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Sectoral Channels of FDI into Productivity Growth in Africa

Anthony Adu-Asare Idun[1], Emmanuella Ekua Efiinu[2], Mohammed Anokye Adam[1], Eric Agyenim-Boateng[3]

[1]Department of Finance, School of Business, University of Cape Coast, Cape Coast, Ghana
[2]Kofi Annan International Peacekeeping Training Centre (KAIPTC), Accra, Ghana
[3]Directorate of Finance, University of Cape Coast, Cape Coast, Ghana
Email: aidun@ucc.edu.gh, eefiinu@gmail.com, aadam@ucc.edu.gh, eagyenim-boateng@ucc.edu.gh

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Abstract

Countries in sub-Saharan Africa have implemented policies to attract foreign direct investment to boost economic performance. However, the discussions have barely centered on whether African countries are leveraging FDI in the right channels to boost productivity growth. In this paper, we examined whether African countries which channel FDI into certain sectors of their economies can induce FDI and productivity growth transmission. In the end, we sought to ascertain whether the attraction of FDI into some strategic sectors can foster sustainable economic development in Africa. This paper also decomposes the net FDI inflows into positive and negative shocks to examine the asymmetric influence of FDI on economic growth. The study used panel data which features 30 sub-Saharan African countries spanning from 1990-2019. Multiple panel data analytic techniques such as the autoregressive distributed lags (ARDL), dynamic ordinary least square (DOLS) and the fully-modified ordinary least squares (FMOLS) were used to achieve the purposes of the study. The findings revealed that the influence of FDI on economic growth was insignificant without the conditioning effect of sectoral value additions. However, when we examined the conditioning effects, we found that FDI that is channeled into agricultural, industrial and manufacturing value addition had strong positive net effect on economic growth. A higher and a lower inflow of FDI was seen to be only significant on economic growth from the transmission in the agricultural and the service sector. The results imply that, to improve welfare FDI inflows should be directed at the agricultural, industrial and the manufacturing sector. In the end, FDI should be channeled to boost technological advancement in the sectors and industrialization which would in turn help to promote sustainable development in Africa.

Keywords

Agricultural Value Addition, Economic Growth, Foreign Direct Investment, Panel Cointegration, Industry Value Addition, Manufacturing Value Addition, Service Value Addition, Sub-Saharan Africa

1. Introduction

The study is motivated by the view that FDI induces economic growth especially for nations with conducive environments to attract capital inflow into productivity growth. FDI inflows can boost technological advancement which will in turn induce productivity growth. Besides, globalization has significantly improved international finance and capital markets. The world has become more integrated and interconnected because of globalization which means that investors have the incentives to invest in attractive markets. One result of increasing globalisation is international capital movement between countries. Foreign direct investment is one of the types of capital movement. A country or individual makes a foreign direct investment by acquiring assets in another country, such as ownership or management of a foreign corporation. Attracting foreign direct investment in various sectors of the economy is one of the most important strategies for most developing countries in achieving rapid economic growth today (Idoko & Taiga, 2018).

The existing literature emphasizes the importance of FDI in terms of job creation, accelerating economic growth, assisting in the adaptation of innovative production methods, and increasing productivity by increasing economic competition (Khan et al., 2022). Foreign direct investment (FDI) is viewed as a means for countries to share their knowledge, technology, and skills. As a result, FDI has been seen as a critical channel for the transfer of international knowledge or technology (Keller, 2010). However, the potential growth impact of FDI, particularly in developing countries, has been a contentious issue in both international economics and development circles, as other researchers have discovered FDI inflows have a negative impact on growth in developing economies.

Furthermore, the Dutch disease hypothesis stipulates that transfer of technology through FDI that is beyond the capacity of the host countries can be injurious to economic growth. We make a substantial contribution to the extant literature by examining whether positive or negative shocks in FDI can have direct and sectoral transitional impact on economic growth of African countries. We sought through our analysis to pinpoint whether higher level of FDI inflows can be harmful as has been portrayed by the dependency theory and the Dutch disease hypothesis. The neoclassical growth model under the assumption of decreasing return to scale stipulates that capital accumalation through investment can be detrimental to productivity growth in the long run. In the same token, the engenous growth model suggests that investments can boost technological ad-

vancement especially when the marginal productivity of capital is high. Eventually, economic models suggest that higher level of investment can either boost economic growth or retard growth in the long run.

This paper examines the channel through which FDI inflows can provide improvement in economic welfare of people to provide the needed information to assist ongoing programmes to attract FDI and other capital inflows. This paper contributes to the ongoing discourse on the contribution of FDI into sustainable development (Opoku, Ibrahim, & Sare, 2019; Adams & Opoku, 2015; Immurana, Yensu, Ibrahim, & Adam 2015; Bengoa & Sanchez-Rob, 2003) by constructing a simple model that show that FDI can be channelled into productive sectors to enhance its growth impact. This paper examined whether African countries can harness FDI into economic growth if FDI inflows are channelled into specific sectoral value addition using the ARDL, fully modified ordinary least square (FMOLS) and dynamic ordinary least square (DOLS) and causality analysis to account for cross-sectional dependence, heterogeneity and long-run causality between FDI inflows and economic growth. A similar study (Opoku et al., 2019) only employed the System GMM ignoring the possible cross-sectional heterogeneity and nonlinear nature of the relationships. Also, Epaphra and Mwakalasya (2017) examined the sectoral transmission of FDI in the agricultural sector of Tanzania from 1990 to 2015 but they did not examine the asymetric impact of FDI.

We found that in the long run, FDI inflows can cause economic growth in sub-Saharan Africa. Concerning the sectoral transmission, we found that FDI inflows into the agricultural, industrial and manufacturing sectors can induce economic growth in the long run. In the long run, we also found that positive shocks in FDI inflows to the Agricultural sector has negative net effect on economic growth which calls a check on the quantum of the inflows into the sector. Similarly, in the long run, positive shocks of FDI into the service sector have strong positive net effect on economic growth.

The paper also includes the following sub-sections: section two contains some facts about FDI inflows into Africa; section three discusses some theoretical and empirical literature on the issues; section four discusses the methods, including the data and data analysis techniques; section five discusses the empirical results; and section six concludes the study and offers recommendations based on the findings.

Some Stylized Facts about FDI Inflows into Africa

Foreign direct investment inflows to Africa are spread across several sectors, including agriculture, services, manufacturing, and industry. Agriculture receives smallest share of these inflows than other sectors (UNCTAD, 2012). Food and cash crop production, as well as the entry of farm input suppliers (agrochemicals) and food distributors, are all affected by FDI in agriculture (Rakotoarisoa, 2011). The growing global interest in agricultural FDI has primarily taken the form of land acquisitions in Africa. FDI inflows to the manufacturing sector are primarily market-seeking, with market size and potential being the primary de-

terminants. "It is largely undiversified, with a little focus on raw material processing or end-product assembly, both of which are low-value-added activities," according to a World Bank report on manufacturing FDI in Sub-Saharan Africa. Most countries have traditionally focused FDI on the food and beverage sector. However, in the short term, this concentration in low-value-added industries may be appropriate, as it is likely to be the first step for economies to integrate into Global Value Chains (GVCs) by capitalizing on comparative advantages" (World Bank, 2015: p. 35).

Between 2012 and 2018, FDI into Africa's service sector increased, making it the continent's largest sectoral recipient. However, the rise is not evenly distributed across African countries. The highest levels of FDI in the service sector were recorded in North Africa and South Africa. TMT (telecoms, media, and technology) is attracting an increasing amount of foreign direct investment. Indeed, it was the single largest source of inward investment in 2018. However, FDI into Financial Services is declining due to a variety of factors, including slower GDP growth and significant historical investments in this sector, leaving less room for new investment. The service sector is one of the most job-creating sectors, accounting for just under 80% of all FDI-related job opportunities. It has recently surpassed financial services (due to fewer investment opportunities in the latter), and its share of the overall services business category is being driven by the need to feed and clothe increasingly urbanizing populations, as well as the need to reduce pollution and induce rising income levels.

Given the importance of the services sector in Africa's recent economic transition, the United Nations Economic Commission for Africa (UNECA) (2015) described it as a "magnet for attracting FDI". The automobile industry, building and real estate, and renewable energy are among the African industries that have attracted FDI inflows. The automotive sector is concentrated in a few main centers, with continuous brownfields investments in South Africa's long-established automotive sector. Morocco has become more active in recent years, and it continues to seek investment, particularly from French automakers (World Bank, 2017).

According to the African Economic Outlook, foreign direct investment (FDI) accounted for roughly 16 percent of investment in Africa, compared to an average of 11 percent globally. In recent years, FDI inflow has been greater than other traditional sources of external financing for Africa, such as financial aid and remittances. While the extractive industry has accounted for a significant portion of FDI inflows into the region, inflows to the services sector have been exceptional (World Bank, 2014). Africa's average FDI inflows increased to approximately US$6.8 billion in the 1990s, up from an average of US$2.2 billion in the preceding decade; however, Africa's contribution to the global and developing economies has decreased by approximately half from the previous time; its proportion in developing countries fell from 10.7 percent to 5.9 percent, while its global share fell from 2.4 percent to 1.74 percent. In 2018, global FDI inflows fell,

but Africa defied the trend, with flows totaling US$46 billion, up 11% from the previous year (UNCTAD, 2019). FDI into Sub-Saharan Africa increased by 13% to $32 billion, regaining ground lost during the previous two years' recession. However, the overdependence on FDI can stifle domestic investment since transnational corporations (TNCs) can stifle economic development by crowding out local entrepreneurs, worsening income distribution, reducing consumer welfare, and introducing inappropriate consumption patterns in host countries. This presupposes that FDI inflows can be injurious to productivity growth if not directed properly.

In recent years, there is enough evidence to show that FDI inflows do not necessarily lead to improvement in the economic welfare of citizens of Sub-Saharan Africa. **Figure 1** shows the distribution of GDP per capita growth rates and net FDI inflows for 30 countries in Sub-Saharan Africa. The figure shows that countries such as Congo Republic and Mozambique received above average inflows of FDI per GDP but had negative growth rates in per capita income. On the other hand, high growth Rwanda, Ghana and Benin did not receive above average FDI inflows per GDP. Mauritania recorded above 3% growth in per capita income but had negative inflows of FDI in 2019. Exceptions include Seychelles with appreciably high growth rate received above average inflows of FDI whilst Sudan, Zimbabwe, Namibia, South Africa, and Burundi with no or little FDI inflows in 2019 had a negative growth rate of per capita income. In general, we cannot conclude that countries with high growth rate of per capita income are those which received greater percentages of FDI in 2019.

The African Union seeks to promote sustainable economic development through industrialization. In their quest to achieve this objective, many African countries have instituted programmes with incentives to attract foreign direct investment. Tax incentives have been one of the tools to induce FDI inflows in Africa. However, the opportunity cost of tax incentives is on the high in recent years. According to the United Nations Economic Commission for Africa, African countries are not getting the needed benefits from tax giveaways to induce FDI inflows. They showed that for every 20% reduction in tax revenue to induce FDI, FDI only increases by 1%. This suggests that taxes may not be the disincentive to attract investment in Africa. Investor tax breaks had cost countries like Ghana, Nigeria, Senegal, and Cote d'Ivoire up to $5.8 billion per year, with losses ranging from 1.8 to 5.4 percent of GDP. The International Monetary Fund (IMF), the Organization for Economic Cooperation and Development (OCED), and the World Bank have all been increasingly critical of such breaks as wasteful giveaways (West African Giveaway Report, 2018). The debate over the implications of tax incentives for FDI is not new, but it is still unresolved. Tax incentives can boost investments of firms especially when the marginal productivity of new investment supersede interest rates plus depreciation of capital. However, tax incentives can have a negative impact on economic growth and development because they deprive developing countries of income that could be used to fund

infrastructure, education, and health-care spending, as well as being ineffective at attracting FDI (Andersen, Kett, & Uexkull, 2017).

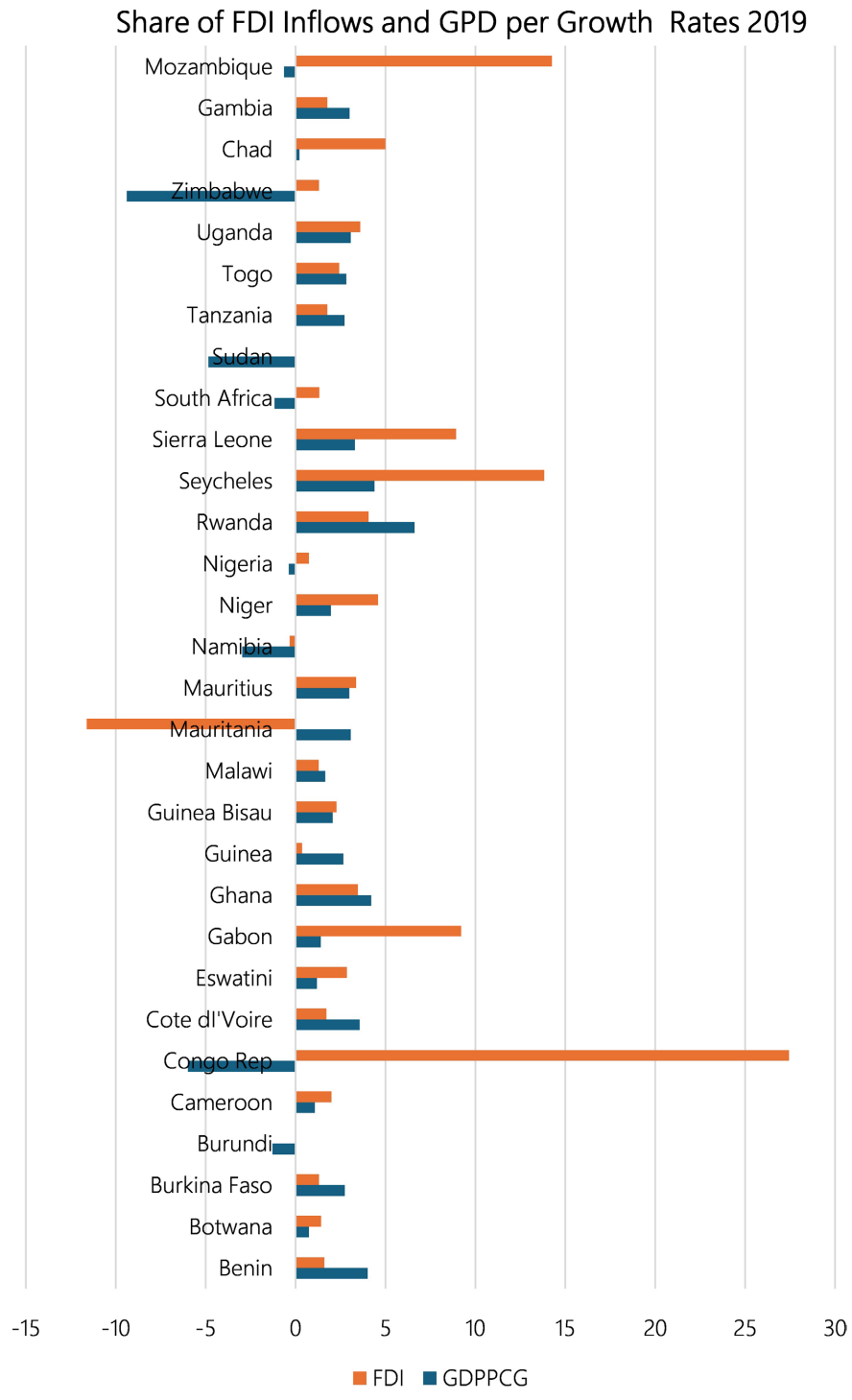

Figure 1. GPD per capita growth rates and net FDI inflows of the countries as at the end of 2019. Drawn from WDI (2020).

The evidence that FDI inflows do not have a clear linkage with economic wel-

fare does not mean that, the sub-region should not be receptive to foreign direct investment. What policy makers need is information about the channels through which the countries can beneficially utilize FDI into sustainable development including improvement in economic welfare. In this paper, we examined the channels of FDI inflows given the volatility in the inflows, that can have greater welfare implications for Sub-Saharan African countries.

2. Review of Literature

Both the neoclassical and the endogenous growth models agree that long run productivity growth is determined by technological advancement. However, unlike the neoclassical model (Solow, 1956), the endogenous growth models (Romer, 1990; Aghion & Howitt, 1992; Aghion, Howitt, & Meyer-Foulkes, 2005) suggest that technological progress results from investments in both human capital, physical capital, and financial capital. Thus, whereas the neoclassical theory of economic growth stipulates that foreign direct investment inflow does not cause long run economic growth, the endogenous growth models suggest that FDI inflow can boost human, physical and financial capital which would in turn lead to productivity growth. Notwithstanding, the neoclassical model admonishes countries which have reached their steady-state level of income to channel FDI into countries with lower capital stock since developing countries can have better and productive use of new investments because of diminishing return associated with investment in capital stock. The neoclassical view on the impact of FDI on economic growth will not prevail if new investment in capital stock led to higher or the same amount return to productivity growth. Putting the neoclassical and the endogenous growth perspectives together, it is undeniable that capital accumulation through transfer of investments can lead to economic growth either in the short run or in the long run (Calvo & Sanchez-Robles, 2003). However, overdependence of capital inflows to support domestic growth can have negative consequences on the host countries.

Two main reasons have been advanced for the inability of host countries to channel FDI inflows into productivity growth. The dependency theory states that economic growth in rich industrialized countries does not always translate to growth in poorer countries because wealthy countries' economic activities frequently resulted in serious economic problems in poorer countries (Prebisch, 1950). The dependency theories predict that foreign investment will have a negative impact on economic growth and income distribution promotes a monopolistic industrial structure, which can result in underutilization of domestic productive capacity. It posits that outsiders will manage the local economy and their decision can deviate from the original progress path created by policy makers. FDI conditionalities may not be in tune with the developmental agenda of the host country and that can be injurious to domestic productivity growth. Sometimes, investors in assets come to the host country with their experts who are foreigners which can reduce domestic employment and net national income. If

the expatriates do not come into the host country with new knowledge which can boost technological advancement, it can stifle human development capacity of the host country since education may not result in corresponding employment as result of the influx of foreign workers.

The other reason why FDI inflows into a country may not yield the desirable end is that the host country may not have the requisite macroeconomic fundamentals, institutional quality, and infrastructure to accommodate FDI inflows into productivity growth. The concept of absorptive capacity is one of the most important in management literature. It was coined by Cohen and Levinthal (1990) and further developed by Zahra and George (2002). The theory has now become a catch-all term for a variety of techniques, routines, and learning processes that influence the ability to utilize external knowledge to construct other organizational capacities (Cohen & Levinthal, 1990). There are two stages of absorbability: the first is to put FDI proposal projects into practice, and the second is to convert FDI benefits into host countries' competencies. In another sense, Cohen and Levinthal (1990) point out that organizations require prior related knowledge to assimilate and use new knowledge (De Mello, 1997). The second most frequently mentioned factor is labor forces, which are described in terms of human capital and education and are found to be essential for absorbing and adapting foreign technology, as well as for generating sustainable long-run growth (Bloomstrom & Kokko, 2003). The third capacity is R&D, which is firms' ability to exploit external knowledge (e.g., Cohen & Levinthal, 1990). According to Miguelez and Moreno (2015), absorptive capacity is a critical component for regions to capitalize on information and knowledge flows, allowing them to gain productivity and competitive advantage. If a country has an appreciable amount of these capacities, she can turn FDI inflows into productive growth and hence into economic growth. The direct benefits from foreign direct investment may include new investments, productive capacity, labor demand, demand for intermediate goods, and, in some cases, exports that improve national income or economic growth (Takii, 2005).

However, absorptive capacity has been defined at the firm or industry level even if the whole nation has not put in place structures to assimilate FDI inflow into productivity growth. Thus, a nation can direct and attract FDI inflows into certain sectors that incentivize productivity. In addition to examining the sectoral effect of FDI on productivity growth and economic growth, the paper also analyses the direct and transitional effects of positive or negative shocks in FDI into economic growth. **Table 1** below summarizes other studies that examined sectoral and asymmetric effect of FDI on economic growth.

From **Table 1**, we found that none of the empirical studies examined the asymmetric effects of FDI inflows in SSA on economic growth conditioned by the sectoral transmissions. This study examined the effects of positive shocks in FDI into sectoral value additions and its transmissions into economic growth.

Table 1. Review of some empirical literature.

Authors	Purpose	Methods	Findings	Gaps
Batten and Vo (2009)	Examined whether the impact of FDI on economic growth is conditions on differences in educational, economic, and institutional conditions.	Fixed effect panel data estimation	They found that countries with strong educational attainment, trade openness, stock market development and lower rate of population growth as well as lower risk are more likely to channel the inflow of FDI into economic growth.	The study did not examine the possibility of positive and negative shocks of FDI on economic growth. The sectoral impact was not investigated.
Acquah and Ibrahim (2019)	Analyzed the influence among FDI, economic growth and financial sector development in Africa from 1980-2016.	System GMM estimation	Financial sector development is detrimental to the impact of FDI on economic growth.	Finding the net interpretation of the interaction terms in the study, one would rather conclude that financial sector development induces positive impact of FDI in economic growth.
Opoku, Ibrahim and Sare (2019)	Examine the impact of the flow of FDI into sectoral value addition on economic growth of 38 African countries from 1960 to 2014.	System GMM estimation	The FDI has significant impact on economic growth and the transmission impact of FDI on growth is only significant in the agricultural and service sectors.	Did not examine the impact of positive and negative shocks in FDI inflows into the sectors on economic growth.
Osei and Kim (2020)	Analyzed the influence among FDI, economic growth and financial sector development among 62 middle- and high-income countries from 1982 to 2016.	Dynamic panel threshold model	Higher levels of financial development beyond 95.6% of GDP can dampen the impact of FDI on economic growth.	The study concentrated on higher income countries neglecting developing countries.
Idun (2021)	Examined whether African countries with some appreciable level of growth in financial development can attract financial technology from the world technological leader that can aid them to improve growth in per capita income towards the income level of the leader.	Robust Least Square Dynamic GMM Panel Estimation	13 African countries which have developed their financial systems to some appreciable level can import financial technologies that can enable them to converge to the per capita income level of USA.	The period only spans from 2002 to 2015. The period of convergence due to financial development was not estimated and reported.

3. Methods

Based on the availability of usable data, we selected 30 countries of Sub-Saharan Africa for the analysis. We collected data on foreign direct investment, economic growth, agriculture value added, industry value added, manufacturing value added, service value added, trade openness, gross fixed capital formation and government expenditure from the World Development Indicators' Database (Online edition) from 1990 to 2019. Subsequently, the pooled mean group analytical procedure was employed to analyze the relationships.

3.1. Model Specification

In the standard Cobb-Douglass production function, output is a function of physical capital, K labor, L and effectiveness of capital, A, and foreign direct investment, FDI as follows:

$$Y_{it} = AK_{it}^{a} L_{it}^{b} \left[FDI_{it}\right]^{u}, \quad a+b+u=1 \tag{1}$$

Multiplying both sides of equation 1 by a constant, c, the number of times output increases as result of changes in all the inputs, we will have (by multiplying and factorizing out c from the right-hand side of Equation (1))

$$cY_{it} = c^{a+b+u} AK_{it}^{a} L_{it}^{b} \left[FDI_{it}\right]^{u} = c^{a+b+u} Y_{it} \tag{2}$$

where, a, b and u are the elasticities of contributions of K, L and FDI respectively and the subscripts, i and t, are the usual indicators of country and time respectively that defines a panel data structure.

From Equation (2), the following are the possibilities depending on the scale of production:

1) The production function exhibits increasing return to scale if $a+b+u>1$. This means that if all the inputs in equation 1 are magnified by c, output will increase more than c.

2) The production function exhibits decreasing return to scale if $a+b+u<1$. In this case an increase in all input by c will result in a less than proportionate increase in output.

3) The production function exhibits constant return to scale or is homogenous of degree 1 or is a homothetic function if $a+b+u=1$. In this case, an increase in all inputs by c will lead to the same amount of the increase in output.

The three conditions above signify the possibilities under the endogenous growth theories (Romer, 1990; Aghion & Howitt, 1992). Under the Neoclassical growth model, the production function exhibits constant return to scale, so that in the long run only the growth in technological advancement, depicted in equation 1 as A, matters for economic growth (Solow, 1956).

Using the output approach of national income accounting, output is measured by the value addition from the agricultural sector, manufacturing sector, industrial sector, and the service sector. Therefore,

$$Y_{it} = AG_{it} + MN_{it} + IND_{it} + SS_{it} \tag{3}$$

Equations (2) and (3) imply that FDI can induce economic growth by inducing either agricultural value added, or manufacturing value added, or industrial value added, or service sector value added or a combination of the above. The current paper sought to analyze the extent with which FDI induces sectoral value added which in turn induces economic growth.

In our empirical analysis we define economic growth as the growth rate of per capita gross domestic product (GDPPC). Therefore, it is convenient to transform equation 2 into its per unit labour form by dividing both sides of equation 1 by L:

$$y_{it} = Ak_{it}^{a}\left[\, fdi_{it}\,\right]^{u} \tag{4}$$

where, $y_{it} = \frac{Y_{it}}{L_{it}}, k_{it} = \frac{K_{it}}{L_{it}}$ and $fdi_{it} = \frac{FDI_{it}}{L_{it}}$.

Finding the natural log of both sizes of Equation (4), we have:

$$\ln y_{it} = \ln A + \alpha \ln k + u \ln\ fdi \tag{5}$$

Finding the first derivative with respect to each of the endogenous variables gives Equation (6) expressed as the growth rates in the variables:

$$g_{y} = g_{A} + \alpha g_{k} + u g_{fdi} \tag{6}$$

Equation (6) is our theoretical model which assumes that labour supply is maximized to utilize the infusion of FDI into economic growth. The constant g_A represents the growth in technology which can be decomposed into changes in government expenditure (according to the real business cycle theory, government expenditure induces technological advancement), and trade openness which defines the receptibility and integration of the countries in the global economy. The current level of technology augments the capability of capital stock per unit labour, *k* and FDI per unit labour, *fdi*. Alternatively, the endogenous growth perspectives imply that African countries with greater accumulation of technological advancement and investment can be better positioned to use FDI inflows to boost economic growth. Inherent in the model is that, under the assumption of decreasing return to scale, the evolution of FDI per unit labour follows the Inada conditions: An initial increase in FDI per unit labour can have a positive impact on economic growth. However, further increase in FDI per unit labour will have vanishing effect on economic growth as it has been portrayed by the dependency theory and the neoclassical growth theory. In the same token, we can see from the model that under increasing return to scale, which may come about because the economy has structures that can magnify the productivity return of FDI inflows, an increase in FDI can have exponential effect on economic growth. For our study, we can stress that the various sectors, if they have developed enabling technologies, can use FDI inflows to magnify sectorial value addition and therefore economic growth as the absorptive capacity portrays. Under constant return to scale, an increase in FDI per unit labour can have a monotonic effect on economic growth.

Our first empirical model specifies the effect of sectoral transmission of FDI on economic growth. This model was developed to determine whether FDI leads to sectoral value addition which will in turn lead to economic growth. The first part of the model accounts for the short run dynamics of the effect of FDI on sectoral growth. The second part of the model accounts for the long run dynamics of the effect of FDI on sectoral growth.

$$\begin{aligned} GRO_{it} = {} & \phi_{it}\left[y_1 FDI_{it} + y_2 SEC_{it} + y_3 X_{it} + \eta\left(FDI_{it} \times SEC_{it}\right)\right] + b_{1,i}\Delta\log FDI_{it} \\ & + b_{2,i}\Delta\log SEC_{it} + b_{3,i}\Delta\log X_{it} + \eta_2\left(FDI_{it} \times SEC_{it}\right) + \varepsilon_{it} \end{aligned} \tag{7}$$

GRO_{it}: denotes economic growth measured by growth rate GDP per capita.

FDI: denotes foreign direct investment.

SEC_{it}: denotes sectoral growth.

X_{it}: denotes control variables.

η: indirect effect of FDI on growth via the four sectors.

$y_{i,i}$: denotes the coefficients for the long run variables.

$b_{i,i}$: denotes coefficients for the short run variables.

ε_{it}: denotes the error term.

The model as depicted in Equation (1) assumes that changes in the explanatory variables, both positive and negative, have the same effect on the dependent variable. The dependency theory and the Dutch Disease hypothesis suggest that difference shocks in FDI inflows can have different effect on sectoral productivity and therefore economic growth. In this case, the nonlinear model is used to assess the asymmetric short-term and long-term relationship between variables (Kurtović et al., 2020):

$$FDI_{it} = y_1 FDI_{it}^{+} + y_1 FDI_{it}^{-} + \varepsilon_{it} \tag{8}$$

Equation (7) denotes an equilibrium between the dependent variable, FDI, and the independent variable, which is divided into a positive and negative effect (Kurtović et al., 2020). The NARDL model requires FDI logarithm decomposition (Kurtović et al., 2020):

$$FDI_{it}^{+} = \sum_{i=1}^{t} FDI_{it}^{+} = \sum_{i=1}^{t} \max\left(\Delta FDI_i = 0\right) \tag{9}$$

$$FDI_{it}^{-} = \sum_{i=1}^{t} FDI_{it}^{-} = \sum_{i=1}^{t} \min\left(\Delta FDI_i = 0\right) \tag{10}$$

The partial decomposition process efficiently divides the FDI stock into positive (FDI_{it}^{+}) and negative (FDI_{it}^{-}) (Kurtović et al., 2020). By incorporating Equations (8) and (9) into Equation (7), the non-linear model is presented as follows (Kurtović et al., 2020)

$$\begin{aligned} GRO_{it} = {} & \phi_{it}\left[y_1 FDI_{it}^{\pm} + y_2 SEC_{it} + y_3 X_{it} + \eta\left(FDI_{it}^{\pm} \times SEC_{it}\right)\right] + b_{1,i}\Delta \log FDI_{it}^{\pm} \\ & + b_{2,i}\Delta \log SEC_{it} + b_{3,i}\Delta \log X_{it} + \Delta \log \eta_2 \left(FDI_{it}^{\pm} \times SEC_{it}\right) + \varepsilon_{it} \end{aligned} \tag{11}$$

The model (Equation (10)) has two sides: one side accounts for the short run dynamics of FDI effect on sectoral growth and the other side accounts for the long run dynamics of FDI effect on sectoral growth. The $\Delta \log$ denote short-run coefficients. The significance of these coefficients shows that the related explanatory variable has a short-run causal relationship with the dependent variable. Long-run coefficients are denoted by ys. The ϕs represents error correction terms (ECTs). If the coefficient of the ECT is both negative and significant, the associated variable has a long-run relationship with the dependent variable, the inverse of the absolute value of these coefficients provides a speed of adjustment estimate.

GRO_{it}: denotes economic growth.

$FDI_{it}^{\pm}$: denotes Positive and negative shocks of foreign direct investment.

SEC_{it}: denotes sectoral growth.

X_{it}: denotes control variables.

η: indirect effect of FDI on growth via the four sectors.

$y_{i,t}$: denotes the coefficients for the long run variables.

$b_{i,t}$: denotes coefficients for the short run variables.

ε_{it}: denotes the error term.

According to Bahmani-Oskooee and Ghodsi (2017), asymmetry effect is observed in the sign and magnitude of positive and negative partials of FDI. The inclusion of various sectors accounts for the direct effect of the transmission mechanism on economic growth. The interaction term between FDI and sectoral value addition accounts for the indirect effect of this transmission mechanism. We included Domestic investments to investigate the influence of FDI on growth while controlling for the effect of the domestic investment rate on growth. By incorporating domestic investment, we can compare the relative effects of foreign and domestic investment on the growth process. Domestic investment is measured by gross fixed capital formation as a share of GDP. In addition, the estimations account for government spending expressed as a percentage of GDP. This is used as a proxy for the size of the government. The sum of imports and exports as a share of GDP is used to measure trade openness and to proxy a country's integration with the rest of the world. The control variables are the standard variables used to measure GDP of countries and which are more likely to induce economic growth according to many studies. The variables and their sources of data are summarized in **Table 2**.

To adequately assess the impact of foreign direct inflows on sectoral growth to improve economic growth, the study used panel data, which is a type of data that includes both cross-sectional and time series data. This allows the researcher to control variables that cannot be observed under the study and allows for the testing of economic questions that cannot be tested using time series or cross-sectional data. Panel data is used because it has several advantages over time series and cross section data, including the ability to provide more informative data, variability, efficiency, and less collinearity among variables (Baltagi, 2008).

Panel data models are frequently estimated using two methods. The first (mean group estimator) involves averaging individual estimates for each of the panel groups. This estimator, according to Pesaran and Smith (1995), produces consistent estimations of the parameters' averages. Pirotte (1999) further shows that for large sample sizes, the mean group estimator yields efficient long-run estimators. It permits the parameters to be freely independent among groups and ignores the possibility of group homogeneity. The traditional panel approach is the second option (random or fixed effects and GMM methods). These models require the parameters to be the same across countries, which could result in inconsistency and misinformation in long-term coefficients, a problem that is amplified when the time dimension of the panel is large.

Table 2. The variables, their definition and source of data.

VARIABLE	EXPLANATION	SOURCE
Foreign direct investment **(FDI)**	FDI is the net inflows of investment and taken as the sum of equity capital, reinvestment of earnings, other long-and short-term capital	World bank world development indicators 1990-2019
Agricultural value added. **(AG)**	It captures forestry, hunting and fishing as well as cultivation of crops as a percentage of GDP	World bank world development indicators 1990-2019
Industry value added. **(IND)**	It comprises value added in mining, construction, electricity, water, and gas as a percentage of GDP	World bank world development indicators 1990-2019
Manufacturing value added. **(MN)**	It comprises value added to physical and chemical transformation of materials of components into new products, whether the work is performed by power driven machines or by hands	World bank world development indicators 1990-2019
Service sector value added. **(SS)**	It captures value added in wholesale and retail trade, transport and government, financial, professional, and personal services	World bank world development indicators 1990-2019
Trade openness **(TRADE)**	It captures the summation of exports and imports as a percentage of GDP	World bank world development indicators 1990-2019
General government expenditure **(GEX)**	It captures all government expenditures for purchases of goods and services, including compensation of employees	World bank world development indicators 1990-2019
Gross fixed capital formation **(INV)**	This measures domestic investments to permit the investigation of exogenous impact of FDI on growth while controlling for domestic investment rate effect on growth	World bank world development indicators 1990-2019
Economic growth **(GDPPCG)**	This is a measure of the growth rate of per capita income. GDP is the sum of gross values added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources	World bank world development indicators 1990-2019

Pesaran et al. (1999) proposed the pooled mean group estimator. This method allows for varied intercepts but requires all fixed cross-section slopes, which can be a very limiting assumption. By combining the benefits of both strategies, the PMG estimator attempts to strike a balance between these two conflicting approaches. Short-run coefficients can differ between nations (like the MG estimator), but long-run coefficients must be homogeneous across all cross sections (akin to the fixed effects estimator). In comparison to other approaches, the PMG estimator has significant advantages.

Ordinary least square (OLS) estimates can produce skewed and inconsistent findings in some cases; hence the pool mean group strategy used in the model helps to achieve the study' goal. The dynamic generalized method of moments (GMM) provides an answer to the endogeneity dilemma. These techniques, on the other hand, often require homogeneity of all slope coefficients, with only the

intercepts varying among countries. According to Pesaran and Smith (1995), these results are impacted by a potentially substantial heterogeneity bias under slope heterogeneity, especially in small nation samples. Short-run coefficients, speed of adjustment and error variances can differ among countries, but long-run coefficients must be homogeneous.

The use of the pooled mean group procedure requires the determination of the order of integration since variables integrated above order one must be excluded. To determine the order of integration, a series of panel unit root tests were run. This accomplishes two goals: first, it avoids the erroneous effects of non-stationarity, and second, it investigates the possibility of cointegration relationships. Due to its superior power when compared to conventional unit root tests, a wide range of panel unit root tests have been established in the literature. The extent to which these tests compensate for cross-sectional dependency and whether they allow for common or individual roots differs significantly. Individual roots are allowed in tests proposed by Im et al. (2003) (hereinafter IPS) and Pesaran (2007). Bai and Ng (2002, 2004), Pesaran (2007), Phillips and Sul (2007), and Moon and Perron (2004) are examples of tests that adjust for cross-sectional dependence (2004). Given the heterogeneity for the 30 countries observed in this paper, only unit root tests that assumed individual roots were considered.

3.2. Variables and Sources of Data

Table 2 provides the descriptions of the variables and their sources of data. The dependent variable includes GDP growth rate per capita. The independent variables include FDI including its positive and negative shocks. The moderating variables include manufacturing, agricultural, industrial and services sectors value addition. The control variables include gross fixed capital formation, government expenditure and trade as these variables can also have level effects on GDP and growth effects on productivity growth.

4. Empirical Results and Discussion

Descriptive Statistics

Table 3 represents the descriptive statistic for the relevant variables employed in the study. It represents the mean, median, standard deviation, minimum and maximum values as well as the observation for the variables of the study. From the table, the mean of economic growth is 1.49 with minimum and maximum values of −47.50 and 37.53 respectively. The median of economic growth is 1.71 while the standard deviation was 4.93. The FDI inflows into sub-Saharan African countries recorded a median of 1.90% share of GDP, the mean of 3.32% of GDP, with the maximum inflow been 57.84% and minimum net inflow as −8.70% respectively. The measure of variation measured by the standard deviation for FDI recorded was 5.58. Taking into consideration the nonlinear effect of FDI inflows into Sub-Saharan African countries, the positive inflows of FDI recorded a me-

dian of 8.36 whilst the negative inflows recorded a median of −6.38. The mean of the positive FDI inflows as a percentage of GDP was 13.39, with the maximum inflow been 129.70 and minimum net inflow as 0.00 whilst that of the negative FDI inflows recorded a mean of −11.11, with maximum inflow as 0.00 and minimum inflow as −103.07. The measure of spread of variation measured by the standard deviation for a positive FDI inflow was 16.37 and that of the negative FDI inflows was 13.99.

Table 3. Descriptive statistics of the dependent and independent variable.

	Mean	Median	Maximum	Minimum	Std. Dev.	Observations
AG	23.60	23.98	61.42	1.83	14.30	831
FDI	3.32	1.91	57.84	−8.70	5.58	831
FDI_NEG	−11.12	−6.38	0.00	−103.07	14.00	831
FDI_POS	13.40	8.36	129.70	0.00	16.38	831
GDPPCG	1.49	1.72	37.54	−47.50	4.93	831
GEX	14.46	13.84	39.45	0.91	5.99	831
IND	24.77	23.00	72.15	4.56	11.18	831
INV	20.78	19.96	93.55	−2.42	9.62	831
MN	11.00	9.76	40.06	0.23	6.08	831
SS	44.87	45.12	70.34	12.44	9.81	831
TRADE	67.68	59.27	225.02	11.47	32.58	831

Correlation Matrix:

	AG	FDI	FDI_NEG	FDI_POS	GDPPCG	GEX	IND	INV	MN	SS	TRADE
AG	1.0000										
FDI	−0.1117	1.0000									
FDI_NEG	0.1413	−0.3206	1.0000								
FDI_POS	−0.1531	0.5991	−0.9460	1.0000							
GDPPCG	−0.0427	0.0656	0.0451	−0.0142	1.0000						
GEX	−0.4501	0.1505	−0.0332	0.0619	−0.0293	1.0000					
IND	−0.6464	0.0541	−0.2820	0.2606	−0.0609	0.1561	1.0000				
INV	−0.3032	0.3931	−0.3232	0.4129	0.0589	0.0974	0.3685	1.0000			
MN	−0.3610	−0.0854	0.1044	−0.1124	−0.0365	0.1526	0.2250	−0.1001	1.0000		
SS	−0.5738	0.0653	0.1202	−0.0877	0.0665	0.3024	−0.1565	−0.0441	0.1981	1.0000	
TRADE	−0.5223	0.3795	−0.4370	0.4716	0.0107	0.3837	0.4361	0.3509	0.1994	0.1694	1.0000

Note: This table presents descriptive statistics for the sample used in the analysis. This sample includes 30 Sub-Saharan African countries for the period of 1990-2019. These countries are Benin, Botswana, Burkina Faso, Burundi, Cameroon, Chad, Congo Republic, Cote d'Ivoire, Eswatini, Gabon, Gambia, Ghana, Guinea, Guinea Bissau, Malawi, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Seychelles, Sierra Leone, South Africa, Sudan, Tanzania, Togo, Uganda, Zimbabwe. GDP represents Economic growth, FDI represent foreign direct net inflows into African countries, TRADE represents trade openness, AG represents agricultural value added, IND represents industry value added, MN represents manufacturing value added SS represents service value added, GEX represents Government expenditure, INV represents gross fixed capital formation.

Over the period under consideration, agricultural value added, manufacturing value added, industry value added, and service value added recorded median values of 24.12, 9.81, 23.04, 45.07 respectively. On average, the value added in agriculture is 23.72 with a range of 1.82 to 61.41. The measure of variation measured by the standard deviation for agriculture value added was 23.72. Manufacturing value added within the period under review recorded a mean of 9.81 with a range of 0.23 to 40.06. The standard deviation recorded by this sector was 6.08. The service sector on the average recorded value addition of 44.79 with a range of 12.45 to 70.34. The measure of variation for the service sector was 9.82. On the other hand, the industry sector recorded a mean of 24.79 within a range of 4.55 to 72.15. The standard deviation for the value addition in this sector was 11.16. For the four sectors, average value addition in the service sector is higher relative to the other three sectors, with the manufacturing sector recording the least value additions.

Furthermore, government expenditure on the average was 14.48 with the maximum value as 39.45 and minimum value as 0.91. The median for government expenditure was 13.84 and the standard deviation was 6.01. Trade openness and domestic capital, which was proxied by gross fixed capital formation recorded median values of 59.08 and 19.9 respectively.

The second panel of **Table 3** represents a pairwise correlational matrix between the variables employed for the study; Foreign direct investment (FDI), Economic growth (GDPPC), Government expenditure (GEX), Domestic investment (INV), Trade openness (TRADE), Service sector value addition (SS), Manufacturing Value addition (MN), Agriculture value addition (AG) and Industry value addition (IND). Using Cohen (1998) the interpretation of the matrix was based on the strength and the direction. The absolute values depict the strength of the relationship, and the sign of the coefficient determines the direction.

From the matrix FDI is negatively correlated with Agriculture and manufacturing sector whilst it shows a positive correlation with the other variables. However, the correlation between FDI and government expenditure showed a weak correlation whilst that with the other variables showed a very weak correlation. With the proxy for economic growth (GDPPCG), it showed a positive and very weak correlation with domestic investment (INV), service value added and trade openness on the other hand showed a negative and very weak relationship with government expenditure, industry value added, and manufacturing value added.

From the matrix a lower level of FDI negatively correlated with government expenditure, domestic expenditure, industry sector and trade openness whilst it shows a positive correlation with the other variables. In the same token, positive shocks in FDI inflow negatively correlate with economic growth, agriculture, service, and manufacturing sector whilst it showed a positive correlation with the other variables.

A close examination of the correlation matrix reveals no multicollinearity in the empirical specification because the variables do not exhibit correlation coefficients that are not close to unity. It must be emphasized that the correlation coefficients and signs on depict the strength and directions of the pair-wise relationship among the variables without the inclusion of the control variables which can affect the relationship between the regressors and the dependent variable. We therefore proceeded to use the pooled-mean-group cointegration procedure to analyze the main objectives of the study.

Table 4. First generation unit root results. Null Hypothesis: Unit root.

At Level												
		FDI	FDI_NEG	FDI_POS	AGRIC	GDPC	GE	GFCF	IND	MAN	SERV	TRADE
With Constant	t-Statistic	0.0820	0.9979	0.9986	0.7784	0.0001	0.4326	0.2654	0.4574	0.7414	0.1669	0.6817
	Prob.	***0.0338***	***0.9328***	***0.8967***	***0.9540***	***0.0259***	***0.3920***	***0.3749***	***0.5597***	***0.0564***	***0.7573***	***0.3326***
		**	n0	n0	n0	**	n0	n0	n0	*	n0	n0
With Constant & Trend	t-Statistic	0.0528	0.9898	0.9303	0.0598	0.0003	0.7972	0.5706	0.0721	0.4947	0.4325	0.6660
	Prob.	***0.0961***	***0.6332***	***0.4925***	***0.0023***	***0.0740***	***0.2254***	***0.4868***	***0.3779***	***0.1964***	***0.2216***	***0.4837***
		*	n0	n0	***	*	n0	n0	n0	n0	n0	n0
Without Constant & Trend	t-Statistic	0.0830	0.9713	0.9999	0.3067	0.1638	0.4812	0.6426	0.7846	0.2607	0.5336	0.8775
	Prob.	***0.0049***	***0.9931***	***0.8494***	***0.0125***	***0.0047***	***0.8854***	***0.3418***	***0.2845***	***0.4003***	***0.9600***	***0.6061***
		***	n0	n0	**	***	n0	n0	n0	n0	n0	n0
At First Difference												
		d(FDI)	d(FDI_NEG)	d(FDI_POS)	d(AG)	d(GDPPC)	d(GEX)	d(INV)	d(IND)	d(MN)	d(SS)	d(TRADE)
With Constant	t-Statistic	0.0000	0.9572	0.0002	0.0000	0.0001	0.0001	0.0000	0.0000	0.0000	0.0003	0.0078
	Prob.	***0.0000***	***0.0241***	***0.0002***	***0.0000***	***0.0000***	***0.0000***	***0.0003***	***0.0001***	***0.0000***	***0.0000***	***0.0000***
		***	**	***	***	***	***	***	***	***	***	***
With Constant & Trend	t-Statistic	0000	0.9637	0.0002	0.0000	0.0018	0.0005	0.0003	0.0002	0.0000	0.0021	0.0408
	Prob.	***0.0002***	***0.0686***	***0.0009***	***0.0000***	***0.0047***	***0.0000***	***0.0019***	***0.0006***	***0.0002***	***0.0004***	***0.0003***
		***	*	***	***	***	***	***	***	***	***	***
Without Constant & Trend	t-Statistic	0.0000	0.9094	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0005
	Prob.	***0.0000***	***0.0048***	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***0.0000***

Table 4 shows the unit root test for the various variables employed for the study. The Augmented Dickey Fuller (ADF) test showed only FDI, and economic growth were stationary at level (integrated at order zero). All the other variables were not stationary at level but at the first-difference level (integrated at order one). The ADF tests indicate that the Pool mean group approach can be used for estimation since all the variables are either integrated at order one or zero. This study confirmed the stationarity of these variables by employing the

Philip Perron unit root test the results of which are available upon request. However, after generating the positive and negative shocks using EVIEWS 12, we realized that both the positive and negative shocks of FDI were stationary after first differencing.

However, we also examined the extent of cross-sectional dependence among the variables. The results of the cross-sectional dependence test would enable us to ascertain whether the traditional unit root tests are enough to determine the order of integration among the series. The null hypothesis of the test is: No cross-sectional dependence among the series. Table 5 presents the results of the tests, and it shows that for all the tests (Pesaran Scaled LM, Biased-Corrected LM and Pesaran CD), the null hypothesis of no cross-sectional dependence is rejected at the 0.05 significant level. This implies that any development in one of the 30 countries can affect the other countries. The evidence of dependence means that the traditional unit root result in Table 4 is biased.

Table 5. Cross-sectionally dependence tests.

Null Hypothesis: No Cross-sectional Dependence						
Variables	Pesaran Scaled LM		Biased-Corrected LM		Pesaran CD	
	t-statistic	*p*-value	t-statistic	*p*-value	t-statistic	*p*-value
GDPCP	5.708274	0.0000	5.191032	0.0000	9.253769	0.0000
INV	62.38381	0.0000	61.86657	0.0000	10.86111	0.0000
GEX	49.23224	0.0000	48.71499	0.0000	2.287947	0.0221
TRADE	53.32193	0.0000	52.80469	0.0000	11.66901	0.0000
AG	113.1848	0.0000	112.6676	0.0000	30.74736	0.0000
IND	64.35384	0.0000	63.8366	0.0000	3.8172	0.0001
MN	94.4245	0.0000	93.90726	0.0000	7.865098	0.0000
SS	81.49307	0.0000	80.97583	0.0000	3.460915	0.0005
FDI	31.38918	0.0000	30.87194	0.0000	20.44137	0.0000

Subsequently, we conducted cross-sectionally dependent unit root tests, which are known as second generation unit root tests. Table 6 contains the results of the Pesaran (2007) CIPS second generation unit root test. The null hypothesis is that there exists unit root in the panel series and that their series are nonstationary. Except for the MN series, all the other series rejected the null hypothesis either at levels or first difference for all deterministic conditions (constant or constant & trend). Specifically, GDPPCG and FDI series are stationary at levels and the other series are stationary after the first difference. Since the MN series is integrated at beyond I(1), it would not produce efficient result in the ARDL based regression. Therefore, for all estimations concerning MN, we used the fully modified ordinary least square estimator which produces efficient estimates in the presence of no stationarity.

Table 6. Cross-sectionally dependent unit root tests (CIPS).

Null Hypothesis: there is unit root in the panel series										
Level Series					First Differenced Series					
Variables	Constant		Constant & Trend		Variables	Constant		Constant & Trend		Order
	t-statistic	*p*-value	t-statistic	*p*-value		t-statistic	*p*-value	t-statistic	*p*-value	
GDPCP	−3.4491	<0.01	−3.69111	<0.01	DGDPCP	−6.01519	<0.01	−6.02861	<0.01	I(0)
INV	−1.62556	≥0.10	−2.26476	≥0.10	DINV	−3.16877	<0.01	−3.32308	<0.01	I(1)
GEX	−1.7206	≥0.10	−2.40605	≥0.10	DGEX	−4.02366	<0.01	−4.01664	<0.01	I(1)
TRADE	−1.95834	≥0.10	−2.27785	≥0.10	DTRADE	−3.69392	<0.01	−3.69392	<0.01	I(1)
AG	−1.91727	≥0.10	−2.00941	≥0.10	DAG	−4.01181	<0.01	−4.23699	<0.01	I(1)
IND	−2.42976	<0.01	−2.83077	<0.01	DIND	−3.69702	<0.01	−4.002	<0.01	I(0)
MN	−1.06974	≥0.10	−1.53096	≥0.10	DMN	−2.11826	≥0.10	−2.25921	≥0.10	>I(1)
SS	−1.98838	≥0.10	−2.00546	≥0.10	DSS	−3.76639	<0.01	−3.90147	<0.01	I(1)
FDI	−2.88049	<0.01	−2.93694	<0.01	DFDI	−4.42432	<0.01	−4.38636	<0.01	I(0)
FDI POS	−1.52025	≥0.10	−2.11819	≥0.10	DFDI POS	−3.47458	<0.01	−3.4982	<0.01	I(1)
FDI NEG	−1.72783	≥0.10	−2.49504	≥0.10	DFDI NEG	−3.6788	<0.01	−3.70674	<0.01	I(1)

The results of the empirical analyses are found in Tables 7-10. Table 7 presents the results of ARDL and FMOLS and DOLS estimations of the long-run coefficients of the relationship between FDI, sectoral value additions and economic growth in sub-Saharan Africa. The significant results in the long run reveal interesting results as many of the variables are significant in explaining economic growth. To begin with columns 01-04 show that agricultural value addition has strong negative effect on economic growth. Since agricultural value addition is one of the components of GDP the results imply that value addition in the sector has level effect on income of the countries but not the growth effect. The results confirm the neoclassical view that economic growth in the long run is caused by growth in technological progress (Solow, 1956). Also, based on the endogenous growth literature, the results suggest that agricultural value addition does not lead to the growth change in technology which causes product variety which can be instrumental to economic growth (Romer, 1990). The mostly traditional methods of agriculture in Africa have been blamed for the inability of the sector to achieve its growth potential. The agricultural sector may not have the needed growth impact because of the underdeveloped nature of the sector in sub-Saharan Africa. However, in column 3, when we interacted the measures of agriculture value addition with FDI inflows, we find that FDI inflows into the Agric to sector boost the sectors value addition can boost economic growth in the long. The coefficient of the net effect is 0.0539 which shows that a 1% boost in FDI into the sector can increase welfare by 0.054% and it is statistically significant at 1%. This result means that FDI can increase technological advancement in the Agricultural sector to induce economic growth in the long run. The policies to attract FDI into the Agric sector, such as tax incentives, should be to induce technological know-how that would transform the sector.

Table 7. FDI in sectoral transmission of economic growth in Sub-Saharan Africa.

Eq Name:	01	02	03	04	05	06	07	08	09	10	11	12
Method:	ARDL Models				FMOLS Model				DOLS Model			
Dep. Var:	GDPPCG				GDPPCG				GDPPCG			
INV	0.0532	0.0747	0.065	0.0744	0.0312	0.0767	0.0925	0.1001	0.0125	0.0487	0.07	0.0451
	(0.0179)**	(0.0185)**	(0.0192)**	(0.0188)**	−0.0352	(0.0334)*	(0.0332)**	(0.0342)**	−0.0246	(0.0216)*	−0.0497	(0.0220)*
GEX	−0.1588	−0.115	−0.1728	−0.1247	−0.3027	−0.284	−0.2265	−0.2558	−0.1933	−0.1521	−0.2546	−0.1466
	(0.0325)**	(0.0316)**	(0.0325)**	(0.0327)**	(0.0520)**	(0.0484)**	(0.0503)**	(0.0494)**	(0.0466)**	(0.0404)**	(0.0804)**	(0.0407)**
TRADE	−0.0056	−0.0024	−0.0019	−0.0036	−0.0234	0.0049	0.0076	−0.0045	−0.0102	−0.0053	0.0074	−0.0018
	(0.0062)	(0.0063)	(0.0063)	(0.0071)	(0.0130)	(0.0118)	(0.0126)	(0.0123)	(0.0103)	(0.0088)	(0.0195)	(0.0090)
AG	−0.1083	−0.0798	−0.1206	−0.1076	−0.2321	−0.0133	−0.0518	−0.0638	−0.0646	−0.0761	−0.0742	−0.0683
	(0.0337)**	(0.0336)*	(0.0344)**	(0.0346)**	(0.2845)	(0.1178)	(0.1171)	(0.1204)	(0.0464)	(0.0403)	(0.1875)	(0.0390)
IND	−0.0246	−0.013	−0.0806	−0.0756	−0.233	−0.2562	0.0095	−0.1829	0.0631	0.0196	−0.1338	0.0113
	(0.0386)	(0.0377)	(0.0411)	(0.0395)	(0.1237)	(0.1143)*	(0.1113)	(0.1139)	(0.0542)	(0.0462)	(0.1725)	(0.0453)
MN	0.0383	0.0786	0.1098	0.0793	−0.4058	−0.3369	−0.582	−0.3605	−0.3436	−0.2048	−0.4576	−0.2012
	(0.0385)	(0.0366)*	(0.0425)*	(0.0389)*	(0.1332)**	(0.1223)**	(0.1327)**	(0.1263)**	(0.0659)**	(0.0487)**	(0.1991)*	(0.0478)**
SS	0.0025	−0.0002	−0.0259	0.0107	−0.2843	−0.1459	−0.1536	−0.203	−0.0117	−0.0342	−0.2092	−0.0215
	(0.0272)	(0.0278)	(0.0281)	(0.0295)	(0.0768)**	(0.0698)*	(0.0749)*	(0.0719)**	(0.0355)	(0.0346)	(0.1356)	(0.0336)
FDI	−0.2482	0.3864	0.286	0.3431	0.7319	−3.1065	−1.5035	0.8626	0.061	0.0574	−1.3992	0.3244
	(0.0640)**	(0.0946)**	(0.0633)**	−0.2003	−0.5767	(0.5659)**	(0.4080)**	−1.086	(0.0619)	(0.0780)	(0.6718)*	(0.1589)*
FDI*AG	0.0128				−0.0414				0.0015			
	(0.0027)**				−0.0294				(0.0027)			
FDI*IND		−0.0105				0.1738				−0.0001		
		(0.0030)**				(0.0319)**				(0.0026)		
FDI*MN			−0.0213				0.1121				0.1078	
			(0.0043)**				(0.0422)**				(0.0678)	
FDI*SS				−0.0063				−0.0234				−0.0055
				(0.0044)				(0.0221)				(0.0033)
Observations:	861	861	861	861	828	828	828	828	861	861	861	861

Note: * and ** denote 5% and 1% significance level, () denote standard errors. The net interaction effect for all interaction terms is estimated as: the coefficient of FDI (FDI_pos or FDI_neg) + mean of a sector's value addition * coefficient of the interaction from the regression output).

Table 8. A rise in FDI in sectoral transmission of economic growth in Sub-Saharan Africa.

Eq Name:	01	02	03	04	05	06	07	08	09	10	11	12
Method:	ARDL				FMOLS				DOLS			
Dep. Var:	GDPPCG				GDPPCG				GDPPCG			
INV	0.0786	0.105	0.0791	0.0854	0.033	0.0637	0.0583	0.0817	0.0158	0.0645	0.0493	0.0478
	(0.0204)**	(0.0213)**	(0.0197)**	(0.0194)**	(0.0324)	(0.0328)	(0.0323)	(0.0354)*	(0.0555)	(0.0222)**	(0.0527)	(0.0205)*
GEX	−0.1665	−0.2152	−0.1887	−0.1216	−0.3254	−0.3945	−0.3103	−0.4072	−0.3225	−0.1628	−0.3066	−0.1779
	(0.0352)**	(0.0378)**	(0.0390)**	(0.0359)**	(0.0525)**	(0.0511)**	(0.0514)**	(0.0531)**	(0.0904)**	(0.0417)**	(0.0864)**	(0.0404)**

Continued

TRADE	−0.0172	−0.0061	−0.011	−0.0144	−0.0045	−0.0191	−0.0179	−0.0168	−0.0045	0.002	−0.0192	0.0014
	(0.0072)*	(0.0078)	(0.0084)	(0.0079)	(0.0125)	(0.0130)	(0.0129)	(0.0134)	(0.0218)	(0.0088)	(0.0214)	(0.0085)
AG	−0.1322	−0.1462	−0.1738	−0.1892	−0.0207	−0.3466	−0.1822	−0.1701	0.0766	−0.0659	−0.1574	−0.0786
	(0.0395)**	(0.0408)**	(0.0421)**	(0.0411)**	(0.1789)	(0.1308)**	(0.1325)	(0.1301)	(0.2502)	(0.0388)	(0.1948)	(0.0379)*
IND	−0.1212	−0.1569	−0.0924	−0.1619	−0.5873	−0.7672	−0.2661	−0.4015	−0.5834	0.0096	−0.2861	0.007
	(0.0430)**	(0.0479)**	(0.0438)*	(0.0445)**	(0.1033)**	(0.1383)**	(0.1086)*	(0.1062)**	(0.1864)**	(0.0488)	(0.1833)	(0.0454)
MN	0.0462	0.0739	−0.0222	−0.0477	0.0134	−0.0310	−0.507	−0.1336	−0.0168	−0.1921	−0.504	−0.178
	(0.0392)	(0.0426)	(0.0494)	(0.0413)	(0.1331)	(0.1341)	(0.1832)**	(0.1359)	(0.2084)	(0.0485)**	(0.2878)	(0.0452)**
SS	−0.0254	−0.0306	−0.0633	−0.051	−0.2018	−0.2818	−0.1712	−0.1978	−0.2214	−0.0167	−0.2065	0.0195
	(0.0318)	(0.0326)	(0.0353)	(0.0341)	(0.0722)**	(0.0706)**	(0.0710)*	(0.0773)*	(0.1407)	(0.0305)	(0.1264)	(0.0305)
FDI_POS	−0.0645	−0.0273	−0.0605	0.2218	1.4714	−1.4626	−0.5076	0.267	1.4872	−0.0386	−0.4959	0.186
	(0.0206)**	−0.0311	(0.0233)**	(0.0638)**	(0.2037)**	(0.2358)**	(0.1781)**	−0.4731	(0.3680)**	(0.0350)	(0.2671)	(0.0578)**
FDI_POS*AG	0.0022				−0.0481				−0.0532			
	(0.0009)*				(0.0144)**				(0.0209)*			
FDI_POS*IND		−0.0003				0.0832				0.0014		
		(0.0010)				(0.0125)**				(0.0011)		
FDI_POS*MN			0.0020				0.0513				0.0508	
			(0.0017)				(0.0180)**				(0.0277)	
FDI_POS*SS				−0.0056				−0.0069				−0.0042
				(0.0014)**				(0.0097)				(0.0012)**
Observations:	831	831	831	831	798	798	798	798	831	831	831	831

Note: * and ** denote 5% and 1% significance level, () denote standard errors. The net interaction effect for all interaction terms is estimated as: the coefficient of FDI (FDI_pos or FDI_neg) + mean of a sector's value addition * coefficient of the interaction from the regression output).

Table 9. A fall in FDI in sectoral transmission of economic growth in Sub-Saharan Africa.

Eq Name:	01	02	03	04	05	06	07	08	09	10	11	12
Method:	ARDL Models				FMOLS Models				DOLS Models			
Dep. Var:	GDPPCG				GDPPCG				GDPPCG			
INV	0.0637	0.0657	0.0561	0.0687	0.0735	0.0761	0.0765	0.1046	0.0517	0.0669	0.0574	0.0494
	(0.0187)**	(0.0190)**	(0.0176)**	(0.0186)**	(0.0332)*	(0.0319)*	(0.0323)*	(0.0334)**	(0.0561)	(0.0216)**	(0.0209)**	(0.0196)*
GEX	−0.1204	−0.1698	−0.1814	−0.135	−0.3375	−0.3368	−0.3309	−0.3762	−0.3359	−0.1615	−0.2035	−0.1808
	(0.0349)**	(0.0377)**	(0.0374)**	(0.0384)**	(0.0526)**	(0.0490)**	(0.0500)**	(0.0500)**	(0.0899)**	(0.0416)**	(0.0421)**	(0.0401)**
TRADE	−0.0101	−0.0004	−0.004	−0.011	−0.009	−0.0102	−0.0125	−0.0153	−0.0039	0.0025	0.0084	0.0003
	(0.0078)	(0.0080)	(0.0078)	(0.0082)	(0.0126)	(0.0120)	(0.0123)	(0.0126)	(0.0228)	(0.0086)	(0.0088)	(0.0082)
AG	−0.1928	−0.1681	−0.1846	−0.1982	0.0017	−0.1116	−0.0024	0.0177	0.0519	−0.0763	−0.087	−0.0952
	(0.0445)**	(0.0446)**	(0.0429)**	(0.0445)**	−0.1716	−0.1318	−0.1307	−0.129	−0.2563	(0.0386)*	(0.0389)*	(0.0377)*
IND	−0.1318	−0.1305	−0.1134	−0.1657	−0.5868	−0.8119	−0.2816	−0.4453	−0.635	−0.0093	0.0181	−0.0098
	(0.0456)**	(0.0497)**	(0.0436)**	(0.0486)**	(0.1032)**	(0.1159)**	(0.1018)**	(0.1041)**	(0.1823)**	−0.0496	−0.0449	−0.0457
MN	0.0321	0.0694	0.0006	−0.0202	−0.1965	−0.2610	−0.7233	−0.3119	−0.1655	−0.1984	−0.2672	−0.1915
	(0.0389)	(0.0422)	(0.0469)	(0.0417)	(0.1299)	(0.1239)*	(0.2232)**	(0.1291)*	(0.2111)	(0.0478)**	(0.0526)**	(0.0447)**

Continued

SS	−0.0489	−0.0367	−0.0636	−0.0441	−0.3054	−0.3895	−0.2769	−0.2257	−0.3295	−0.0237	−0.043	0.0179
	(0.0358)	(0.0353)	(0.0364)	(0.0363)	(0.0737)**	(0.0703)**	(0.0739)**	(0.0779)**	(0.1353)*	(0.0307)	(0.0324)	(0.0305)
FDI_NEG	0.1064	0.0463	0.0879	−0.2337	−2.0283	2.2613	0.6758	−0.7499	−1.9885	0.0743	0.0761	−0.2289
	(0.0260)**	(0.0369)	(0.0247)**	(0.0752)**	(0.3060)**	(0.3152)**	(0.2512)**	−0.7352	(0.5439)**	(0.0413)	(0.0290)**	(0.0680)**
FDI_NEG*AG	−0.0036				0.0546				0.0597			
	(0.0012)**				(0.0174)**				(0.0268)*			
FDI_NEG*IND		0.0001				−0.1382				−0.0024		
		(0.0012)				(0.0170)**				(0.0013)		
FDI_NEG*MN			−0.0034				−0.0931				−0.0055	
			(0.0017)*				(0.0328)**				(0.0018)**	
FDI_NEG*SS				0.0062				0.0127				0.0056
				(0.0016)**				(0.0155)				(0.0015)**
Observations:	831	831	831	831	798	798	798	798	831	831	831	831

Note: * and ** denote 5% and 1% significance level, () denote standard errors. The net interaction effect for all interaction terms is estimated as: the coefficient of FDI (FDI_pos or FDI_neg) + mean of a sector's value addition * coefficient of the interaction from the regression output.

Table 10. Pairwise Dumitrescu Hurlin panel causality tests.

Lags: 2			
Null Hypothesis:	W-Stat.	Zbar-Stat.	Prob.
INV does not homogeneously cause GDPPCG	3.97934	4.02572	6.E−05
GDPPCG does not homogeneously cause INV	2.92042	1.63459	0.1021
GEX does not homogeneously cause GDPPCG	3.93028	3.94001	8.E−05
GDPPCG does not homogeneously cause GEX	2.78950	1.35316	0.1760
TRADE does not homogeneously cause GDPPCG	4.06707	4.25651	2.E−05
GDPPCG does not homogeneously cause TRADE	2.39290	0.45649	0.6480
AG does not homogeneously cause GDPPCG	4.39825	5.00821	5.E−07
GDPPCG does not homogeneously cause AG	3.31904	2.55863	0.0105
IND does not homogeneously cause GDPPCG	3.31296	2.53675	0.0112
GDPPCG does not homogeneously cause IND	2.88994	1.57822	0.1145
MN does not homogeneously cause GDPPCG	3.59949	3.13713	0.0017
GDPPCG does not homogeneously cause MN	2.89472	1.55488	0.1200
SS does not homogeneously cause GDPPCG	3.43794	2.82852	0.0047
GDPPCG does not homogeneously cause SS	2.95619	1.73505	0.0827
FDI does not homogeneously cause GDPPCG	3.82512	3.71126	0.0002
GDPPCG does not homogeneously cause FDI	2.00187	−0.42982	0.6673
FDI_POS does not homogeneously cause GDPPCG	2.97193	1.73697	0.0824
GDPPCG does not homogeneously cause FDI_POS	2.12091	−0.17883	0.8581
FDI_NEG does not homogeneously cause GDPPCG	2.82154	1.39843	0.1620
GDPPCG does not homogeneously cause FDI_NEG	2.71715	1.16342	0.2447

Similarly, column 02 shows that FDI has as strong positive net effect (0.1263) on economic growth when it is transmitted to induce industrial value addition. A 1% increase in FDI into industrialization can lead to 0.1263% increase in economic growth which is very significant. FDI can boost the flow of technology in the countries which use industrialization to promote sustainable economic development. We found a similar result concerning FDI inflows into the manufacturing sector and its effect on economic growth. Column 07 (under FMOLS since MN is not I(1) variable) of **Table 7** show that a 1% increase in FDI to boost manufacturing value addition can induce economic growth by 0.0517%. It implies that FDI inflows into the industrial and the manufacturing sector can turn the fortunes of the sector positively to induce sustainable development in the long run. Therefore, African countries should come up with incentives to induce FDI inflows into the Agric, industrial and the manufacturing sectors to promote growth. We did not find any evidence that FDI into the service sector has any implication on economic growth as shown in column 06.

The service sector receives the greatest percentage of inflows of FDI. The sector from our descriptive statistics received an average of 44.87% of FDI as a share of GDP as against 11.00%, 23.60% and 24.77% for the manufacturing, agricultural and the industry sectors respectively. Yet the inflows into the service sector do not have significant effect on economic growth. Eventually, the results show that an increase in the inflows of FDI can boost economic growth in Africa when it is directed to boost agricultural, industry and manufacturing value addition. This is not surprising as FDI is noted to come along with lots of value additions in the form of capital and technology transfer, employment which ingredients in the growth of these sectors. While the findings are consistent with Balasubramanyam et al. (1996) who argue that FDI remains the doorway to acquire the needed technologies necessary to propel growth, our evidence also contrasts Adams and Opoku (2015) and Agbloyor et al. (2014). It is also consistent with the modernization theory which posits that FDI is important for developing countries because most emerging economies lack the infrastructure and facilities needed to boost growth.

In terms of the controls, given the negative and significant coefficients, government spending does not boost economic growth in the long or short run. As is the situation in most African countries, uncontrolled public spending means higher future tax rates. In fact, Ibrahim & Alagidede (2018) claim, based on data from 29 SSA nations, that increased government spending does not always help economic growth and that the quality of spending is more important than the quantum. When we look at gross fixed capital formation (INV), which a measure of investment, we can see that all the coefficients are positive, implying that capital investment boosts economic growth. Because investment is a long-term undertaking, it has a greater impact on economic growth in the long run than in the short run. The result contradicts the neoclassical thinking that capital accumulation through savings/investment does not lead to productivity growth and

hence growth in per capita GDP (Solow, 1956). The result rather confirms the endogenous growth perspective that under increasing and constant return to scale, investment in capital accumulation can lead to economic growth and therefore improvement of income (Romer, 1990). Although statistically insignificant, trade openness has a detrimental influence on the economy in the short run. Trade Openness can be seen in boosting economic growth in several ways including technology transfer, bait for FDI, source of foreign exchange, and means of getting access to capital equipment to enhance developments. However, the result of this study shows that in the long run, trade openness was only significant in the transmission from the agricultural sector as shown in Equation (2). The results for the other sectors showed an insignificant result.

Table 8 also shows the results of the positive shocks of FDI and their effect in the transmission process through which FDI into the various sectors affects economic growth. Columns 01 and 05 show the impact of the positive shocks of FDI into the agric sector and its implications on economic growth. The columns show that positive shocks of FDI into the Agric sector can have detrimental effect on economic growth. For instance, column 01 shows that a 1% positive change in FDI in the Agricultural sector can reduce economic growth by 0.0432%. Comparing the results to that on column 01 of Table 7 where FDI into the Agricultural sector can boost economic growth, the current results implies that it is the quality of the FDI into the sector that matters but not the quantity of it. Also, the results indicate that the FDI channels of Agric value addition in growth is asymmetric such that there is a threshold of FDI into the Agric sector beyond which FDI ceases to have productive growth effects. The agricultural sector needs investment in technological transfers that can cause structural transformations to bring about economic growth. In terms of the direction of the interaction terms, the study found that, like the agricultural sector, positive change in the FDI inflows into the service sector is injurious to economic growth of the sub-Saharan African countries. This result is in line with the result in Table 7 that FDI inflows into the service sectors have dampening effect on economic growth.

Using the FMOLS estimations, the results indicate that positive in FDI into the industrial and manufacturing sectors can also be injurious to economic growth in the region. Again, the implication is that for all sectors of the region's economies, the quality of FDI matters more than the quantity. Also, it is incumbent on the policy makers to generate and leverage the optimal levels of FDI that can be absorbed by the economies to induce productivity growth.

Conversely, in Table 9, using the net interaction effect estimation procedure (net effect of 0.0214), the study found that the negative shocks of FDI that is directed into the Agric sector can lead to economic growth. This result implies that there is a minimum amount of direct investments into the primary sectors of the economies that can translate into economic growth.

On the other hand, negative shocks of FDI inflows into the services sector can

induce economic growth highlighting the view that the countries should direct FDI into the industry or the manufacturing sectors to advance infrastructural development towards productivity growth. This evidence is shown in column 12 of Table 9. It is shown that a 1% negative shock in FDI into the service sector can result in 0.0224% increase in the growth of GDP per capita. Similarly, negative shocks of FDI into the industrial sector do not have growth induce effect (the net effect is −0.6105 reading from column 06 of Table 9). The result confirms the earlier result that FDI inflows in the industry sector contribute to economic growth stress that FDI and industry value additions are complement in boosting productivity growth. Moreover, the negative shocks in FDI inflows into the manufacturing sectors have positive influence on economic growth which implies that direct investment can serve as a substitute to the development in the manufacturing sector to induce economic growth. When the manufacturing sectors' value addition is dwindling, policy makers should attract more FDI to induce economic growth. The result confirms the results from the level relationships in Table 7 that FDI into the service sector does not induce economic growth and hence the growth in welfare.

Finally, we also estimated Wald test to examine the joint effects of the regressors on economic growth and confirm the long run causality among the variables. The results are shown in the last panel of Table 10. The results of the Wald test showed high joint significance of the regressors in explaining economic growth among the African Countries. Specifically, we found that gross fixed capital formation, Government expenditure, trade openness, agricultural value addition, industry value addition, manufacturing value addition, and services value addition homogeneously caused the growth in GDP per capita. Similarly, FDI inflows homogeneously cause economic growth in SSA. This means that we can use the coefficients of the explanatory variables to determine the direction of economic growth of the sampled countries.

5. Conclusion

FDI provides countries with additional financial and technological resources to increase their economic outcomes. Existing work on the precise impact of FDI on economic growth, on the other hand, has been inconclusive due to a failure to investigate the channels via which FDI influences overall growth. To put it another way, while FDI is thought to influence growth, little is understood about the transmission mechanisms that relate FDI to growth. Aside from the direct impact of FDI, this study suggests that FDI has asymmetric and significant impact on growth via its effects on value addition among sectors of countries in sub-Saharan Africa.

Using asymmetric methods, the study concluded that the impact of FDI on growth on the various sectors is not only dependent on the size of the FDI inflow but also the type of the structural composition of the economy and the quality of optimal FDI inflows. We found that FDI inflow into the agricultural, industry

and the manufacturing sectors can boost economic growth. However, FDI into the service sector can have a dampen effect on economic growth. Despite the monumental surge of FDI into the service sector in recent times, it is the Agric, manufacturing and the industry sectors that can assimilate FDI into sustainable development.

The following recommendations were made based on the study's results and conclusions to assist improve the link between FDI, sectoral growth, and economic growth. To begin with, FDI helps countries with well-developed agricultural, manufacturing, and industrial. Therefore, to get the best out of FDI, much effort must be put in place to develop the various sectors in sub-Saharan Africa. The results showed that incentives to attract FDI into African economies should be given to investors who invest in the agricultural, manufacturing and industry sectors. Policies to boost investment in these sectors can help the economies to promote sustainable development. For instance, tax incentives can be given to induce investment in the agricultural and manufacturing sectors to induce industrialization that translates primary production into secondary production.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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