed.
(ii) Natural resources	Sector specific, and fixed.
(iii) Labor	Labor has 2 categories: skilled and unskilled. Unskilled category in developing regions and countries is segmented into 3 main activities: agriculture; foods, and other industries. Labor is mobile over sectors or within each segmented market. Labor supply is fixed, so is in each segmented market. No international migration is allowed.
(iv) Capital	Sectorally mobile, but immobile internationally. Total supply is fixed for each region and country.
6. Trade-linked Total Factor Productivity (TFP)	TFP is modeled as an increasing function of aggregate imports of capital and technology-intensive products, multiplied by the share of intermediate inputs in sectoral imports.
7. Macro Closures and Assumptions	
(i) Saving-Investment	Current amount of investment are fully financed by savings within each region and country.
(ii) Balanced Trade	Trade remains balanced for each region and country; namely, initial balance of trade in goods and services remains constant.
(iii) Balanced Budget	Public finance remains balanced, including fixed income transfers and exogenous foreign transactions.
(iv) No Financial Market	The model only deals with the real side of the economy.

In factor markets, the model applies different treatments, reflecting certain features of each factor and geographic differences. Land is used only for agriculture, and sector-specific in developed regions, while it is mobile across sectors in developing regions. Natural resources are sector-specific in both developed and developing regions, and used for resource-based energy sectors and part of agriculture. Capital is mobile only within each region, and its aggregate supply is fixed at benchmark. The treatment of labor is differentiated (see the following subsection). No international labor migration is allowed beyond national borders.

In the model, there are three key macroeconomic closures or balances: government balance; saving-investment balance; and balance of external market. For government balance, government savings derived from the difference between current revenues and expenditures are flexible variables, while all transfers and external accounts are fixed. To control any possible welfare effects of variations of government spending, real spending for government consumption is exogenously fixed. For saving-investment balance, the current amount of investment is completely financed by the aggregate savings in each country due to the nature of the static framework. In the model, private saving rates (marginal propensity to save) for the representative household are free variables to balance aggregate savings and current among of investment in each region. Like government consumption, real investment demand is exogenously fixed. For external market, trade is balanced for each region valued at world prices, and exchange rates in each region are equilibrating variables. In other words, initial balance of trade in goods and services remains constant.

5.2. Extensions and Innovations of the Model

Beyond the standard applied general equilibrium models, our model is extended in several ways to capture economic reality in Latin America and to serve for the objectives of the study. First, the model accommodates a large number of agriculture-related sectors, decomposed into three main activities: 4 land-intensive agriculture, 6 labor-intensive agriculture, and 5 processed food industries. This is because the primary objective is to measure the value of the Doha Round on agriculture at greater accuracy at disaggregated levels, taking into account heterogeneity in economic structure, sensitivity and national interests.

Second, the different treatment and closure are applied to labor market, which is decomposed into skilled and unskilled classes, to capture peculiar socio-economic characteristics, rigidities, and geographic differences. The standard treatment applies to skilled labor; workers in this class are mobile across sectors, but internationally immobile. On the other hand, unskilled labor market is segmented into 3 macro-sectors: agriculture; processed foods; and other industries. Unskilled workers can only move within each macro-sector, but cannot move to others. For example, unskilled workers can shift from paddy rice to vegetables or coffee plantations, but cannot be move to food industries, manufacturing or services. Likewise, unskilled labor in industries can move to other manufacturing industries or services, but cannot move to agriculture or food industries. Because this type of market rigidity is quite common in many developed and in particular developing countries. We apply this treatment to all developing regions and countries.

Third, the model incorporates trade-induced productivity gains that lead to an increase in efficiency in the production process. It is widely acknowledged that trade liberalization or trade openness has dynamic effects on productivity resulting from economies of scale, externalities, technological spillovers, specialization increased investment and so on.[14] Numerous empirical studies show that developing

[14] While acknowledging the importance and wide empirical studies, some modelers dismiss this concept, due to the following arguments. First, the applications to the CGE models are based on *ad hoc* methodology. Second, direct

countries can boost domestic productivity through technological spillovers by importing a variety of intermediate and capital goods that embody foreign knowledge. Several notable works include Coe and Helpman (1995); Coe, Helpman and Hoffmaister (1997); and Schiff, Wang and Olarreaga (2002).[15] Some studies apply this endogenous link into the CGE models. They include: de Melo and Robinson (1992); Lewis, Robinson and Wang, 1995; Hinojosa-Ojeda, Lewis and Robinson (1995, 1997); and Polaski (2006). This is a crucial element in Latin America, where trade is a primary source of growth, global competitiveness and foreign currency earnings. Technically it is modeled that an increase in imports of capital products and intermediate inputs by regional integration raise total factor productivity (TFP), which is then transmitted to each sectoral production activity, via intermediate input transactions.

Fourth, the model is built on the IDB-INT FTAA database, which includes numerous regional trade agreements and preferential treatments in place in the Western Hemisphere and European Union. They include seven regional trade agreements: the North American Free Trade Agreement (NAFTA), the Central America Common Market (CACM), the Caribbean Community and Common Market (CARICOM), the Andean Community (AC), the Southern Common Market (Mercosur), the G-3 (Mexico, Colombia and Venezuela), and the new European Union (EU25). It also accommodates four bilateral agreements (Mercosur-Bolivia, Mercosur-Chile, Canada-Chile, and Mexico-Chile). In addition to the MFN (most favored nation) tariffs, the database also includes 3 US unilateral preferential treatments granted to developing countries: Caribbean Basin Initiative (CBI) for Central America and the Caribbean; Andean Trade Promotion and Drug Eradication Act (ATPDEA) for 4 Andean countries (Bolivia, Colombia, Ecuador, and Peru); and Generalized System of Preference (GSP) for other developing countries. For the European Union, MFN and country-specific GSP are taken from the TRAINS.

6. Simulation Results of the Doha Round on Agricultural Liberalization

The simulation results indicate that Latin America and the Caribbean as a whole would be a big winner from the Doha Round agricultural liberalization, even though the positive gains are modest in absolute scale. Nevertheless the overall gains will be greatly heterogeneous among countries and scenarios. Agricultural trade reform raises world prices of agriculture and alters terms of trade, which is one of the primary sources of the gains, according to the initial net trade balance positions in agricultural account. It is also revealed that tariffs of the market access pillar are the most important on trade and welfare effects, followed by domestic support and export subsidies. The inclusion or exclusion of sensitive and special products does change the aggregate trade and welfare effects for the region, and this matters for countries with high share of these products in agricultural exports.

This section analyzes the impact of the Doha Round scenarios on agricultural liberalization, from the Latin American perspective. The section comprises 4 parts. The first part presents the impact on macroeconomic variables: percentage changes in real GDP and income gains in terms of welfare, measured from the benchmark. The second part discusses underlying effects that account for these changes: impact on sectoral production, variations in factor returns. The third part examines changes in world prices and terms of trade, decomposed by three pillars. Finally the last part evaluates the impact on trade: (i) the aggregate impact on exports for Latin America, decomposed by three pillars; and (ii) the impact on sectoral exports for each Latin American countries or sub-regions. Whenever necessarily, our results are compared with recent studies in order to clarify the differences and possible reasons behind.

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linkage between trade openness and productivity is not founded on microeconomic basis, and parameters are not estimated with sufficient accuracy.

[15] Some county studies also include: Moreira (2000) and Muendler (2004) for Brazil; Lopez-Cordoba and Moreira (2002) for Mexico and Brazil respectively; and Roberts (2001) and Stiroh (2001) for the United States.

6.1. Impact on Macroeconomic Variables

Effects on Gross and Agricultural GDP

In all scenarios, the impact on gross GDP in real term is positive but very small to Latin America and the Caribbean as a whole. Under the scenario 3-B (US proposal without sensitive products), the region's GDP will rise the most by 0.013 percent from the base. This nearly corresponds to $260 million at 2001 value. Table 7 presents the impact on gross and agricultural GDP in real term valued at 2001 benchmark.

Table 7. Impact of Doha Scenarios on Gross and Agricultural GDP

	Base values ($billion)	1-A G20 Sensitive	1-B G20 No Sensitive	2-A EU Sensitive	2-B EU No Sensitive	3-A US Sensitive	3-B US No Sensitive	4 NUR	5 Swiss Formula
Real Gross GDP (percentage change from base)									
Argentina	258.4	0.033	0.035	0.030	0.033	0.049	0.049	0.022	0.038
Brazil	501.6	0.018	0.022	0.015	0.020	0.029	0.030	0.012	0.022
Chile	65.8	0.010	0.010	0.012	0.012	0.014	0.016	0.008	0.005
Bolivia	7.7	-0.007	-0.007	-0.020	-0.018	-0.006	-0.005	-0.006	-0.007
Colombia	79.3	-0.007	-0.006	-0.007	-0.006	-0.005	-0.005	-0.003	-0.007
Ecuador	17.9	0.035	0.039	0.031	0.038	0.065	0.066	0.023	0.024
Peru	52.1	-0.009	-0.006	-0.010	-0.006	0.000	0.001	-0.006	-0.003
Venezuela	124.7	-0.008	-0.007	-0.008	-0.008	-0.008	-0.007	-0.006	-0.006
Mexico	617.1	-0.017	-0.016	-0.015	-0.015	-0.014	-0.013	-0.009	0.003
Central America	70.3	0.003	0.010	-0.002	0.012	0.026	0.030	0.008	0.012
Rest of Western Hemisphere	183.9	-0.009	-0.002	-0.014	-0.002	0.015	0.018	-0.010	0.010
Latin America	**1,978.8**	**0.002**	**0.005**	**0.001**	**0.005**	**0.012**	**0.013**	**0.002**	**0.012**
Real Agricultural GDP (percentage change from base)									
Argentina	23.4	0.36	0.35	0.33	0.32	0.52	0.51	0.18	0.35
Brazil	38.6	0.95	1.06	0.75	0.94	1.50	1.52	0.57	0.85
Chile	7.2	0.47	0.46	0.42	0.40	0.66	0.64	0.20	0.51
Bolivia	1.5	0.11	0.10	0.09	0.10	0.15	0.15	0.06	0.10
Colombia	12.8	0.08	0.08	0.07	0.07	0.11	0.11	0.05	0.06
Ecuador	2.4	0.23	0.21	0.23	0.20	0.23	0.22	0.11	0.14
Peru	9.7	0.13	0.12	0.10	0.10	0.18	0.17	0.05	0.09
Venezuela	14.7	0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.07
Mexico	69.2	0.10	0.01	0.08	0.05	0.09	0.05	0.04	-0.07
Central America	12.1	0.25	0.24	0.21	0.20	0.34	0.33	0.13	0.17
Rest of Western Hemisphere	18.4	0.71	0.71	0.53	0.54	1.06	1.05	0.30	0.70
Latin America	**210.0**	**0.36**	**0.34**	**0.29**	**0.31**	**0.52**	**0.51**	**0.18**	**0.35**

Source: Authors' estimation.

Based on the impact on gross GDP, the LAC countries can be grouped into 3—winning, losing and conflicting groups. For winning group, the aggregate impact is positive in all scenarios. Argentina, Brazil, Chile and Ecuador belong to this group. Ecuador and Argentina appear to be the largest winners. On the contrary, the overall impact is negative for losing group, which includes Bolivia, Colombia and Venezuela. For conflicting group, the impact is mixed, depending on scenarios. Nevertheless this group tends to be closer to losing rather than winning group, as table shows. This group includes Peru, Central America, Mexico and rest of the Western Hemisphere.

The above results for Latin America need careful interpretations due to two reasons. First, our simulation exercises do not consider liberalization in non-agricultural sectors. As a result, the impact tends to be negative on non-agricultural trade, which in turn would reduce GDP in manufacturing and services. The larger the share of non-agricultural trade, the greater the negative impact on gross GDP. This well explains the negative impact on Mexico, which has the lowest share of agriculture in trade among Latin American countries. The second reason is the erosion of preferences. This is very serious particularly for Mexico, the country with high trade dependency on NAFTA partners, with 75 percent market share of Canada and the United States of its exports in farm crops and food products. Because each of the NAFTA

partners will commit themselves to undertaking greater cuts in applied or MFN tariffs for third partners, their actions would bring about tremendous negative effects on Mexico.

While identifying global winners and losers, Polaski (2006) does not provide clear analysis on LAC countries. For large Latin American countries, general directions of the impact are similar to ours. In comparing the effects with our most ambitious scenario, however, her results seem a little smaller than our results. For example, Polaski (2006) finds that Argentina increases its real income by 0.01 percent, while Mexico suffers the real GDP by 0.005 percent. These outcomes roughly correspond to the impact of the New Uruguay Round in our scenario.

Anderson et al (2006) shows substantially higher effects for LAC countries, although they do not explicitly present comparable figures, measured in percentage change in GDP. Instead, they evaluate the impact in terms of changes in welfare or real income. However, it must be stressed that these high gains are attributed greatly to their scenario design—complete liberalization in global merchandise trade. Besides, they use a dynamic model, which captures capital accumulation effects and accommodates exogenous increases in factor endowments particularly for labor.

Using the partial equilibrium AGLINK model, OECD (2006) examined the effects of general agricultural policy reform. Its scenarios are hypothetical, and not based on the actual negotiations. They combine two different models. First, the AGLINK model evaluates price effects through general reductions on tariffs and subsidies. Second, these effects are transferred to a general equilibrium model based on GTAP database. In spite of this two-step approach, some results for Latin America would be informative. In general, they find stronger effects. For instance, Brazil will increase its economy by 0.3 percent and 0.1 percent for Mexico. However, these results cannot be directly comparable, because largely of a partial equilibrium approach, which tends to generate stronger price effects. One of the drawbacks of the AGLINK model is its limited commodity coverage and focusing only on the agricultural sectors.

Finally, Bouet et al (2006) analyze the Doha Round, using the dynamic MIRAGE model, based on the latest GTAP database (2001). The Doha Round effects are evaluated for 2 ambitious and unambitious scenarios, in comparison with the full liberalization. They examine the full liberalization of both agriculture and non-agriculture, and find smaller effects than those by Anderson et al. (2006), but greater than ours. As with Polaski (2006), their results are instrumental and useful in evaluating how different the overall effects would be, when incorporating the non-agricultural sectors.

One important finding of these previous studies and ours is that the potential gains of the Doha Round on agriculture will not be large in absolute scale. But the impact varies from one country to another, and depends largely on scenario designs and methodologies applied in the models. Polaski (2006) use the methodology similar to ours, and the results are highly comparable.

As already seen in Table 7, the overall impact on GDP is small for LAC countries, but it is also important to examine the effects on agricultural GDP, because of its importance to each of the Latin American countries. As the bottom of Table 7 indicates, the magnitude and patters of the impact are completely different from those on gross GDP. For most LAC countries, the most ambitious US proposals generate the largest gains, followed by the G20 proposals and the EU proposals, whereas the New Uruguay Round scenario will be the least benefited. The Swiss Formula scenario is positioned in the middle. The exception is Mexico, which would suffer a slight loss in agricultural GDP under the Swiss Formula scenario. In the aggregate, agricultural GDP in Latin America increases by 0.18 percent under the least ambitious Swiss Formula scenario to 0.52 percent in the most ambitious US proposal. These gains correspond to $1.1 billion for the former and $ 380 million for the latter.

Brazil is the largest winner among LAC countries, ranging from an increase by 0.57 percent under the New Uruguay Round scenario to 1.5 percent under the most ambitious US proposal without sensitive products. Under this ambitious scenario, Brazil reaps the gain of agricultural GDP amounting to $0.57 billion. This implies that Brazil accounts for nearly half of the total gains for LAC countries. Argentina and Chile also benefit from global agricultural reform. Under the most ambitious scenario, their gains correspond to $0.12 billion and $0.05 billion, respectively. Thus, the South Cone countries accounts for nearly 70 percent of the gains in agricultural GDP in Latin America. On the other hand, Colombia and Mexico seem to benefit the least. In particular, Mexico would experience a reduction in its agricultural GDP only under the Swiss formula scenario.

Welfare Effects

Latin America will be a net winner in welfare, irrespective of the Doha Round scenarios. The region as a whole will increase its real income, measured by the Hicksian equivalent variation, from $1.1 billion under the least ambitious New Uruguay Round scenario to $3.7 billion in the most ambitious US proposal (scenario 3-B). However, welfare gains vary from one country to another. Argentina and Brazil, the largest agriculture exporters, are the largest winners. Brail increases its real income by around $1.2 billion, followed by Argentina with $0.9 billion. Table 8 presents the welfare effects of the Doha Round on agriculture for Latin America.

Table 8. Welfare Effects of the Doha Round on Agriculture

($million)

	1-A	1-B	2-A	2-B	3-A	3-B	4	5
	G20 Sensitive	G20 No Sensitive	EU Sensitive	EU No Sensitive	US Sensitive	US No Sensitive	NUR	Swiss Formula
Argentina	553.9	615.1	488.3	563.9	908.1	898.6	392.8	712.9
Brazil	647.6	796.6	465.6	684.6	1,155.5	1,193.0	391.5	890.7
Chile	126.2	132.7	117.9	130.1	169.4	173.9	91.7	83.1
Bolivia	-6.2	-0.3	-10.5	0.3	15.9	18.1	-5.0	5.0
Colombia	8.3	32.8	-12.3	33.3	93.0	101.7	11.1	29.2
Ecuador	62.5	69.5	55.4	68.1	91.7	94.9	50.1	33.8
Peru	-50.4	-7.4	-82.8	-4.8	112.9	128.2	-38.6	46.5
Venezuela	22.5	29.5	15.2	28.0	49.8	52.6	12.9	29.8
Mexico	47.4	71.1	26.8	69.9	167.9	184.2	19.4	26.4
Central America	141.1	182.0	101.6	173.6	300.1	315.0	108.5	118.9
Rest of Western Hemisphere	190.4	274.1	70.0	224.8	577.9	606.8	74.2	346.2
Latin America	**1,743.5**	**2,195.7**	**1,235.4**	**1,971.7**	**3,642.3**	**3,766.8**	**1,108.5**	**2,322.3**

Source: Authors' estimation.

A close examination reveals an important finding. Welfare gains are directly linked with market reform. Peru and Bolivia are the cases in point. These countries improve their welfare under the most ambitious US proposals, where they commit themselves to undertaking tariff cuts. But their gains are reversed in less ambitious scenarios (G20 or EU proposals), under which they do not require any reduction commitments. The same rationale applies to the welfare impact on other LAC countries, but within a positive range. As Roberts (2003) and other studies show, the greatest gains in developing countries come from their own agricultural reform. This means that countries, which have initially large distortions, will have greater potentials in reaping positive welfare gains by liberalizing their own agricultural markets.

Anderson et al. (2006) find bigger effects on welfare gains from the full liberalization: complete elimination of tariff and subsidies in agriculture. Latin America will generate its additional income by $28.7 billion in 2015 in equivalent variation. By country, real income will rise by $4.9 billion for Argentina, $9.9 billion for Brazil, $ 3.6 billion for Mexico, and $10.3 billion for the rest of Latin America and the Caribbean. On the other hand, Polaski (2006) finds smaller global effects including Latin America. Under the "Doha Round for Agriculture" scenario, real income will rise around $0.6 billion for the whole Latin America. Argentina will be the largest winner with real income gain by $358 million,

followed by Brazil ($251 million), whereas Mexico will be a big loser with the loss of minus $165 million.

6.2. Effects on Production and Factor Returns

Effects on Agricultural Production

This section examines the effects on production in agricultural sectors: farm crops and processed foods. Annex Table A.3 reports the sectoral impact on agricultural sectors for each Latin American country.

All Latin American countries increase the aggregate agricultural outputs under all scenarios.[16] Yet the gains are asymmetric over countries. Brazil, the biggest agriculture and food producer in the region, will be the largest winner, followed by Chile and Argentina. Brazil increases its agricultural production by 1.5 percent under the most ambitious US proposals. In contrast, gains in other countries are small. The erosion of preferences as a result of US dependency leads Mexico to the least benefited countries in Latin America, along with Bolivia and Colombia.

Throughout Latin America, *oilseeds and soybeans* (particularly *soybeans*), will be the largest winner. The Southern Cone countries expand production by 10 percent under the US proposals. This finding is importance, because these products are the key crops for these countries in terms of production and exports. Because of small production base, Mexico experiences sharp rise in production in these crops; outputs jump by more than 25 percent under the US proposals and 30 percent in the Swiss Formula.

Bovine meat is also a big winner for most countries in Latin America. Brazil, the largest producer and exporter in the region, enjoys strong push in production. In particular, output rises by 7.5 percent under the most ambitious US proposals. Argentina, another large producer, increases production but much slower pace. Chile also enjoys rapid growth (7 percent under the US proposals), but this high increase is thanks mainly to small production base. For other countries (Peru, Mexico, Central America and the rest of Western Hemisphere), outputs increase at modest rates. These asymmetric results depend on domestic production capacity and particularly trade links with the European Union, the largest *bovine meat* demander in the world and whose market is the most heavily protected before liberalization. On the contrary, *pork and poultry meat* will not be the sectoral winner in the region.

Processes sugar, globally most protected product, will be also a clear winner across Latin America. In particular, Central America and the rest of the Western Hemisphere will enjoy robust increases in production; under the US proposals, outputs rise by 4.8 percent and 15 percent, respectively. The favorable outcome is extremely important for Brazil and Mexico, region's main producers.[17] Under the US proposals, Brazil increases sugar production by 1 percent, while output modestly rise (0.4 percent) in Mexico.

The impact on grains varies over commodities and countries. *Cereal grains* will be clear winner in Latin America, except Bolivia. Brazil, Chile and Colombia enjoy strong increase in production. Non-export *paddy rice* is also likely to enjoy rising production in many Latin America, due largely to real income gains, although its output is not large enough in most countries. Mexico's growers are the largest beneficiaries, as output jump by more than 10 percent in all scenarios except the New Uruguay Round scenario, where production increases 6.5 percent. Production in Central America and the rest of the

[16] The only exceptions are Colombia under the New Uruguay Round scenario and Mexico in the Swiss Formula scenario, but the declines in agricultural production is marginal (see Table A.3.).

[17] According to the FAO for production estimates in 2004/5, Brazil is the largest sugar producer and exporter in the world and Mexico is positioned in the sixth place in production.

Western Hemisphere also rises substantially. On the other hand, the impact on *wheat* depends on whether the crop is exportable or not in the country. For non-exporting countries, which are the majority in Latin America, *wheat* production rises due to an increased domestic demand. For exporting countries such as Argentina and Mexico, *wheat* will be a losing sector, as exports decline. Argentina, the largest producer in the region, suffers decline in production by 2 percent under the US proposals.

The effects on *vegetables and fruits* are mixed. Ecuador and Central America enjoy booming production, and Brazil and Chile with modest expansion. Argentina experiences conflicting outcomes, depending on scenarios; production slightly increases under the modest scenarios such as G20 or EU proposals, but declines under the ambitious scenarios. For other countries, the effects are almost negligible, but tend to be in negative side.

Coffee and cocoa will be a big loser across Latin America. Under the US proposals, Production declines in Mexico, the largest producer in Latin America, by 0.7 percent, and Brazil, second largest, by more than 3 percent. Chile, whose production is small, is the most affected, with the decline by 10 percent.

The changes in production are accompanied by domestic resource allocation from affected to booming sectors. This process would be painful particularly for labor market in the shot run. The direction will generally follows the impact of production, although there are some substitutions among factors, as production technologies change. Labor reallocation process differs over skill categories; unskilled labor market is segmented, but skilled labor is not. In agriculture, unskilled workers mostly displaced from *coffee and cocoa*, move to booming *oilseeds and soybeans*, *cereal grains* or *vegetables and fruits*. In food industries, unskilled labor will be absorbed largely in *bovine meat* or *processed sugar*. On the other hand, skilled workers largely shift from processed food industries such as *pork and poultry meat* to dynamic agriculture.

Effects on Factor Returns

The impact on factor returns generated by agricultural trade reform is consistent with intuitions and well explains the aggregate income gains particularly in agricultural GDP. The patterns of the impact over scenarios and among factors are fairly similar over countries in Latin America, although absolute magnitude is different. The most ambitious US proposals generate the largest positive impact, followed by the Swiss Formula scenario. For every country in each scenario, G20 proposals will have greater impact than the EU proposals. On the other hand, the New Uruguay Round scenario is likely to generate the least returns for most LAC countries. The impact on factor returns, measured as a percentage change from base, is presented in Table A.4 in the Annex.

For all countries, land receives the largest return over factor categories in all scenarios. This means that land owners will be the largest beneficiaries in Latin America. Argentina and Brazil, two largest agricultural and food producers in the region, are the biggest winners. Land rent increases by 12 percent for Brazil and 7 percent for Argentina under the most ambitious US proposals, which registers more than twice as large as the return for these countries under the least ambitious New Uruguay Round scenario. This is not the case for other Latin American countries. Chile and Ecuador also experience large impact on factor returns, but their effects are not large as those of Argentina or Brazil.

The impact on wages for unskilled category is positive, but marginal for all LAC countries under any scenario. But the effects on wage remunerations on unskilled agricultural workers are dynamic. Wage increases for unskilled workers in agriculture is nearly as large as land rent. This is a promising result and gives very important policy implications. Unskilled agricultural workers—the majority is the rural poor, and many are landless farmers—will potentially benefit from global agricultural liberalization as equally as agricultural landowners. Like land rent, agricultural workers in unskilled class in Argentina and Brazil

will be the largest beneficiaries, whose wages increase by 7 percent and 11 percent, respectively, under the US proposals. In contrast, agricultural workers in unskilled labor category are less benefited in Colombia, Peru, Venezuela and Mexico.

The impact on wages for other unskilled labor and skilled labor is very small and mixed. These effects clearly follow the impact on production. Wages for unskilled workers in food industries increase only marginally in Brazil and the rest of the Western Hemisphere, whereas they remain unchanged or slightly decline for other countries. This is also true for unskilled labor in industries and services, and skilled class across Latin America. This is because our simulations consider only liberalizing agricultural sectors (agriculture and food industries), but not non-agriculture.

For most LAC countries, the impact on capital closely follows the patters of skilled labor with exactly same underlying rationale. Capital returns slightly fall in LAC countries under any scenario. The returns on natural resources have greater negative impact than capital, because these factors are largely used in resource-based industries, whose protection remains unchanged. Typically Argentina and Brazil are hardest hit; returns on natural resources for these countries decline by 1-2.5 percent.

Our results are very close and comparable to other recent studies. For instance, Polaski (2006), who include two single Latin American countries, finds 13.3 percent of land returns for Brazil and 7.7 percent for Argentina. Capital returns are unchanged for Brazil or slightly negative for Argentina. Although using the dynamic model, Buet et al (2006) report that wage remuneration for unskilled agricultural workers increases by 9.8 percent for Argentina, and 7.9 percent for Brazil.[18] Similarly, land rents increase by 11.4 percent for Argentina, and 10.8 percent for Brazil. In contrast, Mexico suffers 3 percent decline in unskilled agricultural workers, and 11.1 percent loss in land rent.

6.3. Changes in World Prices and Terms of Trade

Changes in World Prices

Table 9 presents the impact on world prices on agriculture. The Doha Round reform on agriculture raises world prices of agriculture by around 2 percent or more under the main scenarios. Among agricultural products, three products heavily protected in global trade see sharp rise in prices: (i) *dairy products* by 9-10 percent; (ii) *processed sugar* by 6-9 percent; and (iii) dairy products by 5-9 percent. In the meantime, wide range of grains will also undergo strong price increases, ranging from 2.5 percent for *wheat*, 4 percent for *paddy rice*, to 5 percent for *cereal grains*. The G20 and EU proposals will have greater impact on world prices than the US proposals. This is primarily because the former proposals have greater price effects on *other food products*, which account for some 40 percent of global agricultural trade and *vegetables and fruits* (9 percent). Table 10 presents the impact on world prices for agricultural sectors.

Graph 7 shows the effects on world agricultural prices, decomposed by three pillars. In general, these price effects well matches the results of the recent studies.[19] In all scenarios, the reduction of domestic support has the greatest effects. Export subsidies have the second largest, and uniform impact, as this pillar of distortion is completely eliminated in all scenarios. In sharp contrast, the reduction of tariffs is likely to lower the world prices in most scenarios. In particular, world agricultural prices decline by 0.5 percent under the most ambitious US proposals. It is also revealed that the EU proposal with sensitive products (scenario 2-A) has small price effect, compared with that of full scenario, due to modest tariff reduction proposal.

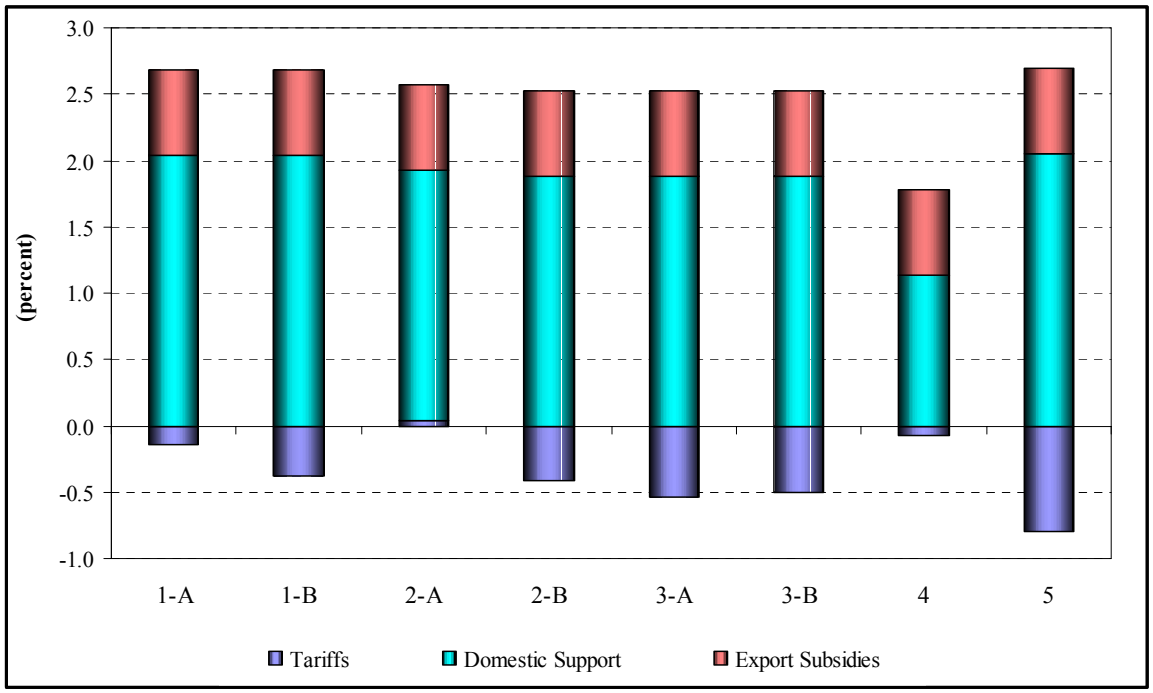
[18] Buet et al (2006) apply segmented labor market structure for unskilled category, but in two classes: agriculture and non-agriculture.
[19] See for instance Diao, Somwaru, and Roe (2001), and Monteagudo, and Watanuki (2004).

Table 9. Impact on World Prices (percentage change from base)

	1-A	1-B	2-A	2-B	3-A	3-B	4	5
	G20 Sensitive	G20 No Sensitive	EU Sensitive	EU No Sensitive	US Sensitive	US No Sensitive	NUR	Swiss Formula
Paddy rice	4.96	4.74	4.27	4.18	4.85	4.84	2.55	4.51
Wheat	2.83	2.72	2.82	2.57	2.89	2.83	1.61	2.93
Cereal grains	3.90	4.19	3.73	4.19	4.25	5.14	2.31	4.98
Oil seeds and Soybeans	5.67	6.90	5.10	6.23	7.25	7.33	4.17	8.06
Vegetables and fruits	2.54	2.30	2.66	2.25	1.74	1.70	2.07	0.60
Sugar cane	-1.76	-2.06	-1.10	-1.61	-4.00	-4.00	-0.74	-3.25
Coffee and cocoa	0.80	0.57	0.92	0.57	-0.52	-0.52	0.82	-0.36
Livestock	0.36	-0.06	0.72	-0.04	-1.15	-1.27	0.23	-0.78
Other agricultural products	1.39	1.07	1.48	0.92	-0.09	-0.18	0.87	0.50
Bovine meat	6.54	6.51	4.80	5.41	8.03	7.93	3.79	6.53
Pork and poultry meat	1.60	1.30	1.83	1.23	0.88	0.81	1.00	0.82
Dairy products	10.00	9.82	9.01	9.27	10.36	10.30	8.32	10.05
Processed sugar	7.50	7.25	6.41	6.03	9.14	9.12	5.14	8.71
Other food products	1.43	0.95	1.78	0.87	0.42	0.20	0.75	0.14
Agriculture	**2.59**	**2.31**	**2.61**	**2.13**	**1.96**	**1.86**	**1.71**	**1.75**

Source: Authors' model estimations.

Graph 7. Decomposition of World Price Effects (percentage change from base)



Source: Authors' model estimation.

The effects on sectoral world prices depend largely on two factors: (i) the type of distortions (pillar); and (ii) size of reduction. Among farm crops, for grains—paddy *rice*, *wheat* and *cereal grains*, the reduction of domestic support is the dominant factor, responsible for almost 85-90 percent of the increased prices. This is also true for *oil seeds and soybeans*, whose world prices rise by 5-7.5 percent. For *vegetables and fruits*, the reduction of domestic support accounts for roughly 50 percent of price increases for G20 and EU proposals, and some 70 percent for the US proposals. For *coffee and cocoa*, the reduction of domestic support contributes to increases world prices by 1.1 percent in all scenarios, but this positive effect is counteracted by the decline in prices induced by tariff reduction.

In food products, *dairy products* experience sharp price increases by 9-10 percent, which is the highest in all agricultural and foods products, followed by *dairy products* by 6-8 percent increase. For these products, the elimination of export subsidies contributes around 65 percent to the price increase and domestic support by another 20-25 percent. For *bovine meat*, whose price also increases by 5-8 percent, the reduction of tariffs plays a greater role in pushing prices; tariffs account for 40-50 percent of the increase in price under the main scenarios with sensitive products. In contrast, the overall impact on pork and poultry meat is modest with around 1 percent price rise. The positive impact by the elimination of domestic support is offset by the negative effect of the reduction of tariffs.

Changes in Terms of Trade

The changes in world agricultural prices alter terms of trade, which in turn affect gains from trade, depending on the initial net trade position. It is reminded that we only consider agricultural policy reform, leaving trade regime unchanged for non-agricultural sectors. Given this framework, countries with net exporting position benefit from expansion of agricultural trade and positive terms of trade, as a result of increased world prices. On the contrary, countries with net importing positions have adverse effects. Table 9 shows the impact on the terms of trade.

Table 9. Impact on Terms of Trade (percentage change from base)

	1-A	1-B	2-A	2-B	3-A	3-B	4	5
	G20 Sensitive	G20 No Sensitive	EU Sensitive	EU No Sensitive	US Sensitive	US No Sensitive	NUR	Swiss Formula
Argentina	1.14	1.27	0.98	1.15	1.94	1.92	0.77	1.48
Brazil	0.70	0.82	0.52	0.70	1.16	1.19	0.41	0.89
Chile	0.32	0.33	0.31	0.32	0.41	0.41	0.22	0.17
Bolivia	0.06	0.09	0.03	0.09	0.20	0.22	0.02	-0.02
Colombia	0.18	0.19	0.15	0.18	0.20	0.21	0.16	0.00
Ecuador	0.79	0.80	0.76	0.78	0.90	0.91	0.63	0.31
Peru	-0.07	-0.05	-0.10	-0.06	0.01	0.01	-0.07	-0.11
Venezuela	-0.12	-0.13	-0.12	-0.13	-0.14	-0.14	-0.11	-0.14
Mexico	-0.12	-0.14	-0.10	-0.13	-0.16	-0.17	-0.08	-0.22
Central America	0.40	0.42	0.35	0.39	0.51	0.52	0.30	0.17
Rest of Western Hemisphere	0.23	0.26	0.12	0.17	0.47	0.48	0.05	0.28

Source: Authors' model estimations.

Argentina and Brazil with clear net exporting position significantly improves terms of trade. Terms of trade also improve for Chile, Central America and the rest of Western Hemisphere. Among the Andean countries, the effects are in positive side for Colombia, Ecuador, and Bolivia, whereas they are mostly in negative range for Peru. On the contrary, Mexico and Venezuela, which have net importing positions, experience deterioration of their terms of trade.

One of the important findings is concerned with the effect of sensitive products. Particularly under the EU Proposals (scenarios 2-A and 2-B), sensitive products have significant effects on terms of trade specifically for large agricultural exporters in the region. Argentina and Brazil improve their terms of trade by 0.17 percentage point, when the negotiations include sensitive products. This effect does not appear in G20 and the US proposals.

Under the full liberalization scenario, Anderson et al. (2006) using the dynamic model estimate the impact in the same direction, but stronger effects than ours. Terms of trade improve by 2.5 percent for Argentina and 4.2 percent for Brazil, while deteriorating 1.1 percent for Mexico. On the other hand, Polaski (2006) finds very different results. Terms of trade slightly improve (0.16 percent) for Brazil, but deteriorates marginally by -0.03 percent for Argentina. Terms of trade also worsen in other part of Latin America: 0.70 percent decline for the rest of Latin America, and 0.49 percent decrease for Central

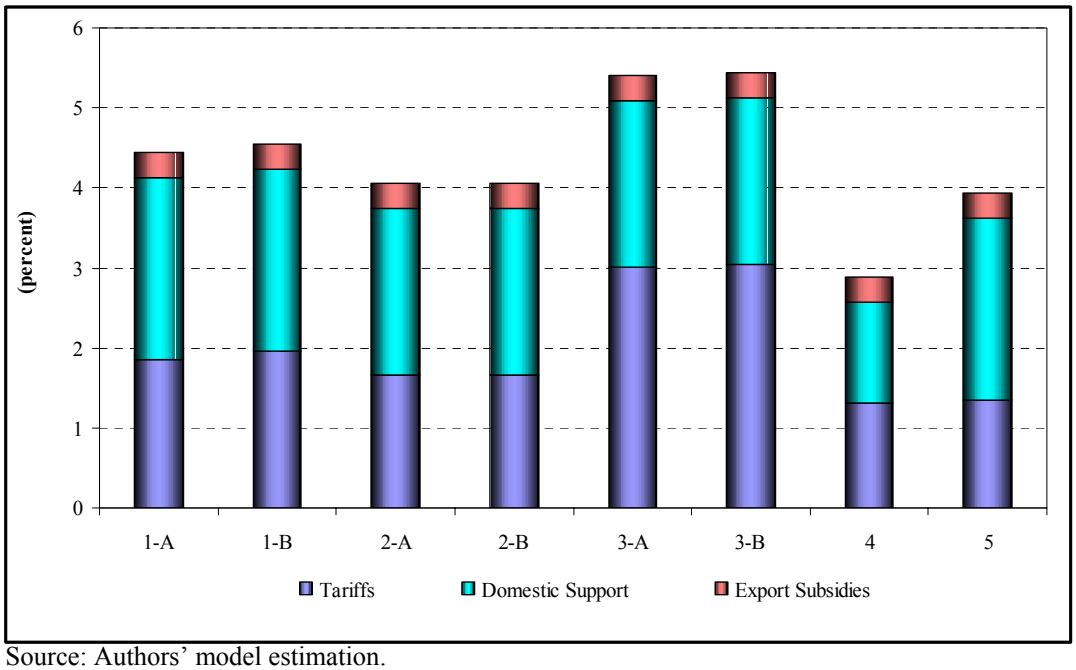
America and the Caribbean. These results, however, seems counterintuitive particularly for Argentina, which has a strong net exporting position in agricultural trade.

Under the ambitious and unambitious liberalization scenarios, Bouet et al (2006) estimate the impact, which have much smaller effects, but in the same direction as those of Anderson et al. (2006) and ours. Their results are not directly comparable to ours, but the analysis would be useful in evaluating the overall effects. They find that terms of trade improve marginally by 0.1 percent for Argentina under both ambitious and unambitious scenarios. For Brazil, terms of trade are unaffected under the unambitious scenario, but improve by 0.1 percent in the ambitious scenario. Mexico and Venezuela slightly worsen their terms of trade.

6.4. Impact on Trade

This section reports the impact of the Doha Round on Latin American trade decomposed by three pillars and summarizes sectoral effects. Tariffs and domestic support are the main drivers to expand exports from the region. The reduction of tariffs is the dominant factor in expanding Latin America's exports under the US proposals. On the other hand, the elimination of domestic support is slightly preferable to tariff cuts for the region under the G20 and EU proposals. The elimination of export subsidies contributes to increase agricultural exports by 0.3 percent for Latin America. Graph 8 shows the decomposition of the impact on agricultural exports for Latin America.

Figure 8. Decomposition of Impact on Agricultural Exports for Latin America (percentage change from base)



Source: Authors' model estimation.

In Latin America, the Southern Cone countries are the largest winners. Central America will also enjoy booming exports, and Andean countries experience modest export growth in most scenarios. Mexico modestly increases agricultural exports, but will be the least benefited countries in Latin America, due to small agricultural share in total trade and deterioration of terms of trade of its net-importing position in agricultural trade.

In terms of commodities, *bovine meat* due largely to tariff reduction will be the largest winner, enjoying the highest export growth; exports from the region sharply increase by more than 20 percent under the EU proposals to 55 percent under the US proposals. *Oilseeds and soybeans* in Argentina and Brazil will be also a clear winner with strong exports. Tariffs are the main factors under the US proposals and Swiss Formula. Throughout Latin America, *vegetables and fruits* enjoy modest but sustained export growth. Chile, Ecuador, Mexico and Central America will be benefited the most. These three products continue to be an engine in export earnings and to boost trade surplus in agricultural trade, contributing nearly 70 percent to the increased agricultural exports in Latin America.

The global reduction in domestic support increases exports in a wide variety of grains in Latin America, but the effect is asymmetric over commodities and countries. *Paddy rice* in Paraguay and Uruguay will enjoy strong exports, whereas modest growth in Argentina and Brazil. *Cereal grains* in Argentina, Brazil and Chile also experience moderate export growth. However, this is not the case with *wheat*, which is an almost non-export commodity in most countries in Latin America. *Wheat* exports in Argentina and Paraguay will modestly increase, but decline in Mexico slightly.[20]

The impact on food products other than *bovine meat* is highly heterogeneous. *Dairy products* increase exports by 7-8 percent in EU proposals to 12 percent under the US proposals. However, these products are mainly traded within the Hemispheric market, the sector does not benefit from the global liberalization commitment. *Processed sugar*, another important and sensitive product, increase exports by 4-6.5 percent. By far, Brazil is the largest winner, followed by Colombia, Mexico and Central America. On the other hand, *pork and poultry meat* in Brazil will face sluggish export growth, but Mexico experiences modest exports.

Across Latin America, *coffee and cocoa* is a biggest loser, but the magnitude differs significantly over counties and scenarios. For Brazil, largest producer and exporter in Latin America, exports remain almost unchanged under the less ambitious scenarios, but sharply decline by more than 4 percent under the ambitious US proposals. Colombia and Central America, the region's second largest exporters, face different outcomes. The former slightly increases exports under the less ambitious scenarios but suffers export losses in the ambitious scenarios, whereas the latter suffers decline in exports in all scenarios. Argentina will be hardest hit. Exports decrease by 5-7 percent under the G20 or EU proposals, and by 12 percent under the US proposals. The main reason is that the sector is already liberalized in global market.

One of the interesting results is concerned with outcome of the Swiss formula, which is designed to eliminate tariff peaks and tariff escalation. Therefore, this scenario has strong impact on commodities with high tariffs. This is particularly the case with *oilseeds and soybeans*. Argentina and Brazil increase exports by 3 percentage point more, compared with the most ambitious US proposals. But, this scheme has weaker effects on low tariffs, where trade actually occurs. As a result, the overall effects on agricultural exports is inferior to the US proposals.

Another important finding is the effects of sensitive products. These products are particularly important for the South Cone countries, which produce a wide range of sensitive products. Under the G20 proposals, the impact on exports of *oilseeds and soybeans* differs by 6 percentage points in Argentina and Brazil, followed by 3 percentage increase in *cereal grain* exports in Brazil, between with and without sensitive products. In the case of the EU proposals, these countries expand exports of *oilseeds and soybeans* as well as *bovine meat* by again 6-percentage point each. Moreover, exports of *cereal gains* in Brazil double to 15.5 percent, upon excluding sensitive products. On the other hand, the US proposals have smaller effects than the previous two sets of proposals, due to limited reduction scope. *Cereal grains*

[20] Tariffs and domestic support have conflicting effects on exports of *wheat* in Latin America. While the latter has the positive impact in raising *wheat* exports, the former has the opposite effect.

in Brazil increase exports by 5 percentage point, followed by 2-3 percentage point increase in Chile and Peru. These sensitive products do not change much the overall agricultural exports, but have significant impact on sectoral export performance, and thereby domestic resource allocations, factor returns, terms of trade.

Argentina

The US proposals, which boost Argentine agricultural exports by more than 6 percent, appear to be the best options. The Swiss Formula scenario seems to be an attractive option after the US proposals, with the aggregate export growth of 5 percent. The G20 and EU proposals are nearly equally preferable, but both are inferior to the US proposals. Among the main proposals, the sensitive products will not affects the country's aggregate exports much.

Argentina enjoys booming agricultural exports, ranging from 3 percent under the New Uruguay Round scenario to 6 percent under the US proposals. The country continues to reinforce its pattern of specialization in exports of *oilseeds and soybeans.* Exports increase by 32 percent under the US proposals, and 35 percent in the Swiss Formula scenario. This difference reflects variations mainly in tariff reduction proposals in China and emerging Asian partners, and partially in domestic support in North America. For these agricultural products, sensitive products matter. Under the G20 and EU proposals, exports rise by 6 percentage point, when sensitive products are excluded. But this is not the case under the US proposals, where no substantial cuts are offered.

Bovine meat is an another big winner. Exports grow much faster at 54 percent under the US proposals. The sensitive products matter in the EU proposals, which offer significant tariff cuts in the EU market,[21] and moderate reduction in the United States; the aggregate exports of *bovine meat* jump by 6 percentage point, once sensitive products are eliminated. This is not the case with the US proposals, where tariff reduction remains unchanged in the United State and the European Union. *Cereal grains*, other key export products, also expand exports but at modest rates. Exports of these product increase faster under the EU proposals, which offer large tariff cuts in the EU and emerging Asian markets, main destination of the Argentine *cereal grain* exports.

Wheat experiences low export growth in spite of large global reduction in tariffs and domestic support. This is mainly because Brazil is the largest destination for this product. Exports of *vegetables and fruits* increase by 2-6 percent, except the Swiss Formula scenario, where exports decline by more than 3 percent. *Dairy products* expand exports by 5-7 percent mostly to Mercosur whose market is already liberalized and to the United States. On the other hand, *coffee and cocoa* is the biggest loser, with sharp contraction of exports by 12 percent under the US proposals.

Brazil

Like Argentina, the ambitious US proposals are the best scenarios, with the export growth over 10 percent, which is the second highest increase in Latin America after Uruguay in all scenarios. Like Argentina, the Swiss Formula proposal appears to be the second best option, after the US proposals. For Brazil, the G20 proposals are preferable to the EU proposals, with more than 1 percent export growth differentials.

Regarding the sectoral impact, Brazil, the region's largest agricultural producer and exporter, has similar patters to Argentina, but much stronger effects in a wider range of products. Under the main proposals,

[21] *Bovine meat* destined to the EU market is subject to the so-called Hilton Quota, an agreement that allows exports from selected Latin American countries including Argentina and Brazil under the regulated trade regime.

the aggregate exports increase by 6-10 percent. As with Argentina, *oilseed and soybeans* plus *bovine meat* are the largest winners. Exports of *oilseed and soybeans* jump by more than 20 percent and *bovine meat* by 65 percent under the US proposals. These two products alone constitute around 70 percent of increased exports under the G20 proposals and more than 90 percent in the Swiss Formula scenario. In farm crops, *cereal grains* enjoy strong export growth at more than 20 percent under the US proposal. *Vegetables and fruits* increase exports by 5-8 percent except the Swiss Formula scenario.

Among processed foods, export performance is modest on *processed sugar*, for which Brazil is the world's largest producer and exporter. This is because despite large global reduction commitments, there still remain substantial barriers in tariffs in major market including the United States, the European Union, and China. Nevertheless exports of *processed sugar* increase export by 3.5-4 percent under the main proposals. On the other hand, *pork and poultry meat*, other important export products, will experience slow export growth.

Like Argentina, *coffee and cocoa* will be a big loser particularly under the US proposals and the Swiss Formula, where exports decline by more than 4 percent. This reflects the fact of low initial protection (2.6 percent) in the European Union, which purchases nearly 50 percent of the Brazilian *coffee and cocoa* products. *Livestock* and *other agricultural products* are also sectoral losers, as trade barriers are already low in the United States and modest in the European Union.

The sensitive products matter for Brazil. Under the EU proposals, differentials in export performance between with and without sensitive products are 8-percentage points for *cereal grains* , 6-percentage points for *oilseeds and soybeans* and *bovine meat*. Under the G20 proposals, these differentials narrow, but still 6-percentage points for *oilseeds and soybeans*, and 3-percentage points for *cereal grains and bovine meat.* The US proposal further expands exports of *cereal grains* by 5 percentage point, while leaving the impact unchanged for other products.

Chile

The impact on the aggregate agricultural exports is modest in all scenarios. Unlike Argentina and Brazil, the US proposals are the less preferable options among main scenarios. Instead, the EU proposals with sensitive products (scenario 2-A) is the best option, followed by scenario 1-A. For Chile, the New Uruguay Round scenario is superior to the Swiss Formula scenario, but inferior to the main scenarios. These outcomes are due mainly to the fact that the country has already liberalized its trade regime, and is not obliged to commit itself to further reducing protection under the present multilateral trade negotiations. Instead, the Doha Round gives Chile an opportunity of a unilateral access to the world market, without any concession.

Sectorally *bovine meat* as well as *oilseeds and soybeans* are the winners. However, because of small initial export base, these protects do not much contribute to trade gains from the national perspective. On the other hand, *vegetables and fruits*, which include the country's major export products such as apples, pears and other similar fruits, experience export growth over 4 percent under the main scenarios. Thanks to large trade share of 30 percent, these products account for nearly half of the increased exports under the main proposals.

Among other products, *cereals and grains* boost exports by more than 10 percent under the G20 and EU proposals, and 16-20 percent under the US proposals. These products account for 10-20 percent share in the increased trade under the main scenarios, and the share jumps to 38 percent under the Swiss Formula scenario. *Other food products*, which include the country's popular wine, modestly increase exports. But because of the dominant share (56 percent) in base exports, these products contribute largest share out of the increased agricultural exports after *vegetables and fruits*.

In contrast, *coffee and cocoa* will be a big loser, followed by *livestock* and *other agricultural products*. Interestingly, unlike Argentina or Brazil, Chile does not experience the largest trade impact from the ambitious US proposals, whose aggregate effects on exports are the least among main scenarios. This is primarily because domestic producers shift resources to flourishing industries, and workers move to booming sectors, which offers higher wages. In Chile, booming sectors are of small size. As a result, in farm crops, domestic resources move away from key *vegetables and fruits* to *oilseeds and soybeans* or *cereal grains*. In processed foods, these shifts occur from *other food products*, mainstay of the country's agricultural exports, to booming *bovine meat* with small export base.

Bolivia

For Bolivia, the G20 and EU proposals are almost equally preferable with export growth at 2.2-2.9 percent, and superior to the US proposals, which increase agricultural exports by 1.5-1.7 percent. The sensitive products have minor effects on the aggregate exports. The Swill Formula scenario is the least preferable option for Bolivia.

The aggregate impact on agricultural exports is modest for Bolivia. Unlike other LAC countries, *vegetables and fruits*, the country's key agricultural exports, are the largest winner. Exports jump by 15-17 percent under the main scenarios. These products constitute roughly half of the increased exports under the G20 and EU proposals, and 85-90 percent under the US proposals. *Oilseeds and soybeans*, other main export products, increase exports modestly, despite they are largely sold in intra-regional market. *Cereal grains* also enjoy booming exports, but they do not much contribute to an increase in new trade, due to small share in base agricultural exports.

The impact on processed food exports is relatively modest due to two factors: (i) vary small export products that would benefit from global trade reform—*bovine meat*, *dairy products* or *processed sugar*; and (ii) large share of other food products (75 percent of agricultural exports) sold primarily to the Hemispheric markets, which impose modest protection on these products. Nevertheless exports of *processed sugar* rise by more than 10 percent under the EU proposals and 14 percent under the US proposals. *Dairy products,* sold only in the Andean market, experience modest export growth. On the other hand, exports of *other food products* increase marginally or decline under the ambitious US proposals and the Swiss Formula scenario.

Colombia

The preferences of the main proposals follows the order of Bolivia; namely the G20 and EU proposals are much preferable to the US ones. In fact, the aggregate impact on exports under the former proposals are almost three times greater than that of the US proposals. In addition, the New Uruguay Round proposal seems to be attractive option, increasing the aggregate exports by 2.4 percent. On the other hand, under the Swill Formula scenario, exports barely increase but instead may decline marginally.

Colombia is one of the least benefited counties in Latin America, due largely to high concentration of *coffee and cocoa*, which account for 50 percent of the agricultural exports and faces relatively low protection. Its aggregate exports rise by 3 percent under the G20 and EU proposals, but decline slightly under the US proposals. Nevertheless *vegetables and fruits*, second largest products (17 percent of the aggregate exports), boost exports by 7-8 percent. These products account for around half of the increased exports under the G20 and EU proposals.

The impact on processed food exports varies. Exports of *bovine meat* sharply jump by 12-15 percent under the EU proposals to more than 30 percent under the US proposals. But these products do not

contribute the country's export growth, due to small share in exports. *Dairy products* increase exports by 5.5-8 percent, and *processed sugar* by 4 percents, both of which are mostly sold in sub-regional or hemispheric markets.

The simulation results show Colombia's dilemma in the negotiations. Exports of these products modestly increase in the G20 and EU proposals, but decline more than 2 percent under the under the ambitious US proposals and the Swiss Formula scenario. Since the sector is not only single largest export commodity contributing export earnings, but also absorbs substantial workers and support a large number of families in rural area, the outcome of the negotiations poses a significant challenge for the country.

Ecuador

Ecuador's preferences of proposals follow Colombia's, but its aggregate impacts are greater than those of Colombia for each corresponding scenarios. Like other Andean countries, the G20 and EU proposals continue to be preferable to US ones, but the latter appears to be slightly inferior to the former proposals. The New Uruguay Round proposal becomes an attractive option, and agricultural exports, unlike Colombia, increase by 0.9 percent under the Swiss Formula scenario.

The aggregate impact on agricultural exports is moderate, ranging from 2.5 to 3.4 percent. Like Bolivia, *vegetables and fruits*, key exports sharing more than 40 percent in agricultural exports, is the sectoral winner. Exports grow at around 6-7 percent under the main scenarios. Thanks to this large share, these products contribute more 85 percent of the increased exports. On the other hand, like other Latin American countries, *coffee and cocoa*, the second largest commodity with the share of 13 percent in agricultural exports, will be a loser. Exports decline slightly over 1 percent under the G20 and EU proposals, but sharply fall by 5 percent under the US proposals. But unlike Colombia, because of lower share in exports, the losses due to export decline are not strong enough.

The overall impact on processed foods is modest. Thanks to an increase in the sales to the United States, exports of *processed sugar* grow at 5-7 percent under the main scenarios. On the other hand, *other food products*, which account for another 40 percent share in agricultural exports, experience very slow export growth, ranging from 0.4 to 1.5 percent. Exports of pork and poultry meat marginally rise under the G20 and EU proposals, but tend to decline slightly under the US proposals.

Peru

The preferences of main proposals follow other Andean countries, but the aggregate impact on agricultural exports significantly varies between the G20 and EU proposals on one hand and US proposals on the other. Furthermore, the EU proposals halve or double the country's agricultural exports between with and without the sensitive products.

The aggregate exports increase over 2 percent under the G20 and EU proposals with sensitive products, but sharply decelerate under the US proposals. Despite the similar composition of the export structure as with Ecuador, this outcome with the US proposals is the result of sharp rise in booming exports in *bovine meat* to the United States and the European Union. Domestic resources are attracted to *bovine meat* particularly from *other food products*, which account for two-thirds of agricultural exports. The net result is that decline in exports of *other food products* surpasses the increase in exports in *bovine meat*.

The sectoral impact other than *bovine meat* is fairly asymmetric. But due mainly to small base exports, the export performance of *cereal grains* is vary dynamic, jumping by around 40 percent under the US proposals, and by 22-28 percent under the G20 and EU proposals. While experiencing modest growth, *vegetables and fruits* continue to be the mainstay in agricultural exports. In processed foods, *processed*

sugar largely sold to the United States, enjoys booming exports, which rise by more than 10 percent under the main scenarios. *Dairy products*, which are sold in hemispheric market, increase exports, but the share in new exports is marginal.

Like Colombia, Peru incurs the small negative impact under the Swiss Formula scenario. Under this scenario, agricultural products with peak tariffs or tariff escalation will benefit the most from sharp reduction commitments. In Peru, this applies to *bovine meat* and *cereal grains*. Exports of the former rise by 20 percent, whereas the latter jump up by 34 percent. But this forces *other food products* to reduce exports in emerging Asian market including China, due to resource allocations. The net effects on exports of *other food products* are negative, and this loss exceeds an increase in exports of *bovine meat*.

Venezuela

Because Venezuela is not agriculture-exporting country, the country is not likely to benefit from the global commitment of agricultural liberalization. The patterns and magnitude of the aggregate impact are not different from those of Chile, with low variations over scenarios. In farm crops, *oilseeds and soybeans* are sectoral winners. Exports increase by more than 20 percent under the ambitious scenarios including the Swiss Formula scenario. In increased exports, the share of these products accounts for 20-40 percent under main scenarios, and jump to 64 percent in the Swiss Formula scenario. *Vegetables and fruits* are another winners. These products account for steady 15 percent share in the new exports except the Swiss Formula scenario.

Like Peru or Colombia, Venezuela is one of the few countries, which do not affect exports in *coffee and cocoa*. Exports marginally increase under the less ambitious scenarios, but decline under the US proposals and the Swiss Formula scenario. Instead, *livestock* will be the largest loser. Exports sharply plummet by more than 5 percent under the US proposals.

Because processed foods are not the main exports, the impact on these products is much smaller than farm crops. Exports of *dairy products*, *pork and poultry meat*, and *processed sugar*—all of which are mainly sold in the sub-regional market—grow marginally or remain unchanged. *Other food products*, which account for 80 percent of agricultural exports, slightly increase exports by around 2 percent under the main scenarios. These products account for 50-60 percent of the increased agricultural exports.

Mexico

Despite Mexico is the third largest agricultural exporter in the region with a wide rage of products, the impact on agricultural exports is very modest. This is due primarily to the effects of erosions of preferences, and partly to large share of exports, whose trade barriers are globally low. In fact, the country sells 75 percent of its agricultural exports to the United States. This high "US dependency" results in undercutting expected gains in exports. Like Andean countries, the most ambitious US proposals do not generate the largest aggregate export performance.

In farm crops, *oilseeds and soybeans* sharply expand exports partly because of small export base: 28 percent under the US proposals, followed by *cereal grains*. Yet the sectoral winner would be *vegetables and fruits*. Due to the strong US orientation (85 percent) and low protection, exports of these farm crops modestly increase: 1.2-1.8 percent under the G20 and EU proposals and 0.7-0.9 percent under the US proposals. But because they constitutes around one-third of the aggregate exports, these products contribute nearly the half of increased exports under the G20 and the EU proposals and 37 percent under the US proposals.

A wide range of processed products experience modest export growth with heterogeneous impact over sectors. Exports of *bovine meat* sharply rise by more than 40 percent under the US proposals. *Dairy products* increase exports at the range of 6-9 percent. *Pork and poultry meat* also enjoy booming exports with 16 percent growth under the US proposals. These high export performances are due primarily to low US dependency. Despite high US dependency but global tariff cuts and reduction in domestic support in the United States and European Union, *processed sugar* will experience moderate export growth—4 percent under the EU proposals and 9 percent under the US ones. *Pork and poultry meat* plus *processed sugar*, Mexico's two main processed export products, continue to support the country's agricultural exports, sharing 30-50 percent of the new agricultural exports.

Like many other LAC counties, *coffee and cocoa* will be the largest loser; exports decline by more than 2 percent under the main scenarios. *Livestock* is another small loser, but decline in export growth would be less than half of that of *coffee and cocoa*. Despite substantial reduction proposals in both tariffs and domestic support in developed regions, w*heat* suffers slight decline in exports, because almost 90 percent of this crops are sold to developing countries.

Like Argentina and Brazil, sensitive products matter on sectoral export performance. Under the G20 proposals, exports of *oilseeds and soybeans* rise by 4-percentage points, and by 2-percentage point for *bovine meat*, when sensitive products are excluded. Under the EU proposals, these two products again increase exports by 4-percentage point. Furthermore, *cereal grains* and *dairy products* both increase exports by 2.5-percentage point, upon excluding of sensitive products. But this is not the case with the US proposals. While *cereal grains* further increase exports by 2-percentage point, the impact on other products remains uncharged at best, or slightly decline. This is because gains from sensitive products are primarily accrued to the region's most competitive Southern Cone countries.

Central America

The preferences of the proposals follow the Andean countries or Chile. The G20 and EU proposals are slightly preferable to the US proposals. But deviations of the impact are small over the scenarios. This implies that the sub-region might take a neutral position, irrespective of the outcome of the negotiations. Exports rise by 2.8-3.3 under the main proposals, and 2.5 percent with the New Uruguay Round and 1.2 percent in the Swiss Formula scenarios. The pattern of the impacts are close to that of Chile but much larger effects, because the sub-region has trade composition similar to Chile's but greater share of *coffee and cocoa.*

Among farm crops, due to small base, *oilseeds and soybeans* enjoy rapid expansion of exports, with growth at 15 percent under the G20 and EU proposals and more than 20 percent under the US proposals. But *vegetables and fruits*, which account for 36 percent of the sub-bloc's agricultural exports, are the sectoral winners, because these products alone contribute 60-70 percent of the increased exports in all scenarios except the Swiss Formula. On the other hand, *coffee and cocoa*, another key export commodities after *vegetables and fruits*, suffers exports. In particular, exports shrink by more than 4 percent under the US proposals.

In processed foods, *dairy products* will experience the largest positive impact—15 percent increase in the EU proposals and 30 percent under the US proposals—but the sectoral share in the new exports is marginal. *Bovine meat* follows *dairy products* with smaller impact; exports rise from 7 percent under the EU proposals to 16 percent under the US proposals. But the winner is *processed sugar*, for which Central America is the second largest exporter after Brazil, and 40 percent of exports are sold to the United State and 30 percent to intra-regional market. Because of this large export base, this product contributes 20-45 percent of the increased exports.

Central America also experiences the effects of the sensitive products, but much smaller than Mexico's. The G20 proposals increase exports of *oilseeds and soybeans* with 2.5-percentage point, when sensitive products are eliminated. Under the EU proposals, exports of *oilseeds and soybeans* again rise by 3.5-percentage point, while *bovine meat* and *dairy products* boost exports by 2.5-percentage point each. But the sectoral impact between with and without sensitive products is not much different under the US proposals. In all main scenarios, however, the impact on the aggregate exports is slightly smaller with sensitive products than without them. Like Andean countries or Mexico, this is because intensifying exports of sensitive products leads to slowing down key exports—*vegetables and fruits* and *coffee and cocoa*, as domestic resources shift from key sectors to booming sensitive sectors.

Paraguay

For agriculture-dominated Paraguay, the ambitious US proposals are the best option, followed by the G20 and EU proposals in this order. The Swill Formula scenario is also attractive after the US proposals. The sensitive products has impacts on the aggregate exports, particularly under the G20 proposals. However, the country does not benefit from the global commitment of agricultural liberalization. This is due primarily to high reliance on Mercosur—around two–thirds of agricultural exports are sold in the intra-bloc market—and partly a limited variety of agricultural exports facing higher initial protection before liberalization sold outside Mercosur.

In farm crops, *oilseeds and soybeans* will be a winner with export growth of 3-4 percent under the main scenarios. Like Argentina and Brazil, the sector, which accounts for 50 percent of the aggregate agricultural exports, continue to be the main driver of agricultural exports, contributing some 60 percent of the increased agricultural exports. Exports of *cereal grains* increase by modest 6-7 percent under the G20 and EU proposals, and by 8.4-9.3 percent in the US proposals. But *paddy rice* and *wheat* barely increase exports, due largely to huge concentration on Mercosur market. Like other LAC countries, the sectoral losers are likely to be *coffee and cocoa*, as well as *livestock*, plus *other agricultural products*. These sectors suffer decline in exports; particularly exports contract by 4-6 percent under the US proposals.

Among food products, *bovine meat* is a small winner, with export growth by 5.5-6 percent in the G20 proposals and 9 percent with the US proposals. But compared with other Mercosur members, which are also exporters of this product with large scale, the impact on exports are moderate. This is largely because its main destination is by far Mercosur and neighboring Chile, and is not well positioned to penetrate into the EU market. This is why the country cannot much benefit from global liberalization of this sector. Because of small export base*, processed sugar* will experience greater positive impact, with the largest growth of 12 percent under the US proposals. But contribution to increased exports is marginal, due to small export share.

Uruguay

In terms of export growth performance, agriculture-dependent Uruguay appears to be a regional winner, surpassing Brazil with 3.9 percent under the EU proposals and 5.8 percent with the US proposals. Like other Mercosur countries, the ambitious US proposals are the most preferable options over G20 and EU proposals. Agricultural exports jump by 10-11 percent under the EU proposals, 13 percent with the G20 proposals and 16 percent in the US proposals. The country also enjoy booming exports under the New Uruguay Round and Swill Formula scenarios. These favorable outcomes, which are different from Paraguay's, is due to relatively greater share of non-Mercosur market and large share of sensitive products. Mercosur accounts for 30 percent of the country's farm crops exports, but the market share of processed food exports is 22 percent by the bloc, followed by the European Union with 15 percent and the United States by 10 percent.

Among the agricultural products, *bovine meat*, which account for 27 percent of agricultural exports, is the clear winner. In all scenarios, this sector enjoys booming exports, ranging from 28 percent in the EU proposals to 45 percent under the US proposals. This product alone accounts for three-quarter of the increased exports in all scenarios. *Dairy products*, for which Uruguay is the second largest exporter after Argentina, will be an another winner. The significant share of NAFTA (5 percent to the United States and 17 percent to Mexico) contribute to booming exports. These products account for some 10 percent of the increased agricultural exports. *Processed sugar*, which are mostly sold to the United States, also experience strong export growth.

the impact on exports vary considerably over farm crops. Thanks to the sales to non-Mercosur market, *paddy rice* and *cereal grains* increase exports. In particular, exports of *paddy rice* jump by 10 percent under the G20 proposals and 12.5 percent under the US proposals. *Vegetables and fruits* also enjoy modest export growth. In contrast, the losing sectors include: *oilseeds and soybeans*, *coffee and cocoa*, *livestock*, and *other agricultural products*. Among others, *coffee and cocoa* as well as *livestock* will suffer decline in exports 4 percent and almost 6 percent, respectively under the US proposals.

7. Summary and Conclusions

The Doha Development agenda has been negotiated over the past years under the auspices of the World Trade Organization. Throughout the negotiations trade issues on agriculture have proven a major stumbling block bringing the whole negotiations to a deadlock. Wide divergences on negotiation issues still persist between developed and developing countries, but also among industrialized countries as well as among developing countries.

Agriculture trade liberalization is therefore a key issue to conclude the Doha Round. Securing market access and eliminating trade-distorting subsidies and domestic supports is in fact the central objective of a number of developing countries including Latin America and the Caribbean, which display comparative advantages in this sector and have long been advocating global agriculture liberalization in the multilateral trading system. However, given the existence of wide heterogeneity in resource endowments, production structures, farm productivity, trade specialization and agricultural net trade position, it is crucial to assess the potential effects of agriculture trade liberalization with greater accuracy for each country of the region.

Despite the existence of a burgeoning literature aimed at evaluating the global gains from the Doha Round, only few studies assessed global agricultural trade reforms considering scenarios based on tariff reduction formulas. Moreover most of them did not explicitly consider the majority of Latin American countries. This study aimed at filling this gap, developing a new multi-region static CGE model incorporating several innovative features in scenario design, database and modeling.

The most salient feature of the study is the evaluation of simulation scenarios based on actual negotiation proposals submitted by major players (the G20, the European Union, and the United States). Scenarios have been constructed considering the impact of reductions commitments based on banded formulas applied to bound tariffs, domestic support measures and export subsidies and resulting in a reduction of the applied levels of protection. *Ad valorem* equivalent tariffs have been built with a bottom-up approach that takes into account protection at the tariff line level.

The simulations suggest a number of important policy conclusions: i) Latin America as whole may reap large gains from agriculture trade liberalization as trade gains may be large for certain countries and commodities; ii) there is nevertheless a great heterogeneity among countries and liberalization scenarios, whereby national welfare gains may be asymmetric and even negative for certain countries; iii) the

market access pillar of trade negotiations is the dominant factor driving trade and welfare effects, while the reduction of trade-distorting domestic support and export subsidies is likely to generate small or even negative effects in certain cases; iv) the trade and welfare effects of the simulated scenarios are very close suggesting that a successful conclusion of the Doha Round negotiations is at reach; v) nevertheless the inclusion of sensitive and special products into simulations scenarios alters significantly the results for individual countries and their treatment will probably drive the final outcome of multilateral trade negotiations for Latin America.

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ANNEX A: DETAILED TABLES

Table A.1. Regions and Countries in the Model

	Index	Region	Country/subregion
		Western Hemisphere	
1.	CAN	Canada	Canada
2.	USA	United States	United States
3.	MEX	Mexico	Mexico
4.	CACM	Central America	Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua
5.	BOL	Bolivia	Bolivia
6.	COL	Colombia	Colombia
7.	ECU	Ecuador	Ecuador
8.	PER	Peru	Peru
9.	VEN	Venezuela	Venezuela
10.	ARG	Argentina	Argentina
11.	BRA	Brazil	Brazil
12.	CHL	Chile	Chile
13.	XWH	Rest of WH	Paraguay, Uruguay, and countries in the Caribbean subregion
		Extra-hemispheric Region	
14.	EU25	EU25	Austria, Belgium, Czech Republic, Cyprus, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, United Kingdom
15.	CHN	China	China
16.	ASA3	Asia3	Korea, Malaysia, Thailand
17.	ASA7	Asia7	Hong Kong, Indonesia, Japan, Philippines, Singapore, Taiwan, Vietnam
18.	ROW	Rest of World	Rest of World

Table A.2. Sectoral Classification in the Model

No.	Index	Sectors	Description
	I.	***Land-intensive Agriculture***	
1.	PDYRC	Paddy rice	Paddy rice
2.	WHEAT	Wheat	Wheat
3.	CRLGR	Cereal grains	Corn, cereal grains, maize, sorghum
4.	OILSD	Oil seeds and Soybeans	Oil seeds, soybeans, sunflower
	II.	***Labor-intensive Agriculture***	
5.	VGFRT	Vegetables and fruits	Vegetables and fruits
6.	SUGAR	Sugar cane	Sugar cane, sugar beet
7.	COFFE	Coffee and cocoa	Coffee and cocoa
8.	LVSTK	Livestock	Bovine cattle, sheep and goats, horses, animal products, wool, silk-worm cocoons, Raw milk
9.	OTHAG	Other agricultural products	Plant-based fibers, cotton, jute, raw milk, forestry
10.	FSHNG	Fishing	Fishing
	III.	***Processed Foods***	
11.	BVNMT	Bovine meat	Bovine meat
12.	OTHMT	Pork and poultry meat	Pork and poultry meat
13.	DAIRY	Dairy products	Dairy products
14.	PRSGR	Processed sugar	Processed sugar
15.	OTHFD	Other food products	Vegetable oils and fats, processed rice, beverages and tobacco products
	IV.	***Resource-based Industries***	
16.	COLGS	Coal, crude oil and gas	Coal, crude oil, gas
17.	MNRLS	Minerals	Mineral products (china, glass, cement), mineral products (china, glass, cement)
	V.	***Labor-intensive Manufactures***	
18.	TXTIL	Textiles	Textiles
19.	WAPRL	Wearing apparel	Wearing apparel
20.	LTHFW	Leather products and footwear	Leather products, footwear, shoes
21.	OLMFG	Other light manufactures	Wood products (furniture), paper products, publishing, books, magazines, manufactures nec, toys, jewels
	VI.	***Capital-intensive Manufactures***	
22.	PETRO	Petroleum	Petroleum, coal products
23.	CHMCL	Chemical and plastic products	Chemical, rubber, plastic products, fertilizers, tires
24.	METAL	Metals and metal products	Ferrous metals, iron, steel, metal products, cutlery, tools
25.	VEHCL	Motor vehicles	Motor vehicles and parts, transport equipment (aircraft, trains, ships)
26.	MCHNY	Machinery and electric equipment	Electronic equipment, machinery and equipment
	VII.	***Services***	
27.	UFISG	Utilities and financial services	Electricity, gas manufacture, distribution, water, financial services, insurance, business services, public administ-ration, defense, education, health
28.	CNSTR	Construction	Construction
29.	TRDTM	Trade and tourism	Trade, recreational and other services, dwellings
30.	TRSPT	Transport and communication	Transport, water transport, air transport, communication

Note: The sectoral classfication follows the GTAP codes.

Table A.3. Sectoral Impact on Agricultural Production (percentage change from base)

	Base values ($billion)	1-A G20 Sensitive	1-B G20 No Sensitive	2-A EU Sensitive	2-B EU No Sensitive	3-A US Sensitive	3-B US No Sensitive	4 NUR	5 Swiss Formula
Argentina									
Paddy rice	0.17	0.18	0.05	0.17	0.02	-0.20	-0.18	-0.19	-0.40
Wheat	2.69	-0.61	-0.99	-0.41	-0.89	-2.17	-2.10	-1.00	-1.84
Cereal grains	2.78	1.07	0.27	1.12	0.35	0.40	0.09	0.19	-0.60
Oil seeds and Soybeans	3.98	3.64	5.51	3.12	5.21	9.84	9.84	3.83	10.81
Vegetables and fruits	2.98	0.10	-0.38	0.43	-0.19	-1.96	-1.89	0.23	-3.33
Sugar cane	0.23	0.70	0.57	0.61	0.47	0.53	0.53	0.28	0.26
Coffee and cocoa	1.27	-4.65	-5.11	-3.86	-4.43	-6.64	-6.56	-2.88	-6.69
Livestock	6.17	0.37	0.29	-0.03	-0.05	0.28	0.29	-0.23	0.00
Other agricultural products	2.67	-0.25	-0.35	-0.26	-0.34	-0.73	-0.71	-0.21	-0.39
Bovine meat	6.75	1.37	1.41	0.62	0.80	1.92	1.93	0.29	1.22
Pork and poultry meat	1.65	-0.70	-0.85	-0.60	-0.80	-1.24	-1.22	-0.62	-1.18
Dairy products	4.18	0.20	0.15	0.12	0.13	0.02	0.03	0.14	0.29
Processed sugar	0.40	0.90	0.76	0.78	0.64	0.77	0.77	0.40	0.43
Other food products	24.75	0.14	0.00	0.27	0.04	0.00	-0.03	-0.09	-0.31
Agriculture	**60.67**	**0.41**	**0.37**	**0.34**	**0.30**	**0.52**	**0.50**	**0.13**	**0.28**
Brazil									
Paddy rice	1.15	0.74	0.64	0.65	0.59	0.79	0.75	0.31	0.48
Wheat	0.24	0.92	0.72	1.19	0.85	1.86	1.56	0.90	1.25
Cereal grains	2.40	3.37	4.09	1.94	4.01	4.87	6.25	1.41	5.21
Oil seeds and Soybeans	6.21	4.24	6.65	3.84	6.28	9.21	9.28	4.08	10.24
Vegetables and fruits	1.83	1.47	0.97	1.88	1.19	0.53	0.39	1.60	-1.76
Sugar cane	3.19	0.33	0.24	0.28	0.18	0.28	0.28	0.19	0.30
Coffee and cocoa	7.57	-1.38	-1.94	-0.91	-1.61	-3.36	-3.44	-0.71	-3.29
Livestock	10.86	1.97	2.00	1.10	1.26	3.21	3.16	0.64	1.93
Other agricultural products	4.74	-0.97	-1.14	-0.44	-0.66	-1.08	-1.12	-0.41	-1.26
Bovine meat	9.38	4.81	5.11	2.78	3.48	7.62	7.58	1.90	5.18
Pork and poultry meat	4.66	-0.64	-0.95	-0.44	-0.89	-0.68	-0.76	-0.58	-1.26
Dairy products	6.87	-0.22	-0.27	-0.01	-0.05	-0.16	-0.17	0.04	-0.28
Processed sugar	4.85	1.00	0.83	0.80	0.64	1.06	1.07	0.56	0.95
Other food products	42.69	0.28	0.24	0.36	0.27	0.30	0.28	0.10	0.07
Agriculture	**106.64**	**0.97**	**1.05**	**0.75**	**0.88**	**1.51**	**1.52**	**0.52**	**1.06**
Chile									
Paddy rice	0.06	0.36	0.30	0.38	0.26	0.47	0.44	0.07	0.31
Wheat	0.79	0.06	0.04	0.05	0.00	0.38	0.33	-0.28	0.48
Cereal grains	0.56	1.99	2.31	1.80	2.48	3.96	4.53	0.76	4.85
Oil seeds and Soybeans	0.03	4.85	6.46	3.91	5.65	9.71	9.63	3.43	10.74
Vegetables and fruits	2.28	1.14	1.11	1.25	1.16	1.13	1.09	1.25	-0.29
Sugar cane	0.14	-1.36	-1.41	-1.27	-1.38	-1.65	-1.69	-1.07	-0.85
Coffee and cocoa	0.27	-6.69	-6.82	-6.31	-6.55	-10.92	-10.94	-4.35	-5.95
Livestock	1.56	0.56	0.59	0.19	0.33	1.17	1.13	0.00	1.04
Other agricultural products	0.84	-0.37	-0.39	-0.37	-0.40	-0.53	-0.54	-0.31	-0.18
Bovine meat	0.73	4.60	4.99	2.65	3.65	7.38	7.37	2.02	5.69
Pork and poultry meat	0.98	-0.29	-0.35	-0.25	-0.35	-0.06	-0.14	-0.51	-0.18
Dairy products	0.65	0.99	1.03	0.55	0.89	1.74	1.75	0.59	1.93
Processed sugar	0.15	1.30	1.23	1.20	1.08	1.68	1.64	0.67	1.38
Other food products	7.90	0.40	0.30	0.47	0.29	0.48	0.43	0.03	0.19
Agriculture	**16.93**	**0.56**	**0.54**	**0.48**	**0.46**	**0.83**	**0.81**	**0.19**	**0.56**
Bolivia									
Paddy rice	0.05	-0.02	-0.12	0.05	-0.11	-0.26	-0.29	-0.10	-0.27
Wheat	0.02	1.51	1.73	1.33	1.58	2.78	2.72	1.10	2.90
Cereal grains	0.13	-0.33	-0.35	-0.37	-0.31	-0.26	-0.23	-0.27	0.02
Oil seeds and Soybeans	0.19	1.59	1.96	1.39	1.74	2.13	2.14	1.23	2.70
Vegetables and fruits	0.47	0.37	0.30	0.42	0.34	0.44	0.44	0.22	-0.38
Sugar cane	0.05	0.09	0.08	0.05	0.07	0.16	0.16	0.01	0.04
Coffee and cocoa	0.12	-0.67	-0.74	-0.63	-0.71	-1.09	-1.10	-0.42	-0.43
Livestock	0.35	-0.50	-0.47	-0.52	-0.45	-0.42	-0.40	-0.35	-0.27
Other agricultural products	0.18	0.07	0.04	0.02	-0.04	-0.10	-0.10	0.04	0.03
Bovine meat	0.32	-0.19	-0.12	-0.26	-0.12	0.07	0.09	-0.15	0.03
Pork and poultry meat	0.29	-0.57	-0.54	-0.58	-0.51	-0.52	-0.50	-0.39	-0.34
Dairy products	0.17	1.10	1.18	0.86	1.12	1.57	1.61	0.89	1.25
Processed sugar	0.10	0.27	0.32	0.16	0.29	0.58	0.61	0.11	0.28
Other food products	1.28	-0.01	-0.12	0.05	-0.11	-0.26	-0.29	-0.10	-0.27
Agriculture	**3.71**	**0.06**	**0.04**	**0.05**	**0.04**	**0.06**	**0.06**	**0.01**	**0.02**

(continued)

	Base values ($billion)	1-A G20 Sensitive	1-B G20 No Sensitive	2-A EU Sensitive	2-B EU No Sensitive	3-A US Sensitive	3-B US No Sensitive	4 NUR	5 Swiss Formula
Colombia									
Paddy rice	0.37	0.39	0.37	0.33	0.31	0.51	0.48	0.15	0.41
Wheat	0.13	2.33	2.71	1.97	2.51	5.72	5.63	0.09	5.53
Cereal grains	0.45	2.17	2.61	1.98	2.70	3.56	4.35	0.78	4.37
Oil seeds and Soybeans	0.24	2.93	3.62	2.47	3.19	4.30	4.31	1.95	4.66
Vegetables and fruits	2.74	0.51	0.47	0.53	0.47	0.98	0.93	0.48	-0.08
Sugar cane	0.17	0.04	0.02	0.04	0.01	0.10	0.08	-0.02	0.00
Coffee and cocoa	2.01	-0.34	-0.45	-0.22	-0.36	-1.99	-2.01	0.15	-1.43
Livestock	3.18	-0.39	-0.39	-0.41	-0.40	-0.24	-0.26	-0.34	-0.09
Other agricultural products	1.79	-0.26	-0.27	-0.31	-0.31	-0.19	-0.21	-0.30	0.06
Bovine meat	1.82	-0.35	-0.33	-0.42	-0.35	-0.11	-0.12	-0.32	-0.02
Pork and poultry meat	1.80	-0.51	-0.50	-0.50	-0.48	-0.37	-0.37	-0.41	-0.21
Dairy products	1.46	0.37	0.41	0.24	0.36	0.70	0.70	0.28	0.68
Processed sugar	0.95	0.50	0.48	0.40	0.40	0.66	0.64	0.31	0.49
Other food products	7.22	-0.03	-0.06	-0.01	-0.07	0.03	0.00	-0.09	-0.10
Agriculture	**24.31**	**0.02**	**0.01**	**0.00**	**0.00**	**0.09**	**0.08**	**-0.02**	**0.04**
Ecuador									
Paddy rice	0.19	-0.06	-0.12	-0.01	-0.14	-0.14	-0.18	-0.29	-0.04
Wheat									
Cereal grains	0.18	0.41	0.55	0.34	0.54	0.68	0.89	-0.19	1.34
Oil seeds and Soybeans	0.04	1.47	2.16	1.03	1.80	2.49	2.55	0.68	4.12
Vegetables and fruits	1.46	2.96	2.95	2.92	2.90	3.82	3.82	2.55	0.99
Sugar cane	0.10	-0.68	-0.67	-0.69	-0.66	-0.61	-0.61	-0.60	-0.18
Coffee and cocoa	0.63	-2.61	-2.61	-2.55	-2.52	-4.00	-3.98	-1.99	-1.40
Livestock	0.41	-0.76	-0.74	-0.76	-0.72	-0.67	-0.67	-0.66	-0.20
Other agricultural products	0.68	-0.44	-0.45	-0.49	-0.50	-0.56	-0.57	-0.51	0.16
Bovine meat	0.28	0.03	0.07	-0.03	0.06	0.21	0.22	0.01	0.12
Pork and poultry meat	0.48	-0.36	-0.32	-0.39	-0.32	-0.23	-0.22	-0.32	-0.05
Dairy products	0.25	0.13	0.17	0.07	0.17	0.29	0.31	0.14	0.18
Processed sugar	0.15	0.71	0.75	0.58	0.68	0.99	1.00	0.41	0.62
Other food products	2.83	-0.02	-0.09	0.04	-0.11	-0.11	-0.15	-0.27	-0.04
Agriculture	**7.49**	**0.27**	**0.25**	**0.27**	**0.23**	**0.31**	**0.30**	**0.12**	**0.13**
Peru									
Paddy rice	0.25	0.26	0.27	0.14	0.20	0.41	0.40	0.08	0.23
Wheat	0.35	1.79	1.96	1.66	1.83	3.09	3.02	0.83	2.98
Cereal grains	0.37	1.45	1.54	1.38	1.55	2.11	2.26	0.91	2.11
Oil seeds and Soybeans	0.12	1.00	1.25	0.85	1.14	1.83	1.81	0.83	1.73
Vegetables and fruits	1.53	-0.06	-0.08	0.00	-0.03	-0.17	-0.17	0.10	-0.50
Sugar cane	0.21	0.13	0.14	0.05	0.09	0.26	0.25	0.01	0.09
Coffee and cocoa	2.27	-0.37	-0.38	-0.35	-0.35	-0.57	-0.56	-0.20	-0.45
Livestock	1.33	-0.04	-0.04	-0.09	-0.07	0.04	0.03	-0.09	-0.05
Other agricultural products	0.56	0.57	0.56	0.46	0.42	0.43	0.42	0.27	0.58
Bovine meat	1.13	1.46	1.63	0.77	1.20	2.61	2.60	0.63	1.87
Pork and poultry meat	0.60	-0.31	-0.23	-0.36	-0.21	-0.08	-0.06	-0.22	-0.14
Dairy products	0.57	1.35	1.47	0.97	1.36	1.77	1.82	0.99	1.38
Processed sugar	0.89	0.06	0.11	-0.03	0.08	0.31	0.32	-0.03	0.13
Other food products	7.87	-0.07	-0.14	-0.02	-0.13	-0.24	-0.27	-0.12	-0.35
Agriculture	**18.03**	**0.13**	**0.13**	**0.09**	**0.10**	**0.18**	**0.17**	**0.04**	**0.04**
Venezuela									
Paddy rice	0.10	0.02	0.01	0.03	0.01	0.03	0.02	-0.03	-0.08
Wheat	0.31	1.67	1.93	1.53	1.89	3.53	3.51	0.46	2.94
Cereal grains	1.38	0.60	0.70	0.50	0.69	0.88	1.06	0.22	0.84
Oil seeds and Soybeans	0.27	3.04	3.80	2.56	3.37	4.30	4.36	2.08	4.51
Vegetables and fruits	3.14	-0.03	-0.07	0.01	-0.06	-0.13	-0.16	0.03	-0.31
Sugar cane									
Coffee and cocoa	0.83	-0.19	-0.19	-0.16	-0.16	-0.37	-0.36	-0.07	-0.41
Livestock	4.38	-0.58	-0.63	-0.51	-0.59	-0.75	-0.78	-0.40	-0.61
Other agricultural products	1.83	0.99	1.00	0.81	0.91	1.15	1.14	0.82	1.14
Bovine meat	2.18	0.08	0.05	-0.01	0.02	0.14	0.02	0.02	0.02
Pork and poultry meat	0.38	0.15	0.12	0.13	0.10	0.07	0.00	0.06	-0.08
Dairy products	2.38	1.07	1.07	0.87	0.99	1.28	1.28	0.90	1.23
Processed sugar	0.85	0.68	0.67	0.62	0.61	0.77	0.76	0.54	0.66
Other food products	15.74	0.04	0.02	0.05	0.02	0.03	0.01	-0.01	-0.11
Agriculture	**33.76**	**0.15**	**0.15**	**0.13**	**0.13**	**0.18**	**0.16**	**0.10**	**0.09**

(continued)

	Base values ($billion)	1-A G20 Sensitive	1-B G20 No Sensitive	2-A EU Sensitive	2-B EU No Sensitive	3-A US Sensitive	3-B US No Sensitive	4 NUR	5 Swiss Formula
Mexico									
Paddy rice	0.14	13.43	13.53	11.44	12.04	16.38	16.40	6.47	16.26
Wheat	0.58	-2.04	-1.74	-1.59	-1.88	-1.33	-1.40	-1.84	-1.76
Cereal grains	3.68	1.20	1.55	0.92	1.62	2.27	2.83	0.34	2.90
Oil seeds and Soybeans	0.18	19.58	24.57	16.22	21.34	26.45	26.88	12.79	31.08
Vegetables and fruits	8.64	-0.05	-0.17	0.09	-0.10	-0.48	-0.54	0.34	-0.93
Sugar cane	1.44	-0.27	-0.29	-0.28	-0.33	-0.19	-0.22	-0.23	-0.02
Coffee and cocoa	8.12	-0.54	-0.60	-0.48	-0.58	-0.71	-0.76	-0.38	-0.67
Livestock	8.18	-0.38	-0.54	-0.38	-0.54	-0.46	-0.66	-0.41	-0.75
Other agricultural products	7.86	0.76	0.76	0.63	0.64	0.60	0.59	0.46	0.51
Bovine meat	12.23	0.80	0.84	0.43	0.69	1.27	1.27	0.41	0.99
Pork and poultry meat	18.92	-0.17	-0.34	-0.15	-0.33	-0.24	-0.50	-0.33	-0.97
Dairy products	4.61	1.93	1.99	1.63	1.80	1.65	1.67	1.57	-0.93
Processed sugar	4.76	0.26	0.24	0.17	0.13	0.43	0.41	0.07	0.36
Other food products	63.89	-0.18	-0.24	-0.12	-0.22	-0.24	-0.28	-0.14	-0.37
Agriculture	**143.24**	**0.08**	**0.03**	**0.06**	**0.02**	**0.08**	**0.02**	**0.01**	**-0.21**
Central America									
Paddy rice	0.28	6.92	6.36	5.86	5.03	6.49	6.49	2.87	6.73
Wheat	0.36	0.95	1.21	0.63	1.04	2.87	2.85	-0.51	3.37
Cereal grains	0.54	1.22	1.61	0.83	1.63	2.43	3.06	-0.08	3.52
Oil seeds and Soybeans	0.40	5.53	7.00	4.56	6.07	7.67	7.79	3.41	9.33
Vegetables and fruits	3.78	1.07	0.99	1.21	1.09	1.54	1.49	1.23	-0.44
Sugar cane	0.32	0.73	0.71	0.40	0.42	1.29	1.26	0.13	1.02
Coffee and cocoa	2.44	-2.38	-2.46	-2.19	-2.26	-3.74	-3.74	-1.52	-1.96
Livestock	2.34	-0.33	-0.34	-0.38	-0.39	-0.25	-0.29	-0.34	-0.22
Other agricultural products	1.12	0.13	0.12	0.05	0.01	-0.04	-0.06	-0.07	0.31
Bovine meat	1.67	0.39	0.47	-0.01	0.29	1.06	1.07	0.02	0.89
Pork and poultry meat	1.30	-0.79	-0.81	-0.66	-0.77	-0.90	-0.97	-0.58	-0.94
Dairy products	1.11	1.10	1.11	1.22	0.93	0.33	0.26	1.20	-0.87
Processed sugar	1.25	3.06	3.05	1.93	2.08	4.84	4.80	1.05	3.64
Other food products	8.58	-0.08	-0.14	-0.02	-0.11	0.02	-0.02	-0.19	-0.12
Agriculture	**25.49**	**0.27**	**0.27**	**0.21**	**0.20**	**0.43**	**0.41**	**0.09**	**0.21**
Rest of Western Hemisphere									
Paddy rice	0.65	3.28	3.26	2.24	2.63	4.30	4.29	1.34	3.66
Wheat	0.62	1.24	1.23	1.25	1.20	1.67	1.62	0.29	2.01
Cereal grains	1.02	1.25	1.43	1.19	1.58	2.03	2.42	0.60	2.14
Oil seeds and Soybeans	1.33	1.43	1.84	1.26	1.62	1.97	2.00	0.88	2.38
Vegetables and fruits	2.86	-0.37	-0.48	0.07	-0.16	-0.91	-0.96	0.30	-1.74
Sugar cane	0.43	4.13	4.08	2.36	2.37	7.17	7.29	1.02	5.21
Coffee and cocoa	1.84	-1.72	-1.81	-1.33	-1.53	-2.65	-2.67	-0.90	-2.08
Livestock	5.27	0.13	0.16	-0.10	-0.02	0.46	0.44	-0.10	0.34
Other agricultural products	2.60	0.57	0.57	0.48	0.54	0.52	0.52	0.56	0.81
Bovine meat	4.67	1.96	2.21	0.98	1.50	3.49	3.48	0.78	2.51
Pork and poultry meat	1.71	-1.01	-1.00	-0.72	-0.78	-1.15	-1.12	-0.57	-0.86
Dairy products	2.71	3.02	3.11	2.55	2.97	3.70	3.73	2.64	3.60
Processed sugar	1.94	9.20	9.12	5.35	5.43	15.78	16.03	2.47	11.58
Other food products	17.26	0.05	-0.03	0.24	0.07	-0.17	-0.25	-0.05	-0.51
Agriculture	**44.90**	**0.89**	**0.90**	**0.66**	**0.68**	**1.33**	**1.32**	**0.38**	**0.89**

Source: Authors' model estimations.

Table A.4. Impact on Factor Returns (percentage change from base)

	1-A G20 Sensitive	1-B G20 No Sensitive	2-A EU Sensitive	2-B EU No Sensitive	3-A US Sensitive	3-B US No Sensitive	4.00 NUR	5 Swiss Formula
Argentina								
Land Rents	3.84	4.52	3.34	4.23	7.09	7.06	3.09	5.66
Natural Resources	-1.43	-1.57	-1.27	-1.43	-2.34	-2.31	-0.97	-1.77
Unskilled Labor	0.16	0.18	0.14	0.17	0.29	0.28	0.11	0.21
Agriculture	3.75	4.41	3.27	4.12	6.90	6.86	3.02	5.51
Processed Foods	0.29	0.08	0.29	0.00	0.03	-0.01	-0.21	-0.40
industries and services	-0.16	-0.18	-0.14	-0.17	-0.27	-0.27	-0.12	-0.21
Skilled Labor	-0.12	-0.14	-0.11	-0.13	-0.22	-0.22	-0.10	-0.17
Capital Returns	-0.09	-0.11	-0.08	-0.11	-0.17	-0.17	-0.08	-0.15
Brazil								
Land Rents	7.11	8.74	5.73	7.95	11.79	12.23	5.03	9.79
Natural Resources	-1.48	-1.78	-1.05	-1.47	-2.43	-2.50	-0.87	-1.93
Unskilled Labor	0.09	0.11	0.08	0.11	0.17	0.18	0.06	0.13
Agriculture	6.42	7.90	5.29	7.30	10.78	11.19	4.63	8.85
Processed Foods	1.02	0.95	0.78	0.72	1.47	1.43	0.38	0.80
industries and services	-0.15	-0.17	-0.12	-0.15	-0.23	-0.23	-0.10	-0.19
Skilled Labor	-0.11	-0.12	-0.08	-0.11	-0.15	-0.16	-0.07	-0.13
Capital Returns	0.00	0.00	0.00	0.00	0.01	0.01	-0.01	-0.01
Chile								
Land Rents	4.70	4.90	4.39	4.78	5.80	5.95	3.67	2.87
Natural Resources	-0.80	-0.93	-0.59	-0.86	-1.09	-1.15	-0.80	-0.63
Unskilled Labor	0.29	0.29	0.27	0.29	0.35	0.35	0.22	0.17
Agriculture	4.04	4.20	3.78	4.08	4.97	5.08	3.09	2.51
Processed Foods	0.55	0.47	0.51	0.38	0.81	0.75	0.03	0.52
industries and services	-0.21	-0.22	-0.19	-0.20	-0.27	-0.28	-0.14	-0.16
Skilled Labor	-0.15	-0.15	-0.14	-0.15	-0.19	-0.19	-0.11	-0.11
Capital Returns	-0.14	-0.14	-0.13	-0.14	-0.17	-0.17	-0.11	-0.09
Bolivia								
Land Rents	1.94	2.16	1.76	2.06	2.89	2.94	1.32	1.55
Natural Resources	-0.24	-0.53	0.02	-0.54	-1.47	-1.57	-0.10	-0.63
Unskilled Labor	0.13	0.15	0.11	0.15	0.22	0.23	0.09	0.10
Agriculture	1.90	2.11	1.71	2.00	2.81	2.86	1.29	1.52
Processed Foods	-0.01	-0.06	-0.03	-0.06	-0.06	-0.07	-0.05	-0.06
industries and services	-0.26	-0.28	-0.24	-0.26	-0.34	-0.34	-0.18	-0.22
Skilled Labor	-0.25	-0.25	-0.23	-0.24	-0.29	-0.29	-0.17	-0.19
Capital Returns	-0.21	-0.23	-0.19	-0.22	-0.29	-0.30	-0.15	-0.19
Colombia								
Land Rents	1.82	1.90	1.74	1.87	1.67	1.76	1.50	0.85
Natural Resources	-0.39	-0.52	-0.29	-0.53	-0.74	-0.79	-0.36	-0.23
Unskilled Labor	0.06	0.07	0.05	0.06	0.07	0.07	0.05	0.02
Agriculture	1.59	1.66	1.49	1.62	1.50	1.58	1.28	0.81
Processed Foods	-0.33	-0.36	-0.35	-0.37	-0.08	-0.13	-0.35	-0.12
industries and services	-0.17	-0.17	-0.16	-0.17	-0.16	-0.17	-0.12	-0.11
Skilled Labor	-0.16	-0.17	-0.16	-0.16	-0.15	-0.16	-0.12	-0.10
Capital Returns	-0.14	-0.14	-0.13	-0.14	-0.13	-0.14	-0.11	-0.09
Ecuador								
Land Rents	5.96	6.06	5.78	5.96	6.34	6.45	5.11	2.10
Natural Resources	-1.03	-1.09	-1.00	-1.09	-1.25	-1.28	-0.87	-0.30
Unskilled Labor	0.47	0.48	0.45	0.47	0.52	0.53	0.39	0.18
Agriculture	5.20	5.28	5.01	5.16	5.49	5.59	4.37	1.98
Processed Foods	-0.15	-0.20	-0.12	-0.22	-0.14	-0.18	-0.37	-0.01
industries and services	-0.18	-0.18	-0.18	-0.18	-0.17	-0.17	-0.14	-0.07
Skilled Labor	-0.14	-0.14	-0.14	-0.13	-0.11	-0.11	-0.11	-0.05
Capital Returns	-0.15	-0.16	-0.15	-0.15	-0.14	-0.15	-0.14	-0.05

(continued)

	1-A G20 Sensitive	1-B G20 No Sensitive	2-A EU Sensitive	2-B EU No Sensitive	3-A US Sensitive	3-B US No Sensitive	4.00 NUR	5 Swiss Formula
Peru								
Land Rents	1.43	1.58	1.22	1.49	2.09	2.14	0.96	1.25
Natural Resources	0.01	-0.13	0.13	-0.12	-0.50	-0.54	0.04	-0.16
Unskilled Labor	0.17	0.20	0.14	0.19	0.30	0.31	0.12	0.17
Agriculture	1.42	1.57	1.21	1.48	2.09	2.14	0.95	1.26
Processed Foods	0.00	-0.04	-0.03	-0.07	-0.04	-0.07	-0.08	-0.15
industries and services	-0.17	-0.17	-0.15	-0.16	-0.19	-0.19	-0.11	-0.12
Skilled Labor	-0.16	-0.16	-0.16	-0.14	-0.15	-0.14	-0.11	-0.10
Capital Returns	-0.12	-0.14	-0.11	-0.14	-0.19	-0.20	-0.09	-0.13
Venezuela								
Land Rents	1.39	1.50	1.22	1.42	1.79	1.86	0.95	1.41
Natural Resources	-0.27	-0.32	-0.23	-0.32	-0.38	-0.39	-0.21	-0.22
Unskilled Labor	0.07	0.07	0.06	0.07	0.09	0.09	0.05	0.07
Agriculture	1.34	1.45	1.18	1.37	1.73	1.80	0.92	1.36
Processed Foods	0.16	0.13	0.14	0.11	0.17	0.12	0.10	0.01
industries and services	-0.13	-0.13	-0.11	-0.13	-0.16	-0.16	-0.08	-0.12
Skilled Labor	-0.10	-0.11	-0.09	-0.10	-0.13	-0.13	-0.07	-0.10
Capital Returns	-0.09	-0.10	-0.08	-0.10	-0.12	-0.12	-0.06	-0.10
Mexico								
Land Rents	2.03	2.19	1.82	2.10	2.40	2.62	1.20	1.58
Natural Resources	0.27	0.27	0.25	0.23	0.30	0.31	0.17	0.39
Unskilled Labor	0.04	0.03	0.04	0.03	0.02	0.02	0.03	-0.03
Agriculture	1.59	1.57	1.46	1.47	1.46	1.47	1.06	0.42
Processed Foods	-0.05	-0.12	-0.07	-0.13	-0.05	-0.12	-0.08	-0.36
industries and services	-0.12	-0.12	-0.11	-0.12	-0.13	-0.13	-0.07	-0.06
Skilled Labor	-0.11	-0.11	-0.10	-0.10	-0.11	-0.12	-0.07	-0.07
Capital Returns	-0.10	-0.11	-0.09	-0.10	-0.10	-0.11	-0.06	-0.08
Central America								
Land Rents	3.15	3.24	2.96	3.11	3.45	3.52	2.48	1.54
Natural Resources	-0.54	-0.57	-0.55	-0.58	-0.53	-0.56	-0.55	-0.14
Unskilled Labor	0.33	0.34	0.30	0.33	0.39	0.40	0.26	0.17
Agriculture	3.07	3.16	2.87	3.01	3.35	3.42	2.38	1.56
Processed Foods	0.09	0.06	0.00	-0.05	0.36	0.31	-0.16	0.10
industries and services	-0.25	-0.25	-0.24	-0.23	-0.25	-0.25	-0.18	-0.13
Skilled Labor	-0.21	-0.20	-0.20	-0.19	-0.19	-0.19	-0.15	-0.10
Capital Returns	-0.22	-0.23	-0.22	-0.22	-0.22	-0.23	-0.18	-0.12
Rest of Western Hemisphere								
Land Rents	3.82	4.01	3.07	3.47	5.20	5.29	2.27	3.64
Natural Resources	-0.61	-0.70	-0.35	-0.52	-1.20	-1.24	-0.23	-0.74
Unskilled Labor	0.16	0.17	0.12	0.14	0.24	0.24	0.09	0.17
Agriculture	3.79	3.98	3.05	3.45	5.12	5.20	2.28	3.64
Processed Foods	1.29	1.26	0.94	0.93	1.96	1.92	0.48	1.22
industries and services	-0.26	-0.27	-0.22	-0.23	-0.33	-0.34	-0.15	-0.23
Skilled Labor	-0.21	-0.21	-0.18	-0.18	-0.25	-0.25	-0.13	-0.17
Capital Returns	-0.15	-0.15	-0.13	-0.15	-0.17	-0.17	-0.11	-0.12

Source: Authors' model estimations.

Table A.5. Sectoral Impact on Agricultural Exports (percentage change from base)

	Base values ($billion)	1-A G20 Sensitive	1-B G20 No Sensitive	2-A EU Sensitive	2-B EU No Sensitive	3-A US Sensitive	3-B US No Sensitive	4 NUR	5 Swiss Formula
Argentina									
Paddy rice	31.2	3.32	3.26	2.52	2.73	2.46	2.63	1.48	2.28
Wheat	1,738.2	1.51	1.06	1.70	1.01	-0.19	-0.20	0.48	0.13
Cereal grains	1,253.3	4.88	3.19	5.08	3.32	4.22	3.34	2.67	1.68
Oil seeds and Soybeans	1,565.6	12.91	18.56	11.21	17.47	31.85	31.74	13.25	34.50
Vegetables and fruits	835.8	5.81	4.89	6.36	5.05	2.22	2.31	5.26	-3.60
Coffee and cocoa	296.6	-6.72	-7.97	-5.59	-6.82	-11.87	-11.76	-3.58	-11.53
Livestock	117.5	-4.67	-5.89	-3.53	-5.38	-9.85	-9.87	-3.89	-8.00
Other agricultural products	116.8	-2.23	-3.10	-1.82	-3.07	-6.91	-6.87	-2.09	-4.82
Bovine meat	383.9	35.57	38.10	21.70	27.01	54.24	54.20	14.90	37.92
Pork and poultry meat	74.5	2.91	2.59	2.77	2.17	5.23	5.15	1.05	1.05
Dairy products	302.5	6.79	6.53	5.43	5.87	7.30	7.31	4.93	9.26
Processed sugar	52.4	7.68	7.13	6.23	5.85	8.21	8.19	3.56	5.31
Other food products	6,165.8	2.19	1.47	2.74	1.47	1.20	0.98	0.77	-0.02
Agriculture	**12,934.2**	**4.71**	**4.79**	**4.43**	**4.35**	**6.38**	**6.18**	**3.08**	**5.11**
Brazil									
Paddy rice	1.9	9.89	9.12	8.38	7.57	9.79	9.62	4.29	9.03
Cereal grains	725.1	12.53	15.52	7.51	15.45	16.97	22.26	5.90	19.68
Oil seeds and Soybeans	2,855.0	11.67	17.58	10.54	16.44	23.51	23.68	10.96	26.12
Vegetables and fruits	446.9	7.87	6.85	8.62	7.10	5.75	5.51	7.30	-1.65
Coffee and cocoa	2,612.4	-0.04	-1.12	0.82	-0.63	-4.37	-4.53	0.76	-4.73
Livestock	211.3	-2.42	-3.52	-1.44	-3.23	-5.62	-5.87	-1.95	-4.71
Other agricultural products	219.2	-3.65	-4.80	-1.32	-3.06	-6.42	-6.66	-1.73	-5.99
Bovine meat	1,175.2	41.78	44.77	25.70	31.82	65.06	64.79	18.12	45.58
Pork and poultry meat	1,765.7	1.11	0.52	1.45	0.41	1.52	1.33	0.49	-0.38
Dairy products	35.8	10.67	10.69	8.33	9.81	13.72	13.75	7.80	11.43
Processed sugar	1,482.1	4.19	3.64	3.56	2.89	3.96	3.97	2.48	3.76
Other food products	4,711.1	3.41	2.74	3.94	2.74	3.02	2.76	1.50	1.22
Agriculture	**16,241.8**	**7.28**	**8.13**	**6.02**	**7.02**	**10.33**	**10.44**	**4.51**	**8.50**
Chile									
Cereal grains	125.3	10.03	11.92	10.27	12.69	16.40	19.05	5.61	17.80
Oil seeds and Soybeans	3.8	17.53	19.59	14.82	16.60	20.57	20.54	9.24	20.93
Vegetables and fruits	1,565.4	4.59	4.37	4.79	4.35	4.05	3.95	4.14	0.79
Coffee and cocoa	237.0	-4.22	-4.54	-3.75	-4.32	-9.31	-9.35	-2.32	-5.16
Livestock	36.6	-1.73	-2.23	-1.33	-2.18	-3.27	-3.46	-1.71	-1.74
Other agricultural products	55.2	0.86	-1.38	-0.68	-1.48	-3.58	-3.69	0.87	-1.06
Bovine meat	25.8	39.77	42.27	22.76	29.20	70.46	70.24	16.88	47.20
Pork and poultry meat	160.3	3.23	2.73	3.41	2.50	4.41	3.95	0.70	1.34
Dairy products	59.3	12.26	12.36	8.47	11.03	18.57	18.62	7.88	18.65
Other food products	2,920.9	1.74	1.24	2.15	1.18	0.91	0.70	0.70	0.37
Agriculture	**5,189.6**	**2.86**	**2.51**	**3.04**	**2.42**	**2.36**	**2.26**	**1.87**	**1.12**
Bolivia									
Cereal grains	2.9	15.99	16.24	13.13	15.93	22.08	22.00	9.56	20.03
Oil seeds and Soybeans	35.8	4.99	5.69	4.59	5.16	5.55	5.55	3.85	6.44
Vegetables and fruits	35.3	14.76	14.33	15.06	14.26	17.52	17.45	9.83	2.22
Coffee and cocoa	11.7	0.66	0.20	0.98	0.19	-2.03	-2.09	0.92	-0.03
Other agricultural products	2.5	2.69	2.29	2.37	1.90	1.05	1.14	1.56	-2.43
Bovine meat	1.2	3.56	3.61	2.42	2.84	-2.12	-0.91	1.84	3.05
Dairy products	7.2	4.81	4.65	3.94	4.25	4.37	4.34	3.56	0.39
Processed sugar	3.1	12.20	11.78	10.18	10.40	14.22	14.13	5.94	7.13
Other food products	331.2	0.96	0.47	1.29	0.45	-0.65	-0.82	0.55	-0.51
Agriculture	**430.8**	**2.68**	**2.31**	**2.88**	**2.22**	**1.67**	**1.53**	**1.75**	**0.51**
Colombia									
Oil seeds and Soybeans	1.1	6.97	7.67	6.51	7.01	7.83	7.78	5.04	6.72
Vegetables and fruits	495.5	7.78	7.39	7.95	7.25	8.20	8.05	6.71	1.41
Coffee and cocoa	1,347.7	1.19	0.84	1.50	0.92	-2.33	-2.39	1.62	-1.72
Livestock	61.1	-1.50	-2.02	-0.98	-1.94	-2.93	-3.11	-1.27	-1.45
Other agricultural products	3.9	-1.01	-1.62	-0.83	-1.70	-2.57	-2.75	-1.15	-4.03
Bovine meat	9.8	20.16	21.47	12.17	15.17	31.91	31.14	8.62	22.43
Pork and poultry meat	5.5	3.52	3.39	3.24	2.94	6.30	6.15	1.73	-1.10
Dairy products	46.3	6.67	6.52	5.50	5.84	7.89	7.82	4.71	7.03
Processed sugar	157.1	4.35	4.02	3.99	3.57	4.04	3.91	2.86	3.50
Other food products	661.3	1.74	1.28	2.03	1.18	0.95	0.75	0.75	0.36
Agriculture	**2,789.2**	**2.77**	**2.39**	**2.96**	**2.33**	**0.97**	**0.86**	**2.40**	**-0.14**

(continued)

	Base values ($billion)	1-A G20 Sensitive	1-B G20 No Sensitive	2-A EU Sensitive	2-B EU No Sensitive	3-A US Sensitive	3-B US No Sensitive	4 NUR	5 Swiss Formula
Ecuador									
Cereal grains	12.4	4.14	4.65	3.93	4.74	4.75	5.89	1.88	6.57
Oil seeds and Soybeans	10.8	5.27	6.53	4.44	5.71	6.54	6.63	3.36	9.07
Vegetables and fruits	1,052.6	6.77	6.50	6.87	6.37	7.06	6.99	5.76	1.83
Coffee and cocoa	326.5	-1.39	-1.62	-1.19	-1.52	-4.92	-4.93	-0.83	-1.72
Livestock	10.4	-2.09	-2.38	-1.96	-2.36	-3.07	-3.12	-2.00	-0.47
Other agricultural products	13.4	0.12	-0.27	-0.09	-0.81	-2.41	-2.50	-1.16	2.05
Pork and poultry meat	22.6	0.41	0.22	0.54	0.18	-0.30	-0.34	0.09	0.48
Processed sugar	14.7	5.93	5.77	5.02	5.07	6.69	6.67	3.18	4.96
Other food products	1,003.2	1.20	0.76	1.49	0.68	0.56	0.38	0.25	0.60
Agriculture	**2,466.6**	**3.27**	**2.95**	**3.45**	**2.86**	**2.65**	**2.56**	**2.48**	**0.91**
Peru									
Cereal grains	5.0	27.58	28.27	21.85	26.35	38.96	41.75	14.74	34.10
Oil seeds and Soybeans	1.9	7.02	7.91	6.49	7.21	7.48	7.51	5.25	7.85
Vegetables and fruits	209.8	4.65	4.16	4.97	4.15	3.18	3.09	4.12	0.22
Coffee and cocoa	233.0	1.17	0.75	1.57	0.86	-1.97	-2.01	1.58	-1.67
Livestock	11.3	-1.84	-2.08	-0.17	-1.58	-4.24	-4.38	-0.96	-3.17
Other agricultural products	4.1	2.00	1.86	1.81	-0.79	1.26	1.24	1.23	-0.78
Bovine meat	97.8	19.05	19.87	12.42	15.14	27.89	27.72	9.18	20.87
Dairy products	4.5	10.11	9.91	8.89	9.22	11.00	10.95	7.93	5.97
Processed sugar	16.8	11.98	11.59	10.08	10.28	13.89	13.79	5.82	8.79
Other food products	1,209.3	0.58	-0.32	1.30	-0.37	-1.99	-2.36	0.16	-1.84
Agriculture	**1,793.5**	**2.34**	**1.66**	**2.53**	**1.36**	**0.54**	**0.27**	**1.41**	**-0.12**
Venezuela									
Oil seeds and Soybeans	24.1	18.75	21.81	16.10	18.99	22.23	22.49	11.43	22.90
Vegetables and fruits	32.6	8.09	7.77	8.20	7.60	7.37	7.29	7.06	1.05
Coffee and cocoa	17.1	1.93	1.77	2.22	1.86	-0.98	-0.98	2.15	-1.43
Livestock	34.8	-1.72	-2.49	0.03	-1.59	-5.12	-5.26	-2.96	-3.12
Other agricultural products	1.2	-1.15	-1.70	-0.80	-1.72	-2.90	0.04	1.19	-1.77
Pork and poultry meat	2.2	2.90	2.30	3.13	2.21	1.94	1.76	1.59	1.17
Dairy products	1.3	4.43	4.28	3.90	3.96	4.49	4.45	3.53	4.20
Processed sugar	1.3	0.30	-0.01	0.27	-0.27	-0.30	-0.52	1.84	2.88
Other food products	432.3	2.30	1.97	2.48	1.87	2.02	1.90	1.11	0.91
Agriculture	**547.0**	**3.10**	**2.90**	**3.25**	**2.74**	**2.67**	**2.58**	**1.70**	**1.57**
Mexico									
Wheat	79.5	-0.09	-0.32	0.11	-0.44	0.06	-0.16	-0.04	0.19
Cereal grains	14.5	12.99	13.81	11.42	14.06	18.85	20.91	7.49	17.65
Oil seeds and Soybeans	27.4	25.63	29.71	21.27	25.24	28.43	28.65	15.62	34.96
Vegetables and fruits	2,844.2	1.53	1.20	1.83	1.23	0.93	0.75	1.61	-0.49
Sugar cane	1.0	-1.52	-1.78	-0.76	-1.23	-3.28	-3.33	-0.55	-2.44
Coffee and cocoa	524.0	-3.91	-4.23	-3.60	-4.14	-2.95	-3.12	-2.90	-1.88
Livestock	466.6	-0.26	-0.70	-0.14	-0.68	-1.10	-1.32	-0.31	-0.39
Other agricultural products	51.2	3.98	3.60	3.70	2.97	1.44	1.34	2.27	3.06
Bovine meat	56.1	26.02	27.73	14.99	20.34	42.13	42.00	11.59	30.02
Pork and poultry meat	267.0	7.40	6.99	7.82	6.90	8.70	8.54	2.94	4.82
Dairy products	58.2	10.33	10.45	7.27	9.58	15.79	16.03	6.28	15.81
Processed sugar	108.4	6.84	6.68	4.43	4.07	9.32	9.45	2.51	9.45
Other food products	3,509.4	0.61	0.13	0.98	0.09	-0.36	-0.57	0.28	-0.16
Agriculture	**8,007.6**	**1.27**	**0.90**	**1.43**	**0.79**	**0.88**	**0.70**	**0.83**	**0.40**
CACM									
Cereal grains	2.5	3.14	3.48	2.82	3.52	3.92	4.76	1.00	5.91
Oil seeds and Soybeans	76.4	15.89	21.06	14.53	18.22	21.54	21.86	10.57	25.91
Vegetables and fruits	1,927.8	5.44	5.13	5.81	5.17	5.51	5.41	5.00	0.36
Coffee and cocoa	1,392.0	-1.28	-1.60	-0.85	-1.36	-4.64	-4.68	-0.32	-2.60
Livestock	27.8	-2.48	-3.03	-1.85	-2.79	-4.37	-4.53	-2.07	-2.53
Other agricultural products	12.9	1.55	1.15	1.34	0.65	-0.76	-0.87	0.16	2.41
Bovine meat	97.5	10.57	11.12	6.58	8.26	16.33	16.47	4.41	12.10
Pork and poultry meat	9.0	3.29	3.32	3.07	2.84	6.96	6.80	1.41	3.32
Dairy products	11.0	20.12	20.83	14.40	17.39	30.58	30.71	11.48	21.41
Processed sugar	580.7	8.54	8.14	5.87	5.94	11.54	11.54	3.57	9.20
Other food products	1,140.5	1.07	0.59	1.47	0.58	0.32	0.12	0.29	0.27
Agriculture	**5,278.0**	**3.29**	**3.02**	**3.22**	**2.76**	**2.79**	**2.71**	**2.45**	**1.16**

(continued)

	Base values ($billion)	1-A G20 Sensitive	1-B G20 No Sensitive	2-A EU Sensitive	2-B EU No Sensitive	3-A US Sensitive	3-B US No Sensitive	4 NUR	5 Swiss Formula
Paraguay									
Paddy rice	1.1	1.20	1.24	0.98	0.95	1.47	1.46	0.51	0.76
Wheat	6.7	0.62	0.74	0.52	0.57	0.83	0.81	0.28	0.41
Cereal grains	42.2	5.71	6.14	6.02	6.91	8.39	9.30	3.82	7.90
Oil seeds and Soybeans	364.2	3.51	4.02	3.30	3.59	3.51	3.59	2.35	3.43
Vegetables and fruits	0.3	7.04	6.71	7.74	7.05	6.04	5.95	7.14	0.65
Coffee and cocoa	5.0	-0.88	-2.18	-0.90	-1.57	-4.87	-4.89	-0.17	-3.83
Livestock	5.5	-2.81	-3.35	-1.75	-2.94	-5.60	-5.79	-1.79	-4.20
Other agricultural products	83.5	-0.88	-2.02	-1.15	-1.88	-4.05	-4.14	-1.05	-2.10
Bovine meat	78.1	5.49	5.96	3.44	4.25	8.91	8.88	2.62	6.17
Processed sugar	9.4	9.83	9.67	6.69	6.57	11.93	12.06	4.06	9.82
Other food products	173.0	1.82	1.80	1.20	1.16	2.84	2.87	0.66	2.13
Agriculture	**768.8**	**2.95**	**3.12**	**2.46**	**2.63**	**3.31**	**3.39**	**1.67**	**3.01**
Uruguay									
Paddy rice	51.4	10.02	10.08	6.44	8.34	12.53	12.54	4.67	11.08
Cereal grains	4.8	3.94	4.34	4.20	4.99	6.63	7.54	1.90	6.15
Oil seeds and Soybeans	5.4	-1.17	-1.38	-1.15	-1.90	-2.36	-2.28	-2.36	1.24
Vegetables and fruits	54.3	7.29	6.95	8.00	7.29	6.09	6.02	7.50	0.75
Coffee and cocoa	3.9	-1.81	-1.51	-0.59	-1.09	-4.04	-4.07	-0.11	-3.10
Livestock	49.7	-3.04	-3.67	-1.92	-3.13	-5.70	-5.89	-1.89	-4.34
Other agricultural products	40.5	-1.80	-1.42	-0.75	-1.31	-3.36	-3.44	-0.68	-1.67
Bovine meat	263.5	34.97	36.48	27.59	30.91	45.99	45.88	24.27	37.25
Pork and poultry meat	22.9	1.49	1.51	1.77	1.49	1.49	1.58	1.55	0.67
Dairy products	130.8	10.44	10.67	7.79	9.34	14.56	14.65	7.02	13.67
Processed sugar	5.5	8.23	8.08	5.39	5.29	14.17	14.33	3.09	10.57
Other food products	341.4	2.71	2.65	1.61	1.56	3.20	3.24	0.71	3.31
Agriculture	**974.2**	**12.60**	**12.99**	**9.82**	**10.87**	**16.20**	**16.19**	**8.34**	**13.51**

Source: Authors' model estimations.

Table A.6. Sectoral Impact on LAC's Agricultural Exports to Major Markets (percentage change from base)

	Base values ($billion)	1-A G20 Sensitive	1-B G20 No Sensitive	2-A EU Sensitive	2-B EU No Sensitive	3-A US Sensitive	3-B US No Sensitive	4 NUR	5 Swiss Formula
United States									
Cereal grains	106.1	4.94	6.13	6.21	7.46	6.94	9.98	2.10	10.85
Oil seeds and Soybeans	37.7	42.87	45.82	36.35	38.64	42.27	42.61	20.84	41.09
Vegetables and fruits	2,299.3	-3.01	-3.37	-2.65	-3.25	-4.31	-4.43	-2.59	-1.90
Coffee and cocoa	2,030.4	3.80	3.41	4.22	3.67	-3.23	-3.18	4.23	-2.62
Livestock	127.1	0.09	-0.49	-0.46	-0.73	-0.54	-0.56	-0.80	0.21
Other agricultural products	26.0	25.02	24.17	22.05	20.91	18.62	18.53	13.24	24.96
Bovine meat	294.4	-9.54	-11.06	-4.89	-7.23	-15.64	-15.72	-5.49	-14.64
Pork and poultry meat	28.0	-2.01	-2.79	-1.35	-2.44	-5.80	-5.95	-1.59	-3.02
Dairy products	57.7	12.23	12.30	11.64	11.00	12.61	12.51	8.79	8.62
Processed sugar	368.7	16.08	15.68	14.05	14.91	18.45	18.27	7.98	9.98
Other food products	3,290.4	-0.60	-0.96	-0.20	-0.91	-2.15	-2.31	-0.40	-1.24
Agriculture	**8,665.8**	**0.58**	**0.20**	**0.96**	**0.38**	**-2.12**	**-2.18**	**0.48**	**-1.25**
Euroean Union									
Paddy rice	35.59	55.30	54.36	34.21	44.73	67.44	67.37	25.23	59.47
Wheat	20.14	37.46	46.61	22.36	35.00	58.62	58.46	16.60	49.59
Cereal grains	363.86	49.69	49.97	39.91	49.03	72.99	76.70	28.81	60.14
Oil seeds and Soybeans	2197.83	7.23	8.71	6.45	7.63	6.81	6.97	4.62	9.19
Vegetables and fruits	3549.99	16.66	16.01	17.10	15.98	16.22	16.14	15.26	1.01
Coffee and cocoa	3180.59	-1.55	-2.31	-0.73	-1.89	-4.29	-4.48	-0.36	-4.64
Livestock	256.33	-8.54	-9.76	-5.91	-8.18	-13.72	-13.85	-5.71	-10.35
Other agricultural products	231.69	-9.92	-10.84	-7.58	-9.18	-13.23	-13.44	-6.63	-11.04
Bovine meat	1018.90	98.99	107.01	59.97	76.36	154.86	154.48	43.14	110.65
Pork and poultry meat	599.78	10.63	11.13	9.12	9.62	23.96	23.70	5.14	9.38
Dairy products	48.08	57.43	60.38	35.39	48.56	102.00	102.90	27.48	61.78
Processed sugar	318.49	79.55	78.70	43.10	41.82	137.85	137.31	14.56	91.88
Other food products	8107.24	5.31	4.80	5.55	4.79	5.97	5.92	2.09	2.49
Agriculture	**19,928.5**	**13.29**	**13.41**	**10.66**	**11.11**	**17.65**	**17.64**	**7.12**	**10.02**
China									
Cereal grains	5.88	-13.44	-25.79	-13.30	-26.00	-26.49	-44.11	-18.35	-51.12
Oil seeds and Soybeans	1618.42	23.89	41.45	21.55	40.23	69.50	69.30	29.10	72.57
Vegetables and fruits	50.14	14.34	12.22	13.05	12.41	23.07	22.12	3.96	22.24
Coffee and cocoa	127.61	7.26	5.56	8.02	6.33	9.86	9.82	1.41	11.25
Livestock	35.01	-3.63	-6.67	-2.72	-6.57	-12.65	-13.52	-4.61	-13.26
Other agricultural products	12.66	-3.23	-5.35	-2.13	-4.41	-8.88	-9.71	-2.59	-8.53
Bovine meat	12.76	3.09	0.74	7.48	4.33	3.55	3.07	1.28	1.01
Pork and poultry meat	53.53	1.49	-0.65	2.66	-0.30	-3.33	-3.85	-0.68	-1.92
Dairy products	3.77	4.77	4.11	5.33	4.17	-38.98	-39.20	4.87	-43.60
Processed sugar	96.25	10.35	9.67	4.91	8.59	12.06	21.00	5.33	27.03
Other food products	534.53	2.94	1.33	3.47	1.29	0.86	0.23	0.63	-0.26
Agriculture	**2,550.6**	**16.80**	**27.32**	**15.28**	**26.57**	**45.37**	**45.38**	**18.85**	**47.68**
Asia 3									
Wheat	2.14	-10.45	-9.90	-10.01	-8.35	-13.79	-12.50	-5.65	-8.55
Cereal grains	381.82	2.76	5.20	-2.06	6.08	2.90	6.15	1.18	5.45
Oil seeds and Soybeans	184.86	-15.11	-44.83	-16.86	-45.76	-46.36	-45.11	-29.64	-43.37
Vegetables and fruits	17.61	-1.23	1.08	-4.81	2.03	3.26	6.36	-0.30	16.15
Coffee and cocoa	73.19	-10.94	-10.32	-13.72	-9.10	-12.25	-10.57	-5.79	-5.03
Livestock	16.31	-3.62	-8.26	-0.65	-8.76	-13.64	-15.45	-3.23	-12.96
Other agricultural products	33.81	-4.12	-5.48	-2.94	-4.64	-9.79	-9.70	-2.26	-7.93
Bovine meat	13.04	-4.41	-6.52	-2.06	-4.05	-3.53	-3.92	-3.05	3.23
Pork and poultry meat	5.53	-1.62	-4.56	0.61	-4.19	-31.95	-32.60	-1.66	-30.65
Dairy products	4.14	1.70	0.79	1.91	1.00	-2.55	-2.64	2.25	-2.46
Processed sugar	137.14	2.12	2.79	-0.97	1.05	3.30	4.20	-0.15	2.81
Other food products	789.19	7.91	3.43	12.02	2.82	5.54	2.90	3.38	2.34
Agriculture	**1,658.8**	**2.36**	**-2.49**	**2.73**	**-2.74**	**-2.34**	**-2.59**	**-1.69**	**-2.49**
Asia7									
Wheat	14.18	-0.18	-0.55	0.74	-0.22	-39.68	-39.67	-1.87	-42.07
Cereal grains	159.02	5.79	6.10	3.95	3.78	4.77	7.24	-0.84	7.82
Oil seeds and Soybeans	287.13	10.18	12.64	9.17	10.95	7.95	8.33	6.62	13.53
Vegetables and fruits	280.58	2.35	1.83	3.66	2.43	-0.89	-0.94	2.67	-3.27
Coffee and cocoa	611.92	-8.71	-9.53	-7.31	-8.84	-13.96	-14.05	-5.22	-9.19
Livestock	67.83	-7.45	-7.68	-4.30	-6.89	-13.85	-14.05	-3.27	-9.64
Other agricultural products	85.72	-3.59	-4.42	-1.73	-3.58	-8.97	-9.09	-1.29	-5.54
Bovine meat	127.25	-19.48	-20.92	-14.06	-17.50	-25.16	-25.26	-11.32	-21.19
Pork and poultry meat	636.51	-1.53	-2.34	-0.15	-1.89	-5.18	-5.33	-1.13	-3.55
Dairy products	17.62	43.09	42.53	18.44	37.05	69.32	69.80	21.00	50.20
Processed sugar	70.74	8.93	8.28	2.73	2.20	41.21	41.55	0.61	53.62
Other food products	1996.27	-1.83	-2.21	-0.93	-2.16	-5.21	-5.04	-1.33	-1.81
Agriculture	**4,354.8**	**-1.68**	**-2.02**	**-0.85**	**-1.97**	**-4.76**	**-4.61**	**-1.22**	**-1.66**

Source: Authors' model estimations.
Note: The impact on the United States excludes exports from Mexico.

ANNEX B: MAIN AGRICULTURE PROPOSALS AND SCENARIOS

1. Common Issues: Tropical Products

As agreed in the July 2004 Framework, the "fullest liberalization" should be achieved in the modalities for tropical products. Yet, there is no agreement about what products should be defined as tropical products. Several Latin American countries have proposed a group of products as tropical and alternative products in their communication to the WTO [JOB(06)/129]. However, it is unlikely that products such as rice and tobacco are designated as tropical products.

To this end, we have prepared the provisional list of non-controversial tropical products, whose protection for the following Headings in the Harmonized Tariff Schedule (HTS) is completely eliminated in developed countries: [22]

HTS Headings: 0801-0804, 0807, 0901, 0902, 0904-0910, 1301, 1401-1404, 1801, 1802, 2101, 5001

2. Main Agricultural Proposals

2.1 G20 proposal

In October 2005, the Group of 20 developing countries has presented new proposals on market access and domestic support as a part of the WTO negotiations on agriculture.

Market Access

In their proposal, the G-20 proposed that developed countries will undertake a formula cut of at least 54% on average, while developing countries will be subject to a maximum tariff cut of 36% on average. In order to accomplish this goal, the G-20 proposed a formula with two different set of bands as well as two set of tariff reduction rates for developed and developing countries.

Tariff Reduction Formula

Both developed and developing countries would have four bands each, with thresholds as listed below. Tariffs within the bands would be subject to linear cuts. There would be a cap of tariffs.

	Developed Countries		Developing Countries	
	Thresholds with AVEs (%)	Linear cuts (%)	Thresholds with AVEs (%)	Linear cuts (%)
Band 1	0-20	45	0-30	25
Band 2	20-50	55	30-80	30
Band 3	50-75	65	80-130	35
Band 4	>75	75	>130	40
Capping	100		150	

Sensitive Products: 2% for developed countries and 3% for developing countries of tariff lines can be designated as sensitive products. 50% deviation of the tariff cuts in each band for these products.

[22] The "fullest" does not necessarily mean "full", but we assume the strongest case of 100 percent.

Domestic Support

The proposal constitutes three bands for the overall trade-distorting domestic support and AMS, with the following cuts. Additional reductions for countries in the third band are : 75% for Japan and 65% for Korea.

Countries	Cuts (%)
Overall Trade-Distorting Domestic Support	
European Union	80
United States and Japan	75
Rest of members*	70
AMS	
European Union	80
United States and Japan	70
Rest of members*	60

* less than 2/3 for Developing with positive AMS.

De Minimis Support: Reduction will be compatible to the rate of cut for the overall trade-distorting support. Developing countries with no AMS are exempt.

2.2 EU proposal

In order to achieve the objectives on the basis of the Doha Declaration and the July Framework Agreement, the EU presented its new proposal in October 2005.

Market Access

The EU position is to seek the middle ground designed to retain the overwhelming support of the WTO members. While rejecting the ambitious US proposal, the EU proposed to accept the G-20 linear approach, but with the following parameters.

Tariff Reduction Formula

The EU's tariff reduction formula essentially follows that of the G20, with slightly different thresholds, but the same tariff capping on both developed and developing countries.

	Developed Countries		Developing Countries	
	Thresholds with AVEs (%)	Linear cuts (%)	Thresholds with AVEs (%)	Linear cuts (%)
Band 1	0-20	45	0-30	25
Band 2	20-50	50	30-80	30
Band 3	50-75	55	80-130	35
Band 4	>75	60	>130	40
Capping	100		150	

Sensitive Products: 8% for developed and 12% for developing countries of tariff lines can be designated as sensitive products. 50% deviation of the tariff cut in each band for these products.

Domestic Support

Additional reduction for countries in the third band is 60% for Korea.

Countries	Cuts (%)
Overall Trade-Distorting Domestic Support and AMS	
European Union	70
United States and Japan	60
Rest of members (inc. developing countries)	50

De Minimis Support: Reduction of 80% for all developed countries.

Blue Box: 5% ceiling.

2.3. US Proposal

In October 2005, the United States presented a comprehensive package to move the WTO agricultural negotiations forward and unleash the full potential of the Doha Development Agenda.

Market Access

Balancing the new proposal on domestic support, substantial reduction are proposed in tariffs, designed for deeper cuts on higher tariffs, through a progressive formula based on the following parameters.

Tariff Reduction Formula

	Developed Countries		Developing Countries	
	Thresholds with AVEs (%)	Linear cuts (%)	Thresholds with AVEs (%)	Linear cuts (%)
Band 1	0-20	60	0-20	40
Band 2	20-40	70	20-40	47
Band 3	40-60	80	40-60	53
Band 4	>60	90	>60	60
Capping	75		100	

Sensitive Products: 1% of tariff lines can be designated as sensitive products. 50% deviation of the tariff cut in each band for these products.

Domestic Support

The US proposal calls for substantial reductions in trade-distorting domestic support, with deeper cuts by countries with larger subsidies. The scale of the reductions and country coverage is the same as with the EU proposal. Additional reduction of 60% cuts are made for Korea.

Countries	Cuts (%)
Overall Trade-Distorting Domestic Support and AMS	
European Union	70
United States and Japan	60
Rest of members (inc. developing countries)	50

De Minimis Support: Reduction of 80% for all developed countries.

Blue Box: 5% ceiling.

2.4. New Uruguay Round

This scenario, New Uruguay Round, is one of the two hypothetical scenarios, designed to replicate the commitment of the previous Uruguay Round Agreement on Agriculture (URAA), and serves as reference.

Market Access

Following the provisions of the URAA, average tariff cuts for all agricultural products are designed as 36 percent for developed countries and 24 percent for developing countries.

Tariff Reduction Formula

	Developed Countries		Developing Countries	
	Thresholds with AVEs (%)	Linear cuts (%)	Thresholds with AVEs (%)	Linear cuts (%)
Band 1	0-30	19.2	0-20	12.8
Band 2	30-60	33.6	20-40	22.4
Band 3	60-90	43.2	40-60	28.8
Band 4	>90	48.0	>60	32.0

Domestic Support

Countries	Cuts (%)
Overall Trade-Distorting Domestic Support and AMS	
European Union	50
United States and Japan	40
Rest of members	30

De Minimis Support: 50% reduction for developed countries and 33% for developing countries.

Blue Box: No reduction.

5. Swiss Formula

Proposed first in the Tokyo Round, the Swiss Formula is special kind of harmonizing method, in which steeper cuts on higher tariffs are designed to narrow the gaps between high and low tariffs. The Paragraph

24 of the Hong Kong Ministerial Declaration says that "…we instruct our negotiators to ensure that there is a comparably high level of ambition in market access for Agriculture and Non-Agricultural Market Access (NAMA)". Some countries[23] have raised this concern and analyzed the formula in depth. Like the New Uruguay Round, this scenario is hypothetical, constructed as a reference for comparison purposes, as this harmonizing scheme was already ruled out in the agricultural negotiations.

The Swiss Formula uses a single mathematical equation, designed to produce:

- a narrow range of final tariff rates from a wide set of initial tariffs, and
- a maximum final rates, no matter how high the original tariffs are.

The Formula is expressed as follows:

$$T_1 = \frac{T_0 * A}{T_0 + A}$$

where, T_1 denotes resulting lower tariff rate (end of period), T_0 is initial tariff rate, and A defines coefficient. A key feature is the number, known as a "coefficient (A)", which appears in the formula above, and determines the maximum final tariff rate. In the scenario, the value of coefficient 25 is assigned for developed countries, and 35 for developing countries.

[23] Particularly the ABI Group (Argentina, Brazil and India).

APPENDIX C:
TECHNICAL SPECIFICATION OF THE AGRICULTURAL CGE MODEL

C.1. Model Parameters

(1) Sets

$i \in I$	:	Sectors or commodities
$r \in R$	:	Regions and countries
$f \in F$	:	Factors of production
$h \in H$	:	Households
$ins \in INS$	:	Institutions

Subset

$i \in IX$	:	Sectors with production
$i \in IXN$	:	Sectors with no production
$i \in IE$	:	Export sectors
$i \in IEN$	:	Non-export sectors
$i \in IEI$	:	Export sectors with different destinations
$i \in IM$	:	Import sectors
$i \in IMN$	:	Non-import sectors
$i \in IMI$	:	Import sectors with different origins
$i \in IT$	:	Technology-intensive sectors
$i \in IAG$	:	Agriculture
$i \in IFD$	:	Processed foods
$i \in IND$	:	Manufacturing industries and services
$r \in RDV$	:	Developed regions and countries
$r \in RDVG$	:	Developing regions and countries
$f \in LAB$	:	Labor
$f \in LSK$	:	Skilled labor
$f \in LUSK$	:	Un-skilled labor
$f \in FNL$	:	Non-labor factors

Alias : $(i, j), \quad (r, s), \quad (f, fp), \quad (h, hp), \quad (ins, inst)$

(2) Structural Parameters

IO_{ijr}	:	Input-Output coefficients
tx_{ir}	:	Output tax rates
tf_{fr}	:	Factor tax rates
tcz_{ir}	:	Commodity tax rates on intermediate inputs
tch_{ir}	:	Commodity tax rates on household demand
tcg_{ir}	:	Commodity tax rates on government demand
tcv_{ir}	:	Commodity tax rates on investment demand
th_{r}	:	Household income tax rates

$etaxr_r$: Firm direct tax rates

$ts_{ins,r}$: Social security tax rates for households

$ensr_r$: Enterprise saving rates

$fshr_{ins,f,r}$: Factor income share parameters

$yshr_{ins,inst,r}$: Transfer income share parameters

te_{irs} : Export tax (subsidy) rates

tm_{irs} : Import tariff rates

tr_{irs} : Trade margin and transport cost rates

β_{ir} : Marginal propensity to consume by households

$cles_{ir}$: Household consumption shares

$gles_{ir}$: Government consumption shares

$iles_{ir}$: Investment demand shares

$pwtx_{ir}$: Output price index weights

$pwts_{ir}$: Domestic price index weights

$pwtc_{ir}$: Consumer price index weights

(3) Function Parameters

AX_{ir} : CES production function shift parameters

AC_{ir} : Upper-level CES function shift parameters

AM_{ir} : Lower-level CES function shift parameters

AT_{ir} : Upper-level CET function shift parameters

AE_{ir} : Lower-level CET function shift parameters

α_{ifr} : CES Function factor share parameters

δ_{ir} : Upper-level CES function share parameters

δm_{irs} : Lower -level CES function share parameters

γ_{ir} : Upper-level CET function share parameters

γe_{irs} : Lower -level CET function share parameters

$zshr_{ir}$: Intermediate input share parameters in sectoral imports

(4) Sectoral Elasticities and Exponents

σp_{ir} : Elasticity of CES production function

σc_{ir} : Elasticity of upper-level CES function

σm_{ir} : Elasticity of lower-level CES function

σt_{ir} : Elasticity of upper-level CET function

σe_{ir} : Elasticity of lower-level CET function

ρp_{ir} : CES Production function exponents

ρc_{ir} : Upper-level CES function exponents

ρm_{ir}	:	Lower -level CES function exponents
ρt_{ir}	:	Upper-level CET function exponents
ρe_{ir}	:	Lower -level CET function exponents
η_{ir}	:	Import demand elasticity for total factor productivity

C.2. Model Variables

C.2.1. List of Endogenous Variables

(1) Prices and Price Indices

PX_{ir}	:	Output prices
PD_{ir}	:	Domestic prices of domestic sales
PQ_{ir}	:	Composite good prices
PVA_{ir}	:	Value added prices
PXE_{ir}	:	Aggregate prices of exports
PXM_{ir}	:	Aggregate prices of imports
PWE_{irs}	:	World prices of exports
PWM_{irs}	:	World prices of imports
PE_{irs}	:	Domestic prices of exports
PM_{irs}	:	Domestic prices of imports
ER_{r}	:	Exchange rates
CPI_{r}	:	Consumer price indices
$PINDEX_{r}$	:	Output price indices
$PINDOM_{r}$	:	Domestic price indices
$GDPDEF_{r}$	:	GDP deflators

(2) Outputs and Trade

X_{ir}	:	Domestic outputs
XD_{ir}	:	Domestic sales of domestic outputs
Q_{ir}	:	Composite goods
XE_{ir}	:	Aggregate sectoral exports
XM_{ir}	:	Aggregate sectoral imports
E_{irs}	:	Sectoral exports by destination
M_{irs}	:	Sectoral imports by source
$TBAL_{rs}$	:	Net bilateral trade balance
INT_{ir}	:	Intermediate demand

(3) Factor Demands and Factor Returns

QF_{ifr} : Sectoral factor demand

FS_{fr} : Factor supply

WF_{fr} : Economywide average factor returns

$WDIST_{ifr}$: Factor wage differentials (for fixed factors)

(4) Institutional Income and Expenditures

YF_{fr} : Factor income

YH_{r} : Household income

YHD_{r} : Household disposable income

$YENT_{r}$: Firm income

CD_{ir} : Sectoral private consumption

(5) Government Accounts

GR_{r} : Government revenue

$HTAX_{r}$: Household taxes

$ENTAX_{r}$: Enterprise taxes

$OUTAX_{r}$: Output taxes

$FACTAX_{r}$: Factor taxes

$COMTAX_{r}$: Commodity taxes

$SSTAX_{r}$: Social security taxes

$EXPTAX_{r}$: Export taxes

$TARIFF_{r}$: Import tariff duties

GDE_{r} : Aggregate government consumption expenditures

(6) Saving and Investment

SAV_{r} : Total savings

$HSAV_{r}$: Household savings

$ENTSAV_{r}$: Enterprise savings

$GSAV_{r}$: Government savings

MPS_{r} : Household saving rates

INV_{r} : Aggregate investment amount

(7) Trade-Productivity Linkage

TFP_{ir} : Import-embedded total factor productivity

$MPROD_{r}$: Technology-intensive imports

(8) National Account and Welfare

$RGDP_r$	:	Real gross domestic product
$GDPVA_r$	:	Gross domestic product at factor costs
EV_r	:	Hicksian equivalent variations

C.2.2. List of Exogenous Variables

$\overline{GD}_{ir}$	:	Sectoral government consumption demand
$\overline{ID}_{ir}$	:	Sectoral investment demand
$\overline{FS}_{fr}$	:	Aggregate factor supply*
$\overline{GSUB}_{ins,r}$	:	Government subsidies to institutions
$\overline{REMIT}_{ins,r}$	:	Institutions' foreign remittance from abroad
$\overline{FBOR}_r$	:	Government's foreign borrowings
$\overline{FSAV}_r$	:	Foreign savings
$\overline{TRDOM}_{ins,inst,r}$	:	Domestic inter-institution transfers
$\overline{TRFRN}_{ins,r}$	:	Institution foreign transfers to abroad
$\overline{GAMORT}_r$	:	Government's foreign amortization payments
$\overline{BOP}_r$	:	Current account balance

* Unskilled labor in developing regions and countries are segmented into 3 labor markets: agriculture, processed foods, and manufacturing industries plus services.

C.3. List of Equations

C.3.1. Prices and Price Indices

(1) Domestic prices of exports:

$$PE_{irs} = (1 - te_{irs}) \cdot PWE_{irs} \cdot ER_r \qquad i \in IEI$$

(2) Domestic prices of imports:

$$PM_{irs} = (1 + tm_{irs}) \cdot PWM_{irs} \cdot ER_r \qquad i \in IMI$$

(3) Domestic sales:

$$PX_{ir} \cdot X_{ir} = PXE_{ir} \cdot XE_{ir} + PD_{ir} \cdot XD_{ir} \qquad i \in IX$$

(4) Absorption:

$$PQ_{ir} \cdot Q_{ir} = PXM_{ir} \cdot XM_{ir} + PD_{ir} \cdot XD_{ir} \qquad i \in (IX \cup IM)$$

(5) Value added prices:

$$PVA_{ir} = (1 - tx_{ir}) \cdot PX_{ir} - \sum_j IO_{ijr} \cdot PQ_{jr} \qquad i \in IX$$

(6) Consumer price indices:

$$CPI_r = \sum_i pwtc_{ir} \cdot PQ_{ir}$$

(7) Output price indices:

$$PINDEX_r = \sum_i pwtx_{ir} \cdot PX_{ir}$$

(8) Domestic price indices:

$$PINDOM_r = \sum_i pwts_{ir} \cdot PD_{ir}$$

(9) GDP deflators:

$$GDIPDX_r = GDPVA_r \big/ RGDP_r$$

C.3.2. Outputs and Factor Demand

(10) CES sectoral outputs:

$$X_{ir} = AX_{ir} \cdot TFP_{ir} \cdot \left[\sum_f \alpha_{ifr} \cdot \left(QF_{ifr} \right)^{\rho p_{ir}} \right]^{\frac{1}{\rho p_{ir}}} \qquad i \in IX$$

(11) Profit maximization for factor demand:

$$WDIST_{ifr} \cdot WF_{fr} = AX_{ir} \cdot PVA_{ir} \cdot TFP_{ir} \cdot \left\{ \sum_{fp} \alpha_{i,fp,r} \cdot \left(QF_{i,fp,r} \right)^{\rho p_{ir}} \right\}^{\frac{1}{\rho p_{ir}} - 1} \times \alpha_{ifr} \cdot \left(QF_{ifr} \right)^{\rho p_{ir} - 1}$$

$$i \in IAG \cup IFD \cup IND \Leftarrow LUSK \cap RDVG$$
$$i \in I \Leftarrow \left(LSK \cap RDVG \right) \cup \left(LAB \cap RDV \right) \cup FNL$$
$$f \in F$$

(12) Intermediate demand:

$$INT_{ir} = \sum_j IO_{ijr} \cdot X_{ir} \qquad i \in I$$

C.3.3. International Trade

(13) Upper-level CES function for composite supply:

$$Q_{ir} = AC_{ir} \cdot \left[\delta_{ir} \cdot \left(XM_{ir} \right)^{\rho c_{ir}} + \left(1 - \delta_{ir} \right) \cdot \left(XD_{ir} \right)^{\rho c_{ir}} \right]^{\frac{1}{\rho c_{ir}}} \qquad i \in \left(IX \cap IM \right)$$

(14) Import demand relative to domestic supply:

$$XM_{ir} = \left(\frac{\delta_{ir}}{1 - \delta_{ir}} \cdot \frac{PD_{ir}}{PXM_{ir}} \right)^{\sigma c_{ir}} \cdot XD_{ir} \qquad i \in \left(IX \cap IM \right)$$

(15) Composite supply for non-imports and non-domestic outputs:

$$Q_{ir} = XD_{ir} + XM_{ir} \qquad i \in \left(IX \cap IMN \right) \cup \left(IXN \cap IM \right)$$

(16) Lower-level CES Function for aggregate imports:

$$XM_{ir} = AM_{ir} \cdot \left[\sum_s \delta m_{irs} \cdot \left(M_{irs} \right)^{\rho m_{ir}} \right]^{\frac{1}{\rho m_{ir}}} \qquad i \in IM$$

(17) Import demand from different sources:

$$M_{irs} = \frac{1}{AM_{ir}^{(1-\sigma m_{ir})}} \cdot \left(\frac{\delta m_{irs} \cdot PXM_{ir}}{PM_{irs}} \right)^{\sigma m_{ir}} \cdot XM_{ir} \qquad i \in IMI$$

(18) Upper-level CET Function for domestic sales:

$$X_{ir} = AT_{ir} \cdot \left[\gamma_{ir} \cdot \left(XE_{ir} \right)^{\rho t_{ir}} + \left(1-\gamma_{ir}\right) \cdot \left(XD_{ir} \right)^{\rho t_{ir}} \right]^{\frac{1}{\rho t_{ir}}} \qquad i \in IE$$

(19) Export supply relative to domestic supply:

$$XE_{ir} = \left(\frac{1-\gamma_{ir}}{\gamma_{ir}} \cdot \frac{PXE_{ir}}{PD_{ir}} \right)^{\sigma t_{ir}} \cdot XD_{ir} \qquad i \in IE$$

(20) Composite supply for non-export sectors:

$$X_{ir} = XD_{ir} \qquad i \in \left(IX \cap IEN \right)$$

(21) Lower-level CET Function for imperfect substitute export sectors:

$$XE_{ir} = AE_{ir} \cdot \left[\sum_{s} \gamma e_{irs} \cdot \left(E_{irs} \right)^{\rho e_{ir}} \right]^{\frac{1}{\rho e_{ir}}} \qquad i \in IE$$

(22) Aggregate export supply for perfect substitute sectors:

$$XE_{ir} = \sum_{s} E_{irs} \qquad i \in IE$$

(23) Export supply for imperfect substitute export sectors to different destinations:

$$E_{irs} = \frac{1}{AE_{ir}^{(1+\sigma e_{ir})}} \cdot \left(\frac{PE_{ir}}{\gamma e_{irs} \cdot PXE_{irs}} \right)^{\sigma e_{ir}} \cdot XE_{ir} \qquad i \in IEI$$

(24) Domestic prices of exports for perfect substitute sectors:

$$PE_{irs} = PXE_{ir} \qquad i \in IEI$$

C.3.4. Institutional Income and Expenditures

(25) Factor income:

$$YF_{fr} = \sum_{i} WDIST_{ifr} \cdot WF_{fr} \cdot QF_{ifr} \qquad f \in F$$

(26) Household income:

$$YH_{r} = \sum_{f} \left(1-tf_{fr}\right) \cdot fshr_{hfr} \cdot YF_{fr} + CPI_{r} \cdot \left(\sum_{ins} \overline{TRDOM}_{h,ins,r} + \overline{GSUB}_{hr} \right) + \overline{REMIT}_{hr} \cdot ER_{r}$$

(27) Household disposable income:

$$YHD_{r} = \left(1-mps_{r}\right) \cdot \left(1-th_{r}-ts_{r}\right) \cdot YH_{r} - \left(CPI_{r} \cdot \sum_{hp} \overline{TRDOM}_{hp,h,r} + \overline{TRFRN}_{hr} \cdot ER_{r} \right)$$

(28) Firm income:

$$YENT_{r} = \sum_{f} \left(1-tf_{fr}\right) \cdot fshr_{fm',fr} \cdot YF_{fr} + CPI_{r} \cdot \left(\sum_{ins} \overline{TRDOM}_{'fm',ins,r} + \overline{GSUB}_{'fm',r} \right)$$

$$+\overline{REMIT}_{'fm',r} \cdot ER_r$$

(29) Private sectoral consumption:

$$CD_{ir} = cles_{ir} \cdot YHD_r \Big/ \left[\left(1 + tch_{ir}\right) \cdot PQ_{ir} \right] \qquad i \in I$$

C.3.5. Government Accounts

(30) Government revenue:

$$GR_r = HTAX_r + ENTAX_r + OUTAX_r + FACTAX_r + COMTAX_r + SSTAX_r + EXPTAX_r + TARIFF_r + \overline{FBOR}_r \cdot ER_r$$

(31) Household direct taxes:

$$HTAX_r = th_r \cdot YH_r$$

(32) Enterprise taxes:

$$ENTAX_r = etaxr_r \cdot YENT_r$$

(33) Output taxes:

$$OUTAX_r = \sum_i tx_{ir} \cdot PX_{ir} \cdot X_{ir}$$

(34) Factor taxes:

$$FACTAX_r = \sum_f tf_{fr} \cdot YF_{fr}$$

(35) Commodity taxes:

$$COMTAX_r = \sum_i PQ_{ir} \cdot \left(tcg_{ir} \cdot GD_{ir} + tcv_{ir} \cdot ID_{ir} + \sum_h tch_{ihr} \cdot CD_{ihr} \right)$$

(36) Social security taxes:

$$SSTAX_r = ts_r \cdot YH_r + ts_{'fm',r} \cdot YENT_r$$

(37) Export taxes:

$$EXPTAX_r = EXR_r \cdot \sum_s \sum_i te_{irs} \cdot PWE_{irs} \cdot E_{irs}$$

(38) Import tariff duties:

$$TARIFF_r = EXR_r \cdot \sum_s \sum_i tm_{irs} \cdot PWM_{irs} \cdot M_{irs}$$

(39) Aggregate government consumption expenditures:

$$GDE_r = \sum_i \left(1 + tcg_{ir}\right) \cdot PQ_{ir} \cdot \overline{GD}_{ir}$$

C.3.6. Saving and Investment

(40) Total savings:

$$SAV_r = HSAV_r + ENTSAV_r + GSAV_r + \overline{FSAV}_r \cdot ER_r$$

(41) Household savings:

$$HSAV_r = MPS_r \cdot \left(1 - th_r - ts_r\right) \cdot YH_r$$

(42) Enterprise savings:

$$ENTSAV_r = ensr_r \cdot \left(1 - etaxr_r - ts_{'fm',r}\right) \cdot YENT_h$$

(43) Government savings:

$$GSAV_r = GR_r - \left(CPI_r \cdot \sum_{ins} \overline{GSUB}_{ins,r} + GDE_r + \overline{GAMORT}_r \cdot ER_r \right)$$

(44) Aggregate Investment Amount:

$$INV_r = \sum_i \left(1 + tcv_{ir}\right) \cdot PQ_{ir} \cdot \overline{ID}_{ir}$$

C.3.7. Trade-Productivity Linkage

(45) Import-embedded total factor productivity:

$$TFP_{ir} = 1 + zshr_{ir} \cdot \left(X_{ir} \cdot \left(\frac{MPROD_r}{MPROD0_r} \right)^{\eta_{ir}} - 1 \right) \qquad i \in I$$

(46) Technology-intensive imports:

$$MPROD_r = \sum_{i \in IT} M_{i,r,rp}$$

C.3.8. National Account and Welfare

(47) Read gross domestic product:

$$RGDP_r = \sum_i PQ_i^k \cdot \left(\sum_h \left(1 + tch_{ihr}\right) \cdot CD_{ihr} + \left(1 + tcg_{ir}\right) \cdot \overline{GD}_{ir} + \left(1 + tcv_{ir}\right) \cdot \overline{ID}_{ir} \right)$$
$$+ ER_r \cdot \left(\sum_s \sum_i PWE_{irs} \cdot E_{irs} - \sum_s \sum_i PWM_{irs} \cdot M_{irs} \right)$$

(48) Gross domestic product at factor costs:

$$GDPVA_r = \sum_i PVA_{ir} \cdot X_{ir} + OUTAX_r + COMTAX_r + EXPTAX_r + TARIFF_r$$

(49) Hicksian equivalent variations:

$$EV_r = \left(YHD_r - CPI_r \cdot SAV_r\right) \cdot \prod_i \left(\frac{PQ_{0ir}}{PQ_{ir}} \right)^{\beta_{ir}} - \left(YHD_0 - SAV_0\right)$$
$$+ GDE_r \cdot \prod_i \left(\frac{PQ_{0ir}}{PQ_{ir}} \right)^{gles_{ir}} - GDE_0 + INV_r \cdot \prod_i \left(\frac{PQ_{0ir}}{PQ_{ir}} \right)^{iles_{ir}} - INV_0$$

C.3.9. Trade Consistencies

(50) Export-import symmetry conditions:

$$M_{irs} = E_{isr} \qquad i \in I$$

(51) World price consistency conditions:

$$PWM_{irs} = \left(1 + tr_{isr}\right) \cdot PWE_{isr} \qquad i \in I$$

C.3.10. Market Equilibrium Conditions

(52) Material balance (commodity market equilibrium):

$$Q_{ir} = INT_{ir} + \sum_{h} CD_{ihr} + \overline{GD}_{ir} + \overline{ID}_{ir} \qquad i \in I$$

(53) Factor market equilibrium:

$$FS_{fr} = \sum_{i} QF_{ifr} \qquad f \in F$$

(54) Foreign saving equilibrium:

$$FSAV_{r} = \overline{BOP}_{r} - \left(\sum_{ins} \overline{REMIT}_{ins,r} + \overline{FBOR}_{r} \right)$$

(55) Net bilateral trade balance:

$$TBAL_{rs} = \sum_{i} PWM_{irs} \cdot M_{irs} - \sum_{i} PWE_{irs} \cdot E_{irs}$$

(56) Balance of payment equilibrium:

$$\overline{BOP}_{r} = \sum_{s} TBAL_{rs} + \sum_{ins} \overline{TRFRN}_{ins,r} + \overline{GAMORT}_{r}$$

(57) Walras' law for saving and investment equality:

$$SAV_{r} = INV_{r}$$

Note: For brevity and avoiding clutters, the set for region *r* is omitted, unless otherwise necessary.