THE IMPACT OF CHINA'S FDI AND FDI FROM OTHER SOURCES ON GROWTH IN SUB-SAHARA AFRICA THROUGH EXPORT UPGRADING

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Abstract

This paper seeks to analyse how FDI from China, US, EU, and the rest of Asia transmit to growth in sub-Sahara Africa through export upgrading for the period (2003-2012). Terms-of-trade is utilized as a proxy for export upgrading. We develop a theoretical argument to show that countries with worsening (less than 1%) terms-of-trade are associated with poor industrialization as a result they can hardly improve quality and quantity of their products for export market, vis-à-vis. In this respect, this study contributes to existing literature in two ways. First, we investigate if technology embodied in FDI from the above-mentioned sources can enhance quantity and quality improvements of export commodities in sub-Sahara Africa. Second, we account for industrial policy heterogeneity of sub-Sahara African countries in order to determine the threshold level at which FDI-induced export upgrading can contribute positively to growth. Using both 2SLS and PTR models, our results reveal that FDI from China and the rest of Asia does not bear significant impact on growth in sub-Sahara Africa through export upgrading. However, PTR analysis demonstrates that FDI from US and EU seem to have a significant negative impact only below a threshold of 1.08%. As the terms-of-trade improves beyond 1.08%, the estimated coefficients of both FDI from US and EU turn positive, albeit insignificant. We conclude that sub-Sahara African countries are far yet to reach a threshold at which FDI-induced export upgrading can contribute positively to growth.

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1 Introduction

Although it can be argued that decrease in terms-of-trade reflects export price competitiveness of the country's goods, this paper equally argues that the improving terms-of-trade implies a rise in the purchasing power of the economy's exports. All other things held constant, a rise in the purchasing power of the country's exports often improves the balance of trade hence growth. Terms-of-trade exhibit an economy's export prices relative to its import prices (Wacker, Grosskurth, & Lakemann, 2014). Accordingly, it can be argued that terms-of-trade improve with the export value of the merchandise. From the production perspective, the terms-of-trade can, therefore, be maximized in various ways including minimizing production costs while improving quality and increasing export basket in terms of quantity. These factors reflect export upgrading and are driven by production know-how because of its ability to stimulate productivity (Zhu & Fu, 2013). Mattoo & Subramanian (2009) suggest that export upgrading and the ability to export to the industrialized economies enhance economic growth in the country. Harding & Javorcik (2012) argue that in developing countries export upgrading is not a trivial task due to several challenges including lack of capital to finance production technologies and poor reputation in the global market. How these impediments can be addressed is subject to a vivid academic debate.

However, the latter concede with Romer (1993) and other potential studies in that FDI is a vital source of innovation to technical laggard economies. In terms of poor market reputation, (UNCTAD, 2005) suggests that FDI provides opportunities for technological laggard countries to access the global market even where substantial costs are involved due to the emanation of positive spillover effects from locational proximity to an innovation leader. 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. These views provide ample evidence in that FDI as a source of innovation can catalyze export upgrading and associated terms of trade in the host country.

Zhu *et al*., (2013) suggest that export-oriented FDI in developing economies is often accompanied by the imports of high technology immediate inputs. These inputs enhance the production of sophisticated final products in the host country let alone making the domestic capital more productive. In line with the latter, Poncet & Starosta de Waldemar (2012) assert that FDI can directly transmit to product upgrading since the quality of commodities produced by multinational corporations (MNCs) in the host country is typically higher than that of the domestic firms. The indirect transmission channel occurs when production technologies from MNCs spillover to domestic firms. However, this channel depends on the capacity of domestic firms to absorb foreign production technologies. Demena & Murshed (2018) argue that significant FDI productivity spillover effects can be realized if domestic firms have the capacity to imitate high tech production processes exposed to them by the MNCs. Otherwise, export upgrading will only be reflected in sophisticated products produced by MNCs. In such cases, growth benefits can hardly be attained and the former asserts that this is highly likely in developing countries.

In the context of sub-Sahara Africa, FDI productivity diffusion might be constrained by the nature of industry which foreign investors seem to be targeting. Literature (Collier & Goderis, 2009; Busse, Erdogan & Muhlen, 2014; Chen, Dollar & Tang, 2015; Donou-Adonsou & Lim, 2018) provide considerable evidence to substantiate that FDI penetration in Africa from both traditional and new emerging investors is mainly driven by the investors' appetite for natural resources. Resource mining projects are capital intensive investments which most domestic firms in sub-Sahara Africa cannot afford to operate relatively with MNCs. This explains why the extraction industry in the region is dominated by foreign investors (Asiedu, 2013). Based on Demena *et al*., (2018) and Poncet *et al*., (2012) assertions, it can be argued that sophistication induced growth in sub-Sahara Africa could be a statistical mirage because export upgrading and associated terms-of-trade are reflected only in the resources extracted by the MNCs. This follows that only resource export platforms of MNCs are likely to benefit from export upgrading and associated terms of trade (Busse *et al*., 2014). However, the benefits are volatile subject to the fluctuations in global prices of natural resources.

Empirical studies on the growth effects of FDI through export upgrading are still scarce particularly in the context of Africa. The available potential studies focus mainly on the impact of FDI on export upgrading in developing countries generally. For instance, Harding & Javorcik (2012) provide evidence that FDI can enhance export upgrading in developing countries. In contrast, Wacker, Grosskurth, & Lakemann (2016) found negative effects of FDI on export upgrading and associated terms-of-trade in South Asia. The latter, however, argue that FDI productivity spillover effects on export upgrading depend on the quality of human capital. Likewise, Zhu *et al*., (2013) provide evidence that the effect of education is significant in FDI-induced-export upgrading in low-income countries. This paper contributes to the existing literature in various ways. First, it uses disaggregated FDI data to investigate how FDI from various sources can transmit to growth through export upgrading. Second, this paper uses the PTR model to account for the heterogeneity of African countries' industrial policy in terms of export upgrading.

The rest of the paper is structured as follows. Section two specifies the model. Section three describes data, variables and empirical strategies. Section four presents the empirical results and discusses the findings of the main parameters. Section five concludes the study.

2 Model specification

In the exogenous growth models pioneered by Solow and Swan (1956), FDI simultaneously serves as a capital and technological input and hence forestalls physical capital falling into diminishing returns due to the presence of consistent contribution of the technology growth (Neuhaus, 2006). Likewise, in endogenous growth theories pioneered by Romer (1986), technology diffusion through MNCs impel productivity coming about to increase economic growth both in the short and long-run. In either case, production technology embodied in FDI promotes capital deepening which enhances the quality of existing varieties of capital goods (Aghion & Howitt, 1992; Aghion, Akcigit & Howitt, 2015) and the invention of totally new varieties of capital goods (Romer, 1990).

Accordingly, the model of this paper follows the FDI-augmented version of the Solow growth model. The model was proposed by Neuhaus (2006) following the lead of Mankiw, Romer, & Weil (1992) and Bassanini & Scarpetta (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. Hence, we account for two different stocks of physical capital; domestic capital investment (K_d) and foreign direct investment (K_f).

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

where Y, K and A proxy for aggregate output, the stock of physical capital, and the productivity parameter respectively. The subscript L denotes labor input while t represents time. α and β represent production elasticities of domestic and foreign capital stocks, respectively.

Since our model follows the neoclassical growth theories, we utilize changes in the log of per capita GDP for income levels in real terms as our dependent variable ($lny_{it} - lny_{it-1}$). The specification of our regressors incorporates fundamental determinants of the steady-state and technical progress variables. The steady-state determinants according to Solow (1956) include the convergence term (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). Bassanini *et al*., (2001) suggest that technical progress (A) consists of two elements. One that accounts for various policy oriented variables ($X_{i,t}$) such as institutional framework, inflation rate, resource rents 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 basic model can be summarised using the following econometric statement:

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

As highlighted before, this paper incorporates FDI both as physical capital input (s_f) and technology input. However, we are much interested on the latter where technology embodied in FDI is transmitted towards the production of new varieties of commodities and quality enhancement of existing varieties of commodities in the host country. Our assumption being that if the quality and quantity of the commodities are improved, export value of the host country is also likely to improve.

Increase in the export value is in this study quantified using terms-of-trade and according to WDI (2019) terms-of-trade above 1% indicate an improvement in the value of export portfolio otherwise a worsening. Wacker *et al*., (2014) assert that terms-of-trade exhibit an economy's export prices relative to its import prices. It can therefore be argued that terms-of-trade increases with the export value of the merchandise. In this respect, we compute interaction term between FDI and terms-of-trade (*FDI*TOT*) to analyse the impact of FDI from China, EU, US and the rest of Asia on growth in sub-Sahara Africa through export upgrading.

Moreover, in the study of Mankiw *et al*., (1992) the depreciation rate of the physical capital stock (*d*) and changes in technology (*g*) is assumed to be constant over time and equal to 0.05. Thus the equation (2) translates to equation (3) as follows;

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

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 subscript i denotes cross-sectional dimension.

2.1 Data and variables description

This paper measures per capita GDP in real terms for income levels. The domestic investment savings rate is measured using Gross Capital Formation as a percentage of GDP while foreign investment savings rate is measured using the share of inward stock of FDI in GDP. 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) argue that that the ratio of inward stock of FDI to GDP is more accurate than flows 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 to capture the revenue obtained from extraction of resources, rule of law to proxy for institutional quality and inflation rate to control for macroeconomic distortions. All these control variables are in logarithms. The summary of all the variable descriptions and data sources is provided in Table 1 below.

Table 1: Variable descriptions and data sources

Our sample embraces a panel of 42 sub-Sahara African countries over the period (2003-2012). Guided by the analytical framework of Sy (2014)[1], our analysis of FDI sources accounts for China, USA, EU, and Asia excluding China (rest of Asia). Our study period (2003-2012) is restricted by the availability of inward stock of FDI data from the named FDI sources to African countries, likewise our sample. The list of the sample is provided in Table 2 below.

Table 2: Sample[2]

[1] An analytical framework of Sy (2014) shows that there has been a surge of inward stock of FDI in Africa from $27.2 billion to approximately $132.8 billion between the periods (2001-2012). This surge was mainly fuelled by China, whose FDI grew at an annual rate of 53 percent, compared with, 16 percent for the EU and 14 percent for the U.S. In addition to China, other new emerging investors were increasingly investing in the continent.

[2] 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

3 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 (3) 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 *et al*., (2018), we instrument each source of FDI with its 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 a Hausman test or C test. For the validity of instruments, we use the Hansen test of overidentifying restrictions.

However, one of the weakness associated with classical fixed-effects models in as much as the interaction term is concerned (*FDI*TOT*) is the inability to capture for varying slopes. Rather, they reflect the heterogeneity of different countries in intercepts. To circumvent this drawback we also run equation (3) using fixed-effects panel threshold regression (PTR) of Hansen (1999). While we acknowledge that PTR model does not fully account for endogeneity, it is crucial to note that the estimation technique is effective in capturing different links in terms of statistical significance, magnitude and signs of FDI from a specific source in distinct regimes of terms-of-trade in sub-Sahara Africa. Accordingly, instrumental variables estimation techniques and PTR model complement each other. In this study, 2SLS is used to confirm robustness of the estimated coefficients of the direct impact of FDI from the sources as well as other control variables while PTR demonstrates how FDI indirectly transmit to growth through export upgrading by capturing industrial heterogeneity in sub-Sahara Africa.

Allowing for fixed individual effects (μ_i) and given terms-of-trade ($TOT_{i,t}$) as a threshold variable, the PTR divides the observations into two or more regimes,

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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.

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;

$$y_{it} = \mu_i + \beta'_{it} s_{f,it} g(TOT_{it}; c) + \varphi' X_{it} + \varepsilon_{it} \quad (4)$$

where X_{it} denotes for fundamental Solow growth variables and other control variables discussed above excluding terms-of-trade. Excluding terms-of-trade from other regressors in the main equation controls for reverse causality and collinearity. The subscript $s_{f,it}$ represents the inward stock of FDI while ε_{it} is the error term. The binary transition function $g(TOT_{it}; c)$ 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:

$$y_{it} = \begin{cases} \mu_i + \beta'_1 s_{f,it} + \varphi' X_{it} + \varepsilon_{it} & if\ TOT_{it} \leq c \\ \mu_i + \beta'_2 s_{f,it} + \varphi' X_{it} + \varepsilon_{it} & if\ TOT_{it} > c \end{cases}, \quad (5)$$

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

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

For multiple thresholds that is, models with $r + 1 > 2$ regimes or threshold parameters $c_1, .. c_r$, the general specification is as follows:

$$y_{it} = \mu_i + \sum_{j=1}^{r} \beta'_j\, s_{f,it} \mathrm{I}_{(c_{j-1} < TOT_{it} \leq c_j)} + \varphi' X_{it} + \varepsilon_{it} \quad (7)$$

where $\mathrm{I}_{(c_{j-1} < TOT_{it} \leq c_j)}$ represents the indicator function and $c_0 = -\infty$ while $c_{r+1} = +\infty$.

Equation (7) ought to be fitted sequentially for instance in the case of a double threshold that is, three regimes model the specification is presented below;

$$y_{it} = \mu_i + \beta'_1 s_{f,it}(TOT_{it} < c_1) + \beta'_2 s_{f,it}(c_1 \leq TOT_{it} < c_2) + \beta'_3 s_{f,it}(TOT_{it} \geq c_2) + \varphi' X_{it} + \varepsilon_{it} \quad (8)$$

where $c_1 < c_2$.

Notwithstanding uncertainty about the endogeneity bias and potential reverse causality, this study uses lagged values of FDI and terms-of-trade. This translates equation (4) and (7) into the following equations, respectively:

$$y_{it} = \mu_i + \beta'_{it} s_{f,it-1} g(TOT_{it-1}; c) + \varphi' X_{it} + \varepsilon_{it} \quad (9)$$

$$y_{it} = \mu_i + \sum_{j=1}^{r} \beta'_j \, s_{f,it-1} \mathrm{I}_{(c_{j-1} < TOT_{it-1} \leq c_j)} + \varphi' X_{it} + \varepsilon_{it} \quad (10)$$

3.1 Estimation procedures

We begin by reporting results of the baseline specification of Solow model. In this case, growth is explained only by fundamental determinants of the steady state as presented below.

$$lny_{it} = \alpha + (\beta + 1) lny_{it-1} + \gamma lns_{d,it} + \varphi \, ln(n_{it} + 0.05) + \lambda_t + \eta_i + \varepsilon_{it} \quad (11)$$

After performing the baseline regression, we estimate equation (3) using the fixed-effects 2SLS estimator to determine how FDI from China, US, EU and rest of Asia contribute to growth in sub-Sahara Africa through export upgrading.

However, the latter estimation procedure ignores the heterogeneity of the sub-Sahara African countries in terms of export upgrading policies. Rather, it regards all countries in the region as one. Precisely, classical fixed-effects models cannot capture for varying slopes rather they reflect the heterogeneity of different countries in intercepts. While we acknowledge that sub-Sahara Africa is a region comprising of countries with common characteristics, industrialization capacity of these countries as determined by terms-of-trade are significantly different and as a result, the structural relationships may vary from one country to the other. We, therefore estimate equation (10) using PTR model to determine the impact of FDI from the above mentioned sources on growth in sub-Sahara Africa subject to different levels of terms-of-trade.

The first test of the PTR model is conducted to determine the significance of the threshold effect in equation (10). 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 (10) collapses to equation (3). The main econometric problem associated with the test for no threshold effects 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 thresholds. A sequential procedure based on $F_2, \ldots F_j$ (until the corresponding H_0 is accepted) allows the determination of the number of thresholds 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).

4 Estimated results

Table 3 reports the results of the standard Solow model variables. Estimated coefficients of lagged dependent variable[3] and domestic investment has 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 analyzed, 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 real GDP per capita. 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.

[3] 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.

Table 3: Standard OLS fixed-effects results for baseline specifications of the Solow model

The estimated results of the fixed-effects 2SLS estimator are exhibited in Table 4 below. Column (1)-(4) shows the regressions relating to the FDI from China, US, EU and the rest of Asia, respectively.

Table 4: Fixed-effects 2SLS estimated results

Across all specifications, the magnitude change in standard Solow model variables is marginal relative to the result of the baseline specification presented in Table 3. The results show that 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. The results also show that the direct impact of FDI from China is negative and statistically significant at 5% while the estimated coefficients of FDI from other sources are statistically insignificant. Thus, a 1% increase in FDI from China can lead to a decrease in sub-Sahara Africa's real GDP per capita by approximately 0.18%. In terms of FDI from the rest of the world, 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. Rule of law coefficient enters the model with the expected sign across all regressions albeit statistically significant only in the regression relating to Chinese FDI. The estimated coefficients of all other variables including the interaction term between FDI and terms of trade are statistically insignificant. Before we can turn to the PTR estimations, we impose some restrictions in the equation (3) in order to examine the robustness of the results obtained in Table 4.

4.1 Robustness checks

Although Busse *et al*., (2014) show that including popuplation growth rate and inflation rate as regressors for real GDP per capita in levels does not distort overall results, we estimate equation (3) with restrictions to check if the same applies to our data. First, we run equation (3) without inflation to check if there is no serial correlation between changes in GDP deflator and real GDP per capita (column (1)). The second restriction exclude population variable presumably population growth might be correlated to the per capita component in the real GDP per capita (column (2)). In column (3) we exclude both inflation rate and population growth rate. The results are shown in the table 5(a) and 5(b) below. Table 5(a) shows the results of all regressions with respect to FDI from China and the rest of Asia while table 5(b) shows all estimations relating to FDI from US and EU.

Table 5 (a): Fixed effects 2SLS estimated results of FDI from China and the rest of Asia

Table 5(b): Fixed effects 2SLS estimated results of FDI from US and EU

Across all the regressions, our results indicate same qualitative outcome. In addition, the change in the estimated coefficients of all variables is marginal. Hence, we are convinced that correlation issues are not a major problem and that our model is valid. We can now proceed to the PTR analysis.

4.2 PTR analysis

This study uses terms-of-trade as the threshold variable. The variable is summarised in Table 6. Row (1) exhibit terms of trade in logarithms while row (2) presents the corresponding values in their raw form as extracted from the WID (2019). Terms-of-trade above 1% indicate an improvement in the value of export portfolio otherwise a worsening.

Table 6: Summary of the threshold variable

In the context of this study, improvement in terms of trade implies increase in export value hence export upgrading. The results reveal that on average, terms to trade in sub-Sahara Africa does not exceed 4,33% while the minimum is 0,55%.

Table 7 presents the results of the hypothesis of no threshold effects and the tests to determine the number of thresholds. These estimation procedures were conducted separately for each source of FDI.

Table 7: Test for threshold effects and number of thresholds

The test statistic F_1 of the regressions relating to FDI from US and EU are both significant at 5% with an equal corresponding bootstrap p-value of 0.02 while the test statistics F_1 of both China and the rest of Asia are statistically insignificant. These results imply that the hypothesis of no threshold effects is rejected for the regression relating to FDI from US and EU while accepted for China and the rest of Asia. Hence, the estimated results in Table 4 holds for FDI from China and the rest of Asia.

For the FDIs which passed the PTR test, the test statistics F_2 of the regression relating to EU is statistically significant at 5% while that of the US is statistically insignificant. The test statistic for a third threshold F_3 of FDI from EU is however statistically insignificant. Thus, the results imply one threshold (two regimes) for PTR analysis of FDI from the US and two thresholds (three regimes) for FDI from the EU. In terms of threshold parameters, the results are exhibited in Table 8 below.

Table 8: Terms of trade threshold level estimates

As shown in Table 8 above, FDI from the US is analyzed in two regimes demarcated with a threshold point estimate of 0.077. Whilst FDI from the EU is analyzed in three regimes separated by threshold point estimates of 0.020 and 0.077. The point estimates of 0.020 and 0.077 correspond to the terms-of-trade threshold levels of 1.02% and 1.08%, respectively. Thus for EU FDI, the first, second and third regime is such that; $TOT_{it} < 1.02$, $1.02 \leq TOT_{it} < 1.08$ and $TOT_{it} \geq 1.08$, respectively. For US FDI, the first and second regimes are respectively separated as; $TOT_{it} \leq 1.08$ and $TOT_{it} > 1.08$. 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.

The main results of the PTR analysis are presented in Table 9. Column (1) reports the results relating to FDI from the US while results in column (2) relate to the FDI from the EU. Notwithstanding uncertainty about potential correlation arising from population growth and inflation variable, we exclude both variables in column (3) and (4). Accordingly, column (3) and (4) are restricted regressions of column (1) and (2), respectively.

Table 9: PTR estimated results

β_1, β_2, and β_3 respectively correspond to the first, second regime for both sources of FDI and third regime for EU FDI only. Results in column (1) reveal that β_1 is negative and significant at 5% while β_2 is positive albeit statistically insignificant. In column (2), β_1 and β_3 are positive however statistically insignificant while β_2 is negative and highly insignificant. All the restricted regressions are robust to the main results.

4.3 Discussion of the main parameters

Accepting the hypothesis of no threshold effects in regressions relating to FDI from China and the rest of Asia serves as a confirmation that FDI from the sources does not bear significant impact on growth of all countries in sub-Sahara Africa through export upgrading. However, FDI from US and EU seem to have a significant impact on growth through export upgrading only below certain thresholds of terms-of-trade. That is, the impact of FDI from the US is negative on growth of all sub-Sahara African countries with terms-of-trade equal to 1.08% and below. In terms of FDI from EU, the impact on growth is statistically insignificant in all countries with terms-of-trade less than or equal to 1.02% yet negative in all countries with terms-of-trade ranging between 1.02% and 1.08%. As the terms-of-trade improves beyond 1.08%, the estimated coefficients of both FDI from US and US turn positive, albeit insignificant. Table 10 classifies sub-Sahara Africa countries into regimes as determined by the results.

Table 10: Classification of sub-Sahara Africa according to terms-of-trade regimes

Generally, our results indicate that sub-Sahara African countries are less industrialized to absorb production technology embodied in either of FDI sources analysed in this study. This is confirmed first, by statistically insignificant interaction term between FDI and terms-of-trade across all the regressions implying that the transmission of technology embodied in FDI towards quality and quantity enhancement of export commodities is statistically mirage. In line with Poncet *et al.*, (2012), it is highly possible that export upgrading is reflected only in the sophisticated products produced by the MNCs. The latter argued that in such cases, it is rare for FDI-induced export upgrading to contribute significantly to growth particularly in developing countries.

Second, we develop theoretical argument to show that industrial policy heterogeneity in sub-Sahara African countries may be one of the explanation for the results obtained using fixed-effects 2SLS. However, the results obtained using PTR still confirm that sub-Sahara African countries are far yet to reach a threshold at which FDI-induced export upgrading can contribute positively to growth. We use terms-of-trade as a threshold variable. Our assumption being that countries with worsening (less than 1%) terms-of-trade are associated with poor industrialization as a result they can hardly enhance quality and quantity of their products for export market. On the other dimension, countries with improving (more than 1%) terms-of-trade are assumed to have capacity to improve the quality and quantity of their products for export market. What is not known however, is the threshold level at which technology embodied in FDI from various sources can transmit to growth in sub-Sahara Africa through export upgrading.

The first segment of Table 10 shows countries with worsening terms-of-trade implying that their industrialization as determined by the export value is very low. Inward stock of FDI from EU appears to be less in these countries hence, the insignificant estimated coefficient of FDI from the source in this segment. FDI from the latter seem to flow towards countries with potential to industrialize as indicated by improving terms-of-trade. However, all countries falling within the second segment are negatively affected. Although the inward stock of FDI from US is statistically significant in both the first and second regime, the impact is negative. In the empirical work of Wacker *et al*., (2016), negative effects of FDI on export upgrading and associated terms-of-trade realized in South Asia were attributed mainly by the shortage of skilled human capital. Likewise, separate studies conducted by Zhu *et al*., (2013) and Fu & Li (2010) provide evidence that skilled human capital is a vital element of FDI-induced-export upgrading in low-income countries. In line with these studies, we relate our findings to scarcity of skilful labor required to absorb technology embodied in FDI. Furthermore, it can also be argued that less industrialized countries specialize in less-skills intensive products which are not competitive in the export market.

Although a threshold level of 1.08% provides direction to cartel FDI-induced export upgrading and associated terms-of-trade so as to overcome the negative growth effects of FDI from both US and EU, the challenge still remains that sub-Sahara African countries are less industrialized. From the list of countries provided in the third segment of Table 10, Angola has the highest average terms-of-trade value of approximately 2.21% and this might probable due to oil exports. Nonetheless, the value is still very low relative to other developing nations outside Africa for instance China, India, Russia and Brazil.

Falling within the third segment are countries rich in oil and other mineral resources that are highly demanded in the world commodity market. This result concurs with several studies including Chen *et al*., (2015) and Asiedu (2013) in that FDI from both China and Western investors in Africa is earmarked for natural resources and therefore the mining industry in the region is highly dominated by multinational companies (MNCs). Could this be the case, there will be literally zero imitation of technologies embodied in FDI (Demena *et al*., 2018) because domestic firms in sub-Sahara Africa hardly invest in heavy extraction projects due to capital constraints.

This also explains why export upgrading is reflected only in the sophisticated products produced by the MNCs. Precisely, FDI-induced export upgrading experienced by these countries equates to oil and mineral resources imported by both US and EU from their mining investments in sub-Sahara Africa. In addition, absorption of knowledge and technology utilized in oil and mineral extraction projects require highly skilled labor and such labor seem to be scarce in some sub-Sahara African.

Quality and quantity of commodities in the host country can also be improved when skills are transferable through physical human capital mobility from the MNCs to the domestic firms and entrepreneurial ventures (Demena *et al*., 2018). However, given the industry which foreign investors seem to be targeting, skills transfer is also constrained due to high wage differentials. MNEs offer high wages relative to domestic companies and the wage differentials are high in developing countries (Aitken *et al*., 1996).

5 Conclusion and recommendations

The recent surge of FDI from both traditional and new emerging investors in Africa has spawned substantial debate in particular on the growth effects of FDI from China as a new emerging investor in Africa. Most of the studies have mainly focused on the approach of measuring the impact of FDI from China as a capital input in the growth model of the continent. However, literature provides ample evidence in that FDI can serve simultaneously as a capital and technology input. This paper intends to contribute to the literature by analyzing how production technology embodied in FDI from China, US, EU and the rest of Asia can spillover to growth in sub-Sahara Africa through export upgrading. We use terms-of-trade to proxy for export upgrading because it quantifies the improvement of export value of the merchandise in the economy. The findings of this study show that FDI from China and the rest of Asia does not influence growth in all sub-Sahara African countries through export upgrading. Whereas FDI from US and EU seem to have a significant impact on growth through export upgrading only below certain thresholds of terms-of-trade. Precisely, all less industrialized countries as reflected by terms-of-trade worse than 1.08% are negatively affected by FDI from the US. EU seem to invest only in countries with potential to industrialize although countries with terms-of-trade ranging between 1.02% and 1.08% are negatively affected. As the terms-of-trade improve beyond 1.08%, the growth effects of FDI from both EU and US turns positive albeit, insignificant.

Our results confirm that sub-Sahara African countries are less industrialized to absorb production technology embodied in either of FDI sources analysed in this study. The threshold level obtained is crucial for FDI-induced-export upgrading development policies in sub-Sahara Africa because it provides direction for mitigation procedures. Thus, a threshold level of 1.08% provides direction to cartel FDI productivity spillover effects on export upgrading so as to overcome the negative growth effects of FDI from the US and EU in sub-Sahara Africa. The mitigation procedures can include but not limited to human capital development and attraction of diversified FDI. Absorption of production know-how embodied in FDI is effective through the streams of the skilled and educated labor force. On the other dimension, FDI attracted towards economic sectors in which domestic firms can be able to imitate production processes from MNCs and compete with them enhances sophistication. Given the availability of data, further studies should be directed towards analyzing FDI-induced-export upgrading in a specific industries of the host economy. Future studies can also look on the possibility to combine instrumental variables estimation techniques and the PTR model into one estimation technique which can simultaneously account for endogeneity issues and heterogeneity among the cross-sections.

References

Aghion, P., Akcigit, U. & Howitt, P. 2015. The Schumpeterian Growth Paradigm. *Annual Review of Economics*, **7**, 557–575. https://www.brown.edu/Departments/Economics/Faculty/Peter_Howitt/publication/Schumpeterian_Paradigm.pdf.

Aghion, P. & Howitt, P. 1992. 'A model of growth through creative destruction', *Econometrica*, **60**(2), 323-351.

Aitken, B.J., Harrison, A.E. & Lipsey, R.E. 1996. 'Wages and foreign ownership : A comparative study of Mexico, Venezuela and the United States', *Journal of International Economics*, **40**, 345-371.

Asiedu, E. 2013. Foreign direct investment , natural resources and institutions. *Working Paper International Growth Center*, (3), 1-38. https://www.theigc.org/wp-content/uploads/2014/09/Asiedu-2013-Working-Paper.pdf.

Bassanini, A. & Scarpetta, S., 2001. The driving forces of economic growth: panel data evidence for the OECD countries. *OECD Economic Studies*, 33(33), pp.9–56. http://hal.archives-ouvertes.fr/halshs-00168383/.

Busse, M., Erdogan, C. & Muhlen, H. 2014. China's impact on Africa - The role of trade, FDI and Aid. http://webcache.googleusercontent.com/search?q=cache:9f7v2mm_oBsJ:2015.essa.org.za/fullpaper/essa_2965.pdf+&cd=6&hl=en&ct=clnk&gl=za.

Chen, W., Dollar, D. & Tang, H. 2015. Why is China investing in Africa? Evidence from the firm level, *The World Bank Economic Review*, August, lhw049. https://academic.oup.com/wber/article-lookup/doi/10.1093/wber/lhw049.

Collier, P. & Goderis, B. 2009. Structural policies for shock-prone developing countries. *Munich Personal RePEc Archive*, (17311). https://ssrn.com/abstract=1473725.

Davies, R.B. 1987. 'Hypothesis testing when a nuisance parameter is present only under the alternative', *Biometrika*, **74**(1), 33-43. http://robertnz.com/pdf/nuisance2.pdf.

Demena, B.A. & Murshed, S.M. 2018. 'Transmission channels matter: Identifying spillovers from FDI', *Journal of International Trade and Economic Development*, **27**(7), 701-728. doi.org/10.1080/09638199.2018.1439083.

Donou-Adonsou, F. & Lim, S. 2018. 'On the importance of Chinese investment in Africa', *Review of Development Finance*, **8**(1), 63-73. doi.org/10.1016/j.rdf.2018.05.003.

Fu, M. & Li, T. 2010. *Human capital as a determinant of FDI technology spillovers and its threshold effects in China : An analysis based on multiple productivity estimates*, Vienna.

Hansen, B.E. 1996. 'Inference when a nuisance parameter is not identified under the null hypothesis', *Econometrica*, **64**(2),413-430.

Hansen, B.E. 1999. 'Threshold effects in non-dynamic panels: Estimation , testing , and inference', *Journal of Econometrics*, **93**, 345-368.

Harding, T. & Javorcik, B.S. 2012. 'Foreign direct investment and export upgrading', *The Review of Economics and Statistics*, **94**(4), 964-980.

Hauk, W.R. 2016. 'Endogeneity bias and growth regressions', *Journal of Macroeconomics*. https://www.researchgate.net/publication/308517778_Endogeneity_and_Growth_ Regressions.

Hoeffler, A.E. 2002. 'The augmented Solow model and the African growth debate', *Oxford Bulletin of Economics and Statistics*, **64**(2), 135-158+84. doi.org/10.1111/1468-0084.00016

Mankiw, N., Romer, D. & Weil, D. 1992. 'A contribution to the empirics of economic growth', *Quarterly Journal of Economics*, **107**, 407-38.

Mattoo, A. & Subramanian, A. 2009. Criss-crossing globalization: Uphill flows of skill-intensive goods and foreign direct investment. *Center for Global Development Working Paper*, (176). https://www.files.ethz.ch/isn/104511/1422581_file_Mattoo_Subramania_Uphill_Skill.pdf.

Mencinger, J. 2003. Direct and indirect effects of FDI on current account. *EIPF and University of Ljubljana*. https://docplayer.net/6986776-Direct-and-indirect-effects-of-fdi-on-current-account.html

Neuhaus, M. 2006. *The impact of FDI on economic growth: An analysis for the transition countries of central and Eastern Europe* M. Miller, Werner A., Bihn, ed., London NWl 9NB: Physica-Verlag A Springer Company.

Poncet, S. & Starosta de Waldemar, F. 2012. Export upgrading and growth: The prerequisite of domestic embeddedness. *CEPII,WP*, 1-40.

Romer, P. 1990. 'Endogenous technological change', *Journal of Political Economy*, **98**, S71-8103.

Romer, P. 1993. 'Idea gaps and object gaps in economic development', *Journal of Monetary Economics*, **32**, 543-573.

Romer, P. 1986. 'Increasing returns and long-run growth', *Journal of Political Economy*, **94**, 1002-1037.

Solow, R. 1956. 'A contribution to the theory of economic growth', *Quarterly Journal of Economics*, **70**, 65-94.

Swan, T. 1956. 'Economic growth and capital acumulation', *Economic Record*, **32**, 334-361.

Sy, A. 2014. Is Africa at a historical crossroads to convergence? *Africa Growth Initiative,The Brookings Institute*, 11–21. https://www.brookings.edu/wp-content/uploads/2016/07/tt20-africa-convergence-sy.pdf.

UNCTAD. 2005. Globalization of R & D and developing countries preface & overview. *United Nations conference on trade and development Geneva*, UNCTAD/ITE(6).

Wacker, K.M., Grosskurth, P. & Lakemann, T. 2016. 'Foreign direct investment, terms of trade, and quality upgrading: What is so special about South Asia?', *Asian Development Review*, **33**(1), 28-55.

Wacker, K.M., Grosskurth, P. & Lakemann, T. 2014. Terms of trade, foreign direct investment, and development: A case of intra-Asian "Kicking away the ladder"? *ADB Working Paper Series on Regional Economic Integration*, (122).

Zhu, S. & Fu, X. 2013. 'Drivers of export upgrading', *World Development*, **51**, 221-233. dx.doi.org/10.1016/j.worlddev.2013.05.017.

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	Terms of trade in %, based on an index 2000=100.	WDI (2019)
Inflation	GDP deflator, annual change in %.	WDI (2019)
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 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)

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	Tanzania	Togo	Uganda	Zambia	Zimbabwe

Table 3: 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

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

Table 4: Fixed-effects 2SLS estimated results

Dependent Variable: ln real GDP per Capita				
	(1)	(2)	(3)	(4)
Lagged Dep Var	0,715***	0,710***	0,719***	0,727***
	(0,084)	(0,066)	(0,068)	(0,058)
ln Domestic Investment	0,013***	0,012***	0,013***	0,013***
	(0,005)	(0,004)	(0,005)	(0,005)
ln Population Growth	(-0,009	0,004	0,008	0,001
	(0,015)	(0,021)	(0,018)	(0,017)
ln inflation	0,005	0,005	0,006	0,005
	(0,007)	(0,007)	(0,008)	(0,007)
ln Natural Resource Rents	0,006	0,005	-0,001	0,005
	(0,015)	(0,17)	(0,016)	(0,016)
ln FDI ROW	-0,061	-0,101	-0,066*	-0,070**
	(0,038)	(0,070)	(0,039)	(0,033)
ln Rule of Law	0,041*	0,040	0,031	0,035
	(0,023)	(0,039)	(0,024)	(0,027)
ln FDI China	-0,182**			
	(0,084)			
ln FDI US		-0,027		
		(0,100)		
ln FDI EU			-0,019	
			(0,051)	
ln FDI ROA				0,061
				(0,138)
ln FDI^{j}*TOT	0,000	0,000	0,000	0,000
	(0,000)	(0,000)	(0,000)	(0,000)
Observations	252	227	237	244
Countries	42	42	42	42
R-Squared (within)	0,803	0,794	0,789	0,800
Hausman/C test (p-value)	0,000	0,001	0,000	0,000
Hansen test (p-value)	0,874	0,238	0,271	0,340

Notes: The subscript *j* represents a specific source of FDI. *FDI^{j}*TOT* is the interaction term between FDI from a specific source and terms of trade. 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, 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.

Table 5 (a): Fixed effects 2SLS estimated results of FDI from China and the rest of Asia

Fixed Effects 2SLS: FDI from China			
Dependent Variable: In real GDP per Capita			
	(1)	(2)	(3)
Lagged Dep Var	0,714***	0,717***	0,716***
	(0,016)	(0,058)	(0,061)
ln Domestic Investment	0,014***	0,013***	0,014***
	(0,005)	(0,005)	(0,005)
ln Population Growth	-0,008		
	(0,016)		
In inflation		0,005	
		(0,007)	
ln Natural Resource Rents	0,006	0,006	0,006
	(0,015)	(0,015)	(0,015)
ln FDI ROW	-0,063	-0,063	-0,063
	(0,040)	(0,038)	(0,040)
ln Rule of Law	0,039*	0,039*	0,038*
	(0,023)	(0,023)	(0,023)
ln FDI China	-0,187**	-0,167**	-0,174**
	(0,086)	(0,087)	(0,090)
ln FDI US			
ln FDI EU			
In FDI ROA			
In FDITOT	0,000	0,000	0,000
	(0,000)	(0,000)	(0,000)
Observations	256	252	256
Countries	42	42	42
R-Squared (within)	0,803	0,803	0,803
Hausman/C test (p-value)	0,000	0,000	0,000
Hansen test (p-value)	0,883	0,836	0,846

Table 5 (a): Fixed effects 2SLS estimated results of FDI from China and the rest of Asia (continued)

Fixed Effects 2SLS: FDI from the rest of Asia			
Dependent Variable: In real GDP per Capita			
	(1)	(2)	(3)
Lagged Dep Var	0,726***	0,727***	0,726***
	(0,059)	(0,058)	(0,060)
ln Domestic Investment	0,013***	0,013***	0,013***
	(0,005)	(0,005)	(0,005)
ln Population Growth	0,002		
	(0,018)		
In inflation		0,005	
		(0,007)	
ln Natural Resource Rents	0,005	0,005	0,005
	(0,016)	(0,016)	(0,016)
ln FDI ROW	-0,073**	-0,070**	-0,073**
	(0,036)	(0,033)	(0,035)
ln Rule of Law	0,033	0,035	0,033
	(0,027)	(0,027)	(0,027)
ln FDI China			
ln FDI US			
ln FDI EU			
In FDI ROA	0,051	0,057	0,0454
	(0,138)	(0,132)	(0,133)
In FDITOT	0,000	0,000	0,000
	(0,000)	(0,000)	0,000)
Observations	248	244	248
Countries	42	42	42
R-Squared (within)	0,801	0,801	0,801
Hausman/C test (p-value)	0,000	0,000	0,000
Hansen test (p-value)	0,390	0,404	0,415

Notes: The subscript j represents a specific source of FDI. FDIj*TOT is the interaction term between FDI from a specific source and terms of trade. 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, 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.

Table 5(b): Fixed effects 2SLS estimated results of FDI from US and EU

Fixed Effects 2SLS: FDI from US

Dependent Variable: In real GDP per Capita			
	(1)	(2)	(3)
Lagged Dep Var	0,708***	0,710***	0,708***
	(0,066)	(0,066)	(0,067)
ln Domestic Investment	0,013***	0,012***	0,013***
	(0,005)	(0,004)	(0,005)
ln Population Growth	0,006		
	(0,022)		
In inflation		0,005	
		(0,007)	
ln Natural Resource Rents	0,005	0,005	0,005
	(0,017)	(0,017)	(0,017)
ln FDI ROW	-0,105	-0,099	-0,103
	(0,071)	(0,065)	(0,067)
ln Rule of Law	0,038	0,040	0,0372
	(0,039)	(0,038)	(0,037)
ln FDI China			
ln FDI US	-0,025	-0,028	-0,026
	(0,101)	(0,098)	(0,099)
ln FDI EU			
In FDI ROA			
In FDITOT	0,000	0,000	0,000
	0,000	0,000	0,000
Observations	232	227	231
Countries	42	42	42
R-Squared (within)	0,794	0,793	0,794
Hausman/C test (p-value)	0,000	0,000	0,001
Hansen test (p-value)	0,178	0,235	0,178

Table 5(b): Fixed effects 2SLS estimated results of FDI from US and EU (continued)

Fixed Effects 2SLS: FDI from EU			
Dependent Variable: In real GDP per Capita			
	(1)	(2)	(3)
Lagged Dep Var	0,716***	0,720***	0,715***
	(0,069)	(0,068)	(0,070)
ln Domestic Investment	0,014***	0,013***	0,014***
	(0,006)	(0,005)	(0,006)
ln Population Growth	0,009		
	(0,019)		
In inflation		0,006	
		(0,008)	
ln Natural Resource Rents	-0,0002	-0,001	0,0001
	(0,016)	(0,015)	(0,016)
ln FDI ROW	-0,068*	-0,062*	-0,063*
	(0,041)	(0,034)	(0,035)
ln Rule of Law	0,029	0,032	0,030
	(0,024)	(0,025)	(0,025)
ln FDI China			
ln FDI US			
ln FDI EU	-0,019	-0,026	-0,028
	(0,050)	(0,048)	(0,048)
In FDI ROA			
In FDITOT	0,000	0,000	0,000
	(0,000)	(0,000)	(0,000)
Observations	241	237	241
Countries	42	42	42
R-Squared (within)	0,789	0,789	0,789
Hausman/C test (p-value)	0,000	0,000	0,000
Hansen test (p-value)	0,281	0,278	0,290

Notes: The subscript j represents a specific source of FDI. *FDIj*TOT* is the interaction term between FDI from a specific source and terms of trade. 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, 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.

Table 6: Summary of the threshold variable

Variable		Min	25% Quantile	50% Quantile	75% Quantile	Max
In terms of trade	(1)	-0,590	-0,097	0,028	0,270	1,465
Terms of trade	(2)	0,554	0,908	1,028	1,309	4,329

Notes: Authors own calculation based on terms of trade data from WID (2019).

Table 7: Test for threshold effects and number of thresholds

	Chinese FDI	US FDI	EU FDI	ROA FDI
Test for Single threshold(two regimes)				
F_1	8,99	24,94	16,35	3.61
P-Value	0,160	0,020**	0,020*	0.680
1% critical values	14,28	38,66	17,02	15.09
5% critical values	12,41	18,78	13,72	13.09
10% critical values	10,88	13,09	12,36	10.95
Test for Double threshold(three regimes)				
F_2		8,86	14,67	
P-Value		0,160	0,040**	
1% critical values		22,33	24,94	
5% critical values		16,37	11,37	
10% critical values		11,65	10,15	
Test for Tripple threshold(four regimes)				
F_3			6,82	
P-Value			0,760	
1% critical values			35,60	
5% critical values			27,36	
10% critical values			19,92	

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 and F_3 corresponds to the test of double threshold against a triple threshold. *significant at the 10% level; **significant at the 5% level; ***significant at the 1% level.

Table 8: Terms of trade threshold level estimates

		Point Estimate	95% Confidence Level	99% Confidence Level
US FDI	Single threshold	0,077	[0,057;0,084]	[0,057;0,084]
EU FDI	Single threshold	0,077	[0,057;0,084]	[0,057;0,084]
	Double threshold	0,020	[0,004;0,026]	[0,001;0,026]

Table 9: PTR estimated results

Dependent Variable: In real GDP per Capita					
		(1)	(2)	(3)	(4)
Lagged Dep Var		0,754***	0,791***	0,753***	0,789***
		(0,039)	(0,040)	(0,040)	(0,041)
ln Domestic Investment		0,012***	0,013***	0,013***	0,013***
		(0,004)	(0,005)	(0,004)	(0,005)
ln Population Growth		0,009	0,010		
		(0,005)	(0,006)		
ln Natural Resource Rents		0,007	0,013	0,007	0,013
		(0,009)	(0,008)	(0,009)	(0,008)
In inflation		-0,0001	-0,0001		
		(0,0002)	(0,0002)		
ln FDI ROW		-0,137***	-0,094**	-0,143***	-0,096**
		(0,043)	(0,037)	(0,043)	(0,037)
ln FDI US		0,062		0,060	
		(0,059)		(0,062)	
In FDI EU			-0,012		-0,024
			(0,050)		(0,050)
ln $FDI^j I_{(.)}$	β_1	-0,073**	0,002	-0,072**	0,001
		(0,032)	(0,029)	(0,032)	(0,029)
	β_2	0,031	-0,116***	0,033	-0,112***
		(0,025)	(0,033)	(0,026)	(0,033)
	β_3		0,020		0,023
			(0,023)		(0,023)
Observations		350	350	350	350
Countries		35	35	35	35
R-Squared (within)		0,866	0,870	0,866	0,870

Notes: The subscript j denotes FDI from a specific source while $I_{(.)}$ represents the indicator/transition function. For EU FDI, β_1: ($TOT_{it} < 0.020$), β_2: ($0.020 \leq TOT_{it} < 0.077$) and β_3: ($TOT_{it} \geq 0.077$) while for US FDI, β_1: $TOT_{it} \leq 0.077$ and β_2: $TOT_{it} > 0.077$. Robust standard errors are in parentheses.*significant at the 10% level; **significant at the 5% level; ***significant at the 1% level.

Table 10: Classification of sub-Sahara Africa according to terms-of-trade regimes

First segment: $TOT < 1.02\%$	**Second segment: $1.02\% \leq TOT < 1.08\%$**	**Third segment: $TOT \geq 1.08\%$**
Botswana; Cape Verde; Central Africa Republic; Comoros; Eritea; Guinea-Bissau; Kenya; Lesotho; Madagascar; Malawi; Senegal; Sychelles; Sierra Leone; Togo; Zimbabwe.	Burkina Faso; Gambia; Mozambique; Swaziland; Uganda.	Angola; Benini; Burundi; Cameroon; Chad; Congo; Cote D'Ivoire; DRC; Equatorial Guinea; Ethopia; Gabon; Ghana; Guinea; Liberia; Mali; Niger; Nigeria; Rwanda; Sao Tome & Principe; South Africa; Tanzania; Zambia.