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Comparative Effects of Foreign Direct Investment from China and Other Sources on Africa's Economic Growth

Marvelous Ngundu
College of Business and Economics
University of Johannesburg

Nicholas Ngepah
College of Business and Economics
University of Johannesburg

Abstract
This study examines comparatively the growth effects of FDI from China, EU, US and the rest of Asia in sub-Saharan Africa for the period (2003-2012). We develop theoretical arguments from the existing literature to show that differences in FDI data sources, methodological and econometric approaches may be part of the explanation for mixed findings of previous empirical studies, precisely on the growth effects of Chinese FDI in Africa. Our results using the 2SLS estimator indicate a significantly negative direct impact of Chinese FDI on growth in sub-Saharan Africa while the impact of other FDI sources is statistically insignificant.

Keywords: *Africa; China; Economic Growth; Foreign Direct Investment.*

JEL: *B22; E22; F43.*

Author Information

Marvelous Ngundu*
PhD. Candidate (Economics)
College of Business and Economics
University of Johannesburg

Nicholas Ngepah
Associate Professor and Coordinator of PhD and Mcom RD Programmes
College of Business and Economics
University of Johannesburg

** Corresponding Author*
P.O Box 524
Auckland Park, 2006
South Africa.
Tel: +27734376829.
E-mail: marvengundu@gmail.com

1. Introduction

Conclusions drawn from various studies conducted to investigate FDI-growth nexus are more often based on aggregate FDI data, that is, total FDI in the host country. One thoughtful assumption of using aggregate FDI data is that all foreign investors in the host country act alike and therefore the impact is diluted evenly among different FDI sources. Nonetheless, the impact of FDI on growth is more likely to depend on the attributes and motives of the foreign investor, and it is rare that all investors in the host country can act alike although they can share common interests. Perhaps the scarcity of reliable disaggregated FDI data has been limiting researchers to provide formal empirical analysis based on specific FDI sources. Therefore, we seek to contribute to the existing studies using the data compiled by UNCTAD for the period (2001-2012).

Anecdotal evidence shows that European Union (EU) and the United States (US) are the traditional investors in the Sub-Sahara Africa. However, an analytical framework conducted by Sy (2014) reflects that the surge of inward stock of FDI in the region from US$27.2 billion to about US$132.8 billion between 2001 and 2012 was mainly inflamed by China. The latter argues that China's FDI grew at an annual rate of 53% compared with 16% for EU, 14% for the US and 29% for Japan. The boom of China's FDI in Africa has provided researchers with an opportunity to look deep into specific sources of FDI in Africa. In this respect, we recognize empirical contributions from various studies including; Donou-Adonsou & Lim (2018); Doku, Akuma, & Owusu-afriyie (2017); Chen, Dollar, & Tang (2015); Busse, Erdogan, & Muhlen (2014); and Zhang, Alon & Chen (2014). Although all these studies focus on China's FDI in Africa, their results vary in one way or another due to a number of factors including the database from which FDI statistics are extracted, treatment attached to the Chinese FDI variable, model specification approaches, and estimation techniques utilized.

In general, the aforementioned studies form two groups. The first group (Chen *et al*., *(2015);* Busse *et al*., (2014); Zhang *et al*., (2014)) uses outward Chinese FDI data from MOFCOM while the second group (Donou-Adonsou *et al*., (2018); Doku *et al*., (2017)) uses bilateral FDI data from UNCTAD. Pigato & Tang (2015) argue that MOFCOM data on outward Chinese FDI flows do not conform to the recognized definition of FDI as stipulated by OECD (2008). OECD's definition of FDI takes into account private investment only, yet MOFCOM includes both private and public financial flows from China. Chen *et al*., (2015) uses firm-level data of Chinese private investment in Africa from MOFCOM and argue that the source provides an accurate picture of Chinese FDI on the continent. On the other dimension, FDI statistics extracted from UNCTAD database are widely acknowledged of conformity to the international standards.

In the presence of FDI database controversy, the result of Chinese FDI impact on Africa's growth obtained by all the studies in the second group concurs with the finding of Chen *et al*., (2015). However, if equal comparison is applied between second group studies and the remaining first group studies, we can deduce that the result obtained using FDI data from UNCTAD contrasts the result obtained using FDI data extracted from MOFCOM, respectively.

Another set of differences derived from all these studies relates to model specifications, estimation techniques and the treatment attached to the Chinese FDI variable. While Chen *et al*., (2015) uses probit and tobit models, the rest of the studies seem to follow a Solow growth type of models, however, with different specifications, estimation techniques and measure for the Chinese FDI variable. To this end, it is logical to assume that the discrepancies outlined above can possibly contribute to results inconsistencies. This calls for the need to adopt a combination of sound FDI data, steady model specification approach, robust estimation technique, and acknowledged measurement of the Chinese FDI variable for the purpose of attaining robust results.

Accordingly, this study looks at the bilateral FDI statistics compiled by UNCTAD and adopts the FDI-Augmented version of Solow growth model proposed by Neuhaus (2006), following the lead of Mankiw, Romer & Weil (1992) and Bassanini & Scarpetta (2001). It also uses instrumental variables estimation technique and measures Chinese FDI as a percentage of the host country's GDP. The 12 years synthetic panel is built to overcome the very short time span of available bilateral FDI data between Africa and its key FDI sources in order to determine the growth effects of these sources over time.

Seeking to give some direction to this end, the study is composed as follows: Section 2 reviews the main empirical arguments with regard to FDI from China and other specific sources of FDI in Africa, the contribution of this study to empirical literature and the theoretical literature of FDI-Growth Nexus. Section 3 depicts the study's model, relevant econometric issues and data used to execute the model. Section 4 is the synopsis and analysis of the empirical findings. It also discusses the results and their robustness while Section 5 highlights conclusions and recommendations based on the results of the main parameters.

2. Growth Effects of Chinese FDI in Africa

Donou-Adonsou *et al*., (2018) investigate the importance of Chinese investment in Africa relative to traditional economic allies of the continent, including US, France, and Germany using a Solow-type growth model and 2SLS technique to 36 African countries over the period (2003-2012). Their results exhibit that all the aforementioned sources of FDI enhance economic growth in Africa. Precisely, the impact is more conspicuous for US, German, China, and France, respectively. Utilizing OLS fixed effects estimator to 20 African countries for the period (2003-2012), Doka *et al*., (2017) also found positive impact of Chinese stock of FDI on economic growth in Africa. The estimated coefficient of Chinese FDI resulted by the latter can be disputed based on probable endogeneity bias which OLS fixed effects can hardly account for. In line with both Donou-Adonsou *et al*., (2018) and Doka *et al*., (2017), the empirical work of Chen *et al*., (2015) shows that the dramatic increase of Chinese FDI in Africa has boosted economic growth on the continent. This result was obtained using probit and tobit models to 25 economic sectors in diverse African countries over the period (1998-2012).

In contrast, both Busse *et al*., (2014) and Zhang *et al*., (2014) found an insignificant impact of Chinese FDI on growth in sub-Sahara Africa using Solow growth and GMM estimator for the period (1991-2011) and (2003-2010) respectively. Following neoclassical growth theories, these studies incorporated the convergence term among other Solow growth variables unlike Donou-Adonsou *et al*., (2018). The other important factor relates to the treatment attached to the Chinese FDI variable. While Busse *et al*., (2014) and Zhang *et al*., (2014) account for China's FDI as a percentage of the host countries GDP, in the study of Donou-Adonsou *et al*., (2018) all sources of FDI including China were normalized using their price level of the capital stock. Such differences can be argued as part of the common cause for the discrepancy in the results reported by the studies in question.

Moreover, the econometric growth equation specified in the studies of Busse *et al*., (2014) and Zhang *et al*., (2014) is somewhat in line with that of Mu, Wang & Wu, (2017). Although the latter focus mainly on China's impact on SSA through the Lens of Growth and Exports, their growth regression output as it relates to Sub-Sahara Africa and its trade partners exhibits a negative and insignificant estimated coefficient of Chinese FDI. This result is consistent to the former. Interestingly, Mu *et al*., (2017) extracted their FDI data from China Africa Research Initiative (CARI), which is a different database from MOFCOM.

The econometric growth equation specified by Busse *et al*., (2014) is legendary relative to the peers in that it incorporates all fundamental determinants of the steady-state. That is, population growth, technological shocks, depreciation of the physical capital stocks, let alone the convergence term. The approach used by the latter to specify the Solow growth model concurs with other studies which explicitly adopted the neoclassical growth theory including Mankiw *et al*., (1992); Bassanini *et al*., (2001) and Neuhaus (2006).

At this point, it is logical to argue that Busse *et al*., (2014) provides both steady econometric growth equation and acknowledged measure for Chinese FDI variable while Donou-Adonsou *et al*., (2018) provides robust estimation technique and sound FDI database. We therefore adopt a hybrid of these strengths to complete the foundation of our contribution, however, without disregarding the contribution of other potential literature. The major aim being to establish robust estimates relating to the impact of Chinese FDI on growth in Africa. Further, we examine comparatively, the growth effects of the latter with FDI from US, EU and the rest of Asia in Africa.

2.1 Overlapping theories of economic growth

Economic growth is regularly defined as the sustained growth of potential output (Barro & Sala-i-Martin, 2004). Hidden implications of this expression can be drawn out using Economic Growth

Models. The primary reference of growth paradigms (exogenous growth models) was roused from the Cobb-Douglas production function by Solow and Swan (1956). These models regard technology as an exogenous source of long-term growth, implying that in the absence of technological progress, economic growth must eventually stop. The second era of growth theories (the endogenous growth models) progressed with the hypothesis of Romer (1986). The paradigms focussed mainly on specifying technological progress so as to counter for growth-destroying forces of diminishing returns in the long-run.

Romer (1986) specified technological progress as a function of research and development and assumed that investment in knowledge can generate positive externalities. Moreover, Lucas (1988), modelled technological progress as a function of human capital accumulation through education and learning-by-doing. Likewise, Mankiw *et al*., (1992) modified Solow's model and contended that excluding human capital accumulation in Solow's model would bring about the prejudiced estimation of the coefficient on saving and populace growth. They contended that cross-country differences in income per-capita are an element of differences in saving rate, populace growth rate, and the level of labour productivity. In essence, Barro (1990) asserted that capital and productive government expenditures are additional inputs that can positively enhance constant returns to scale.

2.2 Transmission channels of FDI on growth

In theory, there are three basic channels through which FDI affects economic growth; namely direct transmission, indirect transmission, and second-round transmission (Neuhaus, 2006).

2.2.1 Direct transmission Channel

In this channel, FDI is viewed typically as physical capital and technology input in the production function of the economy. It follows that FDI directly adds to physical capital widening and subsequently promotes economic growth. Exogenous Growth Models support the idea that an increase in physical capital coming from FDI bears transitory effects on the economic growth of the host economy. However, since FDI is another vital mechanism for technology transfer, the widespread conviction is that FDI must contribute to technological progress, and hence promote the long-run growth. In such manner, FDI can be seen as a vital growth upgrading variable for the nations that might constitute a contention for pro-FDI approaches.

2.2.2 Indirect Transmission Channel

The participation of foreign investors in the FDI-receiving companies is usually accompanied by an indirect transfer of management expertise and production know-how. This shift is effected through training and educating human capital of the FDI-receiving firms (Ozturk, 2007). However, the impact of this channel depends largely on the amount of knowledge transferred to the human capital of the host country. This argument is consistent with the endogenous growth model (Lucas, 1988) and the augmented Solow model of Mankiw *et al*., (1992).

2.2.3 Second-Round Transmission Channel

This channel affects economic growth through technology diffusion and knowledge spill over effects. MNCs are leaders in global Research and Development activities which makes them significant sources of innovation. Furthermore, Moura & Forte (2010) note that MNCs can initiate local research and development to boost their benefits in host countries. According to exogenous growth models, FDI might forestall capital falling into diminishing returns because of the presence of consistent contribution of the technology growth. On the other dimension, Romer (1986) on his 'AK' growth model, modelled technical progress as a function of knowledge spill overs. Through this fundamental yet imperative thinking, he inferred that technology diffusion and knowledge spill overs impel productivity coming about to increase economic growth both in the short and long-run.

2.2.4 Other transmission channels of FDI

FDI enhances the integration of the host country with the worldwide economy, specifically through the financial flows received from abroad (Sy, 2014). This connection is also exhibited by Mencinger (2003) who gives confirmation of an unmistakable relationship between the increase of FDI and the rapid integration into the worldwide trade. The integration also promotes economic growth which can expand as the economy turns out to be more open. For sub-Sahara Africa in particular, Zahonogo (2017) argues that trade threshold is still below the expected benchmark which trade openness can enhance economic growth. Therefore, the region is required to promote effective trade openness in order to enhance economic growth through international trade.

3. Model Specification

To analyse the growth effects of Chinese FDI and FDI from other sources in Africa, we use the FDI-Augmented version of the Solow growth model. The model was proposed by Neuhaus (2006) following the lead of Mankiw *et al*., (1992) and Bassanini *et al*., (2001). Since FDI can directly transmit to growth through physical capital accumulation, the model replaces Human Capital in the augmented-Solow model of Mankiw *et al*., (1992) with the stock of FDI. As a result, the model accommodates two types of capital stocks; foreign direct investment (K_f) and domestic capital investment (K_d).

$$Y(t) = K_d(t)^{\alpha} K_f(t)^{\beta} A(t) L(t)^{1-\alpha-\beta} \tag{1}$$

where Y is aggregate output, K is the stock of physical capital, A is the productivity parameter, L denotes labour input and the subscript t represents time. α and β represent production elasticities and they are assumed to vary for the two types of physical capital stocks. Bassanini *et al*., (2001) point out that $A(t)$

consists of two elements. One that accounts for various policy oriented variables such as institutional framework, inflation, terms of trade and other trade variables. The other element reflects exogenous technical progress, that is, all other unexplained trend growth variables which the model does not explicitly account for.

Since our model is inferred from and follows the neoclassical growth theories, we utilize changes in the log of per capita GDP in real terms as our dependent variable ($lny_{it} - lny_{it-1}$). The specification of our regressors incorporates fundamental determinants of the steady state, that is, lagged dependent variable (y_{it-1}), population growth rate (*n*), changes in technology (g), the rate of depreciation for capital stock (d), and domestic investment savings rate (s_d). Foreign investment savings rate (s_f) is not incorporated as the fundamental variable of the Solow model, rather, the variable of principal interest. Other control variables ($X_{i,t}$) represent the components of *A(t)* and they are discussed below. The basic model can be summarised using the following econometric statement:

$$lny_{it} - ln_{yit-1} = \alpha + \beta lny_{it-1} + \gamma lns_{d,it} + \emptyset lns_{f,it} + \varphi ln(n_{it} + g + d) + \varphi' lnX_{it} + \lambda_t + \eta_i + \varepsilon_{it} \quad (2)$$

$\lambda_t, \eta_i, \varepsilon_{it}$ proxy for period-specific effects that are assumed to affect all countries for example technology shocks, unobserved country-specific effects, and white noise error term respectively. In line with augmented Solow model of Mankiw *et al*., (1992), we assume the depreciation rate of the physical capital stock (*d*) and changes in technology (*g*) to be constant over time and equal to 0.05. Thus, Equation (2) can be presented as follows:

$$lny_{it} = \alpha + (\beta + 1) lny_{it-1} + \gamma lns_{d,it} + \emptyset lns_{f,it} + \varphi ln(n_{it} + 0.05) + \varphi' lnX_{it} + \lambda_t + \eta_i + \varepsilon_{it} \quad (3)$$

3.1 Data and variable description

This study measures per capita GDP in real terms for income levels, Gross Capital Formation as a percentage of GDP for domestic investment savings rate and the share of inward stock of FDI in GDP for the foreign investment savings rate. We use stock rather than flow data of FDI to capture for perpetual and some of the immeasurable effects of FDI on growth. Neuhaus (2006) argues that the ratio of inward stock of FDI to GDP is more accurate than flow in capturing for perpetual and some immeasurable effects of FDI on economic growth. FDI is differentiated between FDI from a particular source and FDI from the rest of the world (ROW) to sub-Saharan African countries. FDI from ROW is controlled by subtracting source's FDI from the total inward stock of FDI to Africa. For population growth, we add 0.05 before generating logs. The components of X_{it} include total natural resource rents as a percentage of GDP, changes in terms-of-trade, inflation rate and institutional indicator. All these control variables are in logarithms except for changes in terms-of-trade as the variable exhibit a large number of negative values.

In terms of institutions, this study uses a comprehensive set of six governance indicators provided by the World Bank. These are; rule of law, regulatory quality, voice and accountability, political stability, government effectiveness and control of corruption. These indicators are widely used in empirical studies to proxy for governance and institutional quality. However, in this study we run a pairwise correlation on all governance indicators at 1% significant level. A governance indicator which exhibits high correlation with other indicators is utilized as a proxy for institutional quality. The summary of all the variable descriptions and data sources is provided in Table 1 below.

Table 1: Variable Descriptions and Data Sources

VARIABLE	DESCRPTION	SOURCE
GDP per capita	Gross Domestic Product (GDP) per capita, constant 2010 US$	WDI (2019)
Domestic Investment	Goss Capital Formation,% of GDP	WDI (2019)
Population Growth	Population growth rate in %	WDI (2019)
Terms of Trade Growth	Changes in terms of trade in %, based on an index 2000=100	WDI (2019)
Inflation	GDP deflator, annual change in %	WDI (2019)
Institutional Quality	Rule of Law: The estimates range from approximately -2,5 to 2.5 indicating weak and strong governance performance respectively	WDI (2019)
FDI ROW	Total inward stock of FDI from the rest of the world(Total inward stock of FDI less inward stock of FDI from China/USA/EU/Asia), % GDP	UNCTAD stat (2019)
FDI (CHINA/USA/EU/ROA)	Inward stock of FDI from China, USA, European Union and the Rest of Asia respectively,% of GDP	UNCTAD stat (2019)
Total Natural Resource Rent (% of DGP)	Total natural resources rents are the sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents.	WDI (2019)
Openness	sum of exports and imports (% of GDP)	WDI (2019)
Regulation	Regulatory Quality: The estimates range from approximately -2,5 to 2.5 indicating weak and strong governance performance respectively	WDI (2019)
Credit	Domestic credit to private sector(% of GDP)	WDI (2019)
School	School enrolment, primary (% Gross)	WDI (2019)

In line with theory, predictions of previous empirical growth studies which utilized augmented Solow growth model and the Solow model itself, we expect a negative coefficient of the lagged dependent variable due to convergence effects, a positive coefficient on domestic investment and a negative coefficient on population growth. Institutional environment and terms of trade should impact growth positively, whereas the opposite is expected for the inflation. Natural resources rents give the value of capital services flows rendered by natural resources. Various studies including Pigato *et al*., (2015) and Busse *et al*., (2014) assert that China's FDI predominantly flows towards African countries that are rich in natural resources. Cheng *et al*., (2015) argue that the motive is indifferent from the Western investors. If this is true, we expect a negative coefficient of total natural resource rents variable due to the resource curse (Hayat, 2014).

Our sample embraces a panel of 42 sub-Sahara African countries over the period (2003-2012). Guided by the analytical framework of Sy (2014), our analysis of FDI sources accounts for China, USA, EU and Asia excluding China (rest of Asia). Our study period and sample are restricted by the availability of inward stock of FDI data from the named FDI sources to African countries. The list of the sample is provided in Table 2 below.

Table 2: Sample

Angola	Benini	Botswana	Burkina Faso	Burundi	Cameroon	Cape Verde	Central Africa Republic
Chad	Comoros	Congo	Cote D'Ivoire	DRC	Equatorial Guinea	Eritrea	Ethiopia
Gabon	The Gambia	Ghana	Guinea	Guinea-Bissau	Kenya	Lesotho	Liberia
Madagascar	Malawi	Mali	Mozambique	Niger	Nigeria	Rwanda	Sao Tome & Principe
Senegal	Seychelles	Sierra Leone	South Africa	Swaziland	Togo	Uganda	Tanzania
Zambia	Zimbabwe						

3.2 Estimation Technique and Procedures

Cheng *et al*., (2015) argue that both Chinese and Western investors' interests in Africa are largely driven by their appetite for natural resources rather than high GDP rates. However, for countries like South Africa and Nigeria, there is a possibility that foreign investors can be attracted by high GDP rates. In this respect, we equally contest that the econometric problem of reverse causality between specific FDI sources and GDP in African countries cannot be merely argued away based on the assertion of foreign investor's appetite for natural resources. Thus, there is probable endogeneity arising from our variables of principal interest (specific sources of FDI in Africa), which should be dealt with. In a single regression framework, the workhorse of dealing with endogeneity is using instrumental variables. Hence, estimations of this paper are conducted using fixed-effects 2SLS regression model. It is only when equation (3) is estimated to check the baseline specifications of the Solow model where standard OLS fixed effects estimator is used. In this case, growth is explained only by fundamental determinants of the steady state as presented below.

$$lny_{it} = \alpha + (\beta + 1)lny_{it-1} + \gamma lns_{d,it} + \varphi ln(n_{it} + 0.05) + \lambda_t + \eta_i + \varepsilon_{it} \quad (4)$$

After performing the baseline regression, equation (3) is split into two specifications for each source of FDI. In the first regression, we extend the baseline model by adding the variable of principal interest, that is, specific FDI controlled for FDI from the rest of the world. In the second regression, we include all control variables, that is, policy variables to capture macroeconomic distortions (inflation), the institutional quality (rule of law), terms-of-trade growth, and total natural resource rents.

Following Donou-Adonsou *et al*., (2018), we take specific FDI sources in Africa and instrument for them using their first three lags. The consistency of fixed-effects 2SLS estimator relies upon the test for endogeneity and the validity of the instruments utilized. The standard formal test for endogeneity is Hausman test or C test. For the validity of instruments, we use Hansen test of over identifying restrictions.

To analyse the effect inherent in treating the Chinese FDI variable using different approaches, we replicate the econometric equation and control variables used by Donou-Adonsou *et al*., (2018). The treatment given to the variable of interest is however different from the latter. We normalize the variable as a percentage of the host country's GDP instead of price level of its capital stock. The econometric equation is defined as follows;

$$lny_{it} = \alpha + \gamma lns_{d,it} + \emptyset lns_{f,it} + \varphi' lnX_{it} + \varepsilon_{it} \qquad (5)$$

where X represents the schooling variable, regulation quality, financial development, and trade openness. Schooling variable proxies for human capital and it is measured by school enrolment, primary (% gross). Institutional quality is accounted for by regulation. Trade openness is measured by the sum of exports and imports (% of GDP). Financial development is represented by domestic credit to private sector (% of GDP). Finally, we add all fundamental determinants of the steady state into equation (5) to check for their impact on the model as well as on the variable of interest. The equation is specified the same way as equation (3), however with different control variables.

4. Estimated Results

The pair-wise correlation matrix of six World Bank governance indicators is presented in Table 3. This symmetric matrix measures the relationship between governance indicators on a scale with a positive one indicating perfect direct correlation, zero no relationship and negative one perfect inverse relationship.

Table 3: Correlation Matrix of Institutional Indicators

	Government Effectiveness	Control of Corruption	Political Stability	Regulation Quality	Rule of Law	Voice & Accountability
Government Effectiveness	1					
Control of Corruption	0.8230***	1				
Political Stability	0.5942***	0.6220***	1			
Regulation Quality	0.8315***	0.6695***	0.5283***	1		
Rule of Law	0.8755***	0.8645***	0.7538***	0.8069***	1	
Voice & Accountability	0.7283***	0.6613***	0.6156***	0.7264***	0.7727***	1

Notes: Correlation Matrix calculated based on all governance indicators provided on the World Bank governance indicators. ***significant at the 1% level.

The results indicate that the correlation between governance indicators can be positively high and highly significant implying that reform in one indicator is likely to have a positive bearing on another. However, rule of law has the highest correlation with the rest of the indicators hence, it is considered to proxy for institutional quality.

Following next in Table 4 are the results of descriptive statistics. Thus, the mean, standard deviation, minimum and maximum values of the variables. Because fixed-effects instrumental variable model only makes use of within-panel variation over time, we are much interested on the within estimations.

Table 4: Descriptive Statistics

Variable		Mean	Std. Dev.	Min	Max	Observations
ln per Capita GDP	overall	6.897	1.060	5.267	9.920	N = 419
	between		1.066	5.427	9.717	n = 42
	within		0.100	6.467	7.231	T = 9.976
ln Domestic Investment	overall	2.807	1.188	-4.605	4.755	N = 392
	between		1.027	-2.976	4.048	n = 41
	within		0.596	1.178	9.397	T-bar = 9.561
ln Population Growth	overall	0.923	0.389	-0.999	1.573	N = 416
	between		0.358	-0.020	1.501	n = 42
	within		0.172	-0.333	1.882	T-bar = 9.905
ln Inflation	overall	3.780	0.489	-3.100	5.036	N = 413
	between		0.144	3.169	3.955	n = 42
	within		0.469	-2.489	5.077	T-bar = 9.833
Terms-of-Trade Growth	overall	0.041	0.217	-2.611	1.369	N = 420
	between		0.057	-0.039	0.180	n = 42
	within		0.209	-2.750	1.231	T = 10
ln Rule of Law	overall	0.218	0.471	-1.280	1.025	N = 420
	between		0.459	-1.018	1.015	n = 42
	within		0.127	-0.504	0.675	T = 10
ln Total Natural Resource Rents	overall	2.211	1.163	-2.721	4.119	N = 406
	between		1.148	-2.102	3.915	n = 41
	within		0.263	1.128	3.801	T-bar = 9.902
ln FDI China	overall	0.056	0.092	0.000	0.566	N = 331
	between		0.083	0.000	0.415	n = 42
	within		0.037	-0.169	0.230	T-bar = 7.881
ln FDI US	overall	0.064	0.207	0.000	2.369	N = 321
	between		0.140	0.000	0.836	n = 42
	within		0.142	-0.372	2.196	T-bar = 7.643
in FDI EU	overall	0.134	0.334	0.000	2.966	N = 330
	between		0.269	0.000	1.401	n = 42
	within		0.169	-1.267	1.699	T-bar = 7.857
ln FDI rest of Asia	overall	0.021	0.051	0.000	0.369	N = 330
	between		0.065	0.000	0.324	n = 42
	within		0.018	-0.031	0.205	T-bar = 7.857

Notes: Descriptive statistics are calculated based on variables common to all specifications and variables of principal interest.

Table 5 below shows the results of the correlation matrix between real per capita GDP and all the explanatory variables of this study.

Table 5: Correlation Matrix of the dependent variable with regressors

Dependent Variable: In real GDP per capita	Dependent Var	Lagged Dependent Var	ln Population Growth	ln Domestic Investment	Terms-of-Trade Growth	ln Rule of Law	In Inflation	ln Natural Resource rents	ln FDI China	ln FDI US	ln FDI EU
Lagged Dependent Var	0.999***	1.000									
	(0.000)										
ln Population Growth	-0.261***	-0.266***	1.000								
	(0.000)	(0.000)									
ln Domestic Investment	0.286***	0.287***	0.047	1.000							
	(0.000)	(0.000)	(0.359)								
Terms-of-Trade Growth	0.068	0.061	0.117**	0.017	1.000						
	(0.165)	(0.213)	(0.017)	(0.744)							
ln Rule of Law	0.240***	0.236***	-0.150***	0.168***	-0.073	1.000					
	(0.000)	(0.000)	(0.002)	(0.001)	(0.134)						
In Inflation	-0.092*	-0.090*	-0.058	-0.029	0.232***	0.047	1.000				
	(0.063)	(0.069)	(0.241)	(0.576)	(0.000)	(0.343)					
ln Natural Resource rents	-0.246***	-0.225***	0.525***	-0.141***	0.171***	- 0.492***	-0.080	1.000			
	(0.000)	(0.000)	(0.000)	(0.006)	(0.001)	(0.000)	(0.111)				
ln FDI China	-0.237***	-0.229***	-0.053	0.044	-0.034	-0.166***	0.006	-0.026	1.000		
	(0.000)	(0.000)	(0.339)	(0.439)	(0.534)	(0.003)	(0.911)	(0.646)			
ln FDI US	-0.074	-0.069	0.009	0.063	-0.004	-0.070	0.019	0.041	0.554***	1.000	
	(0.186)	(0.217)	(0.870)	(0.279)	(0.950)	(0.209)	(0.738)	(0.469)	(0.000)		
ln FDI EU	-0.046	-0.042	-0.113**	0.087	-0.049	0.053	0.010	-0.167***	0.326***	0.582***	1.000
	(0.410)	(0.446)	(0.041)	(0.129)	(0.380)	(0.334)	(0.859)	(0.003)	(0.000)	(0.000)	
ln FDI rest of Asia	0.106*	0.104*	-0.262***	0.094*	-0.036	0.247***	-0.028	-0.309***	0.240***	0.176***	0.122**
	(0.055)	(0.060)	(0.000)	(0.098)	(0.513)	(0.000)	(0.615)	(0.000)	(0.000)	(0.002)	(0.027)

Notes: Correlation Matrix calculated based on variables common to all specifications and variables of principal interest. P-Values in parentheses.*significant at the 10% level; **significant at the 5% level; ***significant at the 1% level

The results show a weak, negative but highly significant estimated correlation coefficient between Africa's real per capita GDP and FDI from China. A similar result is attained in the case of natural resource rents. The estimated correlation coefficient of real per capita GDP and FDI from the rest of Asia shows a positive but weak relationship which is statistically significant at 10%. The association between real per capita GDP and FDIs from EU and US are statistically insignificant. The same applies to terms-of-trade growth. All other variables are significant at 1% and enter the correlation matrix with expected signs. Table 6 reports the results of the standard Solow model variables.

Table 6: Standard OLS fixed-effects results for baseline specifications of the Solow model

Dependent Variable: ln real GDP per Capita	
Lagged Dep Var	0.812***
	(0.041)
ln Domestic Investment	0.013***
	(0.005)
ln Population Growth	0.027
	(0.029)
Observations	390
Countries	42
R-Squared (within)	0.823

Notes: Robust standard errors are in parentheses. *significant at the 10% level; **significant at the 5% level; ***significant at the 1% level.

Estimated coefficients of lagged dependent variable[1] and domestic investment have expected signs and are highly significant. Contrary to the potential literature, population growth estimate is positive, however insignificant and small. At this stage, our estimates are predominantly in line with other results of Solow growth estimations where sub-Sahara African economies are explicitly analysed, including Busse *et al.*, (2014) and Hoeffler (2002). In terms of R-squared, our result shows that the regressors explain approximately 82% of the within-country variation in GDP per capita growth. This implies that the model fits relatively well with the utilized set of data and therefore we can continue to add our variables of principal interest and control variables.

Table 7 presents the estimated results of the fixed-effects 2SLS. Columns (1) and (2) show result for Chinese FDI, columns (3) and (4) report result for US FDI, columns (5) and (6) show result for FDI from EU and finally columns (7) and (8) report result for FDI from the rest Asia. For comparative

[1]In order to assess the effect of the lagged GDP per capita variable on GDP per capita growth, we have to correct the estimated coefficient of 0.812 by subtracting 1 and obtain -0.188. In a corresponding fixed-effects regression, Busse *et al.*, (2014:13) and Hoeffler (2002:42) find a coefficient of -0.132 and -0.230, respectively. The difference in magnitude might be due to the differences in sample size and time frame.

analysis, we consider regressions with all control variables, that is, column (2), (4), (6) and (8) for China, US, EU and the rest of Asia, respectively.

Table 7: Fixed-Effects 2SLS results with FDI from China, US, EU and the rest Of Asia

Dependent Variable: In real GDP per Capita								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lagged Dep Var	0.700***	0.726***	0.696***	0.725***	0.699***	0.726***	0.706***	0.733***
	(0.061)	(0.056)	(0.063)	(0.061)	(0.060)	(0.058)	(0.060)	(0.058)
ln Domestic Investment	0.015***	0.013***	0.014***	0.012***	0.015***	0.013***	0.015***	0.012***
	(0.006)	(0.005)	(0.005)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)
ln Population Growth	-0.005	-0.008	-0.0002	0.006	0.009	0.009	0.002	0.001
	(0.019)	(0.016)	(0.022)	0.022)	(0.020)	(0.018)	(0.020)	(0.017)
ln FDI ROW	-0.083***	-0.060	-0.123**	-0.103	-0.052*	-0.068*	-0.089***	-0.071**
	(0.026)	(0.039)	(0.063)	(0.071)	(0.032)	(0.040)	(0.025)	(0.034)
ln FDI China	-0.161*	-0.178**						
	(0.090)	(0.082)						
ln FDI US			0.012	-0.021				
			(0.092)	(0.100)				
In FDI EU					-0.060	-0.016		
					(0.050)	(0.050)		
In FDI ROA							0.049	0.037
							(0.143)	(0.142)
ln Rule of Law		0.042*		0.042		0.031		0.036
		(0.024)		(0.040)		(0.025)		(0.027)
ln Total Natural Resource Rents		0.003		0.002		-0.004		0.002
		(0.016)		(0.017)		(0.017)		(0.017)
In inflation		0.003		0.004		0.004		0.003
		(0.007)		(0.007)		(0.007)		(0.007)
Terms of Trade growth		0.013*		0.013		0.014*		0.014*
		(0.008)		(0.008)		(0.008)		(0.008)
Observations	258	252	233	227	246	240	250	244
Countries	42	42	42	42	42	42	42	42
R-Squared (within)	0.799	0.805	0.792	0.795	0.798	0.803	0.797	0.803
Hausman/C test (p-value)	0.000	0.000	0.019	0.000	0.000	0.000	0.000	0.001
Hansen test (p-value)	0.866	0.874	0.221	0.227	0.272	0.278	0.325	0.397

Notes: Robust standard errors are in parentheses. *significant at the 10% level; **significant at the 5% level; ***significant at the 1% level. The null hypothesis for Hausman or C test is that FDI from a specific source is exogenous. In all regressions from column 1-8, specific FDIs are instrumented using their first three lags and the p-values of the Hausman test are <10% implying that 2SLS estimates are preferred to standard OLS fixed-effects estimates. All p-values of the Hansen test are >10% implying that the instruments used are valid or the over identifying restrictions are not rejected.

Across all specifications, the magnitude change in standard Solow model variables is marginal relative to the result of the baseline specification presented in Table 6. Both the lagged dependent variable and domestic investment maintained their expected signs and level of significance while the estimates of population growth are still insignificant and small. Moreover, the results show that Hausman or C-tests for endogeneity reject the use of standard OLS fixed-effects in favour of fixed-effects 2SLS estimator while Hansen test fails to reject the over-identification restrictions.

In line with the correlation matrix result in Table 5, 2SLS estimates show that the estimated coefficient of Chinese FDI is negative and significant at 5%. The estimated coefficient of FDI from the rest of Asia is statistically insignificant, however, it portrays the sign derived from the correlation matrix. The same applies to FDIs from US and EU. Precisely, the result shows that a 1% increase in FDI from China reduces Africa's real GDP per Capita by approximately 0.18%.

Separate control for Chinese and US FDI in the total FDI in Africa indicates that the estimated coefficient of FDI from the rest of the world can be only significant albeit negative in the regressions where control variables are not included. In both cases, the inclusion of control variables renders the estimated coefficient insignificant. In contrast, the results show that on account of all control variables, 1% rise in FDI from the rest of the world, while separately controlling for EU and the rest of Asia, decreases Africa's real per capita GDP with approximately 0.07% on both cases.

The result also shows that the estimated coefficient of terms-of-trade growth is positive and significant at 10% only in specifications relating to FDI from China, EU, and the rest of Asia. Thus, a unit increase in terms-of-trade growth raises Africa's real GDP per capita by approximately 0.01% across all the corresponding specifications. Rule of law estimate is significant at 10% only in the Chinese FDI regression, however, it enters all the specifications with expected sign. For the regression relating to Chinese FDI, a percentage increase in the rule of law drives Africa's real per capita GDP up with approximately 0.04%.

4.1 Robustness checks for the estimated coefficient of Chinese FDI

Table 8 demonstrates the estimated results of the regressions conducted to capture the effect attached to the treatment of the Chinese FDI variable and the impact of incorporating fundamental Solow variables in the growth equation. Column (1) represents regression output of equation (5) where we replicate the econometric equation and control variables used by Donou-Adonsou *et al*., (2018). However, we measure Chinese FDI as percentage of GDP of the host country. In column (2) we extend equation (5) to include fundamental Solow growth variables which were not incorporated by the latter.

These variables include lagged real per capita GDP and population growth. The population growth variable includes 0.05 to account for depreciation rate of the physical capital stock and changes in technology (Mankiw *et al*., 1992; Busse *et al*., 2014).

Table 8: Robustness checks for the estimated coefficient of Chinese FDI variable

Dependent Variable: In real GDP per capita		
	(1)	(2)
ln Domestic Investment	0.074**	0.026
	(0.037)	(0.025)
ln FDI China	-0.324***	-0.166***
	(0.106)	(0.062)
ln Regulation	0.013	-0.018
	(0.078)	(0.043)
ln Openness	0.079	0.057**
	(0.053)	(0.024)
In Credit	0.075***	0.010
	(0.017)	(0.015)
ln School	0.091	0.067**
	(0.087)	(0.032)
Lagged Dep Var		0.594***
		(0.077)
ln Population Growth		-0.002
		(0.023)
Observations	190	190
Countries	42	42
R-Squared (within)	0.374	0.749
Hansen test (p-value)	0.766	0.621

Notes: Fixed-effect 2SLS regression output. Robust standard errors are in parentheses. *significant at the 10% level; **significant at the 5% level; ***significant at the 1% level.

The result in Table 8 shows a negative and highly significant estimated coefficient of Chinese FDI in both column (1) and (2). For column (1), the estimated coefficient is very small (-0.324) relative to 0.069 attained by Donou-Adonsou *et al*., (2018). Adding lagged real per capita GDP and population growth variables drives the coefficient up from -0.324 to -0.166. That is an increase of approximately 49%. Interestingly, the estimated coefficient of Chinese FDI attained in the extended regression is within the range of the result attained in Table 7 (column 2), nonetheless using completely different control variables. The result also shows that R-squared has improved significantly from approximately 37% to 75%. The R-squared attained from the replicate estimation (37%) tallies with the one reported by the latter.

To further check the robustness of our estimated coefficient of Chinese FDI and the steadiness of our model, we restrict our cross-sectional dimension by excluding South Africa from our main specification. This allows us to control for the US$5.6 billion South Africa's Standard Bank deal with Industrial and Commercial Bank of China (ICBC) which was finalized in 2008. The surge of FDI in Sub-Sahara Africa in 2008 was largely spiked by this single deal according to Pigato *et al*., (2015). In addition, South Africa is considered as a large recipient of Chinese FDI in sub-Sahara Africa. We also exclude both South Africa and Nigeria in the baseline specification to check for the probable bias arising from high GDP economies. The results are presented in the Tables 9 and 10 below.

Table 9: OLS Fixed Effects Results Baseline Regression without Nigeria and South Africa

Dependent Variable: ln real GDP per Capita	
Lagged Dep Var	0.819***
	(0.044)
ln Domestic Investment	0.013***
	(0.005)
In Population Growth	0.028
	(0.029)
Observations	370
Countries	40
R-Squared(within)	0.819

Table 10: Fixed-Effects 2SLS Chinese FDI regression without South Africa

Dependent Variable: In real GDP per Capita	
Lagged Dep Var	0.748***
	(0.056)
ln Domestic Investment	0.012***
	(0.005)
ln Population Growth	-0.006
	(0.019)
ln FDI ROW	-0.050
	(0.040)
ln FDI China	-0.177**
	(0.079)
ln Rule of Law	0.052**
	(0.023)
ln Natural Resource Rents	0.005
	(0.018)
In inflation	0.003
	(0.007)
Terms to Trade growth	0.014*
	(0.008)
Observations	227
Countries	41
R-Squared (within)	0.809
Hausman/C test (p-value)	0.000
Hansen test (p-value)	0.837

Notes: For both table 8 and 9, robust standard errors are in parentheses. *significant at the 10% level; **significant at the 5% level; ***significant at the 1% level. For table 9 only, the null hypothesis for Hausman or C test is that Chinese FDI is exogenous. Chinese FDI is instrumented using its first three lags and the p-value of the Hausman test is <10% implying that 2SLS estimates are preferred to fixed-effects estimates. The p-value of the Hansen test is >10% implying that the instruments used are valid or the over identifying restrictions are not rejected.

In all the restricted specifications, the estimated effect of all variables is consistent with the main results. The change in the size of the estimated coefficients is marginal, implying that our results are not biased towards or against any of the factors mentioned above.

4.2 Discussion of the main parameters

Yet having adopted an econometric equation specified by Busse *et al*., (2014), let alone the approach used to measure the Chinese FDI variable and having followed Donou-Adonsou *et al*., (2018) in terms of FDI database and estimation technique, our findings are at odds with either of the studies. The former reports that Chinese FDI on growth in Africa is insignificant while the latter found that FDI from China enhances economic growth in Africa. The current study found that the direct impact of Chinese FDI on growth in Africa is negative.

Ceteris paribus, the discrepancy of our findings from the results of the latter can be largely explained by the differences in the manner in which FDI variables were treated, let alone the model specification. Donou-Adonsou *et al*., (2018) normalized FDIs using the price level of their capital stock yet we accounted for FDIs as a percentage of the host country's GDP. For Chinese FDI in particular, we argue based on our result that the method used by the latter to measure the variable tends to overstate the magnitude of the variable's estimated coefficient by approximately 46%. Furthermore, we deduced that adding all the fundamental Solow growth variables into the growth equation improves precision in terms of the size of standard errors, size of the variable of interest, as well as the goodness of fit of the model. Accordingly, our results demystify robustness attached to the approach which we used to measure FDI variables and the growth econometric equation utilized.

With the former, the major contributing factor is assumed to emanate from FDI data-set. Our FDI data are extracted from UNCTAD while Busse *et al*., (2014) gathered their FDI data from MOFCOM. There is a significant proven variation between these databases in terms of how they compile FDI statistics (Pigato *et al*., (2015); OECD (2008)). And, because UNCTAD is highly acknowledged, we believe that our results are robust to solid FDI-data set.

The statistically insignificant coefficients of FDI from US, EU and the rest of Asia provide evidence that the individual impact of the FDI sources on Africa's economic growth is insignificant. Controlling for these FDI sources in total FDI in Africa also reflect disappointing results. Precisely, separate control for EU and the rest of Asia shows that FDI from the rest of the world impacts Africa's economic growth negatively while controlling for China and/or the US reflects insignificant impact. This pattern reflects that FDI from EU and/or the rest of Asia tends to neutralize the detrimental growth effects of FDI from the rest of the world in Africa. Put differently, it seems as if the negative impact of FDI from the rest of the world in Africa is more pronounced in the absence of FDI from EU and/or rest of Asia but in the presence of Chinese FDI. In this respect, the contribution of EU and the rest of Asia ought to be noticed.

The influence of the FDI sources as discussed above seems to correspond with the analytical framework of Sy (2014). The latter argued that an increase of approximately US$105.6 billion stock of FDI in Africa between (2001-2012) was led by China, whose inward stock of FDI in Africa grew at an annual rate of 53%, relative to 29%, 16% and 14% for Japan, EU, and the US respectively. It's however unfortunate that the impact of the leading source of FDI is found to be detrimental to the economic growth in Africa.

Based on the assertion that Chinese FDI is earmarked for natural resources in Africa (Mu *et al*., 2017; Pigato *et al*., 2015; Busse *et al*., 2014), it is logical to relate the negative impact of Chinese FDI on Africa's growth to the resource curse. Nonetheless, Chen *et al*., (2015) argues that the motive is indifferent from the Western investors. Hayat (2014) asserts that the accumulation of FDI in resource sectors tends to negatively affect growth. The curse is likely expected as the resource sector expands relative to the size of the economy. This might as well point to a highly significant although weak negative relationship between real per capita GDP and total natural resource rents (Table 5). The resource rents seem to be low to compensate for the natural resources extracted by the foreign investors.

On the other dimension, recent studies including Jude & Levieuge (2015); Li & Hook (2014); AbuAl-Foul & Soliman (2014) argue that the growth effects of FDI on growth are not automatic. Rather, they depend on the absorptive capacity of the host country, for instance, institutional quality. Although the studies relate to aggregate FDI, this could perhaps apply to specific FDIs as well. Moreover, Su & Ado, (2016) suggest that an institutionally based approach may be most relevant in better explaining China's investment in Africa. This approach might equally apply for other FDIs too.

Various studies have argued that the surge of China's FDI in Africa runs parallel to the growing bilateral trade between the two economies. This perhaps explains the positive and statistically significant estimated coefficient of terms-of-trade growth in the regression equation relating to Chinese FDI. Recently, Mu *et al*., (2017) show that China has become the most important exporting partner of Sub-Sahara Africa among USA and EU since it joined the World Trade Organisation (WTO) in 2001. In essence, Pigato *et al*., (2015) assert that Africa's exports to China have grown more rapidly than imports. Although the export mix is highly concentrated in natural resources, the latter argue that it has generated a significant favourable balance of trade. The imports are extremely diversified, let alone less expensive compared to the same products from USA and EU thus, giving Chinese imports competitive advantage in Africa.

5. Conclusion and Recommendations

With the rise in the discrepancies of the empirical results relating to the growth effects of Chinese FDI in Africa, this paper employs a combination of sound FDI data-set and the widely acknowledged growth model with the aim of establishing robust estimates. Further, we examine comparatively, the growth effects of Chinese FDI with FDI from US, EU and Asia (excluding China) in Africa. We found evidence to dispute the win-win deal between Chinese FDI and economic growth in Africa. Precisely, Chinese FDI bears negative impact on economic growth in sub-Sahara Africa. Likewise, FDI from the rest of the world controlled for EU and/or the rest of Asia. FDIs from US, EU and the rest of Asia seem to have no direct impact on growth in Africa. The conclusion drawn from our empirical results is that the quality of data-set, treatment of the variable of interest and econometrics applied to the model used in research bear a significant impact on the results of the study.

In terms of policy recommendations, policy efforts targeted to improve FDI-induced growth ought to consider the motives of specific FDIs rather than generalizing the growth effects of FDI based on aggregate FDI in the host country. In light of negative and statistically significant effects of Chinese FDI on growth in Africa, we appeal for a more diversified form of FDI in Africa, not only from China but also from other sources of FDI. That is, FDI directed towards agriculture, manufacturing and other non-resource sectors.

A potential limitation of this study relates to the data-set of specific FDI sources in Africa. Meanwhile, the solid bilateral FDI statistics between Africa and its sources of FDI is available only for few African countries and for a short period (2001-2012). Due to these constraints, robust instrumental variable estimators like system GMM can be hardly explored. Given the availability of solid bilateral FDI data, it would be valuable to carry out the same research using system GMM estimator to a considerably large sample over a long period of time.

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