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Economic Growth and Foreign Direct Investment Transnational Exploration in Africa Using Panel Integration and Panel Estimation

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Abstract

The existing macroeconomic literature on the link between foreign direct investment and growth has identified the potential gains from FDI for recipient countries only if they reach a threshold level of absorptive capacity. The present study made an effort in this direction to determine whether FDI affects economic growth based on panel data for 20 African economies over the period 2010-2020. Investment and economic growth. The results strongly suggest that although FDI improves growth in Africa, the extent of its impact depends on absorptive capacity thresholds measured by levels of human capital and infrastructure. African economies that meet these thresholds can only reap the benefits of FDI. This study therefore provides compelling evidence of the synchronized efforts of African economies to attract FDI for their economic growth.

Key words: FDI; Economic growth; Estimation; Integration; Panel

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INTRODUCTION

The structural transformation of the world economy in terms of changes in market orientation has opened up a new paradigm in the treatment of private capital and capital accumulation in theoretical and experimental discussions. The issue of capital flows is seen as the most accessible route for economic growth, with investment seen as the engine of growth. Global changes in mentality and pro-business orientation have recognized the importance of foreign direct investment as one of the possible options for boosting growth momentum. Discussions of foreign capital and growth originate from pre-classical views. Fundamentally, the issue of foreign capital arises from the mercantilist investment-trade mechanism which has been strengthened by the protection of domestic producers and by the competitiveness of exports. Despite the increased savings potential in surplus countries, much of the savings could not be invested due to poor investment opportunities. Classical political economists went beyond the intuitive thoughts of the mercantilists and focused on the causal relationships of economic phenomena. Gradually, neoliberal policies have been effective since the 18th century. Neoclassical doctrine regarded the issue of capital mobility as the important determinant of economic growth. The emerging mobility of capital in terms of FDI had led to the resurgence of neoclassical orthodoxy. International capital movements had been the main component of neoclassical growth theory and politics (Nurkse, 1953). The relevance of FDI is felt through the compensation mechanism to break the vicious circle of poverty. The genesis of the "vicious circle of poverty" can be explained by low real income leading to low saving capacity, which reduces productivity and investment potential. Lack of capital constrains savings capacity and forces investment to revert to low real income rates (Nurkse, 1953). Thus, FDI can stimulate additional resources to break the vicious circle and act as a complementary tool to domestic resources. The link between FDI and growth can be analyzed in the context of economic development. Investigations of the impact of FDI should not only focus on direct

causation on economic growth, but also on the necessary preconditions for growth. Under neoclassical models, the impact of FDI on output growth is limited by the existence of diminishing returns to physical capital with no long-term effect. With the advent of endogenous growth theories, FDI could be seen as the use of new technologies and a highly skilled workforce. As a result, FDI has been incorporated into economic growth theories as (gains from FDI) approach (Krugman, 1998). Over the past two decades, there has been a major shift in the size and composition of cross-border financial flows to developing countries, particularly African countries. African countries have experienced an upsurge in private capital flows due to the liberalization of their capital accounts. One of the fundamental motivations for attracting private capital was the much needed funds that foreign investors needed to recapitalize their economic systems. Among African economies, Nigeria, South Africa Angola and Ivory Coast are enthusiastic liberalizers (Ali Yousif, 2002). The main drivers of foreign capital have been favorable policies to encourage cross-border mergers and acquisitions in the financial sector. However, in the case of South Africa and Nigeria, the liberalization trend is cautious. Although Nigeria has been a late entrant in opening up to foreign participation compared to other African countries, it has recorded a high pace in attracting foreign capital. South Africa economic reforms have made in South Africa businesses versatile and strengthened the strength of the industry. Therefore, the search for higher returns in African economies motivated the study to investigate the theoretical and empirical relationship between FDI and economic growth.

Against this background, this article examines the long-term dynamics between foreign direct investment and economic growth for 20 African economies during the period 2010-2020. The experimental specification emphasizes the concept of endogenous growth theory.

This study looks for integration in a panel setting. The integration relationship is further estimated using panel econometric techniques to determine the threshold level of absorptive capacity for the host country. Unlike previous studies, this article contributes to the existing literature by individually identifying the African economies selected for study based on their threshold level of absorptive capacities captured respectively by levels of human capital and infrastructure development. This article is divided into six sections. Section II provides an overview literature review. Section III discusses on experimental size followed by data and methodology issues in section IV. Section V presents the experimental results followed by a conclusion in section VI.

1. LITERATURE REVIEW

Economic growth can be explained by a variety of social, political, economic and institutional factors. The FDI-growth link has gained prominence in the literature on growth in its various dimensions. The overview of studies confirms various dimensions such as fundamental theories of FDI, various macroeconomic variables that influence FDI, the impact of economic integration on FDI movements followed by benefits and disadvantages of IDE (Yusop, 1992; Jackson and Murkowski, 1995; Cheng and Yum, 2000; Lim and Maisom, 2000). Theoretical models refer to the propositions of growth driven by FDI; Growth-driven FDI and their interdependence through a feedback mechanism. The hypothesis of growth driven by FDI emerged with the development of the theory of endogenous growth. FDI-driven growth was proposed by Goldsmith (1969) who stated that financial intermediaries can stimulate economic growth either by accumulating capital or by increasing levels of savings and investment (Shaw, 1973). Growth theory Schumpeter (1911), the empirical studies of Sala-i-Martin (2002) provide strong evidence for this proposition: FDI accompanied by human capital, exports and technology transfers will play a proactive role in creating a dynamic growth factors (Borenzstein and Lee, 1998; Lim and Maisom, 2000). These growth factors should be encouraged to realize the potential gains from FDI. Microeconomic studies also support this proposition in that spillover effectiveness occurs when domestic firms are able to absorb the benefits of multinational corporations embedded in FDI. In addition, FDI also creates backward and forward linkages which are stimulated by multinationals to stimulate economic growth and development. Blomstrom, Kokko and Zejan (1992) concluded that productivity will increase due to spillovers from FDI. De Mello (1997) highlighted two main channels through which FDI stimulates growth. This involves the acquisition of skills through management practices and workforce training. De Mello's study supported by the findings of the OECD (2002) confirms that FDI contributes positively to income growth and productivity provided that the host country has achieved a certain degree of absorption. A number of macroeconomic studies have corroborated the proposition that FDI is conducive to economic growth. It is seen as the composite set of capital stock that increases the current level of knowledge and instills management expertise. According to Frankel et al (1999), FDI accelerates growth by creating investment demand in terms of filling savings gaps. This proposition is further supported by the findings of Zhang (2002). Zhang highlighted the contribution of FDI to economic growth in terms of providing financial resources, transferring technology, enhancing competitive potentials, and enhancing domestic savings and investment. However, the study by Carkovic and Levine (2002) does not confirm any conclusive results in favor of this proposition.

Another strand of the literature emerges from the GDP-induced FDI hypothesis which is strongly based on the theory of multinationals. Following the eclectic paradigm,

Dunning (1977) argues that multinationals with certain ownership advantages will invest in another country with advantages and location advantages can be effectively captured by "internalizing" production through FDI. Parameters, political stability and governance. Expanding the size of the market, represented by the host country's GDP, is expected to translate into higher profitability. An increase in investment potentials will create better opportunities for FDI inflows (Corden, 1999).

However, the FDI-growth link is best seen in terms of the problem of endogeneity or feedback mechanism. Causality issues affect all studies that attempt to capture the impact of a factor or group of factors on economic growth. The complex phenomenon of economic growth strengthens the feedback mechanism. The findings of Chowdhury and Mavrotas (2003) find mixed results in the direction of causality between FDI and economic growth. They considered the specification of causality by Toda and Yamamoto (1995) independently of Granger's traditional causality approach. The above proposals have been addressed by researchers in their empirical studies based on cross-sectional, time-series and panel data sets. Cross-sectional studies show that FDI in the form of mergers and acquisitions will be conducive to economic growth. Industry-specific studies focus mainly on spillover effects (Smarzynska, 2004; Driffield et al, 2002). However, in the context of methodological issues, cross-sectional studies suffer from serious issues of endogeneity and heterogeneity not observed. Even if the FDI coefficient appears significant in the growth equation, it is not always reliable. The question of causality is of prime importance because it reflects the holistic view of the process of economic growth. A lot of empirical studies are in fact based on time series analyzes that look not only for causation, but also for long-term relationships. These studies apply integration techniques followed by an error correction mechanism. In the case of a cross-national analysis, the studies look for a integrating relationship with respect to each country. The proposition of growth driven by FDI is explored in many studies. In this context, Adewumi (2006) examined the contribution of FDI to economic growth in Africa using annual series, applying a time series analysis from 1970 to 2003. He found that FDI contributes positively to economic growth in most countries, but this is not the case. Statistically significant. However, Herzer et al. (2008) applied time series techniques from 1970 to 2003 for 28 developing countries, 10 Latin American countries, 9 Asian countries and 9 African countries. They found weak evidence that FDI improves GDP in the long or short term. Their findings indicate that there is no clear evidence of the impact of FDI on economic growth. On the other hand, Zhang (2002) examines 11 countries country by country, dividing the countries according to the chronological properties of the data. Long-run causality tests based on an error correction model indicate a strong Granger causal relationship between FDI and GDP growth. For six counties, there is no integrating relationship between FDI and growth and for a single country, Granger causality exists between FDI and growth. Unlike cross-country analysis, Kaushik et al (2008) used Johansen's integration analysis and a vector error correction model to study the relationship between economic growth, export growth, instability of exports and gross fixed capital formation (investment) in South Africa during the period 2000-2005. The empirical results suggest that there is a unique long-run relationship between these variables and that the Granger causal flow is unidirectional from real exports to real GDP. However, there are a number of concerns about time series issues. Although studies confirm that the variables namely FDI and economic growth are integrated in the same order and that appropriate estimation techniques are therefore applied, the small samples generally used can distort the power of standard tests and lead to inaccuracies. Wrong conclusions. Therefore, appropriate measures should be adopted to use the data in the most efficient way by taking care of country specific effects, controlling endogeneity issues and including appropriate instruments. Studies based on panel data sets attempt to address shortcomings in time series analysis. The aforementioned propositions are also addressed by panel studies that research the integration and causality of panels. Basu, Chakraborty and Reagle (2003), for 20 developing countries from (2010-2020), found an integrating relationship between FDI and GDP. In addition, Hansen and Rand (2006), for 31 developing countries from 1970-2000, found that there is an integrating relationship between FDI and GDP. Their results indicate that FDI inflows are positively correlated with GDP, while GDP has no long-term effect on FDI.

Therefore, the existing literature above highlights various dimensions to justify the proposals under the overview of the FDI-growth link. Bearing in mind the shortcomings of cross-sectional and time-series studies, this article examines the impact of FDI on economic growth in Africa in a panel setting. A panel framework is constructed to examine the absorptive capacities of African economies. This article contributes to the existing literature in terms of finding an integrating relationship and thus estimating policy conclusions. Unlike previous studies, this article attempts to determine the thresholds of human capital and infrastructure necessary for economic growth.

2. DISCUSSES ON EXPERIMENTAL SIZE

This section examines the importance of FDI on economic growth by taking into account the absorptive capacity of the host country on the basis of a neoclassical production function. According to Zhang (2001), FDI can influence growth in two ways. First, this article examines the direct impact of FDI on economic growth using the following production function, where output is a function of labor,

domestic capital, and foreign capital, respectively. Thus, the production function can be stated as follows:

Specification -I

$$Y_{it} = f(L_{it}, K_{dit}, K_{fit}) \quad (1)$$

Where Y_{it} denotes output

K_{dit} and K_{fit} denote domestic and foreign capital stock respectively

L_{it} denotes the labour force

Here the subscript **'it'** refers to the panel set up consisting of i=1.....N number of sample countries having t=1.....T number of time-periods.

Second, the impact of FDI can be endogenized by measuring absorptive capacity. In fact, Sala-i-Martin (2002) has highlighted the difficulties in selecting potential determinants of economic growth in empirical discussions. In his study, he considered 67 variables, but of which only 18 are closely correlated with economic growth. The strongest indication is that of enrollment in secondary education and the level of infrastructure. In view of these results, this document considers the inclusion of gross enrollment in secondary education as a proxy of human capital and levels of infrastructure development as the measures of absorptive capacity which affect growth. Thus the Equation **1** can be modified as:

Specification II

$$Y_{it} = f(L_{it}, K_{dit}, K_{fit}, Secedcn_{it}, Infra_{it}) \quad (2)$$

Where gross enrollment in secondary education is represented by **Secedcn** and the level of infrastructure is denoted by **Infra** respectively. The inclusion of these two variables is also supported by the results of Levin and Raut (1997) and Roy and Berg (2006) who concluded that these variables promote growth.

As per the contributions of Romer (1990) and extending the hypothesis of Boreinstein et. Al (1998), the issue of absorptive capacity can be captured by the interaction terms such as the levels of FDI multiplied by the levels of human capital and infrastructure. If the coefficients related to the interaction terms are found to be positive and statistical significant, then the countries having high levels of human capital and infrastructure will be conducive to economic growth. The Equation **2** can be modified as below:

Specification-III

$$Y_{it} = f(L_{it}, K_{dit}, K_{fit}, Secedcn_{it}, Infra_{it}, Secedcn_{it}*Kf_{it}, Infra_{it}*Kf_{it}) \quad (3)$$

Here the indirect impact of FDI on economic growth can be investigated by the interaction terms, Secedcn and Infra multiplied by foreign capital proxied by FDI flows.

Finally, the output equation in per capita terms with the variables in logarithmic form can be stated as:

Specification-IV

$$\log(GDPC_{it}) = \alpha_0 + \alpha_1 \log(GCFPC_{it}) + \alpha_2 \log(FDIPC_{it}) + \alpha_3 \log(SECEDCN_{it}) + \alpha_4 \log(INFRINDEX_{it}) + \alpha_5 \log(FDIPC_{it}*ASC_{it}) + \eta_i + \varepsilon_{it} \quad (4)$$

Where,

log ($GDPC_{it}$): natural logarithm of GDP per capita in real terms as a proxy for economic growth used as dependent variable for all specifications

log ($GCFPC_{it}$): natural logarithm of Gross Domestic Capital Formation per capita in real terms as a proxy for domestic capital. The inclusion of this variable is supported by the findings of Olofsdotter (1998) and Sahoo (2006) in explaining the determinants of economic growth.

log ($FDIPC_{it}$): natural logarithm of inward FDI flows per capita in real terms as a proxy for foreign capital. The inclusion of this variable is supported by UNCTAD studies (1999).

log ($SECEDCN_{it}$): natural logarithm of the percentage of gross enrolment in secondary education as a proxy for human capital. A higher level of human capital is expected to boost up the potentials of FDI in stimulating growth (Aleksynska et al, 2003).

log ($INFRINDEX_{it}$): natural logarithm of infrastructure index computed for all the selected countries on the basis of variables[1] related to all types of infrastructure, namely transport, ICT, energy and banking.

log($FDIPC_{it}$*ASC_{it}): The multiplicative product of FDI with the host country's absorptive capacity variables **(ASC_{it})**, namely gross enrollment in secondary education and infrastructure captures the interaction term or the indirect impact of FDI on economic growth. This will determine the education and infrastructure threshold levels.

i and t : Country (i) and time period (t) respectively

η_i **:** unobserved country specific effect

ε_{it}: the disturbance term

Given the above model specifications, the expected results that can examine the role of host country's absorptive capacity factors to channelize the impact of FDI on economic growth can be illustrated as follows:

1. If both α_2 and α_5 have positive (negative) sign in the growth equation, then FDI inflows have an unambiguously positive (negative) effect on economic growth.

2. If α_2 is positive, but α_5 is negative, then FDI inflows have a positive effect on growth, and this effect

[1] Infrastructure Variables: Transport- air freight million tonnes per km area and length of roads network per 10,000sq km,.ICT- number of telephone lines per 1000 inhabitants,Internet – number of internet users per 1000 inhabitants, Energy- energy use per inhabitant and Banking- domestic credit provided by the banking sector.

diminishes with the improvements in the host country's absorptive factors.

3. If α_2 is negative and α_5 is positive, then this means that the host country has to achieve a certain threshold level (in terms of absorptive capacity developments) for FDI inflows to have a positive impact on economic growth. The threshold level of host country's absorptive capacity is computed by the partial differentiation of FDI on growth.[2] The above specified growth model is empirically tested in a panel structure comprising of 27 countries in African continent covering the period,2010 to 2020.This paper looks into the time-series properties of panel data followed by panel estimation methods.

3. DATA AND METHODOLOGY

The opportunity of this study is limited to 20 African economies covering the period 2010 to 2020. Secondary data on the variables namely GDP per capita (PPP), Gross Domestic capital Formation (GCF), Foreign Direct Investment Inflows (FDI), Gross Enrollment in Secondary Education (SECEDCN) and the total labor force are collected from the World Development Indicators published by the World Bank. The variables Gross Domestic capital Formation (GCF) and Foreign Direct Investment flows (FDI) are converted into real terms at constant prices. The infrastructure index is constructed using Principal Component Analysis (PCA)[3]. Empirical treatment involves the applications of panel-based econometric procedures, namely panel integration techniques and panel estimation procedures. Panel integration analysis guarantees the achievement of a long-term equilibrium relationship between economic growth and its explanatory variables, as specified in the growth equation (4). Poses problems in the estimation results. Ordinary least squares regression results with nonstationary variables will lead to false results. To identify a possible long-term relationship, the variables must be integrated in the same order. However, the standard time series unit root tests, namely the augmented Dicky Fuller test and the Phillips-Perron test, have less power given the sample size and study schedule. Recent literature suggests that panel-based unit root tests have higher power than unit root tests based on individual time series. Recent developments in panel unit root testing include: Levin, Lin and Chu (LLC), Im, Pesaran and Shin (IPS), Maddala and Wu and Hadri. Among the various panel unit root tests developed in the literature, LLC and IPS are the most popular. Both tests are based on the ADF principle. However, LLC assumes homogeneity in the dynamics of the autoregressive coefficients for all panel members. On the other hand, the IPS is more general in the sense that it allows heterogeneity in these dynamics. Therefore, it is described as a "heterogeneous panel unit root test". In addition, the heterogeneity of the slopes is more reasonable in the case where cross-national data are used. In this case, the heterogeneity results from the differences in economic conditions and the degree of development in each country. As a result, the test developers have shown that this test has higher power than other tests in its class, including LLC. Therefore, the IPS test is more preferred than LLC.

The next step is to test the integration relationship. The concept of integration was first introduced in the literature by Granger (1987). Integration implies the existence of a long-term relationship between economic variables. The principle of the integration test is to test whether two or more integrated variables deviate significantly from a certain relationship (Abadir and Taylor, 1999). In other words, if the variables are integrated, they move together over time so that short-term disturbances will be corrected in the long term. This means that if, in the long run, two or more series come together, the difference between them is constant. Otherwise, if two series are not co-integrated, they can drift apart arbitrarily (Dickey et al, 1981). The shortcomings of traditional integration procedures have led to the application of panel integration techniques. A heterogeneous panel integration test developed by Pedroni (2001) overcomes the problems of small samples and allows different individual cross-sectional effects for heterogeneity in intersections and slopes of the integration equation. Pedroni's method includes a group of tests to demonstrate the null hypothesis of no integration in heterogeneous panels. The first group of tests is called "in the dimension". It includes the panel-v, panel rho (r), which is similar to the Phillips test, and Perron (1988), nonparametric panel (PP) and parametric panel (ADF) statistics. The nonparametric panel statistic and the parametric panel statistic are analogous to the ADF single equation test. The other group of tests is called "between dimensions". It is comparable to the mean group panel tests of Im et al. (1997). The "between dimensions" tests include four tests: the group-rho, group-pp and group-adf statistics. Therefore, the Pedroni test establishes the long-term relationship.

The FDI-induced growth proposition is then analyzed using a panel estimation technique, namely the random effect estimator. The random effects estimator controls for heterogeneity by including time dummy variables for each group (Wooldridge 2006). It is more suitable for testing unbalanced panel data, when there are limitations

[2] $\partial\log(GDPC) / \partial\log(FDI) = \alpha2 + \alpha5\ (ASC) = 0$, ASC refers to absorptive level of capacity then the threshold level of host country's absorptive capacity can be computed as, $(ASC) = - \alpha2/ \alpha5$

[3] PCA :The PCA is a multivariate technique used to reduce the number of variables without loosing informetion. It results in fewer variables which explain most of the variation in original variables. The KMO test of sampling adequacy compares the magnitudes of the observed coefficients with that of the magnitudes of partial correlation coefficients.High value of KMO test statistic indicates the appropriateness of PCA technique

or missing observations in the panel data set (Asteriou and Hall, 2007). However, the fixed and random effects estimates are performed in a panel frame. The difference between the fixed-effect and random-effect models arises in the sense that the fixed effect assumes that each country differs in its constant term, while the latter assumes that each country differs in its error terms. The random effect model treats the interceptions for each section not as fixed parameters but as random parameters (Asteriou and Hall, 2007). However, the choice between RE or FE depends on the correlation between the unobserved component and the other control variables. It is important to have a test to examine this hypothesis (Wooldridge, 2006). Hausman (1978) developed a test to choose between random-effect and fixed-effect estimators.

4. EXPERIMENTAL RESULTS

The main objective is to justify the long-term dynamism of FDI on economic growth and to examine whether countries have the absorption capacities to reap the potential gains from FDI. -III. This paper attempts to establish the presence of integration among the variables specified in the growth equation of Section III. For this exercise, the first step is to ensure the stationarity of the panel variables. As discussed in the Methodology section, this article applies panel unit root tests, namely the IPS, LLC, ADF-Fisher and PP-Fisher tests respectively. Table 1 shows the results of both level and first difference tests, including constant and constant with time trend. The four variables of the panel series namely GDPC, GCFPC, FDIPC, INFRINDEX and SECEDCN turn out to be non-stationary in their level form, which accepts the hypothesis concerning the presence of panel unit root with and without time trend. Respectively the last part of Table 1 shows the results of the IPS, LLC, ADF-Fisher and PP-Fisher tests at their first differences with and without time trend respectively.

Table 1
Panel Unit Root Test Results

Variables	Constant				Constant and trend			
	ADF test	PP test	IPS test	LLC test	ADF test	PP test	IPS test	LLC test
Panel unit root test results at levels								
GDPC	-0.20	-0.29	-0.68	-1.04	-0.54	-0.66	-0.87	-0.86
GCFPC	-1.14	-0.47	-1.07	-0.41	-0.47	-0.51	-0.76	-0.76
FDIPC	-0.49	-0.76	-1.06	-0.23	-0.56	-0.42	-0.36	-0.32
INFRINDEX	-0.66	-0.54	-1.45	-0.67	-0.12	-0.36	-1.08	-0.88
SECEDCN	-0.59	-0.34	-0.76	-0.54	-1.25	-1.45	-1.08	-1.23
Panel unit root test results at first-differences								
GDPC	-13.54*	-9.32*	-12.45*	-7.22*	-11.56*	-8.78*	-10.55*	-8.54*
GCFPC	-11.32*	-8.76*	-11.65*	-6.59*	-12.32*	-9.66*	-10.43*	-7.836*
FDIPC	-12.64*	-7.69*	-18.46*	-8.92*	-13.43*	-7.65*	-9.58*	-8.78*
INFRINDEX	-11.32*	-8.41*	-10.62*	-6.61*	-11.42*	-8.56*	-7.68*	-7.44*
SECEDCN	-10.44*	-7.67*	-7.99*	-8.23*	-10.32*	-8.21*	-7.43*	-8.08*

The results confirm that all the variables in the panel series are stationary at their first difference, i.e. the null hypothesis regarding the presence of the unit root of the panel is rejected at the 5% significance level. In addition, the results provide strong evidence that the series are all integrated individually of order one (I (1)) across countries.

To investigate the existence of a long-term relationship between panel variables, it is necessary to investigate panel integration. This exercise is justified because all the variables are integrated of the same order, the test I (1). Pedroni (2001) is carried out to guarantee the presence of integration with the presence of individual interception as well as interception with constant trend. The summary of the results of the Pedroni panel analysis with intercept and both intercept and trend is presented in Table 2.

Table 2
Pedroni panel integration test results (Specification I)

Test statistics	Individual intercept		Individual intercept and constant trend	
	Statistic	Prob.	Statistic	Prob.
	Within dimension			
Panel rho-Stat	3.477556*	0.0003	0.496942*	0.3096
Panel v-Stat	-8.886716*	0.0000	-5.195046*	0.0000
Panel PP Stat	-11.05264*	0.0000	-12.04549*	0.0000
Panel ADF Stat	-8.060624*	0.0000	-8.497430*	0.0000
	Between dimension			
Group rho Stat	-5.502022*	0.0000	-2.641395*	0.0041
Group PP Stat	-10.16093*	0.0000	-13.42647*	0.0000
Group ADF Stat	-8.69874*	0.0000	-7.790504*	0.0000

Regarding specification 1 as specified in section III, Pedroni tests are performed. This specific model that output per capita approximated by GDPC (GDP per capita) is a function of domestic capital per capita approximated by GCFPC (gross domestic capital formation per capita and foreign capital approximated by FDIPC (foreign direct investment per capita), respectively . level in the absence of trend, all test statistics for evaluating strong evidence of the presence of integration among the variables of the series of panels, respectively GDPC, GCFPC and FDIPC. heterogeneous panels for the first and second group of tests or tests for the inner dimension and between the following dimensions. With the inclusion of trend except one test statistic, all remaining test statistics reject the null hypothesis (no integration) at a significance level of 5 %. Long-term equilibrium relationship between the variables stated above that justifies the underlying theory of the neoclassical function of production.

To capture the endogenous impact of FDI on economic growth, this paper focuses on domestic absorptive capacity factors as specified in Specification-2. Two variables namely gross enrollment in secondary education (SECEDCN) and the infrastructure index (INFRINDEX) are included to capture the essence of absorptive capacity in the given production function. Recent literature has shown that a host country will effectively transform the benefits inherent in FDI flows if the host country achieves a threshold level of human capital and infrastructure. The inclusion of these two variables is justified if the long-term equilibrium relationship established in specification 1 remains maintained. To confirm this proposition, the Pedroni test is again performed against specification 2. Table 3 presents the results. Results with both intersection and intersection and trend respectively.

Table 3
Pedroni panel integration test results (Specification II)

Test statistics	Individual intercept		Individual intercept and constant trend	
	Statistic	Prob.	Statistic	Prob.
	Within dimension			
Panel rho-Stat	0.706823	0.2398	-1.662650	0.9518
Panel v-Stat	-2.483361*	0.0065	-0.452409	0.3255
Panel PP Stat	-12.70203*	0.0000	-14.65569*	0.0000
Panel ADF Stat	-8.618903*	0.0000	-9.029617*	0.0000
	Between dimension			
Group rho Stat	-0.299385	0.3823	1.449232	0.9264
Group PP Stat	-14.69785*	0.0000	-18.05361*	0.0000
Group ADF Stat	-7.243145*	0.0000	-7.493950*	0.0000

Note: 1. All statistics are from Pedroni's procedure.
2. * indicates rejection of the null hypothesis of no integration at 5% levels of significance

Table 4
Impact of FDI on economic growth; 2010-2020 (Random Effect Estimator) Dependent variables: log of GDP per capita (GDPC)

Variables	Equation specifications				
	1	2	3	4	5
GCFPC	-0.12* (0.000)	-0.044*(0.000)	-0.041*(0.000)	-0.043*(0.000)	-0.03* 0.000
FDIPC	0.14*(0.000)	0.067*(0.000)	-0.28*(0.000)	-0.13*(0.000)	0.09*0.000
INFRINDEX		3.062*(0.000)	3.37*(0.000)	3.071*(0.000)	3.01*0.000
SECEDCN		0.457*(0.000)	0.406*(0.000)	0.495*(0.000)	0.423*0.000
FDIPC*INFRINDEX			0.35*(0.000)		
FDIPC*SECEDCN				0.15*(0.007)	
FDIPC*GCFPC					-0.016*0.000
Constant	3.87* (0.000)	2.69*(0.000)	2.08*(0.000)	2.28* (0.000)	1.57*0.000
Breusch-Pagan Test (LM Test)	81.14* (0.000)	93.32*(0.000)	75.32*(0.000)	78.43*(0.000)	77.65*0.000
No of Observations	972	972	972	972	972
Threshold Value			0.80	0.86	
P –value of Hausman Test	0.1621	0.2627	0.1127	0.1651	0.1482

Note: * indicates significance of the variables at 5% levels

Pedroni's test confirms that five out of seven test statistics reject the null hypothesis of no integration at a 5% significance level in the presence of intercept only without trend. However, in the presence of both intercept and trend, four out of seven test statistics confirm the presence of panel integration. To justify the presence of mixed results, it is worth mentioning the conclusions of Harris and Sollis (2003). According to Harris and Sollis (2003), it is quite natural that different tests generate mixed results when certain series are integrated or not. Since the majority of statistics conclude in favor of integration combined with the fact that panel studies are no longer reliable except in interception, it can be concluded that there is a long-term integration between the panel variables, GDPC, GCFPC, FDIPC, INFRINDEX and SECEDCN respectively. The results in this case reflect that the inclusion of these two variables does not ambiguously confirm the integration of the panel unlike the previous case. However, considering

the period from 1975 to 2010, the result is not surprising. As noted in the previous literature, the productivity levels of these economies are hampered due to the impact of business cycles during this longer period. This destabilizes the tendencies of these economies to achieve a long-term stable state relationship due to the fragile financial structure and weakened investor confidence (Ali-Yosouf, 2002). Since the aforementioned variables capture the essence of productivity, their inclusion in the production function (Specification-2) gives mixed results. However, according to Harris and Sorris, the panel variables are integrated.

This paper further attempts to estimate the logarithmic integration relationships established above using panel estimation techniques. In addition, this document contributes to the existing literature by determining the threshold level of absorptive capacity in the host country. Before proceeding to the estimation results, the standard Breusch-Pagan Lagrange Multiplier (LM) test for the adequacy of the mutualisation hypothesis is performed. The results reported in Table 4 confirm a very high calculated value of the LM statistic which favors the fixed-effect / random-effect model over the sectional model. The Hausman test is then performed to choose between the random and fixed model for all specifications. The test statistic in this case accepts the null hypothesis of the random effect model. The growth equation already specified in Equation 4 of Section III is finally estimated and Table 4 presents the results of the estimation.

Specification 1 refers to the base model with base variables and all of them are statistically significant at the 5% level. We observe that the FDIPC variable contributes significantly to economic growth such that a one percent increase in FDI inflows increases economic growth by 0.14 percentage point. This finding corroborates the findings of Zhang (2001). FDI enhances competitive potential through technology transfer, acquisition of equity capital and improved growth dynamics. However, unlike the previous literature, the estimated coefficient of GCFPC is negative but statistically significant for all specifications. It can be deduced from this that domestic investment represented by gross domestic capital formation is not conducive to the economic growth of Asian economies due to the mismatch between capital needs and saving capacity. On the contrary, as mentioned above, FDI inflows stimulate economic growth. However, the complementarities between domestic and foreign investments are examined through the interaction term and their impact on economic growth is analyzed under specification 4.5. Specification 2 presents the estimated results of the growth equation with the inclusion of the absorptive capacity variables, SECEDCN and INFRINDEX respectively. The coefficient of SECEDCN (education) estimated according to the random effects model turns out to be positively significant confirming the positive correlation between the level of human capital and economic growth (Barro, 1995). Secondary education levels this level increases economic growth by 0.457 percentage point. This justifies the inclusion of this variable in the growth equation. The index of the infrastructure coefficient contributes positively and significantly to economic growth so that it increases by 3.062 percentage points due to the improvement of infrastructure. However, as noted in studies by the World Bank (1994), Asian economies need to improve the efficient use of infrastructure stocks and services. Although this variable contributes significantly to economic growth, the work of Alexander and Estache (2000), Reinikka and Svenson (1999) and Canning and Bennathan (2000) confirm that the link between investment in infrastructure and economic growth is «ambiguous at best».

To take a closer look at the indirect impact of FDI on economic growth, interaction terms are included in the estimation procedures. Specification 3 tests the hypothesis that the contribution of FDI to economic growth is conditional on the level of infrastructure development. The coefficient for FDI in column 4.3 is negative but the interaction term for FDI with INFRINDEX is positive and significant. According to the proposals set out in Section III of this paper, this result suggests that the relationship between FDI inflows and economic growth depends on the threshold level of infrastructure development for Asian countries. By following the mentioned procedure, the infrastructure threshold for Asian economies in panel structure is calculated. It is equal to 0.78. This value is obtained by considering the derivative of the growth equation with respect to FDIPC and setting it to zero. By solving it, the value of the infrastructure threshold turns out to be positive. By taking the exponential of this value, the minimum threshold level is calculated. Of the Asian countries studied, only those countries that meet this infrastructure threshold will benefit from FDI inflows and be conducive to economic growth. Specification 4 tests the hypothesis regarding the growth effect of FDI in terms of the interaction term with secondary education as an indicator of human capital. He points out that FDI has a negative impact on economic growth while the interaction term with secondary education is positive and significant for economic growth. The coefficient of the interaction term captures the effect of a well-trained workforce on the absorptive capacity of the economy. Using a similar procedure, the secondary education threshold is calculated and reported in Table 4. It turns out to be positive, confirming that a minimum level of human capital is necessary for FDI to positively contribute to growth, confirming the results of Borensztein et al. (1989). By taking the exponential of the value of the education threshold, it is suggested that Asian economies with a relatively well-trained workforce meeting this threshold will have the potential to reap the benefits of FDI inflows. The graphical interpretation of the absorptive capacities of each country is explained in Figure 1. The horizontal axis represents the countries in relation to the average

level of secondary education threshold represented on the vertical axis. Among the 20 countries selected for the study, six countries, namely are below the education threshold which is equal to 35.75. The other 14 countries have reached this threshold and are sufficiently capable of absorbing the spillover effects of FDI inflows over the period 2010-2020. Specification 5 examines the impact of the interaction term between FDI inflows and domestic investment on economic growth. The results differ from previous studies. We observe that FDI inflows contribute positively to economic growth but that its impact is negative and significant with regard to the estimated coefficient of the interaction term. From the discussions in Section III, it can be concluded that the positive effects of FDI diminish as domestic investment improves. Thus, the empirical results obtained are to a certain extent within the expected lines and this call for policy recommendations.

5. CONCLUSION

This article studies the impact of FDI on economic growth in Africa using Panel Integration and Panel Estimation in Transnational Exploration sample of 20 economies for the period 2010-2020. There has been a paradigm shift in the FDI orientation in African countries over the past two decades. This paper further supports the view that FDI can serve as a tool to complement growth dynamics, but the effect of FDI depends on the threshold conditions of the host country. The panel integration technique is applied to the empirical specification of the neoclassical-type production function. In addition, panel estimation techniques are applied for the policy outcomes. The empirical results clearly show that there is a panel integration relationship and that the estimation procedure can therefore be justified. This finding asserts that the production function in per capita terms exists in the long run. The inclusion of the absorptive capacity variables does not preclude the results of achieving long-term equilibrium, which justifies their inclusion. The random-effect panel estimation procedure is applied to the panel integration relationship. The results clearly show that FDI contributes positively to economic growth, followed by significant coefficients for human capital and infrastructure, which supports the empirical literature. The study further contributes to the existing literature with regard to absorptive capacity variables. In the context of the existing literature on FDI growth, this study provides evidence that the ability to absorb the benefits inherent in FDI inflows is conditional on the host country's capacity in terms of human capital and the level of infrastructure. The results confirm that some African economies do not meet the threshold for education and infrastructure levels and therefore these countries need to invest more in education and infrastructure. A more ambitious policy of upgrading the local environment, strengthening the endowment of human capital in terms of skills and expertise, the creation of a solid infrastructure base alongside FDI inflows is complementary to Economic Growth. Therefore, African economies can reap the benefits of foreign capital in terms of capabilities as measured by levels of human capital and infrastructure.

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