Regional Integration: Do intra-African trade and migration improve income in Africa?*

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Abstract

Regional integration in Africa is a subject of great interest, but its impact on income has not been studied sufficiently. Using cross-sectional and panel estimations, this paper examines the impact of African integration on real per capita income in Africa. Accordingly, we consider intra-African trade and migration flows as quantitative measures reflecting the intensity of regional integration. To address the endogeneity concerns, we use a gravity-based 2SLS strategy. Our results show that, from a long-term perspective, African integration has not been strong enough to generate a positive, significant and robust impact on real per capita income in Africa. However, it does appear to be significantly income enhancing in the short and medium terms, but only through inter-country migration. These results are robust to a wide range of specifications. Further analysis shows that economic diversification, financial development and the quality of transport and telecommunication infrastructure significantly affect the impact of intra-African trade on per capita income. Their improvement would make intra-African trade income-improving. Our policy recommendations have been formulated in this direction.

Keywords: Income per Capita, Trade, International Migration, Economic Integration, Africa.
JEL classification: E64, F14, F22, F15, O55.

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1. Introduction

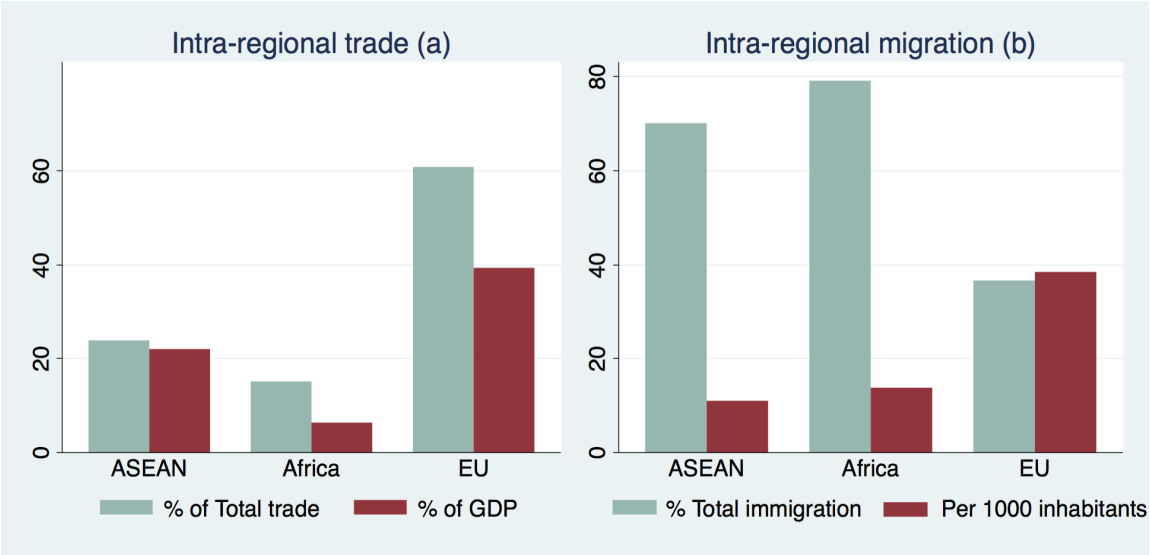
Despite its strong economic growth since the beginning of the twenty-first century, Africa still faces the challenge of inclusive growth and poverty reduction.[1] The integration of African economies is seen by African leaders, as well as by African and international organizations, as a powerful tool to promote inclusive growth and a significant reduction in poverty in Africa. According to the African Development Bank (AfDB), regional integration is imperative for Africa. Increased willingness to support the integration of African economies is also expressed by institutions such as the World Bank and the United Nations Economic Commission for Africa (UNECA), to name just a couple. Similarly, African states themselves have formed several blocks of regional integration[2] across the continent with the same intent of strengthening their economic ties, which is necessary for their economic development.

Although the interest in regional integration in Africa has increased in recent years, this ambition is not new, having been at the origin of the creation of most African institutions, many of which have existed since the 1960s. Despite the efforts made at various levels to achieve this goal, the statistics on the current state of African integration are not impressive. Intra-African trade, which is one of the main quantitative insights into this integration, remains very low at 15% of Africa's total trade in 2015, far behind that of ASEAN (Association of Southeast Asian Nations) at 24% and the European Union (EU) at 61%, as shown in Figure 1. Consequently, the intra-African trade openness rate is only 6.4%, compared with 22% for ASEAN and 39.4% for the EU. In addition to intra-regional trade, the degree of mobility of people in a regional space (intra-regional migration) is a quantitative reflection of integration. This dimension is often overlooked in studies, while people's mobility is by definition one of the key foundations of regional integration. The record for intra-African migration is less dramatic. Indeed, nearly 80% of immigrants in Africa in 2015 are Africans, ahead of ASEAN with an intra-regional migration rate of 70% and the EU with a rate of 36.5%. However, in terms of the population ratio, Africa, with an intra-regional migration rate of 14 per 1000 inhabitants in 2015, is far behind the EU with 39 per 1000, but ahead of ASEAN, for which the ratio is 11 per 1000 inhabitants (see Figure 1, b).

[1] Africa's average economic growth has doubled since the turn of the century compared with the previous two decades (the 1980s and 1990s) and reached 4.5% (average over the period 2000–2015), thus exceeding global economic growth by two points. For sub-Saharan Africa, the average growth rate was 5% over the same period

[2] Several regional economic communities exist: the Arab Monetary Union (UMA), the Common Market for Eastern and Southern Africa (COMESA), the Economic Community of Central African States (ECCAS), the Economic Community of West African States (ECOWAS) and the Southern African Development Community (SADC).

Figure 1: Intra-regional trade and migration in 2015



Notes: The data used to build these graphs are from the World Bank and the United Nations for bilateral migration and the United Nations Conference on Trade and Development (UNCTAD) for bilateral trade.

The contrast between the long-standing political will to promote integration in Africa and the actual data reflecting the degree of integration of African economies raises several questions. Has regional integration in Africa really contributed to improved incomes in African countries? Is there a dominant channel between intra-African migration and trade? These questions are the basis of this study. Although several studies have been devoted to regional integration in Africa, none of them provide answers to these questions, to the best of our knowledge. The existing studies generally focus on intra-African trade or the impact of monetary unions (among others, Limao and Venables, 2001; Anyanwu, 2003; Longo and Sekkat, 2004; Masson, 2008; Anyanwu, 2014) but do not address the issue of the impact of African integration in quantitative terms. Similarly, they study neither intra-African migration nor its impact on income and growth.

While the impact of openness, in particular trade openness, is widely studied in the literature (among others Dollar, 1992; Edwards, 1992; Ben-David, 1993; Sachs and Warner, 1995; Frankel and Rose, 2002; Dollar and Kraay, 2003; Noguer and Siscart, 2005; Freund and Bolaky, 2008), very few studies exist on the impact of regional integration. The existing studies are more theoretical, and the first empirical study on the impact of regional integration on growth dates back nearly twenty years (Vamvakidis, 1998). Looking more closely at the issue, the results of theoretical and empirical studies on regional integration are much more mixed than the general enthusiasm for the income-enhancing effect of regional integration. Several theoretical works predict that regional integration among developing countries, such as those in Africa, is counterproductive for member countries (Grossman and Helpman, 1991a,b; Rivera-Batiz

and Romer, 1991; Coe et al., 1997). According to these studies, integration is only beneficial to developing countries if it is carried out with larger, more open and more developed countries. The main argument is that a country with more advanced and bigger trading partners gains greater technological spillover effects from them (Grossman and Helpman, 1991a,b). It therefore seems risky, without a serious empirical study, to conclude definitively on the impact of regional integration among developing countries, even though the overall opinion tends, a priori, to suggest a positive impact.

The objective of this paper is to study the impact of regional openness – through intra-African migration and trade – on per capita income in Africa. Our starting assumption is that any regional integration process or agreement, including monetary unions, aims to increase trade in goods and services and mobility of people and capital among member countries. This is the commonly accepted definition of regional integration.[3] Given the low level of financial integration between African countries and the lack of bilateral data, we consider intra-African trade and migration as two important quantitative vehicles of African integration. Since countries whose incomes are high for reasons other than trade and migration may trade and migrate more (see Frankel and Romer, 1999; Ortega and Peri, 2014), we use the two-stage least-squares (2SLS) estimation strategy to take into account the potential problem of simultaneity bias. Our 2SLS estimation approach follows recent developments in the international trade and migration literature (Ortega and Peri, 2014; Alesina et al., 2016; Docquier et al., 2016) inspired by the trade literature (Frankel and Romer, 1999).

Our paper contributes to the literature on several points. Firstly, it contributes to the empirical works on the impact of openness, with the peculiarity of studying the impact of regional integration in Africa. Secondly, it provides an additional insight into the impact channels by both testing the effect of intra-African trade and migration and distinguishing their respective impacts.

The rest of the paper is organized as follows. Section 2 is devoted to the review of the literature. Section 3 describes our empirical strategy and presents the data. In Section 3 we present and discuss our main results and provide some robustness checks. Finally, Section 5 concludes the paper.

[3] The European Union, which is an example of regional integration, defines regional integration as "The process of overcoming barriers that divide neighbouring countries, by common accord, and of jointly managing shared resources and assets. Essentially, it is a process by which groups of countries liberalise trade, creating a common market for goods, people, capital and services."

2. From global openness to regional integration

Studies on the impact of regional integration on income are scarce. Those that do exist are often inspired by the broader literature on international openness. In this section, we present the most influential and recent theoretical and empirical studies on the impact of international openness that have inspired our study, as well as the existing studies on the impact of regional integration on income.

2.1. Theoretical literature

The "income-enhancing" effect of international openness is well documented in economics. The new theory of international trade shows that openness to trade increases income through the exploitation of increasing returns to scale and the effects of networks (Helpman and Krugman, 1985; Grossman and Helpman, 1991a,b; Rivera-Batiz and Romer, 1991). This recent literature is essentially based on the endogenous growth model of Lucas (1988), which considers human capital as the engine of growth and analyses the effects of learning by doing. According to this literature, by improving human capital, trade increases income. Indeed, trade increases innovation through economies of scale, technological spillovers and the elimination of the replication of research in research and development (R&D) in different countries (see Vamvakidis, 1998). Grossman and Helpman (1991a,b) consider the innovation of new products as a positive function of past innovations, which represent the stock of knowledge. Given that international trade provides access to a vast international market, to advanced technology and therefore to a larger stock of knowledge, it promotes more innovation and faster growth. Consequently, it is more beneficial for a country to open up to free trade with large economies that have an advanced stock of knowledge. Coe et al. (1997) support this claim by showing that developing countries with limited R&D stocks can increase their productivity by trading with a more developed country that has a wide range of knowledge from its cumulative R&D activities. Obviously, such results challenge the foundations of trade integration between developing countries, such as African countries. However, the literature does not explicitly address the issue of regional integration.

Going further, Ortega and Peri (2014) developed a simple multi-country theoretical model to explain the joint impact of trade and migration on income. In this model, which is a minor extension of the model proposed by Alesina et al. (2000), total production is a function of intermediate goods and human capital, and each region is endowed with a differentiated good and a differentiated type of labor. Given the low mobility or high mobility costs of labor and intermediate goods between regions in different countries, this model defines income per worker as a function of the theoretical measures of trade and migration openness. The positive effect of openness to migration in this model operates through an increase in total factor productivity reflecting a greater diversity in productive skills caused by immigration. Like the studies on trade openness, Ortega and Peri (2014)

address the issue of the impact of international migration indiscriminately and therefore do not address the impact of regional migration.

2.2. Empirical literature

This literature can be split into two. The earliest studies focus more on the impact of openness policies (tariff and non-tariff barriers, trade agreements, protective measures, etc.). The most recent studies rely more on quantitative variables of openness (generally the degree of openness, measured by the sum of exports and imports relative to GDP and/or the rate of international migration).

The first subgroup of studies generally shows that free trade improves income and growth (Dollar, 1992; Edwards, 1992; Levine and Renelt, 1992; Barro and Sala-i-Martin, 1995; Sachs and Warner, 1995). Based on a cross-sectional study of 95 developing countries, Dollar (1992) shows that outward-oriented countries develop faster than inward-oriented countries. Edwards (1992) relies on nine opening indexes proposed in the literature to study the impact of openness and finds a positive correlation between trade openness and growth. In a study designed to identify the robust determinants of economic growth, Levine and Renelt (1992) conclude that free international trade affects growth indirectly through investment. Thus, countries with low trade barriers invest more and grow faster. Sachs and Warner (1995) construct a dummy variable of openness based on five protection dimensions and find that open economies grow faster than closed economies. Similarly, Barro and Sala-i-Martin (1995) use tariffs on capital goods and intermediate inputs as a measure of protection and show that protection has a negative impact on growth and income.

The second subgroup, mainly inspired by Frankel and Romer (1999), also find, for the most part, that openness is favorable to income (see among others Irwin and Terviö, 2002; Dollar and Kraay, 2003; Noguer and Siscart, 2005; Freund and Bolaky, 2008). Frankel and Romer (1999) were the first to provide an original solution to the problem of bi-causality between trade and income. They used a gravity model to estimate bilateral trade on the basis of geographical factors, which they then used as an instrument to demonstrate a positive effect of trade on per capita income. However, the consensus is far from being established on this issue. Rodriguez and Rodrik (2000) consider that these results are not robust since they lose all statistical power when the estimates are corrected for the bias of omitted variables, taking into account variables such as distance from the equator or quality of institutions. More recently, Ortega and Peri (2014) have gone further by pointing out that the geographical factors used by Frankel and Romer (1999) and taken up by other authors are also valid for bilateral migration, which is also a determinant of economic growth. Integrating openness to trade and openness to migration – both instrumented by the same geographical factors – in the real per capita income equation, the authors establish a positive and significant effect of immigration on income per capita in the long term, but fail to do so for trade.

While most empirical studies treat the issue of the impact of openness on income indiscriminately, very few studies are devoted to the issue of the impact of regional integration. Among these are the works of Vamvakidis (1998); Vamvakidis (1999). The author shows that regional integration between small economies has no positive impact on growth and that the latter would benefit more from trading with large economies. For Torstensson (1999), European integration has been favorable to growth, with the main channels being the transfer of “know-how" and increased investment. Spilimbergo et al. (1999) show that regional trade agreements (RTAs) could inhibit growth by changing the composition of trade in favor of low-technology products or goods with less of a learning effect (“learning by doing"). This thesis is also developed by Puga et Venables (1998) and Venables (2003) which show that South-North trade agreements offer better income prospects for countries of the South.

These studies show that the channels that are theoretically envisaged seem to be inoperative for African countries. Indeed, the complementarity effect and technology transfer are unlikely due to the strong similarities in the pattern of trade between countries. Similarly, the migration channel presented above is not very relevant for Africa given the relative homogeneity of qualifications, techniques and institutions between countries. However, there are a number of reasons for the income-enhancing effect of regional integration. The strengthening of intra-regional trade can generate a dynamic that favours the creation of value added through processing, which is conducive to inclusive growth. Similarly, since regional immigration constitutes a productive and useful workforce for host countries in certain sectors such as agriculture (coffee and cocoa plantations in Ivory Coast for example), regional migration can improve income in Africa.

3. Empirical approach

The empirical approach is designed to assess the impact of African integration on per capita income in Africa. In this section we present our empirical model (Section 3.1), discuss the estimation strategies (Section 3.2) and the issue of identification (Section 3.3) and describe the data sources used for the empirical analysis (Section 3.4).

3.1. Model

Our empirical model is inspired by that of Ortega and Peri (2014), which is an extension of the model of Frankel and Romer (1999). It is a model designed to evaluate the impact of openness, initially openness to trade by Frankel and Romer (1999) and several other authors (among others Dollar and Kraay, 2003; Noguer and Siscart, 2005; Freund and Bolaky, 2008). Then, Ortega and Peri (2014) have extended this model to assess both the impact of openness to trade and migration on per capita income. Transposed to Africa alone, this model allows an assessment of the impact of the integration of African economies on per capita income through intra-African trade (trade integration) and

intra-African migration (integration or mobility of people).[4] Therefore, the specification of our model is given by:

$$lny = \alpha_0 + \alpha_1 TSH^{Afr} + \alpha_2 MSH^{Afr} + \alpha_3 lnSize + \sum_k \delta^k X^k + \varepsilon \qquad (1)$$

where y is the real GDP per capita at chained PPPs, TSH^{Afr} represents intra-African trade (import plus export) as a share of GDP, MSH^{Afr} is the intra-Afrcan migration share in the population, *Size* controls for country size (population and area), X are control variables, and ε stands for the error term and accounts for unobserved determinants of log income per capita. The rationale behind this empirical model is given by the literature presented in Section 2. Roughly speaking, while the classical theory of international trade supports the income-enhancing effect of international trade through specialization based on comparative advantage, the new trade theory supports the same thesis by relying on the exploitation of increasing returns to scale and network effects (Grossman and Helpman, 1991a,b; Helpman and Krugman, 1985). The joint impact of trade and migration on income is explained by Ortega and Peri (2014) in a simple multi-country model which is an extension of Alesina et al. (2000).

In the intra-African context, the different channels (network effects, skills and technology transfers, etc.) assumed by these theoretical models are certainly not the most relevant to explain a possible income-enhancing effect of openness (regional integration). Strengthening intra-African trade could create regional value chains conducive to inclusive growth and increased per capita income. Given the relatively homogenous level of labor and income, the income-improving effect of intra-African migration could take place through the importance of labor as an adjustment factor of economic cycles, particularly in agriculture and services. For example, Burkinabe and Malians are often found in coffee and cocoa plantations in Ivory Coast, while the Beninese and Togolese regularly work in cassava plantations in Nigeria. We could multiply these examples.

3.2. The estimation strategies

We use both cross-section and panel specifications of model 1 to analyze respectively the long-term and short-term effects of integration on per capita income in Africa. We also discuss the identification strategy to address the problem of reverse causality.

Equation (2) below presents a cross-sectional specification of model (1). This specification allows us to analyze the long-term impact of intra-African trade and migration (African integration) on per capita income in Africa. In other words, with the

[4] Our approach is thus different from those of previous studies on the impact of regional integration (Vamvakidis, 1998; Torstensson, 1999; Venables, 2003). These studies typically assess the impact of integration through dummies variables that do not represent quantitative measures of integration. Moreover, the role of intra-regional migration is often ignored in these studies.

cross-sectional approach, we can check whether differences between African countries in terms of intra-African openness to trade and migration significantly explain their differences in terms of economic development (real income per capita). Estimates are made using the full-sample averages of the dependent and independent variables for each country:

$$lny_i = \alpha_0 + \alpha_1 TSH_i^{Afr} + \alpha_2 MSH_i^{Afr} + \alpha_3 lnSize_i + \sum_k \delta^k X_i^k + \varepsilon_i \quad (2)$$

where *i* stands for the country index. In this regression, the value of the variables is their simple average calculated over the period of the study (1990-2014).

While the cross-sectional OLS approach is important for placing the relationship between regional integration and income par capita in a long-term perspective, it does not allow analysis of the short-term effects of African integration. To account for this concern, we construct a panel that contains non-overlapping 5-year averages data for each country, since intra-African migration data are also available for each five-year period.

$$lny_{i,t} = \alpha_0 + \alpha_1 TSH_{i,t}^{Afr} + \alpha_2 MSH_{i,t}^{Afr} + \alpha_3 lnSize_{i,t} + \sum_k \delta^k X_{i,t}^k + \varepsilon_{i,t} \quad (3)$$

where *i* and *t* stand for the country and period indices, respectively. This specification also allows the possible heterogeneity between different sub-regions of Africa to be taken into account. Given the relatively small sample size of African countries, the panel specification has the advantage of providing more observations and variability, thus allowing for more robust estimates and certainly more accurate inferences.

3.3. The issue of identification

By estimating equations (2) and (3) by OLS, there is still an important issue – that of endogeneity – that needs to be addressed. The main problem in using cross-sectional and pooled OLS regressions is the endogeneity of our main variable of interest – African integration (intra-African trade and migration). If regional integration can improve the standard of living of the population, an increase in per capita income resulting from an increase in production is itself conducive to integration (more trade, more migration). The relationship between regional integration and per capita income can therefore be characterized by a reversal causality. Furthermore, unobserved characteristics of countries can jointly affect both variables. To account for these potential problems of simultaneity bias, we use a two-stage least squares (2SLS) estimation strategy based on a gravity model.

Roughly speaking, the first step consists in constructing, on the basis of pseudo-gravity regressions, the geography-based prediction of integration (here bilateral trade and bilateral migration) between African countries. To do this, we consider the following pseudo-gravity model:

$$lnWSH_{ij}^{Afr} = \gamma_0 + \gamma_1 lnDist_{ij} + \gamma_2 lnPop_i + \gamma_3 lnPop_j + \gamma_4 lnArea_i + \gamma_5 lnArea_j + \gamma_6 Landlocked_i + \gamma_7 Landlocked_j + \gamma_8 Border_{ij} + \gamma_9 ComLang_{ij} + \gamma_{10} Colony_{ij} + \gamma_{11} Comcur_{ij} + \gamma_{12} Boder_{ij} \times lnDist_{ij} + \gamma_{13} Boder_{ij} \times lnPop_i + \gamma_{14} Boder_{ij} \times lnPop_j + \gamma_{15} Boder_{ij} \times lnArea_i + \gamma_{16} Boder_{ij} \times lnArea_j + \gamma_{17} Boder_{ij} \times Landlocked_i + \gamma_{18} Boder_{ij} \times Landlocked_j + Time_{ij} + e_{ij}$$

Where WSH_{ij}^{Afr} is either the bilateral trade rate (the value of trade – exports + imports – between country *i* and *j* in Africa divided by the GDP of origin country *i*) or bilateral migration (the stock of migrants born in country *i* (*j*) and living in country *j* (*i*) in Africa as a share of origin country *i*'s population), $Dist_{ij}$ is the distance between origin country *i* and destination country *j*, *Pop* denotes population, *Area* is country area, *Landlocked* is a dummy variable for landlocked countries, *ComLang* is a dummy for sharing a common official language, *Border* is a dummy variable to indicate that countries *i* and *j* share a common border. *Colony* is a dummy for colonial ties and *Comcur* is a dummy for sharing the same currency. Following Ortega and Peri (2014) and Coulibaly and al. (2018), we include time zone differences (*Time*). Since a large part of trade is with immediate neighboring countries, we finally include interaction terms of the border dummy with the distance, population, area, and landlocked dummies (see among others, Frankel and Romer, 1999; Ortega and Peri, 2014; Coulibaly et al., 2018).

We rely on the Poisson Pseudo Maximum Likelihood (PPML) non-linear approach to estimate the gravity model. As argued by Silva and Tenreyro (2006), contrary to the log-linearized model estimation by OLS, PPML estimation allows issues relating to observations of the dependent variable with zero value and to heteroskedasticity to be addressed. We rely on the procedure of Silva and Tenreyro (2010) in order to deal with the identification problem of the (pseudo) maximum likelihood estimates of the Poisson regression models with non-negative values of the dependent variable (bilateral migration) and a large number of zeros on some regressors. Once the gravity regressions described by (4) are estimated, we sum them up over destination countries *j* to obtain the predicted trade and migration openness for each origin country *i*. More specifically, let Z_{ij} be the vector of explanatory variables included in Equation (4) and Γ_{tsh} the vector of coefficients in the bilateral trade regression, while Γ_{msh} is the corresponding vector for the bilateral migration regression. The gravity-based predictor of intra-African trade openness for origin country *i* is then obtained by summing up bilateral trade over destination countries:

$$\widehat{TSH}^{Afr} = \sum_{i \neq j} exp(\Gamma_{tsh} Z_{ij}) \qquad (5)$$

Similarly, the gravity-based predictor of intra-African migration openness for origin country *i* is given by:

$$\widehat{MSH}^{Afr} = \sum_{i \neq j} exp(\Gamma_{msh} Z_{ij}) \qquad (6)$$

These two predicted values are used in the 2SLS procedure as instruments for intra-African trade and migration, respectively.

3.4. Data

Our data are taken from various sources. Our dependent variable is the real income per person (real PP P-adjusted GDP per person), collected from the Penn World Tables (PWT version 9.0). Our explanatory variables of interest are intra-African trade and migration. Data on bilateral trade are collected from the IMF's Direction of Trade Statistics (DOTS). The DOTS database contains data on the value of merchandise exports and imports between each country and all its trading partners. The period for which data are available depends on country, but for most countries the data extends from the 1980's to the present. The bilateral migration data are taken from the United Nations Global Migration Database (UNGMD). Data on bilateral migration are available for each five-year period starting in 1990. To estimate gravity models for both bilateral variables, we use geographical variables from the CEPII database described in Head et al. (2010) and from Gallup et al. (1999).

The control variables come largely from the World Bank's World Development Indicators (WDI) database. This is the case for the measure of financial development (domestic credit to private sector as a share of GDP), inflation, population and area. We use the database from Acemoglu et al. (2001) for the historical (colonial origin and European settlement in the colonies) and geographical (latitude and landlocked) variables. Data on real investment is from the PWT9.0 and for education, we use data on the expected years of schooling provided by the UNESCO Institute for Statistics.

Data on bilateral migration are available for each five-year period (1990 – 1995 – 2000 – 2005 – 2010). The other variables in the study are therefore all constructed on five-year averages (1990 – 1994, 1995 – 1999, 2000 – 2004, 2005 – 2009 and 2010 – 2014). We therefore have a panel data structure with a time dimension of five and a country dimension that covers all African countries. Descriptive statistics on the main variables used for these variables are presented in Table 1.

Table 1: Descriptive statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
Cross-sectional data					
Ln Income per capita	7.78	0.85	6.49	9.73	49
Intra-African Trade (% GDP)	8.35	7.7	0	35.72	49
Intra-African Migration (% Pop.)	2.29	3.04	0.05	13.09	49
Ln Population	15.56	1.62	11.26	18.61	49
Ln Area	11.99	2.13	6.13	14.7	49
Education	7.73	2.64	2.76	12.06	49
Financial development	20.66	18.32	4.28	112.86	49
Democracy	-0.9	3.98	-9.35	9.95	47
French colony	0.4	0.5	0	1	47
British colony	0.36	0.49	0	1	47
European settlers 1900	3.7	14.75	0	100	48
Dist. to equator	15.35	9.82	1.11	37.78	47
Inflation	0.45	1.87	0	12.69	49
Domest. Invest. rate (% GDP)	17.33	8.14	6.83	46.97	49
Landlocked	0.23	0.43	0	1	47
Panel data					
Ln Income per capita	7.75	0.94	5.54	10.62	245
Intra-African Trade (% GDP)	8.35	8.47	0	47.87	245
Intra-African Migration (% Pop.)	2.29	3.06	0.04	13.87	245
Ln Population	15.63	1.62	11.18	18.94	245
Ln Area	11.99	2.11	6.13	14.73	245
Education	8.18	3.01	2.05	14.6	243
Financial development	20.26	22.15	1.61	148.31	238
Democracy	0.52	5.26	-9.6	10	235
French colony	0.4	0.49	0	1	235
British colony	0.36	0.48	0	1	235
European settlers 1900	3.7	14.62	0	100	240
Dist. to equator	15.35	9.73	1.11	37.78	235
Inflation	0.58	5.72	0	86.03	233
Domest. Invest. rate (% GDP)	18.42	10.51	1.95	65.94	245
Landlocked	0.23	0.42	0	1	235

4. Empirical results

We begin by presenting the results of our gravity model that are essential to our identification strategy. However, since the gravity model itself is not central to our study, the comments are brief. We then present and discuss the results on the impact of African integration, seen from the perspective of intra-African trade and migration. We then distinguish the long-term impact from the short- and medium-term impacts.

4.1. Gravity model estimates

We estimate the gravity model (4) using both the OLS and the PPML estimator, although we prefer the results from the PPML approach for the reasons mentioned above. The results obtained for both intra-African trade and intra-African migration are presented in Table A-1 in the Appendix. The model is estimated for both cross-sectional (first four columns) and panel (last four columns) data. To account for time-varying dimensions in the panel setting, following Feyrer (2009) and Docquier et al. (2016), we include time fixed effects and interactions between geographical distance and time dummies. This allows the effect of geographical distance to be time varying and thus to capture the reduction in trade and migration costs caused by improvements in transport technology (Docquier et al., 2016).

Several lessons can be drawn from these results. First, the results are consistent with the usual predictions of gravity models. Several expected results are obtained, such as the negative effect of distance on trade and migration and the positive effect of sharing a common language (official or local). We also find that landlocked countries are naturally much less open to trade and migration, which is an expected result. Moreover, we note that the intensity of trade and migration between two African countries increases with the size of the destination country. It should be added, however, that in terms of the effect of size (population, surface area), the results are different in some cases according to the estimator and between trade and migration. The literature itself does not establish a clear and unambiguous relationship on this effect (see Ortega and Peri, 2014). Second, the results from the cross-sectional and panel-based approaches are consistent. The signs obtained for the different variables are generally the same. The results also show that the development of new transport technologies has not contributed significantly to reducing the impact of distance on intra-African migration and trade. Although the OLS estimator shows a downward trend in distance costs, it disappears with the more robust PPML estimator. This result reflects the still-too-high costs of trade and mobility between African countries, largely due to the impressive lack of transport infrastructure. Contrary to expectations, Africans sharing common colonial ties are not more integrated from a migration perspective and appear to be even less integrated from a trade perspective when relying on results from the PPML estimator. What seems to prevail is the sharing of a common language and not of a colonial link. Finally, it is important to note that these results should be interpreted with caution because of the interaction terms introduced in the regression. The latter do not allow the coefficients associated with the variables concerned to be interpreted as their net impact. The coefficients of the interaction terms must obviously be taken into account. We will not go further in the interpretation of these results since they are not central to our study. What is important is that we have evidence that the results of our gravity model fit well with some well-known stylized facts (effect of distance, isolation, language) and are consistent with the results of previous studies (Frankel and Romer, 1999; Ortega and Peri, 2014; Coulibaly et al., 2018).

4.1. Long-term effects of intra-African trade and migration

Table 2 presents the results of the cross-sectional regressions in line with most of the previous studies (among others, Frankel and Romer, 1999; Dollar and Kraay, 2003; Noguer and Siscart, 2005; Freund and Bolaky, 2008; Ortega and Peri, 2014; Docquier et al., 2016; Coulibaly et al., 2018) to analyse the impact of integration from a long-term perspective. We first present the intra-African trade and migration results separately. Then we present the results of the joint impacts to take into account the criticism made by Ortega and Peri (2014) concerning the omitted variable bias.

These results show that intra-African trade and migration, taken separately (columns CS-IV1 and CS-IV2), have an impact of low significance on per capita income. This impact disappears when the two variables are considered simultaneously (Column CS-IV3) to avoid the omitted variable bias. The three central columns in Table 2 extend the baseline by introducing education, which is a key long-term determinant of income, as a control variable. The results do not change significantly. Intra-African trade and migration do have a positive impact on per capita income in the long term, but this impact disappears when the two variables are introduced jointly. As expected, education has a significant and positive impact on per capita income regardless of the specification. In the last three columns of Table 2, we introduce a set of geographical and historical control variables (landlocked dummy, former French colony, former English colony, European settlement), which are considered as exogenous sources of the quality of the current institutions, as well as of the current performances of the government (see Hall and Jones, 1999; La Porta et al., 1999, 2008; Ortega and Peri, 2014). The results still show that intra-African trade and migration do not have a significant impact on per capita income in the long term. In other words, countries that are more open to African trade and migration do not improve their per capita income more.

To summarize, our empirical results do not allow us to establish a positive, significant and robust long-term impact of regional integration on the standard of living in Africa. This may be a reflection of the current low level of integration of African countries, as outlined in the introduction. The still-too-high costs of trade between countries, the sharp lack of inter-country connection infrastructure, the low level of diversification of African economies and the low level of financial development of the countries could explain this result. Does this mean that regional integration is not appropriate for African economies? Should we conclude, as in previous studies (Vamvakidis, 1998; Torstensson, 1999; Venables, 2003), that integration among developing countries is not beneficial to them? Certainly not, given the large potential for progression that exists for African economies. Finally, given the relatively limited number of observations in the cross-section, it is wise not to draw a definitive conclusion at this stage. What about the short- and medium-term impacts of regional integration in Africa? The next section answers this question.

Table 2: Long-term effects of intra-African trade and migration

	Baseline regression			Augmented-baseline regression			Historical and Geo. control variables		
VARIABLES	CS-IV1	CS-IV2	CS-IV3	CS-IV4	CS-IV5	CS-IV6	CS-IV7	CS-IV8	CS-IV9
Intra-African Trade	0.026*		0.014	0.035**		0.026	0.022		0.016
	(0.014)		(0.039)	(0.016)		(0.025)	(0.016)		(0.021)
Intra-African Migration		0.071*	0.040		0.089**	0.032		0.076*	0.032
		(0.042)	(0.119)		(0.039)	(0.068)		(0.045)	(0.062)
Ln Population	0.035	0.066	0.059	0.010	0.043	0.029	-0.003	0.025	0.016
	(0.130)	(0.112)	(0.119)	(0.094)	(0.085)	(0.095)	(0.083)	(0.078)	(0.085)
Ln Area	-0.099	-0.099	-0.103	-0.022	-0.020	-0.026	-0.030	-0.019	-0.029
	(0.097)	(0.090)	(0.091)	(0.078)	(0.069)	(0.073)	(0.072)	(0.070)	(0.070)
Dist. to equator	0.014	0.026*	0.021	0.011	0.026**	0.016	0.011	0.024**	0.016
	(0.018)	(0.016)	(0.024)	(0.015)	(0.012)	(0.017)	(0.014)	(0.011)	(0.018)
Education				0.165***	0.161***	0.164***	0.136***	0.139***	0.139***
				(0.033)	(0.025)	(0.028)	(0.032)	(0.025)	(0.030)
British colony							0.271	0.198	0.227
							(0.257)	(0.230)	(0.237)
French colony							0.295	0.134	0.222
							(0.225)	(0.218)	(0.212)
Landlocked							-0.316**	-0.226	-0.269
							(0.146)	(0.157)	(0.165)
European settlers 1900							-0.002	-0.000	-0.001
							(0.003)	(0.003)	(0.003)
Constant	7.348***	7.190***	7.243***	5.911***	5.765***	5.840***	6.123***	5.904***	6.012***
	(0.321)	(0.338)	(0.413)	(0.317)	(0.217)	(0.340)	(0.278)	(0.265)	(0.356)
Observations	47	47	47	47	47	47	47	47	47
R-squared	0.441	0.533	0.502	0.615	0.723	0.666	0.683	0.740	0.713
Regional Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
K-P F-stat	39.90	22.46	2.436	34.56	22.23	2.500	31.81	15.73	2.580
SW F-stat for Trade	39.90		11.53	34.56		11.40	31.81		10.45
SW F-stat for Migration		22.46	4.800		22.23	5.110		15.73	5.360
SY 10% max IV size	16.38	16.38	16.38	16.38	16.38	16.38	16.38	16.38	16.38
SY 25% max IV size	5.530	5.530	5.530	5.530	5.530	5.530	5.530	5.530	5.530

Notes: Heteroskedasticity-robust standard errors are in parentheses. *, **, and *** denote significance at the 10%, 5% and 1% confidence level, respectively. K-P F-stat is the Kleibergen and Paap (2006) rk Wald F-stat test of jointly weak identification. SW F-stat is the Sanderson and Windmeijer (2016) F-stat test of weak identification for each endogenous regressor separately. In the case of a single endogenous regressor, the SW F-stat is identical to the K-P F-stat. SY 10% max IV size and SY 10% max IV size are the Stock and Yogo (2005) critical values under the i.i.d. assumption.

4.2. Short- and medium-term effects of African integration

As before, we present the results sequentially, on the one hand trade and migration in separate regressions and on the other hand the two variables jointly in the same regression.

These results appear in Table 3 and show that, taken separately, only intra-African migration has a positive and significant impact on per capita income in Africa. Even considering the two regional integration vectors jointly, this result seems to be maintained. Intra-African migration therefore has a positive impact in the short and medium terms on real per capita income in Africa. This result is not affected by the extension of the baseline model to control the effect of education (Panel-IV4, Panel-IV5 and Panel-IV6). Intra-regional trade does not appear to have a significant impact on income in Africa. Education is highly correlated with income levels, even in the short and medium terms. The identification tests confirm the strength of the first stage of our 2SLS strategy.[6] The instruments used are therefore clearly identified. However, as before, it is necessary to extend the investigation to determine whether these results hold up when other important control variables are introduced to explain per capita income.

The last three columns go further by controlling the short- and medium-term impacts of African integration with a set of geographical and historical variables. The previous results are not disrupted at all by these control variables. Intra-regional trade does not have a significant impact on per capita income. Intra-regional migration, meanwhile, still has a positive and significant impact on Africa's standard of living at the 1% confidence level. Such a result is found by Ortega and Peri (2014), but in a cross-country analysis involving both developed and developing countries. They show that the positive impact of international trade identified by Frankel and Romer (1999) disappears when they control for international migration. According to them, countries with a higher rate of immigration improve their per capita income more significantly. Education remains a key variable in improving per capita real income in Africa. We also find that per capita real income is higher in former British colonies while landlocked countries have a lower per capita income. While our short- and medium-term results do not contradict those of Vamvakidis (1998), Torstensson (1999) and Venables (2003) on trade, they do not confirm them either. According to our results, regional integration among developing countries like those in Africa can significantly improve their living standards, particularly through intra-African migration. We cannot therefore look solely at the channel of intra-regional trade to come to a conclusion on the impact of regional integration. We clearly show here that other channels count, and in particular that intra-African migration helps to improve per capita income significantly in African countries, at least in the short to medium term.

[6] The statistics from Sanderson and Windmeijer's (2016) test of weak identification for each endogenous regressor and Kleibergen and Paap's (2006) test of jointly weak identification are higher than the critical values of the Stock and Yogo (2005) test at the usual confidence level.

Table 3: Short- and medium-term effects of intra-African trade and migration

	Baseline regression			Augmented-baseline regression			Historical and Geo. control variables		
VARIABLES	Panel-IV1	Panel-IV2	Panel-IV3	Panel-IV4	Panel-IV5	Panel-IV6	Panel-IV7	Panel-IV8	Panel-IV9
Intra-African Trade	0.011		-0.008	0.013		-0.009	0.001		-0.016
	(0.009)		(0.012)	(0.009)		(0.011)	(0.010)		(0.011)
Intra-African Migration		0.077***	0.089***		0.090***	0.105***		0.069***	0.099***
		(0.016)	(0.025)		(0.015)	(0.022)		(0.017)	(0.025)
Ln Population	-0.015	0.059	0.057	-0.060	0.027	0.024	-0.076	-0.002	-0.009
	(0.062)	(0.055)	(0.054)	(0.054)	(0.051)	(0.049)	(0.047)	(0.048)	(0.044)
Ln Area	-0.080*	-0.103**	-0.099**	0.001	-0.027	-0.022	-0.008	-0.026	-0.011
	(0.047)	(0.044)	(0.043)	(0.040)	(0.037)	(0.037)	(0.036)	(0.038)	(0.036)
Dist. to equator	0.019**	0.029***	0.032***	0.016**	0.028***	0.030***	0.016**	0.025***	0.032***
	(0.009)	(0.008)	(0.009)	(0.007)	(0.006)	(0.008)	(0.007)	(0.006)	(0.009)
Education				0.142***	0.140***	0.140***	0.112***	0.120***	0.119***
				(0.017)	(0.013)	(0.013)	(0.015)	(0.013)	(0.012)
British colony							0.405***	0.254**	0.257**
							(0.122)	(0.116)	(0.109)
French colony							0.355***	0.169	0.121
							(0.115)	(0.113)	(0.109)
Landlocked							-0.382***	-0.247***	-0.232***
							(0.077)	(0.072)	(0.070)
European settlers 1900							-0.002	-0.001	-0.000
							(0.002)	(0.002)	(0.002)
Constant	7.260***	6.969***	6.937***	6.165***	5.839***	5.803***	6.262***	5.970***	5.879***
	(0.169)	(0.183)	(0.190)	(0.183)	(0.164)	(0.177)	(0.174)	(0.174)	(0.187)
Observations	235	235	235	235	235	235	235	235	235
R-squared	0.476	0.544	0.555	0.606	0.672	0.682	0.666	0.692	0.706
Regional Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
K-P F-stat	23.31	122.4	10.10	23.35	126.4	9.956	19.61	126	8.466
SW F-stat	23.31	122.4	18.43	23.35	126.4	18.28	19.61	126	16.29
SY 10% max IV size	16.38	16.38	16.38	16.38	16.38	16.38	16.38	16.38	16.38
SY 25% max IV size	5.530	5.530	5.530	5.530	5.530	5.530	5.530	5.530	5.530

Notes: Heteroskedasticity - robust standard errors are in parentheses. *, **, and *** denote significance at the 10%, 5% and 1% confidence level, respectively. K-P F- stat is the Kleibergen and Paap (2006) rk Wald F-stat test of jointly weak identification. SW F-stat is the Sanderson and Windmeijer (2016) F- stat test of weak identification for each endogenous regressor separately. In the case of a si ngle endogenous regressor, the SW F-stat is identical to the K-P F- stat. SY 10% max IV size and SY 10% max IV size are the Stock and Yogo (2005) critical values under the i.i.d. assumption.

Our results can be partly explained by the fact that intra-regional migration makes it possible to adjust production cycles in countries of immigration and, at the same time, income cycles for migrants themselves. This is particularly true in the construction sector and especially in the agricultural sector. For example, it is quite common to find Beninese and Togolese farmers who go to Nigeria to work in agricultural plantations when the agricultural season is not favorable for their own crops. Similarly the “housing boom" in some African countries such as Ivory Coast attracts many workers from neighboring countries.

4.3. Sensitivity analysis

In this section, we perform a series of sensitivity tests to check the robustness of the previous results. The tests are carried out firstly for the cross-sectional analysis (long-term effect of regional integration) and then for the panel analysis (short- and medium-term effect of regional integration).

4.3.1. Robustness of cross-section regressions

Our previous cross-sectional regression results are based on the average of data for the 1990-2014 period. Although this practice exists in the literature, it is also common for cross-sectional analyses to be performed by taking a particular year and not an average of data. For example, the analysis of Frankel and Romer (1999) is based on data for 1985, that of Ortega and Peri (2014) uses data for 2000 and that of Dramane et al. (2018) uses data for 2000 while checking the robustness for 2010. We therefore use this second practice by considering only the 2010 data to study the long-term effects of regional integration. Table 4 reports the results of cross-sectional regressions on the impact of intra-African trade and migration using 2010 data.[7]

The previous conclusions are not fundamentally affected by the change of approach insofar as the results for the year 2010 do not establish any significant impact of regional integration. On the contrary, neither trade nor migration has a significant impact on per capita income, whether the two variables are considered separately or jointly. This confirms that regional integration in Africa has no significant impact on long-term growth. However, as before, education remains a driver of real income improvement and hence long-term growth in Africa. In addition, the former British colonies in Africa have a higher standard of living.

[7] The results of the gravity model for 2010 are shown in Table A.2 (first four columns) in the appendix. These results are consistent with those based on the 1990-2014 average data.

Table 4: Cross-sectional regression results for 2010

VARIABLES	Augmented-baseline regression			Historical and Geo. control variables		
	CS-IV1	CS-IV2	CS-IV3	CS-IV4	CS-IV5	CS-IV6
Intra-African Trade	0.015		-0.067	0.000		-0.006
	(0.017)		(0.111)	(0.021)		(0.022)
Intra-African Migration		0.127	0.290		0.014	0.028
		(0.121)	(0.432)		(0.057)	(0.039)
Ln Population	-0.164	-0.081	-0.099	-0.140	-0.128	-0.129
	(0.141)	(0.179)	(0.206)	(0.107)	(0.109)	(0.107)
Ln Area	0.038	0.004	0.021	0.081	0.079	0.084
	(0.096)	(0.125)	(0.170)	(0.074)	(0.075)	(0.071)
Dist. to equator	0.000	-0.000	-0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Education	0.159***	0.162***	0.137*	0.156***	0.159***	0.157***
	(0.040)	(0.043)	(0.078)	(0.031)	(0.031)	(0.029)
British colony				0.685**	0.654**	0.647**
				(0.285)	(0.299)	(0.282)
French colony				0.277	0.249	0.245
				(0.266)	(0.267)	(0.258)
Landlocked				-0.265	-0.235	-0.231
				(0.174)	(0.180)	(0.176)
European settlers 1900				-0.000	0.000	0.001
				(0.004)	(0.005)	(0.005)
Constant	6.119***	5.975***	6.538***	5.671***	5.629***	5.660***
	(0.592)	(0.596)	(1.148)	(0.477)	(0.422)	(0.446)
Observations	51	51	51	49	49	49
R-squared	0.531	0.474	0.078	0.656	0.666	0.670
Regional Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
K-P F-stat	19.08	4.452	0.380	20.41	16.99	2.855
SW F-stat for Trade	19.08		3.385	20.41		9.741
SW F-stat for Migration		4.452	0.770		16.99	5.230
SY 10% max IV size	16.38	16.38	16.38	16.38	16.38	16.38
SY 25% max IV size	5.530	5.530	5.530	5.530	5.530	5.530

Notes: Heteroskedasticity - robust standard errors are in parentheses. *, **, and *** denote significance at the 10%, 5% and 1% confidence level, respectively. K-P F- stat is the Kleibergen and Paap (2006) rk Wald F-stat test of jointly weak identification. SW F-stat is the Sanderson and Windmeijer (2016) F- stat test of weak identification for each endogenous regressor separately. In the case of a si ngle endogenous regressor, the SW F-stat is identical to the K-P F- stat. SY 10% max IV size and SY 10% max IV size are the Stock and Yogo (2005) critical values under the i.i.d. assumption

4.3.2. Problem of heterogeneity: the specificity of sub-Saharan Africa

The previous analyses concerned Africa as a whole. Although the region fixed effects were taken into account in the panel analysis, the specificity of sub-Saharan Africa (SSA) was not studied. SSA countries are often categorized for their weak and unstable economic growth (see among others Sala-i-Martin, 1997; Masanjala and Papageorgiou, 2008). To take this feature into account, we performed panel regressions for SSA

countries only. The results of the panel regression on the impact of regional integration are shown in Table 5.[8]

Restricting the sample to sub-Saharan Africa does not change the previous conclusions. In the short term, migration between SSA countries has a positive and significant impact on real per capita income, while trade between SSA countries has no significant impact on the standard of living in sub-Saharan Africa. This result remains solid regardless of the specification (separate effect, joint effect, with or without geographical and historical control variables). In addition to being a driver of long-term growth, education is also crucial in improving the standard of living in the short and medium term. As before, landlocked countries have a lower real per capita income level, while former British colonies in sub-Saharan Africa perform better in terms of per capita income. Finally, it appears that the countries furthest from the equator have a higher level of per capita income. This result is established in the literature and is due to the fact that the countries furthest from the equator benefit from more favourable climate conditions for agriculture.

4.3.3. The omitted variable bias

Until now, we have considered the control variables often used in the literature (Frankel and Romer, 1999, Ortega and Peri, 2014, Coulibaly et al., 2018). However, since these control variables are essentially historical or geographical variables, our results could be criticized for failing to consider more control variables, especially in the panel approach where the number of observations is relatively large. Therefore, we test the sensitivity of previous panel results to the inclusion of other control variables. The basic results are thus revised by introducing economic and political control variables such as investment rate, financial development, inflation rate and democracy index. Table 6 reports the results of these regressions.

By controlling baseline results by economic and political variables (investment rate, financial development, inflation and democracy), intra-African trade seems to have a significant and positive impact when considered separately (Panel-IV1, Table 6). However, this result does not resist the inclusion of intra-African migration (Panel-IV3). Once again, the positive and significant impact of intra-African migration is robust to the inclusion of these control variables. In our ultimate robustness check, we test the strength of our results by controlling the effect of regional integration by including all of our control variables in the model. The results are shown in the last three columns of Table 6 and remain unchanged. They confirm the income-enhancing effect of intra-African migration.

[8] The results of the panel gravity model for SSA countries are shown in Table A.2 (last four columns) in the appendix. These results are very close to those based on Africa as a whole.

Table 5: Short- and medium-term effects of intra-SSA trade and migration

	Baseline regression			Augmented-baseline regression			Historical and Geo. control variables		
VARIABLES	Panel-IV1	Panel-IV2	Panel-IV3	Panel-IV4	Panel-IV5	Panel-IV6	Panel-IV1	Panel-IV2	Panel-IV3
Intra-African Trade	0.016		0.006	-0.004		-0.012	-0.015		-0.022*
	(0.013)		(0.013)	(0.010)		(0.011)	(0.011)		(0.012)
Intra-African Migration		0.077***	0.071***		0.055***	0.066***		0.036*	0.061***
		(0.024)	(0.027)		(0.019)	(0.021)		(0.020)	(0.023)
Ln Population	-0.018	0.041	0.039	-0.009	0.040	0.043	-0.053	-0.007	-0.007
	(0.070)	(0.061)	(0.062)	(0.057)	(0.056)	(0.053)	(0.050)	(0.053)	(0.048)
Ln Area	-0.075	-0.093*	-0.095*	-0.006	-0.033	-0.028	-0.001	-0.028	-0.010
	(0.054)	(0.050)	(0.051)	(0.042)	(0.041)	(0.040)	(0.039)	(0.042)	(0.039)
Dist. to equator	0.012	0.024**	0.022*	0.021**	0.026***	0.030***	0.019**	0.021***	0.029***
	(0.011)	(0.010)	(0.011)	(0.009)	(0.008)	(0.010)	(0.008)	(0.007)	(0.009)
Education				0.174***	0.160***	0.165***	0.131***	0.125***	0.132***
				(0.022)	(0.018)	(0.019)	(0.019)	(0.018)	(0.018)
British colony							0.460***	0.341***	0.364***
							(0.111)	(0.112)	(0.106)
French colony							0.233**	0.166	0.106
							(0.107)	(0.108)	(0.104)
Landlocked							-0.319***	-0.264***	-0.232***
							(0.069)	(0.071)	(0.068)
European settlers 1900							-0.002	-0.002	-0.001
							(0.002)	(0.002)	(0.002)
Constant	7.318***	7.023***	7.034***	6.010***	5.871***	5.811***	6.199***	6.112***	5.971***
	(0.174)	(0.202)	(0.208)	(0.197)	(0.186)	(0.205)	(0.193)	(0.191)	(0.215)
Observations	210	210	210	210	210	210	210	210	210
R-squared	0.385	0.472	0.461	0.599	0.627	0.651	0.650	0.646	0.684
Regional Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
K-P F-stat	22.22	68.82	11.67	19.44	69.22	10.20	15.65	75.87	7.769
SW F-stat for Trade	22.22		21.49	19.44		19.09	15.65		15.11
SW F-stat for Migration		68.82	51.10		69.22	50.79		75.87	45.74
SY 10% max IV size	16.38	16.38	16.38	16.38	16.38	16.38	16.38	16.38	16.38
SY 25% max IV size	5.530	5.530	5.530	5.530	5.530	5.530	5.530	5.530	5.530

Notes: Heteroskedasticity - robust standard errors are in parentheses. *, **, and *** denote significance at the 10%, 5% and 1% confidence level, respectively. K-P F- stat is the Kleibergen and Paap (2006) rk Wald F-stat test of jointly weak identification. SW F-stat is the Sanderson and Windmeijer (2016) F- stat test of weak identification for each endogenous regressor separately. In the case of a si ngle endogenous regressor, the SW F-stat is identical to the K-P F- stat. SY 10% max IV size and SY 10% max IV size are the Stock and Yogo (2005) critical values under the i.i.d. assumption.

Table 6: Short- and medium-term effects of intra-African trade and migration – Inclusion of additional control variables

VARIABLES	Political and eco. control variables			Inclusion of all control variables		
	Panel-IV1	Panel-IV2	Panel-IV3	Panel-IV4	Panel-IV5	Panel-IV6
Intra-African Trade	0.017**		0.005	0.004		-0.007
	(0.007)		(0.010)	(0.008)		(0.010)
Intra-African Migration		0.067***	0.056**		0.055***	0.070***
		(0.015)	(0.027)		(0.017)	(0.025)
Ln Population	-0.090	-0.028	-0.029	-0.132**	-0.065	-0.064
	(0.060)	(0.060)	(0.062)	(0.053)	(0.056)	(0.055)
Ln Area	0.008	-0.009	-0.011	0.017	-0.002	0.002
	(0.042)	(0.041)	(0.041)	(0.036)	(0.038)	(0.037)
Dist. to equator	-0.005	0.005	0.003	-0.003	0.005	0.007
	(0.006)	(0.006)	(0.007)	(0.006)	(0.006)	(0.007)
Education	0.121***	0.117***	0.117***	0.088***	0.092***	0.092***
	(0.016)	(0.013)	(0.013)	(0.016)	(0.013)	(0.013)
British colony				0.462***	0.352***	0.346***
				(0.106)	(0.104)	(0.101)
French colony				0.267***	0.131	0.111
				(0.100)	(0.098)	(0.095)
Landlocked				-0.249***	-0.160**	-0.147**
				(0.072)	(0.067)	(0.064)
European settlers 1900				0.009	0.006	0.007
				(0.011)	(0.010)	(0.010)
Democracy	-0.007	0.003	0.002	-0.012	-0.001	0.000
	(0.009)	(0.009)	(0.009)	(0.008)	(0.009)	(0.009)
Inflation	-0.011***	-0.004***	-0.006*	-0.010***	-0.008***	-0.005
	(0.003)	(0.001)	(0.004)	(0.003)	(0.002)	(0.003)
Financial development	1.010***	0.866***	0.871***	0.925***	0.828***	0.819***
	(0.204)	(0.210)	(0.215)	(0.223)	(0.231)	(0.229)
Domest. Invest. rate	0.015***	0.016***	0.016***	0.018***	0.018***	0.018***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)
Constant	6.219***	6.042***	6.064***	6.250***	6.082***	6.052***
	(0.196)	(0.192)	(0.201)	(0.181)	(0.181)	(0.179)
Observations	214	214	214	214	214	214
R-squared	0.712	0.763	0.756	0.757	0.780	0.786
Regional Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
K-P F-stat	17.83	94.98	7.829	14.66	91.23	6.542
SW F-stat for Trade	17.83		14.46	14.66		12.73
SW F-stat for Migration		94.98	19.85		91.23	17.57
SY 10% max IV size	16.38	16.38	16.38	16.38	16.38	16.38
SY 25% max IV size	5.530	5.530	5.530	5.530	5.530	5.530

Notes: Heteroskedasticity - robust standard errors are in parentheses. *, **, and *** denote significance at the 10%, 5% and 1% confidence level, respectively. K-P F- stat is the Kleibergen and Paap (2006) rk Wald F-stat test of jointly weak identification. SW F-stat is the Sanderson and Windmeijer (2016) F- stat test of weak identification for each endogenous regressor separately. In the case of a si ngle endogenous regressor, the SW F-stat is identical to the K-P F- stat. SY 10% max IV size and SY 10% max IV size are the Stock and Yogo (2005) critical values under the i.i.d. assumption.

On the control variables, we note that they have the expected signs. Roughly speaking, education has a positive and significant impact on per capita income and this appears to be very robust. Investment contributes to a significant improvement in per capita income in Africa, while inflation contributes to its degradation. Financial development also has a positive and significant link with per capita income. Isolation reduces per capita income. Finally, the African countries formerly colonized by the British seem to have a higher level of per capita income. All these results are consistent with the previous literature.

5. How to boost the impact of intra-African trade on income in Africa?

This section analyzes the influence of factors that may inhibit the development of intra-African trade and its impact on income. In other words, we want to investigate how the impact of trade on income may depend on factors such as diversification of economies, financial development and quality of transport and telecommunications infrastructure. These variables are obviously chosen on the basis of the fact that they do not satisfy the conditions for genuine integration of the African countries and also of the essential role that they can play in strengthening regional integration and its impact on income.

We empirically test the extent to which diversification of African economies, financial development and improved infrastructure quality can contribute to making trade integration more conducive to improving the standard of living in Africa. To do so, we consider as before a per capita income equation in which, in addition to regional trade, we successively include the variables mentioned and their interaction with regional trade. Formally, we estimate the following baseline equation:

$$lny_{i,t} = \alpha + \gamma TSH_{i,t}^{Afr} + \theta Z_{i,t} + \lambda\left(TSH_{i,t}^{Afr} \times Z_{i,t}\right) + \varepsilon_{i,t} \qquad (1)$$

where lny is the logarithm of the real GDP per capita at chained PPPs, $TSH_{i,t}^{Afr}$ represents intra-African trade (import plus export) as a share of GDP and $Z = (Div, FinDev, Infrast)$ refers respectively to the index of export diversification (*Div*), the level of financial development (*FinDev*) and the quality of infrastructure (*Infrast*). Equation 1 can be arranged so as to highlight the influence of the variable *Z* in the relationship between regional trade and per capita income (y).

$$lny_{i,t} = \alpha + \left(\gamma + \lambda Z_{i,t}\right)TSH_{i,t}^{Afr} + \theta Z_{i,t} + \varepsilon_{i,t} \qquad (2)$$

Equation (2) thus shows that the impact of regional trade ($TSH_{i,t}^{Afr}$) in Africa depends on the value of the variable *Z*. Therefore, in Equation (1), we are interested in the λ coefficient associated with the interaction variable between sub-African trade and the *Z*

variables. A positive and significant value of the λ coefficient implies that an improvement in the Z variables leads to an increase in the impact of intra-African trade on per capita income. It is important to indicate that in Equation 1, only our parameter of interest λ will be interpreted, as the γ and θ parameters cannot be interpreted as being directly related to $TSH_{i,t}^{Afr}$ and Z respectively, since they measure conditional effects.[9]

5.1 Does economic diversification really matter?

The vast majority of African countries are highly specialized in the production and export of commodities. Since most of these exported goods are not processed on the continent, much of Africa's trade is therefore oriented outside the region. It is conceivable that diversifying the production and exports of African countries could promote intra-African trade and enhance its impact on the standard of living in Africa. The diversification of African economies could thus provide more opportunities for complementarity and product transformation across Africa, making intra-African trade more conducive to improving per capita income. Beine and Coulombe (2007) show, for example, that there is a positive and significant empirical relationship between export diversification and regional trade integration. The theory also suggests that the diversification of economies enhances the benefits of regional integration. In the case of African countries, this would reduce their exposure to exogenous shocks in commodity prices that inhibit any prospect of major long-term investment projects.

Table 7 presents the results of the regressions when Z is replaced by the export diversification index (a proxy of economic diversification). The results are presented sequentially to test the strength of the influence of export diversification on the relationship between intra-African trade openness and per capita income. The estimated λ parameter is 0.02 and is statistically different from zero, implying that a diversification of African economies would significantly increase the impact of intra-regional trade on per capita income in Africa. This result is not sensitive to the inclusion of intra-African migration as a control variable or to the inclusion of education, both being key determinants of income. The last three columns complement the robustness analysis by including historical and geographical controls (Panel-4), economic and political controls (Panel-5) and all the controls (Panel-6). The initial result successfully passes all of these tests. It is clear, therefore, that in addition to limiting their exposure to terms-of-trade shocks, the diversification of African economies contributes to increasing the effect of intra-African trade by making it more significantly income-improving.

[9] Table A-3 in the appendix provides descriptive statistics on the additional data used in this section as well as their source.

Table 7: The effect of economic diversification

	Baseline regressions			Robustness checks		
Variables	Panel-1	Panel-2	Panel-3	Panel-4	Panel-5	Panel-6
Intra-Afr. Trade x Finan. Dev.	0.129***	0.097**	0.168***	0.142***	0.114***	0.103**
	(0.041)	(0.040)	(0.045)	(0.041)	(0.040)	(0.042)
Intra-African Trade	-0.035***	-0.039***	-0.046***	-0.043***	-0.036***	-0.036***
	(0.010)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Financial development	0.688**	0.875***	-0.227	0.117	0.191	0.198
	(0.297)	(0.283)	(0.299)	(0.281)	(0.270)	(0.298)
Intra-African Migration		0.072***	0.060***	0.063***	0.075***	0.067***
		(0.013)	(0.011)	(0.011)	(0.010)	(0.013)
Education			0.165***	0.121***	0.130***	0.100***
			(0.020)	(0.015)	(0.014)	(0.015)
Ln Population					-0.043	-0.091*
					(0.051)	(0.053)
Ln Area					0.025	0.028
					(0.034)	(0.037)
Dist. to equator					0.008	0.007
					(0.006)	(0.006)
British colony				0.240**		0.330***
				(0.094)		(0.097)
French colony				0.154		0.071
				(0.094)		(0.099)
Landlocked				-0.101		-0.140**
				(0.070)		(0.066)
European settlers 1900				-0.000		0.012
				(0.002)		(0.010)
Democracy						0.000
						(0.009)
Inflation					0.002	-0.001
					(0.002)	(0.002)
Domest. Invest. rate					0.014***	0.016***
					(0.004)	(0.004)
Constant	8.120***	8.052***	6.995***	7.104***	6.035***	6.190***
	(0.170)	(0.170)	(0.161)	(0.172)	(0.158)	(0.188)
Observations	238	238	236	228	217	214
R-squared	0.447	0.489	0.644	0.747	0.781	0.800
Regional/Time FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Heteroskedasticity-robust standard errors are in parentheses. *, **, and *** denote significance at the 10%, 5% and 1% confidence level, respectively

As far as the control variables are concerned, the results are also consistent with the expectations. In fact, intra-African migration and education appear to be positively and

significantly associated with per capita income regardless of the specification. The results also show that countries furthest away from the equator have a higher per capita income level. This result is documented in the literature. Climate conditions, the quality of agricultural land and exposure to tropical diseases are the arguments put forward to justify this link. The former British colonies have a higher level of per capita income regardless of specification, which is not the case for the former French colonies. The results also show that landlocked countries have lower per capita income levels. This result is not surprising since they bear higher exchange costs. Finally, as expected, inflation depreciates the level of real income per capita, while investment contributes to its improvement.

5.2 How important is financial development?

The level of financing of African economies by the financial sector is still low. Financial development, and in particular trade finance, appears to be a necessary condition for strengthening integration in Africa. Several empirical studies show the importance of financial development in improving long-term growth (see among others Calderón and Liu, 2003 and Levine, 1997 for a literature review). While enhanced financialization of the economy can be beneficial to the level of development, trade is certainly one of the channels through which its impact passes. Beck (2002) shows that financial development has a positive and significant impact on international trade in manufactured products. Do and Levchenko (2004) also point to a positive relationship between financial development and trade in developing countries, although they argue that trade facilitates financial development. Moreover, Bojanic (2012) shows that financial development and trade both cause long-term economic growth. Therefore, the impact of trade on income is likely to depend on the level of financial development of countries and vice versa.

Table 8 presents the results of the tests on this probable relationship. As expected, the coefficient of interaction between financial development and intra-African trade is significantly positive. Therefore, strengthening financial development contributes to increasing the impact of intra-African trade on per capita income in Africa. More specifically, the results show that an improvement in financial development of 1 point (here 1 percentage point of GDP), leads to an increase in the impact of intra-African trade openness on income by about 0.10 to 0.17%. The decisive role of financial development remains significant regardless of the control tests. This result is therefore robust to the specification. Control variables once again show signs of decline, even though some of them are no longer significantly associated with per capita income. In particular, intra-African migration, education, former British colonies and investment are positively and significantly associated with per capita income.

Table 8: The effect of financial development

	Baseline regressions			Robustness checks		
Variables	Panel-1	Panel-2	Panel-3	Panel-4	Panel-5	Panel-6
Intra-Afr. Trade x Finan. Dev.	0.129***	0.097**	0.168***	0.142***	0.114***	0.103**
	(0.041)	(0.040)	(0.045)	(0.041)	(0.040)	(0.042)
Intra-African Trade	-0.035***	-0.039***	-0.046***	-0.043***	-0.036***	-0.036***
	(0.010)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Financial development	0.688**	0.875***	-0.227	0.117	0.191	0.198
	(0.297)	(0.283)	(0.299)	(0.281)	(0.270)	(0.298)
Intra-African Migration		0.072***	0.060***	0.063***	0.075***	0.067***
		(0.013)	(0.011)	(0.011)	(0.010)	(0.013)
Education			0.165***	0.121***	0.130***	0.100***
			(0.020)	(0.015)	(0.014)	(0.015)
Ln Population					-0.043	-0.091*
					(0.051)	(0.053)
Ln Area					0.025	0.028
					(0.034)	(0.037)
Dist. to equator					0.008	0.007
					(0.006)	(0.006)
British colony				0.240**		0.330***
				(0.094)		(0.097)
French colony				0.154		0.071
				(0.094)		(0.099)
Landlocked				-0.101		-0.140**
				(0.070)		(0.066)
European settlers 1900				-0.000		0.012
				(0.002)		(0.010)
Democracy						0.000
						(0.009)
Inflation					0.002	-0.001
					(0.002)	(0.002)
Domest. Invest. rate					0.014***	0.016***
					(0.004)	(0.004)
Constant	8.120***	8.052***	6.995***	7.104***	6.035***	6.190***
	(0.170)	(0.170)	(0.161)	(0.172)	(0.158)	(0.188)
Observations	238	238	236	228	217	214
R-squared	0.447	0.489	0.644	0.747	0.781	0.800
Regional/Time FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Heteroskedasticity-robust standard errors are in parentheses. *, **, and *** denote significance at the 10%, 5% and 1% confidence level, respectively

5.3 Is infrastructure quality at stake?

The answer seems to be affirmative. There is consensus that the development and improvement of the quality of infrastructure is essential for strengthening regional

integration and its impact on the economic development of African countries. In addition to being insufficient, transport infrastructures in African countries are characterized by their poor quality. In the Global Competitiveness Report 2016-2017 and in previous reports, most African countries are ranked lowest for the quality of their infrastructure, including transport and telecommunications (IT) infrastructures. This situation exacerbates the cost of trade between countries and is not conducive to the integration and development of regional trade. The Word Bank estimates that intra-African trade costs are around 50% higher than in East Asia, and are the highest of intra-regional costs in any developing region. The result of these high costs is that Africa has integrated with the rest of the world faster than with itself. Regional and international institutions (AfDB, AU, ECA, World Bank, among others) are aware that strengthening infrastructure in Africa is essential to boost intra-African trade potential and its impact on economic development and poverty reduction. The AfDB and the World Bank are making it a top priority. We therefore test the empirical link between the quality of transport and telecommunications infrastructure and regional trade in the relationship between trade and per capita income.

Table 9 presents the results on the impact of transport and telecommunications infrastructure (especially internet penetration) on the relationship between intra-African trade and per capita income. These results, while not surprising, are particularly edifying. They confirm the important role of infrastructure in boosting intra-African trade and its impact on the standard of living in Africa. The overall quality of the infrastructures is decisive (the first two columns), since an improvement in the latter contributes significantly to improving the impact of regional integration. Looking more closely, the results show that road infrastructure contributes more to enhancing the impact of intra-African trade on per capita income. Port infrastructure seems to play an equally important role, followed by air transport infrastructure. Contrary to our expectations, the quality of rail transport infrastructure does not seem to play a very important role. Its impact, although positive, remains very low. With respect to telecommunications infrastructure, the results show that improved internet penetration contributes to enhancing the impact of intra-African trade on income in Africa. This result shows the growing role of new information and communication technologies (ICT) in trade. These ICTs help to reduce the costs of transactions between countries considerably. This can be seen as good news for African countries, as these technologies have only spread there since the early 2000s and the trend is on the rise.

Table 9: The effect of the quality of infrastructure

	Overall infrast.		Road infrast.		Railroad infrast.		Port infrast.		Air transp. infrast.		Internet penetration	
Variables	All Infr.	All Infr.	Roads	Roads	Rails	Rails	Port	Port	Air	Air	Internet	Internet
Intra-AfrTrade x Infr	0.011***	0.010***	0.007***	0.007***	0.001	0.003*	0.003	0.007***	0.004*	0.004**	0.084***	0.056***
	(0.004)	(0.003)	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.027)	(0.017)
Infrastructure	0.418***	-0.083	0.304**	-0.074	0.763***	0.013	0.334**	-0.049	0.355***	0.068	4.166***	1.531***
	(0.123)	(0.076)	(0.119)	(0.064)	(0.084)	(0.072)	(0.134)	(0.085)	(0.087)	(0.058)	(0.394)	(0.442)
Intra-AfrTrade	-0.046***	-0.044***	-0.029***	-0.032***	-0.005	-0.008	-0.012	-0.035***	-0.005	-0.018***	-0.001	-0.010***
	(0.015)	(0.012)	(0.010)	(0.007)	(0.009)	(0.005)	(0.011)	(0.009)	(0.006)	(0.006)	(0.003)	(0.003)
Ln Population		0.083		0.084		0.042		0.074		0.033		-0.063
		(0.070)		(0.067)		(0.053)		(0.075)		(0.080)		(0.044)
Ln Area		-0.087*		-0.085*		0.128***		-0.082		-0.060		0.021
		(0.050)		(0.049)		(0.036)		(0.052)		(0.052)		(0.034)
Dist. to equator		0.006		0.005		-0.020***		0.006		0.003		-0.003
		(0.008)		(0.008)		(0.007)		(0.009)		(0.008)		(0.006)
Education		0.156***		0.149***		0.045		0.167***		0.158***		0.108***
		(0.036)		(0.036)		(0.032)		(0.034)		(0.035)		(0.018)
British colony		0.742***		0.716***		0.874***		0.716***		0.702***		0.557***
		(0.112)		(0.111)		(0.128)		(0.121)		(0.110)		(0.099)
French colony		0.397***		0.363**		0.617***		0.365**		0.382***		0.244***
		(0.148)		(0.151)		(0.150)		(0.148)		(0.142)		(0.090)
Landlocked		-0.129		-0.133		-0.143*		-0.061		-0.105		-0.312***
		(0.081)		(0.082)		(0.083)		(0.089)		(0.078)		(0.076)
European settlers 1900		0.019*		0.017*		0.015*		0.007		0.010		0.009
		(0.011)		(0.010)		(0.008)		(0.011)		(0.011)		(0.009)
Democracy		-0.004		0.003		-0.013		-0.001		-0.005		-0.004
		(0.008)		(0.009)		(0.009)		(0.008)		(0.008)		(0.007)
Inflation		-0.009		-0.010		0.003		-0.005		-0.004		-0.007
		(0.007)		(0.007)		(0.007)		(0.007)		(0.007)		(0.006)
Domest. Invest. rate		0.028***		0.029***		0.018***		0.029***		0.027***		0.025***
		(0.004)		(0.004)		(0.003)		(0.004)		(0.004)		(0.004)
Constant	6.633***	5.902***	7.044***	5.910***	6.361***	5.676***	6.804***	5.654***	6.536***	5.323***	7.335***	5.944***
	(0.436)	(0.488)	(0.402)	(0.516)	(0.213)	(0.453)	(0.501)	(0.481)	(0.336)	(0.441)	(0.077)	(0.230)
Observations	186	178	186	178	147	142	186	178	186	178	258	228
R-squared	0.260	0.815	0.192	0.815	0.407	0.887	0.108	0.814	0.161	0.814	0.455	0.813
Regional Fixed Effect	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Time Fixed Effect	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Notes: The dependent variable is the real GDP per capita at chained PPPs. Heteroskedasticity-robust standard errors are in parentheses. *, **, and *** denote significance at the 10%, 5% and 1% confidence level, respectively

6. Conclusion and policy implications

Regional integration is seen as a powerful tool not only to promote inclusive growth and political stability, but also to address the challenges of global economic, technological and ecological change. African leaders and institutions are therefore making enormous efforts to promote regional integration. However, the statistics on the state of African integration are not impressive. The challenges to be overcome to reinforce this integration are therefore still immense.

From the academic point of view, theoretical and empirical studies are, to say the least, very cautious about the income-enhancing effect of integration among developing countries. This paper aims to study the impact of African integration. Accordingly, it considers intra-African trade and migration as two quantitative measures of regional integration. To take the potential simultaneity bias issues into account, we use the two-stage least-squares (2SLS) estimation method with an identification strategy based on the gravity models. Our results show that African integration has not been strong enough to drive a long-term improvement in real per capita income in Africa. In fact, although positive, the long-term impact of regional integration does not resist the robustness tests. However, African integration appears to be significantly income enhancing in the short and medium terms, but only through inter-country migration. Intra-African trade, meanwhile, still fails to have a significant impact on per capita income.

We then conducted additional analyzes to study conditional effects of intra-African trade openness on income by considering a set of structural weaknesses that characterize African countries. In particular, we investigate the effects of intra-African trade, conditional on financial development, economic diversification and the quality of transport and telecommunications infrastructures. Our results clearly show that the impact of intra-regional trade is conditioned by the diversification of African economies, their financial development and the quality of their transport and telecommunications infrastructures. A substantial improvement in these fundamentals would make intra-African trade significantly income-enhancing. Our recommendations above have been made to meet this challenge.

Our study shows the need to modernize road and port infrastructure to reinforce the role of intra-regional trade as a vehicle for inclusive growth in Africa. In concrete terms, we propose to create the **African Transport Infrastructure Fund (ATIF)**. Funding for this fund could be secured through **a special tax on vehicle imports**. There are several reasons for this. First, there is a close link between road infrastructure and the importation of vehicles. Vehicles contribute to the degradation of road infrastructure. But degraded infrastructure encourages the purchase/import of more powerful vehicles that can support these infrastructures, which contributes more to the degradation of infrastructures. So there is a vicious cycle of road infrastructure degradation. The tax can create a virtuous

circle because it would help improve road infrastructure. Under these conditions, users will no longer feel the need to buy/import more powerful vehicles and therefore the road infrastrures will withstand longer. Secondly, we make the plausible assumption that the import of vehicles is weakly elastic or even inelastic to the tax. Indeed, a "middle class" emerges in Africa and imports of cars will continue to increase. In order for this measure to be more effective, it would be preferable for this tax to be homogeneous for all African countries. So their relative competitiveness will not be affected. This tax may also be proportional to the power of the imported vehicle. Concerning port infrastructures, it seems important to ensure the automation of port operations. The AfDB could provide technical and financial assistance to countries in this direction.

Similarly, we find that an improvement in the rate of internet penetration helps to make intra-African trade income-enhancing. This reflects the decline in the costs of trade driven by the use of ICTs. However, the cost of accessibility to these technologies remains relatively high. Governments – through fiscal incentives and the removal of administrative barriers – must encourage private operators to make investments in the renovation and expansion of the telecommunications infrastructure that can reduce the cost of access to ICTs. International institutions, including the AfDB, could support this process by helping these private operators gain access to long-term financing. The AfDB could support the development of the digital network by helping private operators gain access to long-term financing at competitive rates. Moreover, the role of technology in international trade will certainly be increasingly important, including on the African continent, and online exchanges develop. Regional institutions such as the AfDB should anticipate this process to make it a genuine tool for boosting regional integration.

Given the comfort of habit and the cost of renouncing the rent provided by raw materials, many African countries are failing to make the transition to diversification of their economy. In addition to the cost of exposure to terms-of-trade shocks that it implies, the concentration of African economies on commodities inhibits intra-African trade, as shown in our estimates. The diversification of African economies is therefore an imperative for African States and institutions. This diversification must be based on the transformation of economies for the creation of added value chains. In concrete terms, this implies transforming those commodities regionally, which requires carefully-studied industrialization plans. The Ivory Coast, for example, would create more value for its economy and participate more in regional trade by transforming its cacoa and cashew nuts. The AfDB should work with governments to identify their industrial potential. At the same time, the AfDB could put in place a financial incentive to support countries that are making greater diversification efforts. Finally, our results are robust on the role of development in improving the impact of trade integration. Access to finance for commercial activities on an African scale should therefore be facilitated.

Appendix

Table A-1: Results of gravity model estimations

VARIABLES	Cross-sectional regressions (av. 1990-2014)				Panel regressions for Africa			
	Trade		Migration		Trade		Migration	
	OLS	PPML	OLS	PPML	OLS	PPML	OLS	PPML
Ln distance	-1.12***	-0.64***	-2.54***	-0.53**				
	(0.13)	(0.13)	(0.12)	(0.21)				
lndistw1990					-1.91***	-0.89***	-2.38***	-0.49***
					(0.10)	(0.12)	(0.09)	(0.12)
lndistw1995					-1.93***	-0.84***	-2.38***	-0.49***
					(0.09)	(0.12)	(0.08)	(0.12)
lndistw2000					-1.88***	-0.94***	-2.29***	-0.48***
					(0.09)	(0.10)	(0.09)	(0.12)
lndistw2005					-1.78***	-0.88***	-1.54***	-0.54***
					(0.09)	(0.10)	(0.10)	(0.11)
lndistw2010					-1.81***	-0.91***	-1.46***	-0.48***
					(0.09)	(0.10)	(0.10)	(0.11)
Ln pop. origin	0.21***	0.13	-0.70***	-0.72***	0.18***	-0.02	-0.61***	-0.71***
	(0.07)	(0.11)	(0.05)	(0.15)	(0.03)	(0.05)	(0.03)	(0.06)
Ln pop. dest.	0.87***	0.79***	0.38***	0.28**	1.85***	0.46	-0.09	1.24
	(0.06)	(0.10)	(0.06)	(0.11)	(0.51)	(0.88)	(0.55)	(0.81)
Ln area origin	-0.30***	-0.20**	0.17***	0.19*	-0.23***	-0.09**	0.08***	0.20***
	(0.06)	(0.09)	(0.04)	(0.12)	(0.03)	(0.04)	(0.02)	(0.05)
Ln area dest.	-0.16***	0.04	-0.04	-0.05	-1.45***	0.13	0.44	-0.55
	(0.05)	(0.12)	(0.05)	(0.10)	(0.50)	(0.85)	(0.48)	(0.79)
Sum landlocked	-1.33***	-0.69***	-0.56***	-0.38*	-0.83***	-0.44***	-0.36***	-0.55***
	(0.10)	(0.23)	(0.09)	(0.20)	(0.07)	(0.11)	(0.05)	(0.13)
Border	-3.09*	-3.45	-4.14*	0.82	-5.67***	-4.22***	-1.46	2.50***
	(1.84)	(2.15)	(2.17)	(2.58)	(0.96)	(0.95)	(0.97)	(0.96)
Border*Ln dist.	1.03***	1.29***	0.49	0.47	1.46***	1.67***	0.35	-0.25
	(0.38)	(0.45)	(0.54)	(0.58)	(0.22)	(0.22)	(0.21)	(0.19)
Border*Ln pop. origin	-0.08	-0.23	0.33**	0.36	0.06	0.08	0.19***	0.19**
	(0.15)	(0.17)	(0.15)	(0.23)	(0.08)	(0.10)	(0.07)	(0.08)
Border*Ln pop. dest.	-0.02	-0.18	0.39**	0.06	0.03	-0.30***	0.31***	0.05
	(0.15)	(0.18)	(0.17)	(0.18)	(0.07)	(0.08)	(0.08)	(0.10)
Border*Ln area origin	-0.24	-0.27	-0.01	-0.35	-0.45***	-0.45***	0.03	-0.00
	(0.15)	(0.18)	(0.17)	(0.22)	(0.08)	(0.10)	(0.08)	(0.08)
Border*Ln area dest.	-0.12	-0.25	0.13	-0.09	-0.14*	-0.45***	-0.08	0.17
	(0.15)	(0.19)	(0.21)	(0.21)	(0.08)	(0.11)	(0.08)	(0.11)
Border*landlocked	0.88***	0.39	0.62***	0.12	0.84***	0.34**	0.35***	0.01
	(0.21)	(0.31)	(0.20)	(0.26)	(0.10)	(0.16)	(0.09)	(0.13)
Common language	0.72***	0.75***	0.36**	0.77**	0.44***	0.88***	0.45***	1.39***
	(0.18)	(0.22)	(0.14)	(0.31)	(0.08)	(0.12)	(0.08)	(0.15)
Common off. lang.	0.27	0.35*	0.30**	0.20	0.44***	0.01	0.34***	0.22
	(0.18)	(0.19)	(0.14)	(0.32)	(0.08)	(0.12)	(0.07)	(0.15)
Colonial ties	-0.04	-1.88***	-0.37	-0.28	0.07	-1.58***	-0.12	-0.42
	(0.50)	(0.70)	(1.16)	(0.55)	(0.32)	(0.48)	(0.46)	(0.32)
Time zone diff.	-0.45***	-0.60***	0.15**	-0.69***	-0.25***	-0.41***	0.17***	-0.68***
	(0.07)	(0.13)	(0.07)	(0.15)	(0.04)	(0.05)	(0.04)	(0.09)
Common currency	0.81***	-0.51*	0.20	0.10	0.74***	-1.03***	0.22**	0.56***
	(0.20)	(0.27)	(0.22)	(0.41)	(0.10)	(0.17)	(0.10)	(0.14)
Constant	4.80***	1.52*	12.63***	0.01	12.57***	3.95***	4.58***	-2.82*
	(0.99)	(0.83)	(0.91)	(1.20)	(1.02)	(1.48)	(1.07)	(1.45)
Observations	1,829	2,704	1,897	2,704	7,651	13,52	6,685	13,52
R-squared	0.44	0.27	0.55	0.28	0.56	0.43	0.61	0.58

Notes: Heteroskedasticity-robust standard errors are in parentheses. *, **, and *** denote significance at the 10%, 5% and 1% confidence level, respectively.

Table A-2: Results of gravity model estimations

VARIABLES	Cross-sectional regressions (2010)				Panel regressions for SSA			
	Trade		Migration		Trade		Migration	
	OLS	PPML	OLS	PPML	OLS	PPML	OLS	PPML
Ln distance	-1.22***	-0.55***	-1.63***	-0.78***				
	(0.17)	(0.15)	(0.15)	(0.19)				
lndistw1990					-1.85***	-0.81***	-2.37***	-0.46***
					(0.12)	(0.13)	(0.09)	(0.13)
lndistw1995					-1.77***	-0.68***	-2.40***	-0.46***
					(0.11)	(0.13)	(0.09)	(0.13)
lndistw2000					-1.70***	-0.77***	-2.32***	-0.45***
					(0.10)	(0.12)	(0.09)	(0.13)
lndistw2005					-1.61***	-0.73***	-1.56***	-0.51***
					(0.11)	(0.12)	(0.10)	(0.12)
lndistw2010					-1.73***	-0.79***	-1.47***	-0.45***
					(0.11)	(0.12)	(0.11)	(0.12)
Ln pop. origin	(0.17)	(0.15)	(0.15)	(0.19)	0.10**	0.06	-0.56***	-0.67***
	0.13	0.09	-0.90***	-0.81***	(0.04)	(0.06)	(0.03)	(0.07)
Ln pop. dest.	(0.09)	(0.11)	(0.07)	(0.15)	2.92***	0.63	-0.45	0.68
	0.97***	0.81***	0.30***	0.20	(0.68)	(0.99)	(0.64)	(0.83)
Ln area origin	(0.08)	(0.13)	(0.10)	(0.12)	-0.16***	-0.12***	0.10***	0.18***
	-0.25***	-0.19**	0.34***	0.34***	(0.03)	(0.04)	(0.02)	(0.05)
Ln area dest.	(0.07)	(0.09)	(0.06)	(0.12)	-2.52***	-0.06	0.56	0.01
	-0.20***	-0.02	-0.01	0.11	(0.67)	(0.96)	(0.55)	(0.81)
Sum landlocked	(0.06)	(0.14)	(0.08)	(0.11)	-0.88***	-0.32***	-0.46***	-0.49***
	-1.19***	-0.80***	-0.41***	-0.50**	(0.07)	(0.11)	(0.06)	(0.13)
Border	(0.14)	(0.22)	(0.16)	(0.21)	-5.36***	-1.65	-4.62***	2.98***
	0.51	-3.79	-1.06	-0.19	(0.94)	(1.13)	(0.85)	(1.05)
Border*Ln dist.	(2.28)	(2.65)	(1.91)	(2.96)	1.07***	0.95***	0.84***	-0.38*
	0.03	1.34**	0.49	0.87	(0.19)	(0.25)	(0.18)	(0.21)
Border*Ln pop. origin	(0.46)	(0.58)	(0.41)	(0.66)	0.25***	0.23*	0.17***	0.32***
	0.12	-0.08	0.62***	0.52**	(0.08)	(0.13)	(0.07)	(0.09)
Border*Ln pop. dest.	(0.18)	(0.16)	(0.15)	(0.22)	0.09	-0.26***	0.11	-0.16
	-0.12	-0.28	0.17	-0.02	(0.07)	(0.08)	(0.07)	(0.10)
Border*Ln area origin	(0.17)	(0.21)	(0.17)	(0.18)	-0.23***	-0.17	0.07	-0.01
	-0.07	-0.39*	-0.45***	-0.67***	(0.08)	(0.11)	(0.07)	(0.08)
Border*Ln area dest.	(0.17)	(0.20)	(0.16)	(0.24)	-0.07	-0.45***	-0.04	0.26**
	0.17	-0.11	-0.05	-0.17	(0.08)	(0.12)	(0.08)	(0.11)
Border*landlocked	(0.16)	(0.20)	(0.18)	(0.21)	0.92***	0.39**	0.25***	0.07
	0.73***	0.39	0.21	0.32	(0.10)	(0.16)	(0.09)	(0.13)
Common language	(0.25)	(0.33)	(0.22)	(0.26)	0.73***	0.76***	0.44***	1.33***
	0.32*	0.66***	0.33*	0.79**	(0.10)	(0.13)	(0.09)	(0.16)
Common off. lang.	(0.18)	(0.25)	(0.18)	(0.34)	0.15	0.07	0.51***	0.24
	0.33*	0.38*	0.64***	0.45	(0.11)	(0.14)	(0.08)	(0.17)
Colonial ties	(0.19)	(0.21)	(0.20)	(0.39)	1.27***	-2.39**	0.33	0.71**
	1.15	-1.12	-1.28	-1.08**	(0.32)	(1.14)	(0.57)	(0.33)
Time zone diff.	(0.72)	(0.70)	(0.89)	(0.53)	-0.29***	-0.47***	0.17***	-0.71***
	-0.39***	-0.64***	0.12	-0.46**	(0.05)	(0.07)	(0.04)	(0.10)
Common currency	(0.09)	(0.13)	(0.12)	(0.20)	0.83***	-0.70***	-0.08	0.41***
	0.88***	-0.54*	0.49**	0.01	(0.12)	(0.16)	(0.10)	(0.15)
Constant	(0.22)	(0.32)	(0.21)	(0.42)	13.63***	3.52**	3.66***	-3.48**
	5.40***	1.15	6.53***	0.49	(1.29)	(1.68)	(1.25)	(1.45)
Observations	1,467	2,704	641	2,704	5,537	10,580	5,427	10,580
R-squared	0.40	0.28	0.56	0.29	0.57	0.45	0.62	0.50

Notes: Heteroskedasticity-robust standard errors are in parentheses. *, **, and *** denote significance at the 10%, 5% and 1% confidence level, respectively.

Table A-3: Additional descriptive statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
Pooled data					
Export diversification index	-3.22	1.02	-5.34	-0.8	205
Quality of overall infrastructure, 1-7 (best)	3.55	0.76	1.85	5.62	190
Quality of roads, 1-7 (best)	3.45	0.83	1.91	5.83	190
Quality of railroad infrastructure, 1-7 (best)	2.32	0.74	1.24	4.15	147
Quality of port infrastructure, 1-7 (best)	3.74	0.75	1.77	5.64	190
Quality of air transport infrastructure, 1-7 (best)	3.92	0.91	2.11	6.14	190
Percentage of Individuals using the Internet	12.93	13.38	0.58	56.8	271

Notes: The export diversification indexes are produced by the IMF. The rate of Internet penetration data are provided by UTI (International Telecommunication Union). The indices on the quality of transport infrastructure come from the World Economic Forum (WEF).

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