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The Diaspora and Economic Development in Africa

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Abstract

While the dominant collective belief asserts that brain drain is detrimental to the development of small economies, new studies hold the reverse view. This paper aims at studying the role of the African Diaspora in the economic development of Africa. It analyzes both the overall effect and the specific effect of emigration according to the level of education of emigrants. Then, through a deeper investigation, the paper analyzes the main channels through which the Diaspora influences economic development in Africa. The results show that the African Diaspora contributes positively, significantly and robustly to the improvement of real per capita income in Africa. These findings challenge the dominant collective belief since the higher the educational level of the emigrants, the greater the impact of the Diaspora on the level of economic development. Improvements in human capital, total factor productivity and democracy are effective transmission channels of this impact. Finally, the results show that while high-skilled emigrants have an overall greater impact on economic development and democracy, those with a low level of education contribute more to remittances to Africa. The establishment of an annual African Diaspora Summer School (ADSS) by the AfDB in partnership relevant international and regional stakeholders as a channel for the transfer of knowledge, technology and experience would further strengthen the role of the Diaspora in Africa's economic development.

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The Diaspora and Economic Development in Africa

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1. Introduction

International migration has increased significantly since the early 1990s and is now an integral part of globalization. One of the main characteristics of this migration is the size of the youth involved. Indeed, the examination of the architecture of international migration clearly shows a strong dominance of the mobility of the active population (see Figure 1). Africa, which is largely involved in this phenomenon, is characterized by high emigration to developed OECD[3] countries. Moreover, the highly skilled emigration rate from Africa — especially West and East Africa — is among the highest in the world (see OECD, 2015). Figure 2 shows the remarkable increase of migration from African countries to the OECD countries with a growing share of highly skilled migrants. This brain drain from Africa nourishes the stock of the highly skilled African Diaspora.[4]

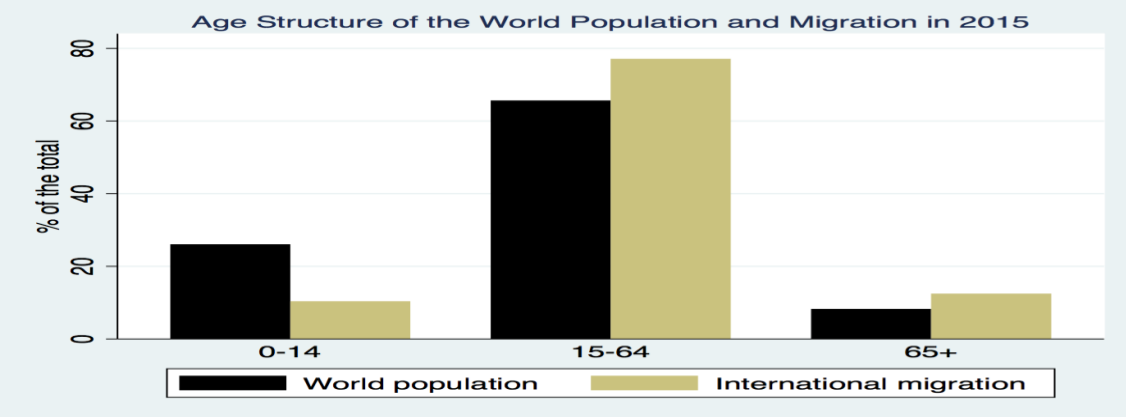
The impact of brain drain from developing countries is a controversial issue on which two paradigms are opposed. The first paradigm, the oldest and most widespread, posits that brain drain is detrimental to the economic development of the sending countries concerned (Bhagwati and Hamada, 1974; Miyagiwa, 1991; Haque and Kim, 1995). The argument is that emigration of an individual with a higher than average level of education and income results in a decrease in the average level of income and education. Thus, GDP per capita is reduced and the average human capital that is needed for future growth is also reduced. In addition, it results in a tax loss for sending countries and a loss of externalities related to the education of the individual. To this, we can also add that when a young graduate emigrates (especially a young, well-trained woman), younger kids and girls growing up lose role models who could have anchored and enlightened their lives. With this physical absence, the country of origin loses positive externalities.

The second paradigm is more recent and challenges the first by putting forward two brain drain effects that could be beneficial to sending countries (Meyer, 2001; Kerr, 2008; Spilimbergo, 2009; Docquier et al., 2010; Agrawal et al., 2011). The first is an incentive effect, which takes place *ex-ante* of emigration itself, and leads families to invest in the education of their children in the perspective of future emigration. As all high-

[3] OECD (Organisation for Economic Co-operation and Development) countries are home to the majority of the Diaspora (at least the highly skilled) from developing countries, including Africa.
[4] Diaspora is defined as the stock of people born in a country and living in another one (see Beine et al., 2011).

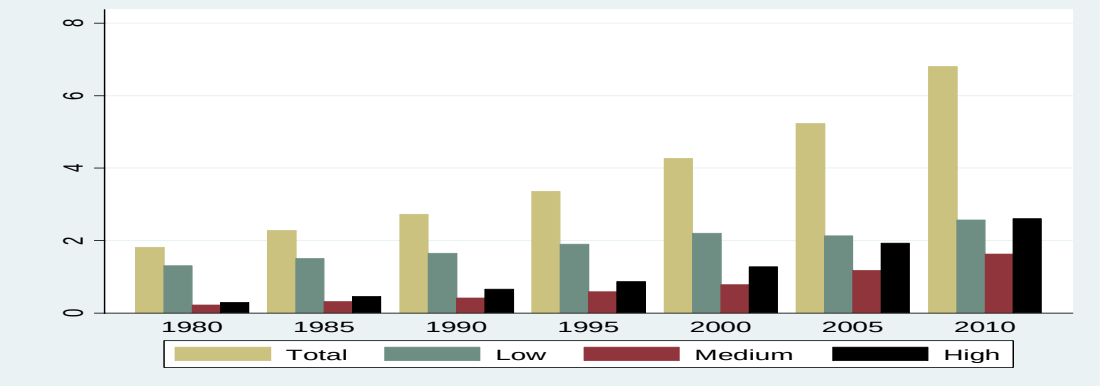
skilled individuals do not emigrate, the stock of human capital could increase with this incentive effect. The second effect is *ex-post* and relates to the links that the Diaspora maintains with the original home country, by their financial transfers or their possible return, but also and especially by their participation in scientific, political and business networks. Such networks potentially generate trade and capital flows, technology transfers, and can also contribute to the dissemination of social and institutional norms conducive to development (Rapoport, 2010). Given these two divergent paradigms, predictions of the macroeconomic impact of the African Diaspora or emigration on economic development in Africa are purely speculative if they are not based on rigorous empirical studies. Also, due to the initial lack of consensual data on migration by skill level, empirical studies on brain drain are relatively recent.

Figure 1: Age distributions of world population and international migration



Notes: Data used to build these graphs are from the United Nations for migration and the World Bank for population.

Figure 2: Migration from Africa to OECD countries by level of education



Notes: We use the Institute for Employment Research (IAB) brain-drain database. Emigration is computed as the sum of emigrants from country *i* (from Africa) to OECD destination countries *j* at time *t* (see Brücker et al., 2013).

This paper aims to study the impact of the Diaspora on economic development in Africa. In order to shed some light on the issue of brain drain *versus* brain gain, we study both the global impact and the specific impact according to the level of education of the emigrants. To ensure the quality of our estimates and conclusions, we use a set of powerful econometric tools to overcome identification problems that are likely to characterize the relationship between the Diaspora and economic development. For example, the causality between emigration and economic development can go both ways.

Indeed, while the Diaspora can contribute to the economic development of the countries of origin, the low level of economic development of these countries generally constitutes an incentive for emigration. To deal with this endogeneity issue, we use an instrumental variable (IV) approach. We rely on two complementary IV strategies: i) a gravity model predicting a country's emigration rate out of a set of reasonably exogenous bilateral variables and ii) internal instruments using both DIF-GMM and SYS-GMM estimations. Finally, using the income decomposition proposed by Hall and Jones (1999), we analyze the main income-related channels through which the effect of the Diaspora passes. Thus, once the human capital channels, capital intensity and total factor productivity are analyzed, we then explore two additional channels by studying the impact of the African Diaspora in developed OECD countries (by level of education) on remittances and democracy in Africa.

The results show that the African Diaspora contributes positively, significantly and robustly to the improvement of real per capita income in Africa. By distinguishing the impact of the Diaspora by skill level, our estimates show that the higher the education level of emigrants, the greater the impact of the Diaspora. These findings challenge the dominant collective belief and are rather compatible with the new paradigm that emphasizes the effects of networks as well as the financial and technological transfers that the Diaspora allows. Then, through the decomposition of income, we show that all components of income are positively affected by the Diaspora, but the intensity of human capital and total factor productivity are the predominant channels. Finally, while the results highlight the overall greater income impact of high education level emigrants, those with a low level of education contribute more to remittances to Africa.

The rest of the paper is organized as follows. Section 2 presents a brief review of the literature on the impact of brain drain or the Diaspora. Section 3 describes our

empirical strategy. In Section 4, we present and discuss our main results, and provide some robustness checks. We propose and analyse of transmission channels in Section 5. Finally, Section 6 concludes the paper and presents some policy implications.

2. Impact of the Diaspora: The two sides of the coin

The literature on the impact of emigration and therefore of the Diaspora has often focused on the effect of brain drain, i.e. emigrants with a high level of education. The general belief is that brain drain is detrimental to the countries of origin (see Docquier and Rapoport, 2012). The main argument relies on the theories of endogenous growth that emphasize the key role of education in growth (Lucas, 1988). Thus, the emigration of skilled workers (brain drain) represents a considerable shortfall for growth in countries of origin. For example, the seminal model of Bhagwati and Hamada (1974) shows that brain drain causes a loss for the developing countries. This loss occurs through the fact that increasing international mobility induces high-skilled workers of poor countries to bargain for higher wages, and low-skilled workers respond by adjusting their wage requirements. Persuaded of the negative effects of the brain drain, some studies propose to tax the incomes of migrants abroad in order to limit the burden on the sending countries (Bhagwati, 1976; Bhagwati and Wilson, 1989). Miyagiwa (1991) builds a theoretical model of brain drain and shows that brain drain increases education and income levels in the host country. Its impact is all the more important as, contrary to the presumption that brain drain hurts unskilled individuals left in the home country, it is rather professionals with mid-level capacities who are more adversely affected. Haque and Kim (1995) also find that brain drain jeopardizes the economic growth of the country of origin by reducing the rate of growth of effective human capital that remains in the economy. In sum, the early models on the consequences of the brain drain (in the endogenous growth framework) find that brain drain raises inequality at the global level, with developing countries becoming poorer for the benefit of the richer ones.[5]

While these early studies emphasize the negative effect of brain drain, several recent studies highlight some benefits from brain drain (Mountford, 1997; Stark et al., 1997; Stark et al., 1998; Vidal, 1998; Meyer, 2001; Beine et al., 2008; Kerr, 2008; Giuliano and Ruiz-Arranz, 2009; Spilimbergo, 2009; Docquier et al., 2010; Agrawal et

[5] Commander et al. (2004) present a broader survey of the theoretical literature on brain drain.

al., 2011; Docquier et al., 2016). The main channels are the incentive to invest in education that the prospect of future emigration entails, resulting remittances that provide an alternative way to finance investment, benefits that home country can acquire from human capital of returning migrants, and the transfer of knowledge and institutional norms through the Diaspora. However most of the theoretical contributions in this recent literature indicate that brain drain can have a positive impact only under certain conditions. For example, for Mountford (1997), this effect operates in the context of uncertainty about the success of emigration. He shows that when human capital accumulation is endogenous and when successful emigration is not a certainty, brain drain may increase average productivity and equality in the source economy even as average productivity is a positive function of past average levels of human capital in an economy.

Empirical studies on the impact of brain drain or the Diaspora are relatively recent because of lack of global data availability. Several of them investigate the impact of the Diaspora from the point of view of host countries that are mainly advanced OECD countries (see, among others, Ortega and Peri, 2009; Boubtane et al., 2013; Ortega and Peri, 2014; Alesina et al., 2016; Jaumotte et al., 2016).[6] Studies on the impact of brain drain or the Diaspora on growth and income for sending countries are few. Based on recent US data, Beine et al. (2003) examine the impact of brain drain on 50 developing countries and find an overall positive effect of brain drain. However, they find that there are winners and losers among sending countries according to their levels of human capital: brain drain appears to hurt home countries with large proportion of highly educated emigrants. In the same vein, Beine et al. (2008) use emigration data on 127 origin countries by education level to examine the impact of brain drain on human capital formation. They find evidence of a promoting impact of skilled emigration on human capital. Batista et al. (2012) use household survey data in Cape Verde and show that a 10 percentage point increase in the probability of own future migration improves the probability of completing intermediate secondary schooling by nearly 4 percentage point for individuals who do not migrate before age 16. Giuliano and Ruiz-Arranz (2009) explore the growth-enhancing impact of emigrant remittances on 100 developing countries. They find that remittances promote growth in less financially developed countries by providing an alternative way to finance investment and by overcoming credit constraints.

[6] As this paper examines the impact of the Diaspora from the point of view of sending countries, we will not go further on the literature on host countries.

Recent studies point to the presence of Diaspora externalities in the transfer of knowledge and technology (Meyer, 2001; Kerr, 2008; Agrawal et al., 2011) and in the diffusion of democratic values and social and cultural norms. Empirical studies by Spilimbergo (2009) and Docquier et al. (2016) highlight the role of emigration in improving political institutions. Using an international dataset, Spilimbergo (2009) finds that foreign students play an important role in promoting democracy in the home country, but only if education is acquired in democratic countries. Using cross-section and panel data, Docquier et al. (2016) also find that general emigration from developing countries to OECD countries helps to improve institutional quality in the countries of origin.

Although Africa has a large Diaspora in developed countries with a high proportion of emigrants with high qualifications, no study to our knowledge has examined the impact of this Diaspora on economic development in Africa. This study fills this gap by analyzing both global and specific effects according to the emigrants' level of education as well as the main transmission channels.

3. Empirical strategy

The first step in our study is to empirically investigate the effect of the Diaspora — depending on the level of education — on economic development in Africa. The second step consists in analyzing the different channels through which this effect operates. We focus on the African Diaspora in the OECD countries, which represents the stock of people from Africa and living in OECD countries. We follow Docquier et al. (2016) by computing the Diaspora rate (or emigration rate) as the sum of emigrants from country i (from Africa in our case) to OECD destination countries j at time t, $\sum_j Diasp_{ij,t}$, divided by the native population of country i, $N_{i,t}$ (proxied by the sum of the resident and emigrant populations). In this section, we present our empirical baseline model (Section 3.1), expose the OLS estimation approaches (Section 3.2), discuss how we deal with endogeneity issues (Section 3.3) and describe the data sources used in our empirical analysis (section 3.4).

3.1 Baseline model

Based on the paper's objective, our baseline model specifies income per capita as the dependent variable and the Diaspora (emigration rate) as the explanatory variable of interest.

$$lny = \alpha + \gamma Diasp^{E} + \sum_{k} \delta^{k} X^{k} + \varepsilon \qquad (1)$$

y is the real GDP per capita at chained PPPs (a measure of economic development), $Diasp^{E}$ is the Diaspora rate of education level E (low, medium, high) that is the sum of emigrants of education E from country i (from Africa) to OECD destination countries j, divided by the native population of country i, X are control variables, and ε stands for the error term. Our reference model is simple. It explains per capita income by the country's Diaspora rate and its size (population and area) as in the international trade model proposed by Frankel and Romer (1999). This model has been widely used in recent studies on openness to trade and migration (see, among others, Noguer and Siscart, 2005; Freund and Bolaky, 2008; Feyrer, 2009; Ortega and Peri, 2014, Docquier et al., 2016). Then, our reference model is supplemented using other control variables. By following the literature, we use the control variables below:

- *Trade openness*, measured as the sum of imports and exports as share of GDP. Since emigration is a measure of openness in the context of globalization, it is important to introduce trade openness to be sure that emigration does not capture other dimensions of openness (see Ortega and Peri, 2014; Docquier et al., 2016). In addition, there is an abundant literature on the impact of trade openness on per capita income (Frankel and Romer, 1999; Dollar and Kraay, 2003; Noguer and Siscart, 2005; Freund and Bolaky, 2008).
- *Country Size*, measured by population and area. Size and trade openness are the control variables we consider in our reference model (1) as in the empirical studies mentioned above. Indeed, it is important to control for the size of the country because larger countries are generally characterized to experience more internal migration and less international migration. As a result, larger countries will have lower shares of Diaspora regardless of whether they are more or less open to migration.

- *Education Attainment,* defined as the number of years of schooling that a child of school entrance age can expect to receive. Education is undoubtedly an important determinant of growth and development (see Barro, 2013). It is therefore important to include this variable among our control variables.
- *Terms of trade,* calculated as the percentage ratio of the export unit value indexes to the import unit value indexes. Given their strong specialization in the export of raw materials, African countries are heavily exposed to fluctuations in the terms of trade that affect their economic development (Blattman et al., 2003).
- *Financial development,* measured by the domestic credit to private sector as share of GDP is used to account for the influence of financial market development on per capita income. This variable is considered to be one of the determinants of long-term growth (De Gregorio and Guidotti, 1995; Calderón and Liu, 2003).
- *Capital openness,* measured by the Chinn and Ito (2006) index of capital account openness and is used to capture the influence of financial liberalization policies on economic development via the impact on saving and investment decisions. Like trade openness, it seems important to control the impact of emigration through financial openness.
- *Historical and geographical controls*. The historical controls are colonial origin dummies and the European settlement in the colonies, measured as the fraction of the population of European descent in 1900 (see Acemoglu et al., 2001). For geographic control variables, we use country latitude and a dummy for landlocked countries.
- *Domestic and foreign investment rate*. While domestic investment is a key determinant of growth and economic development (Anderson, 1990), several studies have also highlighted the impact of foreign direct investment (FDI) on growth and economic development (see among others, Borensztein et al., 1998; Alfaro et al., 2004; Li and Liu, 2005).
- *Democracy index* (quality of institutions), measured by the indices of civil liberty and political right.

- *Official Development Assistance (ODA),* measured as a percentage of GDP. ODA is decisive for several African countries that depend on it to finance development projects and programs.
- *Regional dummies* are introduced to control for unobserved regional heterogeneity.

Although it is important to use control variables to avoid the bias of omitted variables, it is also well known that with the multiplication of explanatory variables, there is a risk of multicollinearity bias. For example, education is probably strongly correlated with emigration, latitude is correlated with colonial origin, the rate of emigration itself is strongly correlated with trade and many geographic variables, and democracy is correlated with latitude and several geographic variables. For this reason, as in Docquier et al. (2016), we will add the control variables by subset and not all at the same time in the same regression.

3.2 Cross-section and pooled OLS specifications

To analyze both the long-term and short-term effects of the Diaspora on per capita income in Africa, we use both cross-section and panel specifications of the baseline model (1).

3.2.1 Cross-section OLS specification

This approach allows us to analyze the long-term impact of the Diaspora on the level of development. In other words, with the cross-sectional approach, one can test whether the differences in the Diaspora proportions among African countries significantly explain their differences in terms of economic development. Estimates are made with the OLS estimator using the full-sample averages of the dependent and independent variables for each country:

$$lny_i = \alpha + \gamma Diasp_i^E + \sum_k \delta^k X_i^k + \varepsilon_i \qquad (2)$$

where *i* stands for country index. In this regression, each variable is the average of the corresponding annual variable for each country over the sample period from 1980 to 2014.

3.2.2 Pooled OLS specification

While the cross-sectional OLS approach is important for placing the relationship between the Diaspora and economic development in a long-term perspective, it does not allow for

analysis of the short-term effects of the Diaspora. To account for this concern, we construct a panel that contains non-overlapping 5-year averages data for each country since our explanatory variables of interest (Diaspora rates) are also available for each five-year period.

$$lny_{i,t} = \alpha + \gamma Diasp^{E}_{i,t-1} + \sum_k \delta^k X^k_{i,t-1} + \vartheta_r R_r + \theta_t T_t + \varepsilon_{i,t} \qquad (3)$$

where *i* and *t* stand for country and period indices, respectively; R_r represents the regional dummies and T_t is time-fixed effect. In this pooled OLS specification, the explanatory variables are introduced with a lag of one period (ie 5 years) to account for their potential lagged effects (see Docquier et al., 2016). This also allows to consider as a member of the Diaspora, an African emigrant who has resided in an OECD country for at least 5 years.

3.3 The endogeneity issue: Identification strategy

Although we want to estimate equations (2) and (3) by OLS, we keep in mind that such regressions raise a number of econometric problems that could lead to estimation bias. The main problem in using cross-sectional and pooled OLS regressions is the endogeneity of our main variable of interest, the rate of emigration (or proportion of the Diaspora). One can imagine that the level of economic development of countries affects the desire of individuals to emigrate. Indeed, most people prefer to leave their country to live in countries with a better standard of living. Thus, the relationship between emigration and economic development can be characterized by an inverse causality. Furthermore, unobserved characteristics of countries can jointly affect the rate of emigration and economic development. To account for these potential problems of simultaneity bias, we use two estimation strategies. We first use a two-stage least squares (2SLS) estimation strategy that requires finding suitable external instruments for migration in the first stage. Then we use GMM estimators with internal instruments as the second identification strategy. This latter strategy allows us to better account for unobservable heterogeneity and persistence in the lagged dependent variable and other regressors.

3.3.1 Gravity-based 2SLS approach

Initiated by Frankel and Romer (1999) in a per capita income equation, this approach has been adopted by several authors (Dollar and Kraay, 2003; Noguer and Siscart, 2005; Freund and Bolaky, 2008; Feyrer, 2009; Ortega and Peri, 2014; Coulibaly et al., 2016;

Alesina et al., 2016; Docquier et al., 2016). Roughly speaking, it consists in constructing, on the basis of pseudo-gravity regressions, the geography-based prediction of the rate of bilateral migration from country i to country j. To do this, we consider the following pseudo-gravity model:

$$lnDiasp_{i,j}^{E} = \tau_0 + \tau_1 lnDist_{ij} + \tau_2 lnPop_i + \tau_3 lnPop_j + \tau_4 lnArea_i + \tau_5 lnArea_j + \tau_6(Landlocked_i + Landlocked_j) + \tau_7 Colony_{ij} + \tau_8 ComLang_{ij} + e_{ij} \qquad (4)$$

where $Diasp_{i,j}^{E}$ is the bilateral emigration rate (diaspora by level of education *E*) i.e., the stock of migrants born in country *i* in Africa and living in country *j* member of OECD as share of country *i*'s population; $Dist_{ij}$ is the weighted distance that is equal to the distance between home country *i* and destination country *j* based on bilateral distances between the biggest cities of the two countries; $Pop_i(Pop_j)$ and $Area_i(Area_j)$ respectively denote the population (area) of origin (destination) country *i*(*j*); Landlocked is a dummy variable for landlocked countries; $Colony_{ij}$ is a dummy for colonial relationship; and $ComLang_{ij}$ is a dummy for sharing a common language. In this gravity model, $Pop_i(Pop_j)$ and $Area_i(Area_j)$ are used to capture the capacity of home (host) country to send (receive) migrants. The migration costs are captured by geographic variables (such as *Dist*, *Landlocked*), linguistic and colonial ties (*Language*, *Colony*). The gravity model (4) is estimated by using both cross-sectional and panel data. To account for time-varying dimension in panel setting, we follow Feyrer (2009) and Docquier et al. (2016) by including both time and destination-country fixed effects and interactions between geographic distance and time dummies. The latter allows the effect of geographic distance to be time-varying, and thus to capture reduction in migration costs, for example, caused by improvements in aircraft technology (see Docquier et al., 2016).

Our gravity model is estimated by the Poisson Pseudo Maximum Likelihood (PPML) non-linear approach. As argued by Silva and Tenreyro (2006), contrary to the log-linearized model estimation by OLS, PPML estimation allows to address issues related to observations of the dependent variable with zero value and to heteroskedasticity. 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. After estimating gravity model

in equation (4), we sum them up over destination countries j to obtain the predicted emigration (Diaspora) rate for each origin country i ($\widehat{Diasp}_i^E = \sum_j \widehat{Diasp}_{ij}^E$) in Africa.

3.3.2 GMM approach

Since our endogenous variable is likely to be characterized by a certain persistence (see Docquier et al., 2016), it seems important to take this phenomenon into account. Thus, we propose, in addition to the previous approaches, a dynamic panel specification as follows:

$$lny_{i,t} = \alpha_i + \beta lny_{i,t-1} + \gamma Diasp_{i,t-1}^E + \sum_k \delta^k X_{i,t-1}^k + \varepsilon_{i,t} \qquad (5)$$

where i and t stand for country and period indices, respectively; α_i is the country fixed effect. Note that under certain conditions, one can easily show that the short term specification (5) becomes that of the long term (2). Indeed, the dynamic specification (5) has often been used for other variables such as democracy, the stock of physical and human capital (among others Acemoglu et al., 2008; Spilimbergo, 2009; Docquier et al., 2016). Thus, if the explanatory variables of equation (5) are themselves persistent (e.g., $Diasp_{i,t}^E = Diasp_{i,ss}^E$ and $X_{i,t} = X_{i,ss}$ $\forall t$, where subscript *ss* stands for steady state) and if the coefficient of the lagged dependent is comprised between 0 and 1 (i.e., $\beta \in [0,1[$), then the level of the dependent variable converges toward a long-run or steady state level($lny = (\alpha + \gamma Diasp_{i,ss}^E + \delta^k X_{i,ss}^k)/(1-\beta)$ which characterizes the long-run relationship between income per capita and the right-hand-side variables (see Docquier et al., 2016 for the case of democracy). The coefficient $\gamma/(1-\beta)$ captures, in this case, the long-term effect of the Diaspora (emigrants) on economic development. Note also that equation (5) can easily be transformed into an equation of economic growth.

Although the introduction of the lagged endogenous variable among the explanatory variables allows to take into account the per capita income persistence, it becomes clearly inappropriate to estimate equation (5) by OLS since the lagged endogenous variable is correlated with the time-invariant country-effects. It is therefore important to use a more robust method to take into account the dynamic effect of the income per capita, as well as problems of multiple endogeneity and error measurements. The generalised method of moments (GMM) for dynamic panel data is well-known and commonly used estimators to overcome the bias of fixed effects, endogeneity, and

measurement. The difference-GMM and the system-GMM are two methods commonly used in the context of panel data. Difference-GMM was developed by Arellano and Bond (1991) following Holtz-Eakin et al. (1988) and consists of transforming all regressors, usually by differencing, and uses GMM to correct the bias of correlation between the unobserved country-specific effects and the lagged dependent variables. System-GMM developed by Arellano and Bover (1995) and Blundell and Bond (1998) Blundell and Bond (1998) augments difference GMM estimator by making an additional assumption that first differences of instrument variables are uncorrelated with the fixed effects (see Roodman, 2009). Accordingly, the efficiency can be considerably improved by the possibility of introducing more instruments. However, one can be confronted with the problem of proliferation of instruments which may be severe when the cross-section dimension is small. We use both GMM estimators. Time-specific effects are included in the regressions to capture common variations in the dependent variable and to reduce the asymptotic bias of the estimator in the presence of cross-sectional error dependence.

3.4 Data

The dependent variables: Given the paper objective and our empirical strategy, several variables are used as dependent variables according to the equation. The main dependent variable is the economic development measured by the per capita GDP at chained PPPs and obtained from the Penn World Table (PWT version 9.0). Then, from our income decomposition equation, there are four dependent variables: output per worker, which is slightly different from our main dependent variable, human capital per worker, capital intensity and productivity. The PWT9.0 contains data on output, human capital (based on years of schooling and returns to education), capital stock and number of workers, which allows us to calculate all of these dependent variables with the exception of productivity. The latter is calculated directly from the production function once the other variables are known. Data on remittances from the Diaspora comes from the World Development Indicators (WDI) of the World Bank. While remittances are an important channel for transmitting the impact of the Diaspora, it should be noted that official remittances data to sub-Saharan African countries are potentially significantly undervalued. The reasons for this are, inter alia, major shortcomings in the reporting of external financial data in several countries and the prevalence of informal channels.

The explanatory variables of interest: The rate of population of African countries living abroad (the Diaspora or emigrants) is our explanatory variable of interest. This variable is also available by educational attainment (low, medium, high). Thus, in addition to the overall emigration rate, we also use emigration rates by level of education. All these variables are obtained from the IAB database (Brücker et al., 2013). The authors computed emigration stocks and rates of the population aged 25 years and older by gender and educational attainment in five-year intervals from 1980 to 2010. We selected emigration data from African countries (countries of origin)[7] to 20 OECD countries (destination countries defined by the authors).[8] Although migration data are collected from official statistics of OECD countries – which reduces the risk of inaccuracy – it is worth noting that these data are potentially underestimated due to differences in definitions about immigrants. In some countries, immigrants who have acquired citizenship of the host country are no longer considered as such and thus escape official statistics.

The control variables: Several sources were used to mobilize the control variables. Trade openness (*export+import/GDP*) and domestic investment are from PWT9.0. Data on the expected years of schooling are from the UNESCO Institute for Statistics. We use the Chinn and Ito (2006) index of capital for capital openness. Our democracy variable is calculated by summing the indices of civil liberty and political right obtained from the Freedom House database. Indeed, these two variables are used by Docquier et al. (2016) as measures of democracy. We use the database from Acemoglu et al. (2001) for the historical variables (colonial origin and the European settlement in the colonies). Data on latitude and landlocked as well as other variables of the gravity model (common language, colonial links), come from the CEPII database.

[7] Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo, Dem. Rep., Congo, Rep., Cote d'Ivoire, Djibouti, Egypt, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, Sudan, Swaziland, Tanzania, Togo, Tunisia, Uganda, Zambia, Zimbabwe.

[8] Australia, Austria, Canada, Chile, Denmark, Finland, France, Germany, Greece, Ireland, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, and United States.

4. Empirical results

The baseline results of the OLS estimates are presented first. Then, we present their equivalents estimated through the gravity-based 2SLS strategy to deal with endogeneity. The results of the cross-sectional and pooled data estimates are presented simultaneously. We thus distinguish the short and long-term impact of the Diaspora on per capita income in Africa. Finally, we present the results of the dynamic panel estimates based on the GMM estimators.

4.1 OLS and 2SLS estimation results

Table 1 presents the baseline results obtained with the OLS estimators. These results show that the African Diaspora contributes significantly to improve the real income per capita in Africa. The impact of the Diaspora increases with the level of education of African emigrants. Indeed, the impact of the Diaspora does not seem to be significant in the cross-sectional regressions when the level of education of emigrants is low. The estimation results on the pooled data confirm the positive and significant impact of the Diaspora on the level of economic development in Africa. In these results, the impact of the Diaspora remains significant and positive whatever the level of education of emigrants. But the higher the level of study of emigrants, the greater the impact of the Diaspora on per capita income. These results contrast with the general belief that brain drain is detrimental to Africa. Obviously, these results are not sufficient to conclude definitively given the potential endogeneity bias. We therefore go further with the results, which are based on 2SLS estimations.

Table 1: Per capita income regressions – Baseline OLS results

	Cross-sectional OLS regression				Panel OLS regression			
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Diaspora	0.104				0.121***			
	(0.065)				(0.028)			
Low skills		0.097				0.114***		
		(0.064)				(0.029)		
Medium skills			0.544*				0.655***	
			(0.317)				(0.144)	
High skills				0.960***				1.060***
				(0.204)				(0.098)
Trade openness_pwt	0.014***	0.015***	0.012**	0.011**	0.008***	0.008***	0.006***	0.006***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.002)	(0.002)	(0.002)	(0.002)
Ln Population	0.080	0.079	0.067	0.050	-0.002	-0.005	-0.011	-0.023
	(0.132)	(0.139)	(0.133)	(0.113)	(0.059)	(0.062)	(0.058)	(0.053)
Ln Area	-0.063	-0.090	-0.054	0.010	-0.025	-0.052	-0.019	0.034
	(0.087)	(0.090)	(0.091)	(0.076)	(0.038)	(0.039)	(0.039)	(0.034)
Constant	6.775***	7.133***	6.894***	6.383***	7.612***	7.979***	7.745***	7.276***
	(1.553)	(1.631)	(1.489)	(1.325)	(0.695)	(0.720)	(0.660)	(0.598)
Observations	49	49	49	49	294	294	294	294
R-squared	0.582	0.559	0.582	0.674	0.523	0.496	0.530	0.604
Regional dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effect					Yes	Yes	Yes	Yes

Notes: Heteroskedasticity-robust standard errors are in parentheses. *, **, and *** denote significance at the 10%, 5% and 1% confidence level, respectively. In the panel regressions, the explanatory variables are lagged by one period.

Before turning to the results in Table 2, it is important to make some comments on the results of the gravity model that are useful in 2SLS regressions. Table A-1 shows the results of the different estimates (cross-section and panel) of the gravity model. These results are interesting for several reasons. First, they are consistent with the theoretical predictions. The distance, the isolation and the size of the population of the country of origin have a negative and siginificant impact on the emigration rate of African countries to OECD countries. The latter increases with the size of the population in the country of destination or when the African and OECD countries have a common language or colonial ties. Second, the results of the panel data estimates show that the impact of distance

decreases over time. They thus confirm the results of Docquier et al. (2016) which show that improvements in transport technologies have led to a reduction in the cost of migration. More interestingly, the results show that the cost of distance varies according to the level of education of the emigrants. Indeed, for the same distance, emigrants with a high level of education face a lower cost than those with a low level of education. This result shows that Africans with high skills migrate easily to developed OECD countries. This may be a consequence of the migration policy of the countries of destination.

Table 2 presents baseline results on the impact of the Diaspora using the gravity-based 2SLS approach. These findings show a greater positive impact of the Diaspora on real per capita income in Africa. Indeed, the impact of the Diaspora is about twice as high with the instrumental variables (IV) method than with the OLS method with both cross-sectional data and panel data. African emigrants with medium skills and those with high skills contribute more strongly to improving the standard of living in Africa. The impact of low-skilled emigrants is only significant in the short to medium term. Given the relatively close coefficients for medium- and high-skill emigrants, we conduct additional regressions by considering the two variables simultaneously (columns 5 and 10) in order to check if one of them has a greater impact. The results show that highly skilled emigrants contribute most to the improvement of real per capita income in Africa. The latter therefore contrasts with the widespread belief that emigration of highly skilled people (brain drain) is detrimental to the economic growth of developing countries. Obviously, the question of the robustness of these results arises. It is for this purpose that we perform a series of additional regressions that distinguish three subgroups of control variables given the relatively large determinants of per capita income.

The first control subgroup is composed of geographical and historical variables (European settlers in 1900, colonial origins, distance to the equator, landlocked dummy) often used to explain the origin of the quality of institutions in different countries (Acemoglu et al., 2001; Sachs, 2003; La Porta et al., 2008). These variables are important in explaining the contemporary economic performance of countries. Since the validity of geographically-constructed instrumental variables is weakened by the fact that geographical features may directly influence income per capita or indirectly through other channels than migration, it is prudent to include these control variables (see Rodriguez and Rodrik, 2000). Table 3 presents the results of this first control group. The Diaspora contributes to a significant improvement in per capita income in Africa regardless of the

educational level of the emigrants and whatever the estimation approach (cross-section or panel). As before, emigrants with a high level of education play a predominant role. It should be noted, however, that the validity tests of the instruments shows a certain fragility of our instruments in the cross-sectional approach except for the specification inculding high-skilled emigrants. This may be due to the limited number of cross-sectional observations since the panel specifications all pass these tests successfully.[9]

The second control subgroup is composed of internal variables depending on the economic and institutional policies of the countries (financial development, domestic investment rate, inflation rate, education, democracy index, capital openness) and which influence real per capita income. These variables are widely used in the literature as determinants of growth and income of countries (see, among others, De Gregorio and Guidotti, 1995; Calderón and Liu, 2003; Barro, 2013). Table 4 shows the results of the estimates with this subgroup of control variables. The results of the cross-country approach show that only highly skilled emigrants have a positive and significant impact on per capita income. However, the panel approach shows that the overall African Diaspora — regardless of level of education — contributes significantly to improving the level of development in Africa. The impact of the Diaspora with a high level of education is always the largest. These results are thus globally consistent with the previous ones.

The last subgroup of controls we consider relates to a set of relatively external variables (terms of trade, foreign direct investment, official development assistance) over which countries have little or no control. Indeed, African countries depend heavily on these variables. The terms of trade affect economic development in African countries (see Blattman et al., 2003) and many African countries rely on ODA to finance development programs and projects. Finally, some studies highlight the importance of FDI in the development of countries (Alfaro et al., 2004; Li and Liu, 2005). Table 5 presents the results of the regressions with this subgroup of control variables. No significant changes are observed compared to baseline results. The African Diaspora contributes to a significant improvement in economic development in Africa, irrespective of the level of education of emigrants. The cross-sectional approach fails to differentiate between moderately and highly skilled emigrants, but the panel approach shows the greater impact of highly skilled migrants.

[9] The statistics from Kleibergen and Paap (2006)'s test of weak identification are higher than the critical values of the Stock and Yogo (2005) at the usual confidence level.

Table 2: Per capita income regressions – Baseline IV results

	Cross-sectional IV regression					Panel IV regression				
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Diaspora	0.388***					0.350***				
	(0.138)					(0.054)				
Low skills		0.336					0.331***			
		(0.212)					(0.086)			
Medium skills			1.823***		-0.241			1.397***		-0.482*
			(0.489)		(0.563)			(0.217)		(0.263)
High skills				1.562***	1.664***				1.395***	1.653***
				(0.229)	(0.345)				(0.174)	(0.243)
Trade openness	0.016***	0.019***	0.010	0.012**	0.013**	0.008***	0.009***	0.004**	0.006***	0.007***
	(0.005)	(0.005)	(0.006)	(0.005)	(0.006)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Ln Population	0.184	0.172	0.114	0.079	0.075	0.052	0.045	0.007	-0.012	-0.021
	(0.116)	(0.105)	(0.126)	(0.096)	(0.096)	(0.058)	(0.058)	(0.058)	(0.052)	(0.053)
Ln Area	0.102	-0.010	0.106	0.095	0.078	0.107***	0.026	0.065	0.078**	0.056
	(0.091)	(0.092)	(0.093)	(0.066)	(0.074)	(0.040)	(0.043)	(0.040)	(0.035)	(0.037)
Constant	2.893	4.552***	4.067**	4.845***	5.133***	5.103***	6.192***	6.453***	6.597***	6.989***
	(2.073)	(1.599)	(2.045)	(1.373)	(1.516)	(0.834)	(0.781)	(0.751)	(0.641)	(0.695)
Observations	47	47	47	47	47	282	282	282	282	282
R-squared	0.262	0.443	0.332	0.644	0.669	0.341	0.401	0.453	0.597	0.606
Regional Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
K-P F-stat	6.185	3.542	12.32	23.80	2.985	31.29	23.65	16.82	75.69	9.161
SY 10% max IV size	16.38	16.38	16.38	16.38	7.030	16.38	16.38	16.38	16.38	19.93
SY 25% max IV size	5.530	5.530	5.530	5.530	3.630	5.530	5.530	5.530	5.530	7.250
Time Fixed Effect						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. K-P F-stat is the Kleibergen and Paap (2006) rk Wald F-stat test of weak identification. 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. In the panel regressions, the explanatory variables are lagged by one period.

Table 3: Per capita income regressions – IV results with historical and geographical controls

	Cross-sectional IV regression					Panel IV regression				
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Diaspora	0.217***					0.203***				
	(0.079)					(0.039)				
Low skills		0.199***					0.197***			
		(0.069)					(0.035)			
Medium skills			1.208**		0.342			0.870***		0.082
			(0.499)		(0.436)			(0.213)		(0.175)
High skills				1.256***	1.132***				1.067***	1.026***
				(0.291)	(0.337)				(0.173)	(0.209)
Trade openness	0.016***	0.016**	0.016**	0.011*	0.012*	0.007***	0.007***	0.006***	0.005**	0.005**
	(0.006)	(0.006)	(0.006)	(0.007)	(0.006)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Ln Population	0.225*	0.201*	0.228*	0.123	0.157	0.087	0.073	0.064	0.021	0.026
	(0.116)	(0.105)	(0.118)	(0.101)	(0.113)	(0.058)	(0.057)	(0.057)	(0.053)	(0.055)
Ln Area	-0.032	-0.072	-0.036	0.024	0.033	-0.004	-0.036	-0.028	0.015	0.017
	(0.079)	(0.084)	(0.083)	(0.073)	(0.072)	(0.036)	(0.037)	(0.036)	(0.035)	(0.034)
British colony	0.891***	0.875***	0.920***	0.589***	0.659***	0.840***	0.839***	0.798***	0.583***	0.598***
	(0.232)	(0.235)	(0.236)	(0.201)	(0.241)	(0.106)	(0.109)	(0.105)	(0.098)	(0.110)
French colony	0.987***	0.836***	1.077***	0.862***	0.985***	0.891***	0.781***	0.831***	0.740***	0.762***
	(0.272)	(0.238)	(0.293)	(0.204)	(0.296)	(0.118)	(0.107)	(0.116)	(0.095)	(0.113)
European settlers 1900	-0.000	-0.000	-0.000	0.001	0.001	-0.003	-0.003	-0.002	-0.001	-0.001
	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Latitude (abs)	-1.612	-0.603	-1.642	-1.800	-2.295	-0.807	-0.053	-0.152	-0.616	-0.693
	(1.444)	(1.402)	(1.539)	(1.494)	(1.476)	(0.704)	(0.678)	(0.689)	(0.700)	(0.671)
Landlocked	-0.434**	-0.463***	-0.433**	-0.405**	-0.395**	-0.532***	-0.551***	-0.540***	-0.493***	-0.493***
	(0.177)	(0.179)	(0.180)	(0.167)	(0.169)	(0.075)	(0.076)	(0.075)	(0.073)	(0.073)
Constant	3.905**	4.854***	3.828**	4.906***	4.199***	5.966***	6.595***	6.651***	6.840***	6.735***
	(1.525)	(1.274)	(1.608)	(1.331)	(1.574)	(0.766)	(0.720)	(0.724)	(0.632)	(0.683)

Observations	45	45	45	45	45	270	270	270	270	270
R-squared	0.713	0.719	0.685	0.764	0.746	0.661	0.657	0.657	0.705	0.704
Regional Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
K-P F-stat	3.247	3.292	2.826	18.73	1.607	18.69	20.83	14.29	93.57	8.714
SY 10% max IV size	16.38	16.38	16.38	16.38	7.030	16.38	16.38	16.38	16.38	19.93
SY 25% max IV size	5.530	5.530	5.530	5.530	3.630	5.530	5.530	5.530	5.530	7.250
Time Fixed Effect						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. K-P F-stat is the Kleibergen and Paap (2006) rk Wald F-stat test of weak identification. 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. In the panel regressions, the explanatory variables are lagged by one period except the dummy variables.

Table 4: Per capita income regressions – IV results with domestic control variables

	Cross-sectional IV regression					Panel IV regression				
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Diaspora	0.162					0.194***				
	(0.131)					(0.048)				
Low skills		0.059					0.178**			
		(0.165)					(0.079)			
Medium skills			0.761		-0.902***			0.815***		-0.397
			(0.510)		(0.330)			(0.177)		(0.284)
High skills				0.923***	1.464***				0.876***	1.164***
				(0.278)	(0.246)				(0.107)	(0.242)
Financial Development	0.009**	0.011***	0.010**	0.008**	0.008**	0.006***	0.007***	0.007***	0.005***	0.005***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Domest. Invest. Rate	-0.000	0.019	0.001	0.008	0.028***	-0.007	-0.000	-0.002	0.005	0.009*
	(0.030)	(0.021)	(0.026)	(0.016)	(0.010)	(0.009)	(0.008)	(0.006)	(0.005)	(0.005)
Inflation	0.034	0.020	0.035	0.025	0.007	-0.001	-0.001	-0.000	-0.003*	-0.004*
	(0.028)	(0.022)	(0.026)	(0.019)	(0.018)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Education	0.120**	0.151***	0.119**	0.100*	0.113**	0.097***	0.115***	0.106***	0.095***	0.097***
	(0.058)	(0.043)	(0.056)	(0.052)	(0.046)	(0.021)	(0.019)	(0.018)	(0.017)	(0.017)
Democracy	0.091*	0.068	0.072	0.092**	0.095**	0.024	0.009	0.012	0.019	0.016
	(0.054)	(0.054)	(0.047)	(0.043)	(0.044)	(0.021)	(0.022)	(0.019)	(0.017)	(0.017)
Capital openness	0.193	0.197	0.172	0.080	0.035	0.146***	0.160***	0.130***	0.079*	0.064
	(0.141)	(0.134)	(0.140)	(0.156)	(0.154)	(0.046)	(0.048)	(0.044)	(0.044)	(0.046)
Constant	6.038***	5.824***	6.141***	5.907***	5.535***	7.091***	7.115***	7.085***	6.981***	6.948***
	(0.968)	(0.793)	(0.931)	(0.714)	(0.649)	(0.346)	(0.336)	(0.300)	(0.275)	(0.272)
Observations	47	47	47	47	47	250	250	250	250	250
R-squared	0.631	0.707	0.668	0.724	0.768	0.593	0.604	0.662	0.710	0.713
Regional Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
K-P F-stat	8.143	7.101	13.53	27.99	6.111	48.84	34.86	29.74	147.4	12.75
SY 10% max IV size	16.38	16.38	16.38	16.38	7.030	16.38	16.38	16.38	16.38	19.93

SY 25% max IV size	5.530	5.530	5.530	5.530	3.630	5.530	5.530	5.530	5.530	7.250
Time Fixed Effect						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. K-P F-stat is the Kleibergen and Paap (2006) rk Wald F-stat test of weak identification. 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. In the panel regressions, the explanatory variables are lagged by one period.

Table 5: Per capita income regressions – IV results with external control variables

	Cross-sectional IV regression					Panel IV regression				
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Diaspora	0.218***					0.266***				
	(0.052)					(0.032)				
Low skills		0.277***					0.352***			
		(0.084)					(0.061)			
Medium skills			1.190***		0.600			1.282***		0.167
			(0.260)		(0.440)			(0.144)		(0.249)
High skills				1.041***	0.566				1.210***	1.074***
				(0.175)	(0.360)				(0.104)	(0.219)
Foreign Direct Inv.	0.057**	0.074**	0.033	0.033	0.031	0.006	0.012	-0.005	0.004	0.002
	(0.029)	(0.029)	(0.027)	(0.031)	(0.027)	(0.008)	(0.008)	(0.008)	(0.009)	(0.009)
Terms of trade	-0.001	-0.002	0.000	-0.001	0.000	0.001	0.001	0.001	0.001	0.001
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
ODA	-0.068***	-0.073***	-0.064***	-0.049***	-0.056***	-0.037***	-0.040***	-0.034***	-0.028***	-0.028***
	(0.016)	(0.017)	(0.014)	(0.012)	(0.013)	(0.006)	(0.007)	(0.005)	(0.004)	(0.004)
Constant	8.240***	8.410***	8.143***	8.225***	8.145***	7.789***	7.831***	7.846***	7.806***	7.806***
	(0.381)	(0.396)	(0.369)	(0.414)	(0.378)	(0.202)	(0.215)	(0.198)	(0.189)	(0.189)
Observations	47	47	47	47	47	269	269	269	269	269
R-squared	0.695	0.670	0.706	0.754	0.746	0.556	0.492	0.588	0.675	0.673
Regional Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
K-P F-stat	8.624	6.406	10.15	30.87	2.356	49.78	35.84	32.97	126.5	10.52
SY 10% max IV size	16.38	16.38	16.38	16.38	7.030	16.38	16.38	16.38	16.38	19.93
SY 25% max IV size	5.530	5.530	5.530	5.530	3.630	5.530	5.530	5.530	5.530	7.250
Time Fixed Effect						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. K-P F-stat is the Kleibergen and Paap (2006) rk Wald F-stat test of jointly weak identification. 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. In the panel regressions, the explanatory variables are lagged by one period.

All the previous results show that the African Diaspora makes a positive and significant contribution to the economic development of Africa. We also show that the higher the education level of emigrants, the greater the impact of the Diaspora. These results are robust to a set of control specifications. They thus break with the old theoretical paradigm which argues that the emigration of highly skilled people from developing countries is detrimental to their economic development (Bhagwati and Hamada, 1974; Miyagiwa, 1991; Haque and Kim, 1995). Our findings are more consistent with the new theoretical and empirical developments that highlight several channels through which emigration can be beneficial to the countries of departure. For African countries, as for most developing countries, the prospect of future emigration could encourage families to invest in education, thus contributing to improving human capital (Beine et al., 2003; Beine et al., 2003). In addition to this potential effect, the African Diaspora could contribute to the economic development of Africa through several channels. Indeed, the Diaspora is a vector of transmission of financial capital (remittances) and of human and technological capital. In addition, some recent studies show that emigration plays an important role in the improvement of political institutions in developing countries (see Spilimbergo, 2009 and Docquier et al., 2016). Finally, in African international institutions, several high-level authorities have been part of the Diaspora and play an important role in the definition and implementation of development policies. All these reasons have undoubtedly explained the very important impact of the Diaspora that our study highlights.

4.2 GMM estimation results

Since previous estimates do not take into account the persistence of per capita income, we use dynamic panel estimates to deal with this phenomenon. In addition to being the most appropriate for dynamic panel estimation, GMM estimators also provide internal instruments to address the endogeneity problem between the emigration rate and the economic development of countries. Therefore, they usefully complement previous results by providing additional robustness tools. Table 6 presents the results of the estimates based on the system-GMM and difference-GMM techniques. These results

show that, even taking into account the persistence that characterizes per capita income, the African Diaspora contributes positively and significantly to the improvement of the income in Africa whatever the approach used. Once again the impact of highly skilled emigrants is the highest. It should be noted that there is no evidence of second order serial correlation in the first-differenced residuals and the Difference Hansen test does not reject the validity of instruments. The dynamic panel estimates are thus consistent with the previous results.

Table 6: Per capita income regressions – Difference-GMM and System-GMM results

	Difference-GMM regressions					System-GMM regressions				
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
L. Ln GDP per capita	0.725***	0.699***	0.706***	0.685***	0.708***	0.861***	0.818***	0.788***	0.941***	0.956***
	(0.117)	(0.116)	(0.126)	(0.122)	(0.125)	(0.109)	(0.116)	(0.149)	(0.087)	(0.073)
Diaspora	0.066*					0.161***				
	(0.036)					(0.059)				
Low skills		0.042					0.168			
		(0.072)					(0.147)			
Medium skills			0.295***		0.085			0.405***		0.006
			(0.075)		(0.124)			(0.149)		(0.125)
High skills				0.313***	0.252**				0.409***	0.553***
				(0.089)	(0.118)				(0.135)	(0.201)
Trade openness	0.006***	0.005**	0.005**	0.004**	0.004***	0.009**	0.008**	0.006**	0.007**	0.005*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.004)	(0.003)	(0.002)	(0.003)	(0.002)
Ln Population	0.373**	0.401**	0.303	0.253	0.337*	0.009	0.129	-0.045	-0.154	-0.078
	(0.183)	(0.178)	(0.187)	(0.193)	(0.198)	(0.266)	(0.319)	(0.264)	(0.224)	(0.143)
Ln Area	5.165	2.495	3.030	1.347	2.637	0.125	0.056	0.090	0.125	0.106
	(6.692)	(4.904)	(5.195)	(3.779)	(4.651)	(0.140)	(0.215)	(0.162)	(0.116)	(0.113)
Education	0.010	0.016	0.017	0.023	0.011	0.028	0.026	0.046	0.048*	0.035*
	(0.018)	(0.018)	(0.018)	(0.017)	(0.017)	(0.042)	(0.041)	(0.029)	(0.027)	(0.020)
Landlocked dummy						-0.575	-1.075	-0.269	-0.418	0.192
						(0.576)	(2.270)	(0.920)	(0.436)	(0.315)
British colony						1.849**	1.874**	2.376**	1.370**	0.683
						(0.839)	(0.883)	(0.912)	(0.512)	(0.409)
French colony						1.231	0.739	0.711	0.728	0.627
						(0.863)	(2.112)	(1.476)	(0.740)	(0.504)
European settlers 1900						-0.000	0.003	0.028	0.003	0.009
						(0.014)	(0.019)	(0.023)	(0.010)	(0.006)
Latitude (abs)						0.277	2.031	-0.497	0.128	0.681
						(2.415)	(4.439)	(3.583)	(1.816)	(1.513)
Constant						2.281	1.602	3.968	4.964*	3.969**

						(3.103)	(2.469)	(3.307)	(2.484)	(1.551)
AR(2) p-value	0.268	0.334	0.289	0.268	0.315	0.303	0.352	0.309	0.336	0.509
Dif. Hansen p-value	0.934	0.745	0.618	0.223	0.182	0.962	0.752	0.487	0.572	0.407
Number of instruments	24	24	24	24	24	36	36	36	36	36
Observations	188	188	188	188	188	235	235	235	235	235
Number of ident	47	47	47	47	47	47	47	47	47	47

Notes: Heteroskedasticity-robust standard errors are in parentheses. *, **, and *** denote significance at the 10%, 5% and 1% confidence level, respectively. L.Ln GDP per capita is treated as pre-determined and emigration variables are treated as endogenous. All variables are instrumented using their own 1st to 3rd lags. Due to the difference operator in the Difference-GMM approach, time-invariant variables are dropped. The area is not completely constant for all countries in our sample. This is the case for Ethiopia and Madagascar. The explanatory variables are lagged by one period except for variables that are invariant over time.

5 The transmission channels

In previous section, we have shown that the African Diaspora contributes significantly to the improvement of the standard of living in Africa. In this last section, we examine the channels through which this positive effect occurs. We therefore analyze the channel of income decomposition, the channel of remittances and that of political institutions.

5.1 The channel of income decomposition

We propose an income decomposition to further explore the channels through which the Diaspora affects economic development in Africa. Such an analysis provides a more precise view of the role of the Diaspora in economic development in Africa. To do this, we follow Hall and Jones (1999) by using the decomposition of income based on a simple Cobb-Douglas production function. Specifically, we consider the following function:

$$Y = K^{\rho}(AH)^{1-\rho} \qquad (6)$$

where Y stands for output, K is the stock of physical capital, H denotes the amount of human capital-augmented labor, A is a labor-augmenting measure of productivity, and ϱ represents the labor share in income. Rewriting this production function in terms of output per worker and using the logarithmic transformation, we get:

$$lny = \frac{\rho}{(1-\rho)}\ln\left(\frac{K}{Y}\right) + lnh + lnA \qquad (7)$$

where $y = Y/L$ denotes output per worker, and $h = H/L$ is human capital per worker. The level of productivity, it is calculated from the production function assuming that $\rho = 1/3$ in line with standard neoclassical approach.[10] Moreover, following Hall and Jones (1999), we consider human capital as a function of returns to schooling ($H = e^{\phi(S)}L$) as estimated in a Mincerian wage regression. φ is a function reflecting the efficiency of a unit of labor

[10] The empirical value of this parameter we get for African countries is 0.30 with the panel data, which is close to the reference value.

with *S* years of schooling. Each of the components on the right-hand side of Equation (7) contributes to the improvement of income per worker. Data on output, human capital (based on years of schooling and returns to education), capital stock and number of workers are from PWT9.0. The productivity is calculated directly from the production function once the other variables are known.

Table 7 reports the results of the 2SLS estimation of Equation 7 considering successively each term (respectively the log of income per worker, the log of the capital-output ratio, the log of human capital per worker, and the log of productivity) as the dependent variable. We present here the results on emigrants with a high level of education since they have the most significant impact according to our previous results. However, the results for the other levels of education (low, medium) are presented in Table A-2 in Appendix. In line with our previous findings, a high rate of Diaspora in developed countries contributes significantly to improving per-worker income in Africa. We find that the African Diaspora contributes to improving per-worker income in Africa mainly through an improvement in human capital per worker and higher productivity. The impact on physical capital intensity is positive but weaker. Specifically, our estimates indicate that a rise of one percentage point in the highly skilled emigration rate increases the contribution of the intensity of physical capital to income of 0.07 percentage point whereas it increases the contribution of human capital of 0.31 percentage point and that of productivity of 1.14 percentage point. Estimates for other levels of education of emigrants (low, medium) give qualitatively similar results (see Table A-2). Thus, the impact of the Diaspora on income per worker mainly passes through the enhancement of human capital and productivity.

Table 7: Results of Income decomposition estimations – High skills

VARIABLES	Income per worker *lnY/L*	Physical capital intensity $(\rho/(1-\rho))lnK/Y$	Human capital intensity *lnH/L*	TPF *lnA*
High skills	1.168***	0.072*	0.310***	1.140***
	(0.193)	(0.038)	(0.071)	(0.175)
Trade openness	0.007***	0.002**	0.001*	0.001
	(0.002)	(0.001)	(0.001)	(0.003)
Ln Population	-0.116*	-0.005	-0.003	-0.065
	(0.062)	(0.020)	(0.014)	(0.077)
Ln Area	0.112***	0.006	0.016	0.094**
	(0.040)	(0.016)	(0.011)	(0.040)
Constant	-1.639**	-0.007	-0.688***	-1.440
	(0.752)	(0.223)	(0.201)	(1.042)
Observations	281	282	228	228
R-squared	0.585	0.113	0.486	0.578
Regional Fixed Effect	Yes	Yes	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes	Yes
K-P F-stat	76.85	75.69	264.6	264.6
SY 10% max IV size	16.38	16.38	16.38	16.38
SY 25% max IV size	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 weak identification. 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

5.2 Diaspora and Remittances to Africa

We extend the analysis of transmission channels by also investigating the channel of remittances. Indeed, in addition to channels based on the decomposition of income, it is now well known that the African Diaspora is a provider of financial capital (remittances) that can be used to reduce financing constraints in Africa. Since the importance of the level of education of emigrants in improving income in Africa has been highlighted, we investigate whether remittances are also affected by the level of education of emigrants.[11]

[11] We do not address the issue of the impact of remittances on economic development. This could be the subject of a separate article. See for example Catrinescu et al. (2009).

Table 8 reports the results of estimations on the impact of the Diaspora on remittances[12] according to the level of education of the emigrants. These results are edifying. They show that the remittances of the Diaspora depend on the level of education of the emigrants. Indeed emigrants with a low level of education contribute more significantly to remittances in Africa. In cross-country regressions, only low-skilled emigrants make significant remittances to Africa. Although in panel regressions the impact of emigrants with a medium or high level of education appears to be significant in explaining remittances (columns 7 and 8), this impact disappears when control variables are introduced in the regression (columns 11 and 12). This result could be explained by the fact that high-skilled emigrants have strong incentives to integrate into the host community, to bring family to the host country, and to undertake long-term life projects (long-term borrowing for home or vehicle purchases) in the destination country. Similar results were found by Faini (2007) and Niimi et al. (2010). Both studies show that highly skilled migrants send less money to their home countries. Faini (2007) indicates that remittances decrease with the proportion of highly qualified individuals among emigrants. These results were confirmed by Niimi et al. (2010) who show that remittances decrease for tertiary-educated migrants even when addressing the issue of endogeneity.

[12] Remittances (% of GDP) are taken from WDI and are defined as the sum of personal transfers and compensation of employees.

Table 8: The Diaspora and Remittances to Africa

	CS-IV regression (Long term)				Panel IV regression				Panel IV regression with controls			
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Diaspora	0.461*				0.458***				0.458*			
	(0.278)				(0.153)				(0.263)			
Low skills		0.787**				0.763***				0.831***		
		(0.312)				(0.182)				(0.288)		
Medium skills			2.057				1.977**				1.515	
			(1.498)				(0.831)				(1.370)	
High skills				1.440				1.520*				1.435
				(1.324)				(0.817)				(1.418)
Trade openness									0.052*	0.050*	0.057**	0.058**
									(0.027)	(0.026)	(0.028)	(0.028)
Financial development									-0.088***	-0.092***	-0.081***	-0.082**
									(0.031)	(0.030)	(0.030)	(0.032)
Capital openness									-0.068	-0.013	-0.073	-0.143
									(0.347)	(0.346)	(0.348)	(0.374)
Constant	0.078	0.112	-0.056	0.295	0.872	0.826	0.948	1.051	-0.463	-0.331	-0.651	-0.695
	(0.370)	(0.235)	(0.563)	(0.434)	(1.782)	(1.781)	(1.787)	(1.804)	(1.311)	(1.290)	(1.349)	(1.396)
Observations	47	47	47	47	242	242	242	242	238	238	238	238
R-squared	0.181	0.188	0.177	0.160	0.145	0.152	0.136	0.124	0.212	0.223	0.198	0.189
Regional Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
K-P F-stat	9.445	6.037	14.67	44.60	48.71	35.29	35.49	129.4	54.15	37.20	33.34	142.8
SY 10% max IV size	16.38	16.38	16.38	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	5.530	5.530	5.530
Time Fixed Effect					Yes	Yes	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. K-P F-stat is the Kleibergen and Paap (2006) rk Wald F-stat test of weak identification. 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.

5.3 The channel of political institutions

The recent literature on the impact of brain drain considers that one of the contributions of the Diaspora in the countries of origin lies in its role in improving the quality of institutions. Docquier et al. (2016) support this point of view by showing empirically that emigration from developing countries to OECD countries helps to improve democracy in the countries of origin. We therefore consider this additional channel by examining the impact of the African Diaspora on democracy in Africa. To this end, we consider three variables of democracy: civil liberties and political rights from the Freedom House database, as well as the composite index of democracy – Policy 2 – from POLITY IV. Political rights ratings are based on an evaluation of three subcategories of issues related to the functioning of the institutions: electoral process, political pluralism and participation, and functioning of government.

With respect to civil liberties ratings, four subcategories of issues are considered: freedom of expression and belief, associational and organizational rights, rule of law, and personal autonomy and individual rights. Each country is assigned a numerical rating from 1 to 7 for both political rights and civil liberties, with a higher score (7) indicating less freedom. For its part, the Polity IV indicator (Polity 2) is conceived on the basis of three essential and interdependent elements: the presence of institutions and procedures through which citizens can express effective preferences about alternative policies and leaders; the existence of institutionalized constraints on the exercise of power by the executive and the guarantee of civil liberties to all citizens in their daily lives and in acts of political participation. Countries have an index of democracy ranging from -10 (strongly autocratic) to +10 (strongly democratic). Note that while the increase in the indices of political rights and civil liberties refers to a deterioration of democracy, that of the Policy 2 index refers to an improvement in democracy.

Table 9 reports the results of 2SLS regressions in which we adopt, as before, the same identification strategy based on the gravity model. As with income, estimates are controlled for historical and geographic variables that may be related to the quality of

institutions. These results unambiguously show that the African Diaspora in developed OECD countries contributes significantly to the improvement of democracy in Africa. This positive and significant effect of the Diaspora is observed whatever the educational level of the emigrants. Moreover, the results are significant at 1% significance level whatever the index of democracy considered. However, the size of the coefficients of estimation indicate that the higher the level of education, the greater the impact of the Diaspora on democracy. These findings confirm those of Docquier et al. (2016) and support the view that improving institutions is one of the channels through which the Diaspora contributes to improving the standard of living in Africa.

Table 9: Impact of the Diaspora on democracy in Africa

VARIABLES	(1) *PR*	(2) *CL*	(3) *P2*	(4) *PR*	(5) *CL*	(6) *P2*	(7) *PR*	(8) *CL*	(9) *P2*	(10) *PR*	(11) *CL*	(12) *P2*
Diaspora	-0.489***	-0.450***	1.327***									
	(0.107)	(0.076)	(0.360)									
Low skills				-0.475***	-0.468***	1.172***						
				(0.099)	(0.074)	(0.307)						
Medium skills							-2.440***	-2.202***	6.201***			
							(0.667)	(0.489)	(2.282)			
High skills										-2.865***	-2.156***	7.958***
										(0.672)	(0.533)	(2.457)
Trade openness	-0.004	-0.005	-0.003	-0.005	-0.005	-0.002	-0.004	-0.004	-0.004	0.000	-0.001	-0.015
	(0.005)	(0.004)	(0.018)	(0.005)	(0.004)	(0.018)	(0.005)	(0.004)	(0.018)	(0.005)	(0.004)	(0.016)
Ln Population	-0.017	-0.167*	-0.261	0.014	-0.148	-0.433	0.015	-0.134	-0.433	0.137	-0.017	-0.704*
	(0.130)	(0.096)	(0.431)	(0.129)	(0.096)	(0.418)	(0.124)	(0.092)	(0.413)	(0.112)	(0.083)	(0.383)
Ln Area	-0.193**	-0.095	0.767**	-0.117	-0.032	0.537*	-0.158*	-0.060	0.654*	-0.268***	-0.118	0.994***
	(0.095)	(0.069)	(0.346)	(0.092)	(0.068)	(0.324)	(0.096)	(0.070)	(0.350)	(0.102)	(0.074)	(0.371)
British colony	-0.980***	-0.886***	2.493***	-0.978***	-0.908***	2.405***	-0.921***	-0.826***	2.289***	-0.333	-0.338*	0.723
	(0.232)	(0.179)	(0.720)	(0.235)	(0.181)	(0.706)	(0.221)	(0.169)	(0.677)	(0.217)	(0.174)	(0.672)
French colony	-0.879***	-1.188***	2.421***	-0.617**	-0.991***	1.535**	-0.867***	-1.159***	2.220**	-0.584**	-0.805***	1.658*
	(0.301)	(0.225)	(0.935)	(0.260)	(0.196)	(0.769)	(0.295)	(0.214)	(0.945)	(0.264)	(0.200)	(0.864)
European settlers 1900	-0.028***	-0.021***	0.121*	-0.028***	-0.021***	0.176***	-0.029***	-0.022***	0.187***	-0.032***	-0.024***	0.159**
	(0.007)	(0.005)	(0.063)	(0.007)	(0.005)	(0.059)	(0.007)	(0.005)	(0.060)	(0.007)	(0.005)	(0.066)
Latitude_(abs)	0.363	1.892	-1.981	-1.451	0.472	2.436	-0.546	0.968	-0.418	0.502	1.036	-3.470
	(1.930)	(1.453)	(6.453)	(1.723)	(1.326)	(5.818)	(1.853)	(1.410)	(6.578)	(1.920)	(1.479)	(6.460)
Landlocked dummy	0.239	-0.017	-1.110*	0.285	0.022	-1.086*	0.249	-0.007	-0.964	0.125	-0.090	-0.712
	(0.196)	(0.133)	(0.614)	(0.196)	(0.133)	(0.617)	(0.197)	(0.135)	(0.618)	(0.200)	(0.137)	(0.613)
Constant	10.296***	10.997***	-15.761**	8.801***	9.898***	-10.012*	9.332***	10.020***	-11.587*	8.616***	8.751***	-11.099*
	(1.997)	(1.461)	(6.973)	(1.807)	(1.323)	(6.046)	(1.807)	(1.309)	(6.456)	(1.652)	(1.210)	(5.968)
Observations	269	269	263	269	269	263	269	269	263	269	269	263
R-squared	0.406	0.479	0.463	0.418	0.487	0.490	0.410	0.497	0.468	0.437	0.523	0.493

Regional Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
K-P F-stat	18.66	18.66	16.66	20.85	20.85	20.94	14.26	14.26	10.90	93.83	93.83	77.63
SY 10% max IV size	16.38	16.38	16.38	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	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. 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. In the panel regressions, the explanatory variables are lagged by one period.

6. Conclusion and policy implications

Emigration from Africa to developed OECD countries has accelerated over the last thirty years with an increasingly high proportion of highly skilled migrants. This dynamic — called brain drain — feeds the African Diaspora and raises several questions, in particular the question of the impact of this Diaspora on economic development in Africa. The discussion remained theoretical for a long time because of the lack of data to conduct empirical studies and the dominant thought foresaw a detrimental effect of the brain drain for developing countries.

This paper uses a bilateral emigration database from African countries to 20 developed OECD countries to study the impact of the African Diaspora on economic development in Africa. It examines both the overall impact and the specific impact of the Diaspora according to the level of education of the emigrants in order to verify the existence of a possible harmful effect for the emigration of people with a high level of education. To address the problem of endogeneity between economic development and emigration, we use two IV approaches. The first is the gravity-based 2SLS approach with external instruments determined from the geographical characteristics of the countries and the second is the GMM approach, which is based on internal instruments.

The results show that the Diaspora contributes positively, significantly and robustly to economic development in Africa and this effect increases with the level of education of emigrants. More in-depth analyzes show that the impact of the Diaspora on the real per capita income goes mainly through the improvement of human capital and especially increase in productivity. Moreover, although the income-improving effect of emigrants with a high level of education is the highest, emigrants with a low level of education contribute more to remittances in Africa.

It is important to note, however, that our approach remains macroeconomic and that, in some cases, brain drain may have adverse effects. Therefore, country specific studies on this issue are promising avenues of research. For example, the question of the externalities of emigration in rural areas or in small towns is an important research issue in development economics. Although our findings do support a significant impact of the high-skilled Diaspora on per capita income, one can imagine more nuanced results in the context of a non-linear model. Indeed, it is likely that beyond a certain threshold of brain drain, this phenomenon becomes harmful for the countries that undergo it. If the positive effect of brain drain predominates in this study, it is probably also because the countries of origin do not offer the

conditions of a better productivity (education, job opportunities, institutional framework, etc.) to this active force of production. Indeed, brain drain is likely to be all the more harmful for the country of origin as it provides the conditions for good productivity and personal fulfillment.

Our results have two major implications. The first is related to the political sense given to the interpretation of these results. Indeed, they should not be interpreted as an incentive for brain drain. By helping to significantly improve the level of income in Africa, the Diaspora reduces the incentive to emigrate because the latter increases when income levels are low in the country of origin. The second area relates to policy measures that could further enhance the impact of the Diaspora on economic development in Africa. Two main virtuous measures could be considered. The first is the institution of the annual African Diaspora Summer School (ADSS) as a vector for the transmission of development drivers (knowledge, technology, experiences in all fields, etc.). The second is the establishment of a Diaspora savings account in banks in developed countries with the aim of alleviating the constraints of financing for development in Africa.

Furthermore, our findings lead to additional implications. Given that medium- and high-skill values of the Diaspora are associated with higher economic development in the sending country, there is need to upskill through the promotion of higher levels of education attainment, including through vocational education. This implies the implementation of both demand and supply policies. Supply-side policies should include increasing teachers' incentives, enhancing the basic quality of schools' physical infrastructure, and researching and implementing teaching methods to increase the learning performance of students who do not do well when left to their own devices. As for side-demand policies, they must include scholarships conditional on attendance, bringing in excluded groups, and developing the accountability of schools and teachers to students, parents, and the broader society to help ensure effective service provider behavior.

Since lower skills are associated with higher inflow of remittances, reducing the cost of remittances transfer should be an important policy target by both sending and receiving economies. Indeed, given the weaknesses of the infrastructure supporting remittances, technological improvements in the banking sector could significantly reduce transaction costs. Furthermore, new banking technologies that can expedite check clearance, reduce exchange losses, and improve disclosure, especially in rural areas in developing countries, can be particularly helpful. New technology would offer potential for greater efficiency, lower costs,

and extended outreach. Innovative financial products such as debit cards and mobile telephony add-on services and pre-paid cards are new additions with huge potential.

Finally, as openness promotes higher economic development, greater trade openness (trade integration) should be encouraged by all stakeholders through the elements of African Development Bank's (AfDB's) "Integrate Africa" High Five priority, elimination of tariff and non-tariff barriers, finance for trade, infrastructural development especially multinational ones, policy harmonization, and product/market diversification.

Appendix

Table A-1: Gravity estimation results of Emigration

Variables	Cross-sectional PPML regression				Panel PPML regression			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	Total	Low	Medium	High	Total	Low	Medium	High
lndistw	-1.66***	-2.02***	-1.63***	-0.94***				
	(0.26)	(0.29)	(0.34)	(0.26)				
lndistw1980					-1.76***	-2.09***	-1.75***	-1.05***
					(0.11)	(0.12)	(0.16)	(0.13)
lndistw1985					-1.73***	-2.06***	-1.70***	-1.01***
					(0.11)	(0.12)	(0.16)	(0.12)
lndistw1990					-1.70***	-2.05***	-1.64***	-0.98***
					(0.11)	(0.12)	(0.16)	(0.12)
lndistw1995					-1.69***	-2.04***	-1.63***	-0.96***
					(0.11)	(0.12)	(0.16)	(0.12)
lndistw2000					-1.68***	-2.03***	-1.61***	-0.95***
					(0.11)	(0.12)	(0.16)	(0.12)
lndistw2005					-1.67***	-2.04***	-1.58***	-0.92***
					(0.11)	(0.12)	(0.16)	(0.12)
lndistw2010					-1.65***	-2.03***	-1.56***	-0.89***
					(0.11)	(0.12)	(0.16)	(0.12)
Ln pop. origin	-0.08	-0.03	-0.30**	0.03	-0.05	-0.01	-0.24***	0.05
	(0.11)	(0.13)	(0.16)	(0.13)	(0.05)	(0.06)	(0.07)	(0.06)
Ln pop. dest.	0.26	0.21	0.32**	0.37***	0.27***	0.22***	0.34***	0.36***
	(0.16)	(0.21)	(0.15)	(0.13)	(0.07)	(0.08)	(0.07)	(0.06)
Ln area origin	-0.43***	-0.55***	-0.26**	-0.38***	-0.46***	-0.56***	-0.31***	-0.40***
	(0.08)	(0.10)	(0.12)	(0.10)	(0.03)	(0.04)	(0.05)	(0.04)
Ln area dest.	0.21	0.10	0.29*	0.27**	0.21***	0.10	0.28***	0.28***
	(0.14)	(0.19)	(0.17)	(0.13)	(0.06)	(0.08)	(0.08)	(0.06)
Sum landlocked	-0.96**	-0.76	-1.16**	-1.09***	-0.93***	-0.74***	-1.12***	-1.08***
	(0.45)	(0.52)	(0.49)	(0.32)	(0.20)	(0.24)	(0.21)	(0.14)
Common off. lang.	1.40***	0.87**	1.39**	1.71***	1.38***	0.85***	1.37***	1.70***
	(0.44)	(0.40)	(0.59)	(0.38)	(0.18)	(0.17)	(0.25)	(0.16)
Colonial ties	1.30***	2.05***	0.72	0.99***	1.33***	2.07***	0.73***	1.01***
	(0.36)	(0.41)	(0.48)	(0.35)	(0.15)	(0.17)	(0.21)	(0.15)
Constant	10.61***	14.16***	7.94***	1.87	10.87***	14.33***	7.90***	1.96**
	(2.21)	(2.49)	(2.51)	(2.07)	(0.92)	(1.00)	(1.19)	(0.96)
Observations	1,000	1,000	1,000	1,000	7,000	7,000	7,000	7,000
R-squared	0.48	0.59	0.29	0.39	0.45	0.56	0.26	0.36

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 Income decomposition estimations – Low and medium skills

	Panel IV regression for low Skills				Panel IV regression for medium Skills			
	lnY/L	$(\rho/(1-\rho))lnK/Y$	*lnH/L*	*lnA*	*lnY/L*	$(\rho/(1-\rho))lnK/Y$	*lnH/L*	*lnA*
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Low skills	0.262***	0.087***	0.113***	0.414***				
	(0.075)	(0.019)	(0.037)	(0.124)				
Medium skills					1.127***	0.207***	0.787***	2.323***
					(0.208)	(0.056)	(0.202)	(0.381)
Trade openness	0.010***	0.002***	0.002**	0.002	0.006**	0.001	0.001	-0.000
	(0.002)	(0.001)	(0.001)	(0.003)	(0.002)	(0.001)	(0.001)	(0.003)
Ln Population	-0.064	0.011	0.004	-0.038	-0.095	-0.002	-0.011	-0.084
	(0.068)	(0.020)	(0.015)	(0.077)	(0.067)	(0.020)	(0.017)	(0.078)
Ln Area	0.064	0.028*	0.001	0.040	0.096**	0.020	0.034**	0.121***
	(0.045)	(0.015)	(0.013)	(0.045)	(0.044)	(0.016)	(0.017)	(0.046)
Constant	-1.996**	-0.565**	-0.628***	-1.214	-1.789**	-0.236	-0.792***	-1.495
	(0.896)	(0.241)	(0.233)	(1.076)	(0.846)	(0.233)	(0.246)	(1.044)
Observations	281	282	228	228	281	282	228	228
R-squared	0.497	0.081	0.413	0.579	0.498	0.093	0.308	0.530
Regional Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
K-P F-stat	23.27	23.65	17.36	17.36	16.86	16.82	11.49	11.49
SY 10% max IV size	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

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 weak identification. 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.

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