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Which Trade Integration Scheme Can Best Help Sub-Saharan Africa Develop and Export More Processed Agricultural Goods?

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ABSTRACT

Trade integration of Sub-Saharan African (SSA) countries' agriculture is pointed out as a powerful driver of agricultural growth, especially if it increases processing of agricultural products. But there is no consensus on which negotiations for increased trade integration to put first. Static effects of regional and multilateral tariff reduction shocks are simulated with the Modeling International Relationships in Applied General Equilibrium computable general equilibrium model in order to compare them and test their coherence with the objective of enhanced value-added in agriculture. Treating existing data issues in the GTAP 7 database reveals that they usually lead to overestimations of gains from some trade integration. Those new results show for the first time that even if at the world level a combination of Duty-Free Quota-Free (DFQF) and Doha Development Agenda brings the highest gross domestic product and real income growth, for Sub-Saharan Africa an ambitious regional integration delivers as much as multilateral integration. Multilateral and regional integration differ on the pattern of agricultural growth they bring: Multilateral liberalization, especially DFQF, would drive SSA countries further away from agricultural-led industrialization, since the increased competition leads to a reorientation of the structure of production and exports of SSA toward raw agricultural products. On the contrary, regional integration fosters the production and trade of processed agricultural products, and thus might be more in line with the stakes of economic development. Nevertheless, from a political economy perspective, identity of the gainers and losers should be considered as regional integration leads to real income losses for many SSA countries. Accompanying policies to mitigate those losses could help further negotiate regional integration.

Keywords: trade policy, multilateral negotiations, competitiveness, agriculture, computable general equilibrium, trade preferences, Sub-Saharan Africa

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All result files and other necessary files to reproduce the simulations are available upon request.

1. INTRODUCTION

Growth of the agricultural sector is an important issue for Sub-Saharan African (SSA) countries[1] (de Janvry and Sadoulet 2010) since it is still a major source of employment (FAO 2010) and an essential part of foreign exchange earnings for many governments . That agricultural growth through its many linkages with the other sectors could be a stimulus to the overall growth of SSA economies is now largely documented (Delgado et al. 1994; Haggblade 2007, Self and Grabowski 2007), even though academic debates on the strength of the intersectoral linkages in the context of globalized agricultural markets and on the pro-poor impacts remain (Christiaensen 2011).. The need to capture those linkages when studying opportunities for increased economic growth in those countries justifies the use of computable general equilibrium (CGE) models.

The Research Question

The research question of this paper stems from a recurrent political recommendation of previous research that increased market integration of smallholder farmers could be a potential powerful driver of economic growth in some developing countries (World Bank 2008) and that there is a strong potential for the development of commercial agriculture in Sub-Saharan Africa (World Bank 2009). Looking at that issue from a country-level perspective, we focus on the impacts of reducing the barriers to market access of SSA countries.

At the regional level, despite the existing economic integration processes, there is a historically low level of regional trade and a high level of protection on regional trade among SSA countries compared to other regions of the world (UNECA 2010).

SSA exports to the world are characterized by their concentration on primary or raw agricultural products (FAOSTAT). In terms of tariff, even though African countries' access to the EU market is fairly good (the EU is the main trading partner), high tariff barriers still apply tariff escalation on processed goods, and this is recurrent to all other destinations (own calculation with the MAcMapHS6-2.1 database described in Boumellassa, Laborde, and Mitaritonna 2009). Sub-Saharan Africa has been increasingly marginalized in global trade (Bora, Bouët, and Roy 2007), which is sometimes thought to be consistent with the poor economic performance of the region as a whole compared to other developing regions (Rodrik 1998; Bouët and Roy 2008), but is also a consequence of the erosion of historical market share by the displacement by similar goods from competing countries (Ng and Yeats 2000) mostly because of a lack of competitive gains in traditional exports (Ng and Yeats 2002).

The main hypothesis tested in this study is that the pattern agricultural growth in terms of type of products and destination of exports matters for development. Most researches on agricultural exports distinguish traditional agricultural export crops (generally coffee, cocoa, cotton, tea, and tobacco) as opposed to nontraditional exports, which are diversely defined, and foodstuff (composed of cereals and livestock). One of the main global general equilibrium studies focusing on the agricultural growth potential of Sub-Saharan Africa is Diao and Dorosh (2007). They look at the impact of different productivity growth and suggest that demand need not constrain rapid agricultural growth, particularly for nontraditional exports, and that simultaneous productivity growth in grains and livestock offers more potential for major impacts on poverty and food consumption. The recent work by Poulton et al. (2009) summarizing the lessons learned from past experience of success and failure with commercial agriculture in Africa analyses the sources of competitiveness of African agricultural exports. Both of those studies

[1] *Sub-Saharan Africa* refers here to all the countries in the African continent below the Sahara, as opposed to northern Africa. Sub-Saharan Africa is composed of Benin, Burkina Faso, Cape Verde, Cote d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Saint Helena, Sierra Leone, Togo Nigeria, Senegal, Ethiopia, Madagascar, Malawi, Mauritius, Mozambique, Tanzania, Uganda, Zambia, Zimbabwe, Botswana, South Africa, Cameroon, Central African Republic, Chad, Congo, Equatorial Guinea, Gabon, São Tomé and Principe, Angola, Democratic Republic of Congo, Burundi, Comoros, Djibouti, Eritrea, Kenya, Rwanda, Seychelles, Somalia, Sudan, Lesotho, Namibia, Swaziland. Note that Reunion is not assumed to be part of Sub-Saharan Africa in this analysis but is included in some of the database used.

emphasize the potential of domestic and regional markets as opposed to international markets. Neither of them, however, looks at the impact of increased market access.

The originality of our approach is that it distinguishes agricultural commodities according to whether they are sold raw or processed and according to the destination market whether regional in Sub-Saharan Africa or the rest of the world. Indeed, further specialization in the production of raw agricultural products is often pointed out as a risk for sustainable development (IAASTD 2008). Following structural changes in the global agricultural supply chains, SSA countries have an interest in strengthening the linkages between industry and agriculture through enhanced value-added in agriculture (Reardon and Timmer 2005). Indeed according to the GTAP 7 database (the version 7 of the Global Trade Analysis Project of Purdue University, the most used database for trade policy analysis at the global level) Sub-Saharan Africa is the region of the world that is still processing the least part of its agriculture production following the classification described in Table B.1., with less than 50 percent in 2004. Whereas the demand for processed agricultural goods is large, both in developed countries where 80 percent of agricultural imports are processed, and within SSA: where more than 70 percent of agriculture imports are processed. . Thus, there is scope for Sub-Saharan Africa to increase the processing of its agricultural production for exports to both the regional and international markets.

In the end, we will compare the economic impacts of different trade integration schemes and study to what extent they might lead to different levels of processing of the agricultural goods.

Comparing Different Levels of Market Integration

Beyond domestic market integration within each country, which seems consensual, there is no consensus at the international level on whether market integration at the regional or multilateral level should be the priority for SSA countries. Many of the countries in SSA face severe analytical and negotiation capacity constraints which hinder independent analysis and assessment of the potential implications of trade agreements for their economies.

Political economy analysis have showed that since the 1980s economic reforms in Africa have been more driven by external political prescriptions of the World Bank mostly pro trade than by the political economy influence of protectionist pressure groups (Jones *et al.* 2010). The World Bank tends to favor agreements between Developed and Developing countries over agreements between Developing countries (Schiff and Winters 2003). At the multilateral level, much of the argument on the Doha Round being beneficial for development is build around the impacts on SSA (Anderson *et al*. 2006) and more recently on its gains from the Duty-Free Quota-Free (DFQF) proposal towards Least Developed countries (LDCs) (Lamy 2011; Bouët et al., 2012).

At the same time there is a renewed political commitment by all governments in SSA and development agencies to accelerate regional integration[2]. Considering the high political stakes, it seems essential to deliver quantitative results to fuel the debates on whether those two types of trade integration are coherent and whether one should be a priority over the other.

A recent literature review (Harrison, McLaren, and McMillan 2010) shows that theory alone cannot predict the detailed impacts of trade liberalization, and thus the answer to our research question is empirical. Since the overall outcome of a trade policy reform on a given country depends on the relative impacts on its competitors, as was shown by Low, Piermartini and Richtering (2005) and Carrere and de Melo (2010), empirical trade policy analysis at a global level is the only way to compare different trade integration levels. Global general and partial equilibrium models are useful to study the long-term perspectives of trade agreements and specifically identify and quantify the opportunities that might arise, and some of the difficulties that might be faced.

Numerous simulations of the impacts of agricultural trade liberalization on SSA countries have been produced in the past, but Bouët (2008) has shown that the results of those studies are hardly

[2] See the Outcome Statement of the "Joining up Africa: Regional Integration" conference agreed in London, United Kingdom on March 4th 2010 by representatives from the African Development Bank, the World Bank, the European Commission, the WTO and the Department for International Development (DFID).

comparable since simulations differ widely by the data, behavioral parameters, or theoretical features of the models used. Furthermore, most simulations focus on one precise trade agreement and assess the impacts of slight variations of the terms of that agreement, neither comparing several agreements nor studying their interactions. Notable exceptions are Fontagné, Mitaritonna, and Laborde (2008), who test the interaction effect of the Economic Partnership Agreement (EPA) with regional integration, Keck and Piermartini (2005) and Berisha-Krasniqi, Bouët and Mevel (2008), who compare EPA with multilateral liberalization, and Kowalski and Shepherd (2006), who compare North–South to South–South multilateral integration. Those studies highlight that different levels of trade integration have different impacts, and that interaction effects of simultaneous integration are important to take into account.

By taking into account the impacts of preferential agreements, several studies, such as Bouët, Mevel, and Orden (2007), have highlighted that some countries currently granted high preferential margins, such as SSA countries, might experience an erosion of those preferences and terms of trade loss with increased competition on their exports, especially with multilateral liberalization. The recognition that some least developed countries (LDCs) are likely to lose because of multilateral liberalization and should be compensated with extra-market access led to the proposal of a Duty-Free Quota-Free (DFQF) provision that, to our knowledge, has not yet been simulated in interaction with multilateral liberalization.

Hence, at the multilateral level, reciprocal liberalization in the form of the Doha Development Agenda as negotiated at the World Trade Organization (WTO), a preferential DFQF is simulated and the interactions tested. The impacts of the different types of multilateral integrations with those of different levels of regional integration within Sub-Saharan Africa are compared. Furthermore, sensitivity of those results to two possible outcomes of the current EPA negotiations is tested: Either bilateral EPA between the EU and each African, Caribbean, and Pacific (ACP) country is signed or, what is already under way, each ACP country is transferred to the European preferential system corresponding to its level of development—everything but arms (EBA) for LDCs and Generalized System of Preferences (GSP) for non-LDCs.

Analyzing Detailed Regional and Sectoral Changes

The SSA region is heterogeneous in terms of the stakes linked with agricultural trade (Ng and Aksoy 2008), which requires one to study the distributive impacts at the country level within Sub-Saharan Africa as much as possible. Indeed, some countries are major exporters of raw tropical products at the global level (Ivory Coast for cocoa, Madagascar for vanilla, Malawi for tobacco, and so on), whereas others, mostly natural-resource-rich countries, hardly export any agricultural goods (Angola, Congo, Equatorial Guinea, Gabon, Nigeria). As for imports, most low-income SSA countries tend to be net food importers (even when agricultural exporters), sometimes also highly dependent on food aid; however, some are self-sufficient or even net exporters of food commodities (FAO 2010 op. cit.). The SSA region is also diverse in terms of level of development. As a consequence, countries are offered different possibilities and require different commitments in current trade negotiations. Indeed, Sub-Saharan Africa is mostly composed of LDCs, which are exempted from commitments at the multilateral level. But the regional level includes both LDCs and non-LDCs.

It is now widely acknowledged that trade liberalization invariably produces contrasted impacts across sectors and countries (Winters et al. 2004). Considering that overall Sub-Saharan Africa is experiencing an increasing food balance deficit and that it is still the first region in the world affected by food insecurity and poverty (FAO 2010), it seems crucial to assess those impacts. They can only be identified through a high degree of sectoral and regional disaggregation and a detailed analysis of the results.

Despite the many simulations of liberalization scenarios produced in the past, most global equilibrium studies fail to assess the impacts at the country level in Sub-Saharan Africa because only 13 of the 52[3] countries of Sub-Saharan Africa appear individually in the GTAP 7 database, and the rest are

[3] Individual countries are Nigeria, Senegal, Ethiopia, Madagascar, Malawi, Mauritius, Mozambique, Tanzania, Uganda,

included in five regions, grouping highly heterogeneous countries. Furthermore, , the agricultural sectors of specific importance for Sub-Saharan Africa, other than grains, are not detailed in the GTAP database: Roots and tubers are not separated and traditional export crops such as coffee, cocoa, cotton, tea, and tobacco are aggregated into the exportable other crops sector. Moreover, most global CGE models have one representative agent and do not permit the analysis of distributional household impacts.

There are several ways that studies address these issues and bring their analysis further; many use alternative databases—Nuetah, Xin, and Zuo (2010) use the United Nations Conference on Trade and Development (UNCTAD) Agricultural Trade Policy Simulation Model (ATPSM),[4] which is a partial equilibrium model, and Fontagné, Mitaritonna, and Laborde (2008) have built their own partial equilibrium models to maximize the available data. Many studies also rely on national or subnational general equilibrium models. One way to address the household-level issue is to link the global model to the household level either through household-level data as in Bourguignon, Bussolo, and Cockburn (2010) or a poverty elasticity as in Hertel et al. (2006), Chemingui and Bchir (2009), and Hertel and Keeney (2009).

Considering the limitations of the poverty elasticity shown in Bouët (2008 op. cit.), this paper will not try to assess the impacts of trade integration on poverty. Direct interpretation of the output of the Modeling International Relationships in Applied General Equilibrium (MIRAGE) model, such as in Bouët et al. (2005), will enable conclusions on the potential impacts on the changes in gross domestic product (GDP) volume, real income, and the agricultural production and trade structure.

The Simulations with the MIRAGE Model and GTAP 7 Database

The trade integration scenarios are implemented in the MIRAGE model, initially developed by the Centre d'Études Prospectives et d'Informations Internationales (CEPII). This model proposes several innovations from other CGE models applied to trade policy analysis, such as horizontal product differentiation linked to varieties, but also to geographical origin (nested Armington–Dixit-Stiglitz utility function) and distinction of product quality. MIRAGE can also describe imperfect competition, imperfect mobility of factors, and several other specifications, including sequential dynamic. A more detailed description of the model is available in Appendix A.

However, following Davis and Mishra's (2007) advice, one should wonder what extent of complexity in the model is really needed to adequately answer one's question. Thus, this simulation exercise does not take advantage of all the specifications MIRAGE has to offer. We consider perfect competition, since imperfect competition significantly affects results (Karam 2009) and introduces a bias detrimental to countries' specialization in agriculture (Decreux and Valin 2007) which we want to avoid when focusing on countries where most household depend on agriculture and value the diversity of agricultural goods (Katungi et al. 2011), and in a static mode since the focus is on the comparison of the long-term effect of multiple scenarios.

The mapping of the study focusing on SSA agricultural sectors is described in Table B.1 and Table B.2 The 13 individualized SSA countries, the 5 SSA regions, and the 18 agricultural sectors are kept.

Thanks to the detailed MAcMapHS6-2.1 database (Bouët et al. 2008), the changes in the tariff barriers for each scenario are first made at the HS6 level for the year 2004. Only then are these data aggregated in the model's nomenclature, according to a procedure designed to limit the extent of the

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Zambia, Zimbabwe, Botswana, and South Africa.

Regions are Rest of Western Africa (Benin, Burkina Faso, Cape Verde, Cote d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Saint Helena, Sierra Leone, Togo), Rest of Central Africa (Cameroon, Central African Republic, Chad, Congo, Equatorial Guinea, Gabon, São Tomé and Principe), Rest of South Central Africa (Angola, Democratic Republic of Congo), Rest of eastern Africa (Burundi, Comoros, Djibouti, Eritrea, Kenya, Mayotte, Reunion, Rwanda, Seychelles, Somalia, Sudan), and Rest of South African Customs Union (Lesotho, Namibia, Swaziland).

[4] See http://r0.unctad.org/ditc/tab/atpsm.shtm.

endogeneity bias. As a result, MIRAGE is based on a precise description of trade barriers at the bilateral level.

However, despite the detailed trade and tariff data from the MAcMapHS6-2.1 2004 database, the model is limited by the regional disaggregation of the GTAP 7 database. Fortunately for the regional scenarios chosen, the GTAP 7 regional aggregation of Sub-Saharan countries is mostly coherent with the regional groups chosen (Table B.3). The only exception is the Rest of Central Africa (XAC) GTAP 7 region, which comprises the Democratic Republic of Congo, which is part of the central region, and Angola, which is part of the southern region.

Thus, results for each scenario are available for the 29 regions, of which 18 are SSA, and the 28 sectors, of which 18 are agricultural. For simplicity, the results are presented in this paper aggregated in five zones of interest—Sub-Saharan Africa (SSA), North Africa (NA), developed countries (DC), emerging economies (EE), and other developing countries (ODC) as detailed in Table B.2—and four sectors of interest based on the existing GTAP 7 classification —raw agricultural products (raw ag), processed agricultural products (processed ag), fishing (fish), and all the other sectors (other) presented in Table B.3—. The analysis focuses on the changes in the structure of raw agricultural products production and exports of SSA countries.

In the end, this study goes further than previous studies on the effects of trade integration on Sub-Saharan Africa for several reasons. First, it brings forward new comparable quantitative assessments of the impacts of several multilateral and regional trade integration scenarios and their interactions with other bilateral negotiations for not only SSA countries, but also the rest of the world. Second, the results are analyzed taking into account the specific economic structure of SSA countries and the stake of structural transformation toward processing agricultural goods. Third, following Bouët *et al.* (2012) it takes into account some data issues of the GTAP 7 database that contribute to significant virtual trade flows being created, leading to bias in the results. The paper further documents them and explains an easy way to treat them. Two important caveats of this study should be noted. First, the analysis of the simulation results explicitly focuses on demand issues and assumes that agricultural supply increases will be achieved if the opportunity arises. Second, we do not consider the impacts of various alternative trade integration shocks on income distribution and poverty. But the changes in many agricultural sectors, grains and other major food staples in particular, are likely to have larger effects on poverty and food consumption than on total GDP or real income. Given that reduction in poverty and hunger is a major development objective, the analysis should be extended beyond consideration of impacts on economic growth and aggregate consumption.

2. IMPLEMENTATION OF THE TARIFF SHOCKS WITH THE MIRAGE CGE MODEL

Scenarios of tariff changes are constructed using the MAcMapHS6-2.1database. They are presented for zones and sectors of interests in Appendix C. General equilibrium effects of those shocks are simulated thanks to the Modeling International Relationships in Applied General Equilibrium (MIRAGE) model.

Pre-Experiment

The Market Access Maps database developed by the CEPII and the International Trade Center (ITC) (MAcMapHS6) represents full structure of protection, bound, MFN applied, and preferential[5] applied duties, in 2004. It is thus necessary to update the database in a pre-experiment step to take into account major changes in tariffs since 2004 that have affected Sub-Saharan African (SSA) countries and their main trade partners. Bouët (2008 op. cit.) shows that without this preliminary step, gains from increased liberalization can be substantially overestimated. Hence, the main trade agreements concerning SSA countries and their main trade partners since 2004 until 2010 are added to the database at the HS6 level, including the end of the multifiber agreements in 2005; the enlargement of the EU to 25 and then 27; the full implementation of preferential agreements such as the Everything But Arms (EBA) offered by the E.U. to some Least Developed Countries (LDC), the African Growth and Opportunity Act of the United States of America and other expanded Duty-Free Quota-Free (DFQF) initiatives by India, China, Turkey, and Korea to some LDCs; some new free trade agreements (FTAs); or the phasing out of the EU protocols for sugar, rice, and bananas.

Looking at the tariffs in Table 2.1, we see that initially every region still applies higher tariffs on agricultural imports than on manufactured (other) imports, that tariff escalation (applying a higher protection on more processed goods) appears in agriculture, that raw agricultural products exports from Sub-Saharan Africa do benefit from a preferential margin from developed countries (which is somewhat reciprocal, since Sub-Saharan Africa also applies a lower tariff on raw agricultural products and other exports from developed countries than from other countries), and that SSA countries are poorly integrated at the regional level.

[5] It should be acknowledged that rules of origin are not taken into account and thus supposed to be fully used, even though there is some evidence that developing countries are not able to fully take advantage of those preferences.

Table 2.1—Average bilateral applied tariff rates by sector and region (percent)

Importer	Sector	Exporter				
		DC	EE	ODC	NA	SSA
DC	Raw ag	14	17	12	11	10
	Processed ag	18	17	16	11	14
	Fish	4	4	5	4	5
	Other	3	4	3	3	2
EE	Raw ag	13	13	11	9	19
	Processed ag	24	21	25	18	32
	Fish	14	11	13	10	20
	Other	8	11	9	6	7
ODC	Raw ag	12	20	17	20	15
	Processed ag	19	32	21	25	22
	Fish	22	21	21	14	21
	Other	7	11	8	7	9
NA	Raw ag	21	25	26	17	12
	Processed ag	40	26	37	18	82
	Fish	25	26	26	11	25
	Other	14	18	17	7	16
SSA	Raw ag	11	16	13	16	18
	Processed ag	26	24	23	34	28
	Fish	16	11	10	5	15
	Other	10	16	12	12	14

Source: MAcMapHS6 2004 after pre-experiment, reference-group weight aggregating method.
Notes: DC = developed countries; EE = emerging economies; ODC = other developing economies; NA = northern Africa; SSA = Sub-Saharan Africa. Raw ag = raw agricultural products; Processed ag = processed agriculture products; Fish = fishing products; Other = primary and manufactured products and services.

DDA Scenario: Multilateral Liberalization in the Form of a Doha Round

The November 2001 declaration of the Fourth Ministerial Conference of the World Trade Organization (WTO) in Doha, Qatar, provides the mandate for negotiations known as the Doha Round. The Doha Development Agenda was to take into account the specific needs of developing countries. So far no agreement has been reached. The July 2008 package is considered a stepping-stone on the way to concluding the Doha Round, and the December 2008 draft modalities text seems to be widely accepted by WTO members as the basis for further negotiations.[6]

Since then, no substantial achievement to conclude the Doha Round has been made, and trade liberalization has, on the contrary, evolved at the bilateral and regional level.

The DDA scenario[7] is based on the December 2008 modalities (WTO 2008a, 2008b) in a similar scenario to Bouët and Laborde (2010). The tariff reduction formula is applied on base rates equal to existing bound tariffs or for currently unbound tariff lines, to average applied MFN rate for 2004 (from MAcMapHS6-2.1) plus 25 percent. Details of the state of the negotiations and the tariff reduction formulas and the flexibilities are described in Laborde and Martin (2010a, 2010b). The simulation of Doha in this paper does not include all flexibilities. For nonagricultural products, the Swiss tariff-cutting formula with an 8 percent coefficient is used for all developed countries and a 23 percent coefficient is chosen for developing countries. Small and vulnerable economies, as defined by the WTO, are allowed to only cut their tariff to the mean between the value found with the Swiss formula with 23 percent coefficient and their base rate. For agricultural products, the tiered formula is used with the proportional cuts for each tariff band. For developed countries, the cut is 0.685 for tariffs above 0.75, 0.685 for tariffs between 0.75 and 0.50, 0.575 for tariffs between 0.50 and 0.25, and 0.50 for tariffs under 0.25. Developing countries have larger bands (1.3, 0.8, and 0.3) and cuts in each band are two-thirds those of

[6] Based on latest updates of http://www.wto.org/.
[7] Detailed formula available upon request.

the developed countries. Small and vulnerable economies can make reductions 10 percent smaller in each band than other developing members. Additional flexibilities are available for the sensitive and special products, defined using the Jean, Laborde, and Martin (2008) method8: Cuts for sensitive products are two-thirds those for other agricultural products for both developed and developing countries, and developing countries can make reductions of 15 percent for special products. The cotton initiative adds free market access by developed countries to LDCs for cotton.

The tariff shock of a DDA, presented in Table 2.2 expressed in absolute point of tariff rate, illustrates that it is crucial to take the issue of sensitive products into account. Even when reduced to a few percentages of the tariff lines, the option to exempt sensitive products from liberalization substantially reduces the effective liberalization of tariff cuts (Bouët 2008 op. cit.). Indeed, in the structure of most developing economies' protection pattern, a few tariff lines are highly protected and account for most of the average protection. Excluding them from tariff reduction widely reduces the effective reduction in protection. Often these products are agricultural products, which are export interests for SSA countries.

Table 2.2—DDA scenario: Average change in points of applied tariff rates by sector and region (percent tariff rate)

Importer	Sector	Exporter				
		DVD	EE	ODC	NA	SSA
DC	Raw ag	-32.15	-35.58	-36.23	-43.03	-34.49
	Processed ag	-36.24	-43.03	-39.46	-37.66	-35.37
	Fish	-51.47	-55.23	-40.55	-51.16	-51.29
	Other	-33.03	-41.31	-41.49	-43.73	-26.61
EE	Raw ag	-0.21	-0.23	-0.28	-0.54	-0.11
	Processed ag	-5.04	-1.62	-2.83	-6.27	-9.95
	Fish	-25.78	-22.81	-30.39	-27.21	-35.38
	Other	-27.17	-21.27	-29.22	-22.66	-12.90
ODC	Raw ag	-0.03	-0.28	-0.09	-0.21	-0.22
	Processed ag	-3.93	-2.29	-3.51	-4.28	-7.02
	Fish	-39.58	-28.56	-30.45	-27.15	-29.64
	Other	-12.95	-21.22	-14.77	-12.36	-9.64
NA	Raw ag	-0.03	-0.64	-0.09	-0.05	-0.23
	Processed ag	-4.62	-4.81	-6.88	-1.32	-3.04
	Fish	-46.58	-45.65	-51.40	-23.74	-47.99
	Other	-31.16	-35.07	-31.58	-30.59	-35.66
SSA	Raw ag	-7.85	-8.38	-5.04	-23.08	-15.35
	Processed ag	-8.42	-12.92	-12.62	-25.21	-22.87
	Fish	-24.70	-5.37	-9.10	-21.25	-4.77
	Other	-4.21	-7.09	-6.20	-4.88	-5.19

Source: Author's calculations, reference-group weight aggregating method.
Notes: DC = developed countries; EE = emerging economies; ODC = other developing economies; NA = northern Africa; SSA = Sub-Saharan Africa. Raw ag = raw agricultural products; Processed ag = processed agriculture products; Fish = fishing products; Other = primary and manufactured products and services.

What is noteworthy is that with the exception of agricultural exports from northern African countries to developed countries, the tariff cuts are always higher for processed agricultural products than for raw agricultural products, which will tend to reduce the existing tariff escalation.

Furthermore, as a region, Sub-Saharan Africa is not exempted from tariff reduction. The value presented in the table above which is the average reference group weighted tariff cut for the region represents that the richest countries are also the countries trading the most. Hence, substantial tariff reduction incurs, for instance, from Nigeria, some of which benefits other SSA countries such as South Africa (Table C.1).

[8] Thanking David Laborde for having made that list available.

DFQF Scenario: Preferential Multilateral Liberalization for Least Developed Countries

It was agreed at the 2005 WTO Ministerial that all developed countries would offer at least 97 percent DFQF access for LDCs. Since 2001, some Organization for Economic Cooperation and Development (OECD) countries have already proposed a DFQF access to some LDCs. A number of emerging countries (Turkey, Korea, and China) have also put in place preferential market access albeit covering fewer products (Elliott 2010). It is crucial to take those preferential agreements that have already happened into account in the pre-experiment because they reduce the potential gains from the DFQF proposal.

Without specifically testing the interaction effects of those different agreements, Berisha-Krasniqi, Bouët and Mevel (2008 op. cit.) and more recently Bouët et al. (2010 op cit.) and Bouët and Laborde (2011), using a general equilibrium model and partial equilibrium models, find that there is little to expect for LDCs from DFQF market access if this market access doesn't cover 100 percent tariff lines and is not extended to as many preference-giving countries as possible, including emerging markets economies. While in some cases including full Economic Partnership Agreement (EPA) and regional integration in the negotiating regions in the baseline, they do not consider parallel impacts of DDA. Building from their results, a rather ambitious DFQF scenario is implemented: 100 percent DFQF market access by OECD countries and Brazil, China, and India to all LDCs.

The equivalent average tariff cut presented in Table 2.3 shows that DFQF would mostly benefit the SSA region, and the few LDCs in the other developing countries group. For SSA, the equivalent average tariff cuts are much higher than from DDA. Moreover, tariff cuts are more important in the raw agricultural products sector than in the processed agricultural products sector, even though initial tariffs were higher in the processed agricultural products sector (Table 2.1). This apparent paradox reflects that overall LDCs export more raw agricultural products than processed agricultural products to OECD countries and emerging economies and some of them face very high tariff peaks on some specific raw agricultural products such as rice to Japan, tobacco to the United States, sugar or fruits and vegetables to India. The major tariff cuts for SSA agricultural exports from a DFQF agreement would come from tariff reduction in India, other Asian countries, and the United States (Table C.2).

Table 2.3—DFQF scenario: Average change in points of applied tariff rates by sector and region (percent tariff rate)

Importer	Sector	Exporter	
		ODC	SSA
DC	Raw ag	-0.52	-18.69
	Processed ag	-0.59	-9.37
	Fish	-2.75	-16.82
	Other	-5.34	-2.92
EE	Raw ag	-17.35	-41.67
	Processed ag	-1.76	-23.79
	Fish	-8.94	-44.45
	Other	-1.64	-14.28
ODC	Raw ag	-0.68	-14.15
	Processed ag	-0.31	-4.22
	Fish	-3.39	-9.21
	Other	-0.62	-5.29

Source: Author's calculations, reference-group weight aggregating method.
Notes: DC = developed countries; EE = emerging economies; ODC = other developing economies; NA = northern Africa; SSA = Sub-Saharan Africa. Raw ag = raw agricultural products; Processed ag = processed agriculture products; Fish = fishing products; Other = primary and manufactured products and services.

DDA+DFQF Scenario

The 100 percent DFQF is now part of the DDA negotiation as compensation toward LDCs for the erosion of preferences they experience in the DDA. Hence a combination of the two is also simulated.

It is noteworthy in Table 2.4 and Table C.3 that the equivalent tariff cuts are not the exact sum of tariff cuts from the two scenarios alone, since some sources of tariff reduction are the same in both agreements. For instance, an important tariff cut for Malawi is the complete elimination of tariff on the tobacco exported to the United States.

Table 2.4—DDA + DFQF scenario: Average change in points of applied tariff rates by sector and region (percent tariff rate)

Importer	Sector	Exporter				
		DVD	EE	ODC	NA	SSA
DC	Raw ag	-32.16	-35.58	-36.56	-43.03	-42.41
	Processed ag	-36.26	-43.03	-39.76	-37.66	-40.86
	Fish	-51.87	-55.23	-42.82	-51.16	-61.67
	Other	-33.04	-41.31	-43.60	-43.73	-28.92
EE	Raw ag	-0.24	-0.23	-17.59	-0.54	-41.69
	Processed ag	-5.12	-1.62	-4.47	-6.27	-29.56
	Fish	-29.13	-22.81	-36.48	-27.21	-66.49
	Other	-27.31	-21.27	-30.55	-22.66	-25.41
ODC	Raw ag	-0.33	-0.28	-0.78	-0.21	-14.36
	Processed ag	-4.01	-2.29	-3.69	-4.28	-9.91
	Fish	-49.74	-28.56	-32.19	-27.15	-34.27
	Other	-13.00	-21.22	-15.17	-12.36	-14.48
NA	Raw ag	-0.03	-0.64	-0.09	-0.05	-0.23
	Processed ag	-4.62	-4.81	-6.88	-1.32	-3.04
	Fish	-46.58	-45.65	-51.40	-23.74	-47.99
	Other	-31.16	-35.07	-31.58	-30.59	-35.66
SSA	Raw ag	-7.85	-8.38	-5.04	-23.08	-15.35
	Processed ag	-8.42	-12.92	-12.62	-25.21	-22.87
	Fish	-24.70	-5.37	-9.10	-21.25	-4.77
	Other	-4.21	-7.09	-6.20	-4.88	-5.19

Source: Author's calculations, reference-group weight aggregating method.
Notes: DC = developed countries; EE = emerging economies; ODC = other developing economies; NA = northern Africa; SSA = Sub-Saharan Africa. Raw ag = raw agricultural products; Processed ag = processed agriculture products; Fish = fishing products; Other = primary and manufactured products and services.

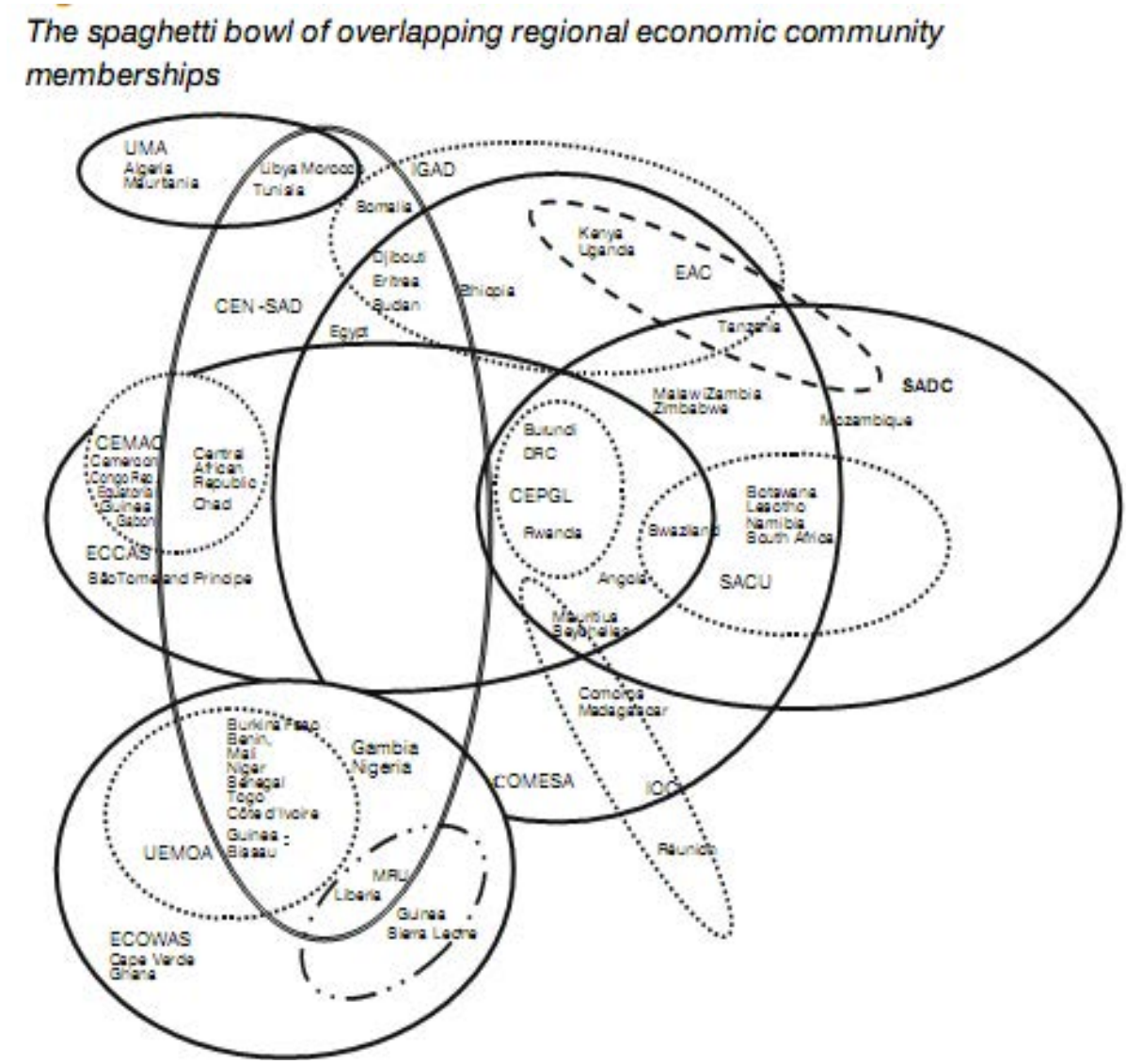
Regional FTA Scenario: Four Regional Free Trade Agreements in Sub-Saharan Africa

Despite the substantial number of trade agreements signed within SSA state, progress in regional integration is uneven across the continent (UNECA 2010). In terms of future prospects, it seems most likely that regional integration will continue, but the pace will highly depend on the willingness of the respective governments to enforce the agreements they have signed.

Considering the overwhelming number of overlapping memberships of SSA countries as illustrated in Figure 2.1, it is necessary to make a choice regarding which regional economic community to choose. A combination of regional economic communities that covers all SSA countries with no overlap is chosen (Figure 2.2): Those correspond to the four groups that were used for the EPA regional negotiations in Africa, namely, a western African group based on Economic Community of West African States (ECOWAS) members plus Mauritania; a central African group based on Monetary and Economic Community of Central Africa (CEMAC) members plus Democratic Republic of Congo and São Tomé and Principe; a southern African group named the Southern African Development Community (SADC) group based on the Southern Africa Customs Union (SACU) members plus Malawi, Mozambique,

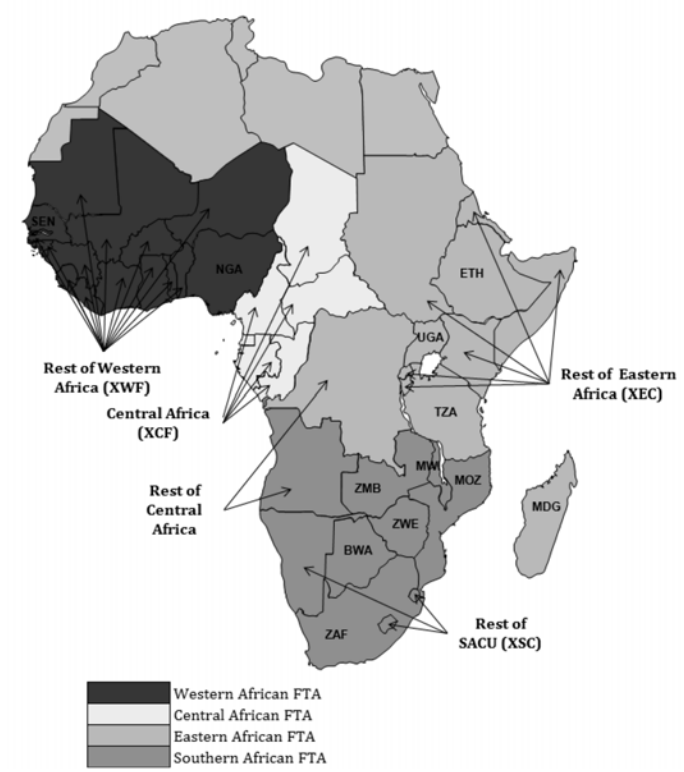
Zambia, Zimbabwe and Angola; and an eastern African group considered as one region but divided into two negotiating groups, one being based on the East African Community (EAC) members and the other one named the ESA (eastern and southern Africa) based on some Common Market for Eastern and Southern Africa (COMESA) members.

Figure 2.1—Assessing regional integration in Africa



Source: UNECA, 2006.

Figure 2.2—Regional FTA simulated and GTAP 7 regions in Sub-Saharan Africa



Source: GTAP 7 database region listing.

Because data on the effective applied tariff and the commitments of various agreements are hard to gather and consolidate, rather drastic regional integration scenarios were chosen. For each SSA country, all *ad valorem* equivalent tariffs applied to imports from other countries of the same region are set to zero, creating four FTAs.

Considering that SSA countries do not trade only with the countries within the same FTA, at the SSA level equivalent tariff cuts (Table 2.5) from the four FTAs are only equal to less than 30 percent cuts on average SSA trade.

Table 2.5—Regional FTA scenario: Average change in points of applied tariff rates by sector and region (percent tariff rate)

Importer	Sector	Exporter
		SSA
SSA	Raw ag	-20
	Processed ag	-23
	Fish	-31
	Other	-24

Source: Author's calculations, reference-group weight aggregating method.
Notes: SSA = Sub-Saharan Africa. Raw ag = raw agricultural products; Processed ag = processed agriculture products; Fish = fishing products; Other = primary and manufactured products and services.

Table C.4 illustrates some of the major tariff cuts for SSA agricultural exports from regional FTAs. It reveals that some countries, such as Nigeria, Mozambique, and countries in eastern Africa, will have to drastically decrease some of their tariffs.

SSA FTA Scenario

An extended version of regional integration is also chosen in the form of a SSA FTA. For each SSA country, *ad valorem* equivalent tariffs applied on imports from other SSA countries are set to zero. Table C.5 illustrates some of the major tariff cuts for SSA agricultural exports from SSA FTAs. Most of them would be beneficial to South African and western African exports.

Testing Alternative Baselines and Interactions

All the possible interactions between the previously presented scenarios are tested. From each interaction we find what has been seen with the DDA+DFQF: The interaction effect of two scenarios counts, and it is not a mere sum of what happens in the two scenarios alone.
From the initial scenarios presented above, two alternative baselines are built depending on the outcome of the EPA negotiations. The initial results are compared with the corresponding scenarios with alternative baselines.

EPA Scenario: Bilateral Economic Partnership Agreements EU-ACP

According to the MAcMapHS6 version 2.1 database, in 2004 the SSA region exported 45 percent of its agricultural exports to the EU, with 17 Sub-Saharan countries depending on the EU for more than 50 percent of their agricultural exports. Since the EU is the main trade partner for SSA countries, the impacts of the potential outcomes of the current negotiations between the EU and Sub-Saharan countries should be tested on the baseline and on other scenarios.

In 2007 the WTO waiver for the Cotonou Agreements[9] ended, without the expected conclusion of the EPA being successfully signed. Initiated as regional negotiations between regional communities in the African, Caribbean, and Pacific (ACP) countries and the EU (which required countries that had overlapping memberships to those regional communities to decide with which to negotiate), the negotiations have now become bilateral negotiations with the EU

Applied *ad valorem* equivalent tariffs between the EU and the corresponding ACP regions are set to zero (Table C.6). Tariffs of the sensitive products are excluded from any cuts. As, only the countries that signed Interim EPA (IEPA) have published their list of sensitive products, these lists are extended to the other countries of the same regional group who have not signed the IEPA.[10]

Overall the EPAs are equivalent to tariff cuts ranging from 4 to 19 percent (Table 2.6) on tariffs applied by SSA on imports from all developed countries and 11 to 35 percent on tariffs applied by all developed countries on imports from SSA.

[9] The Cotonou Agreement signed in 2000 had replaced the Lomé Convention, which had been the basis for ACP-EU development cooperation since 1975, providing nonreciprocal preferential access for all ACP countries to the EU market. The Cotonou Agreements, however, were supposed to be transitional toward the EPAs in which ACP countries would also provide duty-free access to their own markets for EU exports.

[10] Specifically: In the western African group, Ghana and Côte d'Ivoire have their own exclusion lists from their individual IEPA. For the other countries, we use Ghana's list. For all central African countries we use the list of Cameroon's IEPA. In eastern Africa, EAC countries, Comoros, Madagascar, Maurice, Seychelles, Zambia, and Zimbabwe all use their own IEPA exclusion list. For the other countries, we use the EAC exclusion list. For all southern African countries, we use the SAD-1 IEAP exclusion list. All lists were found at http://ec.europa.eu/trade/wider-agenda/development/economic-partnerships/.

Table 2.6—Bilateral ACP-EU EPA scenario: Average change in points of applied tariff rates by sector and region (percent tariff rate)

Importer	Sector	Exporter		
		DC	ODC	SSA
ODC	Raw ag	0.00		
	Processed ag	0.00		
	Fish	-0.01		
	Other	-0.02		
SSA	Raw ag	-0.15		
	Processed ag	-0.19		
	Fish	-0.04		
	Other	-0.17		
DC	Raw ag		0.00	-0.15
	Processed ag		-0.02	-0.35
	Fish		-0.01	-0.11
	Other		-0.01	-0.29

Source: Author's calculations, reference-group weight aggregating method.
Notes: DC = developed countries; ODC = other developing economies; NA = northern Africa; SSA = Sub-Saharan Africa. Raw ag = raw agricultural products; Processed ag = processed agriculture products; Fish = fishing products; Other = primary and manufactured products and services.

GSP Scenario: The Counterfactual Scenario

Considering the difficulties in bringing negotiations forward in the EPA, it is necessary to devise a counterfactual scenario for the case in which the EPA negotiation fails. Since 2008, all countries whose governments initiated the IEPA have benefited from the maintenance of traditional trade preferences from Cotonou. Only the ones that have refused to sign, such as Gabon, Congo, and Nigeria, are no longer Cotonou preference receivers.

Indeed, the EU has preferential programs for developing countries, an everything but arms (EBA) initiative granting all eligible LDCs DFQF access for all products but arms[11] and a Generalized System of Preferences (GSP)[12] for other developing countries. In terms of preferences, the EBA is equivalent to the Cotonou Agreement for ACP LDCs, but for the other ACP countries, the GSP would mean an increase in the tariffs they face for their exports to the EU[13]

Considering the current situation a drastic counterfactual to the EPA scenario is chosen where no EPA is signed and all ACP countries are transferred to the GSP[14] scheme (LDCs are granted EBA).

[11] I consider that the delayed implementation for sugar, rice, and bananas has ended, and include the end of the product protocols in the pre-experiment. Indeed, for sugar, from October 1, 2009, to September 30, 2015: ACPs have free access to the EU market, the only restriction being an automatic safeguard clause for non-LDC ACPs (Commission Regulation [EC] No 828/2009 of September 10, 2009, laid down detailed rules of application for the marketing years 2009/10 to 2014/15 for the import and refining of sugar products of tariff heading 1701 under preferential agreements). Since January 1, 2006, the EBA initiative grants DFQF access for bananas from LDCs to the EU market. Non-LDC ACP countries benefit from DFQF access under the EPA trade regime since January 1, 2008. All ACP banana exporters concluded negotiations on a full or interim EPA at the end of 2007.

[12] Note that the GSP plus scheme is not considered.

[13] Most countries that have signed IEPA so far are African non-LDC highly dependent for a concentrated part of their exports on their preferential access to the European market: Ivory Cost (banana and cocoa) and Ghana (cocoa) for western Africa; Cameroon (banana) for central Africa; Botswana, Swaziland, Zimbabwe (cattle), and Mozambique for southern Africa; and Kenya (textile) and Seychelles (fish) for eastern Africa. Some African LDCs such as Burundi, Rwanda, Tanzania, Uganda, Mozambique, Madagascar, and Lesotho also signed.

[14] See http://trade.ec.europa.eu/doclib/docs/2009/april/tradoc_143051.pdf.

Overall, the increase in the tariffs applied by the EU would mean a 5 percent increase in equivalent average tariffs on processed agricultural products exports to all developed countries (Table 2.7). Nevertheless, this average increase hides that impacts would be concentrated on the few ACP non-LDCs and on some specific sectors, as illustrated in Table C.7, such as sugar (+ 251 percent for Mauritius, + 229 percent for Zimbabwe) or vegetables and fruits (+ 19 percent central Africa, + 11 percent western Africa).

Table 2.7—ACP GSP scenario: Average change in points of applied tariffs by sector and region

Importer	Sector	Exporter	
		ODC	SSA
DC	Raw ag	0.00	0.00
	Processed ag	0.03	0.05
	Fish	0.00	0.01
	Other	0.00	0.00

Source: Author's calculations, reference-group weight aggregating method.
Notes: DC = developed countries; ODC = other developing economies; SSA = Sub-Saharan Africa. Raw ag = raw agricultural products; Processed ag = processed agriculture products; Fish = fishing products; Other = primary and manufactured products and services.

Taking into account this counterfactual illustrates what ACP non-LDCs have to lose from not signing the Interim Agreements and also explains why most did. Table 2.8 summarizes the scenario presented above.

Table 2.8—Scenarios simulated

Scenario	Description
DDA	Successful conclusion of the Doha negotiations: Multilateral reduction of bound tariff barriers of all countries except LDC according to the December 2008 modalities.
DFQF	Complete elimination of all applied tariff barriers imposed by OECD countries, Brazil, China, and India on imports from all LDCs.
DDA+DFQF	Combined tariff reductions of the DDA and the DFQF scenarios.
Reg FTA	Constitution of four subcontinental FTAs in Sub-Saharan Africa: Complete elimination of applied tariff barriers between countries of the same FTA.
SSA FTA	Constitution of one subcontinental FTA in Sub-Saharan Africa: Complete elimination of applied tariff barriers between SSA countries.
DDA+ Reg FTA	Combined tariff reductions of the DDA and the Reg FTA scenarios.
DFQF+Reg FTA	Combined tariff reductions of the DFQF and the Reg FTA scenarios.
DDA+DFQF+Reg FTA	Combined tariff reductions of the DDA, the DFQF and the Reg FTA scenarios.
EPA	Bilateral EPA concluded between each ACP country and the EU: Elimination of applied tariffs between the E.U. and each ACP country. Tariffs applied on the imports of some sensitive products from the EU as defined by each ACP country (IEPA) are unchanged.
GSP	Each ACP country is transferred to the corresponding preferential scheme of the EU: EU eliminates applied tariff barriers on all imports from ACP LDCs. Applied tariffs on imports from ACP non LDCs are set the level of the GSP agreement.

Source: Author's compilation.

3. RESULTS

Comparative Impacts on GDP and Real Income

As found in previous studies such as Bouët et al. (2005 op. cit.), global gains from trade liberalization are small, even at the multilateral level. In our study, they amount globally to a maximum of $[15]53 billion of gross domestic product (GDP) growth or $32 billion of real income growth (respectively 0.13 percent of 2004 world GDP or 0.10 percent of 2004 world real income), reached with a combination of a DDA and a Duty-Free Quota-Free (DFQF; see Tables 3.1 and 3.2).

Table 3.1—Impacts of scenarios on GDP volume ($ billions)

	Absolute increase *(Percent change)*							
	DDA*	DFQF*	DDA+ DFQF*	Reg FTA	SSA FTA	DDA + Reg FTA*	DFQF + Reg FTA*	DDA+ DFQF+ Reg FTA*
DC	40.62 *(0.12)*	0.63 *(0.00)*	40.95 *(0.12)*	-0.02 *(0.00)*	-0.07 *(0.00)*	40.60 *(0.12)*	0.61 *(0.00)*	40.22 *(0.11)*
EE	7.60 *(0.26)*	-0.04 *(0.00)*	7.63 *(0.26)*	-0.02 *(0.00)*	-0.06 *(0.00)*	7.58 *(0.26)*	-0.07 *(0.00)*	7.54 *(0.26)*
ODC	2.18 *(0.09)*	0.37 *(0.02)*	2.46 *(0.11)*	-0.01 *(0.00)*	-0.02 *(0.00)*	2.17 *(0.09)*	0.35 *(0.02)*	2.29 *(0.1)*
SSA	0.49 *(0.09)*	0.23 *(0.04)*	0.69 *(0.13)*	0.33 *(0.06)*	0.65 *(0.12)*	0.80 *(0.15)*	0.55 *(0.10)*	0.27 *(0.05)*
NA	1.27 *(0.47)*	0.00 *(0.00)*	1.27 *(0.47)*	0.00 *(0.00)*	0.00 *(0.00)*	1.27 *(0.47)*	0.00 *(0.00)*	1.27 *(0.47)*
World	52.16 *(0.13)*	1.18 *(0.00)*	53.00 *(0.13)*	0.28 *(0.00)*	0.51 *(0.00)*	52.42 *(0.13)*	1.45 *(0.00)*	51.60 *(0.12)*

Source: Author's calculations from the results of the MIRAGE model.
Notes: *Scenario with specific treatment of GTAP data issues. DC = developed countries; EE = emerging economies; ODC = other developing economies; NA = northern Africa; SSA = Sub-Saharan Africa.

Table 3.2—Changes in real income ($ billions)

	Absolute change *(Percent change)*							
	DDA*	DFQF*	DDA+ DFQF*	Reg FTA	SSA FTA	DDA + Reg FTA*	DFQF + Reg FTA*	DDA+ DFQF+ Reg FTA*
World	32.20 *(0.10)*	0.84 *(0.00)*	32.73 *(0.10)*	0.09 *(0.00)*	0.22 *(0.00)*	32.30 *(0.10)*	0.94 *(0.00)*	31.70 *(0.10)*

Source: Author's calculations from the results of the MIRAGE model.
Notes: *Scenario with specific treatment of GTAP data issues.

[15] All amounts thereafter are in US dollars.

These low prospects of gains from trade liberalization are found in similar studies with the Modeling International Relationships in Applied General Equilibrium (MIRAGE) model but differ from other more positive estimations of the World Bank and GTAP or HRT models for several reasons (Bouët et al. 2005 op. cit.; Anderson et al. 2006 op. cit.). First, the studies using the MAcMapHS6-2.1 database (most studies with MIRAGE) take into account a precise measurement of protection worldwide, especially taking into account the trade preferences, regional agreements, and the gap between applied and bound protection (Bouët et al. 2008 op. cit.). Second, the choice of conservative estimation of behavioral parameters (lower elasticities of substitution for developing countries based on econometric estimations) yields lower trade flows and thus lower gains from liberalization (Bouët 2008 op. cit.) especially in terms of real income. More complex theoretical assumptions (such as the imperfect mobility of factors allowed in MIRAGE) hamper reallocation of factors according to the comparative advantage and thus decrease gains (Gérard and Piketty 2008). Third, like all static simulations, our results lack the *dynamic gains of liberalization* (to start with, the increase in factor supply) that increase the results of dynamic simulations. Fourth, more importantly, by excluding Asian travelers' expenditures in Africa from the exports flows being liberalized, more realistic results from multilateral liberalization are found (all scenarios with "*" at the end). Appendix E explains the issues and the treatment applied in this paper and illustrates the impacts of that treatment on the results from multilateral scenarios. It shows that the world-level real income gains are 83 percent smaller for DFQF than without that treatment.

In terms of comparative gains, a combination of the Doha Development Agenda and the DFQF Market Access, the most ambitious scenario in terms of tariff cuts, results in higher global gains both in terms of real income and GDP. But the gains from the DDA are mostly driven by the gains of developed countries, whereas an ambitious DFQF rebalances the gains toward LDCs (in SSA and other developing economies).

It should be noted that there are interactions effects when combining different trade agreements that make the outcome of the combination different from the arithmetic sum of impacts of each trade agreement alone: The effects from the DDA+DFQF scenario is not the exact arithmetic sum of the effects of DDA plus the effects of DFQF. This discrepancy can be attributed to both agreements offering some similar gains, but also to some of the gains from preferential access with DFQF being lost as a result from multilateral liberalization and erosion of preferences. This illustrates two crucial points: First, simulating interactions is necessary to grasp the complicated effects of simultaneous trade agreements; second, any preferential trade agreement is jeopardized by increased multilateral trade liberalization as a consequence of erosion of preferences.

As for the understanding of those results, we wish to highlight that the interpretation of the figures can lead to diverging conclusions. In terms of percentage change of GDP volume, developing countries may seem to be the winner from DDA+DFQF since GDP in volume increases more in developing countries than developed countries (respectively, 0.20 percent and 0.12 percent). But turning to the absolute increase in GDP volume, which is US$46 billion for developed countries and only US$12 billion for developing countries, the opposite conclusion can be reached that developed countries benefit the most from multilateral and bilateral trade liberalization. Furthermore, taking into account the headcounts and the repartition of the population worldwide can lead to the conclusion that 20 percent of the worldwide population in developed countries obtain 78 percent of the gains (31$/capita), when the 80 percent of the world population living in developing countries only gain 22 percent of the gains (2.2$/capita).

By comparing the impacts of our different scenarios on SSA GDP in volume and real income changes, we can see that regional integration does deliver as much as multilateral integration. Indeed, an ambitious subcontinental integration could bring up to $510 million to Sub-Saharan Africa, and a combined DDA+DFQF would bring $530 million in real income.

Comparative Impacts on Production and Trade Structure

Beyond GDP and real income results, the structure of production and the composition and destination of exports are compared. As expected, they vary across regions and sectors and according to the level of trade integration and its modalities.

In terms of exports structure, initially, Sub-Saharan Africa is the only region in the world exporting more raw agricultural products than processed agricultural products. Considering the stake of agricultural-led growth, the trade integration process should be coherent with the objective of increased value-added in agriculture.

Looking at the evolution of exports of SSA countries presented in Table 3.3, regional integration creates more trade in volume than the multilateral scenarios, mainly because of the creation of trade in *other goods* (driven by primary, other manufactured products, and textiles). Adding regional integration to the multilateral scenarios will more than double the export volumes from the region. Table D.1 presents the distribution of changes in agricultural export volumes across SSA countries. The increased export volumes originate from contrasted countries depending on the scenario. Mostly, increases in raw agricultural products are driven by South Africa, eastern Africa, Zimbabwe, and Malawi and increases in processed agricultural products are driven by South Africa, Rest of SACU, Zimbabwe, eastern Africa, and Tanzania.

Table 3.3—Change in the in export volume ($ billions) of Sub-Saharan Africa

	Absolute increase *(Percent change)*							
	DDA*	DFQF*	DDA+ DFQF*	Reg FTA	SSA FTA	DDA + Reg FTA*	DFQF + Reg FTA*	DDA+ DFQF+ Reg FTA*
Raw ag	0.22	0.84	0.79	0.26	0.38	0.51	1.14	0.02
	(1.53)	*(5.72)*	*(5.35)*	*(1.77)*	*(2.58)*	*(3.43)*	*(7.74)*	*(0.10)*
Processed ag	0.16	0.56	0.64	0.53	0.99	0.67	1.08	0.22
	(1.42)	*(5.09)*	*(5.82)*	*(4.80)*	*(8.95)*	*(6.08)*	*(9.8)*	*(2.03)*
Fish	0.01	0.00	0.01	0.00	0.00	0.01	0.00	0.00
	(2.77)	*(-1.25)*	*(1.59)*	*(-0.05)*	*(0.10)*	*(2.75)*	*(-1.26)*	*(0.37)*
Other	1.02	-0.22	0.92	2.85	5.78	3.71	2.58	5.23
	(0.63)	*(-0.14)*	*(0.57)*	*(1.76)*	*(3.58)*	*(2.30)*	*(1.60)*	*(3.23)*
Total	1.41	1.18	2.36	3.64	7.15	4.90	4.80	5.47
	(0.75)	*(0.63)*	*(1.26)*	*(1.94)*	*(3.81)*	*(2.61)*	*(2.56)*	*(2.91)*

Source: Author's calculations from the results of the MIRAGE model.
Notes: *Scenario with specific treatment of GTAP data issues. Raw ag = raw agricultural products; Processed ag = processed agriculture products; Fish = fishing products; Other = primary and manufactured products and services.

In terms of the processing of the agricultural exports, Table 3.4 reveals that multilateral integration concentrates the exports toward raw agricultural exports: Additional agricultural exports created by trade integration are composed of 41 percent of processed agricultural goods for DFQF. On the contrary, regional integration tends to increase the ratio of processed agricultural goods in total agricultural exports. The additional agricultural exports created in the Regional FTA scenario are composed of 67 percent of processed agricultural goods, and 72 percent in the SSA FTA scenario. In terms of level of processed agricultural exports, there are broadly equivalent between DFQF and Reg FTA, with an ambitious regional integration in the form of a SSA FTA bringing a 30% higher level of exports than the ambitious DFQF scenario proposed. Both types of regional integration further increase the total volume of exports with a large increase in manufactured and primary exports.

Table 3.4—Impacts on the share of processed over total agricultural goods in Sub-Saharan African production, exports and imports

		Initial	Additional							
			DDA*	DFQF*	DDA+ DFQF*	Reg FTA	SSA FTA	DDA + Reg FTA*	DFQF + Reg FTA*	DDA+ DFQF+ Reg FTA*
Production		46%	25%	34%	45%	128%	112%	67%	44%	31%
Exports to all destination		43%	41%	40%	45%	67%	72%	57%	49%	94%
Exports to	DC	41%	38%	38%	46%	52%	57%	26%	34%	63%
Exports to	EE	10%	15%	8%	9%	0%	0%	11%	8%	1%
Exports to	ODC	18%	28%	90%	84%	0%	0%	20%	87%	1%
Exports to	NA	18%	0%	9%	100%	47%	0%	100%	11%	0%
Exports to	SSA	66%	85%	0%	69%	66%	72%	66%	64%	72%
Imports from all destination		74%	90%	67%	77%	66%	72%	66%	63%	72%
Imports from	DC	74%	64%	73%	72%	n.	n.	0%	65%	n.
Imports from	EE	79%	100%	61%	89%	n.	n.	100%	37%	n.
Imports from	ODC	79%	0%	70%	70%	n.	n.	n.	0%	n.
Imports from	NA	66%	85%	0%	69%	66%	72%	66%	64%	72%
Imports from	SSA	89%	97%	73%	92%	n.	n.	99%	0%	n.

Source: Author's calculations from the results of the MIRAGE model.
Notes: *Scenario with specific treatment of GTAP data issues.
DC = developed countries; EE = emerging economies; ODC = other developing economies; NA = northern Africa; SSA = Sub-Saharan Africa.

Table 3.4 illustrates that the structure of production doesn't necessarily change in the same way the structure of exports does, since changes in production depend on changes in the exports, imports, and consumptions structures. Nevertheless, in the end, it is critical to take the structure of production into account to make sure which economy captures the value addition of the final goods created.

The pattern of SSA agricultural exports and production observed can be further explained in light of the structure of the destination exports market. The ratio of processed agricultural goods changes drastically depending on the destination market, ranging initially from only 10 percent of agricultural exports to emerging economies being processed to 66 percent of agricultural exports to other SSA countries being processed. Indeed, looking at the composition of the agricultural trade created, the only destination market where Sub-Saharan Africa always exports more processed agricultural goods than unprocessed goods is the regional market. Three factors affect the evolution of the exports structure from increased trade integration. First, depending on the destination to which market access is granted, the structure of additional exports follows the existing structure of exports to that destination. Hence, regional trade tends to foster more processed exports than trade to emerging economies or even developed countries. Second, evolution in the tariff structure does play a role. For instance, by setting all tariffs to zero, regional integration and DFQF will lead to higher cuts on processed goods than on raw products because of the existing tariff escalation (Table 2.1). The structure of exports tends to change according to those respective tariff cuts. Indeed, following those tariff cuts the ratio of processed to unprocessed agricultural exports to Sub-Saharan Africa increases slightly. Third, competition from other exporters receiving similar preferences or benefiting from the same increased liberalization has a crucial impact. With DDA and DFQF, other countries also benefit from the increased market access. They are major competitors. As a consequence, structure of the increased trade flows from Sub-Saharan Africa toward developed countries and emerging economies is reoriented toward raw agricultural products, which means that they are not competitive.

Even when in interaction with multilateral integration, regional integration does increase the gains of Sub-Saharan Africa, in terms of GDP growth (Table 3.2), real income growth (Table 3.3), and share of agricultural production and exports that are processed (Table 3.4) as proven by the results of the scenarios DDA*+ Reg FTA and DFQF*+ Reg FTA.

Some Insight on the Contrasted Country-Level Impact

SSA countries are far from being homogeneously affected by the different forms of trade liberalization simulated.

At the multilateral level, despite similar initial preferential schemes, SSA countries have a wide range of preferential margins. Countries benefiting from high initial preference margins face erosion of preferences with any trade liberalization at the multilateral level. But countries with a high initial negative margin, such as Malawi, which specializes in the export of highly protected agricultural products (tobacco, sugar), are offered new opportunities. The extent to which each country is able to grasp those opportunities depends on its level of competitiveness compared to other competitors. Since many SSA countries export similar products, and are in competition with Asian LDCs for some products, the distributional impacts within the region are highly contrasted.

At the regional level, the level of tariff barrier that countries apply to each other is diverse and generally high. At the subcontinental level, because of similar agroecological conditions, countries tend to produce similar agricultural products; hence, competition is a real issue. Initial intracontinental trade is also fairly low, which is why regional integration is feared to divert more trade than it creates. Two key factors to take into account with regional integration in Sub-Saharan Africa are thus relative competitiveness (across members but also compared to other trade partners), which is partly captured by the change in terms of trade and allocation efficiency, and the losses in tariff revenue. Indeed, table D.2 shows that some countries can loose up to 69 percent of their tariff revenue with regional integration, as in Zimbabwe. Similarly, changes in terms of trade can affect many countries negatively.

Table 3.5 shows that the distribution of the real income gains and losses differs depending on the type of trade integration. It is noteworthy that South Africa reaps most of the gains from regional integration, DDA, and is also positively affected by DFQF. As a consequence, any combination of those scenarios would bring positive significant changes for the country. Nigeria would be negatively affected by regional integration, but gains the most from the DDA. On the contrary, Rest of Western Africa does benefit the most from regional integration and DFQF, but would be negatively affected by a DDA. Both types of regional integration have a negative impact on a higher number of countries than multilateral integration would have, which could explain why regional integration is harder to agree on for those countries. DFQF reduces the number of losers the most, leading to losses only for some of the non-LDCs of the region.

Interestingly, the DFQF+ Reg FTA* scenario is the one that brings the least numbers of losers while maximizing total gains for Sub-Saharan Africa. In fact, apart from Ethiopia, Mauritius, and Nigeria, who lose from both trade agreements, or Zambia and Zimbabwe, whose losses from regional integration are not compensated by gains in DFQF, all other countries would gain in that scenario. The highest SSA gains would leave more room for compensation of the losers.

Table 3.5—Impacts on real income ($ millions) for SSA countries

	Initial	Absolute change						
		Reg FTA	*SSA FTA*	*DDA**	*DFQF**	DDA+ DFQF*	DDA+ Reg FTA*	DFQF+ Reg FTA*
Botswana	6,000	0.94	-5.35	23.64	-0.36	23.40	24.28	0.52
Central Africa	24,338	-1.56	-24.04	-48.83	5.23	-44.42	-50.24	3.71
Ethiopia	7,417	-0.12	-0.50	2.48	-0.11	2.46	2.34	-0.24
Madagascar	3,375	-0.14	-1.93	-12.08	11.69	-1.48	-12.28	11.50
Malawi	1,958	-13.18	-14.32	-7.29	32.32	21.42	-20.66	17.87
Mauritius	4,691	-0.18	-30.24	-7.01	-0.77	-6.70	-7.16	-0.71
Mozambique	5,165	-9.44	-11.55	2.05	15.10	14.33	-7.61	7.25
Nigeria	38,263	-93.75	-125.08	140.51	-14.60	128.43	64.73	-106.52
Rest of Eastern Africa	45,921	9.72	-56.05	25.10	193.42	169.01	35.68	204.12
Rest of SACU	6,038	18.79	28.19	-24.71	-3.32	-25.35	-5.70	15.84
Rest of Western Africa	50,051	157.76	125.12	-5.52	40.37	31.62	132.96	196.40
Senegal	7,783	4.81	5.97	6.95	51.36	53.14	11.35	55.03
South Africa	173,614	213.87	682.43	91.19	8.39	97.73	301.11	226.77
South Central Africa	19,620	-18.91	-17.71	-51.84	33.56	-20.41	-70.70	14.29
Tanzania	10,624	15.06	-7.07	10.32	58.03	65.34	24.92	71.30
Uganda	6,086	2.19	4.54	5.39	19.66	18.91	7.47	21.91
Zambia	4,428	-16.10	-1.64	-1.90	10.87	7.71	-18.24	-5.51
Zimbabwe	3,452	-41.90	-43.56	-3.15	1.85	-2.20	-42.21	-40.68
SSA	418,823	227.86	507.21	145.30	462.69	532.94	370.04	692.85
Numbers of losers		10	13	9	5	6	9	5

Source: Author's calculations from the results of the MIRAGE model.
Note: *Scenario with specific treatment of GTAP data issues.

Sensitivity to the Baseline Scenario

Considering that the EU is the main trade partner for SSA countries, the impact of potential outcomes of the current negotiations between the EU and Sub-Saharan countries is tested on the baseline and on other scenarios. Main results compared to the previous ones are presented in Table 3.6.

Table 3.6—Comparison of main results for Sub-Saharan Africa with alternative scenarios of EPA negotiations

	Real income (percent change)			Number of losers in SSA (real income)			share processed in increased agricultural export volume		
	none	EPA	GSP	none	EPA	GSP	none	EPA	GSP
Baseline	n.a.	-0.01	-0.03	n.a.	13	8	n.a.	46%	0%
DDA*	0.03	0.02	0.01	9	11	9	41%	46%	0%
DFQF*	0.11	0.10	0.08	5	5	4	40%	43%	12%
Reg FTA	0.05	0.05	0.03	10	12	8	67%	54%	24%

Source: Author's calculations from the results of the MIRAGE model.
Note: *Scenario with specific treatment of GTAP data issues.

It is noteworthy that both the EPA and its counterfactual scenario by themselves would decrease SSA real income and lead to a high number of losers. Thus it seems logical that their interaction with other scenarios could decrease real income.

Similarly to previous results, we find that in terms of real income, gains are of similar order of magnitude for regional integration and multilateral integration, DDA being the most beneficial in terms of GDP volume, closely followed by regional FTA. But DFQF is the most beneficial followed by regional FTA. Regional integration still fosters a higher share of processed agricultural exports, even if it is reduced by the interaction with either EPA or GSP. Independently of the outcome of EPA negotiations, regional integration brings twice as many losers as DFQF, but is closely followed by DDA.

4. CONCLUDING REMARKS

The shifting trade context induces complex challenges and opportunities for Sub-Saharan African (SSA) countries pursuing agricultural export–led growth. General equilibrium modeling is a convenient way to assess impacts of trade policies in a consistent framework. Many simulations in the past have considered SSA interests and constraints, and have highlighted important features of trade liberalization such as the erosion of preferences, and the risk of tariff revenue and terms of trade losses at the regional level. But they have not looked at the question of comparison of different schemes of trade integration. As there is no consensus on whether Sub-Saharan Africa should focus on regional or multilateral integration first, this study brings new comparable results to fuel the debate, while also testing the interactions of various combinations of trade integration. Furthermore, the main hypothesis tested in this study is that not all export growths are equivalent in fostering the increased processing of agricultural exports required for sustainable growth.

First, by simulating the Doha Development Agenda combined with an ambitious Duty-Free Quota-Free (DFQF) and comparing the results with those two trade agreements alone, this study shows that the DFQF proposal would indeed rebalance the gains from the Doha Round toward LDCs. But it also argues that even in a DDA+DFQF scenario, developed countries would reap most of the gains from trade integration.

Second, by simulating different types of regional integration this study reveals that regional integration could deliver as much as multilateral integration for Sub-Saharan Africa in terms of gross domestic product (GDP), real income growth, and agricultural exports volumes.

Third, it highlights that patterns of agricultural export growth do indeed differ between trade integration schemes since they depend on initial trade patterns and are driven by the relative competitiveness of other exporters granted same market access. The simulations show that this consideration is crucial for SSA agricultural growth perspectives, since any multilateral integration would encourage further specialization of the region in the export of unprocessed agricultural exports. This trend is not coherent with the view that SSA countries should not only diversify their export products, but also capture more value-added on their exports. On the contrary, deeper regional integration would foster the processing of agricultural exports. The implication of those results is that in order for a multilateral integration, even preferential such as the DFQF, to be coherent with SSA countries' stake to capture more value-added in agriculture, SSA countries need to first increase their competitiveness. Regional integration could be a way to do so, since it would enable most countries to combine increased exports volume and increase value-added captured.

Fourth, looking at the distribution of gains and losses across SSA countries, this study draws attention to the fact that more countries would experience a decrease in their national real income with regional integration than with multilateral integration, especially DFQF. But it also reveals that DDA would bring almost the same numbers of losers as regional integration. Accompanying policies to mitigate those losses might help the countries be more favorable to the regional option.

Finally, this study wishes to call GTAP data users to exercise caution when simulating drastic market access opening for SSA countries. As this study illustrates, some well-documented data issues can contribute to significant virtual trade flows being created, leading to bias toward an overestimation of the potential benefits from multilateral trade integration.

APPENDIX A: DESCRIPTION OF THE MIRAGE MODEL

This study uses the Modeling International Relationships in Applied General Equilibrium (MIRAGE) model, which is a multisector, multiregion economic model initially developed by the Centre d'Études Prospectives et d'Informations Internationales (CEPII), and the International Food Policy Research Institute (IFPRI) for trade policy analysis. It is a relatively standard, neoclassical model that assumes constant returns to scale and perfect competition in the agricultural sectors and allows for the assumption of imperfect competition in industry and services. The model has a sequential dynamic recursive set-up solved in a sequence of static equilibria linked by population and labor force growth, capital accumulation and productivity. The production function assumes perfect complementarity between value-added and intermediate consumption. On the value-added side, production makes use of five factors: land, skilled labor, unskilled labor, capital, and natural resources. Skilled labor and capital are perfectly mobile across sectors, but land is specific and imperfectly mobile in primary agriculture, and natural resources are specific to the extractive sectors.

Full employment is assumed for all factors except for land. The supply of land is endogenous and depends on the land supply elasticity of the country and on the real rate of remuneration. Skilled labor is perfectly mobile across sectors. Unskilled labor is imperfectly mobile between agricultural and nonagricultural sectors according to a constant elasticity of substitution (CES) function. Growth rates of labor supply are set exogenously. The supply of capital is modified each year by depreciation and investment. Installed capital is sector specific, but new capital is allocated among sectors according to an investment function that depends on the rates of return and the sector stock of capital.

The sectoral composition of the intermediate consumption aggregate stems from a CES function. For each sector of origin, the nesting is the same as for final consumption, meaning that the sector bundle has the same structure for final and intermediate consumption. On the demand side, the model assumes that each region has a representative agent whose utility function is intratemporal and allocates a fixed share of regional income to savings and uses the rest to purchase final consumption. Below the first-tier Cobb-Douglas function, the preferences for final consumption across sectors are represented by an LES-CES function.

The model assumes that products from developed and developing countries belong to two different quality ranges and the substitutability between products from the same quality range is stronger than between those from different quality ranges. Additionally, within a given quality range, there is less substitutability between domestic products and foreign products than between foreign products from different origins. The model’s macroeconomic closure assumes endogenous real exchange rates while maintaining fixed trade balance, equal to the initial value for each region.

APPENDIX B: SUPPLEMENTARY TABLES

Table B.1—Mapping of the sectoral decomposition: 28 sectors of which 18 are agricultural

Type of sector of interest	Sectoral decomposition	GTAP 7 sectoral abbreviation
Raw agricultural products	Cattle	ctl, cmt
	Cereals	gro
	Export crops	ocr
	Milk	rmk
	Oilseeds	osd
	Paddy rice	pdr
	Plants for fibers	pfb
	Sugar plant	c_b
	Vegetables and fruits	v_f
	Wheat	wht
Processed agricultural products	Beverages and tobacco	b_t
	Dairy	mil
	Meat	oap
	Other food products	ofd
	Oils and fats	vol
	OMeat	omt
	Processed rice	pcr
	Sugar	sgr
Fish	Fishing	fsh
Other	Animal fibers	wol
	Other manufactured products	crp, nmm, omf
	Primary products	coa, oil, gas, omn, p_c, i_s, nfm, fmp
	Services	ely, gdt, wtr,
	Textile	tex, wap, lea
	Trade	trd
	Transport	otp, wtp, atp, cmn

Source: GTAP 7 database sectoral listing.

Table B.2—Mapping of the regional decomposition: 29 regions of which 18 are from Sub-Saharan Africa

Type of Zone of Interest	Regional decomposition	GTAP 7 regional abbreviation
Developed	EU	AUT, BEL, DNK, FIN, FRA, DEU, GRC, HUN, IRL, ITA, LUX, NLD, POL, PRT, ESP, SWE, GBR, NOR, ROU, BGR
	U.S.A.	USA
	Japan	JPN
	Rest of the World	AUS, NZL, XOC, CAN, XNA, CYP, CZE, EST, LVA, LTU, MLT, SVK, SVN, CHE, XEF, ALB, BLR, HRV, RUS, UKR, XEE, XER, KAZ, KGZ, XSU, ARM,
Emerging Economies	Brazil	BRA
	China	CHN
	India	IND
	Asian Tiger	HKG, KOR, TWN, MYS, SGP, THAI
Other Developing Countries	Rest of Asia	XEA, KHM, IDN, LAO, MNR, PHL, THA, XSE, BGD, PAK, LKA, XSA
	Rest of Southern	MEX,ARG,BOL,CHL,COL,ECU,PRY,PER,URY,VEN,XSM,CRI,GTM,NIC,PAN,XCA, XCB
North Africa	Northern Africa	EGY, MAR, TUN, XNF
Sub-Saharan Africa	Botswana	BWA
	Ethiopia	ETH
	Madagascar	MDG
	Mozambique	MOZ
	Mauritius	MUS
	Malawi	MWI
	Nigeria	NGA
	Senegal	SEN
	Tanzania	TZA
	Uganda	UGA
	South Africa	ZAF
	Zambia	ZMB
	Zimbabwe	ZWE
	Rest of South Central Africa	XAC
	Central Africa	XCF
	Rest of Eastern Africa	XEC
	Rest of South African Customs	XSC
	Rest of Western Africa	XWF

Source: GTAP 7 database regional listing.

Table B.3—Details of the four regional groups and the corresponding GTAP 7 regions available

EPA regions	Country	GTAP 7 regions
Western African group	**Nigeria**	NGA
	Benin	XWF
	Burkina Faso	
	Cape Verde	
	Ivory Coast	
	Gambia	
	Ghana	
	Guinea	
	Guinea Bissau	
	Liberia	
	Mali	
	Mauritania	
	Niger	
	Sierra Leone	
	Togo	
	Senegal	SEN
Central African group	Cameroon	XCF
	Central African Republic	
	Chad	
	Congo	
	Equatorial Guinea	
	Gabon	
	Sao Tome and Principe	
Eastern African group	**Ethiopia**	ETH
	Madagascar	MDG
	Mauritius	MUS
	Tanzania	TZA
	Uganda	UGA
	Burundi	XEC
	Comoros	
	Djibouti	
	Eritrea	
	Kenya	
	Rwanda	
	Seychelles	
	Somalia	
	Sudan	
	Congo (Democratic Republic)	XAC
Southern African group	Angola	XAC
	Botswana	BWA
	Mozambique	MOZ
	Lesotho	XSC
	Namibia	
	Swaziland	
	Malawi	MWI
	South africa	ZAF
	Zambia	ZMB
	Zimbabwe	ZWE

Source: GTAP 7 database regional listing and latest update of www.acp-eu-trade.org.

APPENDIX C: TOP 20 TARIFF CUTS FOR SSA AGRICULTURAL EXPORTS IN THE DDA SCENARIO

Table C.1—Top 20 tariff cuts for SSA agricultural exports in the DDA scenario

Exporters	Importers	Sectors	Tariff cut (as percent of initial tariff)	Equivalent tariff reduction	Tariff in the DDA scenario	Initial trade (10^6 $)
Malawi	U.S.A.	Exports Crops	-60.79	-0.32	0.20	55.58
Rest of Eastern Africa	Asian Tigers	Oilseeds	-67.71	-0.71	0.34	20.40
Rest of Eastern Africa	Rest of the World	Cattle	-19.01	-0.02	0.08	209.06
Rest of Eastern Africa	Rest of the World	Exportable crops	-35.08	-0.06	0.12	132.19
Rest of Western Africa	Japan	Other food products	-41.10	-0.02	0.04	130.66
Rest of Western Africa	Nigeria	Other food products	-25.96	-0.07	0.19	67.00
Rest of Western Africa	Nigeria	Vegetables and fruits	-50.00	-0.50	0.50	8.35
Rest of Western Africa	Nigeria	Beverages and tobacco	-64.50	-0.90	0.50	3.48
South Africa	Asian Tigers	Vegetables and fruits	-52.39	-0.10	0.09	71.54
South Africa	Asian Tigers	Other food products	-50.22	-0.07	0.07	69.67
South Africa	Asian Tigers	Sugar	-52.13	-0.11	0.10	40.92
South Africa	Japan	Other food products	-47.21	-0.06	0.07	64.97
South Africa	Japan	Vegetables and fruits	-49.54	-0.06	0.06	43.01
South Africa	Japan	Sugar	-30.25	-0.36	0.83	28.46
South Africa	Nigeria	Beverages and tobacco	-59.73	-0.69	0.47	21.27
South Africa	Nigeria	Other food products	-35.26	-0.16	0.30	16.81
South Africa	Rest of the World	Vegetables and fruits	-31.51	-0.04	0.09	203.83
South Africa	Rest of the World	Other food products	-15.98	-0.02	0.12	153.94
South Africa	Rest of the World	Beverages and tobacco	-17.71	-0.06	0.29	75.39
Zimbabwe	U.S.A.	Exports crops	-66.51	-0.37	0.18	14.06

Source: Author's calculations, reference-group weight aggregating method.

Table C.2—Top 20 tariff cuts for SSA agricultural exports in the DFQF scenario

Exporters	Importers	Sectors	Tariff cut (as percent of initial tariff)	Equivalent tariff reduction	Tariff in the DFQF scenario	Initial trade (10^6 $)
Malawi	India	Vegetables and fruits	-100	-0.44	0.00	3.45
Malawi	Rest of South America	Other food products	-87	-0.26	0.04	8.44
Malawi	Rest of the World	Other food products	-15	-0.02	0.14	63.84
Malawi	U.S.A.	Other food products	-100	-0.52	0.00	55.58
Mozambique	India	Vegetables and fruits	-100	-0.31	0.00	23.85
Mozambique	India	Sugar	-100	-1.00	0.00	2.43
Rest of Eastern Africa	Asian Tigers	Oilseeds	-94	-0.99	0.06	20.40
Rest of Eastern Africa	India	Vegetables and fruits	-45	-0.16	0.20	9.61
Rest of Eastern Africa	Japan	Exports crops	-84	-0.06	0.01	53.14
Rest of Eastern Africa	Rest of South America	Exports crops	-41	-0.07	0.10	29.19
Rest of Eastern Africa	Rest of the World	Cattle	-46	-0.05	0.06	209.06
Rest of Eastern Africa	Rest of the World	Oilseeds	-46	-0.04	0.05	94.94
Rest of Western Africa	Asian Tigers	Oilseeds	-65	-0.23	0.12	5.43
Rest of Western Africa	India	Vegetables and fruits	-50	-0.16	0.17	157.55
Rest of Western Africa	India	Plant for fibers	-95	-0.09	0.01	47.91
Rest of Western Africa	Japan	Other food products	-14	-0.01	0.05	130.66
Tanzania	India	Vegetables and fruits	-100	-0.31	0.00	67.55
Tanzania	India	Plant for fibers	-100	-0.10	0.00	13.04
Tanzania	India	Exports crops	-100	-0.78	0.00	2.79
Uganda	U.S.A.	Exports crops	-100	-0.15	0.00	17.36

Source: Author's calculations, reference-group weight aggregating method.

Table C.3—Top 20 tariff cuts for SSA agricultural exports in the DDA+DFQF scenario

Exporters	Importers	Sectors	Tariff cut (as percent of initial tariff)	Equivalent tariff reduction	Tariff in the DDA+ DFQF scenario	Initial trade (10^6 $)
Malawi	U.S.A.	Exports crops	-100	-0.52	0.00	55.58
Mozambique	India	Vegetables and fruits	-100	-0.31	0.00	23.85
Rest of Eastern Africa	Asian Tiger	Oilseeds	-98	-1.02	0.02	20.40
Rest of Eastern Africa	Rest of the World	Cattle	-47	-0.05	0.06	209.06
Rest of Eastern Africa	Rest of the World	Exports crops	-36	-0.07	0.12	132.19
Rest of Eastern Africa	Rest of the World	Oilseeds	-53	-0.05	0.04	94.94
Rest of Western Africa	India	Vegetables and fruits	-50	-0.16	0.17	157.55
Rest of Western Africa	India	Plant fiber	-95	-0.09	0.01	47.91
Rest of Western Africa	Japan	Other food products	-50	-0.03	0.03	130.66
Rest of Western Africa	Nigeria	Other food products	-26	-0.07	0.19	67.00
Rest of Western Africa	Nigeria	Vegetables and fruits	-50	-0.50	0.50	8.35
South Africa	Asian Tiger	Vegetables and fruits	-52	-0.10	0.09	71.54
South Africa	Asian Tiger	Other food products	-50	-0.07	0.07	69.67
South Africa	Asian Tiger	Sugar	-52	-0.11	0.10	40.92
South Africa	Japan	Sugar	-30	-0.36	0.83	28.46
South Africa	Nigeria	Beverages and tobacco	-60	-0.69	0.47	21.27
South Africa	Rest of the World	Vegetables and fruits	-32	-0.04	0.09	203.83
South Africa	Rest of the World	Beverages and tobacco	-18	-0.06	0.29	75.39
Tanzania	India	Vegetables and fruits	-100	-0.31	0.00	67.55
Zimbabwe	U.S.A.	Exports crops	-67	-0.37	0.18	14.06

Source: Author's calculations, reference-group weight aggregating method.

Table C.4—Top 20 tariff cuts for SSA agricultural exports in the regional FTA scenario

Exporters	Importers	Sectors	Tariff cut (as percent of initial tariff)	Equivalent tariff reduction	Tariff in the regional FTA scenario	Initial trade (10^6 $)
Rest of SACU	Rest of Southern Africa	Beverage and tobacco	-83	-0.23	0.05	67.50
Rest of Eastern Africa	Rest of Eastern Africa	Other exportable crops	-100	-0.11	0.00	47.62
Rest of Eastern Africa	Rest of Eastern Africa	Other food products	-100	-0.10	0.00	28.36
Rest of Eastern Africa	Rest of Eastern Africa	Vegetables and fruits	-100	-0.17	0.00	16.41
Rest of Western Africa	Nigeria	Beverage and tobacco	-100	-1.40	0.00	3.48
Rest of Western Africa	Nigeria	Cattle	-100	-0.19	0.00	40.37
Rest of Western Africa	Nigeria	Oil fats	-100	-0.69	0.00	6.16
Rest of Western Africa	Nigeria	Other food products	-100	-0.26	0.00	67.00
Rest of Western Africa	Nigeria	Vegetables and fruits	-100	-1.00	0.00	8.35
Rest of Western Africa	Rest of Western Africa	Oil fats	-100	-0.04	0.00	75.12
Rest of Western Africa	Rest of Western Africa	Other food products	-100	-0.08	0.00	213.22
Rest of Western Africa	Rest of Western Africa	Plant for fibers	-100	-0.05	0.00	182.43
Rest of Western Africa	Rest of Western Africa	Vegetables and fruits	-100	-0.12	0.00	39.14
South Africa	Mozambique	Other food products	-100	-0.19	0.00	33.10
South Africa	Mozambique	Vegetables and fruits	-100	-0.22	0.00	16.56
South Africa	Rest of Southern Africa	Beverage and tobacco	-55	-0.13	0.10	86.37
Tanzania	Rest of Eastern Africa	Other exportable crops	-100	-0.21	0.00	17.88
Tanzania	Rest of Eastern Africa	Other food products	-100	-0.28	0.00	28.25
Uganda	Rest of Eastern Africa	Other exportable crops	-100	-0.11	0.00	35.71
Zimbabwe	Rest of Southern Africa	Sugar	-100	-0.20	0.00	15.86

Source: Author's calculations, reference-group weight aggregating method.

Table C.5—Top 20 tariff cuts for SSA agricultural exports in the SSA FTA scenario

Exporters	Importers	Sectors	Tariff cut (as percent of initial tariff)	Equivalent tariff reduction	Tariff in the SSA FTA scenario	Initial trade (10^6 $)
Mozambique	Malawi	Exports crops	-100	*-0.22*	0.00	26.13
Rest of SACU	Rest of Southern Africa	Beverage and tobacco	-100	*-0.28*	0.00	67.50
Rest of Eastern Africa	Rest of Eastern Africa	Other foodcrops	-100	*-0.11*	0.00	47.62
Rest of Western Africa	Nigeria	Other foodcrops	-100	*-0.26*	0.00	67.00
Rest of Western Africa	Nigeria	Cattle	-100	*-0.19*	0.00	40.37
Rest of Western Africa	Nigeria	Vegetable and fruits	-100	*-1.00*	0.00	8.35
Rest of Western Africa	Nigeria	Beverage and tobacco	-100	*-1.40*	0.00	3.48
Rest of Western Africa	Rest of Central Africa	Other foodcrops	-100	*-0.24*	0.00	34.31
Rest of Western Africa	Rest of Western Africa	Other foodcrops	-100	*-0.08*	0.00	213.22
Rest of Western Africa	Rest of Western Africa	Plant for fibers	-100	*-0.05*	0.00	182.43
South Africa	Mauritius	Sugar	-100	*-0.80*	0.00	10.32
South Africa	Mozambique	Other foodcrops	-100	*-0.19*	0.00	33.10
South Africa	Nigeria	Beverage and tobacco	-100	*-1.16*	0.00	21.27
South Africa	Nigeria	Other foodcrops	-100	*-0.46*	0.00	16.81
South Africa	Rest of Eastern Africa	Sugar	-100	*-0.31*	0.00	20.16
South Africa	Rest of Southern Africa	Beverage and tobacco	-100	*-0.23*	0.00	86.37
South Africa	Zimbabwe	Cereals	-100	*-0.25*	0.00	61.75
South Africa	Zimbabwe	Other foodcrops	-100	*-0.29*	0.00	30.27
South Africa	Zimbabwe	Exports crops	-100	*-0.60*	0.00	13.29
Tanzania	Rest of Eastern Africa	Other foodcrops	-100	*-0.28*	0.00	28.25

Source: Author's calculations, reference-group weight aggregating method.

Table C.6—Top 20 tariff cuts for SSA agricultural exports in the EPA scenario

Exporters	Importers	Sectors	Tariff cut (as percent of initial tariff)	Equivalent tariff reduction	Tariff in the SSA FTA scenario	Initial trade (10^6 $)
Mauritius	EU	Other food products	-33	-0.03	0.05	0.12
Nigeria	EU	Exports crops	-52	-0.01	0.01	0.73
Nigeria	EU	Other food products	-63	-0.07	0.04	0.45
Rest of Central Africa	EU	Vegetable and fruits	-26	-0.04	0.10	0.21
Rest of Eastern Africa	EU	Exports crops	-22	-0.02	0.05	1.22
Rest of Eastern Africa	EU	Other food products	-40	-0.03	0.04	1.34
Rest of Eastern Africa	EU	Vegetable and fruits	-12	-0.01	0.08	0.30
Rest of SACU	EU	Other food products	-39	-0.07	0.11	0.62
Rest of Western Africa	EU	Exports crops	-41	-0.01	0.01	8.67
Rest of Western Africa	EU	Oilseeds	-32	-0.01	0.02	0.38
Rest of Western Africa	EU	Other food products	-33	-0.02	0.04	9.76
Rest of Western Africa	EU	Vegetable and fruits	-17	-0.01	0.06	0.21
South Africa	EU	Beverage and tobacco	-45	-0.13	0.16	0.06
South Africa	EU	Exports crops	-45	-0.05	0.06	1.15
South Africa	EU	Meat	-37	-0.02	0.03	1.04
South Africa	EU	Oilseeds	-68	-0.07	0.03	0.06
South Africa	EU	Other food products	-43	-0.08	0.10	0.75
South Africa	EU	Sugar	-54	-0.11	0.10	5.11
South Africa	EU	Vegetable and fruits	-45	-0.08	0.10	2.33
Zimbabwe	EU	Exports crops	-53	-0.08	0.07	11.12

Source: Author's calculations, reference-group weight aggregating method.

Table C.7—Top 20 tariff increases for SSA agricultural exports to the EU in the GSP scenario

Exporters	Importers	Sectors	Tariff increase (percent of initial tariff)	*Ad valorem* equivalent tariff increase	Tariff in the GSP scenario	Initial trade (10^6 $)
Mauritius	EU	Other food products	13	0.01	0.09	0.12
Mauritius	EU	Sugar	251	0.26	0.37	0.11
Nigeria	EU	Other food products	2	0.00	0.11	0.45
Rest of Central Africa	EU	Oilseeds	2	0.00	0.09	0.00
Rest of Central Africa	EU	Other food products	6	0.01	0.18	0.02
Rest of Central Africa	EU	Vegetables and fruits	19	0.03	0.16	0.21
Rest of Eastern Africa	EU	Oilseeds	0	0.00	0.04	1.16
Rest of Eastern Africa	EU	Other food products	3	0.00	0.07	1.34
Rest of Eastern Africa	EU	Vegetables and fruits	0	0.00	0.09	0.30
Rest of SACU	EU	Cereals	9	0.01	0.18	0.00
Rest of SACU	EU	Meat	1	0.00	0.06	0.01
Rest of SACU	EU	Other food products	10	0.02	0.19	0.62
Rest of SACU	EU	Sugar	228	0.21	0.30	0.13
Rest of SACU	EU	Vegetables and fruits	1	0.00	0.19	0.02
Rest of Western Africa	EU	Exports crops	0	0.00	0.03	8.67
Rest of Western Africa	EU	Oilseeds	3	0.00	0.04	0.38
Rest of Western Africa	EU	Other food products	2	0.00	0.06	9.76
Rest of Western Africa	EU	Vegetables and fruits	11	0.01	0.08	0.21
Zimbabwe	EU	Other food products	14	0.01	0.09	0.01
Zimbabwe	EU	Vegetables and fruits	7	0.01	0.13	0.02

Source: Author's calculations, reference-group weight aggregating method.

APPENDIX D: IMPACTS OF THE TRADE INTEGRATION SCENARIOS ON SSA COUNTRIES

Table D.1—Impacts on the agricultural exports volume ($ millions) of SSA countries

		Initial	Absolute change							
			Reg FTA	SSA FTA	DDA*	DFQF*	DDA+ DFQF*	DDA + Reg*	DFQF +Reg*	DDA+ DFQF+ Reg*
Botswana	Raw ag	70	0.10	0.09	-0.44	-0.05	-0.47	-0.35	0.05	-0.04
Botswana	Processed ag	63	1.09	1.72	-0.93	-0.13	-0.99	0.18	0.96	-1.71
Central Africa	Raw ag	855	-0.75	30.94	15.12	4.06	17.97	14.22	3.28	15.37
Central Africa	Processed ag	191	-0.29	12.18	2.33	14.16	6.52	2.08	13.88	-19.56
Ethiopia	Raw ag	437	-0.52	-1.51	-10.76	0.55	-10.03	-11.35	-0.03	-12.52
Ethiopia	Processed ag	95	-0.36	-0.68	-2.25	0.24	-2.10	-2.61	-0.13	-1.71
Madagascar	Raw ag	285	-0.05	0.92	-6.19	-0.19	-3.15	-6.30	-0.45	-10.16
Madagascar	Processed ag	290	0.75	2.34	14.38	10.58	13.73	14.80	11.40	-0.01
Malawi	Raw ag	336	43.49	48.70	53.34	208.73	180.06	104.59	278.15	48.32
Malawi	Processed ag	76	6.44	3.44	-4.40	-14.66	-14.50	1.79	-9.78	1.78
Mauritius	Raw ag	11	0.16	0.45	0.79	-0.06	0.72	0.95	0.09	1.22
Mauritius	Processed ag	843	-1.86	17.70	-22.18	3.36	-20.16	-23.83	1.55	-275.33
Mozambique	Raw ag	156	45.85	48.77	6.15	63.94	57.06	54.23	121.21	45.38
Mozambique	Processed ag	157	16.27	18.19	-0.08	4.96	4.33	15.89	20.98	9.37
Nigeria	Raw ag	413	12.09	18.90	19.23	1.32	19.39	28.77	13.35	14.91
Nigeria	Processed ag	146	10.46	16.99	7.08	0.64	7.64	17.51	11.20	17.74
Rest of Eastern Africa	Raw ag	2,046	42.00	95.37	56.02	338.61	241.10	97.29	379.84	-77.38
Rest of Eastern Africa	Processed ag	994	65.92	89.26	48.72	171.72	245.11	114.77	238.31	61.47
Rest of SACU	Raw ag	237	1.07	-1.28	9.99	0.97	10.38	10.83	2.14	5.72
Rest of SACU	Processed ag	1,104	48.71	108.70	31.06	7.82	35.81	74.99	57.05	93.79
Senegal	Raw ag	74	0.15	0.20	-0.09	0.92	0.66	0.03	1.14	-2.58
Senegal	Processed ag	402	5.36	13.67	6.01	45.79	39.09	11.29	50.08	-19.28
South Africa	Raw ag	2,708	73.50	78.85	66.86	9.35	73.64	139.48	84.38	-48.83
South Africa	Processed ag	3,488	167.17	392.28	49.29	8.04	56.50	218.08	178.28	210.31
South Central Africa	Raw ag	23	0.97	1.81	0.05	15.92	15.75	1.02	17.58	1.27
South Central Africa	Processed ag	62	2.72	15.01	1.65	43.28	19.94	4.36	47.38	11.44
Tanzania	Raw ag	535	20.26	36.28	4.87	112.57	107.61	25.30	130.37	22.38
Tanzania	Processed ag	375	52.06	60.45	9.48	229.18	226.38	61.41	269.28	40.42
Uganda	Raw ag	398	9.24	10.98	3.31	18.75	16.98	12.37	27.79	7.86
Uganda	Processed ag	217	12.74	24.78	5.32	28.65	10.66	17.96	40.51	22.29
Zambia	Raw ag	317	-3.55	-13.17	4.96	10.42	9.74	1.47	6.15	-18.60
Zambia	Processed ag	65	5.42	29.38	0.49	0.33	0.35	6.12	5.75	29.20
Zimbabwe	Raw ag	677	85.92	80.15	26.85	3.21	27.96	113.44	89.87	103.31
Zimbabwe	Processed ag	300	45.18	51.99	-2.86	0.75	-2.16	38.16	46.05	-41.42

Source: Author's calculations from the results of the MIRAGE model.

Table D.2—Impacts on tariff revenue, terms of trade and allocation efficiency

	Per cent change in total tariff revenue				Percent change in terms of trade				Percent change in allocation efficiency			
	Reg FTA	SSA FTA	DDA*	DFQF*	Reg FTA	SSA FTA	DDA*	DFQF*	Reg FTA	SSA FTA	DDA*	DFQF*
Botswana	-2.3	-0.6	-0.5	-0.1	-0.03	-0.38	0.87	-0.02	0.01	0.02	0.01	0.00
Central Africa	-0.1	-16.6	-2.2	0.2	-0.01	-0.39	-0.40	0.04	0.00	0.10	0.00	0.00
Ethiopia	0.0	0.0	0.0	0.0	-0.02	-0.06	-0.25	0.03	0.00	0.00	0.00	0.00
Madagascar	-0.4	-7.4	-3.5	0.7	-0.01	-0.10	-0.59	0.66	0.00	0.00	-0.05	0.01
Malawi	-49.3	-52.2	2.4	15.4	-1.56	-1.73	0.96	6.30	0.08	0.10	0.10	0.72
Mauritius	-0.3	-19.0	0.0	-0.1	0.00	-0.84	-0.13	-0.01	0.00	0.08	-0.03	-0.01
Mozambique	-54.5	-55.1	0.4	1.8	-0.87	-1.02	0.06	0.67	0.09	0.09	0.00	0.05
Nigeria	-7.0	-13.2	-8.5	-0.1	-0.25	-0.43	-0.53	-0.05	0.14	0.23	0.45	-0.01
Rest of Eastern Africa	-3.3	-11.6	-1.5	4.1	-0.05	-0.57	0.06	1.47	0.02	0.02	0.07	0.17
Rest of SACU	-1.3	-1.1	-4.3	-0.6	0.27	0.34	-0.36	-0.05	0.06	0.09	-0.09	-0.02
Rest of Western Africa	-4.0	-8.5	0.3	0.6	0.87	0.69	-0.08	0.23	0.08	0.08	0.00	0.03
Senegal	-1.6	-4.2	0.3	5.4	0.30	0.35	0.23	2.60	0.02	0.03	0.00	0.16
South Africa	0.9	3.1	-6.0	0.1	0.31	0.98	-0.09	0.01	0.05	0.14	0.08	0.00
South Central Africa	-9.8	-11.6	-0.3	0.7	-0.22	-0.33	-0.37	0.27	-0.04	0.05	-0.05	0.04
Tanzania	-6.1	-26.3	1.0	7.0	0.68	0.15	0.22	3.41	0.06	0.06	0.02	0.12
Uganda	-7.4	-21.3	0.9	3.8	0.29	0.45	0.33	1.48	-0.01	0.05	0.01	0.05
Zambia	-62.2	-62.7	0.2	2.1	-1.94	-1.26	-0.04	0.55	0.60	0.70	-0.03	0.06
Zimbabwe	-68.8	-68.8	-2.2	0.5	-2.50	-2.63	0.22	0.05	0.75	0.77	0.10	0.03
Sub-Saharan Africa	-2.1%	-3.9%	-1.1%	0.4%	0.06	0.13	-0.16	0.26				

Source: Author's calculations from the results of the MIRAGE model.

APPENDIX E: TREATMENT OF SOME DATA ISSUES IN GTAP 7

As already documented by David Laborde[16] and other contributors of the GTAP network, there are several issues in the GTAP 7 database that if combined can lead to a strong overestimation of gains from trade liberalization. Following is a description of those issues, an explanation of the way they are treated in this study suggested by David Laborde and an example of the extent to which they can affect the results of trade liberalization scenarios. A reference to this issue is the forthcoming Bouët and Laborde (2011).

Starting from the GTAP 6 database, travelers' expenditures were added to merchandise trade flows by sector instead of being attributed to a tourism sector. For instance, it means that the consumption by Asian tourists and temporary workers in Africa is accounted in the GTAP 7 database as exports of goods from Africa to Asia. These virtual trade flows increase the bilateral trade flows on which tariff barriers are applied. Thus by comparing trade databases, we can see that the trade flows from some African countries (mainly eastern Africa, Tanzania, Senegal, and Madagascar) to some Asian countries (mainly Japan, China, and India) of goods in GTAP 7 are higher than in other trade databases such as COMTRADE.

Since by default tariff barriers are applied to the overall trade flows, if those tariffs are reduced following liberalization, such as in the DFQF scenario (and to some smaller extent the DDA scenario), those virtual export flows will also expand. The extent to which they will expand is linked to the height of the initial tariff applied, the importance of the demand for the good in the importing country, and the supply capacity of the exporting country.

If initially the sectors were protected by prohibitive tariffs and the demand in importing countries is high, such as rice in Japan, then this export market becomes attractive to countries that were already exporting despite the high tariff (Senegal Tanzania, Madagascar, and Rest of Eastern Africa, for instance), and those countries are considered competitive in exporting there. In the end, the extent to which those countries will increase their rice exports to Japan will depend on their supply capacity. As in MIRAGE, land is perfectly substitutable among agricultural sectors, and we will observe a shift in agricultural production toward rice in those countries (which is not realistic since rice should be irrigated in Africa). But if additionally in the country-level input/output data of GTAP 7 rice production requires low quantity of production factors and intermediate inputs, then the supply increases disproportionally: It is specifically so for Senegal, where imported wheat is the main intermediate input of processed rice (16 percent of intermediate consumption and only 12 percent of paddy rice), and Tanzania, where processed rice is exclusively made of paddy rice (which does not require a lot of land) and almost no factor of production. Those discrepancies are common in developing countries' input/output tables in GTAP 7 and stem partly from bad contributed tables and partly from error in the sectoral repartition of intermediate consumption and factor uses.

In this paper, the treatment applied was to consider all trade flows from SSA countries to Asian countries in paddy rice, processed rice, and raw milk as virtual flows that should not be liberalized in the multilateral scenario. The impacts on real income by countries are shown in Table E.1.

[16] See https://www.gtap.agecon.purdue.edu/databases/v7/v7_data_issues.asp.

Table E.1——Impacts on real income ($ millions)

	Initial Real Income	Absolute change								
		DDA	DDA*	DDA* /DDA	DFQF	DFQF*	DFQF* /DFQF	DDA+ DFQF*	DDA+ DFQF	DDA+DFQF* /DDA+DFQF
EU	10,593,543	13,794	13,795	100%	-294	-125	42%	13,541	13,712	101%
U.S.A.	10,037,684	4,719	4,720	100%	185	175	94%	4,762	4,754	100%
Japan	3,445,072	10,919	10,890	100%	1,963	69	4%	12,113	10,948	90%
Rest of the world	3,228,432	3,585	3,585	100%	-23	8	-33%	3,571	3,604	101%
Rest of Latin America	1,204,656	-544	-544	100%	-60	-31	52%	-583	-552	95%
Asian Tiger	893,668	597	596	100%	71	3	4%	615	562	91%
China	892,423	-1,007	-1,007	100%	-85	-105	125%	-1,060	-1,072	101%
Rest of Asia	579,493	563	564	100%	538	491	91%	857	834	97%
India	509,224	11	11	102%	-50	-61	122%	-19	-23	123%
Brazil	461,614	7	7	100%	-22	-41	192%	3	-15	-594%
North Africa	202,237	-558	-558	100%	15	-1	-5%	-547	-559	102%
South Africa	173,614	91	91	100%	60	8	14%	146	98	67%
Rest of Western Africa	50,051	-5	-6	105%	73	40	55%	60	32	53%
Rest of Eastern Africa	45,921	25	25	100%	239	193	81%	209	169	81%
Nigeria	38,263	141	141	100%	-11	-15	139%	132	128	97%
Central Africa	24,338	-49	-49	100%	2	5	302%	-48	-44	93%
South Central Africa	19,620	-52	-52	100%	32	34	106%	-22	-20	93%
Tanzania	10,624	11	10	94%	1,729	58	3%	1,671	65	4%
Senegal	7,783	7	7	99%	459	51	11%	429	53	12%
Ethiopia	7,417	2	2	100%	0.1	-0.1	-157%	3	2	93%
Uganda	6,086	5	5	100%	37	20	53%	34	19	55%
Rest of SACU	6,038	-25	-25	100%	1	-3	-481%	-21	-25	118%
Botswana	6,000	24	24	100%	-1	-0.4	28%	23	23	104%
Mozambique	5,165	2	2	100%	15	15	99%	14	14	99%
Mauritius	4,691	-7	-7	100%	3	-1	-28%	-3	-7	195%
Zambia	4,428	-2	-2	100%	14	11	78%	11	8	72%
Zimbabwe	3,452	-3	-3	100%	8	2	24%	3	-2	-73%
Madagascar	3,375	-12	-12	103%	79	12	15%	61	-1	-2%
Malawi	1,958	-7	-7	100%	30	32	107%	19	21	110%
World	32,466,867	32,233	32,203	100%	5,009	843	17%	35,974	32,726	91%

Source: Author's calculations from the results of the MIRAGE model.
Note: The symbol "*" indicates scenarios with the treatment of virtual flows.

We can see that this does not change the results from DDA much, but that it does reduce the world gains from DFQF by 83 percent. Indeed, most of the gains from untreated DFQF are driven by Tanzania (39 percent), Japan (35 percent), Rest of Asia (11 percent), and Senegal (9 percent), which are reduced respectively by 97 percent, 96 percent, 9 percent, and 89 percent by the treatment. In the DFQF* simulation, most of the gains are then driven by Rest of Asia, in which most of Asian LDCs are aggregated, and in Africa by Rest of Eastern Africa.

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