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Is Regional Trade Integration a Growth and Convergence Engine in Africa?

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Strategy, Policy, & Review

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Abstract

The main objective of Regional Trade Agreements (RTAs) is to stimulate economic growth in participating countries through increased trade, economies of scale, knowledge and technology transfer. Using a panel data over the period 1979 to 2018, this paper examines the contribution of regional trade integration (RTI) to economic growth and income convergence in Africa and its major Regional Economic Communities (RECs). The results of the instrumental variable and panel fixed-effects estimation show that RTI promotes economic growth in Africa. However, it fosters income divergence, reflecting the distribution of the gains from regional integration in favor of the more developed economies of the continent. The results of this study show the importance to support the African Continental Free Trade Area (AfCFTA) project with policies aimed at reducing non-tariff barriers to trade and improving infrastructure in order to maximize the effects on growth in all participating countries.

JEL Classification Numbers: F15, F43

Keywords: Economic integration, economic growth, income convergence, Africa

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I. INTRODUCTION

Regional integration appealed as a concept that helped promote growth, well-being and economic development among members (Peters-Berries, 2010). It may also foster a variety of non-economic objectives, including promoting regional security and political coordination among members (Carbaugh, 2011). In Africa, regional integration is seen by policymakers and academics as a relevant strategy to raise the level of intra-regional trade, boost economic growth and ensure the integration of African countries into the global economic system. It can also be a lever for accelerating the structural transformation of African countries through economies of scale, improved competitiveness, more efficient resource mobilization and the promotion of regional value chains. Regional trade integration (RTI hereafter) can also promote the dissemination of knowledge and technology and facilitate the design of new products. With this in mind, several regional economic communities (RECs) have been formed in Africa since the years of independence.

Recently, the African Union has launched the operational phase of the African Continental Free Trade Area (AfCFTA), which will be the world's largest free trade area by the number of countries once it's fully up and running. The goal is to establish a single market for goods and services across 54 countries, allow the free movement of business travelers and investments, and create a continental customs union to streamline trade and attract long-term investment. Whereas the AfCFTA could significantly boost intra-regional trade in Africa and promote economic growth, it can also entail costs, and its benefits may not be necessarily uniformly distributed between and within countries. Therefore, leaders often have legitimate concerns that further trade integration of their economies with those of other countries may benefit some industries and penalize others, may have negative effects on profits and employment prospects in some sectors and skill levels, and may reduce fiscal revenues (IMF, 2019 and Frazer, 2012). This highlights the need to examine the potential effects of the AfCFTA on growth and income convergence or divergence and the policies that should be put in place to maximize regional integration benefits and limit its negative effects on some countries.

In addition, the relationship between RTI and economic growth and convergence is of particular interest to economic policy-makers in view of the specific poverty context of African economies. Indeed, the high poverty rate prevailing in this continent makes it imperative to achieve the Sustainable Development Goals (SDOs) and therefore a sufficiently high annual growth rate for significant reduction of poverty and inequality by 2030. While regional integration could promote economic growth and reduce revenue disparities by the channel of bilateral trade flows among member countries, African regional economic communities (RECs) are poorly integrated, with low intra-regional trade flows despite the efforts of several years of economic integration. The main constraints on regional trade development in Africa include inadequate and poor transport infrastructure, structured and regulated cross-border markets, and persistent tariff and non-tariff barriers to trade (Shepherd et al., 2017). A better RTI should be able to have a positive effect on countries' growth and foster economic convergence. Also, the disparate levels of economic development of African countries can also suggest that some countries may benefit more than others, which would increase income disparities. Thus, the analysis of the effects of RTI on economic growth and

income convergence or divergence of African countries makes sense.

In this context and given the expected gains of RTI in terms of economic growth and convergence, job creation and inequality reduction, issues related to regional integration and economic growth are now a major challenge for African countries. After several years of implementing regional economic agreements in RECs and in line with the above, a number of questions can be raised. Does RTI in Africa and African RECs promote economic growth and income convergence? Could further economic integration such as AfCFTA be beneficial to economic growth and income convergence in Africa? The empirical studies, which examined the impacts of regional integration on growth, remain disputed (Te Velde, 2011). Although the role of regional integration contributing to growth was partly acknowledged, the empirical evaluation in Africa seems to be missing. Indeed, empirical studies in developing countries have not yet properly examined this issue. Especially for the African countries, most empirical studies focus exclusively on the role of regional integration in enhancing regional trade (Carrère, 2004; Avom and Gbetnkom, 2005; Agbodji, 2007 and Anyanwu, 2003). This paper fills this gap by relying on a new approach of analyzing REC's contribution in growth and income convergence or divergence of member countries. Therefore, this paper aims to examine whether RTI promotes economic growth and income convergence or divergence in Africa and African RECs.

The rest of the paper is structured as follows. Section 2 is devoted to the literature review of RTI effects on economic growth and income convergence or divergence. Section 3 outlines the methodological approach of the study and the data used. Section 4 presents the main results and their policy implications. Section 5 concludes.

II. LITERATURE REVIEW

In this section, we present the theoretical and empirical review of the effect of regional trade integration on economic growth and income convergence of member countries.

A. Theoretical review

The literature related to the effects of RTI is an extension of the literature on international trade. Carbaugh (2011) defined it as a process of reducing restrictions on international trade, factor mobility and intensification of economic activities among members. It is a policy aimed at eliminating economic borders and trade barriers to the free movement of goods and services among members. The theories of regional integration follow two main lines, each reflecting a stage of development in the evolution of this literature: the traditional trade theory and the new trade theory.

Traditional theories of economic integration explain the possible benefits of integration and are often referred to as classical theory or static analysis of the effects of economic groupings. Pioneering works in the static analysis of the effects of RECs has focused on the effect of different levels of regional integration on the welfare of participating countries rather than on economic growth and convergence. Indeed, Viner's (1950) analyses have shown that the necessary condition for a free trade area or customs union to create trade and increase the welfare of the participating countries is that, for a given good, the price charged by the partners in the economic bloc should be lower than the price charged by the rest of the world.

Another important condition for successful trade integration is a reasonable degree of elasticity of traded goods or the absence of supply-side constraints that may undermine the productive sector. If the partners in the economic bloc are less efficient than the rest of the world, it is the diversion effect that will be observed. Viner (1950) states that the latter case corresponds to the situation in which trade integration leads to the substitution of imports from member countries for imports from previously more efficient third countries. Thus, under certain conditions, regional trade integration can be expected to enhance trade through the tariff dismantling that it implies and thus have a positive effect on growth. The resulted economic growth is due to gains in specialization through the exploitation of comparative advantages. In the African context, it should be outlined that the positive effects of regional integration can be reduced by the loss of fiscal revenues due to lower tariffs, which are likely to be small, but could be significant in some countries that continue to apply high export duties. The removal of trade barriers to promote intra-regional trade may have different short-term effects in different countries.

The static analytical framework of traditional trade or integration theory does not allow the dynamic effects of trade integration to emerge. New theories of economic integration are developed to reflect the evolution of economic conditions and business environments and fall under the scope of dynamic analyses (Hosny, 2013; Marinov, 2014). Schiff and Winters (1998) defined the dynamic effects of economic integration as everything that affects the medium and long-term economic growth rate of the member states participating in the integration agreement. These effects were initially introduced by Balassa (1961) and Cooper and Massell (1965) to provide a better rationale for the creation of RECs. Dynamic positive effects are due to accelerated accumulation of physical and human capital, better transmission of technology through foreign direct investment (FDI) and economies of scale (Tumwebaze et al., 2015 and Busto, 2011). In fact, trade integration provides access to a large regional market, advanced technology, and therefore a greater stock of knowledge, leading to more innovation and faster growth (Grossman and Helpman, 1991; Rivera-Batiz and Romer, 1991; and Romer, 1990). This implies that a country benefits from free trade with its partners and a larger stock of knowledge, assuming that technological spillovers are absorbed to the same degree in all countries.

In addition to these effects, the center-periphery model of Krugman (1991) and Krugman and Venables (1996) has shown that regional integration can ultimately help to reorganize the productive structure within a region according to the natural and factor endowments of the member economies, as well as the quality of regional infrastructure. Such efficient allocation could be beneficial to the economic growth of the region as a whole. There can also be long-lasting effects on productivity through learning by-exporting, and such effects may be appropriated particularly when dealing with more developed partners (Te Velde, 2011). Although there is no reliable method for the quantitative assessment of the dynamic effects of trade integration (Marinov, 2014), dynamic effects appear to have a greater impact on economic processes than static effects because of their deeper scope. Moreover, in the African context where countries are at different levels of development, the appropriation of the dynamic gains resulting from regional integration is likely to be long in the relatively less advanced countries in view of the weakness of the institutions and the shortcomings present in the education systems.

The effect of regional integration on the convergence of economies is ambiguous even if the literature agrees on its beneficial effect on the economic growth of member countries. Indeed, Ben-David and Loewy (1998) have attempted to argue from the endogenous growth model of Lucas (1988) and Romer (1990) that steady-state growth rates depend on the rate of knowledge accumulation. Since regional integration between countries facilitates the dissemination of knowledge and stimulates the growth process, it could also foster convergence among member countries in the long run. Other authors such as Williamson (1996) use Heckscher-Ohlin's factor price equalization theory to show income convergence among countries following trade liberalization. The basic idea of this theory is that countries export goods that are produced using intensively factors that the country is well-endowed with and import goods that intensively use factors that they are less endowed with. In this way, each country will specialize in the production of these goods when it has comparative advantages, which will lead to the equalization of product prices. This equalization of product prices will eventually lead to an equalization of factor prices. Thus, wages are expected to rise in poor countries compared to rich countries.

The positive effect of trade integration on convergence has been criticized by Slaughter (1998) for the unrealistic assumptions of Heckscher-Ohlin's factor price equalization theory. He argued that trade is not sufficient to produce income convergence and more research is needed to clarify the relationship. In the African context, relatively more developed countries would be better able to reap the benefits of reallocating resources from economies of scale in both the short and long term. More diversified economies and established regional trade hubs, already exposed to international competition, are likely to benefit more from deepening regional integration than countries where agriculture and natural resources play a dominant role. In the same vein, Venables (1999) argues that South-South agreements will tend to lead to divergence of income levels of members states, while North-North agreements may lead to convergence of income levels. The explanation of this is based on the position of countries in a region compared to those outside the region. Countries with a comparative advantage (e.g. in manufacturing) closer to the world average do better in a region than do countries that are at the extreme position as the latter are more likely to switch import suppliers (of manufactures) and face trade diversion costs (Te Velde, 2011). The theoretical analysis of the effects of regional integration leads to opposite conclusions, making it impossible to determine with certainty its effects on income convergence. An empirical treatment of the issue may provide more lessons.

B. Empirical works

The empirical literature on the effects RTI has focused more on trade creating effects of regional trade agreements (RTAs) while economic growth and convergence effects have not been sufficiently analyzed in Africa. However, for the past few decades, a number of empirical studies about the growth effects of RTI can be cited. These studies suggest that RTI could have mitigating effects on economic growth and convergence. Balassa (1961) was one of the authors who provided the first empirical evidence of the positive effect of trade on economic growth. Based on a sectoral analysis, the author showed that the dynamic effects of economic integration on economic growth are rooted in economies of scale, technological progress, increased competition, reduced uncertainty and the creation of a more favorable environment for economic activity. More robust econometric results were subsequently

provided. For example, Frankel and Romer (1999) showed using instrumental variable techniques on 1985 data that differences in the value of bilateral trade between countries were positively correlated with levels of GDP per capita. The results are affected by the elimination of zero trade from the sample. However, the effect of RTI remains positive with the inclusion of zero trade data in the analysis by Irwin and Tervio (2002) on a sample covering the period between 1913 and 1990. Levine and Renelt's (1992) analysis of the robust determinants of growth also shows that trade indirectly affects growth through investment. This means that countries with low trade barriers invest more and thus grow faster. Haveman et al. (2001) adopted panel data analysis to observe the growth effects of various forms of integration over the period 1970-1989. They conclude that trade intensity had a positive effect on growth.

Dion (2004) uses endogenous growth models and geographical economics in his analysis of the impact of regional economic integration on member and non-member countries of a regional union. He found that regional economic integration has an impact on growth through interregional diffusion of technology, as knowledge spillovers from leading countries spread to lagging partners. The process of European integration has also provided a suitable framework for testing the effects of economic integration. Studies by Henrekson et al. (1997), Badinger (2001, 2005) suggest positive and significant effects on growth. Other empirical studies indicate that economic integration promotes growth, including Amurgo-Pacheo and Pierola (2007), Jong-Wha et al. (2008) and Nwosu et al. (2013). Recent work by Anderson et al., (2020) confirm these results. They estimated the effect of regional trade agreements on growth within a general equilibrium framework. The main lesson of this study is that trade affects growth through changes in consumer and producer prices that stimulate or impede physical capital accumulation. Simultaneously, growth affects trade, directly through changes in country size and indirectly through changes in the incidence of trade costs.

In contrast to the empirical works cited above, some studies have also shown that economic integration may in fact have no effect or may have a negative effect on economic growth through trade diversion. For example, a study by De Melo et al. (1992) found no evidence that regional integration among developing countries has a positive impact on growth and incomes. According to some studies, the effect of integration on growth would depend on the participating countries. Vamvakidis (1999) found that trade integration appears to have a negative effect on growth. This conclusion was attributed to the fact that most of these economic trade agreements were concluded between small, poor and very similar economies. Moreover, economic integration would have a significant positive effect on growth in developed countries, but that the effects in developing countries were ambiguous, appearing to depend on the size of the countries joining together (Berthelon, 2004).

Empirical studies that have analyzed the cases of African RECs come to similar conclusions. Tumwebaze and Ijjo (2015) examined the contribution of COMESA integration to economic growth in this area. The authors use the GMM method on annual panel data from 1980 to 2010. The results indicate no significant empirical support for a positive impact of integration on growth in the region. Ogbuabor et al. (2019) replicates the same methodological approach on WAEMU data. Contrary to the widely held view that regional economic integration promotes economic growth in participating countries, they find no empirical evidence of a positive impact of WAEMU integration on growth in West Africa. Similarly, Golit and adamu

(2014) argued that intra-African trade has not been effective in fostering growth. They noted that wrong policies, such as preferential trade liberalization schemes, encourage African countries to concentrate on trade among themselves and therefore reflect trade diverting effect. It has been argued that the mixed nature of results is caused by the variation in the selection of methodological approaches and regional integration specifications.

The empirical studies, which examined the impacts of regional integration on income convergence are also disputed. The pioneering works in this branch of the literature were carried out by Ben-David (1996) by focusing on non-poor countries. The author compares two categories of groups. The first category includes countries with their main partners. The second category of group consists of countries and their randomly selected partners. He finds that there is income convergence in the first group of countries. These results are confirmed by Ben-David and Kimhi (2000). In fact, they conducted a similar study and found similar results, forming 127 country pairs based on export data and 134 country pairs based on import data over the period 1960-1985. Some researchers question the positive effect of trade on income convergence. Slaughter (2001), for example, has shown that trade liberalization has rather led to income divergence. Using the difference-in-difference approach, Slaughter (2001) compares the convergence pattern among the liberalizing countries before and after liberalization with the convergence pattern among control countries before and after liberalization. The results suggest that in three of the four observed groups of countries, liberalization has led to divergence rather than convergence, which only confirmed his assumption that free trade does not lead to convergence.

Unlike Slaughter (2001), Choi's (2009) analysis is based on panel data analysis rather than impact assessment methods. He tested whether bilateral differences in income or GDP per capita growth levels decrease or increase when trade intensity between two countries increases over a sample of 63 countries. The estimation results enable the author to conclude that, on average, the income levels of two countries converge when bilateral trade is higher. Moreover, when two countries are geographically closer and speak the same language, this convergence is more pronounced. Te Velde (2011), on the other hand, does not reach the same results when he analyses about 100 developing countries over the period 1970-2004. He has estimated a growth equation and an income convergence equation in which several indicators of regional integration are introduced: an integration index, the level of trade and dummy variables indicating membership of a REC. The results show that it is not possible to establish robust growth effects of regional integration even after using alternative measures of regional integration. However, the indirect effect of integration on growth through trade and FDI is deduced. Furthermore, he finds that integration does not reduce income disparities among participating countries.

In summary, the above review of the empirical literature indicates that although several studies have examined the effects of regional integration on economic growth and convergence of income, none of the recent studies have focused specifically on the specific case of Africa and the different sub-regional blocs on the basis of econometric analysis. To our knowledge, no empirical study has focused on the effect of integration on convergence in Africa as a whole and African RECs. In addition, the few empirical studies on the African RECs suffer from methodological shortcomings related to the endogeneity between the indices used and economic growth and drawbacks related to the use of dummy variables.

Moreover, the occasional studies that have been limited to the effects on growth do not reveal the effects of integration on income distribution at the macroeconomic level. The objective of this study is to fill this gap in the literature. This is important given that African countries have made considerable efforts to open their economies to one another within the framework of Africa's continental free trade agreement (AfCFTA). Econometric evidence is needed to show whether these regional efforts can sustain economic growth and reduce income disparity. Finally, for the African RECs, this study makes it possible to assess the effects of the various integration projects on the continent in terms of economic growth and income convergence.

III. METHODOLOGY

In this section, we describe the methodology and data to be used in the study. The methodology follows a bilateral approach. We form a large dyadic panel dataset (panel of country pairs over time). The panel data allows us to control for country specific and time-specific factors.

A. Econometric model

Empirical works investigating the effects of RTI on growth rely on two methodological approaches. The first approach includes studies that capture the effects of integration on growth by means of dummy variables indicating whether a country participates in a regional integration agreement (De Melo et al., 1992; Vamvakidis, 1998; Tumwebaze et al., 2015 and Ogbuabor, 2019). Secondly, some studies have been based on the construction of integration indices, with a view to capturing the dynamic effects of RTI (Berthelon, 2004; Njoroge, 2010). The use of a dummy variable to capture the effect on growth of regional integration agreements assumes that the expected effects simply arise from the signing of the agreement. This strategy overlooks the importance of the characteristics of the agreement itself, as well as those of the partners, such as the effective level of trade and the level of development or size of the market. While the index approach has the merit of addressing these shortcomings, it does not often take into account the endogeneity between the variables used to construct the index and economic growth. In this paper, regional trade integration is captured directly by the level of bilateral trade between member countries. Compared to the dummy variable approach, this approach allows the effectiveness of trade agreements to be captured by the variability over time of the level of intra-regional trade. Moreover, the use of gravity variables as instrumental variables makes it possible to address the problem of endogeneity between regional trade integration and growth. Therefore, to analyze the effects of RTI on growth, we consider a panel version of the specification of Frankel and Romer (1999) and Frankel and Rose (2002). Since RECs are generally composed of many countries, the study analyzes country-pairs rather than individual countries as in Anyanwu (2003) in order to capture accurately the effects of RTI on growth and convergence or divergence of economies and dealing with endogeneity issues. Therefore, our baseline model (growth model) can be written as follows:

$$\bar{y}(\kappa)_{ij\tau} = \alpha + \gamma Trade(\omega)_{ij\tau} + \theta \bar{Z}_{ij\tau} + \eta_i + \eta_j + \nu_\tau + \varepsilon_{ij\tau} \quad (1)$$

Where $\bar{y}(\kappa)_{ij\tau} = y(\kappa)_{i\tau} + y(\kappa)_{j\tau}$ and $y(\kappa)_{i(j)\tau}$ denotes a growth indicator κ of a country i

(country j) at time τ with κ corresponding to real GDP and real GDP per capita. $Trade(\omega)_{ij\tau}$ denotes the bilateral trade intensity between country i and country j at time τ using trade integration indicator ω (corresponding to: total bilateral trade ($M_{ij\tau} + X_{ij\tau}$); bilateral import ($M_{ij\tau}$) and bilateral export ($X_{ij\tau}$)). However, the preferred indicator of RTI is total bilateral trade. The other trade integration indicators will be used for robustness check. $X_{ij\tau}$ denotes exports from country i to country j during period τ and $M_{ij\tau}$ denotes imports of country i from country j during period τ. $\bar{Z}_{ij\tau}$ is a vector of control variables that capture the other economic growth and convergence determinants identified in the literature. Time fixed effects (ν_τ) are introduced in the empirical model as dummy variables for each period, while η_i and η_j stand for country fixed effects. Finally, $\varepsilon_{ij\tau}$ represents the error term; γ and θ_i are the coefficients (of i control variables) to be estimated.

We expect the coefficient γ to be positive. The size and the significance of this coefficient indicate to what extent RTI is economically meaningful for African countries and RECs. A statistically positive coefficient γ does not guarantee an equitable distribution of the outcomes from RTI among countries. Indeed, we may be faced with the extreme case of unidirectional trade or the case where a country represents a significant share of total bilateral trade, which would reflect an inequitable distribution of the outcomes of regional integration. The growth dynamics of the country pair can therefore be driven by one country experiencing steady growth while the other is stagnating, creating a divergence in countries' incomes. Further analysis is therefore needed to assess the impact of RTI on the convergence of economies. This analysis is particularly relevant as African RECs are fragmented with economies at different stages of development. In other words, there may be winners and losers. There are two traditional ways to test convergence among countries. The first is σ-convergence, which tests whether the cross-sectional income dispersion between periods becomes smaller or not as time goes by. The second is β-convergence, which tests whether poor countries grow faster than rich countries. These approaches are not relevant to this study as they do not clearly outline the effect of regional integration. To analyze the effect of RTI on income convergence or divergence in Africa we consider a specification similar to that of Choi (2009) and Hassan and Murtala (2016) as follows:

$$\tilde{y}(\kappa)_{ij\tau} = \mu + \lambda Trade(\omega)_{ij\tau} + \phi\tilde{Z}_{ij\tau} + \eta_i + \eta_j + \nu_\tau + \epsilon_{ij\tau} \quad (2)$$

Where $\tilde{y}(\kappa)_{ij\tau} = \left|y(\kappa)_{i\tau} - y(\kappa)_{j\tau}\right|$ is the absolute gap in real GDP and real GDP per capita between country pair i and j at time τ. $\tilde{Z}_{ij\tau}$ is the vector of the control variables noted above but transformed as below to have the divergence of these variables between two economies. For a specific control variable Z, $\tilde{Z}_{ij\tau}$ is calculated as follows:

$$\tilde{Z}_{ij\tau} = \left|Z_{i\tau} - Z_{j\tau}\right| \quad (3)$$

Before any estimation exercise of our convergence or divergence model (2), it is important to make sure that for all economies in the sample there is a more or less regular increase in income over the study period so that the convergence process investigated is effectively a catching-up of the countries relatively more advanced by the poor ones. Following checking, the 53 countries in the study experienced steady GDP growth over the study period. Thus, no

country was dropped from the sample. On this basis, let us assume that the coefficient γ is positive and statistically significant. If the coefficient λ is also positive and statistically significant, then RTI promotes economic growth and income divergence between countries. This situation would be typical of an unequal distribution of integration outcomes with the presence of winners and losers. On the other hand, if the coefficient λ is significantly negative, then RTI sustains growth and convergence of economies. If the coefficient λ is not significant then RTI has a positive influence on growth but its effect on income convergence or divergence is marginal.

We include in the vector $\bar{Z}_{ij\tau}$ the following variables: the openness of economies i and j ($\bar{Z}_1$), total investment rate in country i and j ($\bar{Z}_2$), government expenses in country i and j ($\bar{Z}_3$), financial development of countries i and j ($\bar{Z}_4$) and weighted primary school enrollment rate in country i and j ($\bar{Z}_5$). In order to take into account, the effects of price and exchange rate fluctuations, we include in the control variables the terms of trade ($\bar{Z}_6$). of the two countries in the pair. The first three control variables are calculated as follows:

$$\bar{Z}_1 = \frac{M_{it} + M_{jt} + X_{it} + X_{jt}}{GDP_{it} + GDP_{jt}} \times 100 \quad (4)$$

$$\bar{Z}_2 = \frac{Inv_{it} + Inv_{jt}}{GDP_{it} + GDP_{jt}} \times 100 \quad (5)$$

$$\bar{Z}_3 = \frac{Gov_{it} + Gov_{jt}}{GDP_{it} + GDP_{jt}} \times 100 \quad (6)$$

Where $M_{i(j)t}$ is the total imports of country $i(j)$ at time t, $X_{i(j)t}$ is the total imports of country $i(j)$ at time t, $Inv_{i(j)t}$ is the flow of investments of country $i(j)$ at time t, Gov_{it} denotes government expenses of country $i(j)$ at time t and GDP_{it} denotes the real GDP of country $i(j)$ at time t. When calculating the trade openness of the country pair, we deduct from the numerator the total bilateral trade (import and export) of the country pair in order to avoid redundancy in this variable. The financial development of both countries ($\bar{Z}_4$) is calculated as a weighted average of the ratio of private sector credit to GDP. The terms of trade variable ($\bar{Z}_6$) is calculated as a weighted average of the terms of trade of the two countries. The weight used for these variables is GDP, which represents the size of the economy. Population size is used as a weight in the calculation of the weighted average of the primary school enrolment rate ($\bar{Z}_5$). All variables (explained and explanatory) are taken in logarithm after transformation. As part of the robustness tests, other determinants of growth and convergence will be included in equation (1) and (2)[1].

B. Estimation strategy

A straightforward approach to estimate γ and λ is to use the ordinary least squares (OLS) estimator. However, OLS may be inappropriate for γ because of the endogeneity of the

[1] The inclusion of these variables in the basic model reduces the number of observations in the different samples due to missing data. For this reason, their effects are tested to control for the robustness of the effect of the variable of interest.

bilateral trade flows. As Helpman (1988), Bradford and Chakwin (1993), Rodrik (1995), Frankel and Romer (1999) and many others observe, countries whose incomes are high for reasons other than trade may trade more. In addition, the independent variable is measured with errors because official intra-regional trade statistics do not take into account informal trade, which is not negligible in African countries. The instrumental variables (IV) technique could address these limits. However, the choice of instrumental variables must be rigorous. Using measures of countries' trade policies as instruments does not solve the problem. For example, countries that adopt free-market trade policies may also adopt market trade policies and stable fiscal and monetary policies. Since these policies are also likely to affect economic growth, countries' trade policies are likely to be correlated with factors that are omitted from growth and convergence equations. Thus, they cannot be used to identify the impact of RTI on economic growth (Sala-i-Martin (1991) and Frankel and Romer (1999)).

To properly identify the effect of RTI on growth, we therefore need exogenous determinants of bilateral trade patterns to use as instrumental variables. Following Frankel and Romer (1999), the well-known 'gravity' model of bilateral trade motivates our choice of instrumental variables. As the literature on the gravity model of trade demonstrates, geography is a powerful determinant of bilateral trade (see for example Rose (2000), Anderson and Wincoop (2001) and Carrère (2004)). Bilateral trade intensity is therefore instrumented by gravity model variables that are not, in theory, related to economic growth. These are the logarithm of distance between the main cities of the countries within the pair ($Dist_{ij}$), a dummy variable set to one if the countries within the pair have a common border ($Border_{ij}$), a dummy set to one if the countries within the pair have a common ethnic language ($EthnoLang_{ij}$), a dummy set to one if the countries within the pair have a common official language ($OffLang_{ij}$), a dummy set to one if one of the countries within the pair is landlocked ($Landlock_{i(j)}$) and the logarithm of the sum of the areas of the countries within the pair ($Areas_{ij}$). We also consider some bilateral non-tariff agreement as instrumental variable. For this purpose, we also use membership in a monetary union as an instrumental variable of bilateral trade. Bilateral exchange rate volatility is also used as instrument. This variable is the standard deviation of the bilateral exchange rate (in log) computed from quarterly exchange rates data. The relevance of the instruments is controlled by the significance of the coefficients of the gravity model and the F-statistics of the instruments of the first step estimation. The convergence equation (2) is estimated using the panel LSDV method as in Choi (2009) and Hassan and Murtala (2016). Instrumental variable (IV) technique will be used for the convergence model (equation 2) as robustness test to control for potential endogeneity.

C. Dataset

The data used come essentially from three databases: real GDP in dollars (base year 2010), real GDP per capita, GDP growth rate, inflation, total imports, total exports, ratio of private sector credit to GDP, total investment, government expenses, population, population growth rate and primarily school enrollment rate from 1989 to 2018 are drawn from the World Bank's (WB) World Development Indicators (WDI, 2019) database. Quarterly exchange rate data are taken from International Financial Statistics (IFS, 2019). The data relating to the gravity model come from the *Centre d'Etudes Prospectives et d'Informations Internationales*

(CEPII). Bilateral trade data (bilateral exports FOB (free on board) and bilateral imports CIF (cost-insurance-freight)) comes from the International Monetary Fund (IMF) Direction of Trade Statistics (DOTS). One of the difficulties in analyzing bilateral trade data and estimating the gravity equation is the presence of zero bilateral trade. To overcome this difficulty, we transform bilateral (log transformation) trade data by adding an arbitrary value of one (Rose, 2000; WTO, 2012).

The study covers fifty-three (53) African countries and nine (9) major African RECs: WAEMU (West African Economic and Monetary Union), CEMAC (Central African Economic and Monetary Community), ECOWAS (Economic Community of West African States), COMESA (Common Market of Eastern and Southern Africa), the SADC (South African Development Community), EAC (East African Community), ECCAS (Economic Community of Central African States) and Arab Maghreb Union (AMU) and Intergovernmental Authority on Development (IGAD). These countries and RECs are observed over a period covering 1979 to 2018 for data availability. Indeed, the extension of the study period starting from 1974 led to significant data losses due to missing data in many countries. Appendix 3 shows that five (5) of the nine (9) RECs considered in this paper were established after 1979. Furthermore, regional integration is captured in this paper by a proxy variable rather than a dummy variable.

We are first interested in the long-term relationship between regional integration and economic growth and convergence. Therefore, the variables of interest were transformed into a five-year average. With this transformation, we expect to smooth out short-term fluctuations and reduce the proportion of zero trade flows in our dataset. Thus, we split the sample into eight (8) sub-periods as follows: [1979; 1983], [1984; 1988], [1989; 1993], [1994; 1998], [1999; 2003], [2004; 2008], [2009; 2013] and [2014; 2018]. For a given REC composed of n countries, we have $N = n(n-1)/2$ country-pairs. The model is thus specified as a panel data model of N country-pairs over T time periods. Thus, for the African sample, we are left with a maximum of 11,024 ($8 \times (53 \times 52)/2$) observations.

IV. RESULTS

This section presents the empirical assessment of the effects of the RTI on economic growth and convergence in African and African RECs.

A. Descriptive analysis

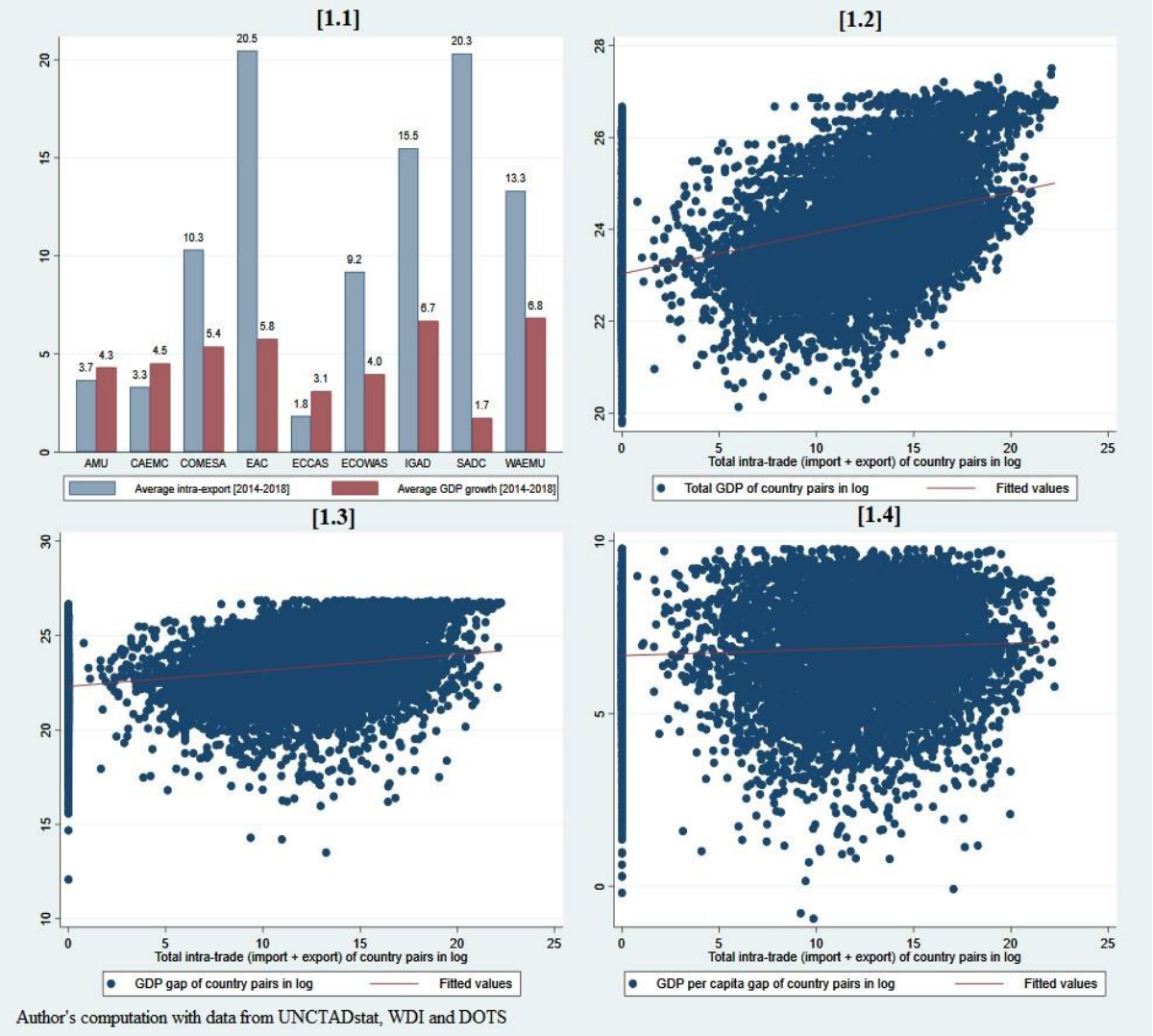
The regional integration landscape in Africa is quite diverse (Appendix 3). Indeed, the continent hosts RECs at relatively different levels of integration, ranging from monetary and customs unions with common external tariffs (WAEMU and CEMAC) to RECs whose first trade agreements are in the process of being elaborated (ECCAS, IGAD and AMU). Between these two extremes are the cases of ECOWAS and EAC, which are at the stage of a customs union, and those of COMESA and SADC, which are at the stage of a free trade area. Moreover, in the framework of monetary integration projects on the continent, ECOWAS, COMESA, SADC and EAC have adopted macroeconomic convergence programs inspired by the Maastricht Treaty and the Stability and Growth Pact for the Eurozone (Appendix 3). Although these convergence programs focus on nominal variables, they may ultimately have

an impact on the real convergence of economies through the macroeconomic stability and economic growth they promote. However, member countries of these RECs have had mixed success in meeting these convergence criteria. At the continental level, it can be noted that in 2018, African countries have made significant progress regarding trade integration. The African Continental Free Trade Area (AfCFTA) agreement has been ratified by 22 countries and entered into force in 2019. Significant growth is expected from the removal of tariffs on most goods, the liberalization of trade in key services and the reduction of non-tariff barriers as a result of this agreement but its potential effects on income convergence are not documented.

Figure 1 below illustrates the relationship between RTI and economic growth and convergence. It shows an unclear relationship at the aggregate level of the RECs, but this becomes clearer when the data are analyzed in terms of pairs at the continental level. Indeed, at the aggregate level, the weighted average economic growth rate of a REC does not seem to be positively related to higher trade intensity (captured by intra-zone exports over the exports of the REC). For similar levels of intra-zone exports in the SADC (20.3%) and the EAC (20.5%), the weighted economic growth average rates are 5.8% and 1.7% respectively (Figure 1, panel 1.1). Moreover, the trade intensity varies significantly from one REC to another and between RECs with a similar level of formal integration. For example, trade intensity is relatively higher in SADC (20.3%) and EAC (20.5%) than in the WAEMU zone (13.3%), which is at the stage of monetary and customs union. Similarly, the difference in trade intensity is high between WAEMU (13.3%) and CEMAC (4.5%), notwithstanding their status as monetary and customs unions.

By focusing on the entire continent and using bilateral data, some stylized facts are highlighted. Panel 1.2 of Figure 1 shows the scatter plot of the couples of total intra-zone trade (bilateral imports and exports) and total GDP of country pairs (average over the last five years, 2014-2018). This graph shows a positive correlation between trade intensity and total GDP of country pairs. Panels 1.3 and 1.4 of Figure 1 also illustrate the positive correlation between trade intensity and the gap between GDP and GDP per capita of country pairs. However, this positive correlation is relatively low when considering the GDP per capita gap of country pairs. This graphical analysis seems at first glance to suggest that trade integration across Africa would foster the divergence of incomes of the economies. However, it does not take into account the inverse causality between trade integration and economic growth, which would require special treatment of instrumental variable technique.

Figure 1. RTI and Economic Growth and Convergence in Africa over the Period 2014-18



B. Estimation results

The results of the econometric analysis are presented in Tables 1 and 2 below and Tables 3 and 4 in the Appendix 4. Table 1 presents the baseline results of the regression of GDP and GDP per capita on total bilateral trade in Africa without the control variables using the instrumental variable method. The results highlight a positive effect of RTI on GDP and GDP per capita. Indeed, the coefficients γ are significant at least at 5 percent level in most RECs and in the core sample of Africa.

Table 1: Baseline estimation of RTI effect on economic growth in Africa and African RECs

	Total GDP				Total GDP per capita			
	Coef γ	Std Err	Obs	Pairs	Coef γ	Std Err	Obs	Pairs
AFRICA	0.1470***	(0.004)	9,044	1,275	0.0472***	(0.002)	9,044	1,275
WAEMU	0.1634***	(0.024)	224	28	0.0326***	(0.012)	224	28
CEMAC	0.1127***	(0.018)	120	15	0.0404	(0.025)	120	15
ECOWAS	0.1874***	(0.016)	771	105	0.0505***	(0.006)	771	105
EAC	0.3382***	(0.055)	76	10	0.1263***	(0.016)	76	10
ECCAS	0.1388***	(0.016)	400	55	0.0359**	(0.014)	400	55
COMESA	0.1511***	(0.011)	995	153	0.0463***	(0.007)	995	153
SADC	0.0765***	(0.006)	715	91	0.0223***	(0.004)	715	91
AMU	0.1171***	(0.031)	64	10	0.0464***	(0.017)	64	10
IGAD	0.1152***	(0.022)	111	21	0.0459***	(0.010)	111	21

Source: author's estimations. RTI is the sum of the bilateral trade (import and export) of countries in the pair. Total GDP is the sum of GDP of countries in the pair and total GDP per capita is the sum of GDP of countries in the pair over their total population. The baseline estimates were made using the instrumental variable method. The instrumental variables are the logarithm of distance between the countries within the pair, common border, common ethnic language, common official language, landlockedness, sum of the areas of the countries and bilateral exchange rate volatility. Country-pair specific effects are included in the models. All regressions include an intercept and are corrected for heteroscedasticity. Robust standard errors in parentheses. *Significant at 10%, **significant at 5% and ***significant at 1%.

For the African sample, the coefficient is estimated to be 0.1470. In the CEMAC zone, the positive effect of RTI on GDP per capita is not significant, however. The more a pair of countries trade with each other, the higher their total GDP and GDP per capita. However, a question that remains is whether the gains from trade in terms of income growth are fairly distributed. In other words, does the RTI promote income convergence or cause divergence among participating countries? The first baseline estimates tend to show a divergence effect on incomes. Indeed, Table 2 provides positive and significant λ coefficients for the African sample for both GDP and GDP per capita. In Africa, the more a pair of countries trade with each other, the wider the gaps in their GDP and GDP per capita. The coefficient λ is positive and significant at least 5 percent level for both GDP and GDP per capita in ECOWAS, ECCAS, COMESA, IGAD and SADC. In WAEMU, EAC and AMU, the positive effect of RTI is significant on GDP divergence and not significant on GDP per capita.

In the CEMAC zone, RTI has a positive but not significant effect on GDP convergence, while it effects on per capita GDP divergence is positive but not significant. The results concerning AMU and EAC zones must be analyzed with caution in respect of the small size in terms of the number of countries and the missing observations that reduced the sample of estimates. The results are in line with our descriptive analysis (Figure 1).

Table 2: Baseline estimation of RTI effect on Income convergence in Africa and African RECs

	GDP gap				GDP per capita gap			
	Coef γ	Std Err	Obs	Pairs	Coef γ	Std Err	Obs	Pairs
AFRICA	0.0520***	(0.002)	9,428	1,326	0.0292***	(0.003)	9,428	1,326
WAEMU	0.1109***	(0.031)	224	28	0.0063	(0.019)	224	28
CEMAC	-0.0128	(0.016)	120	15	0.0313	(0.028)	120	15
ECOWAS	0.0818***	(0.009)	771	105	0.0569***	(0.013)	771	105
EAC	0.2822***	(0.046)	76	10	0.1429	(0.111)	76	10
ECCAS	0.0289**	(0.012)	400	55	0.0326**	(0.014)	400	55
COMESA	0.0461***	(0.009)	1,125	171	0.0269***	(0.008)	1,125	171
SADC	0.0349***	(0.006)	826	105	0.0249***	(0.006)	826	105
AMU	0.0575**	(0.020)	64	10	0.0444	(0.032)	64	10
IGAD	0.0433**	(0.017)	111	21	0.0252**	(0.011)	111	21

Source: author's estimations. RTI is the sum of the bilateral trade (import and export) of countries in the pair. Total GDP gap is the absolute difference of GDP of countries in the pair and GDP per capita gap is the absolute difference of GDP per capita of countries in the pair. The baseline estimates were made using panel LSDV method. Country-pair specific effects are included in the models. All regressions include an intercept and are corrected for heteroscedasticity. Robust standard errors in parentheses. *Significant at 10%, **significant at 5% and ***significant at 1%.

The results of the estimations of the complete models with the control variables, equations (1) and (2), are presented in Tables 3 to 7 in Appendix 4. They show that the results did not change significantly when the control variables were included. The positive effect of RTI on GDP and GDP per capita is significant in Africa and in most African RECs (Tables 3 and 4). The effect on per capita GDP does not seem to be statistically significant in the ECCAS, AMU and IGAD zones. The inclusion of control variables seems to show a positive effect of regional integration on GDP in CEMAC zone and a negative effect on GDP per capita. The robustness of this paradoxical result will be checked by further analysis. Moreover, the openness of economies, investment levels, government expenditure, educational attainment, terms of trade and financial development have emerged as the other determinants of GDP and GDP per capita in Africa (Tables 3 and 4). Concerning income convergence, we found that RTI significantly increases GDP gaps between countries in Africa and in all RECs (Table 6). However, the per capita income divergence effect was only significant in Africa, ECOWAS, COMESA, AMU and IGAD (Table 7). In Table 5, the first stage of the instrumental variable estimates of equation (1) is presented. Most of the instruments are significant in explaining regional trade intensity in Africa. The logarithm of distance, bilateral exchange rate volatility and landlockedness have a negative and significant impact on trade intensities whereas contiguity, currency union membership, the size of the countries (logarithm of total areas) and common language foster trade integration. Moreover, the F-stats of the first stage are significant at least at 5 percent level. Before discussing the results and to be convincing and conclusive, the result needs further robustness checks. We turn to these issues in the following subsection.

C. Robustness Checks

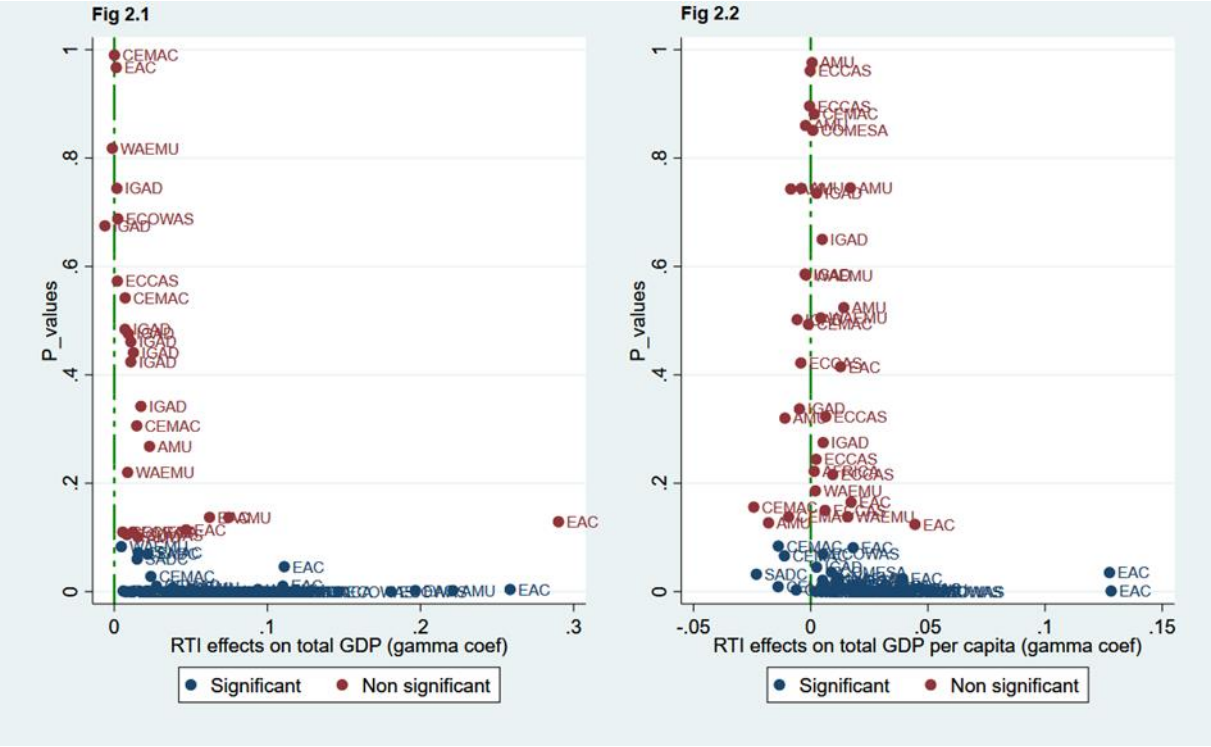
We first test the robustness of our results using alternative indicators of RTI. For this purpose, we use separately bilateral imports and exports between pairs of countries in both growth and convergence equations. We also test the stability of trade integration effect on growth and the convergence to different alternative estimation methods. To this end, we use the system Generalized Method of Moments (GMM) using internal instruments. The system GMM method also allow as to address endogeneity issues of other variables (financial development, trade openness and government spending) using internal variables. Given the relatively small temporal dimension of the sample, we choose an instrumentation with at least one lag. Bilateral trade intensity and other endogenous above-mentioned variables are therefore instrumented by at least their one lag value in the first differences equation. We also use ordinary least squares (OLS) estimation with country fixed effects rather than country-pair specific effects. We introduce time fixed effects to control for unobserved time-invariant factors that affect both RTI and economic growth and convergence. For the convergence equation, we re-estimate it using the instrumental variable method. Gravity model variables used in the estimation of the growth equation served as instruments.

Furthermore, we check that there is no bias of extreme values in our estimates. In fact, outliers in the variables (explanatory as explained) can be an additional source of endogeneity in the estimates. Quantile regression can deal with this issue. Therefore, we re-estimate the growth and convergence equations for the second quartile using the quantiles regressions. Another approach to eliminating the effect of extreme values is to winsorize the data for the variables of interest in the study. Therefore, we winsorize the RTI variable, GDP and GDP per capita at 5% and 95 percentiles. Values smaller than the 5th percentile is replaced by the 5th percentile, and the similar thing is done with the 95th percentile. In addition, initial estimates were made on the five-year average data to mitigate short-term fluctuations and to estimate the long-term relationship between our variables of interest. Are the results of our analysis valid by changing the time frame over which the variables are calculated? Do short-term fluctuations alter the relationship between RTI and economic growth and convergence? To answer this question, we re-estimate the basic equations (growth and convergence) using annual data. Finally, we use another technique to address endogeneity related to an inverse causality between economic growth and intra-regional trade. Therefore, rather than using instrumental variable techniques, the variable relating to RTI is lagged by one period in our empirical models with standard errors clustered at country pair level.

The results of all these robustness checks are presented in Tables 8 to 11 in the appendix 4 for GDP, GDP per capita, GDP convergence and GDP per capita convergence respectively, that is, a total of 80 estimates for Africa and the nine (9) RECs by indicator of growth or economic convergence. We then represent on figures 2 and 3 the scattered points of the parameters of interest (γ and λ) from the different robustness regressions in order to facilitate the analysis of the results. Panels 2.1 and 2.2 of figure 2 respectively summarize the effects of RTI on total GDP and GDP per capita in Africa and the different African RECs. Similarly, Figures 3, panels 3.1 and 3.2 summarize the effects of RTI on GDP and GDP per capita convergence in Africa and the different RECs, respectively. Figure 2, panels 2.1 and 2.2 and tables 8 and 9 show that the effect of trade integration on GDP and GDP per capita is positive and significant in the estimates when the Africa sample is considered. This effect is robust to

the use of alternative indicators and estimation methods. It is also positive and significant in the short run when annual data is used. Overall, 69% of the estimated coefficients show a positive effect of trade integration on GDP in Africa and African RECs while 29% of the coefficients are positive but not significant. The effect on GDP per capita in Africa and African RECs is positive in 51% of regression while 6% of estimates report negative effect in CEMAC and SADC.

Figure 2: summary of robustness checks, RTI effects on GDP and GDP per capita



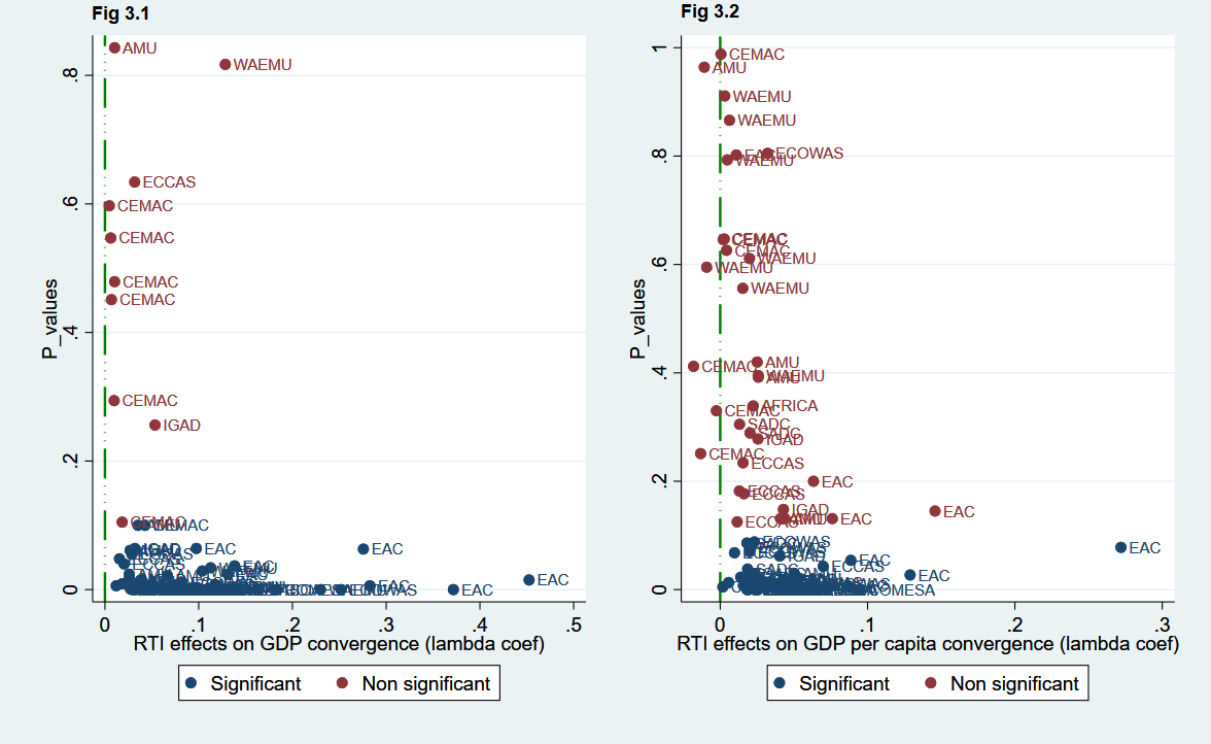
Source: author

The results of the robustness tests also confirm the positive effect of trade integration on the divergence of GDP and per capita incomes in Africa. (Figures 3, panels 3.1 and 3.2 and tables 10 and 11). Indeed, estimates for the Africa sample show a positive and significant coefficient of the RTI variable on the convergence of GDP and GDP per capita in all regressions. Overall, 88% of the estimated coefficients show a positive effect of trade integration on GDP divergence in Africa and African RECs while 12% of the coefficients are positive but not significant. The effect on GDP per capita divergence in Africa and African RECs is positive in 59% of regression while 6% of estimates report negative but not significant effect.

The results of the robustness tests confirm the differentiated effect of RTI when RECs are considered. Indeed, Figures 2 and 3 show that in most cases the coefficients (γ and λ) are positive for both GDP and GDP per capita. However, their significance varies according to the estimation methods and the RECs. A detailed analysis of Tables 8 to 11 reveals some fundamental differences. The positive effect of trade integration on GDP appears robust in WAEMU, ECOWAS, EAC, ECCAS, CEMAC, COMESA, SADC, IGAD and AMU. The positive effect on GDP per capita seems robust only in ECOWAS, WAEMU, COMESA, SADC and EAC. With respect to convergence, Tables 8-11 suggest that the positive effect of trade integration on GDP divergence would be robust in WAEMU, ECOWAS, EAC,

ECCAS, COMESA, AMU, IGAD and SADC. RTI would foster GDP per capita divergence in a more robust way in ECOWAS, IGAD, SADC and COMESA. In addition, its effects in other RECs are not well established. They vary significantly depending on the estimation method and trade intensity indicator. Finally, the results concerning small RECs (AMU, CEMAC, IGAD and AMU) must be analyzed with caution in respect of the small size in terms of the number of countries.

Figure 3: summary of robustness checks, RTI effects on GDP and GDP per capita convergence



Source: author

D. Discussions

Is regional trade integration an engine of growth and convergence? Does membership in a trade and regional integration projects allow catching up the relatively more advanced economies? The results of our econometric analysis showed that RTI has a positive effect on growth and income disparity in Africa. At the macroeconomic level, the distribution of the gains from regional integration is unevenly distributed in favor of the relatively developed economies of the continent. These results are in line with the theoretical and empirical analysis of Venables (1999), which had already shown that South-South agreements will tend to lead to divergence in Member States' income levels, while North-North agreements may lead to convergence in income levels. They are also consistent with the empirical analysis of Slaughter (2001). The results are in contradiction with those of Choi (2009) who found that RTI promotes income convergence. However, it should be noted that Choi's (2009) work cannot be generalized to the African continent, as of the 63 countries in his sample, only 10 are African countries.

As Venables (1999) points out, countries with a comparative advantage closer to the world

average perform better in a RECs than countries at the extreme. In the African context, differences in the level of development, quality of institutions and financial development may tend to favor firms from relatively developed countries in both the short and long term. Moreover, the relatively more developed countries on the continent are more exposed to international competition and therefore better able to absorb the shock of tariff dismantling. In addition, the relatively more skilled labor available in these countries offers them the advantage of attracting more FDI than poor countries and thus benefiting more from the reallocation of resources following regional integration. This analysis is corroborated by the results of a review of recent studies based on computable general equilibrium (CGE) models showing that the ability of African countries to benefit from the AfCFTA depends on the structure of their economies (IMF, 2019; Chauvin et al., 2016; Abrego et al., 2019). More diversified economies would have more to offer than poor countries dependent on exports of a few commodities and raw materials. For the latter, the lack of catching-up of more developed countries could be explained by the deficit in customs resources related to tariff elimination, the negative shock on sectors vulnerable to trade opening and the inability of these countries to absorb the knowledge and technology transfer resulting from trade.

The effect of integration on growth and income convergence is mixed in the African RECs. This result is likely to be related to the specificity of the RECs (form of integration, non-tariff barriers, political crises and degrees of implementation of trade agreements) and that of member countries. However, the results invalidate the hypothesis of convergence in the majority of RECs. The income divergence effect appears more robust in large RECs (ECOWAS, COMESA and SADC). They would suggest that the larger the size of the REC, the higher the probability of grouping countries at different stages of development and the more robust the positive effect on income divergence becomes. The robust effect on divergence over the sample for Africa as a whole corroborates this analysis.

What are the main implications of this research? The positive effect on growth and income disparity of RTI has strong implications for the existing RECs and especially for the continent-wide trade integration project. First, the results show that, all other things being equal, further trade integration would increase intra-African trade and hence more beneficial growth for relatively developed countries. The econometric analysis confirms this result in the continent's large RECs. They do not argue against deeper integration in Africa but rather highlight the urgency (for existing RECs), the need and the opportunity to complement the process of trade integration on the continent with policies that are adequately designed to protect vulnerable sectors in the poorest countries. These programs will make the regional trade integration process a win-win game. Specifically, the results of this study show the necessity to support the AfCFTA project with policies aimed at reducing non-tariff barriers to trade and improving infrastructure in order to maximize the effects on growth in all participating countries. In addition, structural reforms that enhance productivity, targeted social programs and training programs can be put in place to limit the undesirable distributional effects of integration and facilitate inter-sectoral and inter-country mobility.

Second, the positive effect of RTI on income divergence provides empirical evidence that participating in a regional or continental trade integration project is not a panacea. This implies that small and poor countries should undertake deep structural reforms of their

economies to diversify their production in order to capture the full benefits highlighted by economic integration theories. Ultimately, the results also imply that African countries should add to the mission assigned to the integration process and provide the necessary means for its implementation. The crucial role assigned to trade in economic integration generally overlooks other fundamentals of economic growth. Regional integration dominated by trade plays a less crucial role in spurring economic growth and income convergence. Therefore, African countries should place more emphasis on the goal of regional integration towards ensuring the provision of critical infrastructure, improving the quality of institutions, building human capacities and stock of physical capital.

V. CONCLUSION

It has been argued in the literature that regional integration promotes shared economic growth and income convergence among member countries through direct and indirect channels of increased intra-regional trade, economies of scale, dissemination of knowledge and technology, and structural transformation. This paper contributes to this literature in Africa and African RECs. Its main objective was to analyses the effects of RTI on growth and income convergence in Africa and its different RECs. The study examines whether regional integration has played an important role in economic growth and income convergence of member countries in African major RECs in order to draw lessons for the process of establishing the African Continental Free Trade Area (AfCFTA). To this end, the study estimated two models, one for economic growth and the other for income convergence in the African sample and in the African major RECs over the period 1989 to 2018 using the instrumental variable method and the panel fixed-effects model.

The baseline results as well as the results of the multiple robustness tests indicate that RTI promotes economic growth in the participating countries. However, econometric evidence shows that it fuels divergence rather than income convergence across the continent implying that the positive effect on economic growth is mostly captured by the relatively more developed economies on the continent. These results are robust to the use of alternative indicators of trade integration, to the time frame of the analysis and to the estimation method particularly for the sample of Africa and in large RECs including COMESA, SADC, ECOWAS, WAEMU and SADC. For these RECs and in the context of the African continental free trade project, these results show how necessary it is to design specific programs (social programs and training programs) to support the most vulnerable economies in order to protect their sectors that will suffer negative shocks when the African Continental Free Trade Area (AfCFTA) will be in force. The results also show that regional integration offers substantial gains, whose full absorption is conditional on the implementation of comprehensive structural reforms aimed at diversifying economies and increasing their productivity. The positive effect of regional integration on growth suggests that the process of African trade integration would be beneficial to the continent's economic growth. Therefore, the study recommends the elimination of non-tariff barriers in order to increase its effectiveness. Furthermore, regarding the positive effect on income divergence, the study recommends that RTI, beyond its traditional role as an instrument for trade promotion, should also be used as an instrument for providing essential infrastructure, improving the quality of institutions, building human capacity and strengthening the physical capital stock.

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APPENDIX I: LIST OF COUNTRIES IN THE SAMPLES

African sample
Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cabo Verde, Cameroon, Central African Republic, Chad, Comoros, Congo, Democratic Republic of Congo, Republic of Cote d'Ivoire, Djibouti, Egypt, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, Sudan, Swaziland, Tanzania, Togo, Tunisia, Uganda, Zambia and Zimbabwe.
African RECs Samples
The sample of member countries of the different RECs is presented in Appendix 3. However, the EAC and IGAD sample does not include Southern Sudan due to the unavailability of data over a long period of time.

APPENDIX II: DATA SOURCES

• Bilateral exports and imports of goods and services in current USD	Direction of Trade Statistics (DOTS), IMF 2019
• A dummy set to 1 if the two countries in the pair are contiguous • Area (country's area in km2) • Distance is calculated following the great circle formula, which uses latitudes and longitudes of the most important cities/agglomerations (in terms of population) • Landlocked: dummy variable set to 1 for landlocked countries • A dummy set to 1 if the two countries in the pair share a language spoken by at least 9% of the population in both countries • A dummy set to one if the countries within the pair have an official common language	From CEPII website, http: //www. cepii.fr/francgraph/bdd/distances. htm
• Population • population growth rate • GDP in constant 2010 USD • GDP per capita in constant 2010 USD • Consumer price index, basis 100 in 2010 • Exports and imports of goods and services in current USD • Private sector credit to GDP ratio • Primarily school enrolment • Investment or gross capital formation • Terms of trade	World Development Indicators (WDI) 2019
• General government total expenditure	World Economic Outlook (WEO) 2019
• Regional Economic Community (REC) membership	Author's compilation
• Quarterly nominal exchange rate	International Financial Statistics (IFS)

APPENDIX III. MAIN REGIONAL ECONOMIC COMMUNITIES (RECS) IN AFRICA

Arrangements	Type	Member countries	Year	Regional trade agreements and macroeconomic convergence program
West African Economic Monetary Union (WAEMU)	REC, CU	Benin, Burkina Faso, Cote d'Ivoire, Guinea-Bissau (1997), Mali, Mauritania, Niger, Senegal, Togo	1962	Monetary union since 1962. Customs union since 2000 with an operational common external tariff. Macroeconomic convergence program since 1994 and formally since 1999 • Basic fiscal balance/GDP ≥ 0 • Inflation ≤ 3 percent • Public debt/GDP ≤ 70 percent • No accumulation of domestic and foreign arrears
Central African Economic and Monetary Community (CEMAC)	REC, CU,	Cameroon, Congo, Gabon, Central African Republic, Chad, Equatorial Guinea	1964	Monetary union since 1964. Customs union since 2006 with an operational common external tariff. Macroeconomic convergence program since 1994 and formally since 2002 • Inflation ≤ 3 percent • Basic fiscal balance/GDP ≥ 0 percent • Public debt/ GDP ≤ 70 percent • No accumulation of domestic and foreign arrears
Economic Community of West African States (ECOWAS)	REC, CU (project)	Benin, Burkina Faso, Cabo Verde, Cote d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, Togo.	1975	Free trade area (FTA) since 1979 with the adoption of The ECOWAS Trade Liberalization Scheme (ETLS). Customs Union since 2015 with an operational Common External Tariff. The process of creating a monetary union is currently in progress. Macroeconomic convergence program since 1999 and revision since 2012 • Fiscal deficit ratio, including grants (commitments basis) to nominal GDP ≤3 percent • Average Inflation ≤ 5 percent • Central Bank financing of the fiscal deficit ≤ 10 percent of the previous year's fiscal revenue • Gross reserves ≥ 6 months of imports
East African Community (EAC)	REC, CU (project)	Burundi, Kenya, Uganda, Rwanda, South Sudan, Tanzania.	1967	Customs Union protocol signed in 2004.Common market agreement entered into force in 2010. A tripartite free trade agreement amongst COMESA, SADC and EAC launched in 2015 has not yet entered into force. Macroeconomic convergence program since 1997 • Inflation < 8 percent • Fiscal deficit/GDP < 3 percent • Public debt/GDP < 50 percent • Gross reserves ≥ 4.5 months of imports
Economic Community of Central African States (ECCAS)	REC	Angola, Burundi, Cameroon, Central African Republic, Chad, Congo, Democratic Republic of the Congo, Equatorial Guinea, Gabon, Rwanda, São Tomé and Principe.	1983	The process of forming a free trade area (with the aim of establishing a customs union of common external tariff) was launched in 2004 and is ongoing. No formal macroeconomic convergence program
Common Market for Eastern and Southern Africa (COMESA)	REC, CU (project)	Burundi, Comoros, Djibouti, Egypt, Eritrea (1994), Ethiopia, Kenya, Libya (2005), Madagascar, Malawi, Mauritius, Uganda, Democratic Republic of the Congo, Rwanda, Seychelles (2001), Sudan, Swaziland, Zambia, Zimbabwe.	1994	Currently a free trade area (FTA). Custom Union launched in 2009 is still not operational. A tripartite free trade agreement amongst COMESA, SADC and EAC launched in 2015 has not yet entered into force. Macroeconomic convergence program since 1992 and revision since 2012 • Fiscal deficit/GDP < 5 percent • Inflation < 5 percent • Central Bank financing of the fiscal deficit limited to 0 • Gross reserves ≥ 4 months of imports
Southern Africa Development Community (SADC)	REC, CU (project)	South Africa (1994), Angola, Botswana, Lesotho, Madagascar (2005), Malawi, Mozambique, Mauritius (1995), Namibia, Democratic Republic of the Congo (1997), Seychelles, Swaziland, Tanzania, Zambia, Zimbabwe.	1992	Free Trade area (FTA) agreement started in 2001. A tripartite free trade agreement amongst COMESA, SADC and EAC launched in 2015 has not yet entered into force. Macroeconomic convergence program since 2004 • Inflation < 10 percent • Fiscal deficit /GDP < 5 percent • Public debt/GDP < 60 percent
Arab Maghreb Union (AMU)	REC	Morocco, Tunisia, Algeria, Mauritania, Libya.	1989	Trade liberalization was the main objective of the establishing agenda. Nevertheless, practical implementation of the integration agenda has been slow as the free trade area is not yet operational. No formal macroeconomic cooperation.
Intergovernmental Authority on Development IGAD	REC	Djibouti, Eritrea, Ethiopia, Kenya, Somalia, South Sudan, Sudan, Uganda.	1995	The process of creating a free trade area (FTA) is currently in progress. No formal macroeconomic convergence program.

Notes: REC stands for Regional Economic Community and CU for currency union (or monetary union). South Sudan has not been excluded from IGAD and EAC estimation sample for data unavailability.

APPENDIX IV TABLES

Table 3. Estimation results of RTI effect on total GDP in Africa (including control variables)

	AFRICA	WAEMU	CEMAC	ECOWAS	EAC	ECCAS	COMESA	SADC	AMU	IGAD
RTI	0.1211***	0.1153***	0.0213**	0.1495***	0.2710***	0.0614***	0.0818***	0.0507***	0.0440***	0.0194
	(0.005)	(0.033)	(0.009)	(0.022)	(0.055)	(0.013)	(0.013)	(0.011)	(0.013)	(0.020)
Openness of economies	-0.9728***	-0.6132**	0.0603	-1.3090***	-0.8352***	-0.2572	-0.8747***	-1.2717***	-1.3460***	-1.6147***
	(0.052)	(0.283)	(0.346)	(0.145)	(0.174)	(0.166)	(0.128)	(0.231)	(0.328)	(0.267)
Total Investment	0.3165***	-0.3777**	0.0421	0.3935***	0.8203***	0.5216***	0.6917***	0.5789***	0.7939*	1.1783**
	(0.049)	(0.189)	(0.236)	(0.121)	(0.268)	(0.138)	(0.117)	(0.152)	(0.469)	(0.467)
Total government expenses	0.1786***	0.1775	-0.1737	-0.4417***	-0.1698	-0.2771*	-0.0682	-0.2449	0.9814**	-0.8779***
	(0.063)	(0.233)	(0.234)	(0.156)	(0.811)	(0.163)	(0.160)	(0.222)	(0.462)	(0.277)
Financial development	0.2804***	0.2714	0.1338*	0.2057*	0.3171	0.2133***	0.2182***	0.5311***	0.0923	0.8826***
	(0.025)	(0.198)	(0.081)	(0.110)	(0.262)	(0.068)	(0.071)	(0.083)	(0.067)	(0.177)
Primary school enrolment	0.1069	0.6949***	0.6818*	0.7870***	-0.4457**	0.0424	-0.1953	0.5044*	1.4574***	-0.7501*
	(0.072)	(0.192)	(0.373)	(0.172)	(0.222)	(0.232)	(0.165)	(0.286)	(0.357)	(0.443)
Terms of trade	0.3931***	0.4102	0.4173***	0.6666***	0.1944	0.3941***	0.3889***	0.5573***	0.1839	0.1072
	(0.041)	(0.344)	(0.141)	(0.167)	(0.209)	(0.083)	(0.123)	(0.185)	(0.151)	(0.252)
Prob > chi2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Observations	4,331	132	47	445	56	162	472	303	34	45
Number of pairs	1,080	28	15	105	10	45	119	78	10	10

Source: author's estimations. RTI is the sum of the bilateral trade (import and export) of countries in the pair. The dependent variable is total GDP calculated as the sum of GDP of countries in the pair. The estimates were made using the instrumental variable (IV) method. The instrumental variables are the logarithm of distance between the countries within the pair, common border, common ethnic language, common official language, landlockedness, sum of the areas of the countries and bilateral exchange rate volatility. All regressions include an intercept (but not reported) and are corrected for heteroscedasticity. Robust standard errors in parentheses. *Significant at 10%, **significant at 5% and ***significant at 1%.

Table 4. Estimation results (including control variables) of RTI effect on total GDP per capita in Africa and African RECs

	AFRICA	WAEMU	CEMAC	ECOWAS	EAC	ECCAS	COMESA	SADC	AMU	IGAD
RTI	0.0346***	0.0440***	-0.0134**	0.0489***	0.0916***	0.0023	0.0136**	0.0188***	-0.0083	-0.0008
	(0.003)	(0.013)	(0.006)	(0.007)	(0.028)	(0.007)	(0.006)	(0.005)	(0.013)	(0.006)
Openness of economies	-0.1229***	-0.3312**	-0.1291	-0.3543***	-0.3433***	-0.2018***	-0.2124***	-0.2768***	0.3457	-0.5671***
	(0.018)	(0.130)	(0.163)	(0.036)	(0.046)	(0.073)	(0.067)	(0.085)	(0.347)	(0.169)
Total Investment	-0.0101	-0.1496*	0.0045	-0.0633	0.4416***	0.3778***	0.2093***	-0.1073	-0.7064***	0.5212*
	(0.020)	(0.084)	(0.218)	(0.040)	(0.129)	(0.068)	(0.067)	(0.092)	(0.231)	(0.316)
Total government expenses	0.1388***	-0.0901	0.6474***	-0.1574***	0.3008*	-0.1135	-0.0620	0.1952	1.3347***	-0.0317
	(0.029)	(0.133)	(0.234)	(0.051)	(0.156)	(0.086)	(0.078)	(0.128)	(0.243)	(0.205)
Financial development	0.1495***	0.1950**	-0.2373***	0.1962***	0.1416	0.0928***	0.1460***	0.3399***	-0.1361	0.3319***
	(0.012)	(0.091)	(0.086)	(0.040)	(0.092)	(0.036)	(0.036)	(0.040)	(0.116)	(0.095)
Primary school enrolment	0.0527	0.2248**	0.8897**	0.3462***	-0.2853***	-0.0657	-0.0447	0.2180*	0.3993	-0.0693
	(0.033)	(0.099)	(0.380)	(0.051)	(0.050)	(0.138)	(0.058)	(0.123)	(0.634)	(0.202)
Terms of trade	0.1594***	0.0012	0.0443	0.1083*	0.1227*	0.2557***	0.2492***	-0.2621**	0.1619**	0.0186
	(0.017)	(0.136)	(0.097)	(0.055)	(0.074)	(0.064)	(0.044)	(0.117)	(0.066)	(0.112)
Prob > chi2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Observations	4,331	132	47	445	56	162	472	303	34	45
Number of pairs	1,080	28	15	105	10	45	119	78	10	10

Source: author's estimations. RTI is the sum of the bilateral trade (import and export) of countries in the pair. The dependent variable is total GDP per capita calculated as the sum of GDP of countries in the pair over their total population. The estimates were made using the instrumental variable (IV) method. The instrumental variables are the logarithm of distance between the countries within the pair, common border, common ethnic language, common official language, landlockedness, sum of the areas of the countries and bilateral exchange rate volatility. All regressions include an intercept (but not reported) and are corrected for heteroscedasticity. Robust standard errors in parentheses. *Significant at 10%, **significant at 5% and ***significant at 1%.

Table 5. First stage of instrumental variable estimate of RTI effect on income in Africa

	AFRICA	WAEMU	CEMAC	ECOWAS	EAC	ECCAS	COMESA	SADC	AMU	IGAD
Country *i* is landlocked	-2.7025***	-2.3609***	-5.7730***	-2.8925***	-0.0657	-2.3149***	-0.4136	-2.7536***		-0.5220
	(0.118)	(0.553)	(1.268)	(0.479)	(0.653)	(0.576)	(0.418)	(0.472)		(1.167)
Country *j* is landlocked	-1.2386***	-4.0719***	0.9671	-5.1692***	0.2040	-0.2231	0.9457***	-1.4272***		0.4285
	(0.112)	(0.584)	(1.564)	(0.401)	(0.428)	(0.546)	(0.352)	(0.446)		(1.139)
Bilateral exchange rate volatility	-0.2631***			-1.5120*	-1.9038*	0.0191	-0.2845	-0.1329	-6.2376	-0.5238
	(0.056)			(0.885)	(0.982)	(0.146)	(0.231)	(0.116)	(3.975)	(1.494)
Currency union	1.6646***			1.6024***		2.3063***				
	(0.296)			(0.451)		(0.719)				
Common border	2.4064***	3.6980***	2.7264	2.6272***	-0.2283	4.3818***	1.9470***	2.5038***	5.2243***	3.5101**
	(0.257)	(0.560)	(1.856)	(0.442)	(0.329)	(0.761)	(0.622)	(0.651)	(1.862)	(1.351)
Common official language	1.2340***	7.2291***		1.9636***	0.2121	-0.4314	0.1529	0.1352		1.6201
	(0.154)	(0.811)		(0.414)	(0.327)	(0.792)	(0.466)	(0.574)		(1.078)
Common ethnic language	1.0969***	0.1695	2.3649*	1.0324***	1.2619**	3.3445***	2.4153***	-0.5814	5.0779***	-2.0127
	(0.162)	(0.371)	(1.295)	(0.340)	(0.520)	(0.684)	(0.465)	(0.554)	(1.578)	(1.392)
Logarithm of distance	-2.0382***	0.3199	0.0867	-1.4315***	-1.3254	-0.9453***	-2.3550***	-0.7487*	1.1031	-1.0687
	(0.089)	(0.388)	(1.601)	(0.255)	(0.805)	(0.280)	(0.358)	(0.407)	(1.494)	(1.080)
Logarithm of the sum of the areas	1.0705***	0.7159	3.1566*	2.2726***	1.9267***	0.6750***	0.7309***	-0.5705***	-3.5640***	1.1775***
	(0.042)	(0.467)	(1.647)	(0.185)	(0.519)	(0.176)	(0.128)	(0.162)	(1.314)	(0.427)
F-Stat probability	0.000	0.0143	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Source: author's estimations. All regressions include an intercept (but not reported) and are corrected for heteroscedasticity. P-values in parentheses. *Significant at 10%, **significant at 5% and ***significant at 1%.

Table 6. Estimation results (including control variables) of RTI effect on GDP convergence in Africa and African RECs

	AFRICA	WAEMU	CEMAC	ECOWAS	EAC	ECCAS	COMESA	SADC	AMU	IGAD
RTI	0.0552***	0.1205***	0.0120**	0.0916***	0.2771***	0.0321**	0.0495***	0.0265**	0.0375***	0.0382***
	(0.003)	(0.037)	(0.006)	(0.014)	(0.063)	(0.013)	(0.009)	(0.010)	(0.013)	(0.015)
Openness of economies	-0.0049	-0.0349	0.0271	0.0252	-0.0344	0.0012	-0.0418	0.0008	0.1215	-0.2069*
	(0.010)	(0.045)	(0.055)	(0.030)	(0.044)	(0.043)	(0.032)	(0.038)	(0.092)	(0.122)
Total Investment	-0.0087	0.0217	0.0894	-0.0390	0.0745	-0.0112	-0.0212	0.1107**	0.1016*	0.0852
	(0.010)	(0.041)	(0.074)	(0.024)	(0.058)	(0.066)	(0.036)	(0.054)	(0.054)	(0.056)
Total government expenses	0.0134	-0.0147	0.0585	-0.0314	0.0251	0.0954**	0.0034	0.0059	-0.0454	-0.0693
	(0.011)	(0.043)	(0.043)	(0.029)	(0.063)	(0.042)	(0.047)	(0.046)	(0.053)	(0.071)
Financial development	0.0221**	0.0149	0.0242	0.0093	0.0301	0.0563	-0.0089	0.2146***	-0.0049	0.0081
	(0.011)	(0.035)	(0.045)	(0.026)	(0.072)	(0.038)	(0.047)	(0.070)	(0.094)	(0.102)
Primary school enrolment	-0.0431***	0.0701	-0.2091***	-0.0541	0.0053	-0.1062	-0.0277	-0.0142	-0.1720***	-0.0678**
	(0.010)	(0.056)	(0.065)	(0.033)	(0.045)	(0.074)	(0.024)	(0.030)	(0.061)	(0.032)
Terms of trade	0.0058	-0.1404***	0.0061	-0.0078	-0.0428*	0.0043	-0.0296	0.0018	-0.0078	0.0269
	(0.008)	(0.051)	(0.024)	(0.029)	(0.025)	(0.027)	(0.024)	(0.041)	(0.033)	(0.048)
Prob > chi2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Observations	6,095	210	73	610	72	215	701	434	49	51
Number of pairs	1,127	28	15	105	10	45	135	91	10	10

Source: author's estimations. RTI is the sum of the bilateral trade (import and export) of countries in the pair. The dependent variable is total GDP gap calculated as the absolute difference of GDP of countries in the pair. The estimates were made using panel LSDV method. All regressions include an intercept and are corrected for heteroscedasticity. Robust standard errors in parentheses. *Significant at 10%, **significant at 5% and ***significant at 1%.

Table 7. Estimation results (including control variables) of RTI effect on GDP per capita convergence in Africa and African RECs

	AFRICA	WAEMU	CEMAC	ECOWAS	EAC	ECCAS	COMESA	SADC	AMU	IGAD
RTI	0.0225***	0.0235	-0.0008	0.0409***	0.1395	0.0126	0.0353***	0.0159	0.0533**	0.0388**
	(0.003)	(0.019)	(0.006)	(0.013)	(0.087)	(0.008)	(0.008)	(0.011)	(0.021)	(0.016)
Openness of economies	0.0094	0.0525	0.0740	0.0283	0.0078	0.0361	0.0416	-0.0379	-0.0348	-0.0727
	(0.010)	(0.074)	(0.082)	(0.031)	(0.066)	(0.043)	(0.038)	(0.037)	(0.084)	(0.229)
Total Investment	-0.0146	-0.0066	0.1140***	0.0114	0.2482***	0.0855**	-0.0514	-0.0055	0.1260	-0.1384
	(0.009)	(0.033)	(0.033)	(0.025)	(0.095)	(0.042)	(0.032)	(0.041)	(0.095)	(0.095)
Total government expenses	-0.0003	0.0527	-0.0294	0.0210	0.1610***	0.0010	-0.0256	-0.0117	-0.0181	-0.0819
	(0.009)	(0.047)	(0.036)	(0.033)	(0.059)	(0.023)	(0.036)	(0.046)	(0.042)	(0.068)
Financial development	0.0727***	0.1209**	0.0307	0.0991***	0.1019	0.0263	0.1423***	0.1240**	-0.1457	0.2949**
	(0.010)	(0.054)	(0.028)	(0.033)	(0.095)	(0.021)	(0.031)	(0.053)	(0.180)	(0.143)
Primary school enrolment	-0.0205*	0.0515	-0.1287	-0.0363	0.0279	-0.0105	-0.0214	-0.0099	0.0158	0.0134
	(0.010)	(0.071)	(0.130)	(0.033)	(0.056)	(0.055)	(0.020)	(0.026)	(0.048)	(0.052)
Terms of trade	0.0152*	-0.0065	0.0117	-0.0103	-0.0130	0.0264	0.0038	0.0286	0.0053	0.1001**
	(0.008)	(0.046)	(0.017)	(0.023)	(0.033)	(0.019)	(0.016)	(0.038)	(0.048)	(0.047)
Prob > chi2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Observations	6,095	210	73	610	72	215	701	434	49	51
Number of pairs	1,127	28	15	105	10	45	135	91	10	10

Source: author's estimations. RTI is the sum of the bilateral trade (import and export) of countries in the pair. The dependent variable is GDP per capita gap calculated as the absolute difference of GDP per capita of countries in the pair. The baseline estimates were made using panel LSDV method. All regressions include an intercept and are corrected for heteroscedasticity. Robust standard errors in parentheses. *Significant at 10%, **significant at 5% and ***significant at 1%.

Table 8. Robustness tests of RTI effect on GDP in Africa and African RECs

	AFRICA	WAEMU	CEMAC	ECOWAS	EAC	ECCAS	COMESA	SADC	AMU	IGAD
Bilateral import	0.1122***	0.0882***	0.0156*	0.1463***	0.0013	0.0616***	0.0804***	0.0592***	0.0526***	0.0125
	(0.000)	(0.000)	(0.072)	(0.000)	(0.967)	(0.000)	(0.000)	(0.000)	(0.000)	(0.441)
	4,331	132	47	445	56	162	472	303	34	45
Bilateral export	0.0955***	0.0979***	0.0275**	0.0992***	0.0622	0.0357***	0.0854***	0.0218*	0.0402***	0.0108
	(0.000)	(0.000)	(0.010)	(0.000)	(0.137)	(0.000)	(0.000)	(0.069)	(0.001)	(0.461)
	4,331	132	47	445	56	162	472	303	34	45
Panel OLS with country fixed effects	0.0071***	0.0087	0.0001	0.0023	0.1101***	0.0020	0.0055	0.0201***	0.0154	0.0017
	(0.000)	(0.220)	(0.990)	(0.688)	(0.010)	(0.573)	(0.110)	(0.000)	(0.101)	(0.744)
	4,377	132	47	445	56	162	487	316	34	45
System GMM estimation	0.0223***	-0.0013	0.0147	0.0083	0.2585***	0.0122	0.0207***	0.0197***	0.2212***	-0.0061
	(0.000)	(0.818)	(0.306)	(0.105)	(0.004)	(0.110)	(0.000)	(0.000)	(0.002)	(0.675)
	4,377	132	47	445	56	162	487	316	34	45
Quantile regression (second quartile)	0.0514***	0.0853***	0.0071	0.0850***	0.1966***	0.0349***	0.0484***	0.0149*	0.0230	0.0092
	(0.000)	(0.000)	(0.542)	(0.000)	(0.002)	(0.000)	(0.000)	(0.060)	(0.268)	(0.476)
	4,377	132	47	445	56	162	487	316	34	45
IV estimation with annual data	0.1103***	0.0381***	0.0108***	0.0922***	0.1110**	0.0396***	0.0718***	0.0581***	0.0503***	0.0108
	(0.000)	(0.007)	(0.000)	(0.000)	(0.046)	(0.000)	(0.000)	(0.000)	(0.005)	(0.424)
	14,478	517	143	1,484	201	445	1,527	996	141	160
Panel Fixed effects with lagged RTI	0.0124***	0.0046*	0.0084***	0.0058***	0.0469	0.0110***	0.0172***	0.0177***	0.0451***	0.0070
	(0.000)	(0.083)	(0.000)	(0.001)	(0.114)	(0.000)	(0.000)	(0.000)	(0.000)	(0.484)
	14,553	517	143	1,484	201	445	1,552	1,019	141	160
Winsorizing data	0.1261***	0.0938***	0.0239**	0.1807***	0.2901	0.0644***	0.0740***	0.0541***	0.0747	0.0174
	(0.000)	(0.004)	(0.028)	(0.000)	(0.129)	(0.000)	(0.000)	(0.000)	(0.137)	(0.342)
	4,331	132	47	445	56	162	472	303	34	45

Source: author's estimations. RTI is the sum of the bilateral trade (import and export) of countries in the pair. The dependent variable is total GDP calculated as the sum of GDP of countries in the pair. All regressions include an intercept and are corrected for heteroscedasticity. *Significant at 10%, **significant at 5% and ***significant at 1%. For each robustness test, the first row presents the coefficients of the estimates. The second row presents the robust p-values. The third row displays the total number of observations present in the regressions.

Table 9. Robustness tests of RTI effect on GDP per capita in Africa and African RECs

	AFRICA	WAEMU	CEMAC	ECOWAS	EAC	ECCAS	COMESA	SADC	AMU	IGAD
Bilateral import	0.0314***	0.0295***	-0.0139***	0.0491***	0.0127	0.0094	0.0165***	0.0205***	-0.0022	0.0025
	(0.000)	(0.004)	(0.009)	(0.000)	(0.415)	(0.216)	(0.007)	(0.000)	(0.860)	(0.735)
	4,331	132	47	445	56	162	472	303	34	45
Bilateral export	0.0298***	0.0317***	-0.0138*	0.0250***	0.0172	-0.0042	0.0191**	0.0123**	-0.0040	-0.0058
	(0.000)	(0.004)	(0.084)	(0.000)	(0.165)	(0.422)	(0.011)	(0.013)	(0.744)	(0.502)
	4,331	132	47	445	56	162	472	303	34	45
Panel OLS with country fixed effects	0.0015	0.0119**	-0.0112*	0.0105***	0.0472***	-0.0005	0.0088**	0.0107**	-0.0180	0.0053
	(0.222)	(0.025)	(0.066)	(0.000)	(0.005)	(0.896)	(0.036)	(0.018)	(0.127)	(0.275)
	4,377	132	47	445	56	162	487	316	34	45
System GMM estimation	0.0080***	-0.0020	0.0015	0.0053*	0.1282***	-0.0002	0.0051**	0.0061**	0.0169	-0.0048
	(0.000)	(0.584)	(0.881)	(0.069)	(0.001)	(0.961)	(0.021)	(0.012)	(0.745)	(0.337)
	4,377	132	47	445	56	162	487	316	34	45
Quantile regression (second quartile)	0.0096***	0.0158	-0.0243	0.0316***	0.0445	0.0213**	0.0009	-0.0232**	-0.0110	0.0049
	(0.000)	(0.138)	(0.156)	(0.000)	(0.124)	(0.010)	(0.851)	(0.032)	(0.320)	(0.650)
	4,377	132	47	445	56	162	487	316	34	45
IV estimation with annual data	0.0366***	0.0043	-0.0062***	0.0275***	0.0392**	0.0061	0.0182***	0.0241***	-0.0085	0.0025**
	(0.000)	(0.505)	(0.003)	(0.000)	(0.024)	(0.150)	(0.002)	(0.000)	(0.743)	(0.045)
	14,478	517	143	1,484	201	445	1,527	996	141	160
Panel Fixed effects with lagged RTI	0.0047***	0.0020	-0.0010	0.0036***	0.0181*	0.0023	0.0046***	0.0065***	0.0006	0.0022***
	(0.000)	(0.186)	(0.493)	(0.001)	(0.081)	(0.244)	(0.000)	(0.000)	(0.976)	(0.000)
	14,553	517	143	1,484	201	445	1,552	1,019	141	160
Winsorizing data	0.0350***	0.0384***	-0.0094	0.0501***	0.1275**	0.0064	0.0165***	0.0180***	0.0141	-0.0024
	(0.000)	(0.004)	(0.138)	(0.000)	(0.035)	(0.323)	(0.008)	(0.000)	(0.524)	(0.586)
	4,331	132	47	445	56	162	472	303	34	45

Source: author's estimations. RTI is the sum of the bilateral trade (import and export) of countries in the pair. The dependent variable is GDP per capita calculated as the sum of GDP of countries in the pair over their total population. All regressions include an intercept and are corrected for heteroscedasticity. *Significant at 10%, **significant at 5% and ***significant at 1%. For each robustness test, the first row presents the coefficients of the estimates. The second row presents the robust p-values. The third row displays the total number of observations present in the regressions.

Table 10. Robustness tests of RTI effect on GDP convergence in Africa and African RECs

	AFRICA	WAEMU	CEMAC	ECOWAS	EAC	ECCAS	COMESA	SADC	AMU	IGAD
Bilateral import	0.0531***	0.0980***	0.0046	0.0728***	0.1174***	0.0287*	0.0481***	0.0319***	0.0268*	0.0319*
	(0.000)	(0.001)	(0.597)	(0.000)	(0.008)	(0.055)	(0.000)	(0.003)	(0.061)	(0.064)
	6,095	210	73	610	72	215	701	434	49	51
Bilateral export	0.0478***	0.1181***	0.0184	0.0675***	0.0975*	0.0288***	0.0636***	0.0283***	0.0352	0.0328*
	(0.000)	(0.004)	(0.105)	(0.000)	(0.064)	(0.001)	(0.000)	(0.006)	(0.100)	(0.062)
	6,095	210	73	610	72	215	701	434	49	51
IV estimation	0.1617***	0.2299***	0.0428*	0.2519***	0.3717***	0.1425***	0.1835***	0.0867***	0.0666**	0.0818***
	(0.000)	(0.000)	(0.100)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.022)	(0.001)
	5,872	210	73	610	72	215	626	378	49	51
System GMM estimation	0.0625***	0.1128**	0.0103	0.0994***	0.4525**	0.0318***	0.0662***	0.0272***	0.0103	0.0534
	(0.000)	(0.034)	(0.479)	(0.000)	(0.015)	(0.001)	(0.000)	(0.001)	(0.843)	(0.256)
	6,095	210	73	610	72	215	701	434	49	51
Quantile regression (second quartile)	0.0530***	0.1284	0.0098	0.0873***	0.2827***	0.0317	0.0490***	0.0290***	0.0427***	0.0357***
	(0.000)	(0.817)	(0.294)	(0.000)	(0.006)	(0.634)	(0.000)	(0.000)	(0.001)	(0.001)
	6,095	210	73	610	72	215	701	434	49	51
LSDV estimation with annual data	0.0392***	0.1214***	0.0069	0.0648***	0.1383**	0.0155**	0.0374***	0.0324***	0.0259**	0.0300***
	(0.000)	(0.004)	(0.451)	(0.000)	(0.037)	(0.048)	(0.000)	(0.000)	(0.024)	(0.005)
	20,799	809	256	2,060	258	687	2,344	1,452	194	177
Panel Fixed effects with lagged RTI	0.0394***	0.1149***	0.0062	0.0598***	0.1311**	0.0204**	0.0373***	0.0315***	0.0260**	0.0299***
	(0.000)	(0.002)	(0.547)	(0.000)	(0.024)	(0.040)	(0.000)	(0.000)	(0.018)	(0.002)
	20,799	809	256	2,060	258	687	2,344	1,452	194	177
Winsorizing data	0.0459***	0.1038***	0.0120**	0.0824***	0.2757***	0.0251***	0.0490***	0.0184**	0.0375***	0.0382***
	(0.003)	(0.029)	(0.006)	(0.011)	(0.063)	(0.008)	(0.008)	(0.009)	(0.013)	(0.015)
	6,095	210	73	610	72	215	701	434	49	51

Source: author's estimations. RTI is the sum of the bilateral trade (import and export) of countries in the pair. The dependent variable is GDP gap calculated as the absolute difference of GDP of countries in the pair. All regressions include an intercept and are corrected for heteroscedasticity. *Significant at 10%, **significant at 5% and ***significant at 1%. For each robustness test, the first row presents the coefficients of the estimates. The second row presents the robust p-values. The third row displays the total number of observations present in the regressions.

Table 11. Robustness tests of RTI effect on GDP per capita convergence in Africa and African RECs

	AFRICA	WAEMU	CEMAC	ECOWAS	EAC	ECCAS	COMESA	SADC	AMU	IGAD
Bilateral import	0.0252***	0.0048	0.0027	0.0232*	0.0868***	0.0130	0.0400***	0.0236**	0.0503**	0.0404*
	(0.000)	(0.793)	(0.647)	(0.088)	(0.007)	(0.182)	(0.000)	(0.030)	(0.030)	(0.062)
	6,095	210	73	610	72	215	701	434	49	51
Bilateral export	0.0192***	-0.0092	0.0043	0.0206*	0.0109	0.0115	0.0468***	0.0181*	0.0409	0.0422**
	(0.000)	(0.595)	(0.626)	(0.078)	(0.802)	(0.125)	(0.000)	(0.086)	(0.131)	(0.017)
	6,095	210	73	610	72	215	701	434	49	51
IV estimation	0.0603***	0.0199	-0.0181	0.0638***	0.1458	0.0699**	0.0948***	0.0495***	0.0439	0.0429
	(0.000)	(0.611)	(0.412)	(0.010)	(0.145)	(0.043)	(0.000)	(0.004)	(0.131)	(0.148)
	5,872	210	73	610	72	215	626	378	49	51
System GMM estimation	0.0237***	0.0031	-0.0133	0.0450**	0.2720*	0.0161	0.0557***	0.0131	-0.0108	0.0256
	(0.000)	(0.911)	(0.251)	(0.013)	(0.078)	(0.177)	(0.000)	(0.305)	(0.964)	(0.278)
	6,095	210	73	610	72	215	701	434	49	51
Quantile regression (second quartile)	0.0224	0.0063	0.0005	0.0321	0.1289**	0.0155	0.0403***	0.0202	0.0629***	0.0412**
	(0.339)	(0.866)	(0.988)	(0.805)	(0.027)	(0.234)	(0.000)	(0.289)	(0.008)	(0.012)
	6,095	210	73	610	72	215	701	434	49	51
LSDV estimation with annual data	0.0182***	0.0258	-0.0026	0.0277**	0.0633	0.0097*	0.0234***	0.0186**	0.0251	0.0237**
	(0.000)	(0.395)	(0.330)	(0.018)	(0.200)	(0.068)	(0.000)	(0.038)	(0.420)	(0.011)
	20,799	809	256	2,060	258	687	2,344	1,452	194	177
Panel Fixed effects with lagged RTI	0.0187***	0.0153	0.0020	0.0200*	0.0761	0.0139**	0.0257***	0.0190**	0.0258	0.0259***
	(0.000)	(0.556)	(0.646)	(0.070)	(0.131)	(0.023)	(0.000)	(0.023)	(0.392)	(0.009)
	20,799	809	256	2,060	258	687	2,344	1,452	194	177
Winsorizing data	0.0211***	0.0057	0.0018	0.0330***	0.0886	0.0157**	0.0302***	0.0166	0.0536***	0.0331**
	(0.002)	(0.013)	(0.005)	(0.010)	(0.054)	(0.008)	(0.006)	(0.010)	(0.021)	(0.014)
	6,095	210	73	610	72	215	701	434	49	51

Source: author's estimations. RTI is the sum of the bilateral trade (import and export) of countries in the pair. The dependent variable is GDP per capita gap calculated as the absolute difference of GDP per capita of countries in the pair. All regressions include an intercept and are corrected for heteroscedasticity. *Significant at 10%, **significant at 5% and ***significant at 1%. For each robustness test, the first row presents the coefficients of the estimates. The second row presents the robust p-values. The third row displays the total number of observations present in the regressions.