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Abstract

The paper assesses how remittances directly and indirectly affect industrialisation in a panel of 49 African countries for the period 1980-2014. The indirect impact is assessed through financial development channels. The empirical evidence is based on three interactive and non-interactive simultaneity-robust estimation techniques, namely: (i) Instrumental Fixed Effects (FE) to control for the unobserved heterogeneity; (ii) Generalised Method of Moments (GMM) to control for persistence in industrialisation and (iii) Instrumental Quantile Regressions (QR) to account for initial levels of industrialisation. The non-interactive specification elucidates direct effects of remittances on industrialisation whereas interactive specifications explain indirect impacts. The findings broadly show that for certain initial levels of industrialisation, remittances can drive industrialisation through the financial development mechanism. Policy implications are discussed.

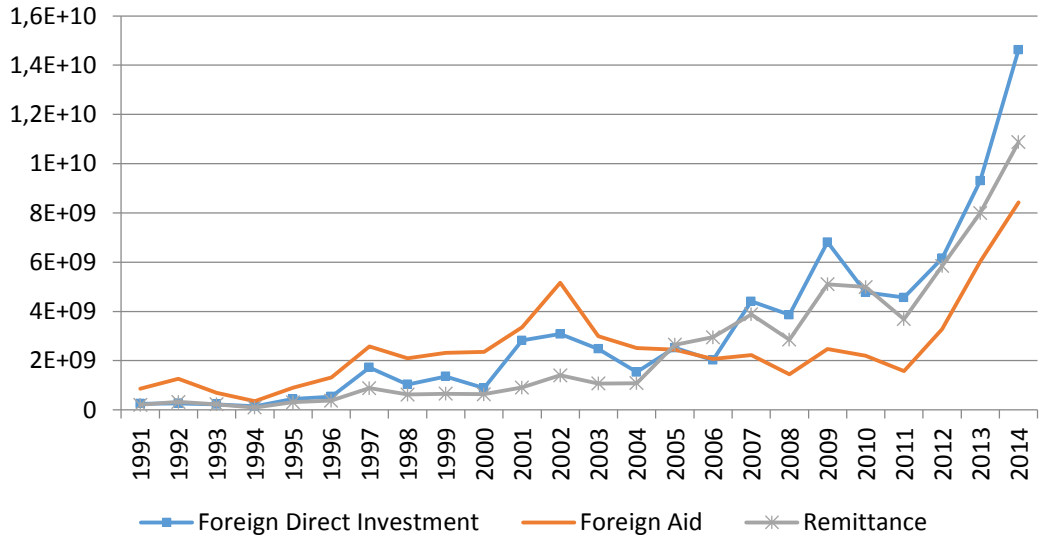
JEL Classification: F24; F43; F63; G20; O55
Keywords: Africa; Financial development; Industrialisation; Remittances

1. Introduction

Remittances from abroad are one important source of foreign capital flow to Sub-Sahara Africa (SSA). From early 2000, its importance is seen in the volume of its inflow, which has increased many folds above foreign aid and very close to the volume of foreign direct investment flow (See Figure 1). Among the benefits of remittance over other forms of foreign capital flow include its less cyclical and volatile nature; meaning that remittances can be more reliable than other sources of foreign capital flow. Little wonder it has become the focus of African Development practitioners, especially considering public policies to

harness this all important capital flow. In 2013, the Joint African Union-Economic Commission for Africa (ECA) emphasised on the need for African countries to refocus attention on leveraging on remittance flow.

Figure 1: Foreign Investment Flow to Africa



Source: Authors' Computation from World Development Indicators

Noting the importance of remittance inflow to African countries, this study examines the possibility of remittances realising the African industrialisation drive. We also take interest in the quality of financial institutions within these countries and how it can play a complementary role in realising Africa's industrialization. It is recognised that most African countries are resource-dependent. Their export is majorly-driven by raw materials and agricultural commodities, with little economic diversification. Almost the entire SSA countries are between 80 – 100 percent dependent on commodity trading as their major source of foreign exchange (UNCTAD, 2014). The danger of this scenario include exposure of African economies to international shocks caused by commodity price changes, hurting governance structure and rent-seeking behaviour caused by over-reliance on primary product and greater exposure to the risk of state fragility caused by rebellion from opposing factions that want to control the resources (Collier & Hoeffler, 2001). These possible incidences point to the need for increased industrialisation of African countries since it can mitigate the negative impact from primary commodity dependence and could increase household consumption, the demand for intermediate goods and further change the drivers of economic growth (Gui-Diby & Renard, 2015).

Harnessing Diaspora remittance inflow could be an alternative policy option to improve the development of African industrial sector not just because of the monetary volume of the

inflow, but because of other technical reasons. For instance, the heightened human capital and skills that exist in Diaspora can be an added knowledge capital in line with the financial resources from abroad. Since these resources and technical capacities are from the nationals of such countries living abroad, then it is possible to expect better indigenization and less resistance as experienced in some African countries. Other forms of foreign financial flow have been viewed with skepticism because of the claim of self-interest, capital repatriation, global volatility that can affect their volume of inflow and its crowd-out effect on smaller indigenous businesses (Fortanier, 2007; Moura & Forte, 2009). For example, following the long history of colonialism of African countries, there are sentiments that investments from foreign nationals may result in neo-colonialism, exposing the host countries and their resources to foreign exploitations. More so, Diasporas may be more willing to invest in fragile economies like some of those in Africa unlike foreign investors who may be unwilling to risk losing their investments.

In fact, there are success stories recorded in African countries as a result of Diaspora investment. Examples are the *Dahabshiil* story of Somalia Diaspora is an important evidence of African Diaspora which thrives rapidly despite state collapse as in Somalia in 1988. In Nigeria, some organizations such as Nigeria in Diaspora Support Programme, the Annual Diaspora Direct Investment Summit and the Nigerian Diaspora Trade and Investment Association are success stories on how the Diaspora can contribute to industrial growth and development. Nonetheless, though Diaspora financial inflow may not be expected to have a huge industrial push in Africa, it can help provide a stable economic foundation on which sustainable industrial development can be fostered. To this end, the impact of Diaspora remittance inflow on industrialization is analyzed with panel data from 49 African countries for the period 1980 to 2015. We ask two important questions: first, to what extent will Diaspora remittance inflow affect Africa's industrialization drive? Second, will this effect be dependent on the quality of the financial institutions in the respective countries? There is a lack of econometric studies that have considered this relationship with a focus on Africa; this paper therefore intends to fill this observed gap. This objective is important considering the rising trend of remittance inflow to Africa and the rising policy interest on how to efficiently maximize this huge economic resource. Thus, it would be worth having a critical view on their impact, which would be helpful in setting a direction for new generation policies on for African development.

The remainder of the paper is organized as follows: the second section contains a brief literature review that explains how remittance inflow can induce industrialization. The third section presents the stylized facts on remittance inflow and industrialization in Africa, while the fourth section presents the research method which contains an overview of the data used and addresses econometric issues stemming from the data analysis. The fifth section presents the empirical results and their interpretation. The conclusion and summary of results are included in the sixth section.

2. Literature review

Industrialisation is defined as a socio-economic process of rapid transformation in significant manufacturing activity in relation to other forms of production and work undertaken within a respective economy (Naude, Szirmai and Lavopa, 2013). It entails the increase in value addition of the manufacturing sector in relation to the overall size of the economy. This entails that a significant development of the manufacturing sector, compared with other sectors, will lead to a faster attainment of any country's industrialisation (Gui-Diby & Renard, 2015). From these definitions, two components are required for industrialisation to thrive. They include the encouragement of the manufacturing sector for production and such production must be sustained in order to meet local and international demands.

On the other hand, remittances, being the financial counterpart of migration, are largely seen as household transfer with altruism motives and have a social insurance role (Agarwal and Horowitz, 2002; Kapur, 2004). However, there are more benefits from remittances than just the household benefit. For instance, considering industrialisation of nations, remittance inflow can be of immense benefit through direct and indirect impacts. There is a rich literature that documents a more active utilisation of capital flow from remittances rather than final demand expenditure. More importantly, as a source of liquidity, remittances can boost domestic entrepreneurship. Furthermore, remittances act as a substitute for inefficient or non-existent credit markets in order to enable local entrepreneurs bypass the barriers to business development that results from lack of start-up capital or high interest rates. Woodruff and Zentano (2001) found that 27% of firms in Mexico were reliant on remittances from abroad to finance their liquidity and that remittances represent 20% of the capital invested for business development.

Massey and Parrado (1998), earlier, concluded that start-up capital for 21 percent of businesses in Mexico required remittances from working in the USA. Woodruff and Zenteno (2007) also associated Mexican enterprise growth and expansion to international migration (Mexico-to-US). Yang (2008) estimates the responses of Filipino households to positive economic shocks in the destination country of migrated household members; these shocks increased the levels of investment in entrepreneurship. In a recent study by Hossain and Hasanuzzaman (2015) on the relevance of remittances to Bangladesh's economy, the authors found a positive long-run effect of remittance inflow on investment. These studies show that remittances can improve entrepreneurship and investment in enterprise and an accumulation of these value addition activities will most likely result in industrialisation.

Another direct channel through which remittance inflow promotes industrialisation is skill and technology transfer, and improved market-oriented production. Brinkerhoff (2006) presents an explicit analysis of how migrants promote skill transfer within the homelands of Peoples Republic of China (PRC), Philippines, and Afghanistan. Syed and Miyazako (2013) found remittance to be an important source of investment in agriculture particularly for a shift from subsistence agriculture to market-oriented production. Likewise in Ghana, remittance is seen to improve both farm and non-farm production (Tsegai, 2004). This important role of remittance is vital for African countries as there is a policy debate on how to improve the agricultural sector from subsistence and primary production to value addition. Traditionally, lack of access to fundamental assets and productive inputs like credit, has prevented the capitalisation of agricultural enterprises and productivity in developing countries. Apart from the agricultural sector, Dzansi (2013) uses manufacturing data on a sample of 40 remittance-dependent economies over the period 1991 to 2004 to conclude that remittance inflow accelerates manufacturing growth. The evidence is robust to industry and year-specific effects. One important channel through which remittance inflow affects productivity is skill and technology transfers that migrants bring to their home countries. Barajas et al (2009) noted that remittance may affect Total Factor Productivity (TFP) growth by changing the size of dynamic production externalities generated by an economy. Moreover, remittances have also been recently documented to contribute to output per worker (Ssozi & Asongu, 2016a) and TFP (Ssozi & Asongu, 2016b) in SSA.

An indirect channel through which remittances inflow affect industrialisation is the exchange rate, which will definitely affect the manufacturing sector's performance.

Remittance inflow can affect the relative growth of traded and non-traded manufacturing sectors. Its impact on the traded manufacturing sector is principally affected by its role on the country's real exchange rate (Rajan & Subramanian, 2005; Selaya & Thiele, 2010). Since remittances affect the exchange rate of countries as a result of the demand for and supply of foreign exchange, the value of tradable manufacturing goods will most likely be affected, which will in turn influences the performance of the manufacturing sector.

The extent to which remittance affects the manufacturing sector through real exchange rate changes is largely dependent on the extent to which the nature of traded-goods production is likely to generate dynamic production externalities (Barajas et al., 2009). Dzansi (2013) supports this argument using a sample of 40 countries for the period 1991-2004. The author finds that remittance inflow promotes the relative growth of traded manufacturing sectors in recipient countries. On the contrary, Acosta, Lartey and Mandelman (2009) found that a massive inflow of foreign currency could be associated with a real exchange rate appreciation and subsequently a loss of international competitiveness. This in turn could lead to a decline in the production of manufactured and other tradable goods. Remittances can also affect the domestic manufacturing sector through the increase in demand for non-tradable goods. Since remittance inflow raises consumption of household (Amuedo-Dorantes, 2014), the demand for non-tradable will also be on the increase and will affect the productive performance of this sector. Lartey et al. (2008) showed this relationship by using a sample of 109 developing and transition countries for the period 1990-2003. Their study found a relative positive impact of remittance inflow on the prices of non-tradable compared to tradable.

Remittance also has an indirect impact on the growth of the manufacturing sector and industrialisation through its impact on financial development. The development of the financial system means that financial institutions are efficient in performing their responsibility of transforming mobilised deposits into credit for economic operators within an economy. Thus, for a financial system to be efficient there must be credit flowing more or less from the financial system to the real economy through the pooling of savings and allocation of capital to productive investments, among others (Levine, 2005; Estrada et al., 2010; Svirydzenka, 2016). In the long-run, the efficiency of the financial system can lead to the growth of the manufacturing sector and industrial development (Shahbaz & Lean, 2012; Udoh & Ogbuagu, 2012; Ewetan & Ike, 2014). Remittances are also seen as an important

source of savings and bank deposit to the financial sector in recipient countries. Aggarwal, Demirguc-Kunt and Peria (2011) using 99 developing countries found evidence that remittances contribute to increasing the aggregate level of deposits and credit intermediated by the local banking sector. In Uganda, Kaberuka and Namubiru (2014) found a positive effect, while Karikari, Mensah and Harvey (2016) also found a positive effect for the entire Africa.

From the literature reviewed, there are different channels through which remittances can affect industrialisation; either directly or indirectly. No matter the channel, some negative externalities can be observed especially with regards to the impact of remittance inflow on the foreign exchange appreciation and the diversion of labour supply from the productive manufacturing sector. Acosta, Lartey and Mandelman (2009) clearly illustrate this phenomenon for El Salvador. However, maximising the positive impact of remittances and translating it to industrial growth will depend on some factors. For instance, the government will be involved in policies oriented towards maximising the gains from migration, firms can be involved in backward integration of domestic enterprises that may have migrant input, and the household/individuals can be involved in skill and capacity development. Most important of these factors is the government's intervention in maximising the gains from migration.

Taking a cue from Chinese industrial growth and the relevance of migrant input, it is evident that the active participation of the government and its dynamic policies targeted at encouraging migrant input to the economy had a great impact on Chinese industrial development (Xiang, 2006). Most importantly, the government creates policies that define the rule of the game and creates incentives to encourage economic interactions. Some of these policies can be directed at improving the quality of the financial institutions in the respective countries. The role of financial institution in the relationship between remittance and industrialisation is entirely supportive. This implies that despite the volume of remittance inflow, the role of financial institutions in supporting investments and business development cannot be neglected. This is based on the wisdom of some studies that have shown a complementary relationship between remittance and financial development (e.g. Osabuohien and Efobi, 2012; Bettin et al, 2012; Efobi et al, 2014). These studies points out that in countries with high remittance inflow and improved financial institutions, remittance recipient can better utilise the fund for investment and business development. However, in

relation to industrialisation, we could not locate any empirical study that has tested this relationship.

3. Stylized facts on remittance and industrialisation in Africa

As earlier noted, the level of industrialisation in Africa is low compared to other regions of the world. The annual growth rate of the industrial sector which was less than 2 percent for the period 2000-02 and about 5 percent for 2003-05, has consistently declined after this period (See Figure 1a). Overall, the annual industry growth rate was not more than 5 percent for the entire period of 1991 to 2015. Apart from countries in Latin America and the Caribbean, countries in other regions like East Asia and Pacific, and Europe and Central Asia (for some period) witnessed a growth rate that is higher than that of SSA countries. The trend in Africa's industrial development is also reflected in the performance of tradable export. Figure 1b shows the trend of manufacturing export to total export for African countries in comparison to countries of other regions of the world. From the Figure, the manufacturing export performance for SSA countries is lower than those of other countries from other regions for the entire period. The highest volume of manufacturing export was 30 percent only for the period 2003-05. After then, a downward slope is observed.

Figure 1a: Industry, value added (annual % growth)

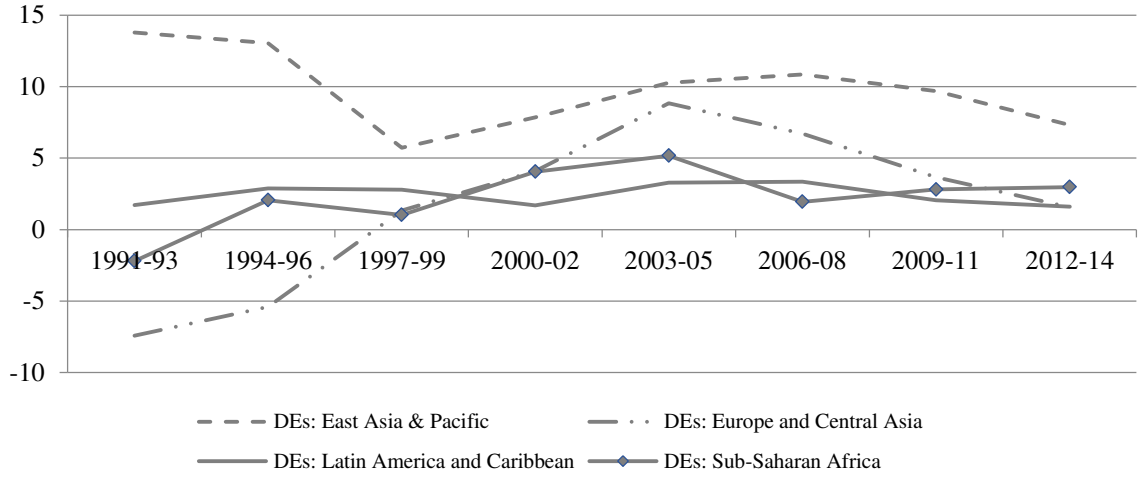
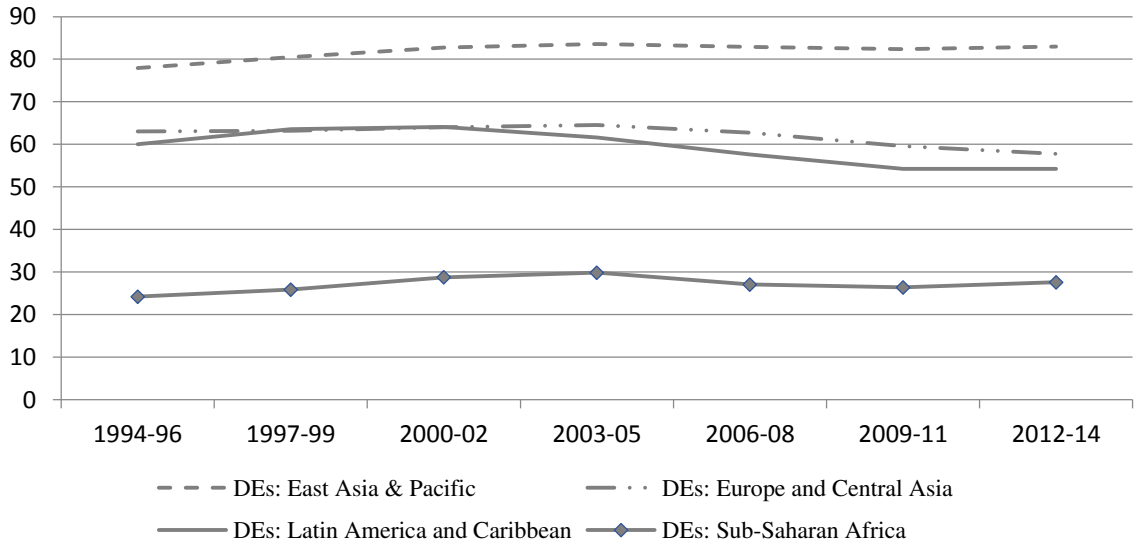
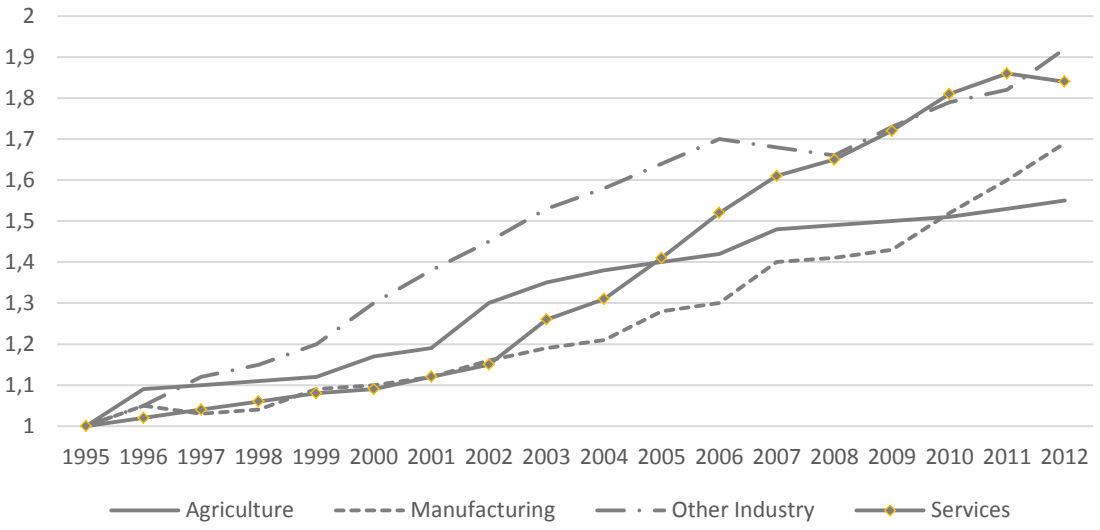


Figure 1b: % of Manufacturing export contribution to total export



We further consider the growth rate of GDP per capita by sector in order to understand the growth rate by sectors and to compare that of the manufacturing sector with other sectors of African countries. This trend is presented in Figure 2; evidently, the manufacturing sector has long performed below other sectors in terms of their growth rate. On the average, the growth rate of manufacturing GDP per capita has remained less than 1.26 percent per year, which is lower than those of the extractive and service sectors. The low growth rate of the industrial sector in SSA countries is largely traceable to poor investment climate; infrastructure and skills, *inter alia* (see Page, 2012). More so, severe lack of local capital available to fund industrialisation and value added production is another challenge that explains low performance of the industrial sector in Africa.

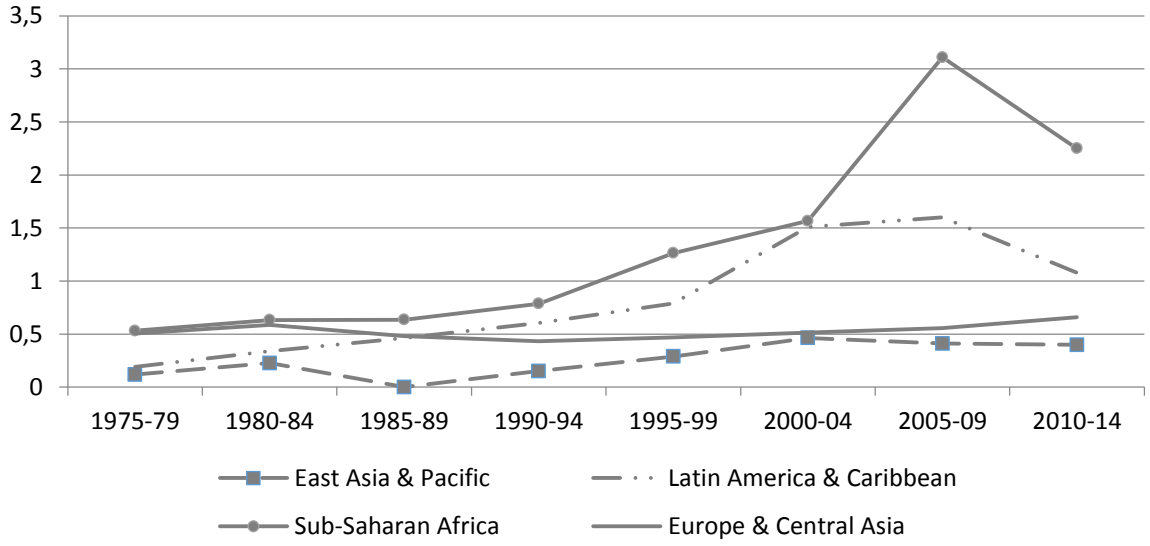
Figure 2: Growth in GDP Per Capita by Sector (SSA Countries)



Source: Recomputed from Ferreira (2014).

Noting the several factors responsible for the slow growth of the industrial sector in Africa, lack of capital and technical resources are important inputs that can spur rapid growth in manufacturing (Gui-Diby & Renard, 2015). Apart from foreign investment, remittance is seen as an essential capital inflow that can have both direct and indirect effects on the volume of industrial development in Africa. Noting this, we then examine the trend of workers' remittances into SSA and then compare it with those of other countries from other regions. In Figure 3, the extent to which remittance inflow matters to the economies of SSA is consistently high, with volumes that are many folds more than those of Europe, Central Asia and, East Asia and the Pacific. On the average and since 2000, remittance inflow to countries in SSA is higher than the 1.5 percent of the total GDP. Remittance inflow for countries in East Asia and the Pacific, Europe and Central Asia never reached this threshold for the entire period displayed in Figure 3. For Latin America and the Caribbean, they only reached this threshold during the period 2000-09 and afterwards, the remittance inflow remained lower than 1.5 percent.

Figure 3: Remittance Inflow as a Percentage of GDP

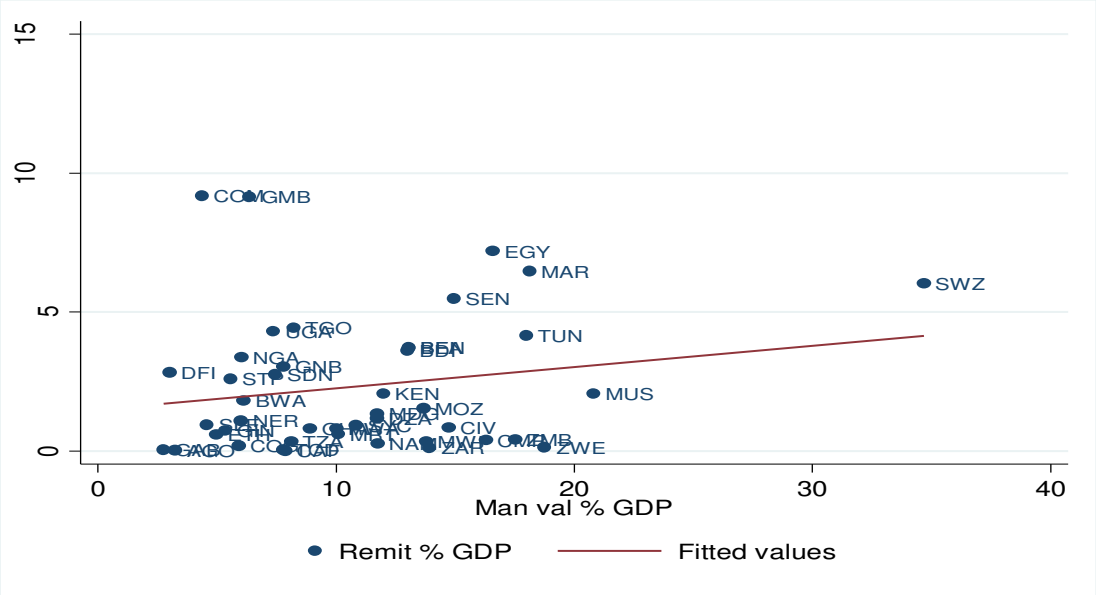


Source: Computed from World Development Indicators (2016).

The importance of remittance in the industrialisation of African countries is seen in the preliminary scatter plot presented in Figure 4. The scatter plot involves some sample countries in SSA, where industrialisation is captured using the manufacturing value added as a percentage of GDP as applied by Gui-Diby and Renard (2015) and remittance is measured as personal remittances received as a percentage of GDP. From the Figure, it is evident that

positive relationships exist between remittances and industrialisation in the selected African countries. For each of these countries, remittance inflow results in an upward shift of the volume of value addition in the manufacturing sector. This relationship suggests that the argument that African countries may benefit from remittances in their drive to ensure the growth rate of the industrial sector is feasible and not overboard. Though this relationship is preliminary, we intend to empirically test it using more sophisticated econometric techniques that take care of endogeneity and simultaneity issues. This will be elaborated further in subsequent sections.

Figure 4: Scatter Plot (Remittance and Industrialisation in Africa – 1980-2015)



Source: Authors' Computation

4. Data and methodology

4.1 Data

This study assesses a panel of 49 African countries with data for the period 1980-2014 from World Development Indicators (WDI) of the World Bank and the United Nations Conference for Trade and Development (UNCTAD) database. Whereas the periodicity for Fixed Effects and Quantile regressions is annual for a 35 years span. The adopted periodicity for the Generalized Method of Moments (GMM) is based on 5 year data averages or non-overlapping intervals in order to mitigate potential concerns of instrument proliferation or over-identification. Hence, there are seven data points used in the GMM specification, notably: 1980-1984; 1985-1989; 1990-1994; 1995-1999; 2000-2004; 2005-2009 and 2010-2014.

Our explained variable is industrialization in Africa, which is measured as the manufacturing value added as a percentage of GDP (constant prices). We prefer the manufacturing value added based on International Standard Industrial Classification (section D). This measure captures the productive manufacturing units that are classified according to the kind of principal economic activity, which include works that are performed by power-driven machinery or manually, factory based work or in a household (United Nations, 1990). Also, this measure of industrialisation is favoured by Kang and Lee (2011), UNIDO (2013) and Gui-Diby and Renard (2015).

Two main independent variables are employed: (i) personal remittances received (as % of GDP) and (ii) financial sector development in terms of bank sector intermediation efficiency and domestic credit to the private sector. Whereas remittance is the main focus of the paper, financial development is used as a channel via which via remittances can influence industrialization. This is consistent with the objective of the study which is to assess the direct and indirect incidences of remittances on industrialization.

The choice of the financial development channels is motivated by the fact that while investment is needed for industrialization, such investment for the most part has to be financed by the banking sector, since financial markets are not developed in most African countries (see Asongu, 2012, 2013a). Accordingly, we argue that even when remittances are used for consumption purposes, they may still be deposited in financial institutions for other investment and/or future consumption purposes. Such corresponding mobilized deposits or liquidity liabilities in financial institutions are then borrowed to economic operators for investment purposes. In the light of these clarifications: (i) banking intermediation efficiency measures the ability of financial institutions to transformed mobilized deposits into credit for economic operators while (ii) domestic credit to the private sector is a measurement of financial activity or the ability of financial institutions to grant credit to economic operators.

In order to account for omitted variable bias in the regressions, five control variables are employed, namely: trade openness, domestic investment, internet penetration, population growth and economic globalization. While from intuition positive effects can be expected from all the control variables on industrialization, market dynamics and expansion could reveal different effects. For instance, domestic investment that is skewed toward social, education and health investment may not directly lead to industrialization or may even slow-down the process. On the other hand, domestic investment to the productive sector directly

affects industrialization. With regard to population growth, if commodities demanded by an increasing population are imported for the most part, this may not engender negative effects on domestic industrialization.

The definitions of the variables (with the corresponding sources) are provided in Appendix 1, while the summary statistics in disclosed in Appendix 2. Two sets of correlation matrices are provided in Appendix 3: one on instrumented variables for the Fixed Effects and Quantile regressions and the other on variables that are not instrumented for the GMM regressions.

4.2 Methodology

4.2.1 Instrumentation and instrumental Fixed effects estimations

Three simultaneity-robust estimation techniques are employed, namely: (i) Instrumental Variable (IV)[1] Fixed Effects to control for the unobserved heterogeneity; (ii) Generalised Method of Moments to control for persistence in industrialisation and (ii) IV Variable Quantile regressions to account for initial levels of industrialisation. The employment of multiple estimation techniques is in accordance with data behaviour (Asongu & Nwachukwu, 2016a).

The issue of simultaneity (or an aspect of endogeneity) in the independent variables is tackled by instrumenting them with their first lags. For instance, the procedure for instrumenting remittances is as follows in Eq. (1) below.

$$\mathrm{Re}_{i,t} = \alpha + \delta_j\left(\mathrm{Re}_{i,t-1}\right) + \varepsilon_{i,t} \quad , \tag{1}$$

where $\mathrm{Re}_{i,t}$, denotes remittances of country i at period t, α is a constant, $\mathrm{Re}_{i,t-1}$, represents remittances in country i at period $t-1$, and $\varepsilon_{i,t}$ the error term.

The instrumentation procedure in Eq. (1) consists of regressing remittances on their first lags, then saving the fitted values that are later used as the independent variable of interest in the Fixed Effects and Quantile Regression specifications. The instrumentation process which is replicated for all independent variables is Heteroscedasticity and Autocorrelation Consistent (HAC) in standard errors.

The panel Fixed Effects (FE) models are presented in Eq. (2) as follows:

$$I_{i,t} = \partial_0 + \partial_1 \mathrm{Re}_{i,t} + \partial_2 Fin_{i,t} + \partial_3 \mathrm{Re}\, Fin_{i,t} + \sum_{h=1}^{5} \omega_h W_{h,i,t-\tau} + \eta_i + \varepsilon_{i,t} \ , \tag{2}$$

[1] Instrumental Variable and Instrumental are used interchangeably throughout the study.

where, $I_{i,t}$ is the industrialization indicator of country i at period t, ∂ is a constant, Re is remittances, Fin represents financial development (financial efficiency or financial activity), $\mathrm{Re}\,Fin$ is the interaction between remittances and financial development, W is the vector of control variables (trade openness, domestic investment, internet penetration, population growth and economic globalization), η_i is the country-specific effect and $\varepsilon_{i,t}$ the error term.

4.2.2 Generalised method of moments: specification, identification and exclusion restrictions

There are five main reasons for adopting a GMM technique. First, the N>T (49>7) criterion that is essential for the application of the estimation approach is met given that the number of countries (or cross sections) is substantially higher than the number of data points used for the GMM specification. It is important to noted, we are using 5 year non-overlapping intervals for the GMM specification. Second, industrialisation is persistent because its correlation with its first lag is 0.968 which is higher than the 0.800 rule of thumb threshold. Third, given that the GMM specification is consistent with panel data analysis; cross-country differences are considered in the regressions. Fourth, the *system* estimator corrects for biases in the *difference* estimator. Fifth, the estimation approach has some bite on endogeneity because it accounts for simultaneity. Moreover, the use of time-invariant omitted variables also increases the control for endogeneity.

Consistent with Bond et al. (2001), the *system* GMM estimator proposed by Arellano and Bond (1995) and Blundell and Bond (1998) has better estimation properties when compared with the difference estimator proposed by Arellano and Bond (1991). In this study, we prefer the Roodman (2009ab) extension of Arellano and Bover (1995) because it has been documented to: (i) restrict over-identification or instrument proliferation and (ii) account for cross-sectional dependence (see Love & Zicchino, 2006; Baltagi, 2008; Boateng et al., 2016). Accordingly, the technique adopts forward orthogonal deviations instead of first differences. The adopted specification approach is *two-step* because it controls for heteroscedasticity. It is important to note that the *one-step* approach is homoscedasticity-consistent.

The following equations in level (3) and first difference (4) summarize the standard *system* GMM estimation procedure.

$$I_{i,t} = \sigma_0 + \sigma_1 I_{i,t-\tau} + \sigma_2 \mathrm{Re}_{i,t} + \sigma_3 Fin_{i,t} + \sigma_4 \mathrm{Re}\,Fin_{i,t} + \sum_{h=1}^{5} \delta_h W_{h,i,t-\tau} + \eta_i + \xi_t + \varepsilon_{i,t} \qquad (3)$$

$$I_{i,t} - I_{i,t-\tau} = \sigma_0 + \sigma_1(I_{i,t-\tau} - I_{i,t-2\tau}) + \sigma_2(\mathrm{Re}_{i,t} - \mathrm{Re}_{i,t-\tau}) + \sigma_3(Fin_{i,t} - Fin_{i,t-\tau}) + \sigma_4(\mathrm{Re}\,Fin_{i,t} - \mathrm{Re}\,Fin_{i,t-\tau}) + \sum_{h=1}^{5}\delta_h(W_{h,i,t-\tau} - W_{h,i,t-2\tau}) + (\xi_t - \xi_{t-\tau}) + \varepsilon_{i,t-\tau} \quad (4)$$

where, τ represents the coefficient of auto-regression and ξ_t is the time-specific constant.

We briefly discussed exclusion and identification restrictions. As documented in recent literature, all explanatory variables are considered as predetermined or suspected endogenous while only time-invariant omitted variables are acknowledged as strictly exogenous (see Asongu & Nwachukwu, 2016a; Boateng et al., 2016). This is because it is unfeasible for time-invariant omitted variables (or years) to become endogenous in first-difference (see Roodman, 2009b). Hence, the process for treating *ivstyle* (years) is 'iv (years, eq(diff))' while the *gmmstyle* is used for predetermined variables.

In the light of above insights, years or time invariant omitted variables influence industrialisation exclusively through the suspected endogenous variables. Furthermore, the statistical validity of the exclusion restriction is examined with the Difference in Hansen Test (DHT) for instrument exogeneity. Accordingly, the alternative hypothesis of this test should be rejected for the time-invariant omitted variables to elucidate industrialisation exclusively via the endogenous explaining variables. Therefore, whereas in the standard instrumental variable (IV) approach, failure to reject the null hypothesis of the Sargan Overidentifying Restrictions (OIR) test shows that the instruments do not elucidate the outcome variable beyond the predetermined variables (see Beck et al., 2003; Asongu & Nwachukwu, 2016b), with the GMM technique, the information criterion needed to examine if time-invariant omitted variables are strictly exogenous is the DHT. Hence, in the findings that are revealed in Section 5, this assumption of exclusion restriction is confirmed if the null hypothesis of the DHT corresponding to IV (year, eq(diff)) is not rejected.

4.2.3 Instrumental Quantile regressions

The preceding modelling approaches are based on mean values of the industrialisation. Unfortunately, mean values reflect blanket policies. Furthermore, such blanket policies may not be effective unless they are contingent on existing levels of industrialisation and specified differently across countries with high, intermediate and low industrialisation. The concern about modelling exclusively at the conditional mean of the dependent variable is addressed with *Quantile* Regressions (QR) which enables the study to assess the relationships

throughout the conditional distributions of industrialisation (see Keonker & Hallock, 2001; Billger & Goel, 2009; Okada & Samreth, 2012; Asongu, 2013b).

Knowledgeable of above facts, studies that assess mean impacts with Ordinary Least Squares are founded on the hypothesis of normally distributed error terms. Such an assumption of normally distributed errors terms is not valid in the QR technique. Moreover, the estimation approach is robust in the presence of outliers because it enables the examination of parameter estimates at various points of the conditional distribution of the outcome variable (or industrialisation) (see Koenker & Bassett, 1978).

The θ^{th} quintile estimator of industralisation is obtained by solving the following optimization problem, which is presented without subscripts for simplicity in Eq. (5)

$$\min_{\beta \in R^k}\left[\sum_{i\in\{i:y_i\geq x_{i'}\beta\ \}}\theta\left|y_i-x_{i'}\beta\right|+\sum_{i\in\{i:y_i\geq x_{i'}\beta\ \}}(1-\theta)\left|y_i-x_{i'}\beta\right|\right], \quad (5)$$

where $\theta\in(0,1)$. As opposed to OLS that is fundamentally based on minimizing the sum of squared residuals, with QR, the weighted sum of absolute deviations are minimised. For instance, the 10^{th} or 90^{th} quintiles (with θ=0.10 or 0.90 respectively) are investigated by approximately weighing the residuals. The conditional quintile of industrialisation or y_i given x_i is:

$$Q_y(\theta / x_i) = x_{i'}\beta_\theta \ , \quad (6)$$

Where unique slope parameters are modelled for each θ^{th} specific quintile. This formulation is analogous to $E(y/x)=x_{i'}\beta$ in the OLS slope where parameters are assessed only at the mean of the conditional distribution of the industrialisation. In Eq. (6), the dependent variable y_i is industrialisation whereas x_i contains a constant term, remittances, financial development, interaction between remittances and financial development, trade openness, domestic investment, internet penetration, population growth and economic globalization. Given that all independent variables are instrumented, the OLS in the QR approach become a Two Stage Least Squares exercise.

5. Presentation of results

While Table 1 presents findings on FE and GMM regressions, Table 2 discloses results on QR. Both models entail 3 specifications: the non-interactive specification and two interactive specifications. One of the interactive specifications corresponds to banking

efficiency, while the other is related to financial activity. The non-interactive specification elucidates direct effects of remittances on industrialisation, whereas interactive specifications explain indirect impacts. In the same vein, Table 2 presents three specifications, one corresponding to non-interactive regressions for direct effects (see Panel A) and the other two related to interactive regressions for indirect impacts (Panels B and C).

From the FE regressions in Table 1, there is a negative marginal effect from the interaction between domestic credit and remittances. In the same table, four principal information criteria are employed to assess the validity of the GMM model with forward orthogonal deviations[2]. Not all control variables are included in the GMM specification in order to avoid instrument proliferation that could substantially bias estimated coefficients. Based on the information criteria, a positive marginal effect is apparent from the interaction between remittances and banking system efficiency.

The following findings are apparent from the QR in Table 2. Consistent differences in estimated coefficients between Two Stage Least Squares and quintiles (in terms of sign, significance and magnitude of significance) justify the relevance of adopted empirical strategy. In Panel A, banking efficiency decreases industrialisation whereas domestic credit increases it. In Panel B, the interaction between remittances and banking efficiency is positive in the 0.50^{th} and 0.75^{th} quintiles while it is negative in the 0.90^{th} quintile. In Panel C, the interaction between remittances and domestic credit is positive from the 0.10^{th} to the 0.50^{th} quintiles and the 0.90^{th} quintile while it is negative in the 0.75^{th} quintile. Most of the significant control variables have the expected signs.

The findings broadly show that for certain initial levels of industrialisation, remittances can drive industrialisation through financial development mechanisms. The direct negative effect of bank efficiency may be traceable to the substantially documented issues of surplus liquidity in African financial institutions (see Saxegaard, 2006; Asongu, 2014). This scenario will certainly need to be addressed to expect a positive and significant complementary impact from remittance inflow on industrialisation. This also explains why

[2] "First, the null hypothesis of the second-order Arellano and Bond autocorrelation test (AR (2)) in difference for the absence of autocorrelation in the residuals should not be rejected. Second the Sargan and Hansen over-identification restrictions (OIR) tests should not be significant because their null hypotheses are the positions that instruments are valid or not correlated with the error terms. In essence, while the Sargan OIR test is not robust but not weakened by instruments, the Hansen OIR is robust but weakened by instruments. In order to restrict identification or limit the proliferation of instruments, we have ensured that instruments are lower than the number of cross-sections in most specifications. Third, the Difference in Hansen Test (DHT) for exogeneity of instruments is also employed to assess the validity of results from the Hansen OIR test. Fourth, a Fischer test for the joint validity of estimated coefficients is also provided" (Asongu & De Moor, 2016, p.9).

the interaction of remittances with private domestic credit has more positive effects throughout the conditional distributions of industrialisation. Moreover, the positive marginal effects with private domestic credit are also of higher magnitude. To put this point into greater perspective, when remittances are deposited in financial institutions as liquid liabilities, such deposits have to be transformed into credit for economic operators in order to affect the industrialisation process. Unfortunately, the substantially documented issue of surplus liquidity is partly confirmed in this inquiry because the banking system efficiency variable does not consistently interact with remittances to affect industrialisation. It is important to note that banking system efficiency or financial intermediation efficiency is appreciated as the ability of banks to transform mobilised deposits into credit for economic operators.

In the light of the above, remittances should be accompanied with complementary financial development policies that have an overall aim of fighting concerns of surplus liquidity. The introduction of information sharing offices that are destined to mitigate information asymmetry between lenders and borrowers is an important step towards this direction. These recommendations are consistent with the perspective that remittances are more effective when a policy environment is good for investment with sound institutions and well developed financial systems (see IMF, 2005). This is also in accordance with recent research which shows that remittances could promote financial development which in turn promotes economic prosperity (Aggarwal et al., 2011). Even in scenarios where financial systems are undeveloped, remittances could directly affect economic development (Giuliano & Ruiz-Arranz, 2009).

Table 1: Fixed Effects and GMM Interactive and Non-Interactive Regressions

	Dependent variable: Industrialisation					
	Fixed Effects			GMM (Based on 5 Yr NOI)		
Industrialisation(-1)	---	---	---	0.960***	0.895***	0.887***
				(0.000)	(0.000)	(0.000)
Constant	16.243***	15.946***	15.138***	2.898**	1.403	0.043
	(0.000)	(0.000)	(0.000)	(0.023)	(0.297)	(0.960)
Remit(IV)	-0.0006	-0.0003	0.0005	0.073***	-0.031	0.097**
	(0.170)	(0.567)	(0.379)	(0.000)	(0.192)	(0.043)
BcBd(IV)	-0.007**	-0.009**	---	-0.002	-0.017	---
	(0.022)	(0.023)		(0.768)	(0.112)	
Domcred(IV)	-0.015	---	-0.012	-0.009	---	0.003
	(0.206)		(0.380)	(0.414)		(0.905)
Remit(IV)×BcBd(IV)	---	0.001	---	---	0.001**	---
		(0.984)			(0.020)	
Remit(IV)×Domcred(IV)	---	---	-0.005**	---	---	-0.004
			(0.018)			(0.134)
Trade (IV)	0.001	0.001	0.0006	-0.016**	0.006	
	(0.898)	(0.818)	(0.936)	(0.039)	(0.291)	
GFCF(IV)	-0.098***	-0.098***	-0.102***	0.009	-0.024	0.011
	(0.000)	(0.000)	(0.000)	(0.674)	(0.133)	(0.112)
Internet(IV)	-0.001***	-0.001***	-0.001***	---	---	---
	(0.009)	(0.003)	(0.008)			
Population(IV)	-0.027	-0.024	-0.023	---	---	---
	(0.137)	(0.181)	(0.194)			
Ecoglob(IV)	-0.002	-0.003	0.008	---	---	---
	(0.902)	(0.857)	(0.659)			
				AR(1)	(0.008)	(0.009)	(0.011)
				AR(2)	(0.188)	(0.148)	(0.254)
				Sargan OIR	(0.219)	(0.029)	(0.068)
				Hansen OIR	(0.732)	(0.281)	(0.811)
				DHT for instruments			
				(a)Instruments in levels			
				H excluding group	(0.513)	(0.472)	(0.531)
				Dif(null, H=exogenous)	(0.710)	(0.222)	(0.812)
				(b) IV (years, eq(diff))			
				H excluding group	(0.546)	(0.354)	(0.563)
				Dif(null, H=exogenous)	(0.801)	(0.250)	(0.931)
R^2(within)	0.056	0.052	0.061			
Fisher	8.78***	8.31***	9.70***	Fisher	135.04***	267.82***	146.46***
				Instruments	28	28	28
Countries	43	43	43	Countries	49	47	47
Observations	1219	1241	1227	Observations	233	212	212

*,**,***: significance levels of 10%, 5% and 1% respectively. DHT: Difference in Hansen Test for Exogeneity of Instruments' Subsets. Dif: Difference. OIR: Over-identifying Restrictions Test. The significance of bold values is twofold. 1) The significance of estimated coefficients and the Fisher statistics. 2) The failure to reject the null hypotheses of: a) no autocorrelation in the AR(1) and AR(2) tests and; b) the validity of the instruments in the Sargan OIR and DHT tests.
IV: Instrumented value. Remit: Remittances. BcBd: Bank Credit to Bank Deposits. Domcred: Domestic credit to the private sector. GFCF: Gross Fixed Capital Formation. Pop: Population. Ecoglob: Economic Globalisation. Industria: Industralisation.

Table 2: Instrumental Quantile Interactive and Non-Interactive Regressions

Dependent variable: Industrialisation

Panel A: Non-Interactive Regressions

	2SLS	Q.10	Q.25	Q.50	Q.75	Q.90
Constant	13.727***	4.921***	7.962***	14.810***	21.484***	21.946***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Remit(IV)	0.0005	0.0003	0.0003	-0.0007*	-0.0005	-0.00007
	(0.358)	(0.359)	(0.302)	(0.078)	(0.352)	(0.942)
BcBd(IV)	-0.018***	-0.001	-0.008***	-0.023***	-0.036***	-0.043***
	(0.000)	(0.754)	(0.007)	(0.000)	(0.000)	(0.000)
Domcred(IV)	0.158***	0.142***	0.162***	0.211***	0.172***	0.135***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Trade (IV)	0.038***	0.018***	0.025***	-0.0002	0.037***	0.044***
	(0.000)	(0.006)	(0.000)	(0.975)	(0.001)	(0.005)
GFCF(IV)	-0.210***	-0.057**	-0.107***	-0.120***	-0.269***	-0.303***
	(0.000)	(0.013)	(0.000)	(0.000)	(0.000)	(0.000)
Internet(IV)	-0.00009	0.0008	0.0009*	0.001*	-0.003***	-0.005***
	(0.921)	(0.233)	(0.086)	(0.091)	(0.001)	(0.006)
Population(IV)	-0.044***	-0.007	-0.016***	-0.038***	-0.064***	-0.106***
	(0.000)	(0.375)	(0.007)	(0.000)	(0.000)	(0.000)
Ecoglob(IV)	-0.017	-0.042**	-0.051***	-0.060***	-0.021	0.132***
	(0.426)	(0.010)	(0.001)	(0.002)	(0.349)	(0.000)
R^2/Pseudo R^2	0.175	0.090	0.116	0.140	0.129	0.139
Fisher	47.34***					
Observations	1219	1219	1219	1219	1219	1219

Panel B: Interactive Regressions with Bank Efficiency

	2SLS	Q.10	Q.25	Q.50	Q.75	Q.90
Constant	11.749***	5.010***	6.425***	12.046***	17.908***	18.946***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Remit(IV)	0.0003	0.0001	0.001*	-0.001*	-0.003**	0.002
	(0.785)	(0.893)	(0.076)	(0.050)	(0.026)	(0.222)
BcBd(IV)	-0.003	0.013**	0.011**	-0.002	-0.027***	-0.025**
	(0.466)	(0.015)	(0.022)	(0.671)	(0.002)	(0.023)
Remit(IV) ×BcBd(IV)	0.00001	-0.0000005	-0.0000005	0.00004***	0.00004***	-0.00001
	(0.181)	(0.637)	(0.517)	(0.000)	(0.002)	(0.372)
Trade (IV)	0.033***	-0.008	0.004	0.003	0.044***	0.057***
	(0.000)	(0.193)	(0.522)	(0.682)	(0.001)	(0.000)
GFCF(IV)	-0.166***	0.025	-0.028	-0.092***	-0.278***	-0.251***
	(0.000)	(0.255)	(0.112)	(0.000)	(0.000)	(0.000)
Internet(IV)	0.0004	0.0004	0.001**	0.002***	-0.004***	-0.005***
	(0.674)	(0.521)	(0.016)	(0.003)	(0.004)	(0.002)
Population(IV)	-0.041***	-0.007	-0.023***	-0.056***	-0.038***	-0.079***
	(0.000)	(0.356)	(0.001)	(0.000)	(0.001)	(0.000)
Ecoglob(IV)	0.042*	-0.011	-0.009	0.004	0.110***	0.182***
	(0.050)	(0.505)	(0.574)	(0.809)	(0.000)	(0.000)
R^2/Pseudo R^2	0.084	0.023	0.029	0.047	0.058	0.126
Fisher	11.92***					
Observations	1241	1241	1241	1241	1241	1241

Panel C: Interactive Regressions with Domestic Credit to the Private Sector

	2SLS	Q.10	Q.25	Q.50	Q.75	Q.90
Constant	12.429***	7.900***	9.153***	13.592***	15.548***	17.486***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Remit(IV)	-0.0004	-0.003***	-0.002***	-0.001***	0.0008	-0.001
	(0.573)	(0.000)	(0.000)	(0.008)	(0.284)	(0.395)
Domcred(IV)	0.093***	0.034**	0.080***	0.088***	0.188***	0.060**
	(0.000)	(0.027)	(0.000)	(0.000)	(0.000)	(0.019)
Remit(IV)×Domcred(IV)	0.00006***	0.0001***	0.0001***	0.00008***	-0.00006***	0.0001***
	(0.007)	(0.000)	(0.000)	(0.000)	(0.007)	(0.001)
Trade (IV)	0.037***	0.017***	0.013**	0.0007	0.034***	0.041***
	(0.000)	(0.000)	(0.036)	(0.929)	(0.001)	(0.001)
GFCF(IV)	-0.205***	-0.046**	-0.076***	-0.092***	-0.254***	-0.350***
	(0.000)	(0.011)	(0.000)	(0.000)	(0.000)	(0.000)
Internet(IV)	0.0003	0.001***	0.001**	0.002***	-0.002**	-0.006***

	(0.682)	(0.007)	(0.041)	(0.003)	(0.010)	(0.000)
Population(IV)	-0.038***	-0.010	-0.013*	-0.036***	-0.061***	-0.092***
	(0.000)	(0.136)	(0.087)	(0.000)	(0.000)	(0.000)
Ecoglob(IV)	-0.005	-0.075***	-0.058***	-0.064***	0.031	0.211***
	(0.797)	(0.000)	(0.001)	(0.001)	(0.122)	(0.000)
R^2/Pseudo R^2	0.167	0.138	0.139	0.135	0.104	0.124
Fisher	61.38***					
Observations	1227	1227	1227	1227	1227	1227

***,**,*: significance levels of 1%, 5% and 10% respectively. IV: Instrumented value. Remit: Remittances. BcBd: Bank Credit to Bank Deposits. Domcred: Domestic credit to the private sector. GFCF: Gross Fixed Capital Formation. Ecoglob: Economic Globalisation. Lower quintiles (e.g., Q 0.1) signify nations where industrialisation is least. 2SLS: Two Stage Least Squares.

6. Conclusion and future research directions

The paper assesses how remittances directly and indirectly affect industrialisation in a panel of 49 African countries for the period 1980-2014. The indirect impact is assessed through financial development channels. The empirical evidence is based on three interactive and non-interactive simultaneity-robust estimation techniques, namely: (i) Instrumental Fixed Effects (FE) to control for the unobserved heterogeneity; (ii) Generalised Method of Moments (GMM) to control for persistence in industrialisation and (iii) Instrumental Quantile Regressions (QR) to account for initial levels of industrialisation.

The non-interactive specification elucidates direct effects of remittances on industrialisation whereas interactive specifications explain indirect impacts. From the FE, there is a negative marginal effect from the interaction between domestic credit and remittances. In the GMM results, a positive marginal effect is apparent from the interaction between remittances and banking system efficiency. In QR: (i) banking efficiency decreases industrialisation whereas domestic credit increases it; (ii) the interaction between remittances and banking efficiency is positive in the 0.50^{th} and 0.75^{th} quintiles while it is negative in the 0.90^{th} quintile; (iii) the interaction between remittances and domestic credit is positive from the 0.10^{th} to the 0.50^{th} quintiles and in the 0.90^{th} quintile while it is negative in the 0.75^{th} quintile.

Considering the importance of remittance inflow as a source of stable foreign capital for the improvement of developing countries' productive capacity and business development, it is important to access other possible channels through which remittance affects industrialisation. This area of enquiry is important to improve the extant literature, especially in relation to African countries.

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Appendices

Appendix 1: Definitions of Variables

Variables	Signs	Definitions of variables (Measurement)	Sources
Industralisation	Industria	Manufacturing (ISIC D)	UNCTAD
Remittances	Remit	Personal remittances, received (% of GDP)	World Bank (WDI)
Bank Efficiency	BcBd	Bank credit to bank deposits (%)	World Bank (WDI)
Domestic Credit	Domcred	Domestic credit to private sector (% of GDP)	World Bank (WDI)
Trade	Trade	Exports and Imports of goods and services (% of GDP)	World Bank (WDI)
Domestic Investment	GFCF	Gross fixed capital formation (including Acquisitions less disposals of valuables) (% of GDP)	World Bank (WDI)
Internet	Internet	Internet users (per 100 people)	World Bank (WDI)
Population	Pop	Population (in millions)	World Bank (WDI)
Globalisation	Ecoglob	Economic globalization	World Bank (WDI)

WDI: World Bank Development Indicators.

Appendix 2: Summary statistics (1980-2014)

	Mean	SD	Minimum	Maximum	Observations
		Panel A: With Un-instrumented Variables			
Industrialisation	11.035	6.692	0.031	38.277	1677
Remittances	498.55	415.73	1.000	1293.0	1715
Bank Efficiency	83.193	49.721	8.043	397.115	1581
Domestic Credit	18.434	15.504	0.198	108.069	1557
Trade Openness	69.926	38.948	0.000	263.877	1715
Gross Fixed Capital Formation	21.082	10.901	1.356	107.846	1677
Internet Penetration	210.67	261.98	1.000	828.00	1715
Population	14.618	22.056	0.066	177.476	1715
Economic Globalisation	39.653	13.926	9.193	84.685	1409
		Panel B: With Instrumented Variables			
Industrialisation	11.035	6.692	0.031	38.277	1677
Remittances (IV)	501.187	406.236	16.395	1280.314	1666
Bank Efficiency (IV)	82.078	45.236	13.263	368.191	1528
Domestic Credit (IV)	18.467	15.064	0.770	106.684	1499
Trade Openness (IV)	70.039	37.348	3.441	255.733	1666
Gross Fixed Capital Formation (IV)	21.084	9.653	3.729	97.995	1628
Internet Penetration (IV)	216.831	230.654	35.874	768.000	1666
Population (IV)	14.786	22.244	0.076	177.335	1666
Economic Globalisation (IV)	39.867	13.577	10.303	84.298	1366

S.D: Standard Deviation. IV: Instrumental Variable.

Appendix 3: Correlation matrix

Panel A: With Un-instrumented Variables (Uniform sample: 1268)

Remit	BcBd	Domcred	Trade	GFCF	Internet	Pop	Ecoglob	Industria	
1.000	-0.001	0.198	-0.013	-0.057	0.417	0.097	0.073	0.097	Remit
	1.000	0.316	-0.078	-0.070	-0.192	-0.140	-0.192	0.019	BcBd
		1.000	0.215	0.222	0.135	0.024	0.298	0.288	Domcred
			1.000	0.569	0.057	-0.234	0.716	0.131	Trade
				1.000	-0.028	-0.031	0.465	-0.101	GFCF
					1.000	0.126	0.259	0.077	Internet
						1.000	0.053	-0.158	Pop
							1.000	0.104	Ecoglob
								1.000	Industria

Panel A: With Instrumented Variables (Uniform sample: 1219)

Remit (IV)	BcBd(IV)	Domcred(IV)	Trade(IV)	GFCF(IV)	Internet(IV)	Pop(IV)	Ecoglob(IV)	Industria	
1.000	-0.006	0.198	-0.014	-0.062	0.407	0.096	0.064	0.098	Remit(IV)
	1.000	0.321	-0.079	-0.072	-0.195	-0.138	-0.194	0.022	BcBd(IV)
		1.000	0.205	0.222	0.123	0.031	0.285	0.291	Domcred(IV)
			1.000	0.568	0.052	-0.237	0.715	0.135	Trade(IV)
				1.000	-0.034	-0.038	0.465	-0.082	GFCF(IV)
					1.000	0.122	0.248	0.070	Internet(IV)
						1.000	0.051	-0.161	Pop(IV)
							1.000	0.099	Ecoglob(IV)
								1.000	Industria

IV: Instrumented value. Remit: Remittances. BcBd: Bank Credit to Bank Deposits. Domcred: Domestic credit to the private sector. GFCF: Gross Fixed Capital Formation. Pop: Population. Ecoglob: Economic Globalisation. Industria: Industralisation.