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This paper is from the
GTAP Annual Conference on Global Economic Analysis
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Trade policies and development in Africa: The Doha Development Agenda, the EU EPAs and ECOWAS

A paper submitted for the Eleventh Annual Conference "Future of Global Economy"

Helsinki, Finland

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Abstract

This paper uses applied general equilibrium modelling under GTAP with the standard closure assumptions and labour market modifications to examine the likely outcome of two trade policy scenarios EPA and DDA and a third policy option-technological change in the ECOWAS region of Sub Saharan Africa. Simulation results show that with the exception of the EU and Ghana, the rest of ECOWAS suffers GDP and welfare losses arising mainly from adverse terms of trade effects of the EPAs. The DDA equally makes the ECOWAS region worse off in terms of GDP and welfare. We notice however that the ECOWAS gains substantially from improvements in technology, with the gains being bigger when technological changes have spillover effects. We therefore conclude that the ECOWAS would benefit more from trade policies aimed at shifting the technological base.

JEL codes: F15, D61, O3

Key words: applied general equilibrium, trade, development, welfare, technology, ECOWAS

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I. Introduction

African countries have hardly made an impact on world trade and African economies may also not be reaping a lot from trade. Yet Africa since the early 1950s has been involved in a multiplicity of trade agreements which have sought to improve the trade and economic positions of African economies. The Doha Development Agenda (DDA) is a consequence of World Trade Organization (WTO) attempts to ensure fair trade and development concerns of developing countries and aims to further open global trade across a broad front. The stalling of the talks in the Doha Round of the WTO in Geneva has however led to questions on the viability of such initiatives for developing countries, especially Africa. The Doha Rounds have sought to work around issues that address the concerns of the developing countries in the area of market access and effective participation in the international trade, as well as approach trade in a development biased manner. These have been aimed at helping address trade and development concerns of developing countries especially African economies. An important observation made by the (Stiglitz, 2000; Rodrik, 2001), is that developing countries often misunderstood commitments resulting from the Uruguay Round. In addition the lack of institutional and technical capacity hampered effective implementation.

African countries represented by the African Caribbean Pacific group (ACP) has hitherto conducted international trade under a series of arrangements with the latest being the Cotonou Partnership Agreement (CPA). With the expiry of the Cotonou Partnership Agreement (CPA) there is a newly proposed Economic Partnership Agreements (EPA) for the African Caribbean and Pacific (ACP) countries. The new partnership is supposed to create trade rather than divert trade. However it is not very clear if this new partnership will make Africa better off or worse off. Arguments and analysis-both theoretical and empirical-do not show convincing welfare benefits for African economies. A number of studies have examined the impact of EPAs on African economies and come out with conclusions showing that Africa could be a net loser especially in terms of tariff revenue loss. Tariff revenue forms an average of 7 to 10 percent of government revenue in sub-Saharan Africa.

In 2001, revenue from import duties as a proportion of total tax revenue was as much as 54.7% for Swaziland, 53.5% for Madagascar, 50.3% for Uganda and 49.8% for Sierra Leone (World Bank WDI 2003).How does Africa lose out here? Tariff removals accompanying the EPA will result in an erosion of these revenues and heavy losses in tariff revenue, a critical revenue source for SSA economies. A study by EUROSTEP (2004) indicated that Cameroon and Ghana will lose close to 30 percent and 20 percent respectively in government revenue from the EPA. Tekere and Ndlela (2003) also conclude on similar loses for the SADC region. Karingi et. al (2005) also show consistent revenue losses in sub-Saharan Africa (SSA) with Nigeria and Ghana being the major loses in ECOWAS, Cameroon being the largest loser in CEMAC and Angola being the largest loser in the SADC (excluding South Africa).

Hinkle and Schiff, 2004 also show that EPAs offer considerable potential benefits to Sub-Sahara African (SSA) countries, but they also pose a number of policy, administrative, and institutional challenges. Some of these challenges include replacing forgone tariff revenues, avoiding serious trade diversion, appropriately regulating liberalised service industries, and liberalising internal trade. It is also argued that African economies are saddled with institutional and capacity bottlenecks which if improved can enhance Africa's trade and development agenda. A related issue to the above is production or export capacity. African production capacity is still well below average world standards, implying that even if there was free access to the export market, production will not increase immediately. Thus what is needed immediately is an increase in capacity through technological development and input efficiency in production. Indeed the proposal by the EPAs to help increase the capacity of African export production by itself shows that in order for Africa to benefit immensely from the EPAs capacity must be improved. Technological changes have an impact on production and consumption and could also lead to changes in prices, production and consumption in related markets Frisvold (1997). Such technological changes would reduce productive and its associated institutional bottlenecks, increase capacity and productivity and thereby increase export volumes of the ECOWAS. Invariably an increased production and trade should translate into higher

incomes, employment and increased welfare. In our view this important area is what has been ignored in the empirics of trade and development in sub-Saharan Africa.

This paper examines the likely outcome of two trade policy scenarios in the ECOWAS region of Sub-Saharan Africa and the possible outcomes of an alternative policy option which influences the institutional sectors of these countries. It first explores the effects of the Doha Development Agenda on the ECOWAS economies (with representation in the GTAP data base). In addition the paper explores the effect of the EU's EPAs being signed between the EU and African economies on these economies. The paper also examines the possible impact of policies aimed at improving the institutional sectors of these economies through technological change. The paper uses GTAP simulations with the standard closure assumptions and where applicable modifications such as labour market closures for unskilled labour market assumptions.

The rest of the paper is organized as follows: the next section briefly discusses trade and economic structure of the ECOWAS region, section III gives an overview of trade related CGE modelling studies. The methodology applied in this paper is presented in section IV, simulations and results are discussed in section V and conclusions drawn in section VI

II. Trade and economic structure of ECOWAS

The ECOWAS is comprised of 16 countries, which include: Benin, Burkina Faso, Cape Verde, Cote d'Ívoire, The Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, and Togo. Total weighted GDP (Table 1) for the ECOWAS amounted to USD 139.3 billion in 2005. Total regional exports, including intra-regional exports, amounted to $68.4 billion in 2005, and ECOWAS registered a trade surplus of $17.5 billion in 2005. The region's major export commodities are energy products (crude oil and refined petroleum products), minerals (gold, diamonds, and bauxite) and agricultural products (cocoa, coffee, groundnuts, and cotton). Economic activity is led by three main economies, Nigeria with a GDP of USD 78 billion in 2005, Cote d'Ivoire-GDP USD16.3 billion, Ghana GDP USD10.2 billion and Senegal USD8.1 billion.

Data from the GTAP Version 6.2 (Table 2) show that exports in the ECOWAS stood at US$ 28267 million with Nigeria's exports making up about 60% and Ghana 10% of total ECOWAS exports. In terms of the composition of exports, exports is largely biased towards the minerals and extractive sectors-53%, agriculture-grains and crops exports constitute 11.5% and heavy manufacturing 9.3%. As expected Nigeria dominates the extractive sector of the region constituting 93% of extraction exports in the ECOWAS. Ghana also contributes 12% of grains and crop exports, 20% of transport and communications sector, 20% of heavy manufacturing sector and 13% of light manufacturing sector.

Economic activity in ECOWAS economies is hardly diversified and dominated largely by primary products: mining, agriculture, fishing and animal husbandry with the share of manufacturing being very weak. A substantial portion of ECOWAS trade-exports and imports is with the European Union, the United States and other Asian economies are however increasingly becoming involved in trade with ECOWAS. The ECOWAS region is therefore highly vulnerable to exogenous shocks such as world price fluctuations, climate and changing world trade arrangements. The ECOWAS region is yet to benefit from global trade despite efforts to integrate into the world economy. Its share in world trade remains insignificant, for instance the EU-West Africa trade flows accounted for just 1.25% of EU exports and 1.03% of EU imports in 2004.

III. Overview of trade related CGE modelling

A number of studies have used CGE modelling in determining the impact of trade negotiations on various economies including those of Africa and have concluded on various issues for Africa. Achterbosch et al (2004) find that under full liberalization of global trade Sub-Saharan Africa gains about 0.3 percent of GDP. However under modest reforms, such as the Doha round, Sub-Saharan Africa losses about 2 percent of GDP, and suffers adverse terms of trade effects. Studies have also documented very large gains for liberalization of trade in services (Brown, Deardoff and Stern, 2001;

World Bank, 2001). These large gains have been attributed to two basic reasons. First, services make up a large proportion of consumption in most middle and high-income countries and second, services are major inputs in the production of manufactures. Hence, any trade-related reduction in the prices of services will translate into a widespread productivity gain for liberalizing economies.

Bouet et al (2004) have however also shown based on a CGE model that incorporates preference erosion, variable employment and binding overhang, that recent results of applied general equilibrium model simulations have overestimated welfare gains from trade liberalization under Doha for developing countries. Using GTAP framework Perez and Karinga (2006) estimate a welfare loss of $0.6 billion and fiscal losses from a fully implemented EPA for Africa. They also estimate trade diversion away from intra-African trade, a salient feature of the EPAs. Ackerman (2005) also shows that the gains from Doha are reducing and biased towards the developed countries rather than poverty alleviation in the developing world. Others, Fang et al. (2006) and Kwa (2006) also arrive at similar conclusions on the impact of trade liberalisation on food security and welfare on SSA. A study by McDonald and Walmsley (2003) reveals that free trade arrangements between EU and South Africa results in gains for the EU and South Africa through allocative efficiency however the rest of Sub-Saharan Africa loses largely in terms of allocative efficiency, employment and terms of trade. Kirkpatrick et al (2006) in a study that also examined the impact of the Doha Development Agenda, show that the economic impact of the DDA is likely to be modest and smaller than earlier predicted. Dynamic effects of the DDA show that poverty may deteriorate in SSA due to trade liberalisation losses and severe supply constraints in Africa. Indeed they argue that there is need for additional aid related policies like aid for trade' (specific trade -related capacity-building measures) if the DDA is to be a 'development round'.

IV. GTAP Methodology

The model used in the simulation is the standard static GTAP model[2], with perfect competition in all sectors and constant returns to scale. Regional production is generated by a constant return to scale technology in a perfectly competitive environment, and the private demand system is represented by a non-homothetic demand system (a Constant Difference Elasticity function). The foreign trade structure is characterised by the Armington (1969) assumption implying imperfect substitutability between domestic and foreign goods.

The macroeconomic closure is a neoclassical closure where investments are endogenous and adjust to accommodate any changes in savings. This approach is adopted at the global level, and investments are then allocated across regions so that all expected regional rates of return change by the same percentage. Although global investments and savings must be equal, this does not apply at the regional level, where the trade balance is endogenously determined as the difference between regional savings and regional investments. This is valid as the regional savings enter the regional utility function. The quantity of endowments (land, skilled labour and natural resources) in each region is fixed exogenously within the GTAP model.

The standard closure rules for the GTAP model were adjusted to more accurately reflect the labour markets of the African economies. There is typically an excess supply of unskilled labour in the ECOWAS and this can be tapped into by industries in the event of increased production. Thus the full employment assumption in the traditional GTAP was relaxed and the real wage rate fixed exogenously with the supply of labour endogenised to take account of the effect on unemployment.

Following Frisvold (1997), our general equilibrium approach to modelling technological changes has appealing advantages. It avoids the problem of underestimating or overestimating welfare, the constant elasticity of transformation (CET) specification of technology is appropriate as a measure of

[2] For a description of the GTAP model see Hertel (1997).

gains to production from technological advancement. A general equilibrium approach also helps examine the impact of technological changes on rewards to factor products. As discussed earlier, technological changes have implications for both production and consumption and ultimately welfare. In addition such changes in the innovation economy can have effects on prices, production and consumption in another market. More importantly new technology can be adopted by neighbouring-other countries thus introducing spillover benefits. As explained by Frisvold (1997) and Davis (1991) such spillover benefits can be substantial. In the experiment, the structure of the model is kept simple, so that trade and other policy arrangements gains and losses emerging from simulation analysis are easy to interpret, being associated with changes in GDP and welfare.

The GTAP 5 data base is updated using GTAPAgg which uses GTAPAgAfr6 an updated GTAP with more African regions which contains 40 regions and 57 sectors. To keep the model within computational limits we have aggregated these to 10 regions and 10 sectors. These 10 regions are North America, Nigeria and the EU (25 members), Ghana, Nigeria, Rest of ECOWAS (including WAEMU) CAEMC, COMESA, SADC, COMESADC and Rest of the World.

V. Simulations and Results

The first simulation examines the impact of an EPA which involves complete tariff elimination between the EU and ECOWAS.

In the second simulation an EPA with the ECOWAS granting 75% tariff reduction on all EU imports whilst the EU reduces tariffs on ECOWAS imports to zero is examined.

The third simulation examines the impact of the Doha Development Agenda for the ECOWAS region. This assumes 100% reduction of tariffs on imports from Sub-Saharan Africa to North America and the EU and an 80% reduction in tariffs on all imports from North America and the EU to Sub-Saharan Africa.

The final set of simulations is that of a technological change of 5% in the ECOWAS region. Four experiments are carried out under technological simulation. The first experiment examines the impact of an increase in output augmentation parameter ao for economies in the ECOWAS region simultaneously. The second experiment-falling behind technology Frisvold(1997) looks at technology change without spillovers given that Ghana and Nigeria are the most dominant economies in the region the 5% technology shock is first applied to only Ghana, and then later to only Nigeria to examine how the rest of the ECOWAS region responds. Finally the last experiment assumes technological spillovers between only Nigeria and Ghana and examines how the rest of the sub region fares.

5.1 EPA with complete tariff elimination

An EPA with complete tariff elimination (Table 3) between the EU and ECOWAS results in a marginal increase in GDP to the region as a whole. Nigeria the biggest economy in the region suffers a 0.56 decline in GDP growth; however Ghana gains 1.85% growth in GDP. Note that this is the effect of zero tariffs between the EU and ECOWAS. The rest of the sub region and Nigeria suffer welfare losses from the EPAs. Welfare loses (Table 4) to the rest of ECOWAS amount to US$216.3 million and US$347.7 million for Nigeria. The only gainers of the EPAs to the sub region are Ghana and the EU itself. Ghana gains US$ 45 million whilst the EU gains a substantial US$ 1142.46 million. The welfare loses for the rest of the ECOWAS region are driven mainly by terms of trade losses and the investment savings (change in the cost of capital exports to imports) effect. In the case of Nigeria, welfare losses are driven largely by a reduction in allocative efficiency and adverse terms of trade effects. Ghana's welfare gains appear to be driven largely by efficient utilization of resources (allocative efficiency) and endowment gains from utilizing unemployed factors of production. Contrary to the trend in all other economies, the EU gains in allocative efficiency, terms of trade effects and investment savings effect. The terms of trade effect appears to be the biggest driver of the EU's welfare gains. Thus it appears the EPAs will help the EU enjoy from favourable terms of trade even though tariffs will be reduced. A further decomposition of the terms of trade effect (Table 5)

shows that the rest of ECOWAS and Nigeria loss out in all three sub components of the terms of trade effect; namely: world price effect, export price effect and import price effect. Ghana and the EU only lose out in the import price effect, with Ghana losing more US$ 0.41million than the EU US$ 0.009 million.

5.2 EPA with complete moderate tariff cuts

The second simulation is based on a moderate EPA with the ECOWAS granting 75% tariff reduction on all EU imports whilst the EU reduces tariffs on ECOWAS imports to zero. Results for the GDP changes are shown in Table 6. The GDP effects are not too different from the complete tariff elimination case. GDP losses are however reduced in Nigeria to 0.15 slow down in GDP and an increase in GDP for the rest of the ECOWAS region by 0.11%, with Ghana still recording a positive GDP growth of 1.79%. Similar to the complete tariff elimination scenario welfare effects (Table 7) of the moderate EPA simulations also show welfare losses to the rest of ECOWAS to the tune of US$ 55.5 million, and US$ 81.5 million for Nigeria. Ghana and the EU again gain US$ 78.38 million and 640.81 million respectively. Again welfare losses and gains are driven primarily by allocative efficiency, terms of trade effects and investment savings effect. Further decomposition of the terms of trade effect shown in Table 8 reveals that the rest of ECOWAS suffers from adverse world price and export price effects, whilst Nigeria suffers from all three price effects. Ghana is the only partner that gains on all three price effects.

5.3 Doha Development Agenda

We next examine the impact of the Doha Development Agenda for the ECOWAS region to determine if the effects would differ significantly from that of the EPAs. In this simulation we assume 100% reduction of tariffs on imports from Sub-Saharan Africa to North America and the EU and an 80% reduction in tariffs on all imports from North America and the EU to Sub-Saharan Africa. Interestingly the results (Tables 9, 10 11) again do not differ too widely from the EPA effects. The trends in GDP growth rates follow that of the moderate EPAs. Whilst welfare losses are reduced as compared to the EPA scenarios they are still significant for the rest of ECOWAS US$ 84.6million and

US$ 96million for Nigeria. Ghana and the EU again gain to the tune of US$ 65.54million and US$ 593.6million respectively. Welfare losses in the rest of ECOWAS come from terms of trade effects and investment savings effect. Nigeria's welfare losses are driven mainly by losses in terms of trade and allocative efficiency. Other gainers are the CAEMC-US$ 84.2 million and COMESADC-US$ 689.7 million

5.4 Technological change

Our last set of simulation exercises are based on an assumption that growth, development welfare improvement in Sub-Saharan Africa is driven by institutional changes and growth augmented by technological improvements. Hence we shock the technological parameter by 5% to examine the impacts. Results from technological shock which allows for spillovers within the ECOWAS are shown in Table 12. GDP increases substantially in the ECOWAS sub region with Ghana witnessing the highest growth rate of 13.27%. Nigeria and the rest of the ECOWAS gain 9.48% and 9.98% respectively in GPD growth. A technological change induces substantial welfare gains (Table 13) for the ECOWAS region as well. Welfare gains are higher in Nigeria-US$ 3933.5 million and US$ 2959.8 million for the rest of the sub region. Most importantly allocative efficiency drives welfare changes. In addition the endowment effects show the increased and efficient utilization of unemployed factors of production-in this case unskilled labour. This is further evidenced in the table on returns to factors of production in Table 14. Returns to unskilled labour in the ECOWAS region are greater than that of all other factors of production. Returns to unskilled labour is highest in Nigeria US$ 474.

We next assume technological shocks without spillovers. First we run simulations with shocks to only Ghana, and then subsequently shocks to only Nigeria and finally joint shocks to Ghana and Nigeria without spillovers to the rest of ECOWAS (Tables 15 to 20). A technological shock to Ghana alone induces growth in GDP but reduces welfare in Nigeria. Subsequent technology simulations produce growth in GDP and welfare gains in the ECOWAS region with no losers. However GDP growth and welfare gains are marginal when compared to technological shocks with spillovers. On the whole, it

appears that in terms of growth and welfare, the ECOWAS region would benefit significantly and much more from a 5% technological improvement than the EPA and DDA trade arrangements.

VI. Conclusion

This paper uses GTAP's applied general equilibrium model to examine the impact of EPAs; DDA on growth and welfare in ECOWAS in Africa. It also examines the effect of a technological change in ECOWAS to examine whether technology developments are more important in driving growth and welfare. The results show that an EPA arrangement with a complete tariff reduction results in welfare losses to Nigeria- US$347.7 million and the rest of ECOWAS S$216.3 with gains only to Ghana and the EU. An EPA with moderate tariff cuts also yields losses to the rest of ECOWAS to the tune of US$ 55.5 million, and US$ 81.5 million for Nigeria. In all the welfare loses for the rest of the ECOWAS region are driven mainly by terms of trade losses-world price effect, export price effect and import price effect-and the investment savings (change in the cost of capital exports to imports) effect. Ghana's welfare gains appear to be driven largely by efficient utilization of resources (allocative efficiency) and endowment gains from utilizing unemployed factors of production. The terms of trade effect appears to be the biggest driver of the EU's welfare gains.

Simulations based on the Doha Development Agenda for the ECOWAS region show effects that do not vary widely from the EPA effects. The trends in GDP growth rates follow that of the moderate EPAs. There are still welfare losses of US$ 84.6million to the rest of ECOWAS and US$ 96million for Nigeria. Ghana and the EU again gain to the tune of US$ 65.54million and US$ 593.6million respectively. It therefore appears that in terms of GDP and welfare gains, the EPAs and the DDA arrangements may be beneficial only to the EU and Ghana. Other economies within the ECOWAS region stand to lose out on such arrangements. Without going further to examine sectoral effects of the EPAs and DDA, it is clear from decomposing the welfare impacts that the arrangements as they stand have adverse terms of trade effects which divert trade rather than create trade. More so these adverse effects are strong enough to override any favourable gains to be made from these

arrangements. Unlike the EU economies, the economies in the ECOWAS are not able to take advantage of the EPAs and other trade and development agendas like the DDA.

Finally as an alternative or advice to the EPA, DDA or any other trade related development policy, we propose a policy that aims mostly at increasing the output augmenting base of economies in the ECOWAS region and or other parts of sub-Saharan Africa. We therefore run simulations which increase technology by 5% in the ECOWAS. A technological change induces substantial welfare gains for the ECOWAS region. Welfare gains are higher in Nigeria-US$ 3933.5 million and US$ 2959.8 million for the rest of the sub region. An important issue here is the fact that welfare changes are driven to a significant extent by allocative efficiency. Thus there is improved efficiency in utilization of resources in production. In addition the endowment effects show an increased and efficient utilization of unemployed factors of production in the ECOWAS region. Indeed returns to unskilled labour in the ECOWAS are greater than that of all other factors of production. Note here that there is substantial supply of labour (unemployment) especially unskilled labour in the sub region. On the whole, it appears that in terms of growth and welfare, the ECOWAS region would benefit significantly and much more from a 5% technological improvement than the EPA and DDA trade arrangements. Therefore in addition to the need for fair trade and elimination of tariffs and subsidies in global development, in the case of a trade and development agenda for less developed economies it may be more prudent for trade and development arrangements to aim largely at helping increase technological base rather than just focusing on tariff arrangements.

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Tables

Table 1 Economic growth ECOWAS 2005

Country	Gross Domestic Product 2005 (Billions of U.S. $)	Real GDP Growth Rate,
Benin	$4.3	4.8
Burkina Faso	$5.2	3.5
Cape Verde	$1.1	5.9
Cote d'Ivoire	$16.3	1.1
Gambia	$0.5	4.5
Ghana	$10.2	5.7
Guinea	$3.0	3
Guinea-Bissau	$0.3	2.3
Liberia	$0.5	7.5
Mali	$5.3	5.8
Niger	$3.3	3.5
Nigeria	$78.0	5.9
Senegal	$8.1	5.8
Sierra Leone	$1.1	6.9
Togo	$2.1	2.8
Regional Total/Weighted Average	$139.3	5

Source: Global Insight

Table 2 Value of Merchandised Exports FOB

VXMD	Ghana			Nigeria			RECOWAS		ECOWAS	
Commodities	USD millions	%	%ECOWAS	USD millions	%	%ECOWAS	USD millions	%	USD millions	%
Grains & Crops	394.82	0.20	0.12	271.39	0.02	0.08	2577.43	0.25	3243.64	0.11
Livestock & Meat	8.86	0.00	0.08	9.05	0.00	0.09	88.07	0.01	105.98	0.00
Extraction	80.03	0.04	0.01	14100.91	0.88	0.93	924.56	0.09	15105.50	0.53
Processed Food	244.73	0.12	0.17	154.38	0.01	0.10	1077.92	0.11	1477.04	0.05
Textiles & Cloth	16.57	0.01	0.09	23.58	0.00	0.13	145.74	0.01	185.88	0.01
Light Manufacture	283.23	0.14	0.13	184.82	0.01	0.09	1703.27	0.17	2171.32	0.08
Heavy Manufacture	512.04	0.26	0.20	221.75	0.01	0.08	1884.46	0.18	2618.24	0.09
Utilities & Construction	31.43	0.02	0.08	199.92	0.01	0.54	141.58	0.01	372.93	0.01
Transport & Comm.	274.82	0.14	0.20	330.25	0.02	0.24	779.53	0.08	1384.61	0.05
Other Services	117.03	0.06	0.07	606.04	0.04	0.38	879.10	0.09	1602.17	0.06
Total	1963.57	1.00	0.07	16102.10	1.00	0.57	10201.65	1.00	28267.33	1.00

Source: authors' computation from GTAP Data base

Table 3 GDP Effects-Complete tariff reduction EPA

Region	Simulated GDP change
North America	0
EU_25	0
Ghana	1.85
Nigeria	-0.56
Rest ECOWAS	0
CAEMC	-0.01
COMESA	0
SADC	0
COMESADC	0
Rest of World	0

Source: authors' computation from GTAP simulations

Table 4 Welfare effects of EPA complete tariff cuts

Region	Allocative Efficiency	Endowment Effect	Terms of trade effect	Investment Savings effect	Total Welfare
North America	-38.606	0	-53.004	-39.385	-130.995
EU	121.873	0	1012.803	7.789	1142.466
Ghana	64.084	33.542	-10.804	-41.777	45.045
Nigeria	-280.887	50.937	-184.111	66.334	-347.728
Rest ECOWAS	0.641	0	-104.332	-112.662	-216.353
CAEMC	-1.245	0	-5.007	0.876	-5.376
COMESA	-0.475	0	-1.796	-0.821	-3.091

SADC	-5.296	0	-26.613	5.512	-26.397
COMESADC	0.315	0	-3.086	0.179	-2.592
Rest of World	-78.889	0	-628.573	114.854	-592.608
Total	-218.487	84.479	-4.523	0.901	-137.63

Source: authors' computation from GTAP simulations

Table 5 Terms of Trade Decomposition of EPA complete tariff cut

Terms of trade components	North America	EU	Ghana	Nigeria	Rest ECOWAS	CAEMC	COMESA	SADC	COMESADC	Rest of World	Total
world price	0.002	0.002	0.003	-0.058	-0.001	-0.044	-0.006	-0.002	-0.021	-0.003	-0.127
export price	-0.019	0.043	0.164	-0.558	-0.196	-0.028	-0.028	-0.068	-0.015	-0.027	-0.733
import price	0.01	-0.009	-0.41	-0.519	-0.495	0.01	0.01	0.02	0.017	0.009	-1.356
Total	-0.007	0.036	-0.244	-1.135	-0.691	-0.062	-0.023	-0.05	-0.02	-0.02	-2.216

Source: authors' computation from GTAP simulations

Table 6 GDP effect of moderate EPA

Region	Simulated GDP change
North America	0
EU	0
Ghana	1.79
Nigeria	-0.15
Rest ECOWAS	0.11
CAEMC	0
COMESA	0
SADC	0
COMESADC	0
Rest of World	0

Source: authors' computation from GTAP simulations

Table 7 Welfare effect of moderate EPA

Region	Allocative Efficiency	Endowment Effect	Terms of trade effect	Investment Savings effect	Allocative Efficiency	Total Welfare
North America	-28.033	0	-51.793	-26.39	0	-106.217
EU	22.513	0	614.145	4.159	0	640.818
Ghana	68.074	26.62	9.165	-25.475	0	78.384
Nigeria	-106.279	45.652	-68.039	47.11	0	-81.556
Rest ECOWAS	34.418	0	-9.029	-80.929	0	-55.54
CAEMC	-0.968	0	-3.601	0.643	0	-3.926

COMESA	-0.41	0	-1.663	-0.627	0	-2.7
SADC	-4.213	0	-20.909	4.058	0	-21.064
COMESADC	0.24	0	-2.276	0.124	0	-1.912
Rest of World	-62.168	0	-467.213	77.701	0	-451.68
Total	-76.826	72.272	-1.212	0.372	0	-5.394

Source: authors' computation from GTAP simulations

Table 8 Terms of Trade decomposition of moderate EPA

Terms of trade components	North America	EU	Ghana	Nigeria	Rest ECOWAS	CAEMC	COMESA	SADC	COMESADC	Rest of World	Total
world price	0.001	0.002	0.001	-0.038	-0.003	-0.028	-0.006	-0.002	-0.015	-0.002	-0.089
export price	-0.013	0.029	0.346	-0.365	-0.107	-0.021	-0.019	-0.05	-0.009	-0.019	-0.228
import price	0.007	-0.009	0.049	-0.006	0.016	0.004	0.005	0.012	0.01	0.005	0.093
Total price	-0.006	0.022	0.396	-0.409	-0.093	-0.045	-0.02	-0.04	-0.015	-0.015	-0.224

Source: authors' computation from GTAP simulations

Table 9 GDP effects of DDA

Region	Simulated GDP change
North America	0
EU	0.01
Ghana	1.9
Nigeria	-0.18
Rest ECOWAS	0.13
CAEMC	0.21
COMESA	0
SADC	-0.01
COMESADC	0.09
Rest of World	0

Source: authors' computation from GTAP simulations

Table 10 Welfare Effects of DDA

Region	Allocative Efficiency	Endowment Effect	Terms of trade effect	Investment Savings effect	Total Welfare
North America	17.752	0	5.584	-37.425	-14.089
EU	475.738	0	127.861	-9.931	593.668
Ghana	75.649	24.665	0.171	-34.945	65.54
Nigeria	-122.935	47.497	-77.143	56.566	-96.015
Rest ECOWAS	39.246	0	-24.502	-99.411	-84.667
CAEMC	42.882	0	-5.539	46.94	84.283
COMESA	-0.173	0	-6.542	-1.333	-8.048
SADC	-11.864	0	-36.298	2.648	-45.514
COMESADC	34.218	0	663.157	-7.67	689.705

Rest of World	-126.532	0	-663.418	85.369	-704.581

Source: authors' computation from GTAP simulations

Table 11 Terms of Trade Decomposition of DDA

Terms of Trade Components	North America	EU	Ghana	Nigeria	Rest ECOWAS	CAEMC	COMESA	SADC	COMESADC	Rest of World	Total
world price	0.001	0	0.01	-0.015	0.014	-0.005	0.01	0.001	0.005	-0.001	0.02
export price	-0.008	0.016	-0.089	-0.452	-0.307	-0.052	-0.057	-0.034	4.448	-0.03	3.434
import price	0.006	-0.011	0.059	0.008	0.043	-0.013	-0.015	-0.052	-0.108	0.009	-0.074
world price	-0.001	0.005	-0.019	-0.459	-0.251	-0.07	-0.062	-0.084	4.344	-0.022	3.38

Source: authors' computation from GTAP simulations

Table 12 GDP Effects of ECOWAS technology shock with spillovers

Region	Simulated GDP changes
North America	0
EU	0
Ghana	13.27
Nigeria	9.48
Rest ECOWAS	9.98
CAEMC	0
COMESA	0
SADC	0
COMESADC	0
Rest of World	0

Source: authors' computation from GTAP simulations

Table 13 Welfare effects of ECOWAS technology shock with spillovers

Region	Allocative Efficiency	Endowment Effect	Terms of trade effect	Investment Savings effect	Allocative Efficiency	Total Welfare
North America	-51.621	0	0	-90.796	31.518	-110.9
EU	-71.003	0	0	24.758	59.318	13.072
Ghana	162.064	73.754	465.663	71.127	-21.632	750.977
Nigeria	391.543	263.845	3255.737	-52.898	75.322	3933.549
Rest ECOWAS	423.995	0	2672.757	148.529	-285.446	2959.834
CAEMC	-0.233	0	0	-1.657	0.198	-1.692
COMESA	-0.171	0	0	0.378	0.222	0.429
SADC	0.331	0	0	4.102	-0.176	4.257
COMESADC	-0.367	0	0	-1.488	0.194	-1.661

Rest of World	-57.615	0	0	-106.448	146.765	-17.298
Total	796.922	337.599	6394.157	-4.393	6.283	7530.568

Source: authors' computation from GTAP simulations

Table 14 Rewards to factors of production of ECOWAS technology shock (spillovers)

Factors	North America	EU	Ghana	Nigeria	Rest ECOWAS	CAEMC	COMESA	SADC	COMESADC	Rest of World	Total
Land	-100.169	-143.329	10.334	9.572	5.069	3.877	6.088	7.154	3.898	-3.442	-200.949
Unskilled Lab	312.914	760.983	157.653	474.152	105.684	95.475	72.064	52.657	43.149	166.779	2241.509
Skilled Lab	307.971	761.86	52.871	49.063	111.107	100.153	81.752	52.991	43.931	219.459	1781.158
Capital	43.35	-47.672	52.871	49.064	28.156	20.362	36.455	33.004	25.085	23.483	264.158
Natural Res	6.339	4.467	5.287	4.906	3.165	2.869	4.236	3.448	4.073	2.943	41.734
Total	570.404	1336.308	279.016	586.758	253.181	222.737	200.595	149.254	120.135	409.221	4127.609

Source: authors' computation from GTAP simulations

Table 15 GDP effect of technology shock to Ghana (no spillovers)

Region	Simulated GDP change
North America	0
EU	0
Ghana	13.23
Nigeria	0
Rest ECOWAS	0.01
CAEMC	0
COMESA	0
SADC	0
COMESADC	0
Rest of World	0

Source: authors' computation from GTAP simulations

Table 16 Welfare effects of technology shock to Ghana (no spillovers)

Region	Allocative Efficiency	Endowment Effect	Terms of trade effect	Investment Savings effect	Allocative Efficiency	Total Welfare
North America	-12.905	0	0	-25.852	-4.096	-42.853
EU	-16.111	0	0	-19.292	5.953	-29.449
Ghana	161.101	72.882	465.41	68.507	-22.808	745.093
Nigeria	-1.288	0.083	0	0.004	-0.147	-1.348
Rest ECOWAS	4.394	0	0	4.082	3.058	11.534
CAEMC	-0.069	0	0	0.009	0.022	-0.038
COMESA	-0.047	0	0	0.118	0.033	0.103
SADC	0.32	0	0	1.511	-0.498	1.333

COMESADC	-0.093	0	0	0.275	0.002	0.184
Rest of World	-16.097	0	0	-30.804	19.092	-27.809
Total	119.205	72.966	465.41	-1.441	0.611	656.751

Source: authors' computation from GTAP simulations

Table 17 GDP effect of technology shock to Nigeria (no spillovers)

Region	Simulated GDP change
North America	0
EU	0
Ghana	0
Nigeria	0.02
Rest ECOWAS	9.47
CAEMC	0
COMESA	0
SADC	0
COMESADC	0
Rest of World	0

Source: authors' computation from GTAP simulations

Table 18 Welfare effects of technology shock to Nigeria (no spillovers)

Region	Allocative Efficiency	Endowment Effect	Terms of trade effect	Investment Savings effect	Allocative Efficiency	Total Welfare
North America	-4.209	0	0	5.72	-14.341	-12.829
EU	1.014	0	0	72.706	-16.916	56.804
Ghana	0.825	0.182	0	2.116	0.222	3.345
Nigeria	392.206	262.57	3255.581	-53.444	74.659	3931.572
Rest ECOWAS	0.769	0	0	0.815	0.045	1.63
CAEMC	-0.14	0	0	-2.03	0.063	-2.107
COMESA	0.009	0	0	-0.719	-0.048	-0.758
SADC	0.619	0	0	2.136	-0.743	2.012
COMESADC	-0.07	0	0	-2.271	-0.036	-2.377

Rest of World	9.896	0	0	-25.498	-42.333	-57.936
Total	400.92	262.752	3255.581	-0.469	0.572	3919.356

Source: authors' computation from GTAP simulations

Table 19 GDP effect of technology shock to Ghana and Nigeria simultaneously (no spillovers to rest of ECOWAS)

Region	Simulated GDP change
EU	0
Ghana	0
Nigeria	13.25
Rest ECOWAS	9.47
CAEMC	0.02
COMESA	0
SADC	0
COMESADC	0
Rest of World	0
EU	0

Source: authors' computation from GTAP simulations

Table 20 Welfare effect of technology shock to Ghana and Nigeria simultaneously (no spillovers to rest of ECOWAS)

Region	Allocative Efficiency	Endowment Effect	Terms of trade effect	Investment Savings effect	Allocative Efficiency	Total Welfare
North America	-17.089	0	0	-20.124	-18.425	-55.639
EU	-15.087	0	0	53.417	-10.967	27.362
Ghana	161.837	73.07	465.54	70.529	-22.595	748.381
Nigeria	390.934	262.672	3255.675	-53.487	74.522	3930.315
Rest ECOWAS	5.154	0	0	4.887	3.095	13.137
CAEMC	-0.208	0	0	-2.019	0.084	-2.142
COMESA	-0.038	0	0	-0.6	-0.015	-0.654

SADC	0.937	0	0	3.641	-1.239	3.339
COMESADC	-0.163	0	0	-1.995	-0.034	-2.191
Rest of World	-6.19	0	0	-56.201	-23.253	-85.644
Total	520.087	335.742	3721.215	-1.953	1.172	4576.263

Source: authors' computation from GTAP simulations