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TECHNOLOGY GAP AND TOTAL FACTOR PRODUCTIVITY GROWTH IN RESOURCE ENDOWED SUB-SAHARAN AFRICA

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Abstract

This study examined the impact of technology gap (relative backwardness) on productivity growth using a panel of 26 resource-rich Sub-Saharan African countries over the period 1996–2016. The study employed two measures of relative backwardness, namely: the distance from the technological frontier (DISTF) and the income gap (GAP).

Two-step dynamic panel estimation methods were used to investigate this relationship. The findings from this study reveal that FDI inflow has a positive impact on the productivity growth with conditioning on the absorptive capacity or relative backwardness of the host countries in SSA. This implies that FDI is a means of transferring existing technologies from the frontier countries through direct investment by multinational corporations. Meanwhile, both measures of technology gap (relative backwardness) do exhibit a negative relationship with TFP growth. This reveals that, the larger the distance of the host countries to the technologically advanced countries, the wider the evidence of catch-up. In addition, evidence from the result as shown in the model the FDI inflow to Sub-Saharan are significantly impacted TFP growth in resource-rich countries. Hence, this result divulges that FDI inflows to Sub-Sahara Africa are more of natural resources extraction rather than knowledge base.

Keywords: technology gap, FDI inflow, income gap, technology frontier, resources endowment

Introduction

The extent to which resource-endowed economies benefit from technological progress spill across national frontiers should be of interest to academia because of how it may provide insight into economic growth in these set of African countries has not been encouraging. Another reason why this has received attention from both academic researchers and policymakers in recent years is because of the concentration of research and development (R & D) activity in a handful of developed economies. Despite the inflows of foreign investment into some of these resources endowed economies, it seems that it makes no significant impact on their productive capacity. The literature has investigated almost exclusively technology diffusion across the OECD economies and a number of papers have shown that foreign sources of technology are an important contributor to productivity growth for the developed economies. Less developed economies (LDCs) carry out very little own R & D and for these economies, the degree of technology diffusion from countries close to the frontier is likely to be a key question for the growth of total factor productivity (TFP) (Andreas, & Marios, 2002). Theory suggests various channels by which technology can be transmitted across countries. Technology is embodied in the capital and intermediate goods so the direct import of these goods is one channel of transmission. This channel is consistent with the models of Grossman and Helpman (1991), and Eaton and Kortum (2001). Foreign direct investment by MNCs may be another channel for the international transmission of technology and this is indeed one of the (reputed) benefits of FDI that many theories emphasize. Parente and Prescott (2000) argue that differential access to the global pool of knowledge is the result of human barriers to technology, and institutional arrangements that minimize these barriers will yield faster rates of technological adoption. Dated back to Gerschenkron (1962), emphasized the importance of technology transfer and the role of

absorptive capacity in fostering growth (Abramovitz, 1986). In that spirit, a lot of attention has been devoted to the role played by technology in explaining economic growth and world disparities in income growth rates (Fagerberg, 1994).

Kumar and Russell, (2002) argue that capital deepening plays the most prominent part in explaining output per capita growth differences across countries. Other contributions point to the role played by total factor productivity (TFP) (Caselli, 2005; Easterly and Levin, 2001; Hall and Jones, 1999; Prescott, 1997). Easterly and Levin (2001) wind up that, the residual (TFP) rather than factor accumulation accounts for most of the income and growth differences across nations.

The existing literature had contributed to the words of experience in term of the effect of FDI on productivity and economic growth in Africa. It has been noted that some scholars, such as Kumar and Pradhan (2002) and Sylwester (2005), that FDI has differential effects in different regions. Despite these divergent results, they are not able to fully capture the overall effect of FDI on productivity growth in African economies especially resources endowed Sub-Saharan Africa countries. The goal of this paper is to provide a quantitative analysis of the effect of technology diffusion on TFP growth through FDI in a sample of 26 resource-rich Sub-Saharan Africa countries between 1996-2016. We exploit both cross-sectional and time series dimensions of data.

The remaining part of this paper is arranged as follow, what follows this introductory section is literature reviews. Section 3 deal with the model specification and description of data. Section 4 presents the estimation and discussion of the findings, and Section 5 concludes and make policy recommendations.

Literature Review

FDI has been increasingly seen as an important stimulus for productivity and economic growth both for developing and developed countries. Its triggers technology spillovers assist human capital formation, contributes to international trade integration, helps create a more competitive business environment, and enhances enterprise development (OECD, 2002). (Jyun-Yi and Chih-Chiang, 2008) considered Foreign Direct Investment as an important channel for the transmission of technology in many developing countries. The endogenous growth theory postulates that FDI raises economic growth by generating technological diffusion from the developed world to the host country (Borensztein et al., 1998). Crespo and Fontoura (2007) summarise the five main channels of technological diffusion linked to FDI flows and these include: demonstration or imitation; labor mobility; exportation; competition; and backward and forward linkages with local firms. Hence, FDI does not only help to introduce new technologies into the host economy but may also assist in raising the skill level, reducing prices and changing the competition structure.

Studies on the relationship between foreign direct investment (FDI) and productivity growth have provided conflicting or mixed results. Studies like Bitzer and Gorg (2009), Liu et al. (2000) and Woo (2009) conclude that FDI has a positive effect on productivity growth. In contrast, some researchers find that FDI may negatively affect productivity (Azman-Saini et al., 2010; Ang, 2009; Alfaro et al., 2004; Aitken and Harrison, 1999; Haddad and Harrison, 1993). For example, Aitken and Harrison (1999) find that FDI negatively affects the productivity of domestic firms. They postulate a ‘market-stealing’ hypothesis to explain their results. This hypothesis states that while FDI may promote technology transfer, foreign investors ‘steal’ market share at the expense of domestic firms and this forces domestic firms to produce smaller

output at higher average costs. As a result, the overall benefit of FDI is negligible at best or even negative.

Some studies also observe that a positive effect of FDI on productivity is dependent on the sector (Sjöholm, 2008; Buckley et al., 2008); the degree of complementarity and substitution between FDI and domestic investment (De Mello, 1999); and local conditions in the host country. For instance, Alfaro et al. (2009) find that countries with well-developed financial markets gain significantly from FDI via productivity improvements. Roy (2008) shows that the distance to the technology frontier is significant in determining the ability of the host country to take advantage of spillovers from FDI. He also finds that while there is a positive and significant effect of FDI on productivity, this effect is lower the higher the technological gap.

Some studies investigate foreign direct investment, productivity and the technology gap, they use the income gap and distance from frontier to measure relative backwardness (Li and Liu, 2005; Ashraf, Herzer, and Nunnenkamp, 2014, Christopher, and Prosper 2018). For instance, Li and Liu (2005) investigate the impact of FDI on economic growth using a large sample of 84 countries for the period 1970–99 conditional on relative backwardness. They define relative backwardness using the ratio of host country GDP to US GDP. They include FDI interacted with the proxy for relative backwardness in their growth regression. They find a significantly negative coefficient for this interaction term along with a positive coefficient for the FDI term. This implies that the higher the relative backwardness of the host country, the smaller the effect of FDI on growth. They calculate a threshold value for relative backwardness of 12.6, below which FDI is no longer beneficial for the host country. Christopher and Prosper (2018) investigate the impact of foreign direct investment on total factor productivity conditional on relative backwardness in a panel of 45 African countries over the period 1980–2012. We use two

measures of relative backwardness, namely: the distance from the technological frontier and the income gap. They apply the fixed effects and two-step system GMM methods. They find a generally positive but weak effect of FDI on productivity growth. Meanwhile, the results do not support the convergence theory of Findlay (1978) and Wang and Blomstrom (1992) that relative backwardness would result in higher productivity growth via the adoption of foreign technologies.

By and large, the literature on the impact of foreign direct investment and technology gap on total factor productivity growth in African countries is limited and in particular, the role of natural resource endowment is often neglected. Some of the papers that attempt to address this issue are Aseidu, (2006), Davood, Siab, and Azhdar (2010), Asghari, Hilmi, and Safa, (2014) and Gylfason, and Zoega, (2001). Aseidu, (2006) examined the determinants of FDI to Africa. She employed a fixed-effects panel estimation analysis. The analysis employs an unbalanced panel data for 22 countries over the period 1984–2000. The results indicate that large local markets, natural resource endowments, good infrastructure, low inflation, an efficient legal system, and a good investment framework promote FDI. In contrast, corruption and political instability have the opposite effect.

There is no contradiction that, the existing literature had contributed to the words of experience in term of the effect of FDI on productivity and economic growth in Africa. It has been noted that some scholars, such as Kumar and Pradhan (2002) and Sylwester (2005), that FDI has differential effects in different regions. Despite these divergent results, they are not able to fully capture the overall effect of FDI on productivity growth in African economies especially resources endowed Sub-Saharan Africa countries.

Methodology

Model Specification

The nature of the relationship between technology, natural resources, and economic growth is not clearly understood, particularly as it pertains to regional environmental effects. The theoretical and empirical literature has identified some of the 'pre-conditions' necessary for technology and natural resources to stimulate national growth, yet their importance may vary dramatically by region. Although the mechanisms through which they stimulate regional economies have largely been ignored, "new" growth theories imply a pivotal role for FDI.

The endogenous growth literature has emphasized the importance of both human and knowledge capital in forestalling decreasing returns to capital accumulation. As such, growth is not limited to exogenous forces that drive the rate of technical change; rather, policies or conditions that environmental policy, trade and an inflow of FDI may actually spur growth.

Observing from theory the possible growth promoting roles of both FDI and natural resources, this research work will be modeled in an aggregate production function (APF) framework. The standard APF model has been extensively used in econometric studies to estimate the impacts of FDI inflows and natural resources on growth in many developing countries. The APF assumes that, along with "conventional inputs" of labour and capital used in the neoclassical production function, "unconventional inputs" like FDI, trade and natural resources may be included in the model to capture their contribution to economic growth. The Aggregate Production Function model has been used by Kohpaiboon (2004), Mansouri (2005), Feder (1983), Fosu (1990) and Herzer et al. (2006). The aggregate production function is model as follow.

$$\mathrm{Y} = AK^{\alpha}(L)^{1-\alpha} + NR + TEC \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Following the nature and characteristics of this research work, the work of Fegerber, 1987, Asghari, et al, 2014 and Christopher and Prosper (2018) shall be adopted with modifications

$$\mathrm{Y_{it}} = AK_{it}{}^{\alpha}(L_{it})^{1-\alpha} + NR + TECG + FDI + \varepsilon_{it} \ldots\ldots\ldots.\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where $\mathrm{Y_t}$ denotes the aggregate production of the economy (real GDP per capita) at time *t* and $A_t\ K_t\ L_{it}$ are the total factor productivity (TFP), the capital stock and the stock of labour, respectively. While NR is Natural resources endowment, TECG are Technology transferred mechanisms and FDI is foreigna a direct investment. In order to achieve the set objectives for this study the above model is therefore, modify as follow.

$$\mathrm{TFP_{it}} = \beta_{0it}\mathrm{TFP_{it-1}} + \beta_{1it}\mathrm{FDI_{it}} + \beta_{2it}\mathrm{POPGW_{it}} + \beta_{3it}\mathrm{TOP_{it}} + \beta_{4it}\mathrm{DTF_{it}} + \beta_{5it}\mathrm{IGAP_{it}} + \varepsilon_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. (3)$$

The modification we introduce to the original Christopher and Prosper (2018) model specification is the inclusion of a set of control variables in Equation (3). This is to ensure that our results are not driven by the choice of model specifications. The set of control variables we use include population growth, WDI (2018); openness (measured as the ratio of exports plus imports to GDP), derived from and calculated through data from WDI (2018)

Data Description

The data cover 26 resource-rich Sub-Saharan Africa countries over the period 1996-2016.

Foreign Direct Investment (FDI) inflow. The main categories of capital flows are FDI, Portfolio equity investment, and debt inflows (Woo, 2007). The FDI categories include controlling stakes in acquired foreign firms and Greenfield investment (construction of new production facilities).

Since we are interested in technology diffusion from foreign countries we first consider FDI inflows to a country from abroad as a share of the recipient country's GDP. This is denoted as inward FDI (IMF). Also, according Feenstra, (1999) outward FDI as well as inward FDI may lead to a transfer of technology into the country, that is, acquisition of foreign firms (in advanced countries) can bring with it some knowledge or technology that cannot be obtained by simply buying the product of the foreign firm. The World Development Indicator (WDI 2006). World Bank reports annual data for gross FDI flow (sum up inward and outward FDI capital flows as a share of GDP), using the International Financial Statistics (IFS) as the primary data source. Given the primary interest in investigating technology diffusion from technology frontier nations, we focus on the FDI flow from industrial countries and sourced from (WDI 2018).

Technology Gap (TG) (Relative Backwardness) Measures in term of distance from technological frontier (DTF) and income gap (IGAP) as suggested by Ashraf & Herer 2014. Distance from technological frontier (DTF) is the ratio of technology level in the leader to the technology level of the host countries which is proxy by ratio labour productivity of the frontier to the labour productivity of the host countries while income gap is the ratio of income of the leader country to the income of the host countries, $ln\left(\frac{Ymax_{it}}{Y_{it}}\right)$. That is, ratio of GDP per capita of the leader's country to GDP per capital of the host country as measure by (Ashraf & Herer 2014, as cited in Christopher and Prosper, 2018).

Total Factor Productivity (TFP) is the portion of output not explained by the number of inputs used in production. As such, its level Is determined By how efficiently and intensely The Inputs Are Utilized In Production. TFP Growth is usually measured by the Solow Residual. $Y(t) = [K(t)]^{\alpha}[A(t)\,L(t)]^{1-\alpha}$. Let Y(t) denote the growth rate of aggregate output,(GDPt); K(t) the

growth rate of aggregate capital, l(t) the growth rate of aggregate labor and alpha the capital share A(t) Diego (2006).

$$SR(t) = \frac{\frac{\partial Y}{\partial t}}{Y} - \left(\alpha \frac{\frac{\partial K}{\partial t}}{K(t)} + (1-\alpha) \frac{\frac{\partial L}{\partial t}}{L(t)} \right)$$

Therefore, for the purpose of this research work the total factor productivity is calculated as the ratio of output to the weighted average of capital and labour input $TFP = \frac{(GDPt)}{K^{\alpha}+L^{1-\alpha}}$ Where GDP_t is Total Production in an economy; K is Capital in the production proxy by gross capital formation and L represent labour also proxy by labour force as written by Obaidullah 2015

Empirical Findings and Discussion

Table, 1.1 Two-step dynamic panel model estimation results with TFP growth as the dependent variable.

Independent Variables	Coefficient	P-value
LnFDI	0.0123	(0.0526)**
LnIMPT	-0.0804	(0.4836)
LnTOP	-0.0316	(0.2526)
LnDIST	-0.0495	(0.4697)
ln IGAP	-0.0167	(0.8544)
LnPOPGW	-0.7399	(0.1810)
Lagged TFP	0.7903	(0.0000)***
Constant	2.3809	(0.3463)
No of obs		518

No of groups		26
AR(1)p-value		0.0425
AR(2)p-value		0.2387
Sargan test		1.0000

Notes: p-value are in parenthesis. *, **, *** indicate statistical significance at 10%, 5%, and 1% level respectively

Source: Author's computation, 2018

The results presented in Table 1.1 show the relationship between technology gap and total factor productivity in resource-rich Sub-Saharan African countries using two steps dynamic panel model estimation. In Table 1.1, the result indicates there a positive significant relationship between TFP growth and FDI. Meaning that FDI inflow to resource endowed SSA are positively impacted productivity growth, this result indicate that, this study corroborate the assertion of (Asiedu, 2004) that FDI in resource-rich countries are concentrated in natural resources, and investments in such industries tend not to generate the positive spillovers (e.g. technological transfers, employment creation) that are often associated with FDI.

It's also shown the role of technology gap (relative backwardness) as proxy by DIST and IGAP. As shown in Table 1.1 DIST has a negative and insignificant effect on TFP growth in resource endowed SSA. This is inconsistent with the findings of Findlay (1978) and Wang and Blomstrom (1992). But consistent with the findings of Christopher and Prosper (2018). The result reveals that 1unit point of distance from technology frontier countries will lead to .049 decreases in TFP growth in selected resource endowed Sub-Sahara Africa countries. This implies that the lower the level of technological development in the host country the smaller the impact of FDI on TFP growth as applauded by (Baltabaev, 2014). This is therefore little or no catching up by the relative backward countries. However, this finding is also in line with Sjoholm (1997)

who argue that the huge technology gap may present an impediment to the absorption of any potential spillovers from FDI. Similarly, Glass and Saggi (1998) posit that relative backwardness is a deterrent to productivity growth because it limits the kind of technology that can be transferred to the host country. Additionally, Falvey et al. (2005) show that a huge technology gap is unlikely to automatically translate to greater knowledge diffusion and catch-up unless certain preconditions exist that allow countries to absorb the inflow of foreign ideas and knowledge. Furthermore, Danquah and Ouattara (2014) show that proximity to the frontier is a significant determinant of productivity growth in SSA. This then supports the view that a huge technology gap presents an impediment to the absorption of any potential spillovers from FDI in African countries.

In the same vein, import of goods and services, trade openness and population growth in the selected region exhibits an insignificant negative relationship with TFP growth. This result contrasts with the work of Yaya, (2017) which shows that trade openness has positive effects on economic growth both in the short and long run. More also is against the new endogenous growth models which explain a positive relationship between trade openness and economic growth as a result of the international diffusion of advanced technologies (Coe & Helpman, 1995; Grossman & Helpman, 1991a; Romer, 1994). A country with a higher degree of openness has a greater ability to use technologies generated in advanced economies, and this capability leads them to grow more rapidly than a country with a lower degree of openness

Thus, TFP growth in resource endowed Sub-Sahara Africa countries is characterized by a great desire which allows for rapid and dramatic change. Indeed, higher immediate past year's level of TFP are associated with current levels of TFP and this is significant at 5 percent significance level. The result, however, suggests that although higher levels of immediate past TFP are

positively and significantly associated with current levels of TFP, above a certain point, higher levels of past TFP act to increase the current level of TFP between 84-99 percent holding other factors constant. This relationship suggests that the marginal effect of past TFP exhibits increasing return for current TFP growth in Sub-Sahara Africa countries.

Conclusion

In this paper, we addressed the question of technology influence on Africa economy using the 26 resources rich Sub-Saharan Africa economies between 1996 -2016 using two-step dynamic pane estimation method. Via the empirical findings, we recognized that FDI inflow to the selected resource-rich Africa countries has a significant positive effect on their productivity growth. Import of goods and services, trade openness and population growth used as control variables in the model exhibits an insignificant negative relationship with TFP growth in the selected economies in the region. This is attributed to the export of primary goods and services and also the low percentage of the total output of African are export to the international market. Based on statistics from the International Monetary Fund's World Economic Outlook Database, the total Gross Domestic Product for Africa calculated on a Purchase Power Parity (PPP) basis amounted to roughly $6.358 trillion in 2017. Therefore, exports account for about 6.6% of Africa's total economic output (IMF, 2017). This paper recommends that Various governments in Sub-Saharan Africa countries should tailor their policies towards strengthening and improve their absorptive capacity and thereby close the technological gap with technological frontier countries. Also, the resource-rich Sub-Saharan African countries should diversify their means of production from primary product to manufacture production so as to change their export mean to bridge the balance of payment deficit with other economies.

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