Economics Bulletin

Volume 37, Issue 1

Does migration promote industrial development in Africa?

Mawussé K. N. Okey
University of Lomé, Togo

Abstract

This paper examines the effect of international migration on industrial development in Africa. Econometric estimations are implemented on a panel of 45 African countries over the period 1980-2010 using the generalized method of moment estimators and the migration dataset constructed by Brücker, Capuano and Marfouk in 2013. Our results suggest that on average, emigration affects industrial development in Africa positively and significantly during the period of interest. Both low-skilled and medium-skilled emigrants affect more industrial development. The results also reveal that international financial flows, business networks and scientific networks are the channels through which migration affects industrial development. African countries may benefit more from international migration by developing institutions that facilitate international financial flows, business networks and scientific networks.

We want to thank an anonymous referee and the Editor John P. Conley for constructive comments and suggestions. We also thank Avafia K. Kpoblahoun for his excellent proofreading. All remaining errors are our own.
Citation: Mawussé K. N. Okey, (2017) "Does migration promote industrial development in Africa?", *Economics Bulletin*, Volume 37, Issue 1, pages 228-247
Contact: Mawussé K. N. Okey - mawusseo2000@gmail.com.
Submitted: August 08, 2016. **Published:** January 26, 2017.

1. Introduction

A broad strand of literature has revealed that industrialization is one of the most important factors of economic growth (Szirmai, 2012)[1]. It is also widely agreed that industrial development has direct effects on poverty in the form of more well-paid and good quality jobs and higher incomes (Lavopa and Szirmai, 2012; Tregenna, 2008) as well as indirect effects through employment multipliers, technology spillovers and induced demand (Lavopa and Szirmai, 2012). Scarcely has any country grown without industrializing (UNIDO, 2009). In this respect, Morris and Fessehaie (2014) consider that only a massive industrialization effort will enable Africa to eradicate poverty and achieve sustainable development. This study seeks to shed light on factors affecting industrialization in Africa by focusing on the effect of emigration.

Africa has the highest emigration rate (especially emigration rate of the highly educated) compared to other regions of the world (OECD-UNDESA, 2013; Figure 1 in the appendix) but is still the least industrialized of the world's macro-region (Tregenna, 2015; Saha, 1991). More than half of the 30.6 million estimated numbers of African emigrants in 2010 lives overseas (Ratha et al. 2011). In addition to this brain drain problem, some of the major issues concerning industrial development have been the significant bottlenecks in skills development, lack of technological capabilities, innovation and access to technology, access to capital markets, trade barriers and poor infrastructures (Morris and Fessehaie, 2014; Saha, 1991). However, premature deindustrialization, which will not be easy to reverse, is one of the current characteristics of some African countries (Grabowski, 2016). In this context, the knowledge of the effect of emigration on industrialization could help African countries not only to define better migration policies but also to achieve the ninth United Nations Sustainable Development Goal that focuses on infrastructure, sustainable industrialization, and innovation.

Previous studies have suggested a variety of mechanisms through which international migration may influence industrial development in source countries. A common point of departure is the debate between the brain drain view and the brain gain view. Brain drain view advocates posit that out-migration has potentially detrimental impacts on economic growth (Bhagwati and Hamada, 1974; Di Maria and Lazarova, 2012); besides, they consider that the resulted brain drain negatively affects the average level of human capital in the sending country (Stark and Byra, 2012). This view also compares the macroeconomic effects of the resulted remittances to those of Dutch disease problem (Lucas, 2005) which could lead to deindustrialization in the receiving country (Beine et al. 2012). By contrast, the beneficial brain gain literature reveals that through remittances, increased incentives to invest in human capital, facilitation of technology adoption, and trade, migration may benefit source countries (Docquier and Rapoport, 2012). In general, international migration may affect industrial development of source countries through many channels namely (i) remittances and other international financial flows such as foreign direct investment that relief financial constraints (Djajić, 2014; Ratha et al., 2011; Docquier and Lodigiani, 2010; Acosta et al. 2009a), (ii) Business and social networks and bilateral trade flows facilitation between host and source countries that reduce formal and informal trade barriers (Ehrhart et al., 2014), (iii) scientific, knowledge and innovation networks that bridge technology gaps (Agrawal et al., 2006, 2011; Kerr, 2008). However, the impact of migration is ultimately an empirical matter (Özgen et al. 2010).

[1] Szirmai (2012) has summarized empirical and theoretical arguments in favors of industrialization as the main engine of growth in economic development.

In our knowledge, there is surprisingly little systematic empirical evidence regarding the links between industrialization and international migration in the African context, while both phenomena have been central questions of African policymakers for years. Thus, this article aims at examining the effect of emigration on industrialization over the period 1980-2010. It focuses on 45 African countries and uses five years interval data in econometric estimations because of the limited span of the series[2]. We test the hypothesis that emigration affects industrial development in the source country.

We contribute mainly to the literature on the effect of international migration and the determinants of industrialization in three ways: first, contrary to previous studies that focus on host countries, the present study finds evidence of a positive industrializing effect of international migration on source countries. Most of earlier studies have mainly looked at the effect of migration on host countries human resources, innovation and welfare (Aubrya et al., 2016; Ganguli, 2014; Borjas and Doran, 2012; Hunt and Gauthier-Loiselle, 2010) but the effect on the source country is less documented. In addition, some studies explore the effect of emigration on the source country's economic growth and development (Cooray, 2014; Cantore and Calì, 2015), institutions (Docquier et al., 2016) and export performance (Boly et al., 2014) but do not focus on the specific effect on industrialization except Papakonstantinou and Inklaar (2014)[3] and Dzansi (2013). Moreover, emigration is often omitted among the determinants of industrial development in African countries (Gui-Diby and Renard, 2015). Second, the channels through which emigration affects industrial development in source countries are identified. Results in this study show that international financial flows, business networks and scientific networks are the channels through which migration affects industrial development. Only remittances channel is empirically examined by Cooray (2014). Third, the extent to which migrants' education level affects their propensity to contribute to industrial development in the source country has been surprisingly understudied (Özden et al., 2011). In this study, we use data on emigration rates by skill level (high, medium and low) constructed by Brücker, Capuano, and Marfouk in 2013. Results show that low-skilled and medium-skilled migrants have the largest direct and indirect effect on industrial development.

This paper is structured as follow: besides this introductory section, the following section presents the method of empirical analysis and the data; the results and interpretations are given in section 3. In the final section (4), we conclude by summarizing the study.

2. Empirical analysis

2.1 Empirical model

To estimate the effect of emigration on industrial development, our model is based on the works of Gui-Diby and Renard (2015) and Papakonstantinou and Inklaar (2014). It takes the following form:

$$I_{it} = \alpha_0 + \beta_0 I_{it-1} + \beta_1 m_{it} + \beta_2 X_{it} + u_i + \epsilon_{it} \quad (1)$$

Where the variable I_{it} represents the level of industrial development, specifically the added value of the industrial or manufacturing sector as a percentage of GDP; I_{it-1} the (one period) lagged value of the industrial or manufacturing share (one period represents five years, 1980, 1985, 1990, 1995, 2000, 2005 and 2010). m is the indicator of emigration (emigration rate,

[2] This is due to data availability especially the lack of annual data series on migration.
[3] However, their study focuses on knowledge-intensive industries.

Personal remittances, received (% of GDP)). According to our first hypothesis, the coefficient β_1 is expected to be positive (that is $\beta_1 > 0$); migrants are likely more able to transfer, money, information and knowledge, in order to enhance industrial development in the source country. X_{it} is a vector of time-varying explanatory variables such as agricultural added value as a percentage of GDP, GDP per capita, the quality of institutions, education, investment (gross fixed capital formation in percentage of GDP), trade openness (exports and imports), FDI, financial development (money supply as a percentage of GDP, M2) and the technological level. ϵ denotes the error term. u_i is the country fixed effects.

The added value of the agricultural sector as a percentage of GDP (*AGRI*) is included to capture the fact that the expansion (contraction) of a sector corresponds to the contraction (expansion) of other sectors (Gui-Diby and Renard, 2015). The level of household income is labeled as "*gdp_pc*" in the regression tables. In this study, GDP per capita is used as a proxy for the level of income. This variable measures the market size and internal demand. For the quality of institutions and Governance we use *Polity 2* index. Human capital (labeled as "*Education*") is measured by secondary school enrollment (% gross). Domestic Investment (labeled "*invest*") is the gross fixed capital formation as a percentage of GDP. Trade openness is captured by two indicators, exports (*Exports*) and imports (*Imports*) as a percentage of GDP. For FDI we use foreign direct investment net inflows as share of GDP (*FDI*). The role of the financial sector is highlighted through the inclusion of money supply as a percentage of GDP (*M2*). Technological level (*tech*) is measured by the number of scientific and technical journal articles published (from WDI). The ideal is to use citation of articles, patents or R&D expenditures. Unfortunately data series on these variables are not available for our country sample.

In order to identify the channels through which emigration affect industrial development, equation (1) is reformulated to include the interaction term of migration rate and the indicators of the potential channel C_{it} (international financial flows (FDI), business networks (exports) and scientific networks (tech)):

$$I_{it} = \alpha_0 + \beta_0 I_{it-1} + \beta_1 m_{it} + \beta_2 X_{it} + \beta_3 C_{it} + \beta_4 (m_{it} * C_{it}) + u_i + \epsilon_{it}, \quad (2)$$

where $(m_{it} * C_{it})$ is an interaction term of emigration rate of country i at time t and the indicator of a specific channel of country i at time t. Equation (2) allows the testing of the second hypothesis. β_4 reflects the extent to which the variables capturing the specific channel moderate or enhance the effect of emigration rate on industrial development. The relevance of a specific channel is analyzed through the statistical significance of the coefficient β_4.

The relevance of three types of channels is tested in this study. For the channel of international financial flows, indicators used are FDI and remittances. Emigration is seen as a stimulus of international financial flows, especially in the form of (i) private money transfers by diasporas (remittances) to family members (Ratha et al., 2011), (ii) flow of savings repatriated by returned migrants to source countries (Djajić, 2014) and (iii) foreign direct investment (Boly et al. 2013) which allow home countries to finance their industrial development. On one hand, financial flows to source countries may relieve financial and other constraints that the manufacturers face. However, contrasting views suggest that the flow of remittances can cause the real exchange rate depreciation in the receiving country which affects negatively the development of the tradable manufacturing sector (Acosta et al., 2009a; Beine et al., 2012).

It was shown that through business networks, diasporas can have a substantial impact on trade flows, by alleviating not only informal trade barriers (information costs and cultural barriers) but also formal trade barriers (transportation costs and tariffs) (Ehrhart et al. 2014). Exports are used for the channel of business networks while publication of scientific and technical papers is the indicator used for the channel of scientific networks. Scientific networks formed by migrants ensure and foster diffusion of knowledge and ideas between the home and host countries (Papakonstantinou and Inklaar, 2014). However, in one hand, returned migrants return as consultants to teach and do research (Shaw, 2007) as well as contribute to the provision of complementary skills such as management and entrepreneurship. On the other hand, with the rapid expansion of information and communication technology (ICT), migrants no longer need to return home in order to influence technologies in their homelands (Douglas, 2015). Finally, special emphasis is put on remittances as another variable to test the channel of international financial flows. This allows us testing our third hypothesis according to which the effect of emigration on industrial development is conditioned by the educational level of migrants.

2.2 Data description

Panel data over the period 1980-2010 with observations corresponding to five-year intervals are used. Data on industrial development are from World Development Indicators (WDI). Two indicators of industrial development are used in the empirical analysis that follows. One is the industrial added value as a percentage of GDP from WDI. The other is the manufacturing added value as a percentage of GDP. The main independent variable of interest is measures of openness to emigration especially emigration rate m, available for origin country $i = 1; \ldots; N$ and year $t = 1; \ldots; T$. In our regressions, the emigration rate is calculated as the sum of emigrants from country i to destination countries j at time t, $\sum_j M_{ijt}$, divided by the native population of the source country i, $N_{i,t}$ (Docquier et al. 2016). That is $\frac{\sum_j M_{ijt}}{N_{i,t}}$. Data on total emigration rate and emigration rates by educational level are from Brücker et al. (2013). This includes data for the emigration rate of men and women over 25, by educational levels namely high, middle and low. Emigrants with upper-secondary education are classified as medium, those with post-secondary education as high and those with less than upper-secondary education (including no schooling, primary and lower-secondary) as low. Remittances are also used as an indicator of emigration. Other control variables are from the WDI.

The definitions and sources of all the variables are presented in Table A1 and the descriptive statistics (means and standard deviations) of the variables are reported in Table A3 in the Appendix. To have an idea of the relationship between migration and industrial development indicators, the correlation matrix is provided in Table A4 in the Appendix. Considering this table, industrial added value is correlated positively with total migration rate and low-skilled migration and negatively with high-skilled and medium-skilled migration, and remittances. Manufacture added value is correlated positively with all the migration indicators (*total, high, medium, low and remittances*).

2.3 Estimation method

The explanatory variables on emigration rate are potentially endogenous and measured with error, and estimation of the emigration effect by the Ordinary Least Squares estimator (OLS) is biased. We use the System GMM estimator (Arellano and Bover, 1995; Blundell and Bond, 1998) that is supposed to solve this problem and take into account the dynamic aspect of the model. In all the estimations, equations in levels and equations in first differences are

combined in a system and estimated with an extended System-GMM estimator; therefore lagged differences and lagged levels of the explanatory variables are used as instruments. In order to check the validity of the instruments, two specification tests are carried out. The first is the Sargan/Hansen test of over-identifying restrictions. The second examines the hypothesis that there is no second-order serial correlation in the first-differenced residuals. To avoid the problem of instrument proliferation (Roodman, 2009), the matrix of instruments is collapsed and the number of lags is set at a level which ensures that the number of instruments is lower than the number of cross sections.

3. Results and discussions

3.1 Baseline results

The results of the estimated equation 1 (direct effect of emigration rate and remittances on industrial added value and manufacturing added value) are reported in Table 1 and 2. Table 3 and 4 contain the estimation results of equation 2. Table 5 and 6 report the results of the analysis of the migrant skill categories that influence more industrial development through remittances. Our instruments are valid with regard to the results of AR and Hansen tests. Our econometric estimates indicate that the coefficients on the lagged dependent variables are positive and statistically significant. These results support the choice of the dynamic GMM approach used.

Table 1 reports the results of the direct effect of emigration rate and remittances on industrial added value in the 45 selected African countries. Each of emigration variables has a positive and statistically significant effect on industrial development. A 1% increase in the total emigration rate, for example, leads to an increase in industrial added value by 0.437% in column 1.1. These results are consistent with those of Papakonstantinou and Inklaar (2014) who find that countries with higher emigration rates realize faster growth in knowledge-intensive manufacturing industries. Similarly, remittances have a positive and significant effect on industrial development. In column 1.5, a 1% increase in remittances leads to a 0.29% increase in industrial added value. This result is consistent with those of Dzansi (2013) but is not consistent with the Dutch Disease view according to which the flow of remittances, by causing the real exchange rate depreciation in receiving country, could affect negatively the development of the tradable manufacturing sector (Acosta et al., 2009a; Beine et al., 2012).

When we desegregate emigration rate by educational levels of migrants, high-skilled emigration rate (column 1.2), medium-skilled emigration rate (column 1.3) and low-skilled emigration rate (column 1.4), all have the expected positive sign with statistically significant estimated coefficients of 0.413, 0.433 and 0.546, respectively. This result then suggests that all of the categories of emigrants promote directly industrial development in the source countries. However, the unskilled category has the larger effect. Coray (2014) explains similar result by the fact that low-skilled migrant is the largest migratory category in number in South Asia. The mean value of low-skilled emigration rate (*low*) for our sample is 1.69, lower than the mean value of *medium* (2.67) and *high* (17.03) (Table A3 in the appendix). Thus, contrary to the explanation of Coray (2014), we explain this larger effect of *low* by the fact that low-skilled migrants have relatively more connection with their countries of origin and tend to be largely temporary compared to other categories of migrants. This is because they have their families there and often plan to return. In this context, they are more motivated to encourage the (industrial) development of their countries of origin.

Table 1 Results of regressions of model 1– Dependent variable: *va_indus*

	1.1	1.2	1.3	1.4	1.5
L.va_indus	0.262	0.233	0.179	0.202	0.374
	(2.68)***	(2.31)**	(1.91)*	(2.02)**	(5.29)***
total	**0.437**				
	(1.96)**				
high		**0.413**			
		(2.05)**			
medium			**0.433**		
			(2.61)***		
low				**0.546**	
				(2.13)**	
remittances					**0.292**
					(3.11)***
va_agri	-0.380	-0.465	-0.257	-0.284	-0.254
	(2.45)**	(3.89)***	(1.99)**	(1.86)*	(3.11)***
gdp_pc	-6.054	-5.579	-2.669	-2.935	-1.425
	(2.28)**	(2.37)**	(1.38)	(1.54)	(0.81)
polity2	-0.894	-0.760	-0.880	-0.954	-0.492
	(3.00)***	(2.77)***	(3.95)***	(3.58)***	(2.31)**
education	0.213	0.166	0.137	0.094	0.061
	(2.28)**	(2.08)**	(1.18)	(0.89)	(0.94)
invest	0.370	0.374	0.480	0.347	0.202
	(3.00)***	(1.53)	(3.63)***	(1.80)*	(1.85)*
m2	-0.359	-0.402	-0.409	-0.391	-0.172
	(4.42)***	(4.57)***	(4.39)***	(3.61)***	(2.70)***
fdi	0.169	0.419	0.236	0.641	0.531
	(0.94)	(0.58)	(0.45)	(0.87)	(2.28)**
exports	0.580	0.572	0.768	0.682	0.436
	(4.14)***	(3.84)***	(5.28)***	(4.69)***	(4.09)***
imports	-0.194	-0.238	-0.300	-0.223	-0.235
	(1.47)	(1.40)	(2.67)***	(1.82)*	(2.63)***
tech	0.007	0.009	0.008	0.009	0.003
	(3.05)***	(3.93)***	(2.72)***	(3.10)***	(2.46)**
_cons	53.596	50.528	30.699	34.648	25.486
	(2.89)***	(3.86)***	(2.35)**	(2.18)**	(2.37)**
Observations	265	265	265	265	265
Countries	45	45	45	45	45
Instruments	37	35	36	36	34
AR(1) (p-value)	0.023	0.035	0.026	0.045	0.003
AR(2) (p-value)	0.808	0.581	0.675	0.700	0.960
Hansen (p-value)	0.143	0.227	0.603	0.335	0.732

Note The estimation method is two-step system GMM. *L.va_indus* is the lagged dependent variable. Robust and absolute z-statistics in parentheses. The null hypothesis of the AR tests is that the errors exhibit no second order serial correlation.*** ** and * denote significance at the 1% 5% and 10% levels respectively.

Table 2 Results of regressions of model 1– Dependent variable: *va_manufac*

	2.1	2.2	2.3	2.4	2.5
L.va_manufac	0.572	0.829	0.873	0.904	0.799
	(2.15)**	(4.74)***	(4.33)***	(5.07)***	(6.70)***
total	**0.990**				
	(2.47)**				
high		**0.161**			
		(1.97)**			
medium			**0.473**		
			(2.41)**		
low				**0.631**	
				(2.04)**	
remittances					**0.073**
					(1.99)**
va_agri	-0.211	-0.164	-0.110	-0.087	-0.007
	(2.02)**	(2.13)**	(1.22)	(1.08)	(0.17)
gdp_pc	3.035	1.855	1.587	2.417	1.371
	(1.68)*	(1.10)	(1.05)	(1.76)*	(1.90)*
polity2	-1.442	-0.632	-0.592	-0.522	-0.383
	(4.49)***	(2.64)***	(2.64)***	(2.40)**	(2.95)***
education	0.129	0.091	0.150	0.073	0.024
	(1.42)	(1.44)	(1.74)*	(1.13)	(0.96)
invest	-0.456	-0.096	-0.191	-0.258	-0.136
	(3.09)***	(0.83)	(1.78)*	(2.34)**	(2.27)**
m2	-0.467	-0.370	-0.402	-0.379	-0.040
	(4.53)***	(3.91)***	(3.40)***	(3.22)***	(1.07)
fdi	1.492	0.690	0.702	0.862	0.387
	(2.12)**	(1.53)	(1.70)*	(2.91)***	(2.77)***
exports	-0.222	-0.145	-0.141	-0.145	-0.063
	(2.60)***	(2.06)**	(2.17)**	(2.62)***	(1.74)*
imports	0.183	0.089	0.115	0.118	0.023
	(3.41)***	(2.09)**	(2.63)***	(3.18)***	(0.92)
tech	0.007	0.005	0.004	0.005	0.000
	(2.69)***	(2.20)**	(1.90)*	(2.31)**	(0.26)
_cons	2.593	0.709	2.111	-1.470	-3.694
	(0.23)	(0.07)	(0.23)	(0.16)	(0.62)
Observations	270	270	270	270	270
Countries	45	45	45	45	45
Instruments	29	37	37	37	29
AR(1) (p-value)	0.059	0.029	0.020	0.018	0.011
AR(2) (p-value)	0.814	0.749	0.898	0.594	0.261
Hansen (p-value)	0.445	0.206	0.474	0.440	0.937

Note The estimation method is two-step system GMM. *L.va_manufac* is the lagged dependent variable. Robust and absolute z-statistics in parentheses. The null hypothesis of the AR tests is that the errors exhibit no second order serial correlation.*** ** and * denote significance at the 1% 5% and 10% levels respectively.

In Table 1, the results show that the coefficient on *FDI* is statistically non-significant except in column 1.5. This result is similar to those of Gui-Diby and Renard (2015) who find that FDI did not have a significant impact on the industrialization of African countries during the period of 1980–2009. *Education*, *invest*, *exports*, and *tech* have a positive and statistically significant effect on industrial development as expected. By contrast, *polity2*, *gdp_pc*, *m2* and imports have a negative and statistically significant effect. The coefficient of *va_agri* has a negative sign as expected. Institutions (democracy indicator *Polity2*) exert a negative influence on industrial development. This result is not in line with Guillaumont Jeanneney and Hua (2015) but it is consistent with Guadagno (2015) as well as Beji and Belhadj (2016) who also surprisingly find a negative effect of governance on industrialization in their panel

of 35 African countries over the period 1970-2012. This result may be explained by the average low level of governance indicators in African countries. The mean of polity2 indicators of the sample countries is -1.51 (Table A3 in the appendix). The negative coefficient of the financial development variable *m2* may be explained by the low level of financial development in most of African countries.

We replicate the estimations using manufacturing added value as the dependent variable and report the results in Table 2. All the estimated emigration variables have a positive coefficient as expected. Of these, all of them are statistically significant. The low skilled emigration rate has the larger significant effect on manufacturing added value. This result demonstrates that total emigration and all its components promote manufacturing development in Africa (column 2.1 to 2.3). These results confirm those found using Industrial added value as the dependent variable (Table 1) and are not in line with Papakonstantinou and Inklaar (2014) who find that high- and medium-skilled migrants drive the growth in human-capital-intensive industries. Remittances flows have a positive direct effect on the manufacture sector development in the source country. A 1% increase in remittances leads to an increase in manufacturing added value by 0.07% (column 2.5).

3.2 Channels of impact

One of the research questions is: what are the channels through which emigration affects industrial development in source countries? In this study, the relevance of three types of channels is tested. To achieve this, total emigration rate is interacted with selected variables. Three interaction variables are created and the results are reported in Table 3 and Table 4. Table 3 reports the results with industrial added value as the dependent variable. All the estimated coefficients of the three interacted variables are positive and statistically significant at 5% level. In column 3.1, the interaction variable between emigration rate and FDI (*TotalXFdi*) has a positive and statistically significant coefficient (0.141). This demonstrated that international financial flows (reflected here by FDI) reinforce the effect of emigration on industrial development. In other words, the more the country is open to emigration, the more it receives international financial flows to finance industrial development.

The channel of business network is also significant. The coefficient of the interaction term between emigration rate and exports (0.05) is positive and statistically significant (column 3.2). The more the country is open to emigration, the more it develops the international trade that boosts domestic industrial development. A broad strand of literature has emphasized the importance of trade to promote industrial development. For example, import of machines from industrialized countries could lead to gain access to technical know-how (Guadagno, 2015; Squicciarini and Voigtländer, 2015). Moreover, migration could foster international trade (Ehrhart et al., 2014) through migrant networks that offset the institutional weakness of source countries (Docquier et al., 2016) and facilitate access to information within trade partners. In this context, the presence of migrant networks could compensate for the lack of good institutions. Also, migration may facilitate access to information given that migrant networks could promote bilateral trade by providing information on market risks or business opportunities and by connecting economic agents. This information channel is facilitated by migrants' knowledge of the language, the functioning of institutions and legal framework of both their host and home country (Ehrhart et al., 2014).

Table 3 Results of regressions of model 2– Dependent variable: *va_indus*

	3.1	3.2	3.3
L.va_indus	0.912	0.793	0.393
	(5.64)***	(5.52)***	(3.08)***
TotalXFdi	**0.141**		
	(2.31)**		
TotalXexports		**0.054**	
		(2.18)**	
TotalXTech			**0.004**
			(1.96)*
total	-0.280	-1.068	0.419
	(0.95)	(1.67)*	(2.30)**
va_agri	-0.254	-0.312	-0.304
	(1.76)*	(2.79)***	(1.92)*
gdp_pc	4.351	1.898	-8.788
	(0.77)	(0.42)	(2.80)***
polity2	-0.328	-0.385	-0.325
	(1.94)*	(1.59)	(1.93)*
education	0.045	0.022	0.154
	(0.35)	(0.18)	(1.40)
invest	0.326	0.350	0.376
	(1.78)*	(2.87)***	(3.05)***
m2	-0.925	-0.767	-0.333
	(3.72)***	(3.78)***	(3.88)***
fdi	-0.409	-0.081	-0.036
	(1.89)*	(0.37)	(0.26)
exports	-0.006	-0.066	0.674
	(0.05)	(0.53)	(4.58)***
imports	0.183	0.104	-0.182
	(1.51)	(1.32)	(1.48)
tech	0.013	0.012	0.005
	(1.30)	(1.52)	(1.26)
_cons	-5.958	12.607	63.454
	(0.18)	(0.49)	(3.69)***
Observations	270	270	265
Countries	45	46	46
Instruments	33	33	37
AR(1) (p-value)	0.051	0.046	0.008
AR(2) (p-value)	0.639	0.901	0.466
Hansen (p-value)	0.452	0.507	0.072

Note The estimation method is two-step system GMM. *L.va_indus* is the lagged dependent variable. Robust and absolute z-statistics in parentheses. The null hypothesis of the AR tests is that the errors exhibit no second order serial correlation.*** ** and * denote significance at the 1% 5% and 10% levels respectively.

Table 4 Results of regressions of model 2– Dependent variable *va_manufac*

	4.1	4.2	4.3
L.va_manufac	0.433	0.485	0.760
	(2.20)**	(2.19)**	(3.07)***
TotalXFdi	**0.109**		
	(2.10)**		
TotalXexports		**0.039**	
		(2.00)**	
TotalXTech			**0.018**
			(1.73)*
total	-0.221	-0.827	0.198
	(0.38)	(1.16)	(0.42)
va_agri	-0.305	-0.523	-0.382
	(1.44)	(2.17)**	(2.26)**
gdp_pc	6.490	5.305	1.331
	(1.98)**	(1.92)*	(0.38)
polity2	-0.753	-0.564	-1.286
	(1.43)	(1.02)	(2.34)**
education	0.068	0.009	0.460
	(0.80)	(0.08)	(2.61)***
invest	-1.317	-0.672	0.088
	(3.85)***	(1.53)	(0.28)
m2	-0.090	-0.322	-0.766
	(0.86)	(2.13)**	(2.68)***
fdi	-0.213	0.092	-0.887
	(0.42)	(0.10)	(1.00)
exports	-0.890	-0.943	-0.522
	(3.62)***	(3.18)***	(2.28)**
imports	0.708	0.487	0.270
	(2.67)***	(2.24)**	(1.60)
tech	0.003	0.009	-0.033
	(0.55)	(0.97)	(1.48)
_cons	-1.407	14.624	18.798
	(0.06)	(0.83)	(0.88)
Observations	270	270	265
Countries	45	45	45
Instruments	21	32	31
AR(1) (p-value)	0.051	0.014	0.043
AR(2) (p-value)	0.428	0.434	0.184
Hansen (p-value)	0.386	0.371	0.604

Note The estimation method is two-step system GMM. *L.va_manufac* is the lagged dependent variable. Robust and absolute z-statistics in parentheses. The null hypothesis of the AR tests is that the errors exhibit no second order serial correlation.*** ** and * denote significance at the 1% 5% and 10% levels respectively.

Finally, the third channel is statistically significant. The coefficient of the interaction term between emigration rate and skill (*TotalXTech*) is positive and significant; this suggests that the more the country is open to emigration, the more it realizes technology transfer necessary to industrial development. These results confirm our second hypothesis that emigration affects industrial development through, international financial flows, business networks and scientific networks. Table 4 reports the results of the regression of model 2 using manufactured added value as the dependent variable. Here again, all the estimated coefficient of interacted variables are positive and statistically significant. This result suggests that the channels through which emigration promotes manufacturing development are international financial flows, business networks and scientific networks and thus confirms the above result using industrial added value as the dependent variable**.**

3.3 Special emphasis on remittances

Apart from FDI, we consider remittances as another variable to test the channel of international financial flows. Table 5 and Table 6 report the results. Interacted variable between remittances and total emigration rate is positive and statistically significant (column 5.1) confirming the relevance and the significance of the channel of international financial flows. Moreover, we extend the analysis to check the migrant skill (or education) category that influences more industrial development through remittances. We test whether the effect of remittances on industrial development depends on the skill level of emigrants. To achieve this we create three interaction variables between remittances and disaggregated emigration rates (high skilled, medium skilled and low skilled). All the interacted variables are statistically significant except the interaction variable between remittances and high emigration rate. The magnitude of interaction between remittances and low emigration rate exhibits the highest coefficient, 0.026 (column 5.4). Remittances from low-skilled migrants have the most beneficial effect on industrial development. Table 6 reports the results using manufacturing added value as the dependent variable. The results here confirm the significance of the medium and low skilled migrants' components.

Table 5 Results of regressions of model 2– Dependent variable *va_indus* Interaction between migration rate and remittances

	5.1	5.2	5.3	5.4
L.va_indus	0.389	0.377	0.404	0.423
	(3.94)***	(4.95)***	(3.02)***	(3.32)***
total	-0.045			
	(0.16)			
TotalXRemit	**0.026**			
	(2.09)**			
high		0.022		
		(0.44)		
highXRemit		**0.010**		
		(2.04)**		
medium			-0.039	
			(0.24)	
mediumXRemit			**0.020**	
			(2.67)***	
low				-0.015
				(0.07)
lowXRemit				**0.026**
				(2.71)***
remittances	**0.369**	**0.191**	**0.281**	**0.289**
	(2.85)***	**(1.96)****	**(2.67)*****	**(3.35)*****
va_agri	-0.188	-0.198	-0.187	-0.191
	(2.53)**	(2.14)**	(1.83)*	(2.33)**
gdp_pc	-1.985	-0.857	-0.954	-1.599
	(0.75)	(0.49)	(0.32)	(0.79)
polity2	-0.313	-0.343	-0.476	-0.410
	(3.50)***	(4.42)***	(3.10)***	(3.08)***
education	0.044	0.038	0.070	0.064
	(0.64)	(0.71)	(0.92)	(0.98)
invest	0.139	0.103	0.105	0.144
	(0.88)	(0.64)	(0.82)	(0.96)
m2	-0.182	-0.182	-0.212	-0.190
	(1.93)*	(2.45)**	(2.33)**	(2.62)***
fdi	0.644	0.639	0.601	0.538
	(1.71)*	(2.91)***	(2.43)**	(2.10)**
exports	0.471	0.422	0.396	0.417
	(4.72)***	(5.03)***	(4.80)***	(5.40)***
imports	-0.279	-0.243	-0.212	-0.240
	(2.48)**	(2.87)***	(3.33)***	(3.35)***
tech	0.005	0.004	0.005	0.004
	(2.52)**	(1.71)*	(2.00)**	(2.35)**
_cons	28.819	23.155	22.448	25.869
	(2.20)**	(2.26)**	(1.41)	(2.44)**
Observations	270	270	270	270
Countries	45	45	45	45
Instruments	32	39	38	38
AR(1) (p-value)	0.003	0.002	0.006	0.004
AR(2) (p-value)	0.837	0.947	0.937	0.835
Hansen (p-value)	0.826	0.694	0.529	0.766

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

Note The estimation method is two-step system GMM. *L.va_indus* is the lagged dependent variable. Robust and absolute z-statistics in parentheses. The null hypothesis of the AR tests is that the errors exhibit no second order serial correlation.*** ** and * denote significance at the 1% 5% and 10% levels respectively.

Table 6 Results of regressions of model 2– Dependent variable *va_manufac* interaction between emigration rate and remittances

	6.1	6.2	6.3	6.4
L.va_manufac	0.693	0.795	0.716	0.684
	(6.71)***	(4.93)***	(5.27)***	(6.84)***
total	0.065			
	(0.33)			
TotalXRemit	**0.010**			
	(2.09)**			
high		0.163		
		(2.03)**		
highXRemit		-0.005		
		(1.26)		
medium			0.020	
			(0.18)	
mediumXRemit			**0.008**	
			(2.03)**	
low				0.060
				(0.28)
lowXRemit				**0.011**
				(2.03)**
remittances	**0.066**	0.097	0.087	**0.063**
	(1.69)*	(0.81)	(0.75)	**(1.66)***
va_agri	-0.084	-0.177	-0.089	-0.085
	(2.49)**	(2.07)**	(2.15)**	(2.47)**
gdp_pc	-0.084	1.249	0.049	-0.052
	(0.15)	(0.79)	(0.07)	(0.09)
polity2	-0.193	-0.681	-0.189	-0.198
	(2.96)***	(3.24)***	(1.72)*	(3.08)***
education	0.046	0.129	0.032	0.048
	(1.74)*	(1.80)*	(1.21)	(1.74)*
invest	-0.059	-0.023	-0.071	-0.058
	(1.27)	(0.19)	(0.93)	(1.21)
m2	-0.090	-0.292	-0.075	-0.091
	(2.05)**	(2.48)**	(1.97)**	(2.01)**
fdi	0.086	-0.095	0.228	0.080
	(0.81)	(0.58)	(0.87)	(0.75)
exports	-0.052	-0.133	-0.039	-0.054
	(1.69)*	(1.77)*	(0.64)	(1.70)*
imports	0.019	0.090	-0.019	0.022
	(0.52)	(1.14)	(0.21)	(0.61)
tech	0.001	0.002	0.001	0.001
	(1.69)*	(1.24)	(1.23)	(1.66)*
_cons	8.470	1.919	8.652	8.344
	(1.85)*	(0.18)	(1.47)	(1.85)*
Observations	270	270	270	270
Countries	45	45	45	45
Instruments	39	40	39	39
AR(1) (p-value)	0.023	0.006	0.021	0.023
AR(2) (p-value)	0.790	0.323	0.684	0.758
Hansen (p-value)	0.568	0.216	0.138	0.579

Note The estimation method is two-step system GMM. *L.va_manufac* is the lagged dependent variable. Robust and absolute z-statistics in parentheses. The null hypothesis of the AR tests is that the errors exhibit no second order serial correlation.*** ** and * denote significance at the 1% 5% and 10% levels respectively.

3.4 Robustness tests

Use of external instruments

In this study, we primary opt for internal instruments. However, one may suggest the use of external instruments that are susceptible to reduce the bias of weak instruments. For robustness check, we use an external instrument especially, weighted GDP per capita of the five main migrant host countries (weighted by migrant stocks) (Aggarwal et al., 2011). To obtain the data series of this external instrument, we refer to Acosta et al. (2009b). The weights are from Aggarwal et al. (2011) and Bilateral Remittances Matrices from World Development Indicators (WDI). The data of some African countries such as Algeria, Angola, Burundi, Central African Rep., Comoros, Congo Dem. Rep. Djibouti, Guinea, Zambia, and

Zimbabwe does not appear in the paper of Aggarwal et al. (2011) but they are available in Bilateral Remittances Matrices from WDI[4]. The results using external instruments are reported in Table 7 and are not different from those with exclusively internal instruments.

Lagged effects of migration

Potential lagged effects of migration on industrial development are checked. In order to (i) rule out reverse causality issues and (ii) take into account the potential lagged effects of migration on more long term outcomes such as industrial and manufacturing, we use lagged value of explanatory variables (especially migration indicators, *L.total, L.high, L.medium, L.low* and *L.remittances)*, instead of their contemporaneous values in the estimations. The results are reported in Table 8 and show that lagged values of migration indicators are positive and statistically significant. International migration has, therefore, both positive short term and long term effects on industrial development in Africa.

Table 7 Results of regressions of model 1 with external instruments

Dependent variable	*va_indus*					*va_manufac*				
	8.1	8.2	8.3	8.4	8.5	8.6	8.7	8.8	8.9	8.10
L.va_indus	0.274	0.270	0.180	0.212	0.378					
	(2.68)***	(2.21)**	(1.79)*	(2.09)**	(5.45)***					
L.va_manufac						0.579	0.837	0.892	0.906	0.798
						(2.66)***	(5.68)***	(5.11)***	(5.49)***	(7.37)***
total	0.433					0.909				
	(1.98)**					(1.97)**				
high		0.120					0.134			
		(2.54)**					(1.75)*			
medium			0.447					0.439		
			(2.70)***					(2.10)**		
low				0.538					0.581	
				(2.19)**					(1.98)**	
remittances					0.273					0.073
					(2.69)***					(2.02)**
va_agri	-0.389	-0.389	-0.269	-0.292	-0.266	-0.354	-0.143	-0.094	-0.081	-0.007
	(2.55)**	(3.65)***	(2.27)**	(1.90)*	(2.96)***	(3.20)***	(2.15)**	(1.23)	(1.10)	(0.17)
gdp_pc	-6.705	-6.158	-3.083	-3.131	-1.465	3.474	1.423	1.287	2.193	1.370
	(2.28)**	(2.71)***	(1.75)*	(1.61)	(0.83)	(1.63)	(0.96)	(0.94)	(1.69)*	(1.98)**
polity2	-0.905	-0.860	-0.968	-1.037	-0.485	-1.297	-0.566	-0.552	-0.501	-0.382
	(3.05)***	(3.23)***	(5.13)***	(4.18)***	(2.60)***	(3.79)***	(2.21)**	(2.55)**	(2.39)**	(2.88)***
education	0.224	0.191	0.143	0.106	0.057	0.156	0.076	0.128	0.064	0.024
	(2.54)**	(1.95)*	(1.37)	(1.07)	(1.04)	(1.88)*	(1.53)	(1.55)	(1.05)	(0.99)
invest	0.362	0.291	0.407	0.306	0.202	-0.474	-0.116	-0.197	-0.254	-0.136
	(3.03)***	(1.30)	(2.73)***	(1.79)*	(1.94)*	(2.72)***	(1.05)	(1.91)*	(2.39)**	(2.32)**
m2	-0.333	-0.316	-0.360	-0.361	-0.170	-0.455	-0.292	-0.338	-0.342	-0.040
	(3.62)***	(1.98)**	(3.94)***	(3.38)***	(2.44)**	(4.37)***	(3.05)***	(2.72)***	(2.80)***	(1.09)
fdi	0.193	0.631	0.418	0.714	0.514	0.828	0.615	0.659	0.827	0.387
	(1.14)	(0.95)	(0.85)	(1.04)	(2.30)**	(1.20)	(1.31)	(1.64)	(2.77)***	(2.71)***
exports	0.578	0.577	0.750	0.653	0.422	-0.548	-0.133	-0.136	-0.139	-0.063
	(4.02)***	(2.93)***	(5.89)***	(4.31)***	(3.56)***	(3.06)***	(2.23)**	(2.47)**	(2.70)***	(1.75)*
imports	-0.203	-0.215	-0.284	-0.215	-0.225	0.320	0.082	0.105	0.110	0.023
	(1.49)	(0.97)	(2.48)**	(1.68)*	(2.46)**	(2.33)**	(2.37)**	(2.83)***	(3.17)***	(0.93)
tech	0.007	0.008	0.008	0.009	0.003	0.004	0.004	0.004	0.005	0.0002
	(2.94)***	(3.06)***	(2.89)***	(3.34)***	(2.22)**	(1.82)*	(2.03)**	(1.88)*	(2.13)**	(0.25)
_cons	56.950	53.225	32.253	35.427	26.214	8.852	1.808	2.439	-0.933	-3.680
	(2.91)***	(4.37)***	(2.50)**	(2.12)**	(2.37)**	(0.77)	(0.20)	(0.28)	(0.11)	(0.63)
Observations	265	265	265	265	265	270	270	270	270	270
Countries	45	45	45	45	45	45	45	45	45	45
Instruments	38	36	37	37	35	28	38	38	38	29
AR(1) (p-value)	0.020	0.042	0.022	0.038	0.003	0.036	0.027	0.016	0.017	0.011
AR(2) (p-value)	0.863	0.844	0.704	0.685	0.928	0.971	0.620	0.741	0.507	0.262
Hansen (p-value)	0.157	0.133	0.520	0.320	0.790	0.333	0.167	0.439	0.456	0.958

Note The estimation method is two-step system GMM. *L.va_indus* and *L.va_manufac* are the lagged dependent variables. Robust and absolute z-statistics in parentheses. The null hypothesis of the AR tests is that the errors exhibit no second order serial correlation.*** ** and * denote significance at the 1% 5% and 10% levels respectively. The external instrument is weighted GDP per capita of the five main migrant host countries (weighted by migrant stocks).

[4] http://www.worldbank.org/en/topic/migrationremittancesdiasporaissues/brief/migration-remittances-data

Table 8 . Results of regressions of model 1 : Lagged effects of migration on industry and manufacture

Dependent variable	*va_indus*					*va_manufac*				
	7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8	7.9	9.10
L.va_indus	0.241	0.200	0.173	0.187	0.380					
	(2.59)***	(1.71)*	(1.95)*	(2.14)**	(5.43)***					
L.va_manufac						0.600	0.833	0.869	0.886	0.784
						(2.03)**	(4.95)***	(4.25)***	(4.85)***	(5.99)***
L.total	0.560					0.976				
	(2.38)**					(1.99)**				
L.high		0.133					0.135			
		(2.27)**					(1.84)*			
L.medium			0.429					0.460		
			(2.56)**					(2.00)**		
L.low				0.633					0.488	
				(2.64)***					(2.02)**	
L.remittances					0.171					0.095
					(2.28)**					(2.25)**
va_agri	-0.383	-0.434	-0.252	-0.299	-0.257	-0.200	-0.137	-0.105	-0.096	0.002
	(2.62)***	(3.43)***	(1.85)*	(1.95)*	(3.31)***	(1.90)*	(1.79)*	(1.14)	(1.25)	(0.05)
gdp_pc	-5.534	-4.296	-2.558	-2.612	-1.242	2.609	1.615	1.505	2.228	1.370
	(2.11)**	(2.38)**	(1.18)	(1.38)	(0.76)	(1.09)	(1.11)	(0.98)	(1.56)	(1.72)*
polity2	-0.956	-0.894	-0.919	-0.984	-0.522	-1.529	-0.599	-0.575	-0.513	-0.345
	(3.28)***	(2.96)***	(3.69)***	(3.26)***	(3.20)***	(3.68)***	(3.17)***	(2.36)**	(2.51)**	(3.00)***
education	0.214	0.195	0.142	0.097	0.052	0.159	0.099	0.155	0.058	0.015
	(2.23)**	(2.04)**	(1.30)	(0.88)	(0.94)	(1.75)*	(1.63)	(1.80)*	(0.97)	(0.55)
invest	0.376	0.229	0.468	0.340	0.193	-0.437	-0.133	-0.198	-0.239	-0.126
	(3.04)***	(0.94)	(3.87)***	(1.68)*	(2.55)**	(2.67)***	(1.20)	(1.82)*	(2.11)**	(2.22)**
m2	-0.384	-0.440	-0.399	-0.404	-0.176	-0.460	-0.348	-0.403	-0.361	-0.035
	(4.52)***	(3.90)***	(4.37)***	(3.77)***	(2.13)**	(2.92)***	(3.74)***	(3.55)***	(3.27)***	(0.87)
fdi	0.150	0.735	0.263	0.590	0.562	1.344	0.704	0.738	0.830	0.274
	(0.83)	(1.02)	(0.58)	(0.78)	(2.31)**	(1.70)*	(1.83)*	(1.77)*	(2.47)**	(2.04)**
exports	0.604	0.500	0.777	0.694	0.382	-0.217	-0.128	-0.142	-0.144	-0.048
	(4.25)***	(3.00)***	(5.44)***	(4.44)***	(3.65)***	(2.02)**	(2.06)**	(2.25)**	(2.46)**	(1.32)
imports	-0.203	-0.126	-0.299	-0.236	-0.179	0.191	0.083	0.112	0.115	0.014
	(1.43)	(0.68)	(2.79)***	(1.90)*	(2.32)**	(2.77)***	(2.24)**	(2.63)***	(2.98)***	(0.58)
tech	0.007	0.009	0.008	0.009	0.004	0.006	0.004	0.004	0.005	0.001
	(3.11)***	(3.30)***	(2.49)**	(2.82)***	(2.39)**	(2.05)**	(2.14)**	(1.90)*	(2.23)**	(0.65)
_cons	50.882	47.868	29.614	34.106	24.30	2.767	1.516	2.712	-0.090	-4.011
	(2.87)***	(3.77)***	(2.01)**	(2.33)**	(2.54)**	(0.19)	(0.17)	(0.30)	(0.01)	(0.60)
Observations	265	265	265	265	265	270	270	270	270	270
Countries	45	45	45	45	45	45	45	45	45	45
Instruments	36	35	35	35	32	29	37	36	37	28
AR(1) (p-value)	0.028	0.057	0.025	0.049	0.004	0.076	0.019	0.019	0.021	0.016
AR(2) (p-value)	0.653	0.717	0.637	0.595	0.866	0.833	0.461	0.872	0.551	0.301
Hansen (p-value)	0.186	0.110	0.578	0.320	0.866	0.245	0.221	0.414	0.312	0.986

Note The estimation method is two-step system GMM. *L.va_indus , L.va_manufac, L.total, L.high, L.medium, L.low,* and *L.remittances* are the lagged variables. Robust and absolute z-statistics in parentheses. The null hypothesis of the AR tests is that the errors exhibit no second order serial correlation.*** ** and * denote significance at the 1% 5% and 10% levels respectively.

4. Conclusion

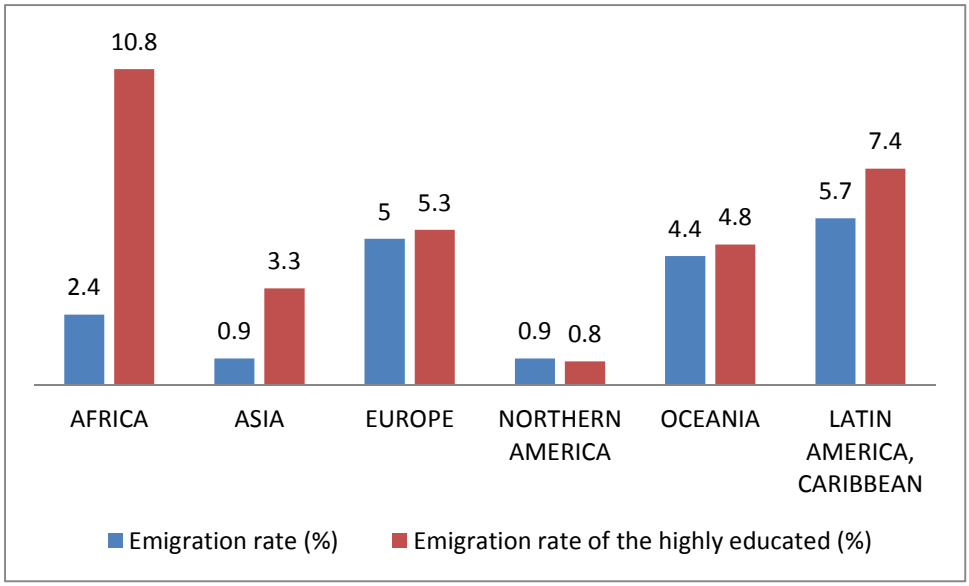
This paper contributes to shed light on the mechanism by which migrants can contribute to their source country development, looking at a specific and particularly relevant dimension: industrial development. The first research question concerned the effect of emigration rate and remittances on industrial and manufacturing added values. The results provide strong evidence in favor of the hypothesis that migration and remittances have an important significant effect on industrial and manufacturing added values in Africa. The results are in line with those of previous studies which find migration contributing positively to the source country GDP (Cooray, 2014), export performance (Boly et al., 2014), knowledge-intensive industries (Papakonstantinou and Inklaar, 2014) and traded manufacturing sectors (Dzansi, 2013). Secondly, we check the channels through which migration affect industrial development. The results show that international financial flows (especially FDI and remittances), business networks (especially exports) and scientific networks (especially scientific and technical publication) are the main channels through which migration affects industrial development. Thirdly, we asked whether this relationship between emigration and

industrial development depends on the skill level of the migrants (high skill, medium skill, and low skill). The study also finds that low-skilled and medium-skilled migrants have the largest direct and indirect effects on industrial development. The results are consistent with those of Cooray (2014).

Overall, our results are consistent with the beneficial brain gain hypothesis. As policy implications, African countries may benefit more from international migration by developing institutions that facilitate international financial flows, business networks and scientific networks. In this paper, we focus on three main channels (namely international financial flow, business network, and scientific network), however, a deeper investigation of the relevance of other channels especially, financial development and institutional development may be the focus of our research in the future.

Appendix

Figure 1. Emigration rate, emigrant population 15+ in the OECD in 2010/2011 by region of birth



Source: Author using data from OECD-UNDESA, 2013

Table A1**:** Definitions and sources of the variables

Variable	Definition	Source
va_indus	Industry, value added (% of GDP)	World Development Indicators (WDI) online
va_manufac	Manufacturing, value added (% of GDP)	WDI online
total	Ratio of the number of people that lived abroad to a country's population in %.	Brücker et al. (2013)
high	Ratio of high-skilled migrants to population in %	Brücker et al. (2013)
medium	Ratio of medium-skilled migrants to population in %	Brücker et al. (2013)
low	Ratio of low-skilled migrants to population in %	Brücker et al. (2013)
remittances	Personal remittances, received (% of GDP)	WDI online
va_agri	Agriculture, value added (% of GDP)	WDI online
gdp_pc	logarithm of GDP per capita (current US$)	WDI online
polity2	polity2 is a combined index of democracy and autocracy of POLITY IV project, ranged from -10 (strongly autocratic) to +10 (strongly democratic)	Polity IV
education	School enrollment, secondary (% gross)	WDI online
invest	Gross fixed capital formation (% of GDP)	WDI online
exports	Exports of goods and services (% of GDP)	WDI online
imports	Imports of goods and services (% of GDP)	WDI online
fdi	Foreign direct investment, net inflows (% of GDP)	WDI online
m2	Money and quasi money (M2) as % of GDP	WDI online
tech	Scientific and technical journal articles	WDI online

Table A2: Countries Sample

Algeria, Angola, Benin, Botswana, Burkina, Burundi, Cameroon, Cape Verde, Central African, Chad, Comoros, Congo Dem. Rep., Congo Republic, Cote d'Ivoire, Djibouti, Egypt, Ethiopia, Gabon, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, South Africa, Sudan, Swaziland, Tanzania, Togo, Tunisia Uganda, Zambia, Zimbabwe.

Table A3: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
va_indus	315	27.35	13.82	4.49	75.38
va_manufac	315	11.06	6.57	0.24	45.67
total	315	2.13	4.80	0.01	33.63
high	315	17.03	15.65	1.22	76.92
medium	315	2.67	5.73	0.01	38.15
low	315	1.69	4.35	0.00	29.81
remittances	315	3.61	9.56	0.00	90.41
va_agri	315	27.20	15.39	2.03	72.03
gdp_pc	315	6.40	0.97	4.60	9.15
polity2	315	-1.51	5.97	-10.00	10.00
education	315	30.86	21.35	2.48	95.39
invest	315	20.07	9.28	1.10	70.13
exports	315	30.05	17.70	2.86	89.63
imports	315	39.62	20.91	7.07	145.15
fdi	315	2.19	4.01	-6.34	43.82
m2	315	30.50	19.95	0.83	110.30
tech	310	143.21	418.12	0.00	2971.80

Table A4 : Correlation Matrix (Uniform sample=310)

	va_indus	*va_manufac*	*total*	*high*	*medium*	*low*	*remittances*	*va_agri*	*gdp_pc*	*polity2*	*education*	*invest*	*m2*	*fdi*	*exports*	*imports*	*tech*
va_indus	1.000																
va_manufac	0.148	1.000															
total	0.045	0.105	1.000														
high	-0.031	0.102	0.669	1.000													
medium	-0.057	0.014	0.903	0.705	1.000												
low	0.046	0.100	0.996	0.635	0.890	1.000											
remittances	-0.005	0.079	0.190	0.088	0.182	0.198	1.000										
va_agri	-0.677	-0.300	-0.260	-0.031	-0.119	-0.259	-0.111	1.000									
gdp_pc	0.586	0.220	0.281	0.050	0.100	0.272	-0.042	-0.774	1.000								
polity2	-0.150	-0.013	0.170	0.178	0.128	0.147	0.046	-0.098	0.123	1.000							
education	0.361	0.290	0.269	0.124	0.072	0.252	0.030	-0.564	0.750	0.257	1.000						
invest	0.201	0.000	0.385	0.136	0.352	0.389	0.434	-0.289	0.267	0.087	0.221	1.000					
m2	0.109	0.220	0.400	0.229	0.290	0.383	0.186	-0.485	0.504	0.133	0.574	0.325	1.000				
fdi	0.170	-0.008	0.080	0.099	0.090	0.067	0.175	-0.118	0.066	0.135	0.108	0.438	0.053	1.000			
exports	0.695	0.129	0.102	0.038	-0.044	0.091	-0.055	-0.653	0.588	-0.032	0.369	0.154	0.194	0.185	1.000		
imports	0.204	0.198	0.255	0.178	0.182	0.254	0.640	-0.379	0.172	0.038	0.128	0.535	0.284	0.368	0.509	1.000	
tech	0.155	0.240	-0.047	-0.117	-0.079	-0.059	-0.036	-0.263	0.338	0.127	0.502	0.004	0.426	-0.053	-0.047	-0.184	1.000

References

Acosta, P.A., Lartey, E.K., Mandelman, F.S., 2009a. Remittances and the Dutch disease. *Journal of International Economics* 79(1), 102-116.

Acosta, P. A., Baerg, N. R., Mandelman, F. S., 2009b. Financial development, remittances, and real exchange rate appreciation. *Economic Review-Federal Reserve Bank of Atlanta*, 94(1), 1-12.

Agrawal, A., Cockburn I., McHale J. 2006. Gone but not forgotten: knowledge flows, labor mobility, and enduring social relationships. *Journal of Economic Geography* 6(5), 571-591.

Aggarwal, R., Demirgüç-Kunt, A., and Pería, M. S. M. 2011. Do remittances promote financial development? *Journal of Development Economics*, 96(2), 255-264.

Arellano, M., Bover, O. 1995. Another look at the instrumental variable estimation of error-components models. *Journal of econometrics*, 68(1), 29-51.

Aubrya A., Burzynski M., Docquier F. 2016. The welfare impact of global migration in OECD countries. *Journal of International Economics*, 101, 1-21.

Beine M., Lodigiani E., Vermeulen R. 2012 Remittances and financial openness. *Regional Science and Urban Economics*, 42(5), 844-857.

Beji, S., Belhadj, A., 2016. The Determinants of Industrialization: Empirical Evidence for Africa. *European Scientific Journal, ESJ*, 12(10).

Bhagwati, J., Hamada, K., 1974. The Brain Drain, International Integration of Markets for Professionals and Unemployment. *Journal of Development Economics* 1(1), 19-42.

Blundell, R., Bond, S. 1998. Initial conditions and moment restrictions in dynamic panel data models. *Journal of econometrics*, *87*(1), 115-143.

Boly, A., Coniglio, N. D., Prota, F., Seric, A., 2014. Diaspora Investments and Firm Export Performance in Selected Sub-Saharan African Countries. *World Development* 59(0), 422-433.

Borjas, G. J., Doran K. B. 2012., The collapse of the Soviet Union and the productivity of American mathematicians. *The Quarterly journal of economics*, 127(3), 1143-1203.

Brücker, H., Capuano, S., Marfouk, A. 2013. Education, Gender and International Migration: Insights from a Panel-Dataset 1980-2010, mimeo. Retrieved from: http://www.iab.de/en/daten/iab-brain-drain-data.aspx.

Cantore N., Calì M., 2015. The Impact of Temporary Migration on Source Countries" *International Migration Review* 49(3), 697-726.

Cooray, A. 2014. Do low-skilled migrants contribute more to home country income? Evidence from South Asia. *BE Journal of Economic Analysis and Policy* 14 (3), 1185-1212.

Di Maria, C., Lazarova, E. A. 2012. Migration, Human Capital Formation, and Growth: An Empirical Investigation. *World Development* 40(5), 938-955.

Djajić, S., 2014. Temporary Migration and the Flow of Savings to the Source Country. *Review of Development Economics* 18(1), 162-176.

Docquier, F., Lodigiani, E. 2010. Skilled migration and business networks. *Open Economies Review*, 21(4), 565-588.

Docquier, F., Lodigiani, E., Rapoport, H.; Schiff, M. 2016. Emigration and democracy. *Journal of Development Economics*, 120, 209-223.

Docquier, F., Rapoport, H. 2012. Globalization, brain drain, and development. *Journal of Economic Literature*, 50(3), 681-730.

Douglas K. N., 2015. International knowledge flows and technological advance: the role of migration. *IZA Journal of Migration* 4:13.

Dzansi, J. 2013. Do remittance inflows promote manufacturing growth? *The annals of regional science*, 51(1), 89-111.
Ehrhart, H., Le Goff, M., Rocher, E., Singh, R., 2014. Does Migration Foster Exports? Evidence from Africa. World Bank, Washington, DC.
Ganguli I. 2014. Immigration and Ideas: What Did Russian Scientists 'Bring' to the US? Stockholm Institute of Transition Economics Working Paper No. 30.
Grabowski, R., 2016. Resource-based economies and deindustrialisation: an Indonesian perspective on sub-Saharan Africa. *Canadian Journal of Development Studies / Revue canadienne d'études du développement,* 37(1) 27-46.
Guadagno, F., 2015. The determinants of Industrialization in Developing Countries, 1960-2005. UNU-MERIT Working Paper No. 2016-031.
Gui-Diby S. L., Renard M-F., 2015. Foreign Direct Investment Inflows and the Industrialization of African Countries. *World Development*, 74, 43-57.
Guillaumont Jeanneney S., Hua P., 2015. The impact of Chinese competition on Africa's manufacturing. Etudes et Documents, No. 21, CERDI. http://cerdi.org/production/show/id/1721/type_production_id/1
Hunt, J., Gauthier-Loiselle M., 2010. How much does immigration boost innovation? *American Economic Journal: Macroeconomics* 2(2), 31-56.
Kerr W., 2013. U.S. High-skilled immigration, innovation, and entrepreneurship: empirical approaches and evidence. NBER Working Paper No. 19377, Cambridge, MA.
Lavopa, A., Szirmai, A., 2012. Industrialization, employment and poverty. UNU-MERIT Working Paper No. 2012-081.
Lucas Robert E. B., 2005. International Migration and Economic Development: Lessons from Low-income Countries. Edward Elgar Publishing.
OECD-UNDESA. 2013. *World Migration in Figures.* October 2013. http://www.oecd.org/els/mig/World-Migration-in-Figures.pdf.
Özden, Ç., Rapoport, H.; Schiff, M. 2011. Five questions on international migration and development. *The World Bank Economic Review*, 25(1), 1-11.
Papakonstantinou M., Inklaar R., 2014. Brain Drain or Gain? The Structure of Production, Emigration and Growth. GGDC Research Memorandum 145.
Ratha, D., Mohapatra, S., Özden, Ç., Plaza, S., Shaw, W., Shimles, A. 2011. *Leveraging Migration for Africa: Remittances, Skills, and Investments*. World Bank Publications.
Roodman, D. 2009. A note on the theme of too many instruments. *Oxford Bulletin of Economics and statistics*, 71(1), 135-158.
Saha S. K., 1991. Role of Industrialisation in Development of Sub-Saharan Africa: A Critique of World Bank's Approach. *Economic and Political Weekly* 26(48), 2753-2762.
Shaw, W., 2007. Migration in Africa: A Review of the Economic Literature on International Migration in 10 Countries. Development Prospects Group The World Bank.
Squicciarini M. P., Voigtländer N. 2015. Human Capital and Industrialization: Evidence from the Age of Enlightenment. *The Quarterly Journal of Economics*, 130(4), 1825-1883.
Stark, O., Byra, L., 2012. A Back-Door Brain Drain. *Economics Letters* 116(3), 273-276.
Szirmai, A., 2012. Industrialisation as an engine of growth in developing countries, 1950-2005. *Structural Change and Economic Dynamics* 23 (4), 406-420.
Tregenna F., 2015. Deindustrialisation, structural change and sustainable economic growth. UNU-MERIT Working Paper Series 2015-032.
Tregenna, F. 2008. The contributions of manufacturing and services to employment creation and growth in South Africa.*South African Journal of Economics*, 76(s2), S175-S204.
UNIDO, 2009. Industrial Development Report 2009 Breaking In and Moving Up: New Industrial Challenges for the Bottom Billion and the Middle-Income Countries. (http://www.unido.org/fileadmin/user_media/Publications/IDR/2009/IDR_SUMMARY_print.pdf).