The impact of China on Africa through the lens of output growth and foreign direct investment.

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Abstract

This paper uses a vector of foreign direct investment (FDI) weighted real gross domestic product (GDP) growth rates to proxy for output growth of China, United States (US), European Union (EU), and Asia excluding China. Using 2SLS estimator over a sample of 42 sub-Sahara African countries for the period (2003-2012), our findings reveal that only output growth of EU can directly impact growth in the entire region. Thus, a 1% increase (decrease) in the EU's output growth can lead to a 0.02% increase (decrease) in real per capita GDP growth of sub-Sahara Africa. However, the results obtained from the panel threshold regression (PTR) analysis indicate that African countries with resource rents of at least 24.3% and 24.1% receive significantly positive output growth spillovers from China and US, respectively. These are mostly oil abundant countries. Our results imply that policies targeted to promote diversified FDI are likely to enhance positive output spillovers in both resource and non-resource rich African countries. Diversified FDI may also hedge against negative shocks arising from the economic rebalancing of FDI sources. Moreover, effective management of natural resources towards increased resource rents can place Africa in a better position to benefit from output growth of China and the US through FDI lens.

Keywords: Foreign Direct Investments; Output growth; Shocks; Resource rents.

1. Introduction

The initial growth episode experienced in Africa took off around the 1960s and it stopped around 1980s, aftermath the oil shocks in 1970s. From the 1980s, it took until the beginning of the millennium for Africa to recover and surpass the previous economic growth episode. The post-millennium growth episode is linked to several factors including reform of institutions (Rodrik 2014; McMillan & Harttgen 2014), the surge of FDI from various sources with China dominating the block (Sy 2014) and an increase of natural resource prices particularly during the pre-global financial crisis period (Eunomix 2012; Rodrik 2016). Edinger & Pistorius (2011) argue that the price boom of raw materials was mainly driven by the Chinese appetite for natural resources and sub-Sahara Africa has increasingly become the supplier. Likewise, Collier & Goderis (2009) and Drummond et al. (2013) assert that China's rapid economic growth and the resulting demand for natural resources has prompted Chinese investments in resource-rich countries in sub-Sahara Africa. Consequently, there has been a surge of FDI in Africa as Africa's traditional and new emerging investors also scrambled for natural resources in the continent to capitalize profits out of high global market prices. This is in line with Chen et al. (2015) who argue that FDI from both western investors and China is concentrated in resource abundant African countries.

There is some ample evidence to show that Africa's growth is exposed to the shocks of its FDI sources. Rodrik (2016) asserts that a moderate and steady growth rate in Africa is subjected to external environment progress and China's ability to manage its own sustainable challenges. The analytical approach of Igbinoba (2016) shows that Chinese demand for natural resources falls as its economy transits thereby dragging the global prices of commodities down. Moreover, Anderson et al. (2016) argue that the spillover of China's output growth to sub-Sahara Africa's growth transmit through global commodity markets. Since a larger portion of FDI is found in resource-rich countries, the shrunk of FDI in Africa can also be associated with the fall in global prices of natural resources (Jumanne & Keong 2018). Anecdote evidence suggests that the decline of Africa's real GDP growth rate in 2009 was largely driven by the drop of natural resource prices. This concurs with Collier et al. (2009) who found that adverse external shocks negatively affects the short-term real GDP growth of shock-prone developing countries.

The above views implicate investment in natural resources as the main factor connecting Africa's growth prospects to the output growth of its FDI sources. This is a risk source of growth in several aspects. First, FDI led growth in Africa is likely to fluctuate with global market prices of natural resources. Second, while FDI in natural resources is capital intensive at the initial stages, cash injection in the form of FDI in the host country tends to decrease as the exploration project progresses (Asiedu 2013). Thus, FDI induced growth is likely to stagger with cash flow injections. This concurs with the study of Hayat (2014) which suggests that FDI directed towards exploration of natural resources is likely to cause resource curse in the host country. However, Eunomix (2012) argues that the boom of natural resource prices bears positive impact on growth through resource rents and therefore in the current growth episode sub-Sahara Africa was not a victim of the resource curse, ceteris paribus. Resource rents reflect the host country's revenue obtained from natural resources (Asiedu 2013). Thus, high resource rents might boost growth even post the initial investment outlay of the exploration project.

This paper empirically investigates how Africa's economic growth depends on the real GDP growth rates of China, US, EU and the rest of Asia through the lens of FDI. Several studies focus on the impact of trading partners' growth on domestic growth through the export lens. For instance, Mu et al. (2017) found that a percentage increase in China's real GDP per capita rises sub-Sahara Africa's GDP per capita with 0.02%. This impact is more pronounced for African countries exporting natural resources to China. Drummond et al. (2013) found that a percentage point increase in China's domestic investment growth leads to 0.6% point increase in sub-Sahara Africa's export growth. Likewise, the impact is large for natural resource exporting countries. Furthermore, the empirical study of Arora & Vamvakidis (2004) show that the economic performance and relative income levels of trading partners bear a strong impact on domestic growth. Assuming natural resources as the connecting factor, this paper also analyses the threshold level at which resources rents can spur win-win deal between Africa and its FDI sources.

Seeking to give some direction to this end, the study is composed as follows. Section 2 specifies the model, discusses the variables, data, econometric techniques and procedures to execute the model. Section 3 synopses and analyses the empirical findings. Section 4 discusses the results of the main parameters. Section 5 highlights conclusions and recommendations based on the results of the main parameters.

2. Model specification

The model of this study is adopted from the neoclassical growth theories where long-run growth is explained by fundamental determinants of the steady-state and technical progress. According to Solow and Swan (1956), the fundamental determinants of the steady state include; the convergence term (y_{it-1}), domestic investment savings rate ($s_{d,it}$), population growth rate (n), changes in technology (g) and the rate of depreciation for capital stock (d). Bassanini & Scarpetta (2001) argue that technical progress (X_{it}) consists of two elements. One that accounts for various policy oriented variables such as institutional framework, inflation, and terms of trade among other variables. The other element reflects exogenous technical progress, that is, all other unexplained trend growth variables which the model does not explicitly account for. The model can be summarised using the following econometric equation:

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

where $\lambda_t, \eta_i, \varepsilon_{it}$ 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. The subscripts i and t respectively denote cross-sectional and time dimensions.

This study incorporates the vector of FDI-weighted real GDP growth rates of each source of FDI (G_{it}) as part of the explained technical progress component. In addition, Mankiw et al. (1992) proposed that the depreciation rate of the physical capital stock (d) and changes in technology (g) can be assumed to be constant over time and equal to 0.05. Therefore the equation (1) translates to equation (2) as follows;

$$lny_{it} = \alpha + (\beta + 1)lny_{it-1} + \gamma lns_{d,it} + \varphi\, ln(n_{it} + 0.05) + \emptyset' lnG_{it} + \varphi' lnX_{it} + \lambda_t + \eta_i + \varepsilon_{it} \quad (2)$$

Following the approach used by Mu et al. (2017), the output growth of each source of FDI is calculated using the inward stock of FDI as weights:

$$G_{it} = \left[\left(\frac{GDP_{jt}}{GDP_{jt-1}} - 1\right) * \frac{FDI_{j,it}}{FDIw,it}\right] \quad (3)$$

Where j denotes GDP of and FDI from a specific source while w represents total FDI from the world. Total FDI from the world captures the dynamics of the relative importance of each source of FDI.

2.1 Data and variable description

This study measures sub-Sahara Africa's growth using per capita GDP in real terms, gross capital formation as a percentage of GDP for domestic investment savings rate and inward stock of FDI for the foreign direct investment. 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 to capture the value of extraction, changes in terms-of-trade to account for trade openness, rule of law to proxy for institutional quality and GDP deflator, annual change in percentage to control for inflation. All these control variables are in logarithms except for changes in terms-of-trade, as the variable exhibit a large number of negative values. The summary of all the variable descriptions and data sources is provided in Table 1 below.

Table 1: Summary of variable descriptions and data sources

VARIABLE	DESCRIPTION	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)
FDIW	Total inward stock of FDI from the world in US$	UNCTAD stat (2019)
FDI (CHINA/USA/EU/ROA)	Inward stock of FDI from China, USA, European Union and the Rest of Asia, respectively.	UNCTAD stat (2019)
Total Natural Resource Rent (% of GDP)	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)
China's GDP growth	China's Annual Average Growth Rate of GDP, constant 2010 US$	UNCTAD stat (2019)
EU's GDP growth	EU's Annual Average Growth Rate of GDP, constant 2010 US$	UNCTAD stat (2019)
US's GDP growth	US's Annual Average Growth Rate of GDP, constant 2010 US$	UNCTAD stat (2019)
ROA's GDP growth	Rest of Asia Excluding China, Annual Average Growth Rate of GDP, constant 2010 US$	UNCTAD stat (2019)

Our sample embraces a panel of 42 sub-Sahara African countries over the period of (2003-2012). Guided by the analytical framework of Sy (2014), our analysis of FDI sources accounts for China, US, EU and Asia excluding

China (rest of Asia). The study period of this paper is restricted by the availability of inward stock of FDI data from the above mentioned FDI sources to African countries, likewise our sample. 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						

2.2 Estimation techniques

Endogeneity is a central econometric problem prone to economic growth models. Hauk (2016) asserts that bias arising from omitted variables and reverse causality are the most common sources of endogeneity which often renders the OLS parameter estimates of the growth models inconsistent. In a single regression framework, the workhorse of dealing with endogeneity is using instrumental variables estimator and the popular form of that estimator, often utilized is known as two-stage least squares (2SLS). Accordingly, the estimates of the equation (2) are derived from the fixed-effects 2SLS regression model. Regressions are conducted separately for each source of FDI. Following the approach utilized in the study of Donou-Adonsou & Lim (2018), for each source of FDI we take equation (3) and instrument it using its first three lags. The consistency of fixed-effects 2SLS estimator relies upon the validity of the instruments utilized. The standard formal test for the validity of instruments is the Hansen test of overidentifying restrictions.

However, literature provides evidence that the investment in natural resources is the main variable connecting Africa's growth to the output growth of its FDI sources. This follows that the exposure of African countries to the shocks of its FDI sources might be differentiated by the abundance of natural resources. To investigate this notion empirically, we also conduct fixed effects panel threshold regression (PTR) of Hansen (1999) using resource rents as the threshold variable. PTR also allows an analysis of the resource rents threshold point at which natural resources investment deals can spur the win-win outcome between Africa and its FDI sources. Thus, this estimation technique can account for different links in terms of statistical significance, magnitude and signs of equation (3) subject to resource rents.

Allowing for fixed individual effects (μ_i) and given resource rents ($RR_{i,t}$) as a threshold variable, the PTR divides the observations into two or more regimes, depending on whether each observation is above or below a threshold level. The econometric equation of PTR model with two extreme regimes can be defined as follows;

$$y_{it} = \mu_i + \emptyset' G_{,it} g(RR_{it}; c) + \varphi' X_{it} + \varepsilon_{it} \quad (4)$$

Where X_{it} proxies for fundamental Solow growth variables and other control variables discussed above excluding resources rents. The role of the threshold variable explains its absence among other regressors in the equation (4). This also controls for reverse causality and collinearity. The subscript G_{it} represents the output growth of specific

FDI source as defined in the equation (3) while ε_{it} is the error term. The binary transition function $g(RR_{it};c)$ divides the single threshold equation (4) into two regimes with coefficients β_1 and β_2, where c is the threshold parameter. This translate equation (4) into the following equation:

$$y_{it} = \begin{cases} \mu_i + \beta_1' G_{it} + \varphi' X_{it} + \varepsilon_{it} & if\ RR_{it} \leq c \\ \mu_i + \beta_2' G_{it} + \varphi' X_{it} + \varepsilon_{it} & if\ RR_{it} > c \end{cases} \quad (5)$$

Equation (5) can be thought of as linear heterogeneous panel model with coefficients that vary across sub-Sahara African countries and over time. Where the slope parameters satisfy;

$$\frac{\partial y_{it}}{\partial s_{f,it}} = \emptyset_{it}' = \begin{cases} \beta_1\ if\ RR_{it} \leq c \\ \beta_2\ if\ RR_{it} > c \end{cases} \quad (6)$$

Notwithstanding uncertainty about the endogeneity bias and potential reverse causality, this study uses lagged values of equation (3) and lagged values of the resource rents. This translates our equation of interest (equations (4)) into the following equation:

$$y_{it} = \mu_i + \emptyset' G_{,it-1} g(RR_{it-1}; c) + \varphi' X_{it} + \varepsilon_{it} \quad (7)$$

2.3 Estimation procedures

First, we estimate equation (2) using the fixed effects 2SLS estimator to determine how Africa's growth is directly exposed to the economic shocks of its FDI sources. Second, we estimate equation (7) using the fixed effects PTR model to analyze the impact of the shocks between resource and non-resource abundant countries. PTR also allows us to identify the resource rents threshold level at which win-win resource investment deals are expected between Africa and its FDI sources.

The first test of the PTR model is conducted to determine the significance of the threshold effect in equation (7) (Hansen 1999). The threshold effect hypothesis can be presented as follows;

$$H_0: \beta_1 = \beta_2$$

The rejection of H_0 is an indication that the single threshold regression is appropriate otherwise, equation (7) collapses into a linear panel regression model with fixed effects. The main econometric drawback, however, is the presence of the nuisance parameter in the null hypothesis. Thus, the threshold parameter c is not identified under H_0 Davies (1987). This problem renders the asymptotic distribution of F_1 statistic non-standard. Hansen (1996) proposed the use of bootstrap simulation as a solution to the nuisance parameter issue. The bootstrap analog produces first-order asymptotic distributions and therefore test statistic F_1 and the corresponding *p*-value attained from the bootstrap are asymptotically valid. The null hypothesis is rejected if the test statistic $F_1 >$ its critical value.

The second test of the PTR model is conducted to determine the number of regimes. A sequential procedure based on $F_2, \ldots F_j$ (until the corresponding H_0 is accepted) allows the determination of the number of regimes hence the appropriate regression. Starting with statistic F_2, H_0: Single threshold regression. The hypothesis of the single threshold is rejected in favor of a double threshold if $F_2 >$ its critical value. The corresponding asymptotic *p*-value for $F_2, \ldots F_j$ can again be estimated using bootstrap simulation (Hansen 1999).

3. Estimated Results

Table 3 presents the estimation results of the fixed-effects 2SLS estimator. Column (1)-(4) shows the estimated coefficients relating to the output growth of China, US, EU and the rest of Asia, respectively.

Table 3: Direct impact of FDI sources' output growth on sub-Sahara Africa's growth

Dependent Variable: In real GDP per Capita				
	(1)	(2)	(3)	(4)
Lagged Dep Var	0.734***	0.735***	0.733***	0.742***
	(0.042)	(0.042)	(0.043)	(0.041)
ln Domestic Investment	0.013**	0.013**	0.014**	0.013**
	(0.006)	(0.006)	(0.006)	(0.005)
ln Population Growth	-0.009	-0.008	-0.008	-0.007
	(0.019)	(0.019)	(0.019)	(0.020)
ln China's Growth	0.007			
	(0.006)			
ln US's Growth		-0.009		
		(0.007)		
In EU's Growth			0.019***	
			(0.006)	
In ROA's Growth				-0.108
				(0.086)
ln Rule of Law	0.068***	0.068***	0.066***	0.059***
	(0.023)	(0.023)	(0.023)	(0.020)
ln Natural Resources Rents	-0.0001	-0.0003	-0.002	-0.003
	(0.019)	(0.019)	(0.019)	(0.021)
In inflation	-0.002	-0.003	-0.008***	-0.002
	(0.002)	(0.004)	(0.003)	(0.003)
Terms to Trade growth	0.016**	0.015**	0.012	0.019**
	(0.006)	(0.006)	(0.007)	(0.008)
Observations	222	222	222	222
Countries	42	42	42	42
R-Squared (within)	0.747	0.756	0.750	0.730
Hansen test (p-value)	0.686	0.464	0.884	0.213

Notes: Output growth of each source of FDI is calculated using Equation (3). Robust standard errors are in parentheses. *significant at the 10% level; **significant at the 5% level; ***significant at the 1% level. In all regressions from column 1-4, output growth variables of each source of FDI are instrumented using their first three lags. All p-values of the Hansen test are >10% implying that the instruments used are valid.

The results in Table 3 above show that the estimated coefficient of EU's growth is positive and highly significant while the growth coefficients of other FDI sources are statistically insignificant. Thus, a 1% increase (decrease) in the EU's output growth can lead to a 0.02% increase (decrease) in sub-Sahara Africa's per capita real GDP.

All standard Solow growth variables carry the expected signs across all the regressions. The estimated coefficients of the convergence term and domestic investment are significant at 1% and 5%, respectively while population growth is statistically insignificant and small. In line with the literature, the estimated coefficient of rule of law is positive and highly significant across all the regressions. Moreover, the estimated coefficient of terms to trade growth is positive and significant at 5% in the regressions relating to China, US and the rest of Asia while statistically insignificant on EU regression. Natural resource rents coefficient is negative, very small and insignificant across all regressions. The estimated coefficient of inflation enters the model with the expected sign on the regressions relating to China, US and the rest of Asia albeit statistically insignificant. Contrary to the literature, the latter coefficient is positive and highly significant on the EU regression however, very small.

3.1 Natural resources as a transmission channel of output growth spillovers

Since literature provides considerable evidence in that investment in the natural resource is the main factor connecting Africa’s growth to the output growth of its FDI source, we run the 2SLS with an interaction term between output growth of specific FDI and resource rents in sub-Sahara Africa. The results are presented in Table 4 below. Column (1)-(4) shows the estimation results of the regression relating to the output growth of China, US, EU, and ROA, respectively.

Table 4: Interaction term between output growth of specific FDIs and resource rents in sub-Sahara Africa

Dependent Variable: In real GDP per Capita				
	(1)	(2)	(3)	(4)
Lagged Dep Var	0.735***	0.737***	0.735***	0.741***
	(0.041)	(0.042)	(0.043)	(0.043)
ln Domestic Investment	0.013**	0.014**	0.013**	0.013**
	(0.006)	(0.006)	(0.006)	(0.006)
ln Population Growth	-0.009	-0.008	-0.010	-0.006
	(0.019)	(0.019)	(0.019)	(0.020)
In inflation	-0.001	-0.004	-0.006	-0.002
	(0.002)	(0.005)	(0.002)	(0.003)
Terms to Trade growth	0.020**	0.012*	0.018***	0.016**
	(0.008)	(0.007)	(0.007)	(0.007)
ln Rule of Law	0.067***	0.067***	0.063**	0.060***
	(0.023)	(0.023)	(0.025)	(0.019)
ln China's Growth	0.021			
	(0.028)			
ln US's Growth		-0.019		
		(0.030)		
ln EU's Growth			0.049	
			(0.032)	
In ROA's Growth				-0.123
				(0.083)
In $Growth^j$*RR	-0.019	0.004	-0.032	0.014
	(0.026)	(0.024)	(0.032)	(0.015)
Observations	222	222	222	222
Countries	42	42	42	42
R-Squared (within)	0.745	0.756	0.740	0.726
Hansen test (p-value)	0.624	0.454	0.790	0.235

Notes: The subscript *j* denotes output growth of a specific source FDI. $Growth^j$*RR is the interaction between output growth of a specific source of FDI and resource rents in sub-Sahara Africa. *significant at the 10% level; **significant at the 5% level; ***significant at the 1% level. In all regressions from column 1-4, Output growth variables of each source of FDI are instrumented using their first three lags. All p-values of the Hansen test are >10% implying that the instruments used are valid.

The results in Table 4 above indicate that the estimated coefficients of all interaction terms are statistically insignificant. In essence, adding the interaction term renders the estimated coefficient of the EU's growth in Table 3 insignificant while the growth coefficients of other FDI sources are still statistically insignificant. The change in the estimated coefficients of the standard Solow variables and the rule of law is marginal. Terms to trade growth coefficient are positive and significant at 5%, 10%, 1% and 5% for regression relating to China, US, EU, and

ROA, respectively. The estimated coefficient of inflation enters the model with expected sign however, insignificant across all regressions.

Nonetheless, the weakness associated with classical fixed effects models is that they cannot capture for varying slopes of the interaction terms rather they reflect the heterogeneity of countries in intercepts. Hence, we turn to utilize the fixed effects PTR model because it allows the estimated coefficient of equation (3) to take different values subject to resource rents in sub-Sahara Africa reaching the threshold level.

3.2 Fixed effects PTR regression

The estimation results of the PTR model are based on 34 sub-Sahara African countries for the regression relating to China and 35 countries for other sources of FDI. Countries removed from the main sample are Benini, Ghana, Guinea-Bissau, Mali, Rwanda, Sao Taome & Principe, Senegal, and Togo. We removed Ghana on the regression relating to China only. These countries reported very few observations (mostly less than three) of inward stock of FDI from all the FDI sources considered in this study for the period (2001-2012). The estimation of PTR using STATA is very sensitive to missing values hence, these countries were removed to obtain a strongly balanced panel data. We hardly could ipolate and epolate for the missing FDI values of the removed countries.

This study uses resource rents as the threshold variable. Row (2) of Table 5 shows that on average the maximum and minimum logged values of total natural resources rents as a percentage of GDP in sub-Sahara Africa are -2.721 and 4.119, respectively. These values respectively correspond to resource rents of 0.07% and 61.5% (row (1)).

Table 5: Summary statistics of the threshold variable

Variable		Min	25% Quantile	50% Quantile	75% Quantile	Max
Lagged Resource Rents	(1)	0.066	5.094	9.341	21.81	61.51
ln of lagged resource rents	(2)	-2.721	1.628	2.234	3.082	4.119

Notes: Authors own calculation based on total natural resource rents (% GDP) data extracted from WDI (2019). In the context of sub-Sahara Africa, 50% quantile is the average percentage of resource rents.

Table 6 below reveals that the hypothesis of no threshold effects is rejected for the regression relating to the output growth of China and the US while accepted for EU and the rest of Asia. For the regression relating to China and EU, the test statistics F_1 are both significant at 5% with corresponding bootstrap *p*-values of 0.04 and 0.02, respectively. The test statistics F_1 of EU and ROA are both statistically insignificant. Thus, PTR is only appropriate in regressing the impact of output growth of China and the US on Africa's growth using FDI lens with resource rents as the threshold variable. Regression relating to EU and ROA collapses to normal panel regression with fixed effects. Hence, fixed effects 2SLS estimates in Table 3 hold for the latter FDI sources.

Table 6: Hypothesis of no threshold effects and the determination of regimes

	China's Growth	US's Growth	EU's Growth	ROA's Growth
Test for Single threshold(two regimes)				
F_1	14.82	17.55	12.88	11.60
P-Value	0.04**	0.020**	0.160	0.240
1% critical values	20.02	18.91	25.38	41.41
5% critical values	14.69	13.35	21.71	37.92
10% critical values	11.39	9.73	16.72	13.53
Test for Double threshold(three regimes)				
F_2	4.28	4.30		
P-Value	0.520	0.640		
1% critical values	42.76	38.87		
5% critical values	29.74	26.04		
10% critical values	13.70	21.16		

Notes: *P*-values and critical values are computed from 50 bootstrap simulations. F_1 represents the Fisher type statistic associated with the test of H_0 of no threshold against a single threshold. F_2 corresponds to the test of a single threshold against a double threshold. **significant at the 5% level.

To determine the number of thresholds, results in Table 6 shows that the test statistics F_2 of the FDI sources which passed the PTR test are all statistically insignificant. This result conveys information that there are two regimes for each source of FDI demarcated by the respective resource rents threshold point estimate. The first regime is associated with a low percentage of resource rents while the second regime corresponds to a high percentage of resource rents implying high revenue obtained from natural resources.

Results of the resource rents threshold parameter estimates of regressions relating to the output growth of China and US are exhibited in Table 7 below. The point estimate of the former is 3.189 and that of the latter is 3.182. On average, these values correspond to the resource rents of 24.3% and 24.1%, respectively. A difference of 0.2% might seem marginal yet significant in terms of monetary value. The results also show that the asymptotic confidence intervals for the thresholds are equal at 95% and 99% across all the estimations, indicating certainty about the nature of this division.

Table 7: Resource rents threshold point estimates

		Estimate	95% Confidence Level	99% Confidence Level
China's Growth	Single threshold	3.189	[3.749;3.935]	[3.749;3.935]
US's Growth	Single threshold	3.182	[3.747;3.935]	[3.812;3.935]

Table 8 presents the PTR estimations. Column (1) reports the results regarding the output growth of China while results in column (2) relates to the output growth of US.

Table 8: Main results of the fixed effects PTR model.

Dependent Variable: In real GDP per Capita			
		(1)	(2)
Lagged Dep Var		0.800***	0.800***
		(0.041)	(0.041)
ln Domestic Investment		0.013***	0.013***
		(0.005)	(0.005)
ln Population Growth		0.025***	0.019**
		(0.009)	(0.009)
In inflation		-0.0003	-0.0002
		(0.0002)	(0.0002)
Terms to Trade growth		0.030***	0.030***
		(0.005)	(0.005)
ln Rule of Law		0.079	0.081
		(0.048)	(0.048)
ln China's Growth		-0.005	
		(0.009)	
ln US's Growth			-0.014*
			(0.007)
ln $GROWTH^j g(.)$	β_1	0.007	0.006
		(0.005)	(0.006)
	β_2	0.035**	0.022**
		(0.013)	(0.009)
Observations		340	350
Countries		34	35
R-Squared (within)		0.847	0.852

Notes: The subscript j denotes output growth of a specific source FDI while $g(.)$ represents the binary transition function. For China, β_1: $RR_{it} \leq 3.189$ and β_2: $RR_{it} > 3.189$ while for US, β_1: $RR_{it} \leq 3.182$ and β_2: $RR_{it} > 3.182$. Robust standard errors are in parentheses.*significant at the 10% level; **significant at the 5% level; ***significant at the 1% level.

The results in Table 8 above show that the estimated coefficients of β_1 are all statistically insignificant while that of β_2 are all positive and significant at 5%. Thus, growth output of both China and the US can positively impact the growth of sub-Sahara African countries which are above 24.3% and 24.1% in terms of resource rents, respectively. These resource rents are above the 75% quantile (Table 5) implying a very high percentage in the context of sub-Sahara Africa.

4. Discussion of the main parameters

The positive and significant estimated coefficient of EU's growth provides evidence that the growth of sub-Sahara African countries is directly exposed to the economic shocks of the EU through FDI lens. Whether resource or non-resource abundant country, the magnitude impact is the same across all countries in the region. This is evident following the acceptance of the hypothesis of no threshold effects on regressions relating to the latter and the rest of Asia. The growth coefficients of China, US and the rest of Asia are statistically insignificant implying that the vector of FDI-weighted real GDP growth rates of these FDI sources does not bear a direct impact on the sub-Sahara Africa's growth. However, the results obtained from the PTR analysis conveys information that sub-Sahara African countries with resource rents of at least 24.3% and 24.1% receive positive and significant influence from the output growth of China and US, respectively.

Looking at our sample, the countries which are averagely above 24.1% in terms of resource rents include Angola, Burundi, Chad, Congo, DRC, Equatorial Guinea, Ethiopia, Gabon, Liberia, and Nigeria. Burundi and Liberia are the only non-oil rich countries on the list. Burundi is rich in nickel and gold among other natural resources while Liberia is rich in iron ore, diamonds, and gold. Our findings are in line with the studies of Mu et al. (2017) and Drummond et al. (2013) which concluded that China is a crucial marginal importer of oil in sub-Sahara Africa, playing a relatively significant role in affecting global oil prices. Moreover, Asiedu (2013) highlighted that oil industry in sub-Sahara Africa is dominated by foreign investors. It is therefore likely that the oil imported by both China and US is sourced from their oil mining investments in sub-Sahara Africa. This might as well apply to other natural resources (Collier et al. 2009; Drummond et al. 2013). Thus, these channels jointly expose the growth of natural resource abundant countries in sub-Sahara Africa to economic shocks of China and the US.

Eunomix (2012) asserts that the resource rents of at least 5% are high enough to benefit the economy. On average the 25% quantile of resource rents in sub-Sahara Africa is 5.1% implying that most countries in the region are above the benchmark. Our results are therefore consistent with latter in that sub-Sahara Africa did not suffer from resource curse in the recent growth episode. However, only rich countries seem to have benefited from natural resources FDI deals.

5. Conclusion and Recommendations

According to literature, FDI in natural resources seems to have played a significant role in amplifying the dependency of sub-Sahara Africa's growth to the output growth of its FDI sources. Precisely, China’s increased demand for natural resources to support its rapid investment-driven economic growth seem to have driven resource prices high in the global market. This development prompted traditional and new emerging investors including China to source for natural resources in sub-Sahara Africa through FDI. Although the surge of FDI from various sources might have helped drive growth in the region, it has also made sub-Sahara Africa’s growth to be more susceptible to the economic shocks of its FDI sources.

This study was conducted to accomplish the following objectives. First, to determine the direct dependency of growth in sub-Sahara Africa to the growth of its FDI sources through FDI lens. Second, to analyze the threshold level at which resources rents can spur win-win investment deals between sub-Sahara Africa and its FDI sources. We found that only EU’s output growth can directly spillover to sub-Sahara Africa's growth through FDI lens. Thus, a 1% increase (decrease) in EU's vector of FDI weighted real GDP growth rate can lead to a 0.02% increase (decrease) in real per capita GDP growth of sub-Sahara Africa. This impact does not change between resource and non-resource countries as confirmed by accepting the hypothesis of no threshold effects for the regression relating to the latter and the rest of Asia. The resource rents threshold level of 24.1% and 24.3% exist for the output growth of the US and China, respectively. Our results provide evidence that only sub-Sahara African countries which have resource rents of at least 24.1% and 24.3% benefit from output growth of the US and China, respectively. These are mostly oil-producing countries. Moreover, we also found that most countries in the region have surpassed a 5% benchmark of resource rents required to sustain growth. These findings are based on a sample of 42 countries for the period (2003-2012).

Equal impact of EU's output growth on growth of both resource and non-resource rich countries in sub-Sahara Africa conveys information that FDI from EU is diversified relative to FDI from China, US and the rest of Asia. In contrast, FDI from China and the US seem to be concentrated in resource rich-countries, precisely oil producing countries. Hence, the growth of resource-rich countries is vulnerable to the economic shocks of China and the US. Since the resource rents of most sub-Sahara Africa countries are over 5%, the region might have not suffered a resource curse in the recent growth episode. However, only oil abundant countries seem to have benefited from natural resources FDI deals. Given this empirical analysis, policies formulated to promote diversified FDI are likely to enhance positive output growth spillovers from the FDI sources to all countries in the region. This can also minimize the risk associated with resource paradigm growth and hedge against negative shocks arising from the economic rebalancing of FDI sources. Moreover, management policies targeted to sustain natural resources can positively impact resource rents. Higher resource rents place sub-Sahara Africa in a better position to benefit from output growth of China and the US through FDI lens.

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