Modeling the Impact of Non-Tariff Barriers in Services on Intra-African Trade: Global Trade Analysis Project Model

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Abstract

In 2015, the African Union launched negotiations to establish an African free trade agreement named AfCFTA (African Continental Free Trade Area). This paper examines the effects of the AfCFTA on intra-African trade in the short and long term. Associated with the implementation of this trade agreement, this paper assesses the impact of a reduction of 90% in import tariffs and 50% in non-tariff barriers (NTBs) for goods and services on GDP and intra-African trade. In this study, we highlighted the role of services in intra-African trade. We use the computable general equilibrium model (GTAP) and ad valorem equivalents (AVEs) of NTBs in services calculated using the Services Trade Restrictiveness Indices (STRIs) from the World Bank database following the Australian Productivity Commission's methodology. Our results suggest that liberalization of services stimulates GDP growth in the long run. The reduction of NTBs in services leads to a rise in intra-African exports of agricultural products, manufactured goods, processed food, fuel, energy-intensive products, wood and paper products, textiles and clothing in the long run. The manufacturing and natural resources sectors are the most affected by the reduction of barriers to services trade in Africa. Moreover, this trade agreement creates both long-term trade creation and diversion.

Keywords: AfCFTA, Restrictions in Services, Trade in services, GTAP model.

JEL: F12, F13, F17.

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I. Introduction

On the 7th of July 2019, Nigeria became 53rd signatory to African Continental Free Trade Agreement (AfCFTA) in Niamey, Niger republic.[1] The AfCFTA major objectives are to establish a single continental market for goods and services including the unhindered movement of business persons and investments which will ultimately open the way for the creation of the Customs Union (CU) in Africa. Once the AfCFTA (full tariff elimination) is effective, it could generate welfare gains of $16.1 billion, at the cost of $4.1 billion in trade revenue losses (or 9.1% of current tariff revenues). GDP and employment are expected to grow by 0.97% and 1.17%, respectively in long-term. Intra-African trade growth is estimated at 33% and the continent's trade deficit is expected to drop by 50.9% (Saygili, Peters, and Knebel, 2018). This agreement will help stimulate intra-African trade, which remains highly fragmented and less competitive on a global scale. As a major fallout of this agreement, the issue of tariff reduction and possible elimination of tariff on goods and services have taken the center stage. However, the issues surrounding Non-Tariff Barriers (NTB) have not been given a deserved attention, especially its effects on components of trade in services among African countries. Studies have identified the importance of trade in service for merchandise trade, economic performance and trade diversification (Hoekman, 2017). Consequently, policies and efforts to promote intra-African merchandise trade with reduction in tariff and NTBs under AfCFTA should not just be extended to trade in service on paper but through active implementation.

NTBs have been identified as a major contributor to high cost of intra-African trade. In this regard, Hamilton (2018) described NTBs as the main obstacles to trade between African countries. According to Vanzetti, Peters and Knebel (2017), African countries could gain $20 billion each year by eliminating NTBs at the continental level and this is much more than $3.6 billion that could benefit by eliminating tariffs. This simply suggests that competitiveness of African countries lie in addressing the NTBs prevalent in the continent. This will go a long way positioning them for both African and global relevance. In this same report, the distribution of welfare gains across African countries associated with the elimination of NTMs is positive all over the continent. This is a sharp contrast to the elimination of tariff in the continent that will lead to welfare loss for some countries in the continent. This clearly underscores the imperativeness of NTMs elimination for a successful.

Just like trade in goods, trade in services also encounters NTBs in forms of national regulations. The impact of these regulations sometimes cut across supplier, personnel and equipment and usually with significant cost implication (Kox and Nordås, 2007). The prevalence and stringency of these regulations are not considered as the major hindrance but their heterogeneity between origin and destination markets (Kox and Nordås, 2007). Based on Trade Cost Index data[2], trade costs for services are higher than for agricultural products. The trade costs for manufactured goods are the lowest. This emphasis the need to go beyond identification of regulations that impact on trade in service but working towards harmonization of national regulations across African countries as a major way to improving intra-African trade in service.

African trade analysis shows a very concentrated trade in free trade areas. Indeed, intra-African

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[1] To date, 54 countries have signed the agreement, Eritrea has not signed and 34 countries including South Africa and Nigeria have both signed and approved ratification of the agreement.

[2] The WTO Trade Cost Index illustrates the evolution of trade costs over time, the incidence of trade costs across economies and sectors (Economy-Sector), for different household income groups, by gender, firms size and skill groups (Economic Agents) as well as identify the main factors determining trade costs (Determinants). Data can be accessed at: http://tradecosts.wto.org/. For more information, see Egger, Larch, Nigai and Yotov (2021).

trade is much more significant between member countries of the same regional economic community (free trade agreement or customs union). Eight Regional Economic Community areas (REC) exist in Africa, and inter-community trade is very poorly developed. Ntara (2016) shows that the main economic and trading blocks in Africa are the Economic Organization of West African States (ECOWAS),[3] the Common Market for Eastern and Southern Africa (COMESA),[4] the Southern African Development Community (SADC),[5] and the Community of Sahel and Sahara States (CENSAD).[6] Other regional trading blocks are the East African Community (EAC), the Economic Community of Central African States (ECCAS), the Intergovernmental Authority on Development (IGAD) and the Arab Maghreb Union (AMU).

According to the Africa Regional Integration Index report of 2016, among the eight regional trading blocks in Africa, SADC and ECOWAS have higher than average REC scores on regional integration overall. SADC has higher than average REC scores across the dimensions of regional infrastructure, free movement of people and financial and macroeconomic integration. ECOWAS has higher than average REC scores across the dimensions of free movement of people and financial and macroeconomic integration. Moreover, intra-regional trade is more significant than inter-regional trade. Trade between ECOWAS and SADC member countries accounts for more than 50% of intra-African trade. However, bilateral trade between these two trading blocs is about 30% and 4% of intra-African trade (UNCTAD data).

This is explained by trade cost factors such as distance, various languages, restrictive customs procedures, high tariffs and barriers to entry into services. Therefore, the African Continental Free Trade Area can provide a platform of dialogue and negotiation among the eight regional economic communities in order to boost inter-regional trade. Indeed, the goal of the AfCFTA is to progressively reduce tariff, non-tariff barriers and trade facilitation bottlenecks. The objective is to create a liberalized market for goods and services through successive rounds of negotiations. The agreement foresees in 2021 a 90% reduction of tariff lines and a 50% reduction of NTBs in the goods and services sector with measures to facilitate trade through the implementation of the WTO Trade Facilitation Agreement (TFA). In 2025 an additional 7% reduction in tariffs. In order to boost intra-African trade, this agreement should stimulate trade among regional trading blocs in Africa.

The objective of this paper is to assess the effect of AfCFTA (elimination of import tariffs, non-tariff barriers in goods and services) on intra-African trade. In this paper we highlight the effects of services liberalization on intra-African trade. In line with the AfCFTA modalities, the paper examines the effects of a tariff elimination on 90% of tariff lines on goods and a reduction on 50% of non-tariff barriers on goods and services on a most favored nation (MFN) basis. We do not consider the effects of measures that facilitate trade through implementation of a trade facilitation agreement (TFA). We consider the service sector to analyze critically its impacts and to formulate policy suggestions and recommendations. Indeed, services accounted for 23% of world trade in 2018 and represent an important part of economic activity and production in Africa (UNCTAD, 2019b). Finally, services are the most protected sectors compared to the agricultural and manufacturing sectors, which are more liberalized (WTO, 2019).

Several studies have examined the impact of trade liberalization (reduction of tariffs and non-tariff barriers) on the performance of the agricultural sector in African trading blocks (Nin-Pratt

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[3]It is composed of Western Africa nations.
[4]It groups Central and Eastern African states.
[5]It brings together Southern African countries.
[6]Composed of Northern, Central and Western African states.

and Diao, 2014; Elbushra et al., 2011). Others have assessed the impact of AfCFTA on GDP and total intra-African trade (AfDB, 2019; Abrego et al., 2019). Some studies have investigated the effects of services liberalization on the economic growth in African (Tekin, 2012; Maune, 2019). Few studies have examined the impact of AfCFTA on export performance by considering the services sector. Our study contributes to the existing literature on the quantitative impacts of the African Continental Free Trade Area in three ways.

Figure 1: African goods exports by trading partners (% of total African exports), 2016-2020
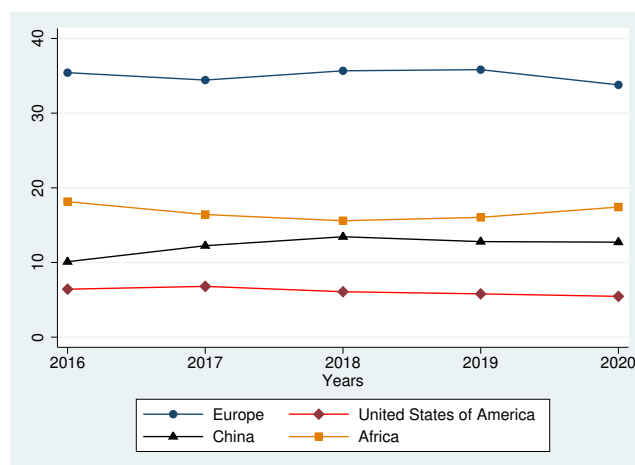
Source: UNCTAD

First, we study the impact of services liberalization on intra-African trade in goods and on trade between Africa and its trading partners (Europe, China and the United States).[7] While the papers that have assessed the effects of AfCFTA on intra-African trade have focused on liberalisation of the goods sector, our study examines the effects of NTB reduction in services on bilateral trade in goods. We consider the agriculture, manufacturing, agri-food, natural resources, wood and textile sectors as the most important for African economies. We also highlight the contribution of services to economic growth in African countries. Second, for modeling restrictions in services, we use the tariff equivalents (AVEs) of entry barriers established by Jafari and Tarr (2017). They estimate the AVEs of restrictions on 11 services sectors in 103 countries including African countries. These AVEs are more sectoral with a range of countries than the ones established by Benz and Jaax (2020) which covers 5 sectors in 46 countries (OECD and emerging countries). Third, in order to evaluate the effects of services sector liberalisation on intra-African trade, we use the latest version of the GTAP model (v10) with 2014 as the reference year.[8] Indeed, the GTAP database is a consistent representation of the world economy for a pre-determined reference year. Underlying the database there are several data sources, including among others: national input-output (I-O) tables, trade, macroeconomic, energy and protection data. The GTAP 10 database describes the world economy for 4 reference years (2004, 2007, 2011, and 2014) and distinguishes 65 sectors, up from 57 in the previous release (GTAP v9), in each of the 141 countries/regions. The 121 countries in the database account for 98% of world GDP and 92% of world population. For each country/region, the database reports production, intermediate

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[7]China, Europe and the United States are the main trading partners of Africa because they account for almost 60% of total African exports (see Graph 1).

[8]GTAP (Global Trade Analysis Project) is a global network of researchers and policy makers conducting quantitative analysis of international policy issues.

and final uses, international trade and transport margins, and taxes/subsidies. This database underlies most, if not all, applied global general equilibrium models.

Our study suggests that the services sector liberalisation increases African GDP by about $20.68 billion on average in the long run. The analysis of trade in goods shows services liberalization increases intra-African exports of agricultural goods by nearly $69.97 million, manufacturing goods by $827.3 million, processed foods by almost $116.93 million, and fuel products by about $290.52 million. Energy-intensive products also increased by approximately $515.23 million, wood and paper products by approximately $32.26 million and textiles and apparel by around $126.26 million. Manufacturing and natural resources are the sectors most affected by services liberalization. The reduction of barriers to service providers is contributing to an increase of African exports to its trading partners (Europe, China and the United States).

The remainder of this paper is structured as follows. In the first part, we review the literature on the effects of AfCFTA on intra-Africa trade. Second, we would describe the weight of non-tariff barriers and service sector in Africa trade. The third part highlights our GTAP model with data, sources, types of methodology and scenarios used. The last section presents our different results, the discussion and policy recommendations.

II. Literature Review

The existing literature on the quantitative impacts of the African Continental Free Trade Agreement (AfCFTA) has mainly focused on the effects of the reduction of tariffs and non-tariff barriers (NTBs), as well as trade facilitation measures, also on the African welfare. Among those studies of impact, the computable general equilibrium approach through the Global Trade Analysis (GTAP) model is the widely used. Moreover, some analyses also use the TASTE model (Tariff Analytical and Simulation Tool for Economists) to investigate the impacts of cuts in tariff lines. Other authors apply the MIRAGE-e CGE (Computable General Equilibrium) model with GTAP data to examine the impacts of tariffs, NTBs, and trade cost reduction.

i.   Removal of tariffs on intra-AfCFTA trade

The authors who analyzed the effects of tariff reduction on intra-African trade are Mevel and Karingi (2012). They use a MIRAGE (Modeling International Relations in Applied General Equilibrium) CGE model with GTAP data (v7, 2004 being the base year). They assume an removal of all tariff barriers on goods within the African continent and see the effects relative to the baseline scenario in 2017. They find that the establishment of a Continental Free Trade Area (CFTA) would boost Africa's exports to the world, relative to the baseline scenario in 2022 by 4.0% (or $25.3 billion) an increase in GDP of almost 0.2%. At the sectoral level, it is in agriculture and food that African exports would rise the most with the adoption of the agreement, with +9.4% (or $5.0 billion), as compared to the reference scenario in 2022. Moreover, the establishment of a CFTA would result in a significant rise in intra-African trade, increasing by 52.3% ($34.6 billion). Most of the increase is in manufacturing products ($27.9 billion) with most of the rest in agriculture.

The study by Jensen and Sandrey (2015), which is very similar to the previous one, first examines the effects of the full elimination of tariffs (all intra-African tariffs going to zero) applied to goods on intra-African trade in 2025. It uses a GTAP model similar to the MIRAGE model[9] but with

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[9]The only difference is the sectoral aggregation.

2011 as the base year for its simulation (GTAP v9). They find that total African exports increase by nearly 3.11% in 2025, with intra-African trade increasing by about 4.3%. GDP grows by nearly 0.70%.

Saygili, Peters, and Knebel (2018) also investigate the impact of tariff reductions on intra-African trade following the African Free Trade Agreement (AFTA). As before, they use a GTAP model and analyze the impacts across two scenarios in long run, which differs from the studies above. The first is the full elimination of tariffs on goods in the FTA. They found that GDP increased by almost 0.97%, intra-African trade rose by 33%, and Africa's total trade deficit was cut in half. Also, the vast majority of individual countries gained from the FTA. The second scenario assumes the elimination of tariffs on all product categories, exempting certain sensitive products from liberalization. They assumed that the exempted products currently exhibit relatively high tariffs and significant imports. Their simulations showed lower GDP growth than the first scenario (0.82%). Intra-African trade would increase by 24%, but Africa's overall trade deficit only shrinks by 3.8%. However, the simulations showed that more countries experience welfare losses if sectors with high current tariff revenues are permanently excluded from liberalization. Vanzetti, Peters, and Knebel (2018) study the quantitative impacts of AfCFTA from tariff reduction through 2 shocks: (1) full tariff elimination; (2) tariff elimination with exemptions for 5% of sensitive products. The results on intra-African trade show an increase in intra-African exports of about 1 and 0.4% respectively under scenarios 1 and 2.

By using a GTAP (v10) model, the African Development Bank in their study (AfDB, 2019) showed that the removal of bilateral tariffs led to an increase in African intraregional trade by 14.6% (+$10.1 billion) and GDP by 0.10% (+$2.8 billion). Also, because the share of intraregional trade in total trade is small, intraregional trade relative to total trade increases only from 12% to 13.6%. There is a modest trade deviation - Africa exports somewhat less to the rest of the world ($-4.3 billion), and the rest of the world exports a bit less to Africa, with reductions of about 0.8%. The World Bank study (World Bank, 2020) is similar to the African Development Bank study (AfDB, 2019) in that it uses a GTAP (v10) CGE model and analyzes the long-run effects of a gradual removal of 97% of tariffs on intra-AfCFTA trade. The results suggested a growth in African exports and imports of goods to the world by respectively 1.78% (or $35 billion) and 2.31% (or $41 billion). Intra-African trade increased by 21.76% ($131 billion) and the GDP grew by 0.13% (or $12 billion).

ii. Removal of tariffs and NTBs on intra-AfCFTA trade

The literature on trade liberalization has increasingly focused on the effects of non-tariff barriers (NTBs) on trade. It showed that reducing NTBs makes a significant contribution to economic welfare. In the second part of their study, Jensen and Sandrey (2015) estimate the effects of a total reduction in tariffs and a 50% reduction in NTBs in the goods sector using the GTAP model. The tariff equivalent of NTBs is taken from the World Bank. The estimates indicated an increase in total African exports and intra-African trade by 6.28% and 7.26% respectively. GDP grew by 1.6%. Overall, the 50% reduction in NTBs contributes to about 3% growth in total exports and intra-African trade and 0.9% growth in GDP.

Vanzetti, Peters, and Knebel (2018) in their study through the third scenario highlights the effects of NTB reduction in goods on intra-African trade. The AVEs of NTBs are taken from Cadot et al. (2015). Their study is different from others because they consider a reduction in NTBs in goods without a reduction in tariffs. They find that more significant gains in exports are associated with addressing non-tariff measures (an increase in intra-African exports of almost 2 percent). The

greatest increase in exports is recorded by Cameroon, Ivory Coast, Rwanda, and South Africa. This reflects the composition of exports, with these countries exporting a larger share of goods that attract NTMs, such as livestock products and fruits and vegetables.

Abrego et al. (2019) in the context of AfCFTA, examine the welfare effects of the full elimination of import tariffs and a partial but substantial reduction in NTBs (35% reduction) for 45 African countries. Contrary to the other studies, they do not use a GTAP CGE model but a multi-country, multi-sector general equilibrium model based on Costinot and Rodriguez-Clare (2014). Data on applied effective tariffs come from the Global Trade Analysis Project (GTAP) Africa database (2014). The Ad valorem equivalents of NTBs are obtained from the Economic and Social Commission for Asia and the Pacific (ESCAP) and World Bank database for 2016. The results show significant potential welfare gains from trade liberalization in Africa (an increase of 2.1% compared with the baseline). As intra-regional import tariffs in the continent are already low, the bulk of these gains come from the lowering of NTBs. Intra-African trade increased by 8.40%. They argue that the size of the potential gains that may be obtained from AfCFTA is largely dependent on the degree of openness, the initial level of trade barriers, and the strength of initial trade linkages among African countries. In their scenario nine of them with gains of 5% or more.

The second scenario in the AfDB study (AfDB, 2019) adds to the tariff removal an elimination of 50% of NTBs in goods and services. The observed effects on intra-African trade are as follows: the elimination of tariffs and NTBs on imports of goods and services into Africa leads to a large boost in intra-African trade of about 107% (+$74.3 billion). This increase in intra-African trade is accompanied by a large 44% (+$107.2 billion) increase in exports to the rest of the world. GDP increased by 1.25% (+$37 billion). Under this scenario, intra-African trade as a share of total African exports rises from 12% in the reference solution to 17.2%. Compared to scenario 1 of this study, NTBs contribute to an increase in trade of nearly 92.6%. Besides a gradual reduction of 97% of tariffs, the World Bank study (World Bank, 2020) adds in its second scenario, a reduction of 50% of NTBs in goods and services. AVEs of NTBs for goods are taken from Kee, Nicita, and Olarreaga (2009). The results suggest an increase in intra-African trade and exports to the rest of the world by 51.85% and 18.84% respectively. GDP increased by 2.24%. Compared to the first scenario, NTBs contribute to an increase of almost 24% in intra-African trade.

In addition to the welfare gains, this continental free trade agreement will boost intra-African trade with the rest of the world. It will render intra-African trade more resilient to global price shocks. African countries will also trade among themselves a more diverse set of goods and products because trade with non-regional partners tends to be highly concentrated and focused on primary commodities. Finally, deeper regional integration, such as AfCFTA, also creates opportunities for a further reduction of trade barriers and potential to generate economies of scale (Ahmed et al., 2018).

III. SERVICE SECTOR AND AFRICA TRADE

African trade in services is less developed than trade in goods. While the share of value added of services in GDP and world trade is significant in industrialized countries, trade in services represents a marginal share in total African trade. Intra-African trade in services represents less than 4% of trade between Africa and the rest of the world, according to the TRALAC report (TRALAC, 2015). Between 2018 and 2019 Africa's services exports declined by 3%, while global services exports increased by 2% (TRALAC, 2020). The services sector in Africa tends to be dominated by low value-added and informal transactions. The sector is still less competitive, digitized, and inefficient at acting as an input to economic activity for industry and agriculture

([ITC, 2017](#)). However, the United Nations Conference on Trade and Development ([UNCTAD, 2015a](#)) notes that a number of African countries have become service-oriented economies and contribute to almost half of Africa's total output. The hub countries are South Africa, Egypt and Nigeria which are the biggest exporters and importers of services on the continent. Moreover, this sector is strong and some countries have specialized in key services such as banking and transports (e.g., Angola, Ivory Coast, Egypt, Gabon, Morocco, Nigeria, Rwanda and South Africa).

The services sector significantly contributes to the growth of African GDP (see Figure 2), it remains one of the sectors with the highest employment rate in Africa and absorbs a large share of youth employment and plays a major role in gender parity ([UNCTAD, 2015a](#); [Maune, 2019](#)).

Figure 2: Goods and services sector value added (% of GDP), 2015-2019
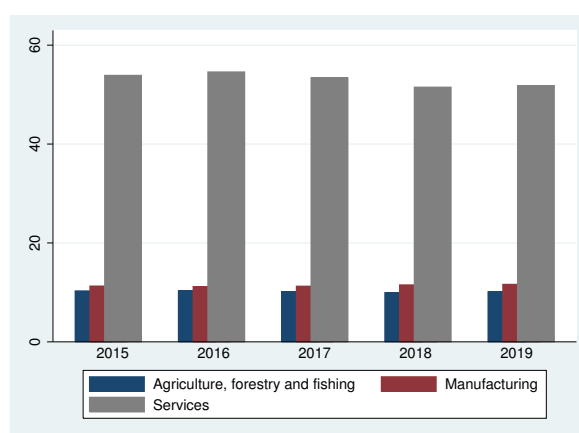
Source: World Development Indicators Database (World Bank)

Services in Africa is one of the most closed sectors with high barriers to entry. It is one of the continents with the most restrictions in the services sector. Although goods and commodities are subject to low tariffs, sectors such as telecommunications have tariff equivalents of about 200% ([Jafari and Tarr, 2017](#)). Figure 3 highlights the importance of services in goods and services exports. We note a significant contribution of services to exports of goods, particularly manufactured products. Services contributed to almost 30% of African exports of manufactured goods in 2015. Also the share of services as inputs in mining exports is important compared to other sectors (about 5%).[10] The agricultural sector, the backbone of the African economy, is a sector that uses few inputs in services. This graph shows a high degree of servicification of African trade in goods.

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[10]The services value added in our case is foreign sourced. Africa includes Morocco, Tunisia and South Africa.

Figure 3: The share of services value-added in African goods and services exports, 2015
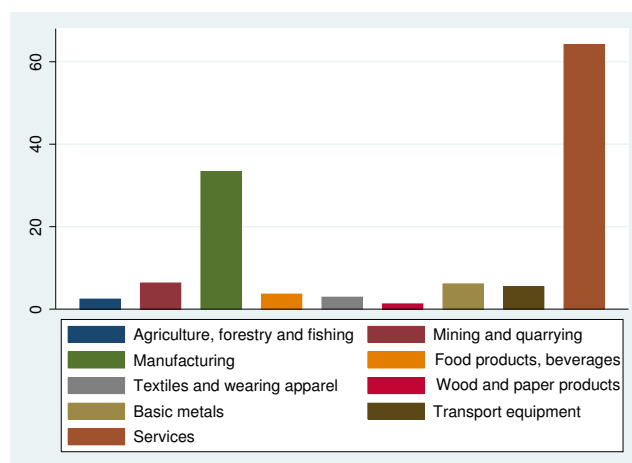
Source: OECD TiVA database (2018)

The share of services in manufacturing trade in Africa remained relatively stable between 2005 and 2015. The contribution of foreign service suppliers to manufacturing exports in emerging economies (Asia and Latin America) is the largest compared to advanced economies (see Figure 4). Liberalization of services will not only lead to beneficial gains for emerging countries and African countries, but also to an important place for these countries in the global value chain (GVC). Indeed, at the regional level, intra-African trade in value-added is low (9%), compared to 45% in Asia and 18% in Latin America (Slany, 2019) and services could boost this intra-regional trade.

Theoretically, services can participate in GVC in two main ways: backward integration and forward integration (Efogo, 2020). Backward integration refers to countries (or firms) that export or import raw materials or intermediate products entering as inputs in heavy industries. Backward integration refers to countries (or firms) exporting processed intermediate or final goods and services through international distribution networks. Trade in services can contribute to the integration of countries into GVCs. Services can be the object of a GVC whatever the entry mode (Baldwin and Venables, 2013). This type of GVC exists in various sectors such as financial services, tourism, education, health, information (Heuser and Mattoo, 2017; Miroudot, 2016). Services can also be an element of the GVC (UNCTAD, 2013), particularly as a raw material, as a backward activity or as a forward activity (design, logistics, transport, marketing, and so forth). They can likewise be an input into the production of other products or services. Services as inputs are supporting the export activities of manufacturing products through transport, logistics and financial services, but are also factors in Africa's export competitiveness. For example, services account for 83% of the final price of Ethiopian roses in the Netherlands (AfDB, 2015). Services may be a key input into environmental service exports. Indeed, business and financial services can promote the production of environmental services such as BioTrade[11] to achieve sustainable development goals. Services would contribute to the creation of environmental service providers such as ecotourism and REDD+ projects (UNCTAD, 2021).[12]

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[11]BioTrade, encompasses activities related to the collection, production, transformation and commercialization of goods and services derived from biodiversity (genetic resources, species and ecosystems) under environmental, social and economic sustainability criteria (UNCTAD, 2020a).

[12]REDD: Reducing Emissions from Deforestation and Forest Degradation.

Figure 4: The share of services value-added in goods and services exports by region, 2015
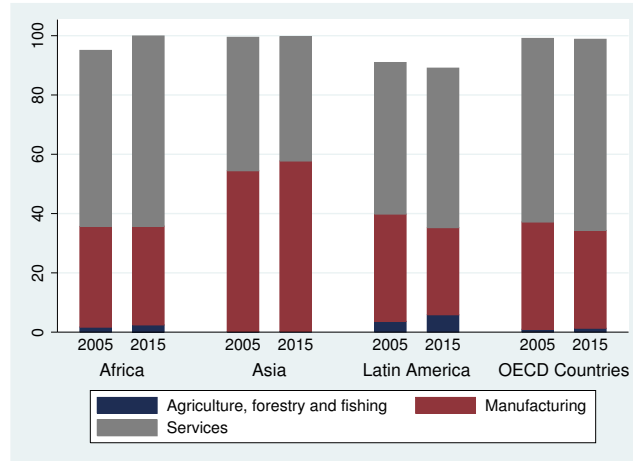
Source: OECD TiVA database (2018)

IV. Methodology

i. GTAP Model: desciption

To evaluate the impact of AfCFTA on intra-Africa trade, we use a GTAP model. It is a multi-region, multi-sector, multifactor model, and a computable general equilibrium model with the assumptions of perfect competition and Constant Returns to Scale (CRS) of production. Production in each sector and each region is represented by a nested Constant Elasticity of Substitution (CES) function. The model incorporates the Armington assumptions that each firm uses a CES composite of domestically produced and imported intermediate goods in fixed proportions with a value-added CES composite, based on five endowed factors of production (land, natural resources, unskilled-skilled labor, and capital).

In the GTAP model, a fundamental element is the closure of the model, i.e., defining the endogenous and exogenous variables of the model. We decide to use two microeconomic closures: first, a closure based on the neoclassical approach - fixing the capital stock (exogenous) and allowing the rate of return on capital to adjust (endogenous factors). This type of closure is interpreted as representing the short term (John .P , 2001).[13] Indeed in all of the small countries regions (i.e., developing countries), the inputs to capital creation are import-intensive and subject to large tariffs. Therefore, in these regions, the removal of tariffs due to AfCFTA tends to reduce the capital costs, and thus the capital rent, relative to the general price of output (Adams et al., 1997). The second is a model for an analysis of long-run effects (see, Walmsley, 1998). Here, the rate of return on capital is fixed exogenously and the level of the capital stock is adjusted (Francois et al., 1996). In this closure, percentage changes in capital stocks are equated to percentage changes in investment (where $EXPAND("capital", r)$[14] is exogenously equal to 0).

$$EXPAND(i, r) = qcgds(r) - qo(i, r) \qquad (1)$$

where: i = "capital"
r=country

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[13]The period considered is not long enough for new investments to come online as productive capital.
[14]Note that although written in upper case, $EXPAND("capital", r)$ is a percentage change variable.

As a result, investment ($qcgds(r)$) and capital stocks ($kb(r)$) change by the same amount. Thus the percentage change, in the solution period, of the growth rate of capital equals zero and the growth rate of capital in each region returns to that rate which prevailed prior to the shock. When the initial database is a grow-less steady state, the growth rate of capital returns to a rate of zero percent. The result is a change in the steady state levels of capital and income (Walmsley, 1998). The long run approach is defined as that period of time long enough for capital stocks to have adjusted to the shock and be available for production in the region.

For the macroclosure, we apply the methodology developed by Walmsley (1998) consisting in adjusting the trade balance (endogenous) and fixing the savings rate (exogenous). The fixed assumption of the saving rate is the default macroclosure in the GTAP model, i.e., the savings rate (percentage of income that is saved) is assumed to be exogenous and constant, so the quantity of the saving changes whenever income changes. Investment spending then changes to accommodate the change in supply of savings. A model with this closure is called "savings-driven" because changes in savings drive changes in investment. An advantage of this closure is that a nation's savings rate remains the same as the rate observed in the base year (Burfisher. M, 2017). By adjusting the trade balance variable, capital moves across regions and regions' trade balances change accordingly, thus the percentage changes in the expected rates of return do equate across regions (Yuan and Burfisher, 2021; Walmsley, 1998).[15]

ii. Data

The core data for this study are sourced from the Global Trade Analysis Project (GTAP) database -see Appendix A. These data provide a snapshot of the global economy in 2014, including domestic interindustry flows and bilateral trade flows. The full database covers 141 regions, of which 121 are individual countries, and 65 sectors. For this analysis, the 141 regions are aggregated into 36 regions, including all 32 regions in Africa that are part of the database (see Tables A.1 and A.2). Of those 32 regions, 26 are individual countries, with the remaining countries grouped into six regional components.[16] The 65 sectors are aggregated into 8 sectors (see Table A.3).[17] The core data are supplemented by additional information. The study incorporates estimates of the ad-valorem equivalents (AVEs) of non-tariff trade barriers (NTBs).[18] AVEs of NTBs for goods are taken from the World Bank's World Integrated Trade Solution (WITS) database and documented by Kee, Nicita, and Olarreaga (2009). They are aggregated to the model's regional and sectoral aggregation using trade weights. Estimates for missing countries and regions are simple averages of available estimates. AVEs of NTBs for services are sourced from Jafari and Tarr (2015). The average of the AVEs across the 11 services is the overall AVE for the services sector (Tables A.6 and A.7). Modeling services trade in Africa is tricky because bilateral services trade data are scarce and AVEs for African countries are mostly based on extrapolations. These data sources are incorporated into the 2014 baseline.

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[15] For more details on the model closure see Table A.8.

[16] Rest of Central Africa; Rest of East Africa; Rest of North Africa; Rest of South African Customs Union; Rest of West Africa; South Central Africa.

[17] The first 45 sectors (1-45) are aggregated into agricultural and manufacturing sectors and the last 20 (46-65) into service sectors.

[18] To model the impacts of non-tariff barriers for goods and services, we need the data on ad-valorem equivalents (AVEs).

iii.   Different Shocks and Scenarios

We simulate the creation of a free trade area between African countries by reducing tariff and non-tariff barriers in goods and services. To evaluate these effects, two shocks or scenarios have been developed. Shocked variable is $rTMS(i,r,s)$. This exogenous variable represents the import tariff rate on trade goods or services (i) imported by country (s) from country (r). This parameter has three dimensions: It is defined for the set of traded goods or services (i); the set of source countries (r); and the set of destination countries (s). The $rTMS$ is a percentage target rate.

We have two different scenarios in our study: (1) a reduction of tariff lines by 90% and NTBs by 50% only in the agricultural and manufacturing sectors, (2) we consider the first scenario but including a 50% reduction of NTBs in all services sector. The goal of the AfCFTA is to eliminate tariffs on 90% of tariff lines (tariffs on non-sensitive goods). Non-least developed countries liberalize tariffs on non-sensitive goods over 5 years and least developed countries (LDCs) over 10 years. In our study, we assume a liberalization of 90% of the total number of tariff lines. The implementation of the AfCFTA leads to a reduction of the trade costs associated with NTBs by creating a common set of rules for participating countries in areas such as competition, technical barriers to trade, and sanitary and phytosanitary standards. Implementing reforms in these areas by reducing trade costs is a difficult task. In line with the objectives of the AfCFTA, we assume that the scenario of 50% of NTBs are actionable (reduced). Indeed, only a fraction of NTBs are actual barriers that could be actionable (i.e., politically feasible in a trade agreement); the rest are assumed to be beyond the reach of politically viable trade policies (World Bank, 2020). This assumption is consistent with previous studies on AfCFTA (AfDB, 2019 and World Bank, 2020) and other deep agreements, such as the Trans-Pacific Partnership study by Petri and Plummer (2016). The NTB changes are assumed to apply to MFN countries, i.e., they apply as well to imports from non-African countries (AfDB, 2019 and World Bank, 2020).[19]

The two scenarios highlight the effects of NTB reduction in services on intra-African trade. The effects are observed on macroeconomic variables such as GDP and trade variables of interest.
To model the NTBs in the GTAP model, we will build a new tax named "Altertax". This tax will take both the tariffs and the NTB (AVE) of goods or services i imposed by each country. Indeed, it will be the sum of the two types of tax (AVE + customs tariff).

V.   Simulation Results and Discussion

The results generated from our different scenarios are analyzed in this section. We evaluated our results on macroeconomic variables: change in GDP and bilateral exports.

i.   Macroeconomic Impacts of AfCFTA

The AfCFTA's goal is to reduce progressively tariff and non-tariff trade costs to boost intra-African trade. In our analysis we consider two micro-closures to take into account the short- and long-term effects: the capital stock is exogenous in the first case and endogenous in the second. However, we will focus on the long-term effects

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[19]Africa's trading partners: China, Europe and the United States.

ii. Change in Percentage GDP

The tables above describe the effects of our two scenarios on the change in real GDP in the short and long term. Real GDP increases with the introduction of the two policies in the short and long term (see Table 1). Moreover, the effects are more significant in the long term. Interestingly, GDP growth rises with the liberalisation of the services sector. Indeed, a reduction in tariff lines by 90% and NTBs by 50% in the agricultural and manufacturing sectors is associated with an increase in African GDP by 0.22% and 0.95% respectively in the short and long run. The liberalisation of services leads to an increase in GDP by 0.47 and 1.07% in the short and long run, respectively.[20] In comparison, the study by AfDB (2019) highlights an increase in African GDP by 1.25% and the study by World Bank (2020) a rise by 2.24% following the reduction of tariffs and NTBs. Reducing NTBs in services increases African GDP by about $20.68 billion on average in the long run (Table 2).

Interestingly, the gains are unevenly spread. Indeed, Benin and Senegal were the country that recorded a decline in GDP growth following the liberalization of services (Table 2). In Benin's case, this can be explained by the fall in capital goods investment. Indeed, Benin is one of the countries where the share of capital goods in imports is the lowest in Africa (nearly 15% in 2015, AfDB, 2019). This low share has a negative impact on the industries' productivity and even the share of industries in Benin's GDP. Indeed, imports of capital goods play a key role in the structural change and growth in export-led industries. Countries where imports have focused on upstream, capital-intensive products and industries have been more likely to see accelerated growth, increased industrialization, improved trade balances, and lower external debt following an increase in exports and import substitution compared to countries in which initial imports were driven mostly by the final consumption sectors. The tourism and telecommunications sectors are the service sectors that contribute significantly to Senegal's GDP growth (nearly 11% and 5% of GDP respectively in 2014, BCEAO, 2014). Tourism appears to be the largest single foreign exchange earner, but since the 2010s, the sector's share of GDP growth has been falling. Liberalization of the telecommunications sector could have negative effects on the profit margins of providers, potentially explaining the drop in GDP (Rouzet and Spinelli, 2016).[21] (AfDB, 2019). The contribution of services to GDP is higher in service-oriented economies such as Nigeria, Egypt, and South Africa with an increase of $1.319 billion, $1.255 billion, and $478 million respectively. Services liberalization has a lower impact on GDP in West African countries than in North, South, and East Africa. South Africa and Nigeria account for nearly 32% of African GDP in 2018 (UNCTAD data, 2018) and are the largest exporters and importers of services in Africa followed by Angola, Egypt and Morocco (TRALAC, 2015). Reducing barriers to entry for service providers has positive and significant effects in these economies. However, services trade-restrictive countries such as Ethiopia, Mozambique, and Kenya registered significant GDP growth (+$1.045 billion, $906 million and $848 million respectively).

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[20]These results are obtained by the difference between the average GDP growth in column 2 and 1 for the short run and that in column 4 and 3 for the long run.

[21]They find that a higher broadband density is associated with lower profit margins, which suggests that mark-ups tend to fall as markets mature.

Table 1: Changes in Real GDP (in percent)

	Types of Scenario			
	Short run		Long run	
	AfCFTA 1	AfCFTA 2	AfCFTA 1	AfCFTA 2
Countries	Reduction of tariffs and NTBs in all sectors except services (1)	Reduction of tariffs and NTBs in all sectors including services (2)	Reduction of tariffs and NTBs in all sectors except services (3)	Reduction of tariffs and NTBs in all sectors including services (4)
Guinea	1.24	1.88	6.48	10.37
Rest of Eastern Africa	2.95	3.23	8.43	9.02
Rest of South African Customs	0.18	1.36	0.9	4.94
South central Africa	-0.06	1.51	0.01	4.54
Mozambique	-0.06	2.08	0.14	4.3
Burkina Faso	0.13	0.9	1.4	3.84
Togo	1.31	1.7	2.66	3.11
Senegal	0.19	0.24	2.47	2.19
Ghana	0.08	1.02	0.71	2.08
Rest of Central Africa	-0.13	0.79	0.28	2.08
Namibia	0.14	0.32	1.27	1.88
Rest of West Africa	0.02	0.94	0.59	1.62
Ivory Coast	0.68	0.78	1.4	1.52
Ethiopia	0.02	0.75	0.06	1.39
Uganda	0.04	0.57	0.3	1.34
Kenya	0.01	0.57	0.12	1.34
Malawi	-0.01	0.87	0.11	1.24
Tanzania	0.17	0.69	0.47	1.23
Zimbabwe	-0.1	0.42	0.23	1.13
Zambia	0.04	0.34	0.32	1
Tunisia	0.03	0.23	0.63	0.92
South Africa	0.14	0.19	0.71	0.84
Botswana	0	0.21	-0.25	0.75
Rwanda	0.06	0.37	0.22	0.66
Madagascar	0	0.65	0	0.64
Egypt	0.02	0.12	0.15	0.53
Morocco	0.04	0.1	0.28	0.4
Cameroon	0.17	0.17	0.33	0.34
Nigeria	0.02	0.06	0.08	0.3
Mauritius	0	0.12	0.08	0.26
Rest of North Africa	0	0.16	0.05	0.21
Benin	-0.13	-1.11	-0.12	-1.22
Average (%)	0.22	0.69	0.95	2.02

Source: GTAP model, GTAP v10, AfCFTA database.

Table 2: Changes in Real GDP (in USD millions): the impact of services liberalization

| | Types of Scenario Long run | | |
| | AfCFTA 1 | AfCFTA 2 | |
Countries	Reduction of tariffs and NTBs in all sectors including services (1)	Reduction of tariffs and NTBs in all sectors except services (2)	Service contribution (1) - (2) (3)
South central Africa	8785.44	22.89	8762.55
Nigeria	1814.88	495.63	1319.25
Rest of Central Africa	1513.41	201.05	1312.36
Egypt	1758.31	502.78	1255.53
Ethiopia	1094.14	49.12	1045.02
Mozambique	937.97	31.04	906.93
Kenya	929.27	80.49	848.78
Rest of Eastern Africa	8972.33	8381.66	590.67
Ghana	893.25	305.91	587.34
South Africa	3112.38	2633.53	478.85
Rest of West Africa	748.2	274.07	474.13
Rest of North Africa	580.63	136.13	444.5
Tanzania	680.03	258.87	421.16
Burkina Faso	524.61	192.07	332.54
Uganda	403.6	89.02	314.58
Rest of South African Customs	373.18	68.35	304.83
Guinea	794.6	496.85	297.75
Zambia	289.04	91.36	197.68
Botswana	124.57	-41.26	165.83
Tunisia	463.93	314.77	149.16
Zimbabwe	184.42	37.69	146.73
Morocco	454.05	317.73	136.32
Namibia	263.87	178.47	85.4
Malawi	84.49	7.52	76.97
Madagascar	77.29	0.37	76.92
Ivory Coast	555.94	511.46	44.48
Rwanda	60.58	20.54	40.04
Mauritius	35.62	10.52	25.1
Togo	158.54	135.47	23.07
Cameroon	115.77	113.29	2.47
Senegal	395.7	446.47	-50.77
Benin	-149.89	-14.92	-134.97
Total	37030.15	16348.94	20681.21

Source: GTAP model, GTAP v10, AfCFTA database. The change in millions of GDP is calculated using the column Ch/%Ch. It measures the change as the difference between the post-shock and pre-shock value of GDP.

VI. RESULTS ON BILATERAL TRADE

This section shows the results of the impact of services liberalization on intra-African trade and on trade between Africa and its trading partners. We include the agricultural sector because it is still one of the main economic activities in a majority of African countries. Intra-African exports of agricultural commodities are still higher than other products (UNCTAD data). this sector provides the employment for about two-thirds of the continent's workforce population and contributes an average of 15% of GDP and about 70% of value of exports in 2017.[22] In 2019, total intra-African agricultural trade was valued at $23 billion ($11.6 billion exports and $10.7 billion imports) representing some 17% of total intra-African exports and 16% of intra-African imports (TRALAC, 2020).

We take into account the manufacturing sector because it accounts for a significant share of intra-African trade. It represented almost 46% of intra-African trade in 2015. Approximately 57% of intra-Africa exports are neither commodities nor agricultural products and include flexible tubing, vessels, electrical energy, diamonds, motor vehicles and cement (TRALAC, 2020).

[22]UNCTADstat and World Development Indicators data in 2015.

We consider the processed food goods because it it represented a significant share of intra-African manufactured exports (about 44% of total manufacturing exports in 2018) and is highly dependent on the services sector (Amara, 2021). Also at the continental level, the average trade weight tariffs are at about 5%, with the highest tariffs imposed on processed foods, textiles and wearing apparel. The manufacturing sector accounts for 12.6% of employment, of which 42% is in food processing (World Bank, 2020). We also consider the natural resources sector due to the fact that the continent is struggling to implement renewable energy policies. The African economy is highly dependent on fossil fuels and Africa has enormous fossil fuel potential, accounting for about 9.5%, 8%, and 4% of the world's total proven reserves of crude oil, natural gas, and coal, respectively (BP, 2011). Also most of the global value chains that use minerals and precious stones are located outside of Africa.
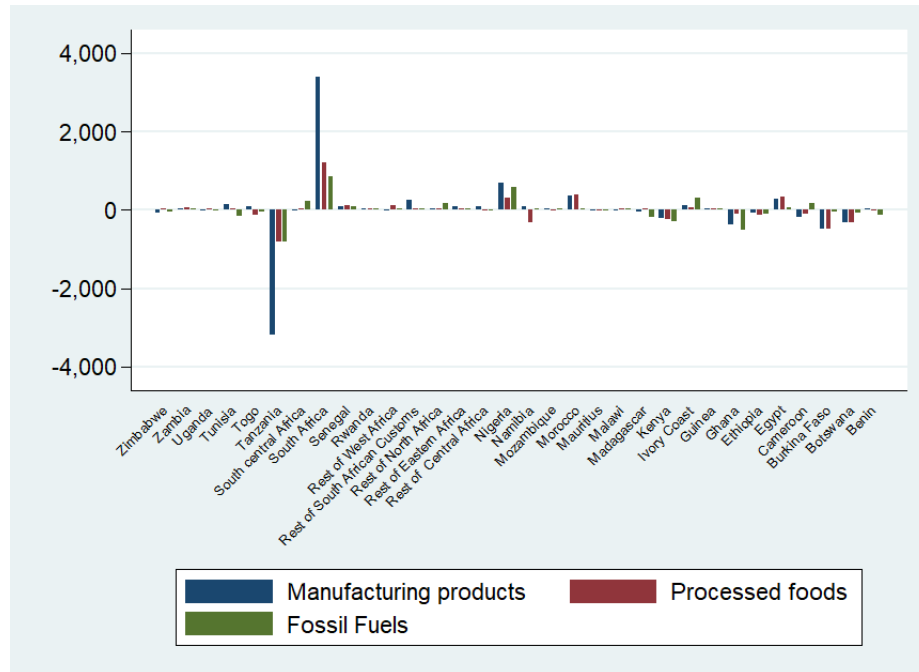
We see the effect of services liberalization on trade in wood and paper because according to the Food and Agriculture Organization (FAO) Africa's forests and woodlands are estimated to cover 650 million hectares, or 21.8% of the continent's land area (FAO, 2003). The forestry sector does not entail only wood production. It is associated with food security and better nutrition (AfDB, 2018). Indeed, it contributes directly to subsistence food production due to the richness of forest soils. It provides energy, especially for cooking. Income and employment generation; and the provision of ecosystem services (soil fertility enhancement, water storage, pollination, windbreaks, shelter). Finally, the effects of the reduction of NTBs in services are examined on the textile sector because this sector can drive Africa's industrial transformation and create many jobs. It is estimated that up to 600% of the value can be created along the cotton value chain: from cotton production, spinning and twisting into yarn, to weaving and knitting into fabric, and then to dyeing, printing and design (Moungar and Gregorio, 2018).

Figure 5: The effects of NTB reductions in services on Africa's exports (US$ millions)
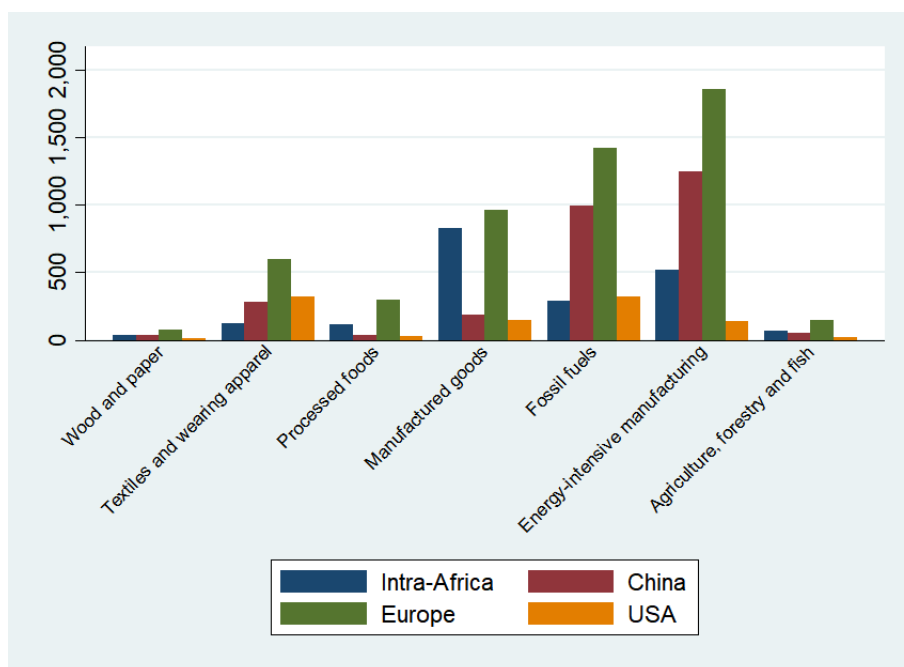
Source: The author's construction using GTAP v10 data

Figure 6: The Effects of services liberalization on intra-African exports by country (in millions of US dollars)

Source: The author's construction using GTAP v10 data
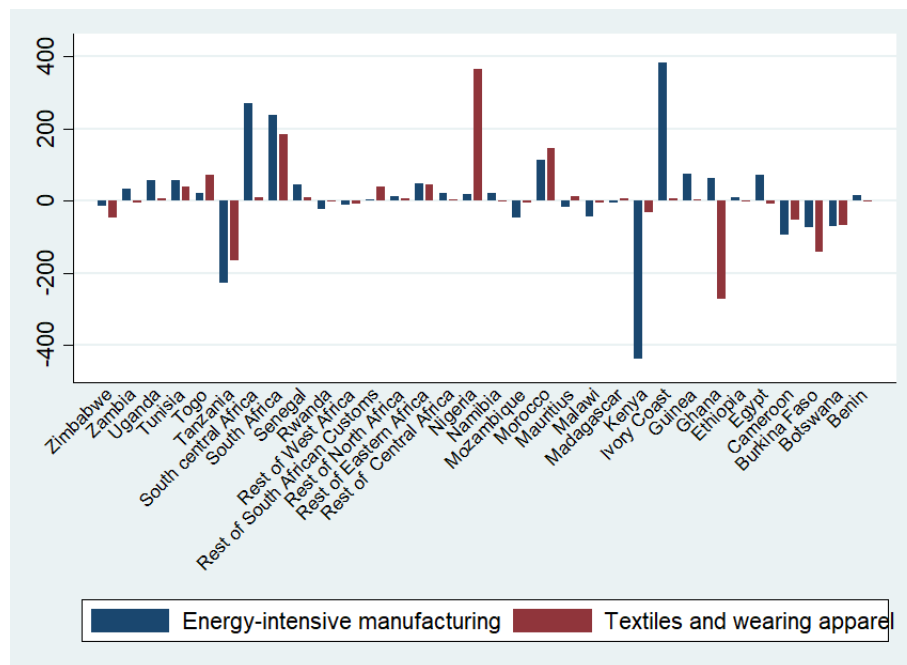
Figure 7: The Effects of services liberalization on intra-African exports by country (in millions of US dollars)

Source: The author's construction using GTAP v10 data

In monetary terms, the liberalization of services led to a significant increase in intra-African exports of manufacturing products, natural and energy resources (fossil fuels, metals and precious

stones, etc.), textiles and processed foods products (see Figure 5). Moreover, the agricultural and wood sectors are less dependent on services in Africa. These results confirm those of Figure 3, which highlighted the significant servicification of the manufacturing, mining and quarrying, and food sectors. Under the AfCFTA scenario by World Bank (2020), manufacturing exports gain the most, 62% in overall terms, with intra-African trade increasing by 110% and exports to the rest of the world by 46%. There are smaller gains in agriculture, 49% and 10% for intra- and extra-African trade, respectively. Indeed, of the $2.5 trillion in exports projected for Africa, $823 billion are in manufactured goods, $690 billion in natural resources, $191 billion in agriculture.

The liberalization of services would be beneficial to the largest exporters of manufacturing and agri-food products (South Africa, Nigeria, Morocco, Egypt, see Figure 6) rather than to small exporters. Indeed, in many African countries, services exports are limited to direct exports of services, while for others, services exports also include exports incorporated in goods and other services, through their forward linkages (Sáez, McKenna and Hoffman, 2015). For example, in the most advanced African economies, the contribution of services to manufactured exports is more important than their contribution to the domestic value added of manufacturing, so services liberalization would positively affect the largest exporters of manufactured goods. The same finding is observed when considering the natural resources sector (see Figures 6 and 7) Further on, Services liberalization contribute to a higher growth of African exports of fossil fuels, energy-intensive manufactured and textiles products to its trading partners (see Figure 5). As a result, services liberalization generates trade diversion. This is explained by the fact that these products are important raw materials for manufacturing industries in Europe, United States and China. Intra-African exports of energy resources and mining products are low compared to those with its trading partners (UNCTAD data) and, thus services liberalization generates more benefits through extra-Africa trade.

VII. Conclusion and Policy Recommendations

This paper contributes to the literature about the impacts of AfCFTA on intra-African trade. We examine the effects by highlighting the contribution of services sector to economic growth and intra-African trade in two scenarios. The contribution of services to economic growth in Africa is significant, providing large jobs and used as inputs in production and exports. However, barriers to entry are significant and therefore impede intra-African trade.

To assess the impacts of this FTA on intra-African trade, we use the GTAP model and to model the restrictions in services with, we consider the ad valorem equivalents of NTBs in services of Jafari and Tarr (2017). AVEs of NTBs for goods are taken from the World Bank's World Integrated Trade Solution (WITS) database and documented by Kee, Nicita, and Olarreaga (2009). The effects are observed in the short and long term with a focus on the long term.

We find that the liberalization of services stimulates GDP growth in the long term. The reduction of NTBs in services leads to a rise in intra-African exports of agricultural products, manufactured goods, processed food, fuel, energy-intensive products, wood and paper products, textiles and clothing in the long run. The "servicification" is still important in intra-African exports of manufacturing goods. Moreover, this trade agreement creates both long-term trade creation and diversion.

This paper is the first to quantify the effects of services liberalisation on intra-African trade, however it has shortcomings. It does not address the issue of whether liberalization of services increases or decreases rents for foreign providers. This measure of Jafari and Tarr (2017) does not

decompose AVE into economic rents for the exporter and the importer. The solution might be to use the approach of Francois et al (2013), who allocates an average of 60% of the estimated AVEs to trade efficiency cost and assumed that one-third of the remaining 40% were appropriately described as economic rents to exporter and two-thirds as economic rents to importer.

Services liberalisation has positive effects on economic growth and intra-African trade. However, several challenges need to be addressed to ensure that the establishment of AfCFTA has beneficial effects on intra-African trade. These challenges should be in the form of support policies. We formulate four policy recommendations:

First, Transportation and logistics services are essential inputs in the production and commercialization of manufacturing products. Moreover, competitive transport and logistics services are key to reduce trade costs, in particular in the food sector (Amara, 2021). Also, information and communication infrastructure play a key role in intra-African trade. Indeed the study by Bankole et al. (2015) suggested that information and communication infrastructure and institutional quality have a robust positive effect on intra-African trade. The first policy to consider would be the development of regional transport, communication and energy infrastructure to facilitate the movement of goods, people and trade in services. Government cooperation with financial actors, particularly the African Development Bank, should continue to invest in transport infrastructure projects and in new information and communication technologies in order to boost intra-African trade.

Second, customs services are a crucial sector in intra-African trade. The OECD Services Trade Restrictiveness Index (STRI) estimates the level of restrictions in the customs services sector in South Africa at 0.28, compared to an average of 0.046 in the European Economic Area in 2018, which is significant. Reforms aimed at simplifying customs procedures are to be implemented (Kouty Manfred, 2021).[23] Measures ranging from the digitalization of these services to the publication of information on trade activities and border customs procedures should be implemented to reduce trade costs.[24] The reduction of trade costs can be achieved through the WTO's Trade Facilitation Agreement (TFA).[25]

The production and commercialization of goods and services in Africa is dependent on the financial sector (banking intermediation).[26] Moreover, lack of trade finance is a significant non-tariff barrier to trade, particularly (but not exclusively) in developing countries (WTO, 2016). Restrictions in the banking sector hamper the provision of massive credit in Africa and the trade finance gap is very large in Africa compared to other regions (WTO, 2016). Lack of access to finance is the main concern when operating in international markets. The WTO study (WTO, 2016) indicates that lack of access to finance is a major obstacle for traders, especially small and medium-sized exporters in Africa. For an intra-African free trade area to be beneficial, the African Development Bank's Trade Finance Facilitation Program, as well as those of other development finance institutions (multilateral financial institutions, export credit agencies etc.), are needed to boost intra-African trade. Also regulating the banking system in order to implement policies to boost the banking rate in Africa, with a wide range of financial services such as online payments, and connecting the financial sector to mobile payments (highly developed in sub-Saharan Africa).

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[23]It shows that trade procedures such as the number of documents required to import goods and border compliance negatively affect intra-African trade.

[24]Godwin et al. (2020) find that digitalization (mobile subscriptions, internet users and broadband subscriptions) has a positive contribution to the economic growth in Sub Saharan Africa.

[25]The implementation of trade facilitation measures through cooperation of African countries is included in Phase I of AfCFTA objectives.

[26]Almost 80% of global trade is supported by trade finance or credit insurance (WTO, 2016).

Last, political and economic crises in regional trading blocs can impede the gains from trade liberalization in Africa. Indeed, political instability in certain regions of Africa has a negative effect on economic activities. The study by Yushi and Borojo (2019) shows that intra-African trade and overall trade in Africa are robustly determined by the quality of institutions, border and transport efficiency, and physical and communication infrastructure. The estimates also indicate that the marginal effect of institutional quality, physical and communication infrastructure on trade flows appears to be increasing in GDP per capita. Political instability and lack of good governance are impediment to economic growth and to the implementation of free trade agreements, including AfCFTA, regional cooperation in Africa should therefore be strengthened. COVID-19 highlighted the strong relationship between global trade, particularly services trade, and the health system. Africa's global trade was negatively impacted by the crisis in 2020, and a large part of its population remains unvaccinated (WTO, 2021). Access to the vaccine in Africa has been made possible through the COVAX initiative (COVAX AMC). Moreover, of the 6.4 billion vaccine doses administered worldwide, only 2.5% have been administered in Africa-although the continent accounts for a little over 17% of the world's population (World Health Organization data). The unequal access to vaccines is due to poor health systems in Africa, ranging from a lack of trained medical personnel to inadequate health and transportation infrastructure (including adequate vaccine storage facilities). The establishment of the AfCFTA should be supported by the cooperation of governments in public investments in the African health system (hospital infrastructure, investment in research and development (R&D), reduction of barriers to intellectual property (IP) rights, and technology transfer) in order to address potential health crises that could affect African economic growth.[27]

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[27]Cooperation on investment, intellectual property rights and competition policy are among the objectives (Phase II) of the AfCFTA.

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A. Appendix

i. Appendix A: Data Sources

The main source of data for this analysis is the Global Trade Analysis Project (GTAP) database coordinated by the Center for Global Trade Analysis in the department of agricultural economics at Purdue University. This analysis uses the latest GTAP version (10). In addition two modifications of the standard GTAP aggregate are introduced as changes to the baseline data:

1. Introduction of AVE estimates of non-tariff barriers (NTBs) to traded goods, based on estimates from Kee, Nicita, and Olarreaga (2009).

2. Incorporation of estimates of the quantification of barriers in services trade based on estimates from Jafari and Tarr (2017).

i.1 Quantification of Non-Tariff Barriers in Goods

AVE estimates of non-tariff barriers for goods are taken from the World Bank's World Integrated Trade Solution (WITS) database, based on the methodology developed by Kee, Nicita and Olarreaga (2009). They transform the quantity impact of NTBs into price-equivalents. The original data cover 78 developing and developed countries and goods at the Harmonized System 6 (HS6) level. These estimates are converted to the 7 aggregate goods sectors of the GTAP database (by simple average). The aggregated NTB database is in a CSV format (AVE-GTAP-Data.csv) with three fields: the country's ISO (International Organization for Standardization) code, the GTAP sector code, and the value of the NTB estimates. The coverage of African countries in this database is limited to Algeria (DZA), Burkina Faso (BFA), Cameroon (CMR), Ivory Coast (CIV), Arab Republic of Egypt (EGY), Ethiopia (ETH), Gabon (GAB) Ghana (GHA), Kenya (KEN), Madagascar (MDG), Malawi (MWI), Mali (MLI), Mauritius (MUS), Morocco (MAR), Nigeria (NGA), Rwanda (RWA), Senegal (SEN), South Africa (ZAF), Sudan (SDN), Tanzania (TZA), Tunisia (TUN), Uganda (UGA) and Zambia (ZMB). For the missing countries and regions (individual and aggregate regions), we use simple averages of the available country estimates.

i.2 Quantification of Non-Tariff Barriers in Services

Services have a specific characteristic contrary to goods. They are intangible and restrictions are qualitative information. The authors that estimated tariff equivalents of services restrictions use information's from the OECD and World Bank's Services Trade Restrictiveness Index (STRI) database. The most recent is the tariff equivalent estimated by Benz and Jaax (2020). They include only OECD and emerging countries, not African countries except South Africa. The estimate by Jafari and Tarr (2017) is the most complete as it covers Africa countries. The country coverage for Africa consists of Algeria (DZA), Botswana (BWA), Burundi (BDI), Cameroon (CMR), Ivory Coast (CIV), the Democratic Republic of Congo (COD), the Arab Republic of Egypt (EGY), Ethiopia (ETH), Ghana (GHA), Kenya (KEN), Lesotho (LSO), Madagascar (MDG), Malawi (MWI), Mali (MLI), Mauritius (MUS), Morocco (MAR), Mozambique (MOZ), Namibia (NAM), Nigeria (NGA), Rwanda (RWA), Senegal (SEN), South Africa (ZAF), Tanzania (TZA), Tunisia (TUN), Uganda (UGA), Zambia (ZMB), and Zimbabwe (ZWE).The missing data include rest of North Africa (XNF), which is mapped to North Africa (NAF) as shown in table F.1. Benin, Burkina Faso, Guinea, Togo, rest of West Africa, rest of Central Africa (XCF), rest of South-Central Africa (XAC), rest of East Africa (XEC), and rest of SACU (South African Customs Union) are all mapped to the Sub-Saharan (SSA). They estimate the ad valorem equivalents of the discriminatory barriers

against foreign suppliers of services in 11 service sectors in 103 countries. The estimates are based on recent available data on discriminatory regulatory barriers against foreign suppliers of services in these sectors and countries, produced by the World Bank (Brochert et al.,2014).

The World Bank's STRI database focuses exclusively on discriminatory barriers faced by foreign suppliers of services. However, Jafari and Tarr (2017) reconstruct STRI indices from the World Bank database based on a series of studies supported by the Australian Productivity Commission. This modification ignores, except for EU countries, preferential commitments and focuses exclusively on MFN barriers. Indeed, in the case of EU countries, the transformation of the World Bank database includes the weighting of intra-EU and extra-EU services regulatory regimes.

The authors regress a measure of the price or costs of services against their STRIs and other relevant variables in a cross-country regression at a point in time to determine the impact the regulatory barriers on the price of services. Through these regressions, the authors finally estimate the ad valorem equivalents of regulatory barriers in the countries in their sample. The simple average of the AVEs of the 11 sectors constitutes the overall AVE of the service sector.

ii. Appendix B: Tables

Table A.1: Regional Aggregation: GTAP concordance

	Region	GTAP concordance
1	Egypt, Arab Rep. (EGY)	Egypt, Arab Rep. (EGY)
2	Morocco (MAR)	Morocco (MAR)
3	Tunisia (TUN)	Tunisia (TUN)
4	Rest of North Africa (XNF)	Algeria (DZA), Libya (LBY), Western Sahara (ESH)
5	Benin (BEN)	Benin (BEN)
6	Burkina Faso (BFA)	Burkina Faso (BFA)
7	Cameroon (CMR)	Cameroon (CMR)
8	Ivory Coast (CIV)	Ivory Coast (CIV)
9	Ghana (GHA)	Ghana (GHA)
10	Guinea (GIN)	Guinea (GIN)
11	Nigeria (NGA)	Nigeria (NGA)
12	Senegal (SEN)	Senegal (SEN)
13	Togo (TGO)	Togo (TGO)
14	Rest of West Africa (XWF)	Cape Verde (CPV), Gambia, Guinea-Bissau (GNB), Liberia (LBR), Mali (MLI) Mauritania (MRT), Niger (NER), Saint Helena (SHN), Sierra Leone (SLE)
15	Rest of Central Africa (XCF)	Central African Republic (CAF), Chad (TCD), Congo (COG), Equatorial Guinea (GNQ), Gabon (GAB), Sao Tome and Principe (STP)
16	South Central Africa	Angola (AGO), Congo, Democratic Republic of the (COD)
17	Ethiopia (ETH)	Ethiopia (ETH)
18	Kenya (KEN)	Kenya (KEN)
19	Madagascar (MDG)	Madagascar (MDG)
20	Malawi (MWI)	Malawi (MWI)
21	Mauritius (MUS)	Mauritius (MUS)
22	Mozambique (MOZ)	Mozambique (MOZ)
23	Rwanda (RWA)	Rwanda (RWA)
24	Tanzania (TZA)	Tanzania (TZA)
25	Uganda (UGA)	Uganda (UGA)
26	Zambia (ZMB)	Zambia (ZMB)
27	Zimbabwe (ZWE)	Zimbabwe (ZWE)
28	Rest of East Africa (XEC)	Burundi (BDI), Comoros (COM), Djibouti (DJI), Eritrea (ERI), Mayotte(MYT), Seychelles(SYC), Somalia (SOM), Sudan (SDN)
29	Botswana (BWA)	Botswana (BWA)
30	Namibia (NAM)	Namibia (NAM)
31	South Africa (ZAF)	South Africa (ZAF)
32	Rest of South African Customs Union (XSC)	Eswatini (SWZ), Lesotho (LSO)

Table A.2: Continued

	Region	GTAP concordance
33	China (CHN)	China (CHN)
34	United States (USA)	United States of America (USA)
35	European Union + EFTA (weu)	Austria (AUT), Belgium (BEL), Cyprus (CYP), Czech Republic (CZE), Denmark (DNK),

Estonia (EST), Finland (FIN), France (FRA), Germany (DEU), Greece (GRC), Hungary (HUN), Ireland (IRL), Italy (ITA), Latvia (LVA), Lithuania (LTU), Luxembourg (LUX), Malta (MLT), Netherlands (NLD), Poland (POL), Portugal (PRT), Slovakia (SVK), Slovenia (SVN), Spain (ESP), Sweden (SWE), United Kingdom (GBR), Switzerland (CHE), Norway (NOR), rest of EFTA (XEF) , Bulgaria (BGR), Croatia (HRV), Romania (ROU)

36	Rest of the world (row)	Australia (AUS), New Zealand (NZL), rest of Oceania (XOC), Bangladesh (BGD), India (IND), Nepal (NPL), Pakistan (PAK), Sri Lanka (LKA), rest of South Asia (XSA), Canada (CAN), Mexico (MEX), rest of North America (XNA), Argentina (ARG), Bolivia (BOL), Brazil (BRA), Chile (CHL), Colombia (COL), Ecuador (ECU), Paraguay (PRY), Peru (PER), Uruguay (URY), Venezuela (VEN), rest of South America (XSM), Costa Rica (CRI), Guatemala (GTM), Honduras (HND), Nicaragua (NIC), Panama (PAN), El Salvador (SLV), rest of Central America (XCA), Dominican Republic (DOM), Jamaica (JAM), Puerto Rico (PRI),Trinidad and Tobago (TTO), rest of Caribbean (XCB), Albania (ALB), Belarus (BLR), Russian Federation (RUS), Ukraine (UKR), rest of East Europe (XEE), rest of Europe (XER), Kazakhstan (KAZ), Kyrgyzstan (KGZ), Tajikistan (TJK), rest of former Soviet Union (XSU), Armenia (ARM), Azerbaijan (AZE), Georgia (GEO), Bahrain (BHR), Iran, Islamic Rep. (IRN), Israel (ISR), Jordan (JOR), Kuwait (KWT), Oman (OMN), Qatar (QAT), Saudi Arabia (SAU), Turkey (TUR), United Arab Emirates (ARE), rest of Western Asia (XWS), Rest of East Asia (XEA), Hong Kong, SAR, China (HKG), Japan (JPN), Mongolia (MNG), Republic of Korea (KOR), Taiwan, China (TWN), rest of East Asia (XEA), Brunei Darussalam (BRN), Cambodia (KHM), Indonesia (IDN), Lao PDR (LAO), Malaysia (MYS), Philippines (PHL), Singapore (SGP), Thailand (THA), Vietnam (VNM), rest of Southeast Asia (XSE), Antarctica, Bouvet Island, British Indian Ocean Territory, French Southern Territories.

Note: EFTA = European Free Trade Association.
Source: GTAP model, GTAP v10, AfCFTA database.

Table A.3: GTAP sector concordance

	Sector name (aggregated)	GTAP concordance
1	Agriculture (AGR)	Paddy rice (PDR); wheat (WHT); cereal grains, NEC (GRO); vegetables, fruit, nuts (V-F); oilseeds (OSD); sugar cane, sugar beet (C-B); plant-based fibers (PFB); crops, NEC (OCR); bovine cattle, sheep and goats, horses (CTL); animal products, NEC (OAP); raw milk (RMK); wool, silkworm, cocoons (WOL); forestry (FRS)
2	Fossil fuels (FFL)	Coal (COA); oil (OIL); gas (GAS); petroleum, coal products (P-C)
3	Energy-intensive manufacturing (KE5)	Mineral products, NEC (NMM); ferrous metals (I-S); metals, NEC (NFM); Other extraction (formerly other manufacturing (omn), minerals, NEC) (OXT)
4	Processed foods (PFD)	Bovine meat products (CMT); meat products, NEC (OMT); vegetable oils and fats (VOL); dairy products (MIL); processed rice (PCR); sugar (SGR); food products, NEC (OFD); beverages and tobacco products (B-T)
5	Textiles and wearing apparel (TWP)	Textiles (TEX); wearing apparel (WAP); leather products (LEA)
6	Wood and paper products (WPP)	Wood products (LUM); paper products, publishing (PPP)
7	Manufactures, NES (XMN)	Chemical, rubber, and plastic products (CRP); Chemical products (CHM); basic pharmaceutical products (BPH); rubber and plastic products (RPP); Metal products (FMP); computer, electronic, and optical products (ELE); electrical equipment (EEQ); machinery and equipment, NEC (OME); motor vehicles and parts (MVH); transport equipment, NEC (OTN); manufactures, NEC (OMF)
8	Services	Electricity (ELY); gas manufacture, distribution (GDT); construction (CNS); trade (TRD); accommodation, food, and service activities (AFS); warehousing and support activities (WHS); transport, NEC (OTP); water transport (WTP); air transport (ATP); communication (CMN) financial services, NEC (OFI); insurance (formerly ISR) (INS); real estate activities (RSA); business services, NEC (OBS); water (WTR); recreational and other service; public administration and defense (OSG); education (EDU); human health and social work activities (HHT); dwellings (DWE)

Source: GTAP model, GTAP10 AfCFTA database.

Table A.4: Ad Valorem Equivalents of Non-Tariffs Measures in Africa: agricultural and manufacturing products

Sectors	SPS	TBT	Others	Total NTM
Animals	9.5	4.2	4.6	18.3
Vegetables	14.2	2.7	2.3	19.2
Fats and oils	7.8	0.2	3.9	11.9
Beverages and tobacco	11.4	5.8	2.9	20.1
Minerals	4.6	8.2	1.8	14.6
Chemicals	5.6	5.8	2.9	14.3
Plastics	0.1	8.1	1.3	9.5
Leather	5.4	5.5	3.6	14.5
Wood product	4.3	6.7	0.6	11.6
Paper	0	9	0.8	9.8
Textile and clothing	0	6.4	2.5	8.9
Footwear	0	9.2	3.3	12.5
Stone and glass	0	8.3	4.3	12.6
Pearls	0	3.1	6.2	9.3
Metals	0	9.6	4.8	14.4
Machinery	0	11.3	10.4	21.7
Vehicles	0	9.2	4	13.2
Optical	0	11.1	6.1	17.2
Arms	0	5.9	9.5	15.4
Miscellaneous	0	12.6	3.9	16.5

Source: AVEs data compiled by Cadot et al. (2015).

Table A.5: Ad Valorem Equivalents (AVEs) by services sector and geographical region

	AVEs estimations						
Region	North America	Europe and Central Asia	East Asia and the Pacific	South Asia	Latin America and Caribbean	Middle East and North Africaf	sub-Saharan Africa
Accounting	36	26	38	34	27	45	33
Legal services	34	34	48	58	33	63	46
Air transport	10	24	31	58	37	59	23
Rail transport	28	49	45	67	41	66	53
Road transport	18	19	35	35	31	56	26
Banking	1	8	12	16	12	32	16
Insurance	18	22	21	29	27	34	28
Fixed line	16	7	90	388	60	30	545
Mobile line	0	0	1	2	1	1	3
Retail	2	2	3	4	3	5	3
Maritime transport	8	16	30	67	34	57	18
AVEs Average	**15.55**	**18.82**	**32.18**	**68.91**	**27.82**	**40.73**	**72.18**

Source: Jafari and Tarr (2017)

Table A.6: Estimated Ad Valorem Equivalents of Services Restrictions: Individual countries

Countries	Accounting	Legal	Air transport	Rail transport	Road transport	Banking	Insurance	Fixed line	Mobile line	Retail	Maritime	Average
Botswana	21	35	75	65	65	18	23	64	1	2	n/a	36.9
Cameroon	26	34	0	56	37	1	25	29	0	2	0	19.09
Democratic of the Congo	29	36	0	84	62	3	104	915	1	2	58	117.64
Egypt	56	73	69	84	0	44	35	18	1	1	39	38.18
Ethiopia	19	73	84	62	84	106	105	915	37	14	82	143.73
Ghana	29	25	0	26	0	34	26	915	1	2	65	102.09
Ivory Coast	51	56	0	84	60	17	13			1	0	31.33
Kenya	26	73	0	84	0	2	38	915	1	1	0	103.64
Lesotho	16	13	0	84	0	1	16	109	1	2	n/a	24.2
Madagascar	25	40	0	62	70	18	23	915	2	1	n/a	115.6
Malawi	33	49	59	42	5	18	21	915	6	2	n/a	115
Mali	60	50	0	20	20	4	21	915	2	1	n/a	109.3
Mauritius	10	65	0	84	42	17	2	1	0	0	n/a	22.1
Morocco	27	47	0	0	0	2	26	13	1	1	73	17.27
Mozambique	20	20	0	37	20	1	2	915	2	1	0	92.55
Nambibia	41	55	0	68	56	18	27	63	2	1	0	30.09
Nigeria	30	27	37	84	0	2	48	35	0	3	0	24.18
Rwanda	21	15	0	84	5	14	27	915	3	7		109.1
Senegal	46	65	81	84	0	13	13	60	1	1	0	33.09
South Africa	32	73	70	0	0	6	29	23	1	1	0	21.36
Tanzania	44	52	54	72	0	13	33	915	1	1	61	113.27
Tunisia	79	69	69	68	60	10	29	12	1	6	75	43.45
Uganda	40	49	0	18	0	2	16	915	4	1	n/a	104.5
Zambia	26	27	0	0	53	5	24	915	2	1	n/a	105.3
Zimbabwe	39	48	69	77	75	23	31	267	2	11	n/a	64.2

Source: Jafari and Tarr (2017) AVEs estimated.

Table A.7: Estimated Ad Valorem Equivalents of Services Restrictions: regional area

	North Africa (NAF)	Sub-Saharan Africa (SSA)	Rest of East Asia	Western Europe	Rest of the world
Accounting	54	31	43	28	32
Legal	60	45	63	28	41
Air	55	23	46	16	38
Rail	59 59	57	18	50	
Road	36	31	45	24	33
Banking	17	15	17	2	16
Insurance	29	31	26	11	26
Fixed line	13	546	134	4	75
Mobile	1	3	1	1	1
Retail	5	2	4	1	3
Maritime	67	12	40	7	30
Average	36	72.55	43.27	12.73	31.36

Source: Jafari and Tarr (2017) AVEs estimated.

Table A.8: GTAP Closures

	Short-run	Long-run
Exogenous	qo(capital) or kb	EXPAND
Endogenous	EXPAND	qo(capital)
	DTBAL is endogenous	DTBAL is endogenous

Source: Jafari and Tarr (2017) AVEs estimated.

qo(capital) or kb : beginning-of-period capital stock

EXPAND: change in investment levels relative to endowment stock

DTBAL: change in trade balance

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