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Assessing the Nexus among Energy Consumption, Foreign Direct Investment and Economic Growth in Sub-Saharan Africa

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This study examines the dynamic relationship among energy consumption, foreign direct investment, and economic growth in Sub-Sahara Africa. Beyond assessing the tripartite causal relationship, the study investigates the extent of impacts among energy consumption, foreign direct investment, and economic growth using the Generalised Method of Moments. The study utilises data from 42 Sub-Saharan African countries spanning 1991 to 2018. Findings from the study show that a percentage increase in energy consumption engenders economic growth by 1.3 percent. Conversely, economic growth increases energy consumption by 0.004 percent. Also, there is a significant one-way causality running from foreign direct investment (FDI) to economic growth. The link between energy consumption and FDI were not statistically significant in both directions. The study advocates that government in Sub-Saharan Africa should ensure more energy access to enhance economic growth.

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1. Introduction

The Sub-Saharan Africa (SSA) region has grappled with the problem of low energy consumption over a long period, impeding domestic and foreign investment, and economic growth. The SSA region has the lowest per capita energy consumption, an indicator that measures socio-economic development, and an incentive for crowding-in investment. For instance, the SSA has an average per capita electricity consumption of 200 kWh per year making it the lowest in the world (United Nations, 2018). Besides, the SSA region has for long suffered from the challenges of low economic growth due partly to the energy crisis and inadequate investment in spite of its vast energy resources and market size. Moreover, the challenge persists as the

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SSA region has consistently remained at the bottom of the economic growth and development ladder. Since foreign direct investment (FDI) is needed to spur growth and development (Akinlo, 2004), it therefore becomes imperative to explore the link among energy consumption, FDI, and economic growth for prompt policy action in the region.

A developed energy sector is vital for the attraction of FDI in bridging the resource gap for economic growth. Thus, energy-intense countries present an opportunity for attracting FDI and the realisation of economic growth and development. This is plausible due to increased industrialisation resulting from higher energy consumption (Tang, 2009). However, the opportunity to attract FDI could be constricted if the macroeconomic environment and policy uncertainty pose a great challenge to the development of the energy market. As such, a massive deficit in energy infrastructure as experienced in the SSA could serve as a disincentive to investment, and ultimately, the growth of the economy.

The energy consumption-FDI-growth nexus has received some attention in the literature, due to the role played by energy and investment in economic growth. Omri and Kahouli (2014) in their study on countries of different income levels found a mixed outcome in this relation. Energy consumption was found to exhibit a two-way mutual relation with economic growth across the high, middle, and low-income countries, while one-way causation running from energy consumption to FDI was found only in high-income countries. A two-way relationship was also established between FDI and growth across all income levels. Another study by Smile (2009), found an interrelationship such that electricity consumption and FDI granger cause economic growth. Further, a study by Mavikela and Khobai (2018) established a unidirectional causality flowing from FDI to energy consumption, and a bi-directional relationship between energy consumption and economic growth.

Broadly, studies close to this in the literature can be grouped into those that considered the energy consumption-FDI relationship, the energy consumption-economic growth nexus, and those that investigate the link between economic growth and FDI. Firstly, studies in the literature that considered the energy consumption-FDI relationship showed mixed results. For instance, a study by Khatun and Ahamad (2015)

reveals a positive and unidirectional short-run causal relationship running from FDI to energy use in Bangladesh.

Secondly, in studies that examined the energy consumption and economic growth nexus, a unidirectional relationship running from electricity consumption to economic growth was established (Akinlo, 2008; Iyke, 2015). While Esso (2010), Zeshan (2013), and Solarin and Ozturk (2016) found bi-directional causality between energy consumption and economic growth. In other studies, the conservative hypothesis holds between economic growth and energy consumption, such that economic growth stimulates energy consumption (Yoo & Kim, 2006; Esso, 2010).

Further, some of those studies that investigated the nexus between economic growth and FDI revealed that FDI has a unidirectional relationship with economic growth (Saddique *et al.*, 2017). A study by John (2016) shows that FDI has a positive and significant effect on GDP. In yet another study, economic growth is directly related to FDI (Adeleke *et al*., 2014), while Khandker *et al*. (2018) confirm no relationship between FDI and economic growth in Bangladesh.

From the foregoing, the link among energy consumption, FDI, and economic growth in the SSA has been empirically established. In assessing the link, this study specified three system equations to establish the effects of energy consumption and FDI on growth using generalised method of moments (GMM) approach. The contribution of this study to the literature is two folds. First, the analysis of the interrelationship among energy consumption, FDI, and economic growth in SSA is a nascent area in the literature. Previous studies have mainly concentrated on energy consumption-growth, energy consumption-FDI, and FDI-growth relations. The study by Kivyiro and Arminen (2014) is very similar to ours. However, there is a major difference in terms of scope. Their study used a sample of only 6 countries in SSA (Republic of Congo, DR Congo, Kenya, South Africa, Zambia, and Zimbabwe), the justification of which was not known. Of course, the sample is quite small and may not be representative of the entire SSA region. Second, we specified a simultaneous equation model estimated with a GMM estimator. The estimator helps to overcome the dynamic bias problem, which results from endogeneity associated with such models. Among other studies that have used the GMM in related subjects, only Adom, *et al*.

(2019) focused on Africa. However, their study was focused on the link between FDI and energy demand, ignoring economic growth. Omri *et al*. (2014) also used the GMM technique, but their study was on the relationship among CO_2 emission, FDI, and economic growth in a global panel of 65 countries. Furthermore, the usage of GMM also allows for correcting the misspecification bias that permeates single equation models employed by previous studies in the energy consumption, FDI, and economic growth relationship. As such, the GMM which is a simultaneous equation model is adopted to neutralize the bias due to unobserved individual-specific effects, thus accounting for unexpected behaviour among the selected variables of interest (Wooldridge, 2002).

Empirical findings from the study show that energy consumption and economic growth determine each other in SSA, while there was a significant one-way causation from FDI to economic growth but reverse causation from economic growth to FDI was insignificant. Also, the energy consumption-FDI nexus was not statistically significant in both directions. The bi-directional relationship between energy consumption and economic growth is an indication that more energy consumption is needed to propel growth in the region and vice-versa. The insignificant relationship between energy consumption and FDI explains the low level of energy consumption in the SSA as a dampener on economic productivity and FDI inflows while the insignificant causation from economic growth to FDI highlights the low level of growth in SSA as a disincentive for investment. These, therefore, indicate the need for policy actions to boost economic growth in the region while also ensuring more energy consumption.

In addition to the introductory section, the remainder of the study is rendered as follows: Section 2 provides a review of the theoretical and relevant empirical literature, while Section 3 presents a description of the dataset used and the methodology. Section 4 discusses the empirical results, and Section 5 contains the conclusion and policy recommendations.

2. Literature Review

2.1 Theoretical Literature

Standard economic growth theories have established growth in labour, capital and technical/technological progress as enablers of economic growth and development. In that sense, FDI inflows not only provide capital for production purposes but also promotes economic growth through the enhancement of skills and knowledge spillovers (Wenfei *et al*., 2012). In the case of energy consumption, access, coverage, and use of energy greatly determine opportunities for economic development, particularly in developing countries (Stern *et al*., 2019). Key issues for consideration are quality of service (related to infrastructural development) and sustainability (related to the role of renewable sources). For technological advancement, increased energy demand and use are crucial for attaining a higher level of economies of scale in production.

Furthermore, the energy consumption-FDI-growth nexus is also traceable to the Environmental Kuznet Curve (EKC) hypothesis which argued for the existence of a reversed U-shaped association between economic growth and the environment (Kuznet, 1955). In the EKC hypothesis, the initial stages of growth are marred by a high level of environmental damage and pollution, but after a threshold level of income, there is a trend reversal as economic growth leads to environmental improvement at higher levels of income (Beyene & Kotosz, 2020). The theory rejects the view that greater economic activity reduces environmental quality on the grounds that the claim is based on static assumptions regarding the state of technology, tastes and environmental income. The theory thus contends that as income rises (economic growth), the demand for higher environmental quality (green energy alternatives) increases, as will the resources available for investment (FDI).

The neoclassical neutrality hypothesis argued that due to the existence of other economic growth enabling factors other than energy, there could be no relationship existing between energy consumption and economic growth (Menegaki, 2011; Armeanu *et al*., 2018). However, the non-neutrality preposition presumes that energy is an important input for productivity, and as such, policies for environmental protection and conservation can dampen the growth of an economy.

Thus, the theoretical argument on energy consumption-FDI-growth nexus is inconclusive, owing to the existence of different schools of thought on the subject matter. Empirical findings from country-level and cross-country studies can only agree with some theoretical postulations and refute others.

2.2 Empirical Literature

The literature on the energy consumption-FDI-growth nexus can be grouped into four lines of thought, with consideration for the impact of carbon emission in some of the studies. The first group of studies are those that examined the relationship between energy consumption and economic growth. However, the findings of these studies are mixed and inconsistent as the conclusion runs from the bi-directional, unidirectional, and neutral relationship between energy consumption and economic growth. Studies that established bi-directional relationships opined that more energy consumption is required to spur economic growth, while on the other hand a higher level of growth in an economy is required to ensure sufficient energy use. For instance, a study by Hou (2009) examined the energy consumption-growth linkage in China between 1953 and 2006 using cointegration and Hsiao's causality techniques. The results could not confirm a long-run cointegration between the variables. However, there was evidence of bi-directional causality between energy consumption and China's economic growth. Ozturk and Acaravci (2010) also conducted a study to explore the Hungarian evidence of the energy-growth nexus and found a two-way mutual association. Conversely, Akinlo (2008) investigated the electricity consumption-economic growth relationship in Nigeria from 1980 to 2006, using cointegration and co-feature analysis. The results indicated that there is unidirectional causality from electricity consumption to real GDP in Nigeria. Also, Tang *et al.* (2016) examined the energy consumption-growth nexus in Vietnam from 1971 to 2011 using Cointegration and Granger Causality techniques. The study found that while the variables are cointegrated, energy consumption stimulates economic growth, suggesting a unidirectional relationship between energy consumption and growth. More recently, Awodumi and Adewuyi (2020) employed the non-linear autoregressive distributed lag (NARDL) model in their examination of the influence of non-renewable energy (petroleum and natural gas) consumption on economic growth and carbon emission in African oil-

producing countries from 1980 to 2015. The study found disparities in the response of economic growth to changes in the consumption of non-renewable energy across the countries.

The second strand of research focuses on the relationship between FDI and economic growth. Omri, *et al*., (2014) examined the relationship among CO2 emission, FDI and economic growth in a global panel of 65 countries and three regional subpanels from 1990 to 2011 using the Arellano and Bond (1991) GMM estimator. The study found in all the panels (global and regionals) that a two-way causal relationship holds between FDI and economic growth. Belloumi (2014) investigated the relationship between FDI, trade, and economic growth in Tunisia using annual data from 1970 to 2008, estimated through the ARDL technique. Although the study noted the existence of long-run cointegration among the variables, no causality was found to exist between FDI and economic growth. Abbes *et al*. (2015) found a uni-directional causality from FDI to economic growth in their study of a global panel of 65 countries from 1980 to 2010 using panel cointegration and Granger causality techniques. Analysing the FDI-growth nexus in the Eurozone through the use of fully modified ordinary least squares (FMOLS) and dynamic ordinary least squares (DOLS) between 2002 and 2012, Pegkas (2015) found the existence of a long-run positive relationship and that FDI is growth-enhancing in the Eurozone. The same result was found by Fadhil and Almsafir (2015) in their study of the role of FDI on economic growth in Malaysia, using annual data from 1975 to 2010 analysed through Johansen cointegration and hierarchical multiple regression methods.

The third research strand dealt with the energy consumption-FDI relation. This area has received relatively lesser attention than the other research areas in the energy consumption-FDI-growth literature, more so that Omri and Kahouli (2014) described it as nascent. However, it has been attracting a lot of research attention lately. For instance, Doytch and Narayan (2016) in their study of the energy consumption effect of sectoral FDI in a global panel of 75 countries from 1985 to 2012 using the GMM estimator found a negative effect of FDI on energy consumption for non-renewable energy sources, but the positive effect of FDI on the consumption of renewable energy sources, with divergence in the magnitude of effect across sectors. Wang and

Jiayu (2019) also studied the nature of the effect of FDI on energy consumption in the Shandong Province of China from 2000 to 2016. The study employed regression and simultaneous equation models and found a negative scale and structural but positive technical effect of FDI on energy consumption, thus concluding a negative total effect of FDI on energy consumption. In a recent study of 27 African countries, Adom *et al.* (2019) employed the GMM estimator to examine the FDI-energy demand relationship using data from 2000-2014. The results pointed to a concave effect of FDI on energy consumption in Africa.

The last cluster of research, closely related to our study, are those that have considered the energy consumption, FDI and economic growth trinity, but most of them assumed a linear relationship and have employed linear models to investigate this nexus. Some other studies only employed cointegration and granger causality techniques to examine the existence of cointegration and causation among the variables. However, the inadequacy of these approaches is the inability to reveal the dynamic interrelationship among energy consumption, FDI, and economic growth which have great policy implications both at the country and regional levels. Although some studies have been able to capture this dynamism in other countries and regions, much attention has not been given to Sub-Saharan Africa.

For instance, Pao and Tsai (2011) examined the dynamic relationship among CO2 emission, energy consumption, FDI, and economic growth in BRICS countries (Brazil, Russia, India, China and South Africa) from 1980 to 2007, except for Russia whose scope was from 1992 to 2007. The study used a panel cointegration technique and found that long-run equilibrium exists among the variables. The results further revealed short-run bi-directional causality between energy consumption and growth as well as between energy consumption and FDI while a uni-directional causality runs from economic growth to FDI both in the short run and long run. Omri and Kahouli (2014) studied the interrelationship between energy consumption, FDI, and economic growth in a global panel of 65 countries from 1990 to 2011 with some sub-panels based on countries' level of income. The study specified dynamic simultaneous models estimated with the generalized method of moments (GMM). The study found a two-way link between economic growth and FDI in countries across all

income levels. Economic growth and energy consumption have a bi-causal relationship in the global panel, high and middle-income countries, but one-way nexus from economic growth to energy consumption in countries with low-income. A one-way causality exists from FDI to energy consumption in the global panel and middle-income countries, whereas in low-income countries, the direction is from energy to FDI. In high-income countries, causality is bi-directional.

Also, Kivyiro and Arminem (2014) examined the causal nexus among CO2 emission, energy consumption, FDI and economic growth in Sub-Saharan Africa using only a sample of six countries (Republic of Congo, DR Congo, Kenya, South Africa, Zambia and Zimbabwe) from 1971 to 2009 using ARDL and Granger causality techniques. The study found a unidirectional causality from economic growth to FDI and other different causal relationships across the countries. In Egypt, Ibrahiem (2015) studied the links among renewable electricity consumption, FDI, and economic growth from 1980 to 2011 using ARDL and Granger causality. The findings showed bi-directional causality between growth and electricity consumption and unidirectional causality from FDI to economic growth. Saidi, *et al*., (2017) employed panel cointegration and vector error correction mechanism (VECM) to investigate the causal relationship between energy consumption, FDI and economic growth in a global panel of 53 countries from 1990 to 2014 with several regional sub-panels. The result found a positive long-run relationship between the variables. Lin & Nelson (2018) examined the dynamics of the energy consumption-FDI-growth nexus in a panel of MINT countries (Mexico, Indonesia, Nigeria and Turkey) from 1990 to 2014. The study employed the panel dynamic ordinary least squares (DOLS) technique and found bi-causal relations among energy consumption, FDI and economic growth in all the countries, except Indonesia and Nigeria where uni-directional causality only runs from FDI to energy consumption.

Muhammad and Khan (2019) studied how bilateral FDI, energy consumption, CO2 emission, and capital affect economic growth in 34 host countries of Asia and 115 source countries from 2001 to 2012, using fixed and random effect models as well as GMM. The results indicated that FDI flows, energy consumption, and CO2 emission significantly affect economic growth. More recently, Fan and Hao (2020) examined

the dynamism of the causal relationship among renewable energy consumption, FDI and economic growth in 31 Chinese provinces from 2000 to 2015 using the vector error correction mechanism (VECM) and impulse response function. The findings showed a long-run relationship among the variables and that a reduction in GDP and targeted FDI will increase the consumption of renewable energy in China.

From the review of the literature, it could be inferred that the direction of causality among energy consumption, FDI and economic growth seems to be a settled issue as each of these variables can cause changes in one another, depending on the specific country-level and regional characteristics. The present study, therefore, departs from extant studies by examining the magnitude of the dynamic relationship among energy consumption, FDI and economic growth in Sub-Saharan Africa as literature in this regard is sparse.

3. Data and Methodology

3.1 Data

Based on data availability, annual data for forty-two (42) Sub-Saharan African countries from 1991 to 2018 were employed.[3] Data on energy consumption was measured in Quadrillion British thermal units (QBTU) and sourced from the US Energy Information Administration (EIA). Other variables like GDP growth rate, FDI (measured in current US$), gross fixed capital formation (in current US$), labour force (in annual total), inflation, population growth rate, financial development (domestic credit to private sector ratio to GDP), trade openness (ratio of total trade to GDP), and exchange rate were collected from the World Bank's World Development Indicators. All variables were normalised by taking their growth rates. The variables were selected based on the relevant empirical studies (see Omri and Kahouli, 2014; Lin and Nelson, 2018).

3.2 Theoretical Framework

The theoretical framework follows the Cobb-Douglas production framework with labour and capital inputs alongside their respective elasticities (Omri & Kahouli 2014, Abdouli & Hammami, 2017). The framework has an efficiency parameter,

[3]The selected countries are listed in Appendix A.

otherwise known as the total factor productivity, which allows for the model expansion. In analysing other factors of economic growth, asides from capital and labour, an expanded form of the production function is employed. Thus, the production function takes a modified form that includes energy consumption and FDI. The additional inputs are factors of economic growth (Smile, 2009; Ibrahiem, 2015; Lin & Nelson, 2018; Pham *et al*., 2018; Zeng *et al*., 2020).

Specifically, energy consumption through its services directly enters production as an additional input. The indirect impact is through factor productivity by reducing transaction and other costs due to more efficient use of conventional processes (Straub, 2008). The economic growth effect of FDI occurs on the premise of technological transfer and the spill-over effect of FDI inflows (Zeng *et al*., 2020). Thus, the FDI affects economic growth through the efficient use of capital formation (Abdouli and Hammami, 2017). As cited in Cheng (2002), FDI also enhances economic growth through capital stock accumulation that engenders backward and forward integration in an economy. The combination of these inputs with capital and labour indicators stimulates economic growth. The proposition is consistent with theoretical literature.

3.3 Model Specification

Following Omri and Kahouli (2014), we begin by specifying a production function that identified capital and labour as production (growth) inputs in an economy. We introduce the energy consumption and FDI variables into the model to enable us empirically determine their impacts on economic growth. Inflation is also included in the economic growth equation as a control variable since studies have noted its significant impact on economic growth (Lin & Nelson, 2018). Thus, the model takes the form:

$$GDP = f(EC, FDI, K, L, INF) \tag{1}$$

where *GDP* represents economic growth (measured by growth rate of GDP), *EC* represents energy consumption, *FDI* represents foreign direct investment, *K* represents the stock of capital (measured by gross fixed capital formation), *L* represents the labour force (measured by total labour force), *INF* represents the inflation rate (mea-

sured by growth rate of consumer price index).

Since the study is interested in the dynamic relationship among energy consumption, FDI and economic growth, we specify the model in simultaneous form whereby energy consumption, FDI and economic growth are treated as endogenous to enable us capture the three-way dynamics. While equation (2) is the growth equation, energy consumption and FDI equations are specified in equations (3) and (4) respectively, containing other variables that have been noted to affect energy consumption and FDI in the literature.

$$GDP_{it} = \alpha_0 + \alpha_1 GDP_{i,t-1} + \alpha_2 EC_{it} + \alpha_3 FDI_{it} + \alpha_4 K_{it} + \alpha_5 L_{it} + \alpha_6 INF_{it} + \varepsilon_{it} \quad (2)$$

$$EC_{it} = \beta_0 + \beta_1 EC_{i,t-1} + \beta_2 GDP_{it} + \beta_3 FDI_{it} + \beta_4 K_{it} + \beta_5 L_{it} + \beta_6 POP_{it} + \beta_7 FD + \varepsilon_{it} \quad (3)$$

$$FDI_{it} = \nu_0 + \nu_1 FDI_{i,t-1} + \nu_2 GDP_{it} + \nu_3 EC_{it} + \nu_4 K_{it} + \nu_5 L_{it} + \nu_6 TOP_{it} + \nu_7 RER + \varepsilon_{it} \quad (4)$$

The subscripts $i=1,\ldots,N$ and $t=1,\ldots,T$ represent the number of countries (42 Sub-Saharan African countries) and time period (1991-2018) covered in the study respectively, while ε is the error term.

In equation (3), POP represents population and FD is financial development while in equation (4), TOP is trade openness and RER is real exchange rate. The specifications in equations (2-4) follow a dynamic panel data model in simultaneous form whereby each equation contains a lagged form of the dependent variable as an independent variable, indicating the presence of endogeneity problem in the model since the lagged dependent variables could correlate with the stochastic error term. As a result, the ordinary least square (OLS) technique becomes inappropriate and inconsistent in analysing these models (Omri & Kahouli, 2014; Muhammad & Khan, 2019). However, the appropriateness of the GMM estimator has been well established in the literature and its supremacy over random and fixed effects models and pooled OLS models has been noted in solving basic econometric problems such as endogeneity, simultaneity, weak instrumentation and unobserved heterogeneity in dynamic panel data models with little time span and large cross-sections (Muhammad & Khan, 2019).

Although there are other variants of GMM such as instrumental variables and two stages least squares; which could serve as an estimator, the weakness of these techniques is that they use external instruments, and getting external instruments that simultaneously correlate with the endogenous variables but are uncorrelated with the stochastic error terms is quite herculean. However, for GMM adopted in this study, the lags of the endogenous variables are used as instruments, which makes the endogenous variables predetermined and therefore uncorrelated with the error term (Baum *et al.,* 2003; Olubusoye *et al.*, 2016).

Hence, our model is operationalized using the GMM estimator of Arellano and Bond (1991). Omri (2014) noted that by transforming the regressors through first differencing, the Arellano and Bond (1991) approach removes country-specific effects. Furthermore, unobserved fixed effects no longer enter the equations as they are by assumption constant between periods.

The analytical version of the model therefore becomes:

$$GDPg_{i,t} = \alpha_0 GDPg_{i,t-1} + \alpha_1 ECg_{i,t} + \alpha_2 FDIg_{i,t} + \beta X'_{i,t} + \mu_{i,t} + \varepsilon_{i,t} \tag{5}$$

$$ECg_{i,t} = \phi_0 ECg_{i,t-1} + \varphi_1 GDPg_{i,t} + \varphi_2 FDI_{i,t} + \beta X'_{it} + \mu_{i,t} + \varepsilon_{i,t} \tag{6}$$

$$FDIg_{i,t} = \nu_0 FDIg_{i,t-1} + \nu_1 GDPg_{i,t} + \nu_2 ECg_{i,t} + \beta X'_{i,t} + \mu_{i,t} + \varepsilon_{i,t} \tag{7}$$

where $GDPg_{i,t}$ and $GDPg_{i,t-1}$, $ECg_{i,t}$ and $ECg_{i,t-1}$, $FDIg_{i,t}$ and $FDIg_{i,t-1}$ represent growth rates of GDP, energy consumption, foreign direct investment of country i and year t and their respective lagged values, X represents a vector of variables used to control for economic growth (gross fixed capital formation, labour force and inflation), to control for energy consumption (gross fixed capital formation, labour force, population growth rate and financial development), and to control for FDI (gross fixed capital formation, labour force, trade openness and exchange rate), μ represents the country-specific effects and $\varepsilon$is the error term.

Based on economic intuition and findings from previous studies, we expect a positive bi-directional relationship between energy consumption and economic growth. This

is due partly to the importance of energy as direct or indirect input in production; and the fact that economic growth enables countries to have more resources for investment in infrastructures, including electric-power infrastructure. A positive link between FDI and economic growth is expected (Abdouli & Hammami, 2017; Zeng *et al.,* 2020). Likewise, a positive impact of FDI on energy consumption is anticipated, because when FDI leads to increased economic growth, there is the likelihood that energy consumption is positively affected by an increase in FDI (Omri & Kahouli, 2014).

3.4 Estimation Procedure

The estimation procedure includes a descriptive analysis that shows the characteristics and some preliminary summary statistics of the values of all the variables as employed in the empirical analysis. The statistics include the mean, standard deviation, skewness, and kurtosis. The second procedure is the test of correlation, with the view to detecting potential multicollinearity, especially among the selected explanatory variables. The absence of which enhances the reliability of the inferences, especially for policy decisions.

Furthermore, due to the problem of endogeneity among the selected variables, a simultaneous equation model using the System GMM approach was estimated. By this, we established the economic growth-energy consumption-FDI nexus in SSA. Based on the GMM framework, some diagnostic tests of the model were performed. These include tests of model specification, serial correlation, and model significance. These tests are the Hansen J-test of over-identification restrictions and the AR2 test of serial correlation. The F-test was used to determine the overall model significance.

4. Results and Discussion

4.1 Pre-estimation Results

The result of the summary statistics of the variables over the sampled period is presented in Table 1. All the variables in the series exhibit positive skewness, except the population growth rate which is negatively skewed. This negative skewness implies that the variable has a fatter tail on the left and that its mean is less than the median value. The average economic growth rate in Sub-Saharan Africa within the sampled period is about 4.3 percent while the average growth rate of energy consumption

stood at approximately 2 percent. Average FDI flow into the region has grown by about 1996 per cent. The population of the selected countries has grown by about 2.5 percent, on average, over the period under study with the average inflation standing at 50 percent. We omitted the descriptive statistics of the exchange rate due to differences in currency across the countries. It is only practicable to describe the average exchange rate for each country against the US dollar.

Table 1: Summary statistics

Variables	observation	Mean	std. dev.	skewness	Kurtosis
GDP growth rate	1157	4.283	7.369	7.414	144.086
Energy Consumption	1132	2.192	36.829	9.316	200.354
FDI	1165	1995.948	58737.8	33.830	1150.942
Labour Force	1148	31.619	470.96	16.878	328.827
Population	1169	2.526	0.971	-0.779	6.801
Inflation	1086	50.315	754.002	29.093	905.787
GFCF	1040	10.660	90.672	13.776	248.218
Trade Openness	1159	.710	0.396	1.451	7.247
Financial Development	1106	19.043	22.986	3.559	17.646

Note: std. dev. indicates standard deviation.

The study also examined the correlation coefficients among the selected variables to detect potential multicollinearity problems. However, from the result of the correlation analysis presented in Table 2, there is no presence of multicollinearity as none of the variables exhibited perfect correlation coefficients. The highest correlation coefficient among the series is 0.759 between gross financial development and energy consumption. Since this is within an acceptable range, it is an indication of the absence of a serial correlation problem in the specified model. This is following Kim (2019)'s threshold of possibility of multicollinearity problem when the correlation coefficient exceeds 0.8.

Table 2: Correlation Coefficients

Variables	GDP growth rate	EC	FDI	GFCF	L	POP	TOP	FD	ER	INF
GDP growth rate	1.00									
EC	-0.02	1.00								
FDI	0.09	0.47	1.00							
GFCF	0.05	0.71	0.65	1.00						
L	-0.02	-0.01	0.18	0.01	1.00					
POP	0.15	-0.19	-0.02	-0.04	0.03	1.00				
FD	-0.06	0.76	0.29	0.43	-0.03	-0.45	1.00			
TOP	0.11	-0.11	0.02	-0.12	0.20	-0.19	0.09	1.00		
ER	0.05	-0.11	-0.04	-0.09	0.00	0.11	-0.21	-0.12	1.00	
INF	-0.06	-0.01	-0.02	-0.01	0.00	0.05	-0.03	-0.03	-0.02	1.00

GDP is gross domestic consumption, EC is energy consumption, FDI is foreign direct investment, POP is population. GFCF represent gross fixed capital formation, L represent Labour force, POP represent population, FD represent financial development, TOP represent trade openness, ER represent exchange rate, and INF represent inflation

4.2 Estimation Results

The result of the energy consumption-FDI-economic growth interrelationship is presented in Table 3. Following the specification in equations (5) - (7), the result contains three models (1-3) estimated in a dynamic simultaneous form using the System GMM technique.

For the results of the economic growth model, the coefficient of energy consumption was positive and statistically significant at 1 percent level. This implies that energy consumption is positively related to economic growth in Sub-Saharan Africa. One percent increase in energy consumption is associated with an increase in economic growth in the region by 1.32 percent . The result is an indication that economic growth in the region depends partly on the level of energy consumption. The coefficient of foreign direct investment is positive and statistically significant at 5 percent level, and this means that foreign direct investment greatly determines economic growth. As such, a percentage increase in foreign direct investment inflows to the SSA Sub-region can be attributed to 0.11 percent increase in economic growth. Also, the estimate of gross fixed capital formation was positive and statistically significant at 1 percent level. The implication of this is that capital formation is a significant

determinant of economic growth in Sub-Saharan Africa. One percent increase in capital formation increases economic growth in the region by 1.5 percent .

The result of the energy consumption model showed a positive and significant coefficient of GDP growth rate on energy consumption at 1 per cent level of significance. One percent increase in economic growth brings about a 0.004 percentage increase in energy consumption. Although at a minimal rate, economic growth engendered an increase in energy consumption in Sub-Saharan Africa. The coefficient of foreign direct investment exhibits a negative but insignificant effect on energy consumption. Thus, suggesting that foreign direct investment does not prompt energy consumption in the region. The coefficients of gross fixed capital formation and labour force are positive but while the former was statistically significant at 1 percent level, the latter was significant only at 10 percent level. This means that gross fixed capital formation, which is a measure of public and private net investment, and labour force have positive influence on energy consumption. The implication of this is that increase in the domestic stock of investment will lead to an increase in energy consumption since machineries and tools for productive purposes are also largely energy-dependent. And of course, labour force is also an input in the production process which follows that increase in labour force would mean that there would be an increase in energy consumption. However, the coefficients of both population and financial development are positive but statistically not significant showing that they do not significantly affect energy consumption.

In the result of the FDI model, economic growth does not appear to exert significant influence on foreign direct investment in Sub-Saharan Africa. This is because the coefficient of economic growth was not statistically significant. Also, the coefficient of energy consumption was negative and statistically significant at 5 percent level. This means that energy consumption has a significant negative influence on FDI inflows such that a percentage increase in energy consumption reduces FDI inflows by about 0.1 percent . This result could be explained by low rate of energy consumption in SSA which has been a disincentive to FDI inflows. However, the coefficients of gross fixed capital formation, labour force and trade openness are positive and statistically significant at 1 percent level. A percentage increase in capital formation,

labour force and trade openness increase FDI inflows into the region by 0.6, 0.4 and 1.1 percent respectively. This means that both capital and labour significantly affect FDI flows into Sub-Saharan Africa, while openness of the region to trade with countries in other regions also positively influences FDI inflows. Also, the result showed positive coefficient of exchange rate, indicating that exchange rate depreciation boost FDI inflows into Sub-Saharan Africa, although this effect was not statistically significant. The foregoing indicates that FDI inflow into Sub-Saharan Africa is more positively influenced by capital formation, labour force and trade openness, and negatively influenced by energy consumption which could be the result of low levels of energy consumption in the region. While a positive relationship exists between FDI and economic growth as shown by the coefficients, the relationship was not statistically significant which could be an indication that the level of economic growth in SSA is still inadequate to attract foreign investors into the region.

It can thus be concluded that a bi-directional relationship exists between energy consumption and economic growth. This means that energy consumption is crucial in propelling economic growth, with higher economic growth also an important stimulator of greater energy consumption. The result conforms to the findings of Pao and Tsai (2011), Omri and Kahouli (2014), Lin and Nelson (2018), and Ozturk and Acaravci (2010). Also, there was a one-way positive relationship between FDI and economic growth running from FDI to growth, while the reverse causality from economic growth to FDI was not statistically significant. This result is in agreement with that of Belloumi (2014). Finally, the result showed that no significant relationship exists between energy consumption and FDI in both ways in Sub-Saharan Africa over the period studied. This outcome may arise from the low level of energy-intensive activities, which is reflected in the low level of industrialization in the region. The result is in line with the findings of Fan and Hao (2020) where it was found that FDI does not significantly respond to changes in energy consumption.

Table 3: System GMM Regression results

	Model 1 Economic Growth	Model 2 Energy Consumption	Model 3 FDI
GDP growth rate (-1)	0.117*** (0.0047)	-	-
GDP growth rate	-	0.004*** (0.0000)	0.004 (0.0031)
Energy Consumption	1.319*** (0.0013)	-	-0.103** (0.0399)
FDI	0.111** (0.0465)	-0.000 (0.0001)	-
Labour force	0.123 (0.0618)	0.003* (0.0015)	0.405*** (0.0065)
GFCF	1.543*** (0.0031)	0.021*** (0.0044)	0.608*** (0.0005)
Inflation	-0.003 (0.0024)	-	-
Energy Consumption (-1)	-	0.978*** (0.0005)	-
Population	-	0.000 (0.0004)	-
Financial Development	-	0.000 (0.0006)	-
FDI (-1)	-	-	0.265*** (0.0013)
Trade Openness	-	-	1.123*** (0.0011)
Exchange rate	-	-	0.006 (0.0053)
Constant	-36.826*** (0.0147)	-0.521*** (0.0964)	-5.025*** (0.5829)
Hansen J-test	2.37	5.06	3.33
AR2 test	-0.30	0.73	0.44
F-test	6.86*** (0.0027)	40316.17*** (4.0316)	95.02*** (0.0095)

Note: Standard errors are in parenthesis (), *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Hansen J-test for over identifying restrictions AR2 test: Arellano-Bond's test for 2nd order autocorrelation in first differences F-test for overall significance of the model

The diagnostic tests indicate that the model is well specified, and the moment conditions are met. First, the Hansen J-test of over-identification of restrictions confirms the overall validity of the instruments used. Second, the AR2 test could not reject the null hypothesis of no second-order serial correlation, implying that the differenced error term is first and second-order serially uncorrelated. The F-test confirms the overall significance of the models. Furthermore, in each of the models, the coefficient of the lags of the dependent variables (used as instruments) is less than one and statistically significant, indicating convergence to long-run equilibrium.

5. Conclusion and Policy Recommendations

Different from studies in existing literature, this study investigated the dynamic link among energy consumption, FDI and economic growth in SSA. Most empirical literature considered energy consumption-economic growth, energy consumption-FDI, or economic growth-FDI relationship based on country-specific or cross-country analysis. Where a tripartite relationship among energy consumption-FDI-economic

growth is assessed, analysis is limited to the causal relationship, with little attention to the extent to which impact exists. Departing from the existing literature, we examined the effect as well as the relationship among energy consumption, FDI, and economic growth across forty-two (42) SSA countries where studies of this nature are sparse. Our dataset spans from 1991 to 2018. Also, assessing the dynamic effects through a simultaneous equation model avails the opportunity for correcting the misspecification bias that permeates single equation models when considering the energy consumption-FDI-economic growth relationship.

Key findings that emerged from the study show that energy consumption and economic growth are jointly determined. Hence, the result indicates that a bi-directional relationship exists between energy consumption and economic growth in SSA. In other climes where the level of development is high, the suggestion would have been towards encouraging energy conservation policies. However, this implication may not hold in the SSA, as more energy consumption is required for increased growth and vice versa. This is tenable considering the minimal level at which economic growth drives energy consumption in the region. Thus, policies that could stimulate more economic activities, as well as more energy consumption, are germane in the region. The strategy should be to provide support mechanisms that could boost private sector participation in all economic activities including the energy sector.

Further, there was evidence of a one-way significant relationship running from FDI to economic growth in the SSA region while the reversal of economic growth causing FDI inflows was not significant. This is expected as the policy environment is usually shredded in uncertainty in most countries of the region, which is a disincentive to foreign investors. Hence, governments of those countries should endeavour to ensure a stable macroeconomic environment for attracting significant FDI for more economic growth.

Finally, the result showed that an insignificant relationship exists between energy consumption and FDI in SSA. This could be due to the low level of energy intensity relative to economic activities in the region, thus explaining the fact that low energy consumption could serve as a binding constraint to economic productivity and hence FDI inflow. This is because where economic activities are derived from the

use of energy-induced technologies, manufacturing and industrial activities will be boosted, thus, the foreign direct investment would increase (Tang, 2009). However, energy consumption in SSA is largely driven by the transport sector demand as most productive activities are dominated by the small informal sector. Alas, the size and the nature of operations in those informal sectors are mostly labour-intensive with little or no requirement for energy utilisation.

References

Abbes, S. M., Mostéfa, B., Seghir, G., & Zakarya, G. Y. (2015). Causal interactions between FDI, and economic growth: Evidence from dynamic panel co-integration. *Procedia Economics and Finance*, *23*, 276–290. https://doi.org/10.1016/s2212-5671(15)00541-9

Abdouli, M., & Hammami, S. (2017). Exploring links between FDI inflows, energy consumption, and economic growth: Further evidence from MENA countries. *Journal of Economic Development,* 42 (1), 95-117.

Adeleke, K. M., Olowe, S. O. & Oladipo, F. O. (2014). Impact of foreign direct investment on Nigeria economic growth. *International Journal of Academic Research in Business and Social Sciences*, 4(8), 234-242.

Adom, P. K., Opoku, E. E. O., & Yan, I. K. M. (2019). Energy demand–FDI nexus in Africa: Do FDIs induce dichotomous paths? *Energy Economics*, *81*, 928–941. https://doi.org/10.1016/j.eneco.2019.05.030

Akinlo, A. E. (2004). Foreign direct investment and growth in Nigeria: An empirical investigation. *Journal of Policy Modelling*. 26, 627-639

Akinlo, A. E. (2008). Energy consumption and economic growth: Evidence from 11 Sub-Sahara African countries. *Energy Economics*, 30, 2391-2400

Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte carlo evidence and an application to employment equations. *The Review of Economic Studies*, *58*(2), 277. https://doi.org/10.2307/2297968

Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics*, *68*(1), 29–51. https://doi.org/10.1016/0304-4076(94)01642-D

Armeanu, D., Vintilă, G., Andrei, J. V., Gherghina, S. C., Drăgoi, M. C., & Teodor, C. (2018). Exploring the link between environmental pollution and economic growth in EU-28 countries: Is there an environmental kuznets curve? *PLos ONE, 13*(5), e0195709

Awodumi, O. B., & Adewuyi, A. O. (2020). The role of non-renewable energy consumption in economic growth and carbon emission: Evidence from oil producing economies in Africa. *Energy Strategy Reviews*, *27*, 100434. https://doi.org/10.1016/j.esr.2019.100434

Baum, C. F., Schaffer, M. E., & Stillman, S. (2003). Instrumental variables and GMM: estimation and testing. *The Stata Journal*, *3*(1), 1-31.

Belloumi, M. (2014). The relationship between trade, FDI and economic growth in Tunisia: An application of the autoregressive distributed lag model. *Economic Systems*, *38*(2), 269–287. https://doi.org/10.1016/j.ecosys.2013.09.002

Beyene, S. D., & Kotosz, B. (2020). Testing the environmental kuznets curve hypothesis: an empirical study for East African countries, *International Journal of Environmental Studies*, 77(4), 636-654, DOI: 10.1080/00207233.2019.1695445

Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*, *87*(1), 115–143. https://doi.org/10.1016/S0304-4076(98)00009-8

Cheng, H. (2002). Foreign direct investment and open endogenous economic growth. *Economic. Research Journal*. 10, 71–78.

Doytch, N., & Narayan, S. (2016). Does FDI influence renewable energy consumption? An analysis of sectoral FDI impact on renewable and non-renewable industrial energy consumption. *Energy Economics*, *54*, 291–301. https://doi.org/10.1016/j.eneco.2015.12.010

Esso, J. L. (2010). Threshold cointegration and causality relationship between energy use and growth in seven African countries. *Energy Economics*, *32*(6), 1383-1391.

Fadhil, M. A., & Almsafir, M. K. (2015). The role of FDI inflows in economic growth in Malaysia (Time Series: 1975-2010). *Procedia Economics and Finance*, *23*, 1558–1566. https://doi.org/10.1016/s2212-5671(15)00498-0

Fan, W., & Hao, Y. (2020). An empirical research on the relationship amongst renewable energy consumption, economic growth and foreign direct investment in China. *Renewable Energy*, *146*, 598–609. https://doi.org/10.1016/j.renene.2019.06.170

Hou, Q. (2009). The relationship between energy consumption growths and economic growth in China. *International Journal of economics and finance*, *1*(2), 232–237.

John, E.I. (2016). Effect of foreign direct investment on economic growth in Nigeria. European *Business and Management*, 2, 40-46

Ibrahiem, D. M. (2015). Renewable electricity consumption, foreign direct investment and economic growth in Egypt: An ARDL approach. *Procedia Economics and Finance*, *30*(15), 313–323.
https://doi.org/10.1016/s2212-5671(15)01299-x

Iyke, B. N. (2015). Electricity consumption and economic growth in Nigeria: A revisit of the energy-growth debate. *Energy Economics, 51*, 166-176

Khandker, L.L., Amin, S.B., & Khan, F. (2018), Renewable energy consumption and foreign direct investment: Reports from Bangladesh. *Journal of Accounting, Finance and Economics,* 8(3), 72-87.

Khatun, F. & Ahamad, M. (2015). Foreign direct investment in the energy and power sector in Bangladesh: implications for economic growth. *Renewable and Sustainable Energy Reviews* 52, 1369-1377

Kim, J. H. (2019). Multicollinearity and misleading statistical results. *Korean Journal of Anaesthesiology*, *72*(6), 558-569

Kivyiro, P., & Arminen, H. (2014). Carbon dioxide emissions, energy consumption, economic growth, and foreign direct investment: Causality analysis for Sub-Saharan Africa. *Energy*, *74*(C), 595–606. https://doi.org/10.1016/j.energy.2014.07.025

Kuznet, S. (1955). Economic growth and income inequality. *American Economic Review,* 45(1), 1-28.

Lin, B., & Nelson, B. I. (2018). Causal relationships between energy consumption, foreign direct investment and economic growth for MINT: Evidence from panel dynamic ordinary least square models. *Journal of Cleaner Production*, *197*, 708–720.
https://doi.org/10.1016/j.jclepro.2018.06.152

Mavikela, N., & Khobai, H. (2018). Investigating the link between foreign direct investment, energy consumption and economic growth in Argentina, MPRA paper No. 83960. Available at https: // mpra.ub.uni-muenchen.de/83960/

Menegaki, A. N. (2011). Growth and renewable energy in Europe: A random effect model with evidence for neutrality hypothesis. *Energy Economics*, 33(2), 257–263. doi: 10.1016/j.eneco.2010.10.004.

Muhammad, B., & Khan, S. (2019). Effect of bilateral FDI, energy consumption, CO2 emission and capital on economic growth of Asia countries. *Energy Reports*, *5*, 1305–1315. https://doi.org/10.1016/j.egyr.2019.09.004

Olubusoye, O. E., Salisu, A. A., & Olofin, S. O. (2016). Applied panel data analysis. *A publication of Centre for Econometric and Allied Research (CEAR).*

Omri, A. (2014). An international literature survey on energy-economic growth nexus: Evidence from country-specific studies. *Renewable and Sustainable Energy Reviews*, *38*, 951-959.

Omri, A., & Kahouli, B. (2014). Causal relationships between energy consumption, foreign direct investment and economic growth: Fresh evidence from dynamic simultaneous-equations models. *Energy Policy*, *67*, 913–922. https://doi.org/10.1016/j.enpol.2013.11.067

Omri, A., Nguyen, D. K., & Rault, C. (2014). Causal interactions between CO2 emissions, FDI, and economic growth: Evidence from dynamic simultaneous-equation models. *Economic Modelling*, *42*, 382–389. https://doi.org/10.1016/j.econmod.2014.07.026

Ozturk, I., & Acaravci, A. (2010). CO2 emissions, energy consumption and economic growth in Turkey. *Renewable and Sustainable Energy Reviews*, *14*(9), 3220–3225. https://doi.org/10.1016/j.rser.2010.07.005

Pao, H. T., & Tsai, C. M. (2011). Multivariate granger causality between CO2 emissions, energy consumption, FDI (foreign direct investment) and GDP (gross domestic product): Evidence from a panel of BRIC (Brazil, Russian Federation, India, and China) countries. *Energy*, *36*(1), 685–693. https://doi.org/10.1016/j.energy.2010.09.041

Pham D.L & Ngoc, B.H., & My, D.T. (2018). The relationship between foreign direct investment, electricity consumption and economic growth in Vietnam. *International Journal of Energy Economics and Policy*, 8(3), 267-274.

Pegkas, P. (2015). The impact of FDI on economic growth in Eurozone countries. *Journal of Economic Asymmetries*, *12*(2), 124–132. https://doi.org/10.1016/j.jeca.2015.05.001

Saidi, K., Rahman, M. M., & Amamri, M. (2017). The causal nexus between economic growth and energy consumption: New evidence from global panel of 53 countries. *Sustainable Cities and Society*, *33*, 45–56. https://doi.org/10.1016/j.scs.2017.05.013

Siddique, H. M. A., Ansar, R., Naeem, M. M., & Yaqoob, S. (2017). Impact of FDI on economic growth: evidence from Pakistan. *Bulletin of Business and Economics*, 6(3), 111-116.

Shahbaz, M., & Feridun, M. (2012). Electricity consumption and economic growth empirical evidence from Pakistan. *Quality and Quantity*, *46*(5), 1583–1599. https://doi.org/10.1007/s11135-011-9468-3

Smile, S. (2009). Foreign direct investment and electricity consumption on economic growth: evidence from South Africa. Economia Internazionale / International Economics, Camera di Commercio Industria Artigianato Agricoltura di Genova, 62(2), 175-200.

Solarin, S. A. & Ozturk, I. (2016). The relationship between natural gas consumption and economic growth in OPEC members. *Renewable and Sustainable Energy Reviews*, 58(C), 1348-1356.

Stern, D. I., Burke, P. J. & Bruns, S. B. (2019). The impact of electricity on economic development: A macroeconomic perspective. I*nternational Review of Environmental and Resouce Economics, 12*(1), 85-127.

Straub, S., (2008). Infrastructure and growth in developing countries: recent advances and research challenges. Policy Research Working Paper Series 4460, The World Bank

Tang, C.F., (2009). Electrcity consumption, income foreign direct investment, and population in Malaysia: new evidence from multivariate framework analysis. *Journal of Economic Studies, 36 (4), 371-382*

Tang, C. F., Tan, B. W., & Ozturk, I. (2016). Energy consumption and economic growth in Vietnam. *Renewable and Sustainable Energy Reviews*, *54*, 1506–1514. https://doi.org/10.1016/j.rser.2015.10.083

Tang, C. F., & Tan, B. W. (2014). The linkages among energy consumption, economic growth, relative price, foreign direct investment, and financial development in Malaysia. *Quality and Quantity*, *48*(2), 781–797. https://doi.org/10.1007/s11135-012-9802-4

United Nations (2018). World Urbanization Prospects: The 2018 Revision. Department of Economic and Social Affairs. Population Division, United Nations

Wang, C., & Jiayu, C. (2019). Analyzing on the impact mechanism of foreign direct investment (FDI) to energy consumption. *Energy Procedia*, *159*, 515–520. https://doi.org/10.1016/j.egypro.2018.12.006

Wenfei, H., Guangkuo, G. & Yongchong, W. (2012). The relationship of energy consumption, economic growth and foreign direct investment in Shanghai. *Advances in Applied Economics and Finance, 3*(1), 507-512.

Wooldridge, J. M. (2002). Econometric Analysis of Cross Section and Panel Data. The MIT Press, Cambridge.

Yoo, S. H., & Kim, Y. (2006). Electricity generation and economic growth in Indonesia. *Energy*, *31*(14), 2890-2899.

Zeeshan, M. (2013). Finding the cointegration and causal linkages between electricity production and economic growth in Pakistan. *Economic modelling*, 31, 344-350.

Zeng, S., Liu, Y., Ding, J., & Xu, D. (2020). An empirical analysis of energy consumption, FDI and high quality development based on time series data of Zhejiang province. *International Journal of Environmental Research and Public Health-MDPI*. https://www.mdpi.com pdf

Appendix A: Selected Sub-Saharan African Countries

S/N	Country	S/N	Country	S/N	Country	S/N	Country
1	Angola	13	Cote D'Ivoire	25	Madagascar	37	South Africa
2	Benin	14	Equatorial Guinea	26	Malawi	38	Tanzania
3	Botswana	15	Eritrea	27	Mali	39	Togo
4	Burkina Faso	16	Ethiopia	28	Mauritania	40	Uganda
5	Burundi	17	Gabon	29	Mauritius	41	Zambia
6	Cape Verde	18	Gambia	30	Mozambique	42	Zimbabwe
7	Cameroun	19	Ghana	31	Namibia		
8	Central African Republic	20	Guinea	32	Niger		
9	Chad	21	Guinea Bissau	33	Nigeria		
10	Comoros	22	Kenya	34	Senegal		
11	Congo DR	23	Lesotho	35	Seychelles		
12	Congo Republic	24	Liberia	36	Sierra Leone		