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## Article

# Impact of china's outward fdi on sub-saharan africa's industrialization: Evidence from 26 countries

Cogent Economics & Finance

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*Suggested Citation:* Megbowon, Ebenezer; Mlambo, Courage; Okuneye, Babatunde Adekunle (2019) : Impact of china's outward fdi on sub-saharan africa's industrialization: Evidence from 26 countries, Cogent Economics & Finance, ISSN 2332-2039, Taylor & Francis, Abingdon, Vol. 7, Iss. 1, pp. 1-14,  
<https://doi.org/10.1080/23322039.2019.1681054>

This Version is available at:

<https://hdl.handle.net/10419/270687>

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To cite this article: Ebenezer Megbowon, Courage Mlambo & Babatunde Adegunle | (2019) Impact of china's outward fdi on sub-saharan africa's industrialization: Evidence from 26 countries, Cogent Economics & Finance, 7:1, 1681054, DOI: [10.1080/23322039.2019.1681054](https://doi.org/10.1080/23322039.2019.1681054)

To link to this article: <https://doi.org/10.1080/23322039.2019.1681054>



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Received: 01 March 2019  
Accepted: 07 October 2019  
First Published: 15 October 2019

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Reviewing editor:  
Christian Nsiah, Baldwin Wallace University, United States

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## GENERAL & APPLIED ECONOMICS | RESEARCH ARTICLE

# Impact of china's outward fdi on sub-saharan africa's industrialization: Evidence from 26 countries

Ebenezer Megbowon<sup>1\*</sup>, Courage Mlambo<sup>2</sup> and Babatunde Adekunle<sup>3</sup>

**Abstract:** The growing involvement of China in the African region has continued to stimulate questions on the impact of her involvement in the region. This paper attempt to contribute to this debate and as well pursue a development goal by empirically answering the question that “can China’s FDI in sub-Saharan Africa (SSA) stimulate the sub-region’s industrialization?” Consequently, data used for this study were obtained from China Africa Research Initiative, the World Bank and the Energy Information Administrator (EIA) websites for a sample of 26 economies in the SSA over the period 2003–2016. Panel-Corrected Standard Error (PCSE) was used to achieve the objectives of the study. The PCSE estimate result indicates that China’s FDI in SSA has an insignificant but positive effect on SSA industrialization. Suggesting that China’s FDI is not enough to boost industrialization in SSA. Furthermore, the result shows that the electricity supply in SSA has a significant and positive impact on industrialization in the continent. For SSA to benefit from China FDI significantly, SSA government must prioritize and where necessary modify future agreement to promote or prioritize Chinese investment in sectors with

### ABOUT THE AUTHORS

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### PUBLIC INTEREST STATEMENT

The rising interest and involvement of China in the Africa continent is perceived to be a subtle neo-colonization of Africa by China. Empirically, the impact of China involvement in the continent has been mixed as well. In view of this, the study examined the impact of Chinese FDI on SSA’s industrialization, an economic outcome which has not been investigated using panel econometric models. The outcome of the study flags a caution to SSA government on the nature of their agreement with China considering the fact that China FDI in the continent is found to be insignificant to her industrialization process and pursuit.

positive linkages with the manufacturing sector and increasing local outsourcing of inputs and intermediate production activities.

**Subjects: Macroeconomics; Econometrics; Development Economics**

**Keywords: China; FDI; industrialization; sub-Saharan Africa**

**Subjects: C23; F21; O14**

### 1. Introduction

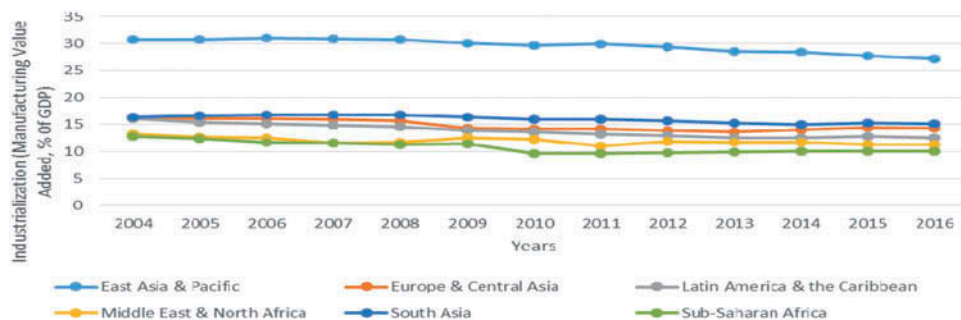
At the United Nations summit held in New York in 2015, 17 ambitious Sustainable Development Goals (SDG) also referred to as post-2015 development agenda were adopted by world leaders as a continued pursuit of global development, following various successes recorded with respect to the MDGs (Millennium Development Goals) of 2015 and these goals have been targeted to be achieved by the year 2030. One of these goals is the goal number 9 which is “to build resilient infrastructure, promote sustainable industrialization and foster innovation”. Industrialization which is a subset of the 9th goal and related to the manufacturing sector is imperative as noted by United Nations Development Organizations (UNIDO, 2017) because it covers economic, social and environmental dimensions of sustainable development which is applicable to both developing and developed countries. Besides, Anyanwu and Ozurunma (2018) noted that a thriving manufacturing sector often triggers industrialization.

The importance of industrialization is further buttressed as being a distinguishing factor and reason for inequality and wealth gap between developed and developing countries. UNIDO (2017) estimated that it will take more than 100 years for the LDCs to achieve the current level of industrialization of industrialized economies and around 50 years if the rate of industrialization grows at a hypothetical rate of 10% per annum. Unfortunately, it is asserted by Gui-Diby and Renard (2015) and Carmignani and Mandeville (2014) that Africa in general has never been industrialized, or as noted by Morris and Fessehaie (2014) has weak industrialization level, this is buttressed in Figure 1.

Figure 1 reveals that when compared to the rest of the world industrialization in sub-Saharan Africa (SSA) region has been consistently low, it declined from about 13% in 2004 to 11.4% in 2009. Between 2010 and 2015, industrialization rate between 2010 and 2016 remained at an average of 9.8%. The figure further reveals that the East Asia and Pacific region top industrialization rate between 2004 and 2016. However, slight decline was observed across various regions which is an indication of de-industrialization and may be associated with the global financial crisis experienced in the period. Hence, without doubt rapid industrialization is indispensable especially for the SSA region which is home to the highest proportion (67.4%) of less-developed economies (LDE) in the world.

**Figure 1. Graph drawn by Authors.**

Source: Data for the graph was obtained from the World Bank



Foreign direct investment (FDI) flows have been theoretically argued to be imperative for economic prosperity and sustainability which has elements of industrialization, employment generation, capital formation, environmental sustainability and economic growth among others (Liu, Hao, & Gao, 2017). Specifically, FDI is important in countries where there is lack of capability to explore natural resources due to poor human and physical capital, inadequate technological know-how and economic instability (Iamsiraroj & Ulubaşoğlu, 2015; Megbowon, Ngarava, & Mushunje, 2016). It is further maintained that the need to promote the dynamics related to efficiency in consumption of factors of production and their subsequent outputs through transferring of technology innovation to developing economics can only be achieved through international trade with and the incorporation of FDI from developed economies, respectively (Alvarado, Iñiguez, & Ponce, 2017; Anwar & Nguyen, 2010). Thus, with globalization and economic integration, the importance of FDI in economic growth and development remains unquestionable.

However, evidences from empirical literature indicate that its impact have not been equal across economies of the world (Alvarado et al., 2017; Folawewo & Adeboje, 2017; Gui-Diby & Renard, 2015; Inekwe, 2013; Jude & Silaghi, 2016; Makun, 2017; Megbowon et al., 2016; Sunde, 2017). This according to Zhao and Du (2007), Folawewo and Adeboje (2017), Adams and Opoku (2017) is largely due to the source, type and drivers of FDI, concentration and recipient sector of FDI and the nature of production technology in such sector, recipient countries' absorptive capacity, such as a free trade policy, export-oriented FDI policy and the level human capital development. Thus, considering the lagging behind of SSA's industrialization which is relatively due to inability of attracting sufficient FDI as noted by Chen, Geiger, and Fu (2015), and the recent significant increase in China's FDI in SSA as well as China's level of industrialization, this paper's objective is to empirically answer the question that "can China's FDI in the SSA sub-region stimulate the region's industrialization?". This paper contributes not only to issues and literatures on FDI-industrialization relationship but most especially on China's FDI impact on SSA's development and industrialization process. The rest of this paper is divided into four sections: a review of relevant literature is presented in section 2; section 3 discusses the methodological approaches used in the study. Results and discussion, and conclusion are presented in sections 4 and 5, respectively.

## 2. Literature review

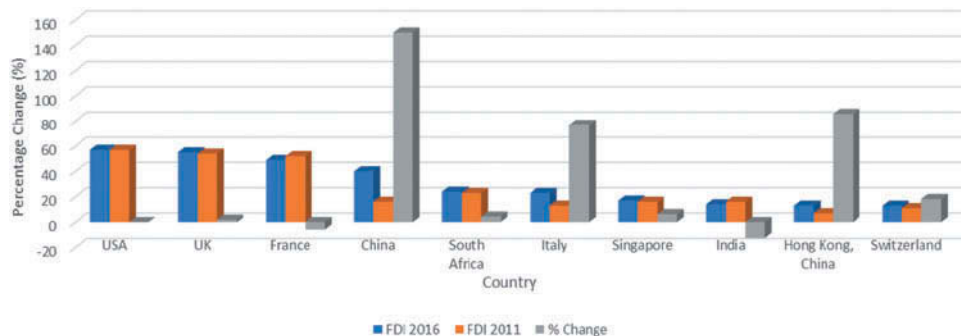
### 2.1. Chinese FDI in Africa

Recently, China emerged on the international financial scene across the world and as the largest SSA export destination, financier, development and investment partner with a growing outward FDI in the continent. This significant presence is unsurprising considering the "Go Global" policy of the Chinese government which was launched in 1999. The policy as pointed out by Luo, Xue, and Han (2010) is because of the growing awareness of Chinese leaders that offers China an opportunity to project its influence and power beyond the boundaries of the Chinese nation-state, thus allowing China to "rise" and fortify its influence in the structures and protocols governing international politics and the world economy. Likewise, as noted by Ding, Akoorie, and Pavlovich (2009), the policy encourages strong Chinese enterprises to invest more overseas to improve their competitiveness and secure an international business presence.

China's engagement in Africa is seen in development finance (aid and loans), trade, investment and infrastructural support which are considered economic (Donou-Adonsou & Lim, 2018; Mlambo, Kushamba, & Simawu, 2016). In terms of investment, as at 2015, China has direct investment in 51 African countries and these direct investment stock has increased significantly over the years compared to other countries as clearly shown in Figure 2. Inward FDI (stock) from China increased by over 150% from US\$ 16 billion in 2011 to about US\$ 40 billion in 2016. Donou-Adonsou and Lim (2018) noted that China's FDI explosion in Africa which is preceded by President Jiang Zemin and President Hu Jintao visit to Africa in 1996 and 2004, respectively, is driven by the increased demand for resources and markets to support China's fast-growing economy, with a corresponding commitment to the growth and development of Africa. China's fast growing

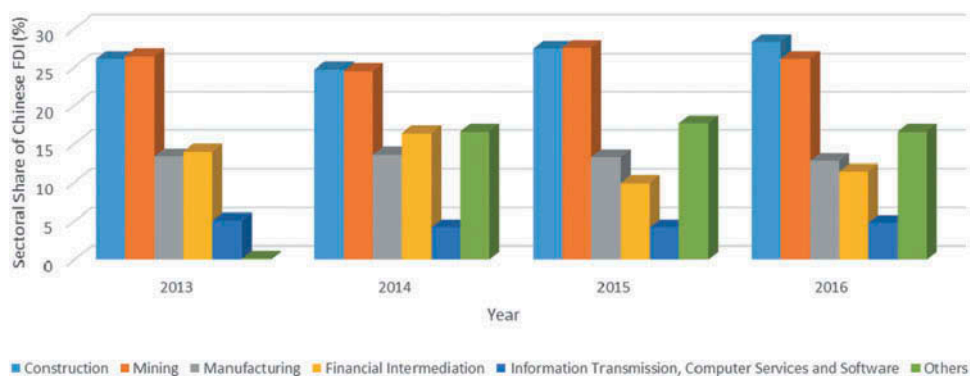
**Figure 2. Comparative distribution of FDI inflow in Africa.**

Source: Data for the graph was obtained from UNCTAD



**Figure 3. Sectoral share of China FDI in Africa.**

Source: Data for the graph was obtained from China-Africa Research Initiative



economy is also reflected in its level of industrialization. Specifically, between 2004 and 2011, the share of industrial output in China was about 33% and from 2012 to 2015, the share of industrialization to GDP hovered around 30%. This economic performance positioned China as a country which could expand its business empire to other countries of the world.

Also, as shown in Figure 3, Chinese investment in Africa covers various sectors which include construction, mining, manufacturing, financial intermediation, information transmission, computer services and software and others, which is an indication of the diversification of its foreign investments in the continent. Nevertheless, as shown in Figure 3, the construction and mining sectors continue to be the main sector target of Chinese investment. Both sectors received the highest proportion of total FDI inflow from China between the years 2013 and 2016, accounting for 26.1% and 26.4% in 2013, and 28.6% and 26.1% in 2016, respectively. The information, transmission, computer service and software sector received the least, receiving a meagre 5.1%, 4.2%, 4.2% and 4.8% in 2013, 2014, 2015 and 2016, respectively. The high proportion of Chinese investment in the mining and construction sectors in the continent is because China needs natural resources to power her economic growth, but on the other hand offers loans to African governments for infrastructural development purposes. These loans are, however, offered on the condition that Chinese firms are involved in the construction and building of infrastructures (Bräutigam, Diao, McMillan, & Silver, 2017; Bräutigam & Gallagher, 2014).

## 2.2. Empirical literature review

Several strands of empirical literatures exist on the impact of FDI on industrialization and have reported contradictory findings on the magnitude of impact and causality relationship between FDI and industrialization. Firstly, there are studies that show a positive effect of FDI on industrialization. For example, Dabla-Norris, Thomas, Garcia-Verdu, and Chen (2013) in their study, on benchmarking structural transformation across the world, found that FDI in non-resource sectors is positively and significantly associated with manufacturing value added for a panel of 168

countries considered. The empirical result suggests that liberalization of FDI can boost productivity growth in manufacturing and service sectors in middle-income countries and foster economy-wide productivity gains. Anyanwu (2017) examined key drivers of manufacturing value added in the Northern Africa sub-region using pooled panel OLS regression with year fixed effects and the IV-2SLS estimates over a time series of cross-sectional data set for the period 1990 to 2014. Among the several findings of the study, inward stock of FDI in the sub-region was found to be having a significant and positive relationship with manufacturing development. Adegboye, Ojo, and Ogunrinola (2016) investigated the impact of FDI on Africa's industrial performance using panel of 43 African countries for the year period 1995–2015 using both pool OLS and fixed effect least square dummy variable estimations. A positive and statistically significant but negligible impact was revealed from the result of both estimations. Ongo Nkoa (2016) investigated the impact of FDI to the industrialization in the Africa using the generalized method of moments (GMM) in system estimation approach for information obtained from 53 African countries for the period 1975–2014. Findings from the study show the impact of FDI in Africa to be very significant when industrialization is proxy by industry value to GDP but not industrial employment. This suggests that FDI in the continent is not employment-driven perhaps due to the capital-intensive nature of foreign investments.

Secondly, there are other empirical investigations that reported negative influence of FDI on industrialization. For instance, Nwosa (2018) concluded that FDI is harmful to the Nigerian industrial sector in the short-run following a negative but significant result obtained from the application of an error correction model over the period 1970–2016. Gui-Diby and Renard (2015) examined the relationship between inward FDI and the industrialization process in Africa for a panel of 49 countries from 1980 to 2009 and found that inward FDI did not have a significant impact on the industrialization of the countries examined. The study proposed that the role of FDI in the transformation agenda, which is currently being discussed in Africa, should be carefully analysed to maximize the impact of these capital inflows. In a study carried out by Anyanwu and Ozurunma (2018) where FDI stock was incorporated in the assessment of impact of human capital on industrialization in Africa for the period 1990–2011, inward FDI was found to have a significantly decreasing impact on industrialization in the continent.

Additionally, some other studies considered analysis of inward FDI and their relative impacts on disaggregated manufacturing sector components. Anyanwu and Kponnou (2017) in their study found that inward FDI stock is not significantly related to food, beverages and tobacco MVA (Manufacturing Value Added) in the all-Africa and SSA samples but very significantly reduces FBT in North African countries. Also, the study found inward FDI stock to be positive and significantly related to food and beverages MVA in the SSA sample only. In another disaggregated analysis of the manufacturing sector by Anyanwu and Ozurunma (2018), it was revealed that FDI inward stock is significantly and positively related to machinery and transport equipment value added but differs (negative and significant) with respect to food beverages and tobacco and chemicals value added. This suggests that impact of inward FDI differs across sectors. The study of Kanu, Nwaimo, Onyechere, and Obasi (2017) where the Nigerian industrial sector was disaggregated into manufacturing and mining sub-sectors showed that the impact of FDI is only positive and significant in the mining sub-sector in the short-run. This shows that foreign investors are mostly interested in the natural resource of the country, a sector where maximum return can be obtained. It is further worrisome that no spill-over effect from the mining sub-sector that would have improved the development of the other sectors of the economy is observed. Samouel and Aram (2016) in their study where GMM approach was utilized found that the impact of inward FDI on industrialization differs among African region examined. For example, the impact of FDI on industrialization was significant for only Southern Africa but not significant for North Africa, Eastern Africa and West African regions, respectively.

Beside FDI inflow, quite a few other macroeconomic indicators that have some extent of impact of industrialization have been identified in several literatures. These indicators include income,

domestic investment, monetary policy, financial development, globalization, human capital, political factor, migration and infrastructure among others (Dong, Song, & Zhu, 2011; Mawejje & Mawejje, 2016; Okey, 2017; Tabi & Ondo, 2011; UNIDO, 2017; Weiss & Clara, 2016). Finally, with respect to the impact of China's FDI on the African economy, empirical studies in this regard have been considered in relation to economic growth, bilateral trade and employment. On economic growth, by testing economic growth determinants in SSA countries based on growth accounting theory, Zhang, Alon, and Chen (2014) found that neither FDI net inflows nor Chinese FDI in SSA has a significant effect on economic growth in the sub-region. A contrary conclusion was however reached in the study of Doku, Akuma, and Owusu-Afriyie (2017) where a 1% increase in China's FDI stock in Africa was found to significantly increase Africa's gross domestic product (GDP) growth by 0.607%, all things being equal following fixed effect estimation carried out by the authors. Donou-Adonsou and Lim (2018) examined the impact of Chinese FDI on the standard of living in Africa. Estimates from the study show that Chinese FDI plays a more important role in raising income per capita in the African region. It further suggests that Chinese investment is mutually beneficial for both China and Africa. Using a panel data for the period 2007–2012, Khodeir (2016) investigated the effect of Chinese FDI on employment in 38 countries in African countries. The result from the study indicates that for Africa as a whole, Chinese direct investments had a significant positive effect on employment. A robust regression estimation from the study of Boakye-Gyasi and Li (2015) also suggests a positive and significant impact of inward Chinese FDI flows on employment in Ghana via a direct effect on building and construction sector of Ghana. This study builds on the literature on impact of Chinese FDI by investigating its impact on industrialization in the SSA.

### 3. Methodology

#### 3.1. Model specification and econometric technique

The impact of FDI on host country's economic performance and development, mostly economic growth, has been foregrounded in formal hypothesis, growth theories and models, for example the Endogenous and New Growth Theories. On the other hand, FDI's impact on other economic performance indicators like industrialization and poverty reduction is majorly based on logical grounds or on the theory of spill-over effects. Rostow's five stages of development theory also identified that capital accumulation through external support which include FDI is necessary for poor countries in the take-off stage of development, that is, the third stage. Therefore, the model specification used in this study is based on an assumed linear relationship which is also in line with the study of Gui-Diby and Renard (2015). This is expressed as follows:

Firstly, a generic panel model which is stated in the following mathematical function is presented in Equation 1.

$$y_{it} = \varnothing + \alpha_i X_{it} + \varepsilon_{it} \text{ where } i = 1, 2, \dots, n, t = 1, 2, \dots, T \quad (1)$$

where  $y_{it}$  is a vector of the dependent variable;  $\varnothing_i$  is the intercept which represents the country-specific effect;  $X_{it}$  the matrix of independent variables;  $\alpha_i$  is the vector coefficients of independent variables; and  $\varepsilon_{it}$  is the error term which is assumed to be normally distributed. Secondly, to restrict Equation (1) to only the objective of this study, the variables used in the study were substituted in Equation (1) in their logarithm form to arrive at Equation (2).

$$\ln INDS_{it} = \varnothing + \alpha_1 \ln CFDI_{it} + \alpha_2 \ln ELECT_{it} + \alpha_3 \ln Y_{it} + \alpha_4 \ln DI_{it} + \alpha_5 \ln EXP_{it} + \alpha_6 \ln IMP_{it} + \varepsilon_{it} \quad (2)$$

where  $INDS$  is industrialization, it is the variable of interest and an important component of the SDGs.  $CFDI$  represents Chinese FDI inflow (stock) and the second variable of interest,  $ELECT$  is defined as the total electrical power generated or supplied,  $Y$  is income,  $DI$  is domestic investment,  $EXP$  is export and  $IMP$  is import. The logarithmic transformation of the model helps capture the non-linear and non-monotonic relationship between the industrialization and the independent variables. Also, the transformation of the variables implies that the coefficients of the variables



measure elasticities. The conversion is necessary in order to scale down the raw data of variables and generates better estimation results. A panel estimation approach is used because of its superiority over cross-section and time series data in using all the evidence obtainable, which are not measurable in pure cross-section and time series (Baltagi & Kao, 2000).

To investigate the impact of Chinese FDI on SSA industrialization, the study employed the panel-corrected standard errors (PCSE) estimation technique, although other static panel estimation techniques, fixed effect (FE) Hausman (sigmamore option) and feasible generalized least squares (FGLS) were carried out but are known to be less efficient compared to PCSE. The PCSE technique is employed because it provides an estimate that put the problems of unobserved autocorrelation and heteroscedasticity into consideration, thus producing robust standard errors (Beck & Katz, 1995). PCSE uses OLS parameter estimates but replaces the OLS standard errors with PCSE.

### 3.2. Data

This paper used data on manufacturing sector value added as percentage of GDP (a proxy for industrialization), Chinese FDI stock, electricity supply, income, domestic investment (proxied by gross fixed capital formation), export and import for a sample of 26 economies in SSA comprising of Angola, Benin, Botswana, Burkina Faso, Cameroon, Congo Democratic Republic, Congo Republic, Cote d'Ivoire, Gabon, Ghana, Guinea, Kenya, Liberia, Malawi, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sierra Leone, South Africa, Tanzania, Togo, Uganda and Zimbabwe. The choice of the scope of these 26 countries was basically determined by the availability of data for the variables of interest for a balanced panel analysis. Moreover, these countries all together account for an average of about 68% of Chinese FDI in the region between 2003 and 2016 and are therefore sufficient representatives' recipients of Chinese FDI in the region. Data on industrialization, income, domestic investment, export and import were sourced from the World Development Indicators (WDI) of World Bank; electricity supply data were obtained from the Energy Information Administrator website ([www.eia.gov](http://www.eia.gov)); and China FDI stock data were sourced from China-Africa Research Initiative website ([www.sais-cari.org](http://www.sais-cari.org)). All data were converted to natural logarithm and covers a time from 2003 to 2016 for all sampled countries.

**Industrialization (INDS)** is the dependent variable and first main variable of interest in this study, and it is often used synonymously in relation to the manufacturing sector. Opoku and Yan (2019) defined it as an increase in the value added of the secondary sector (that is non-agricultural and non-services sectors) in relation to GDP. According to United Nations Development

**Table 1. Summary of variable description**

Variable	Description and Unit of Measurement	Source
<b>Industrialization</b>	Manufacturing sector value added as percentage of GDP (%)	World Bank
<b>CFDI</b>	China's Foreign Direct Investment (stock) in Africa (US\$ Million)	China-Africa Research Initiative website
<b>Electricity Supply</b>	Net Electricity supply Billion Kilowatt/hour	EIA
<b>Income</b>	Proxy by GDP per capita (constant 2010 constant prices, US\$)	World Bank
<b>Domestic Investment</b>	Proxy by Gross Fixed Capital Formation as (% of GDP) Percentage	World Bank
<b>Export</b>	Exports of goods and services (% of GDP) Percentage	World Bank
<b>Import</b>	Imports of goods and services (% of GDP) Percentage	World Bank

Source: Authors

Organizations (UNIDO) (2017), it is measured as manufacturing sector value added as percentage of GDP or per capita GDP. It is also a measure of percentage contribution of manufacturing sector employment of total employment. For this study, industrialization is proxy by manufacturing sector value added as percentage of GDP.

**China's Foreign Direct Investment (CFDI)** is the main interest of the study. Considering the levels of industrialization and technology advancement in China, FDI from China could stimulate industrialization process in SSA all thing being equal through the deployment of its' technologies into the region and opening of its' domestic market to external market. Inward FDI stock rather than flow was utilized because unlike FDI flows, FDI stock captures the total amount of productive capacity owned by foreign investors in the host country over time. Such that it provides a better approximation of the long-run behaviour of investment decisions which is imperative for relevant economic performance (Camarero et al., 2018).

**Electricity Energy Supply/Generation (ELECT)** is also a stimulant or otherwise of industrialization, it is one of the energy sources that provide fundamental support for growth and development across the world (Abokyi et al. 2018; Mawejje & Mawejje, 2016) and it directly reflects the growth potential of the manufacturing sector. This suggests that the amount of electricity energy supplied can inhibit or boost the level of industrialization (Abokyi et al. 2018). Osakwe (2018) noted that poor energy infrastructure reduces capacity utilization, makes domestic firms less effective and hinders lending to local manufacturing firms.

**Income (Y)** as one of the factors that impacts industrialization reflects the level of demand for commodities, measures of output level which also relates to production and ultimately the size of the domestic market (Dong et al., 2011). An increasing income promotes industrialization and establishment of modern industries. The variable is proxy by per capita GDP.

**Domestic Investment (DI)** which is the total of investment in the form of available and necessary infrastructure and technologies that support and stimulate industrial growth in an economy promote industrialization by stimulating aggregate demand and boosting productive capacities (Martorano & Sanfilippo, 2017; Weiss & Clara, 2016). As a result, higher investments play a key role in sustaining the development of the local industry, fostering structural transformation and being a pre-requisite for long-term growth (Cornia & Martorano, 2012; Martorano & Sanfilippo, 2017). The variable is proxy by gross fixed capital formation.

**Export (Exp)** can also lead to industrialization by speeding up the industrialization process of a country through exporting goods for which the nation has a comparative advantage. Also, in taking advantage of trade openness, export can promote exploitation of economies of scale, access to enlarged size of the market only if local resources can be deployed in adequate quantities to produce goods for the external market and generate technological progress in response to consumption abroad among others. However, the extent of impact depends on the type, amount and sectoral source or destination of export of a country (Guadagno, 2016; Gui-Diby & Renard, 2015; Kaya, 2010; UNIDO, 2017).

**Import (Imp)** is another component of globalization which exerts some level impact of industrialization with respect to the type, amount and sectoral source or destination of import into a country (Gui-Diby & Renard, 2015; Kaya, 2010; Tabi & Ondo, 2011). Importation of advanced technologies in manufacturing process could aid industrialization while the importation of finished consuming commodities could be detrimental to industrialization process.

#### 4. Results and discussion

Table 2 gives a brief description of the variables used in the estimations with respect to correlation which is a measure of the direction and strength of linear relationship between the variables in the model. From Table 2, the correlation between industrialization and Chinese

**Table 2. Correlation matrix**

	lnINDS	lnCFDI	lnELECT	lnDI	lnY	lnEXP	lnIMP
<b>lnINDS</b>	1.0000						
<b>lnCFDI</b>	0.0638	1.0000					
<b>lnELECT</b>	0.1903	0.0341	1.0000				
<b>lnDI</b>	-0.1418	0.1675	0.0459	1.0000			
<b>lnY</b>	0.1820	0.2959	-0.0894	0.2457	1.0000		
<b>lnEXP</b>	0.0014	0.1314	-0.0219	0.0951	0.5870	1.0000	
<b>lnIMP</b>	-0.2563	0.0374	-0.0503	0.0844	0.0187	0.5477	1.0000

Source: Authors

**Table 3. Levin–Lin–Chu panel unit-root test**

Variable	Level			Decision
	Unadjusted t	Adjusted t*	P-value	
<b>lnindus</b>	-11.8137	-8.6967	0.0000	I (0)
<b>lnCFDI</b>	-10.6123	-8.5243	0.0000	I (0)
<b>lnELECT</b>	-6.3282	-4.4609	0.0000	I (0)
<b>lnY</b>	-5.9344	-4.5033	0.0000	I (0)
<b>lnDI</b>	-10.3402	-5.0248	0.0000	I (0)
<b>lnEXP</b>	-8.1393	-2.5002	0.0062	I (0)
<b>lnIMP</b>	-8.9887	-2.6792	0.0037	I (0)

Source: Authors

FDI, electricity generation, income and export are positive, suggesting that as these independent variables increase rate of industrialization increases as well, whereas the correlation among domestic investment, import and industrialization is negative. Likewise, following the argument of Dohoo, Ducrot, Fourichon, Donald, and Hurnik (1997) that multicollinearity is certain at the 0.9 level of a correlation coefficient or higher, then it can further be concluded that there is no possible multicollinearity among the variables examined in this study as shown in Table 2.

Beside the correlation relationship that was examined, the stationarity property of the variables was also examined using the Levin–Lin–Chu panel unit-root test. As shown in Table 3, the Levin–Lin–Chu bias-adjusted t-statistic is significant at all the usual testing levels (1%, 5% and 10%). Therefore, the null hypothesis that panels contain unit roots is rejected and it is concluded that the series/variables are stationary at level. Hence, since the variables are integrated at I(0), then investigating existence of cointegration relationship among variables becomes unnecessary. Rather, regression analyses with static panel estimation techniques reporting robust standard error are carried out.

Table 4 contains the results of three different static panel models, namely FE, FGLS and PCSE. However, as earlier mentioned and based on argument in literature (Beck & Kartz, 1995; Greene, 2003; Le, 2017), only the PCSE estimate is discussed. Results from PCSE estimation highlight that industrialization in SSA is significantly influenced by four of the six microeconomic factors examined, namely, electricity energy supplied, domestic investment, income and import. Thus, only the main variable of interest and the significant variables are discussed.

From Table 4, it could be seen that the variable of interest (China’s FDI) is positive but not significant. Specifically, the result indicates that a 1% increase in China’s FDI stock in the SSA

**Table 4. PCSE, FGLS and fixed effect estimation techniques**

	PCSE Estimations		FGLS Estimation		Fixed Effect	
	Coefficient	Robust Std. Err.	Coefficient	Robust Std. Err.	Coefficient	Robust Std. Err.
<b>Constant</b>	3.0565*	0.2293	2.8814	0.0782	7.9930*	2.8354
<b>lnCFDI</b>	0.0071	0.0059	0.0047**	0.0021	0.0337	0.0275
<b>lnELECT</b>	0.0639*	0.0067	0.0568*	0.0046	-0.0346	0.0511
<b>lnDI</b>	-0.2689*	0.0543	-0.2150*	0.0199	-0.0120	0.1013
<b>lnY</b>	0.1250*	0.0247	0.11174*	0.0075	-0.8367***	0.4372
<b>lnEXP</b>	0.0183	0.0894	0.0105	0.0140	-0.2044	0.1258
<b>lnIMP</b>	-0.3077*	0.0782	-0.2785*	0.0166	0.1871	0.1435
<b>No of obs.</b>	364		364		364	
<b>No. of Groups</b>	26		26		26	
<b>No. of Instruments</b>			-			
<b>Wald chi<sup>2</sup>(6)</b>	158.17		1335.52		3.25	
<b>Prob &gt; chi<sup>2</sup></b>	0.0000		0.0000		0.0169	

Notes: \* p < 0.01, \*\* p < 0.05, \*\*\* p < 0.10

region significantly though negligible reduces SSA's industrialization by 0.007% all things being equal. This means that China's FDI stock in SSA cannot be relied on for the continental industrialization process. Possible explanation for this could be that China has no substantial interest in the manufacturing sector as revealed in the Figure 4 of the study showing low Chinese FDI in the sector, being that it has no maximum impact on China's growing economy. Other possible reason is that main sector focuses on Chinese FDI have no form linkages with the manufacturing sector of SSA, or the tendency for foreign investors pushing out of local manufacturing industries from business due to their monetary resource and technical advantage. Equally, situation like this arises when foreign investors refuse to utilize local intermediate good suppliers for their production activities but rather massively import finished goods into their host countries economy, utilize advanced technologies that provide economics of scale and eventually knocks out local competitors out of business. In this case, the negative effect of inward foreign investment on local industries out ways, positive contribution thereby making its impact altogether insignificant.

The coefficients for electricity energy supply are positive and significant, indicating that 1% increase in the total electricity energy supplied leads to about 0.064% increase in industrialization level. This finding is similar to some empirical studies that found a positive and causal relationship from electricity consumption to industrial output (Danmaraya & Hassan, 2016; Mawejje & Mawejje, 2016; Abid & Mraih, 2015). This implies that electricity is an essential infrastructure that can enhance economic activities in the SSA and without it the production capacity of the industry is marred. The implication of this finding is that SSA government should accelerate its provision of infrastructural facilities like electricity that will guarantee, promote and improve small-scale entrepreneurship, commercial manufacturing sector capacity utilization and performance.

Income which is proxied by per capita GDP was found to be a significant determinant of industrialization in SSA, thus reflecting the idea that as income increases the probability of industrialization increases as well and which is also in line with the *a priori* expectation of this study. From the Table 4, 1% increase in income will significantly decrease industrialization in the SSA region by about 0.13% if all other variables are held constant. This could be as a result of increasing possibility of fund being freed for manufacturing sector use as income increases could promote industrialization. The result also shows a negative relationship between domestic

investment and industrialization. This is however not surprising because of power investment and low infrastructure and technologies obtainable in majority of SSA economies. The result is in line with the study of Adose and Oyedokun (2018) which was carried out in Nigeria and revealed a negative non-significant relationship between economic growth and capital formation in Nigeria. Poor spending on relevant infrastructure, and in ability of necessary monetary policy that attract private domestic investment, or inflow like high interest rate to fund necessary infrastructural investment could be possible for such result.

Concerning the impact of import, the analyses show negative but significant result. This is not unexpected considering the argument put forward by UNECA (2011) that African countries have a growing dependence on imports which has eroded her weak industrial base. In this case, it is the importation of manufactured consumption good rather than industrial machines and equipment which would have benefited the manufacturing sector's productivity. This is supported by the studies of Edwards and Jenkins (2015) and Makoto and Ngendakumana, (2018) who all noted that import penetrations from China has negatively affected the clothing and textile in South Africa, and wood and furniture and paper industry in Zimbabwe, respectively. This is also a reflection of the failure of the import substituting industrialization strategy in promoting the performance of the manufacturing sector in the region which Mendes, Bertella, and Teixeira (2014) and Makoto and Ngendakumana, (2018) noted to be as a result to great structural constraints of the domestic market, strong external restrictions, fragile institutions domestic firms' rigidity in design and dynamic inefficiencies coupled by failure to respond to diverse and ever-changing consumer needs, respectively. For instance, the results suggest that increased import penetration from China caused South African manufacturing output to be 5% lower in 2010.

## 5. Conclusion

There has been a significant increase in the level of FDI from China as revealed by several studies and data. The positive or otherwise effect of this huge financial flow has been generating debates in different quarters thereby, necessitating the need for this study seeking to examine the effect of FDI flow from China on industrialization perspective of SSA using a panel study of 26 SSA countries. A PCSE estimation was used to achieve the objective of the study. Findings from the study show that Chinese FDI has an insignificant but positive impact on industrialization in SSA. This implies that rather than the continent getting industrialized, as a result of increasing investment from China, the reverse is the case. The study also found that electricity supply has both significant and positive effects on industrialization in SSA. An increase in the rate of electricity supplies to a substantial development of the industrial sector.

Based on these findings, SSA governments need to take advantage of market or resource seeking Chinese FDI to benefit the region's manufacturing sector by ensuring China FDI is focused on sectors that have positive backward and forward linkages with the manufacturing sector, increased domestic content-based sourcing for inputs of production where possible and contracting out of necessary intermediate good production activities in production process to domestic entrepreneurs. The study also suggests that government, in a bid to entertain Chinese FDIs in SSAs, should safeguard local industries, by ensuring that they are not suffocated or outmuscled by the financial and technology prowess of the Chinese investments. Additionally, SSA government should ensure adequate electricity supply for the industries to carry out their economic activities. If this is not done, the capacity utilization of the industries will not be optimal as activities will be stalled and where alternative power is provided by the industries, it would have a ripple and adverse effect on cost of production, then the pricing of goods and, ultimately, the welfare (cost of living) of the citizens. Equally, measures that could encourage the consumption of locally made commodities should be promoted.

### Funding

No specific grant from any funding agency in the public, commercial, or not-for-profit sectors was received for this study.

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### Disclosure Statement

The authors do not have any competing financial, professional, or personal interests from other parties.

### Citation information

Cite this article as: Impact of china's outward fdi on sub-saharan africa's industrialization: Evidence from 26 countries, Ebenezer Megbowon, Courage Mlambo & Babatunde Adekunle, *Cogent Economics & Finance* (2019), 7: 1681054.

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