Sectoral Linkages with Non-Tradable Goods: a Comparative Analysis of Regional Trade Agreements in Africa

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Abstract

This article uses a Ricardian model with sectoral linkages between trade and non-tradable sectors to quantify the impact of four Regional Trade Agreements (RTA) in Africa. We find that the four RTAs studied, namely COMESA, SADC, EAC and CEMAC have been costly for many participating countries, as in each agreement there are countries that have registered a loss in welfare and real wages due to a deterioration in their terms of trade and to trade diversion. These losses however are small, often below 0.1% in terms of welfare. The winners' gains are also small, albeit slightly bigger, ranked between 0.1% and 0.7%. Our results highlight the poor results of African RTAs where only a reduction in tariffs is achieved. However, we find that while these aggregated effects are small, RTAs have strong effects at the sectoral level (e.g., in the agricultural sector).

F1, F13, F15 Trade integration, Gravity, RTA

1 Introduction

Sixty years after the first wave of independence and a quarter century after the signing of several Regional Trade Agreements (RTAs), fifty-five African countries envision redefining their trade interdependence by implementing the African Continental Free Trade Area (AfCFTA). This proposed continental RTA generates great hopes as illustrated by a report of the World Bank (2020) asserting that "it has the potential to lift 30 million people out of extreme poverty [...] Real income gains from full implementation

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of AfCFTA could increase by 7 percent by 2035, or nearly US$450 billion". These hopes, however, are not based on a consensus regarding the effectiveness of past RTAs in Africa. The first wave of research in the 1990s, concluded that African RTAs have fundamentally failed to achieve their goals (see Foroutan & Pritchett (1993)). A second recent wave, based on the estimation of a so-called structural gravity equation, has been more favorable, but however, it also provides contradictory results.[1]

Here we propose to shed light of the effects of African RTAs by using a multi-country, multi-sector model, which in comparison to the literature based on gravity equations, allows the decomposition of the effects of RTAs at the disaggregated level of eleven sectors. Furthermore, we analyze features of African countries that have been partially neglected in the study of RTAs in Africa, such as sectoral linkages, the dispersion of tariffs across sectors and non-tradable goods. African countries are known to be specialized in final agricultural goods and minerals, but they use a high volume of intermediate goods often coming from domestic non-tradable goods. Indeed, many goods and services are provided locally, and as non-tradable sectors are linked to trade-exposed sectors, taking into account these linkages matters to fully understand the global effects of RTAs. Finally, this sectoral analysis enables the taking into account of the strong dispersion of tariffs across sectors, and then the consequences of the cancellation of these gaps with the implementation of RTAs.

Thus, our two research questions are: What are the effects of African RTAs (trade creation, diversion, terms of trade change, welfare impact)? What is the decomposition of these effects at the sectoral level? To comprehensively answer these questions using a well-defined research design, we use the model deployed by Caliendo & Parro (2014), hereafter denoted CP. This model, built to study RTAs,[2] perfectly fits the aforementioned stylized facts, as it takes into account intermediate goods, sectoral linkages and non-tradable sectors in a Ricardian model of trade (Eaton & Kortum (2002)). While the existing literature often considers the non-tradable good sectors as an outside sector, here producers of non-tradable goods use intermediate goods, differ in terms of productivity levels, and supply goods both for consumption and for production. In Africa where differences in productivity in the formal and informal sectors are important, and where the informal sector is often linked to the formal one to produce final and intermediate goods, this modeling enables the analyzing of the feedback between heterogeneous sectors.

We focus our contribution on four RTAs, which are the Economic and Monetary Community of Central Africa (CEMAC), the Common Market for Eastern and Southern Africa (COMESA), the Southern

[1] To give some examples on the effect of RTAs obtained from a gravity equation, Mayer & Thoenig (2016) find that members of the EAC have experienced an increase in bilateral trade of 213 percent after the enforcement of this agreement, while Nguyen (2019) estimating the same equation but with a different estimator (PPML instead of OLS) finds a negative effect. Regarding the ECOWAS, Carrere (2004) find no trade diversion but trade creation, while Rose (2000) concludes that this agreement has been insignificant.

[2] CP analyses the North American Free Trade Agreement (NAFTA) and Aichele et al. (2014) have improved it to study the Transatlantic Trade and Investment Partnership.

African Development Community (SADC) and the East African Community (EAC).[3] These four agreements, comprising thirty-three members, differ according to their dynamics and composition. SADC, CEMAC and COMESA are free trade areas that face difficulties in deepening their integration. The COMESA is the largest bloc in this group and includes members that also belong to other trade areas (the EAC and SADC). The CEMAC is a customs union with a common external tariff that began to be implemented in 2006. The EAC, first implemented in 2000, became a fully-fledged customs union of five countries in 2009, and is often viewed as one of the best performing RTAs in Africa.[4].

We find that whichever RTAs are considered, the gains are small, often less than 0.5% in terms of GDP and furthermore they also generate some negative outcomes. For instance, five countries belonging to these different RTAs have simultaneously encountered a decrease in their volume of exports, a deterioration in their terms of trade, a reduction in real wages and trade diversion from the rest of the world.[5] Many other participating countries have also suffered at least one of these negative effects.[6] While these effects are small, at worst involving a decrease in GDP of 0.1%, they also show that these regional integrations are not a Pareto improvement on the bloc scale, and since gains are also small it is difficult to see an economic motivation to improve these agreements (e.g., by the incorporation of compensation mechanisms).

Finally, by analyzing countries with overlapping agreements, we find that a majority of them gain more in the COMESA than in SADC, but the greater size of the COMESA is not a guarantee of greater success; indeed, countries that belong both to the EAC and COMESA have smaller gains in the latter bloc.

Our work is related to three types of studies that have used different tools to analyze RTAs in Africa, namely Gravity Models (estimated with different estimators and specifications), New Trade Quantitative Models (hereafter NTQM), and Computable General Equilibrium models (hereafter CGE).

This research is indirectly related to the gravity equation literature since we use the elasticity of trade provided by CP from a formula based on a gravity equation. However, we do not propose any contribution to this type of literature. Our work is more related to the NTQM literature and, in particular to the research by Mayer & Thoenig (2016) and Candau et al. (2019). In comparison with these authors who use a one-sector model and find that RTAs bring small gains for all partners, our analysis shows that

[3]The lack of data explain why the different RTAs are rarely analyzed in a single paper. Here, the lack of tariffs at the disaggregated level before the implementation of many RTAs in the 90s lead us to abandon the analysis the Economic Community of West African States (ECOWAS) and its sub-integration the West African Economic and Monetary Union (WAEMU). The database on tariffs MAcMap for instance only starts for the year 2001.

[4]Mayer & Thoenig (2016) conclude: "this evidence clearly indicates that EAC has been a particularly successful agreement among the large (but admittedly very heterogeneous) set of existing RTAs". They even consider this agreement has a pacifying effect in inter-state relations.

[5]Burundi and Kenya in the EAC, Central Africa Republic and Chad in CEMAC, Malawi and Tanzania in SADC.

[6]A decrease in the terms of trade in Gabon, Seychelles, Mauritius, Zambia, Zimbabwe, Uganda, added to a decrease in real wages in Egypt, Mozambique and Madagascar.

there are losers in this process, and allows the decomposition in more detail of the sectoral consequences of a reduction in tariffs.

We find that the deterioration in the terms of trade mainly comes from the agricultural sector. However, RTAs also have a significant impact on many other sectors, such as Wood and Paper in Madagascar, Electrical and Machinery in Egypt, and Fishing in Tanzania. Analyzing the Herfindalh Index of Exports Concentration before and after RTA implementation, we find that the effects of RTAs are not homogeneous. The CEMAC has almost no effect on specialization, while the COMESA and EAC have ambiguous effects, reinforcing the specialization of some countries and allowing the diversification of others. In contrast the SADC has fostered the specialization of its members. These different effects come from the patterns of trade liberalization due to RTAs. The gaps in tariffs between members before the implementation of the agreements were highly concentrated in a few sectors (e.g., fishing), explaining the strong effects on specialization once reduced for SADC members.

Our model is also related to Computable General Equilibrium models (CGE) which provide results at the sectoral level (Willenbockel (2013), Balistreri et al. (2016)). While applying these models to Africa is challenging in terms of data availability and calibration, the advantage of the current model lies in its parsimony, requiring relatively few data and enabling their analysis without relying on estimates of unobserved structural parameters.[7]

The remainder of the paper is organized as follows. In Section 2 we first present some stylized facts about the dispersion of tariffs and the high volume of non-tradable goods, used in the production of intermediate goods in African countries belonging to the RTAs studied. We then present the model based on these facts and the data used. In Section 3 we present the results of the reduction in tariffs due to the implementation of these RTAs. Section 4 provides the conclusion section which outlines the policy implications of these results.

2 Tariffs, intermediate goods and sectoral linkages

2.1 Stylized facts

As explained in the introduction, multi-sector models are useful when tariffs inside an RTA bloc differ between sectors.

Figure (1) shows the maximum, the minimum and the average tariffs rates applied in the countries

[7] The goal of CGE is different than the one of NQTM that have flourished since the seminal contribution of Arkolakis et al. (2012). Thanks to their richness, CGE models are interesting to analyze the effect of trade liberalization on variables that are out of reach for NQTM (e.g. the effect of trade on the distribution of income or on poverty). In comparison, NQTM are useful to analyze simple question, such as the effect of trade integration on GDP and trade flows. On these questions, Kehoe & Rossbach (2017) by comparing the CP model with other CGE models, find that the CP framework outperforms other models for a significant number of the country pairs.

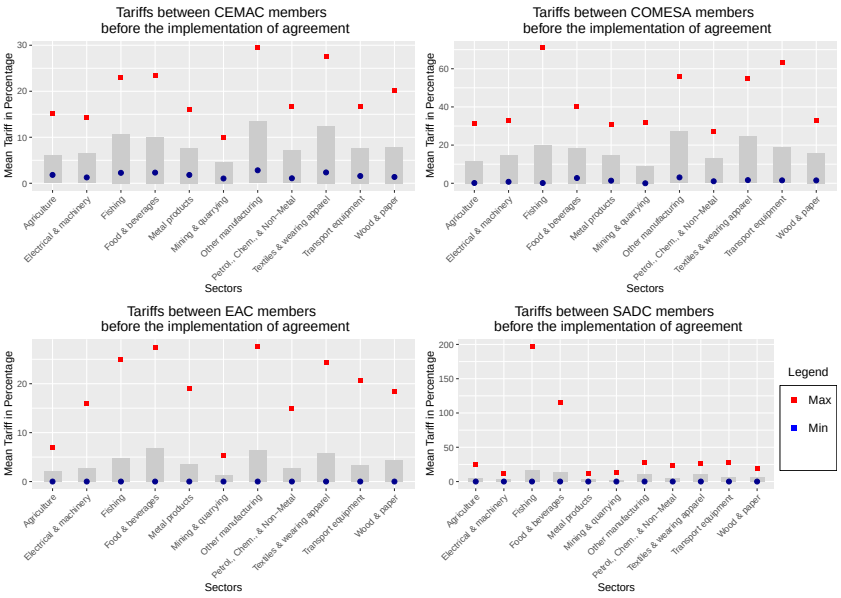

Figure 1: Tariffs between members for each agreement studied before implementation

of the four RTAs studied at the sectoral level of our analysis (before implementation of the RTAs). The source and the computation of these tariffs are described in the data section. The average tariff rate in the CEMAC and COMESA is between ten and twenty percent, while the EAC and SADC display a smaller average of around five percent or lower. The SADC stands out from the other RTAs by the small differences between the maximum and the minimum tariff rates in almost all sectors, with the noteworthy exception of Fishing and Mining. In all other RTAs, the dispersion is high. For example, gaps of 30%, 70% and 30% exist between the highest and the lowest tariffs in Textiles and Wearing apparel in the CEMAC, in Fishing in the COMESA and in Food and Beverages in the EAC respectively.

In respect of the volume of intermediate goods used by members of RTAs in Africa, we show in Figure (2) that in many sectors this percentage is far from being trivial. Materials are obviously less used in Africa than in developed countries; however, they represent a significant part of the production in Electrical and Machinery goods, in Food and Beverages, in Petroleum, and in Chemical and Non-Metallic Mineral goods. Obviously, while these figures include the domestic consumption of intermediate goods from non-tradable sectors, it is noteworthy that the share of intermediate goods traded by African countries is much smaller (around 5% for the aforementioned goods and even smaller for other sectors). However, what matters when considering trade liberalization is the inter-sectoral linkages that go beyond the sectors liberalized. Figure (2) indirectly indicates that non-tradable sectors are used in African intermediate sectors, and thus need to be considered to understand the consequences of RTAs.

To increase accuracy, Figure (3) reports the share of tradable and non-tradable goods of each countries inside each trade bloc. The results reinforce the fact previously outlined that non-tradable goods

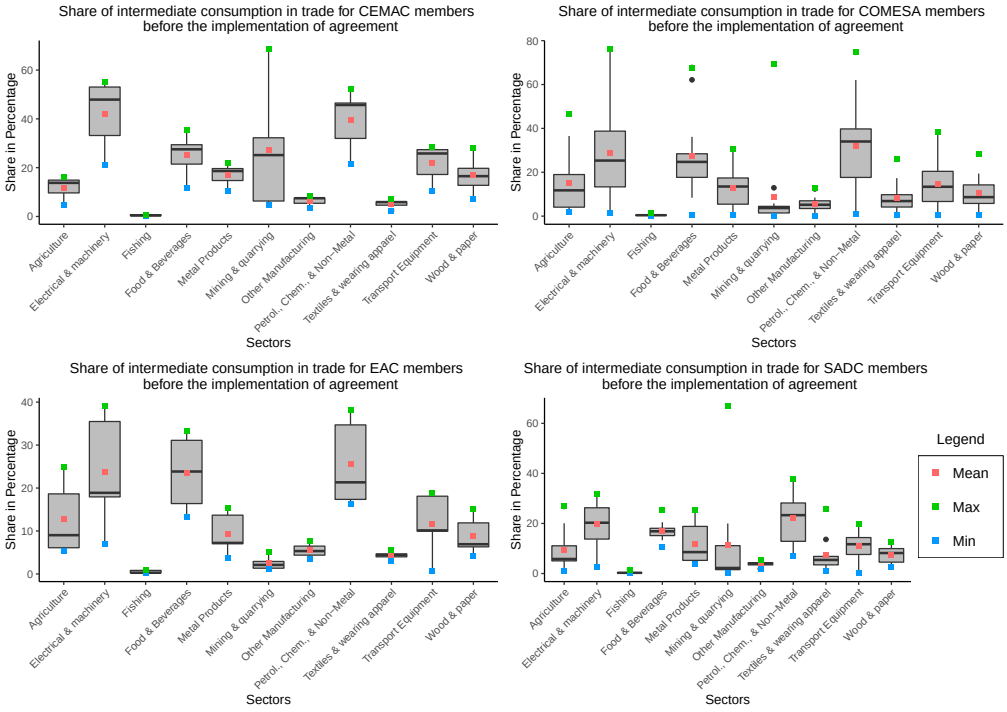

Figure 2: Share of intermediate input

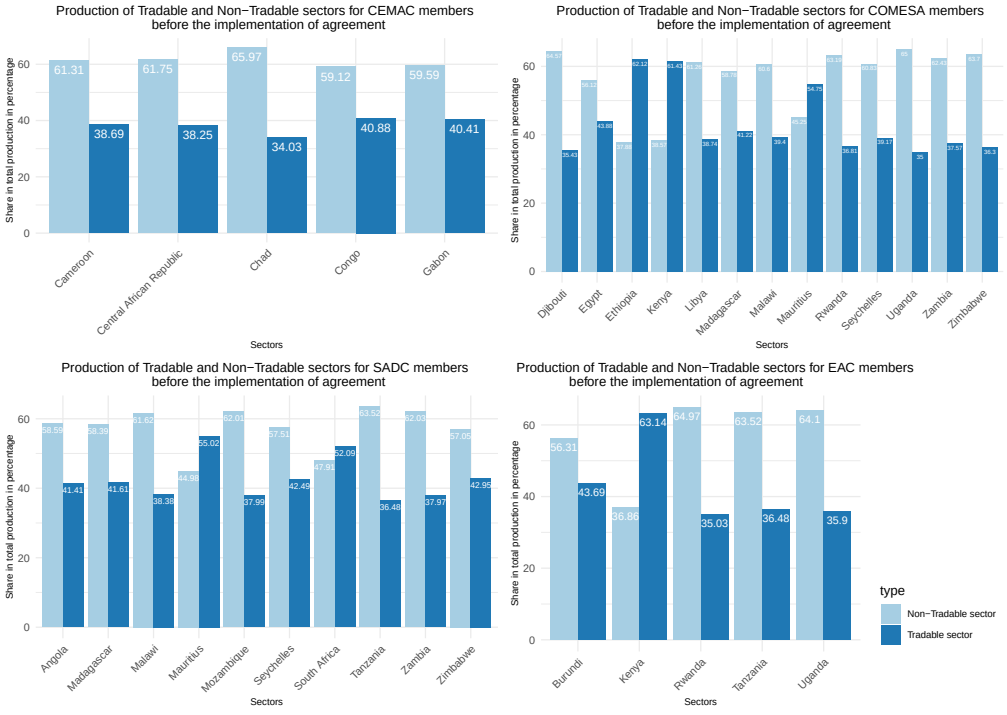

Figure 3: Production of Tradable and Non-Tradable sector for members of each agreement studied

represent in many cases a significant percentage of the production process (often around 60%).

The next section presents a model that takes into account all of these stylized facts.

2.2 The model

Our analysis is based on Caliendo & Parro (2014) who propose a multi-country and multi-sector Ricardian model (i.e. an extension of Eaton & Kortum (2002)). There are N countries and J sectors. Subscripts k and j are used for sectors, o and d for countries. This economy is composed of L representative households that maximize a Cobb-Douglas utility function of final goods denoted C_d^j, with α_d^j the preference parameter for these goods:

$$u(C_d) = \prod_{j=1}^{J} \left(C_d^j\right)^{\alpha_d^j}$$

which is maximized under the income constraint $I_d = C_d P_d$ where income depends on wages and on a lump-sum transfers of tariff revenues (defined later) with the consumption price index, P_d, given by:

$$P_d = \prod_{j=1}^{J} (P_d^j/\alpha_d^j)^{\alpha_d^j} \tag{1}$$

These final goods are produced in the intermediate sectors with the same technology than intermediate goods. A continuum of intermediate varieties, denoted $\omega^j \in [0,1]$ is produced in each sector j. These producers differ in their efficiency to produce by a factor $z_d^j(\omega^j)$ drawn from a Fréchet distribution. In this sector, the production is a Cobb-Douglas function with $\gamma_d^{k,j}$ the share of materials from sector k used in the production of intermediate good j, denoted $m_d^{k,j}(\omega^j)$, and γ_d^j the share of labour, $l_d^j(\omega^j)$. This production function is given by:

$$q_d^j = z_d^j(\omega^j)[l_d^j(\omega^j)]^{\gamma_d^j} \prod_{k=1}^{J} [m_d^{k,j}(\omega^j)]^{\gamma_d^{k,j}} \tag{2}$$

Labor is paid w_d and is mobile between sectors but not between countries. Intermediate goods, which are tradable and non-tradable goods, are produced under constant return to scale. Firms evolve under perfect competition and set the price at the unit cost $c_d^j/z_d^j(\omega^j)$ with c_d^j the cost of an input given by:

$$c_d^j = A_d^j w_d^{\gamma_d^j} \prod_{k=1}^{J} (P_d^k)^{\gamma_d^{k,j}} \tag{3}$$

where A_d^j is a constant (depending only of γ_d^j) and P_d^k the price index of intermediate goods. This equation describes sectoral linkages, where change in a price of one intermediate good affects the cost of other products.

The supply of all intermediate goods in the sector k and country d, following the Ethier (1982)

formulation, is given by:

$$Q_d^j = \left[\int r_d^j(\omega^j)^{1-\sigma^j} d\omega^j \right]^{1/(1-\sigma^j)}$$

where σ^j is the elasticity of substitution between intermediate goods within sector j and where $r_d^j(\omega^j)$ is the demand which after optimization is given by:

$$r_d^j(\omega^j) = \left[\frac{p_d^j(\omega^j)}{P_d^j} \right]^{-\sigma^j} Q_d^j$$

where $p_d^j(\omega^j)$ is the lowest price of intermediate good ω^j across all location d (defined below). Trade costs, κ, depend on tariffs and distance:

$$\kappa_{do}^j = \tilde{\tau}_{do}^j d_{do}^j \tag{4}$$

with $\tilde{\tau}_{do}^j = (1 + \tau_{do}^j)$ where τ_{do}^j is the ad-valorem tariff and d_{do} the distance between o and d.

Producers in sector j in country d supply a composite intermediate good by purchasing intermediate goods ω^j from the lowest cost suppliers across countries. Since trade costs take the form of iceberg costs, a tradable good produced in o is available at location d at the following price:

$$p_d^j(\omega^j) = \min \left\{ \frac{c_o^j \kappa_{do}^j}{z_o^j(\omega^j)} \right\}$$

Infinite international trade costs are assumed for non-tradable goods as well as zero local trade costs such as $p_d^j(\omega^j) = c_d^j / z_d^j(\omega^j)$.

Using all these assumptions, the price index of composite goods is given by:

$$P_d^j = A^j \left[\sum_{o=1}^{N} \lambda_o^j (c_o^j \kappa_{od}^j)^{-\theta^j} \right]^{-1/\theta^j} \tag{5}$$

with A^j a constant, λ_d^j the location parameter of the Fréchet distribution that varies by country and sector, and θ^j the shape parameter of this distribution that is sector specific.

Finally the market clearing condition on the good market equals the supply to the demand of final goods and intermediate goods:

$$Q_d^j = C_d^j + \sum_{k=1}^{J} \int m_d^{j,k}(\omega^j) d\omega^j.$$

Using the properties of the Fréchet distribution, the expenditure shares, denoted π_{do}^j, takes the following

form:

$$\pi_{do}^{j} = \frac{\lambda_o^j [c_o^j \kappa_{do}^j]^{-\theta^j}}{\sum_{h=1}^{N} \lambda_h^j [c_h^j \kappa_{dh}^j]^{-\theta^j}} \tag{6}$$

This share is thus just a function of prices, technologies and trade costs. Total expenditures on goods j, X_d^j, is the sum of the expenditures such as:

$$X_d^j = \sum_{k=1}^{j} \gamma_d^{j,k} \sum_{o=1}^{N} X_o^k \frac{\pi_{od}^k}{1+\tau_{od}^k} + I_d \alpha_d^j \tag{7}$$

where the final absorption in country d, I_d, depends on wages w_d, tariff revenues $R_d = \sum_{j=1}^{J} \sum_{i=1}^{N} \tau_{do}^j M_{do}^j$ (with M_{do}^j the amount imported $M_{do}^j = X_d^j \frac{\pi_{do}^j}{1+\tau_{do}^j}$) and trade deficit D_d:

$$I_d = w_d L_d + R_d + D_d$$

with D_d the trade deficit which is the sum of sectoral deficits, $D_d = \sum_{k=1}^{J} D_d^k$ such as $D_d^k = \sum_{o=1}^{N} M_{do}^j - \sum_{o=1}^{N} E_{do}^j$ where the export E_{do}^j is given by $E_{do}^j = X_o^j \frac{\pi_{od}^j}{1+\tau_{od}^j}$. Aggregate trade deficits in each country are exogenous but sectoral trade deficits are endogenously determined.

The model is solved for changes in prices and wages after a discrete change in tariff from τ to τ'. All the variables that are affected by this new tariff are analyzed in relative change and denoted with a "hat" (i.e. $\hat{x} = x'/x$). Then the equilibrium is get from the following equations with the cost of the input:

$$\hat{c}_d^j = \hat{w}_d^{\gamma_d^j} \prod_{k=1}^{J} (\hat{P}_d^k)^{\gamma_d^{k,j}}, \tag{8}$$

the price index:

$$\hat{P}_d^j = \left[\sum_{o=1}^{N} \pi_{do}^j [\hat{\kappa}_{do}^j \hat{c}_0^j]^{-\theta^j} \right]^{\frac{-1}{\theta^j}} \tag{9}$$

the trade share:

$$\hat{\pi}_{do}^j = \left[\frac{\hat{\kappa}_{do}^j \hat{c}_0^j}{\hat{P}_d^j} \right]^{-\theta^j} \tag{10}$$

with $\widehat{\kappa} = (1+\tau_{do}^{j'})/(1+\tau_{do}^j)$.

Total expenditures in each country and sector is defined by:

$$X_d^{j'} = \sum_{k=1}^{j} \gamma_d^{j,k} \sum_{o=1}^{N} \frac{\pi_{od}^{k'}}{1+\tau_{od}^{k'}} X_o^{k'} + \alpha_n^j I_n^{'}. \tag{11}$$

with $I_n^{'} = \widehat{w_d} w_d L_d + \sum_{j=1}^{J} \sum_{i=1}^{N} \tau_{do}^{j'} \frac{\pi_{do}^{j'}}{1+\tau_{do}^{j'}} X_d^{j'} + D_d$.

Using the definition of expenditures and trade deficits gives the trade balance:

$$\sum_{j=1}^{J} \sum_{o=1}^{N} \frac{\pi_{do}^{j'}}{1+\tau_{do}^{j'}} X_d^{j'} - D_d = \sum_{j=1}^{J} \sum_{o=1}^{N} \frac{\pi_{od}^{j'}}{1+\tau_{od}^{j'}} X_o^{j'} \tag{12}$$

These five equations (8), (9), (10), (11) and (12) give the equilibrium in relative changes. The great advantage of this system is that it can be resolved with few data and estimations. Only tariffs, trade shares, value added, production and their respective shares and the sectoral dispersion of productivity are necessary. The trade elasticities are here directly determined by the dispersion of productivity θ^j which are the only parameter that need to be estimated for the quantitative trade policy assessment of RTAs.

2.3 Taking the Model to the Data

2.3.1 Elasticity

The impact of RTAs on welfare gains depend crucially on trade elasticity. With a high θ^j, the productivity is concentrated and goods are not substitute. As a result a change in tariff will not have a strong effect on the share of traded goods because producers of the composite aggregate are less likely to change their suppliers. This means that our results depend on the values of these elasticities. Here, we use the sectoral elasticities of Caliendo & Parro (2014). These authors use the expenditure share (6) and a triple differentiation to estimate only from tariffs these elasticities, reported in Table 5 of Appendix A.

2.3.2 Data

In order to assess the impact of RTAs in Africa, we define a baseline year before the implementation of these agreements, called "benchmark", and a year after the implementation, called counterfactual. Depending on the agreement analyzed (and of the data availability), different time periods are analyzed. For CEMAC and COMESA, the reference year is 1995, and the counterfactual is based on 2007, for EAC and SADC, the benchmark and counterfactual years are respectively 2006 and 2016.

Value added (V_d^j)[8], input-output coefficients and gross production (Y_d^j) come from the EORA global

[8]These data with the production are employed to compute shares of value added.

supply chain database Lenzen et al. (2012, 2013)) for the aforementioned years. This database consists of a multi-region input-output time series (1990-2015) for 26 sectors and 190 countries. Bilateral trade flows come from BACI (Gaulier & Zignago (2010)), international trade database at 6-digit level of aggregation, provided by CEPII. Bilateral tariff data (Most-Favoured-Nation are employed and replaced by Preferential tariff if the information is available) at the sectoral level come from United Nation Conference on Trade And Development Trade Analysis Information System (UNCTAD-TRAINS) for the year of benchmark and counterfactual as described above. Due to lack of data, some tariffs are taken in the previous four year for the benchmark and the next four years for the counterfactual[9]. Furthermore, tariffs used in the analysis are tariffs weighted by the total imports of each country (we take the mean of two or three years covering the period). In order to maintain a single classification, trade flows and tariffs are converted to EORA classification. This is done in two steps. First, by using the World Integrated Trade Solutions (WITS) correspondence tables, we move from the HS nomenclature to the 4-digit ISIC Rev 3 nomenclature. Then, the transition from ISIC to EORA classification is made through the classification proposed by Lenzen et al. (2012, 2013). Our counterfactual exercises cover 11 sectors, 46 countries and 56 countries for COMESA/CEMAC and EAC/SADC, respectively [10], including an aggregated rest of the world.

2.4 Tariff, real wage and welfare

To understand the result of the quantitative model, it is useful to decompose the effect of tariffs on real wage and welfare.

Using the cost function (8) with trade shares (10), the counterfactual change in real wages is solved in each sector j as a function of the share of expenditures on domestic goods and sectoral prices. Using this expression in the consumption expenditure shares, gives the following expression:

$$\ln \frac{\hat{w}_d}{\hat{P}_d} = \underbrace{-\sum_{j=1}^{J} \frac{\alpha_d^j}{\theta^j} \ln \hat{\pi}_{dd}^j}_{final\,goods} \underbrace{-\sum_{j=1}^{J} \frac{\alpha_d^j}{\theta^j} \frac{1-\gamma_d^j}{\gamma_d^j} \ln \hat{\pi}_{dd}^j}_{Intermediate\,goods} \underbrace{-\sum_{j=1}^{J} \frac{\alpha_d^j}{\gamma_d^j} \ln \prod_{k=1}^{J} \left(\hat{P}_d^k / \hat{P}_d^j\right)^{\gamma_d^{k,j}}}_{Sectoral\,linkages} \tag{13}$$

This decomposition allows to illustrate how real wages are affected in an economy with intermediate goods and sectoral linkages. For instance, the same model where intermediate goods are produced with

[9] In the case of counterfactual of EAC and SADC, we don't have tariffs for Cameroon and Djibouti. These countries not being part of these agreements, tariffs are replace for previous year of counterfactual (2014 for both countries).

[10] Appendix A, tables 2 and 3 give the list of countries used in this study. Namibia, South Africa, Botswana, Lesotho and Swaziland being part of SACU and BACI Gaulier & Zignago (2010) providing only aggregated flows for this zone, these are aggregated together for the rest of data (VA, tariffs, production).

labor only $\gamma_d^j = 1$ gives a very simple equation:

$$\ln \frac{\hat{w}_d}{\hat{P}_d}\Big|_{\gamma_d^j=1} = -\sum_{j=1}^{J} \frac{\alpha_d^j}{\theta^j} \ln \hat{\pi}_{dd}^j$$

Then, changes in wages depend mainly on sectoral elasticity θ^j and on the share of this sector in the final demand α_d^j. In this model, the aggregate effect of tariff reduction on producers of these goods does not play any role on welfare. Indeed, there are no reduction in the price of intermediate goods and so the gain coming from the decrease in the cost of production is simply not taken into account. Lastly, the effect of sectoral linkages in the general model (13) depends on the ratio between the share spent on final goods and the share of value added in production (α_d^j/γ_d^j). As this ratio increases, the effect of sectoral linkages on real wages increases.

Totally differentiating the welfare function of the representative consumer in country d yields:

$$d\,ln\,W_d = \frac{1}{I_d}\sum_{j=1}^{J}\sum_{o=1}^{N}\left(E_{do}^j d\,ln\,c_d^j - M_{do}^j d\,ln\,c_o^j\right) + \frac{1}{I_d}\sum_{j=1}^{J}\sum_{o=1}^{N}\tau_{do}^j M_{do}^j\left(d\,ln\,M_{do}^j - d\,ln\,c_o^j\right) \tag{14}$$

This expression enables to decompose the welfare impact of tariffs into terms of trade and volume of trade effects across countries and sectors. The terms of trade given by the first part of equation (14) measure the gains of an increase in exporter prices relative to a change in importer prices from tariff reduction. This component impacts the welfare through the sectoral deficit and sectoral prices. The second part represents the volume of trade and measures the gain of an increase in the volumes of trade from tariff reduction.

At the national level, the change in bilateral Terms of Trade (hereafter denoted ToT_{do}) and the change in the bilateral Volume of Trade (VoT_{do}) are respectively given by:

$$ToT_{do} \equiv \sum_{j=1}^{J}\left(E_{do}^j \triangle\, ln\, c_d^j - M_{do}^j \triangle\, ln\, c_o^j\right), \tag{15}$$

$$VoT_{do} \equiv \sum_{j=1}^{J}\tau_{do}^j M_{do}^j\left(\triangle ln\, M_{do}^j - \triangle ln\, c_o^j\right). \tag{16}$$

The change in the sectoral terms of trade and volume of trade are similarly given by:

$$ToT_d^j \equiv \sum_{i=1}^{N}\left(E_{do}^j \triangle\, ln\, c_d^j - M_{do}^j \triangle\, ln\, c_o^j\right), \tag{17}$$

$$VoT_d^j \equiv \sum_{i=1}^{N}\tau_{do}^j M_{do}^j\left(\triangle ln\, M_{do}^j - \triangle ln\, c_o^j\right). \tag{18}$$

Then the welfare change takes the following form:

$$\triangle ln\, W_d = \frac{1}{I_d} \sum_{j=1}^{J} \left(VoT_d^j + ToT_d^j \right) \tag{19}$$

Using data from I-O tables, trade flows (M_{do}^j), value added (V_d^j) and gross production (Y_d^j) we get π_{do}^j, γ_d^j, $\gamma_d^{j,k}$ and α_d^j, and with the estimates of sectoral productivity dispersion θ^j, we can solve the model for tariff changes in order to study how real wages (13) and welfare (14, 15, 16, 17, 18) have been affected by each agreement and by trade liberalization in general.

3 Main results

3.1 Country analysis

3.1.1 General effects

We analyze the effects of each RTA separately. To compute the effects of each RTA, we introduce two different shocks. In each case we calibrate the model on the year when the RTA was signed, i.e., before its implementation, and we take into account trade deficits. In the first shock, we introduce the observed change in the world tariff structure before and after the implementation. In the second shock, we still consider the observed change in the world tariff structure before and after the implementation but holding the RTAs tariffs fixed. The difference between these two simulations allows the isolation of the effects of RTAs from other changes in the world.

In Column 1 of Tables 4, we provide results concerning welfare change (see Equation 14) while Column 2 and 3 of these tables reveal the source of this change by analyzing changes in the terms of trade and in the volume of trade (Equations 15, 16). Finally, Column 4 provides the impact of RTAs on real wages (Equation 13).

The primary result of this analysis is that RTAs are not beneficial for all partners; however, losses (and gains) are small. Eleven participating countries see their welfare decrease after the implementation of these RTAs but the maximum losses represent a decrease in welfare of only 0.1% and other losses are even smaller at the country level. Gains are more significant, with the maximum gain at around 0.8%; however, in most cases the gains are around 0.1%. The EAC is detrimental to Kenya and Burundi which undergo a decrease in welfare (and real wages) due to a simultaneous deterioration in their volumes and terms of trade. Rwanda, Tanzania and Uganda are the winners of this agreement, benefiting from a rise in well-being brought about by an improvement in their volumes and terms of trade. This result is worth commenting on in the light of the historical formation of the EAC. Founded in 1967 by the three

EAC				
	Welfare			
	Total	ToT	VoT	Real Wage
Burundi	-0.11	-0.051	-0.055	-0.59
Kenya	-0.056	-0.022	-0.034	-0.38
Rwanda	0.14	0.017	0.12	0.65
Tanzania	0.029	0.012	0.017	0.094
Uganda	0.045	0.0092	0.036	0.13
CEMAC				
	Welfare			
	Total	ToT	VoT	Real Wage
C. Afr Rep.	-0.053	-0.012	-0.041	-0.21
Cameroon	0.2	0.18	0.019	0.59
Congo	-0.071	-0.26	0.23	-1.1
Gabon	0.18	-0.22	0.4	0.11
Chad	-0.032	-0.012	-0.02	-0.13
COMESA				
	Welfare			
	Total	ToT	VoT	Real Wage
Djibouti	0.47	-0.13	0.6	3.7
Egypt	-0.0036	-0.01	0.0066	-0.34
Ethiopia	0.84	0.46	0.38	7.3
Kenya	0.42	0.19	0.23	1.9
Libya	0.29	0.21	0.076	1.0
Madagascar	0.061	0.023	0.038	0.3
Mauritius	0.16	0.094	0.069	0.77
Malawi	0.019	0.021	-0.0016	0.27
Rwanda	-0.062	-0.057	-0.0045	-5.3
Seychelles	0.03	-0.026	0.056	-1.4
Uganda	0.011	-0.03	0.041	0.24
Zambia	0.12	0.061	0.061	0.27
Zimbabwe	0.075	0.038	0.037	0.29
SADC				
	Welfare			
	Total	ToT	VoT	Real Wage
Angola	0.015	-0.037	0.052	0.11
Madagascar	-0.011	-0.057	0.046	-0.74
Mozambique	-0.3	-0.38	0.08	-1.1
Mauritius	-0.0057	-0.0058	0.00017	0.01
Malawi	-0.37	-0.13	-0.24	-1.6
Seychelles	0.27	-0.044	0.31	0.14
Tanzania	-0.12	-0.072	-0.048	-0.74
SACU	0.063	0.055	0.0074	0.29
Zambia	0.027	-0.29	0.32	0.088
Zimbabwe	0.66	-0.055	0.72	1.7

Figure 4: Welfare Effects of tariff reduction

countries Kenya, Tanzania and Uganda, the first EAC collapsed in 1977 on the grounds that Kenya was taking the lion's share of the benefits of the EAC. Members of the new EAC implemented in 2000 by Kenya, Tanzania and Uganda and then by Rwanda and Burundi in 2007, adopted a more positive point of view by regarding this regional integration as mutually beneficial. Table 4 shows that this point of view is neither totally right nor totally wrong, as at least the largest economy of the bloc cannot be accused of being the winner that takes all the benefits. Furthermore, the fact that Rwanda is the country that benefits the most from this RTA, may explain its decision to withdraw its application to join the SADC, in favor of reinforcing its current membership of the EAC.

In the CEMAC, the two landlocked countries, the Central African Republic and Chad, are negatively impacted but the total loss in terms of welfare is very small (between 0.03% and 0.05%). The deterioration in the terms of trade is observed in all partners with the exception of the most diversified economy, Cameroon, which benefits the most from this agreement. However, even for this winner, the gains are small, at around 0.2% in terms of welfare. Half of the members of the SADC, are negatively affected (Madagascar, Mozambique, Mauritius, Malawi and Tanzania) with the size of their losses varying between 0.001% and 0.4%. Zimbabwe and the Seychelles are the two beneficiaries with an increase in welfare of around 0.7% and 0.3% respectively. This positive effect arises from an increase in their volumes of trade which compensates for the deterioration in their terms of trade.

If we consider the COMESA as a laboratory to analyze a large free trade area that regroups different existing RTA areas (the COMESA includes the countries of the EAC and the majority of countries belonging to the SADC), then the conclusions arising from Table 4 are a warning to be circumspect about the prospective benefits of such an arrangement. A comparison between the COMESA and SADC, shows that five countries that are participants in these two agreements are slightly better-off in the largest bloc (Zambia, Zimbabwe, Malawi, Mauritius and Madagascar) and only one country, the Seychelles, is worse-off. However, these results reflect more the limited opportunities in the SADC than the relative success of the COMESA. Indeed, by now analyzing the two countries that belong to both the COMESA and EAC (Rwanda and Uganda), we observe that they gain more in the smallest bloc.

So far, trade diversion has not been caught, and to tackle it, Table 5 decomposes ToT (in Columns 1 and 2) and VoT (in Columns 3 and 4) by considering exchanges between countries in the RTAs and the Rest-of-the World (RoW).

In the CEMAC and SADC an important part of the losses occurring comes from a diversion effect from the RoW, as both the volume and the terms of trade deteriorate. This result is particularly obvious in the SADC group, where all countries (with the exception of the Southern African Customs Union countries) suffer a deterioration in their ToT and VoT with the RoW. For instance, the deterioration in ToT observed for Zambia in the previous section, is mainly due to a diversion effect (-0.23%). In a

EAC				
	ToT		VoT	
	EAC	RoW	EAC	RoW
Burundi	-0.01	-0.041	0.033	-0.087
Kenya	-0.0053	-0.017	0.0004	-0.034
Rwanda	0.0091	0.0077	0.017	0.1
Tanzania	0.0036	0.0084	-0.0041	0.021
Uganda	0.0055	0.0037	-0.007	0.043
CEMAC				
	ToT		VoT	
	CEMAC	RoW	CEMAC	RoW
C. Afr Rep.	-0.01	-0.041	0.033	-0.087
Cameroon	-0.0053	-0.017	0.0004	-0.034
Congo	0.0091	0.0077	0.017	0.1
Gabon	0.0036	0.0084	-0.0041	0.021
Chad	0.0055	0.0037	-0.007	0.043
COMESA				
	ToT		VoT	
	COMESA	RoW	COMESA	RoW
Djibouti	-0.13	0.00076	1.7	-1.1
Egypt	-0.0029	-0.0073	0.11	-0.1
Ethiopia	0.056	0.4	0.78	-0.4
Kenya	0.043	0.15	0.0092	0.22
Libya	0.004	0.21	0.0075	0.068
Madagascar	-0.0043	0.027	0.048	-0.0096
Mauritius	-0.0016	0.095	0.0067	0.062
Malawi	-0.0063	0.027	0.0095	-0.011
Rwanda	-0.0026	-0.055	0.8	-0.81
Seychelles	-0.012	-0.014	0.95	-0.89
Uganda	-0.037	0.0069	0.089	-0.047
Zambia	-0.0017	0.063	0.069	-0.0082
Zimbabwe	0.0016	0.037	0.0029	0.034
SADC				
	ToT		VoT	
	SADC	RoW	SADC	RoW
Angola	0.0033	-0.04	0.074	-0.022
Madagascar	-0.0042	-0.053	0.25	-0.21
Mozambique	-0.1	-0.28	0.25	-0.17
Mauritius	-0.0043	-0.0015	0.0046	-0.0045
Malawi	0.03	-0.16	0.25	-0.5
Seychelles	-0.013	-0.031	3.0	-2.7
Tanzania	-0.017	-0.055	0.11	-0.16
SACU	0.0066	0.049	6.7e-05	0.0073
Zambia	-0.056	-0.23	0.39	-0.074
Zimbabwe	-0.0055	-0.049	0.84	-0.12

Figure 5: Bilateral Welfare Effects from Tariff Reduction

similar way, the decrease in the VoT in Malawi and Seychelles comes from a reduction in trade with the RoW of -0.5% and -2.7% respectively. Although these effects remain small, they do not bode well for African countries that are already highly marginalized from international trade.

Trade diversion is less general in respect of the COMESA countries at least when we observe their terms of trade; however, when looking at the volume of trade many countries see a decrease in their exchanges (Djibouti, Egypt, Ethiopia, Madagascar, Malawi, etc). Diversion effects are even smaller in the EAC where only Burundi and Kenya suffer a very small deterioration in their ToT and VoT with the RoW.

Interestingly, due to the relative similar specializations of African countries, inside each agreement some exporters are crowded out by increased competition, which explains the negative trade creation effect (i.e., a trade destruction effect). Indeed, inside each bloc many countries also suffer from a decline in their terms of trade with theirs RTA partners. In terms of decreased ToT, this applies to seven countries in the SADC bloc, nine in the COMESA, and two in the CEMAC and EAC.

In conclusion, the trade creation effects of RTAs in Africa are small and often smaller (or negative) compared to the trade diversion effects, which explains the losses observed in each agreement or the small beneficial effects of these agreements.

3.2 Sectoral analysis

The table 6 presents the sectoral contribution on welfare.

The agricultural sector is responsible for the bulk of our results concerning the deterioration in the ToT in many countries. More than 80% of changes to the ToT in Djibouti, Rwanda (COMESA), Malawi (SADC), and for the Central African Republic and Chad (CEMAC) are due to the agricultural sector. The contribution of this sector is smaller for the EAC; however, it accounts for more than 50% of the change in Kenya. In some countries, the agricultural sector is responsible for the deterioration in the ToT (e.g., Kenya) while in others, this sector is the source of an improvement (e.g., Rwanda), revealing that RTAs in Africa which have competing producers of similar goods, can have small effects at the aggregated level but a high impact at the sectoral one.

Depending on the specialization of countries, other sectors also explain an important part of the changes, such as Textile and Clothing in Madagascar (30%), Metal Products in Mozambique (56%), and Mining and Quarrying in Egypt (37%). These results come from the significant reduction in tariffs which are magnified by the volume of materials used in the production. Indeed, the large volumes of materials used in production and the strong reductions in tariffs have a big impact on sectoral export prices and then on the sectoral contribution to welfare.

EAC		Agri	Fishing	Mining & Quar-	Food & Beverag	Textiles Wearing	Wood and	Pet, Chem &	Metal	Electrical &	Trans- port	Other Manu
Burundi	ToT	21,50	41,00	2,33	0,50	-0,16	-0,13	-0,43	2,05	26,20	5,76	1,41
	VoT	-8,12	-0,35	4,47	-0,62	5,76	13,60	38,50	7,09	33,20	3,66	2,81
Kenya	ToT	56,60	1,97	5,46	6,90	8,56	2,25	7,61	6,24	2,50	0,10	1,83
	VoT	53,90	0,59	0,14	8,90	6,21	6,14	12,50	3,76	4,81	1,14	1,89
Rwanda	ToT	61,90	0,21	16,40	1,31	1,36	1,47	4,49	3,68	7,39	0,27	1,52
	VoT	4,90	0,02	3,96	1,98	3,17	9,00	25,40	20,90	28,90	0,15	1,65
Tanzania	ToT	27,40	38,60	6,92	5,11	1,29	1,61	7,81	6,44	3,82	0,12	0,94
	VoT	2,18	0,12	3,06	22,90	11,70	12,00	16,70	18,70	10,90	0,30	1,52
Uganda	ToT	28,00	15,90	14,50	7,59	1,95	3,91	12,30	7,63	6,51	0,14	1,56
	VoT	3,30	0,10	14,80	24,50	8,67	13,10	16,20	13,40	5,59	0,05	0,34

CEMAC		Agri	Fishing	Mining & Quar-	Food & Beverag	Textiles Wearing	Wood and	Pet, Chem &	Metal	Electrical &	Trans- port	Other Manu
C Afr. Rep	ToT	84,50	1,45	3,20	-0,55	-1,63	-0,03	3,01	7,16	2,66	0,18	0,09
	VoT	8,38	0,31	0,62	34,80	2,83	2,69	9,85	20,50	17,60	0,53	1,86
Cameroon	ToT	70,50	0,34	20,50	1,11	0,14	0,22	0,75	5,83	0,57	0,02	0,04
	VoT	0,21	3,13	-2,19	20,80	3,83	4,89	20,70	23,00	21,20	2,07	2,40
Congo	ToT	35,40	1,69	58,50	1,37	0,10	0,08	0,62	0,81	1,33	0,03	0,04
	VoT	1,52	-1,22	0,00	55,20	-4,82	5,22	81,60	-26,40	-10,80	-0,64	0,26
Gabon	ToT	35,80	0,83	63,60	-0,09	0,01	-0,02	-0,08	-0,03	0,00	0,03	0,00
	VoT	1,07	-0,01	0,77	72,30	0,11	0,97	8,91	12,30	2,04	-0,02	1,54
Chad	ToT	82,80	0,03	5,34	3,13	0,18	1,66	1,43	1,57	1,57	2,17	0,14
	VoT	9,08	0,14	5,00	44,80	2,91	4,86	9,17	9,23	12,60	0,29	1,87

COMESA		Agri	Fishing	Mining & Quar-	Food & Beverag	Textiles Wearing	Wood and	Pet, Chem &	Metal	Electrical &	Trans- port	Other Manu
Djibouti	ToT	81,40	-0,15	22,80	0,58	-0,13	-0,15	-1,03	-1,53	-1,64	-0,01	-0,10
	VoT	53,20	0,05	1,56	4,66	7,05	1,83	21,70	2,57	6,82	0,06	0,43
Egypt	ToT	30,80	0,32	37,20	2,23	6,89	0,63	5,75	13,40	1,70	0,28	0,80
	VoT	-39,00	-3,52	-2,69	6,93	-49,20	-74,30	417,00	5,88	-146,00	-8,63	-6,31
Ethiopia	ToT	67,00	0,04	4,33	26,70	0,39	-0,14	-0,44	1,90	0,21	0,09	-0,05
	VoT	10,30	2,05	2,71	11,00	26,30	4,36	8,55	13,00	13,50	0,52	7,79
Kenya	ToT	66,40	5,14	5,85	5,13	2,64	1,55	4,47	5,02	2,88	0,04	0,92
	VoT	13,50	-0,36	0,94	5,33	13,60	8,94	29,50	12,10	13,80	0,35	2,26
Libya	ToT	0,29	0,08	88,80	0,33	0,01	0,02	7,94	2,45	0,11	0,00	0,01
	VoT	5,59	0,06	0,26	5,16	5,80	6,53	35,40	8,42	25,10	3,76	3,95
Madagascar	ToT	38,50	30,90	9,50	9,64	9,48	0,60	0,29	-0,19	0,46	0,12	0,72
	VoT	13,20	0,02	0,00	0,94	73,60	2,22	3,05	2,57	4,01	0,09	0,31
Mauritius	ToT	9,83	1,51	-5,50	25,20	62,10	0,10	1,19	1,61	2,56	0,09	1,33
	VoT	11,30	1,25	0,43	9,45	1,40	7,16	23,80	18,90	15,20	6,00	5,16
Malawi	ToT	107,00	0,12	-2,45	4,05	4,86	-2,11	-6,65	-3,78	-1,07	0,04	-0,35
	VoT	451,00	-2,89	-6,23	-32,90	-17,80	-18,80	-76,90	-73,30	-105,00	-1,65	-14,60
Rwanda	ToT	88,60	0,21	1,91	4,12	0,16	0,03	1,68	1,45	1,41	0,00	0,46
	VoT	12,70	137,00	-10,70	-588,00	8,34	273,00	-16,90	-144,00	910,00	4,73	-66,10
Seychelles	ToT	22,60	17,00	24,90	14,80	1,40	6,73	5,86	3,16	2,76	0,40	0,50
	VoT	77,70	141,00	-14,80	67,10	5,50	19,30	-37,70	-62,00	-71,80	-7,54	-17,20
Uganda	ToT	-15,10	-2,38	39,90	11,30	2,30	5,51	18,90	24,70	8,32	0,27	6,33
	VoT	-4,14	0,00	0,09	25,60	17,30	9,35	34,30	1,16	1,16	0,87	14,40
Zambia	ToT	15,00	0,11	2,11	-0,07	0,05	-0,27	-0,05	82,20	0,96	0,19	-0,21
	VoT	6,24	0,90	2,05	33,60	10,70	8,12	20,90	4,82	7,42	0,31	5,02
Zimbabwe	ToT	49,40	0,29	7,01	12,00	3,74	1,10	2,59	20,30	2,02	0,28	1,24
	VoT	4,68	0,89	1,91	8,15	2,15	12,50	29,90	12,80	24,80	1,59	0,57

SADC		Agri	Fishing	Mining & Quar-	Food & Beverag	Textiles Wearing	Wood and	Pet, Chem &	Metal	Electrical &	Trans- port	Other Manu
Angola	ToT	-0,51	0,95	107,00	-1,61	-0,12	-0,13	-0,56	-2,42	-1,18	-0,81	-0,37
	VoT	2,82	2,65	2,67	22,60	2,88	3,47	35,60	20,90	1,00	0,29	5,09
Madagascar	ToT	20,10	22,00	5,27	7,10	30,80	4,37	2,01	3,53	2,82	0,54	1,41
	VoT	-16,10	-0,13	-5,67	16,20	-4,59	91,20	2,79	9,14	0,57	-0,74	7,26
Mozambique	ToT	13,40	6,72	15,60	3,41	0,32	0,25	1,63	56,60	1,51	0,36	0,12
	VoT	-8,43	-4,04	-2,66	43,00	4,71	14,70	38,00	-7,98	13,90	-0,44	9,32
Mauritius	ToT	-23,30	-16,10	29,60	26,10	14,70	7,23	17,50	27,30	13,90	1,16	1,94
	VoT	-349,00	-5,64	-1,96	761,00	-13,50	-20,20	-241,00	-47,30	-53,50	-13,70	84,90
Malawi	ToT	111,00	0,09	-37,20	10,20	5,51	1,02	2,16	2,01	4,78	0,21	0,34
	VoT	2,07	0,01	0,03	-8,29	-2,33	-5,57	142,00	-15,10	-8,68	0,13	-4,16
Seychelles	ToT	2,74	30,00	29,00	22,50	0,43	0,93	3,01	3,95	6,45	0,49	0,44
	VoT	1,07	15,60	0,00	82,50	0,85	-0,01	0,05	-0,02	-0,07	0,01	-0,02
Tanzania	ToT	29,90	45,70	5,57	1,99	0,57	0,95	4,52	6,64	3,81	0,21	0,18
	VoT	4,68	0,29	5,60	8,36	-2,23	25,80	30,00	14,80	12,60	0,52	-0,48
SACU	ToT	6,41	33,80	16,50	3,63	1,82	1,71	6,21	20,20	8,24	0,77	0,65
	VoT	6,63	0,35	0,09	4,76	26,50	8,31	30,00	7,02	11,20	3,40	1,74
Zambia	ToT	19,70	1,35	12,00	1,73	0,12	0,31	1,74	60,50	2,39	0,15	0,10
	VoT	4,47	0,80	-0,78	5,33	4,64	4,17	64,40	5,64	8,29	0,48	2,59
Zimbabwe	ToT	15,50	14,20	-68,50	7,80	1,60	8,50	46,80	53,50	15,10	3,50	2,10
	VoT	2,94	0,03	0,61	3,19	2,13	5,20	82,60	0,62	2,01	0,28	0,42

Figure 6: Sectoral Contribution to Welfare Effects from Tariff Reductions (with elasticities from Caliendo and Parro's Methodology)

The impact on the VoT is more balanced and new sectors have a significant positive contribution, such as Wood and Paper in Madagascar, Electrical and Machinery in Egypt, Food and Beverages in Zambia and Fishing in Tanzania. Finally and quite logically, the Petroleum/Chemical sector and the industrial sector producing metal products explain the volume of trade in Angola, Congo and Egypt. These sectors are relatively homogeneous, and thus even a small change in tariffs has a strong impact on trade since it is easy to find substitute suppliers.

To study how African RTAs have affected sectoral specialization, Table 7 presents the Herfindalh Index of Exports Concentration before and after RTA implementation. The interesting result is that depending on the RTA implemented the effect on specialization is very different. The effect of the CEMAC is almost zero in that respect. In the COMESA, Ethiopia and Rwanda reinforce their specialization in agricultural products and suffer a decrease in Foods and Beverages, while the opposite holds true for Kenya and Zambia. In comparison the SADC has led to an increase in specialization in many countries.

EAC		
	Before	After
Burundi	0.19	0.2
Kenya	0.13	0.16
Rwanda	0.29	0.28
Tanzania	0.2	0.19
Uganda	0.2	0.22

CEMAC		
	Before	After
Central Afr.	0.49	0.54
Cameroon	0.43	0.38
Congo	0.58	0.56
Gabon	0.68	0.68
Chad	0.79	0.79

COMESA		
	Before	After
Djibouti	0.19	0.17
Egypt	0.17	0.16
Ethiopia	0.56	0.59
Kenya	0.25	0.18
Libya	0.83	0.75
Madagascar	0.26	0.25
Mauritius	0.39	0.34
Malawi	0.57	0.57
Rwanda	0.36	0.47
Seychelles	0.36	0.34
Uganda	0.69	0.59
Zambia	0.72	0.7
Zimbabwe	0.23	0.22

SADC		
	Before	After
Angola	0.99	0.99
Madagascar	0.26	0.83
Mozambique	0.42	0.45
Mauritius	0.23	0.44
Malawi	0.53	0.54
Seychelles	0.31	0.3
Tanzania	0.2	0.49
SACU	0.15	0.44
Zambia	0.57	0.55
Zimbabwe	0.15	0.15

Figure 7: Herfindahl Index

4 Conclusion

While trade integration is currently being questioned in developed countries, as illustrated by trade wars and by Brexit, African countries follow a different path and pursue the implementation of RTAs, such as the AfCFTA, with the ambition of creating a free-trade zone stretching from Cape Town to Cairo. The idea behind this large scale integration is that existing trade areas are too small to maximize trade creation, reduce trade diversion and generate input-output circular linkages leading to economic growth. While an accurate analysis of this thesis remains to be done, the current analysis shows that the four agreements studied did not achieve their promise.

The aim of the current paper was to provide an assessment of four major African RTAs that have been implemented over the past thirty years, namely EAC, COMESA, CEMAC and SADC in a unified framework. To our knowledge, this is the most comprehensive analysis to-date regarding the number of RTAs, countries and sectors studied in Africa with a NQTM. We found that these RTAs have brought limited welfare gains, and in most cases the welfare gain is below 0.3%. In a similar way, losses are small. This may be good news for the poorest countries which are often afraid to lose the few industries they have in competition with their more advanced neighbors. At the same time, our analysis at the sectoral level shows that these aggregate small gains/losses, hide significant change at the disaggregated level. The agricultural sector is the most affected, but significant change (depending on the country) occurs in all sectors revealing the economic interconnection of sectors within each country. However, RTAs have failed to provide successful structural changes and in some cases the degree of specialization has been strengthened, which is problematic for African countries which are already considered insufficiently diversified to be resilient. Our analysis also shows that some RTAs, such as the SADC have created diversion effects, leading to the further isolation of African countries from world trade. Even if these diversion effects are small, they are aggravated by the fact that due to the similar specializations of African countries, the trade creation effects have been small and sometimes negative. Successful RTAs are more demanding than a simple decrease in tariffs, and even reach beyond the reduction in non-tariff measures or investment in infrastructure, as an ambitious regional industrial policy may be key to promoting growth in Africa. From that standpoint, a deeper integration of the existing RTAs could be more successful than the race forward to build ever larger trade areas.

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5 Appendix A

Table 5 presents these trade elasticities, the range is from 2 to 18 showing strong heterogeneity across sectors.[11]

Eora sectors	Caliendo & Parro
Agriculture	9.11
Fishing	9.11
Mining and Quarrying	13.53
Food & Beverages,	2.62
Textiles and Wearing Apparel	8.1
Wood and Paper	14.846
Petroleum, Chemical, Non-Metallic Mineral Prod	18.015
Metal Products	5.135
Electrical and Machinery	7.994
Transport Equipment	1.115
Other Manufacturing	1.98

Note: Caliendo and Parro ISIC Rev 3 are converted in EORA classification through the classification proposed by Lenzen et al. (2013)

Table 1: Sectoral trade elasticities

[11] In a previous version of this paper, we estimate these elasticities from the method of Feenstra (1994), Broda & Weinstein (2006) and Soderbery (2015) and find similar results for the EAC and CEMAC (similar results are obtained) but encounter difficulties to resolve the model for the COMESA.

ISO Code	Country Name
ARG	Argentina
AUS	Australia
BEL	Belgium
BRA	Brazil
CAF	Central Af. Rep.
CAN	Canada
CHN	China
CMR	Cameroon
COG	Congo
DEU	Germany
DJI	Djibouti
EGY	Egypt
ESP	Spain
ETH	Ethiopia
FRA	France
GAB	Gabon
GBR	United Kingdom
GIN	Guinea
IDN	Indonesia
IRL	Irland
ITA	Italia
JPN	Japan
KEN	Kenya
LBY	Libya
MDG	Madagascar
MEX	Mexico
MLI	Mali
MOZ	Mozambique
MUS	Mauritius
MWI	Malawi
NGA	Nigeria
NLD	Netherlands
NOR	Norway
PRT	Portugal
RWA	Rwanda
SWE	Sweden
SYC	Seychelles
TCD	Tchad
TGO	Togo
TZA	Tanzania
UGA	Uganda
USA	United States
ZAF	South Africa
ZMB	Zambia
ZWE	Zimbabwe
ZZZ	Rest Of the World

Table 2: List of countries include in the CEMAC/COMESA aggregation

ISO Code	Country Name
AGO	Angola
ARG	Argentina
AUS	Australia
AUT	Austria
BDI	Burundi
BEL	Belgium
BRA	Brazil
CAF	Central Af. Rep.
CAN	Canada
CHL	Chile
CHN	China
CIV	Côte d'Ivoire
CMR	Cameroon
DEU	Germany
DJI	Djibouti
DNK	Denmark
EGY	Egypt
ESP	Spain
ETH	Ethiopia
FIN	Finland
FRA	France
GAB	Gabon
GBR	United Kingdom
GIN	Guinea
GRC	Greece
IDN	Indonesia
IND	India
IRL	Irland
ITA	Italia
JPN	Japan
KEN	Kenya
MDG	Madagascar
MEX	Mexico
MLI	Mali
MOZ	Mozambique
MUS	Mauritius
MWI	Malawi
NGA	Nigeria
NLD	Netherlands
NOR	Norway
NZL	New Zealand
PRT	Portugal
RWA	Rwanda
SWE	Sweden
SYC	Seychelles
TCD	Tchad
TGO	Togo
TUN	Tunisia
TUR	Turkey
TZA	Tanzania
UGA	Uganda
USA	United States
ZAF	South Africa
ZMB	Zambia
ZWE	Zimbabwe
ZZZ	Rest Of teh World

Table 3: List of countries include in the EAC/SADC aggregation