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ELECTRICITY SUPPLY AND STABLE POLITY FOR GREEN GROWTH IN SUB-SAHARAN AFRICA

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ABSTRACT

This paper examines the impact of clean electricity and political stability on green growth in sub-Saharan Africa. The Generalized Method of Moments (GMM) was used as the estimation method and 45 sub-Saharan countries were considered from 2008 to 2017. The interactive result reveals a positive and significant effect of clean electricity on green growth. Political stability also shows a positive and significant impact on green growth. However, the non-interactive result suggests an insignificant effect of clean electricity on green growth. In general, clean electricity has a positive impact on green growth in sub-Saharan Africa. The implication of this for policymakers is that for clean electricity to have the desired impact on green growth, a stable political environment cannot be overemphasized. Moreover, clean electricity development can instantaneously encourage the development of smart cities and job creation in the region.

INTRODUCTION

The global share of clean electricity energy supply has climbed to 28% in the first quarter of 2020 which represent a 2% increase in the same quarter in 2019 (EIA, 2020). Thus, increasing access to cleaner sources of energy is important to unlocking speedy economic and social development in Africa. Clean energy generation can facilitate the development of smart cities, enhance job opportunities, improved education and green growth. On the contrary, the absence of modern energy can constrain socio-economic development (AEO, 2014).

This study is inspired by some reasons: notably, the need to increase access to clean electricity in the region; the abundant potential of clean electricity sources that are yet to be taped; the need to embrace green growth in line with sustainable development goals and the gap in the extant literature of not including stable polity in the nexus between clean electricity and green growth. These motivations of the study are expanded one after the other as follows.

First, more than two-third population (about 620 million people) of the sub-Saharan region live without electricity (AEO, 2014). Although several regions of the world have not achieved the goal of universal electricity access, the gap in achieving this goal for sub-Saharan Africa is wider than all other regions of the world (Trotter et al., 2017). For instance, South Asia which is the next region with the lowest electricity access record has rural electricity access four times more than that of sub-Saharan Africa.

Second, the region is widely endowed with huge potentials of clean electrical energy that include hydropower, solar, wind and geothermal, sufficient enough to meet the need of its growing population. However,

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more than 730 million people in sub-Saharan Africa depend on the inefficient form of energy (AEO, 2014). While some people use generator to generate electricity, others used biomass for cooking and heating. Generators use fossil fuel energy to generate electricity which emissions increase greenhouse gases. Although biomass like fuel-wood and charcoal is cheap in the region (Ajoku, 2012), their use often generates environmental consequences.

Third, to achieve sustainable and green growth, the goal of ensuring affordable and modern energy for the region cannot be overemphasized. Thus, the generation of electricity must come from cleaner sources. Despite that Nigeria and South Africa have accounted for more than 50% of the region's economy, the use of cleaner energy was compromised.

Fourth, several studies including studies in sub-Saharan Africa (Ajoku, 2012, Ozturk and Bilgili, 2015; Maji, 2015; Adewuyi and Awodumi, 2017; Sulaiman et al., 2017; Adu and Denkyirah, 2017) have examined the link between clean energy and green growth. However, these studies did not include a measurement of political stability in their studies, as such, constitute a gap in the literature. Nevertheless, achieving green growth requires a better system of governance and political stability (IEA, 2018). Political instability resulting from unhealthy competition among various political organs or conflict arising from ineffective governance can hinder economic growth. This study used the generalized method of moments to further consider the interaction of clean electricity and political stability variables.

LITERATURE REVIEW

The perception that clean energy can be able to replace the conventional energy sources soon has attracted the attention of energy economists, policymakers, and international energy organization. Recently, there is also a paradigm shift from studies that examine the nexus between conventional energy and economic growth to studies that examine the nexus between clean energy and green growth (Polat, 2018). This is owing to the increasing need to reduce greenhouse gas emissions from the use of conventional energies.

In the literature, four main hypotheses had emphasized on the clean energy - economic growth nexus. These include the conservation hypothesis, growth hypothesis, the feedback hypothesis and the neutral hypothesis (Kocak and Sarkgunesi, 2017; Kahia et al., 2017). The conservation hypothesis remarked that a causal relationship runs from economic growth to clean energy consumption. As such, economic growth drives clean energy development. The conservation hypothesis maintained that a causal link runs from clean energy usage to economic growth. Hence, clean energy use is the driver of economic growth. The feedback effect posits that bidirectional causality exists between economic growth and clean energy use while the neutral hypothesis shows that causality does not run from clean energy to economic growth and from economic growth to clean energy.

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Furthermore, the nexus between clean energy and economic growth has been analyzed using time series data (Ben Jebli and Youssef, 2015; Boontome et al., 2017; Rafindadi and Ozturk, 2017; Mu et al., 2018; Charfeddine et al., 2018). However, there is no consensus in the empirical findings owing to differences in the sets of variables employed, the range of data sets, methods and difference in the country of study. Example, Charfeddine et al. (2018) observed that energy consumption drives economic growth, thus a growth hypothesis exists. Rafindadi and Ozturk (2017) revealed a feedback effect between clean energy and economic growth in Germany while Sinha and Shahbaz (2018) suggest a negative impact of renewable energy on environmental indicator.

Equally, recent literature has used a panel data analysis to investigate similar relationship by including environmental quality and observed conflicting results (Bhattacharya et al., 2017; Kahia et al., 2017; Adu and Denkyirah, 2017; Narayan and Doytch, 2017; Rahman, 2017). The inclusion of environmental quality indicators like carbon emissions is not surprising given the recent concern to increase the share of renewable energy in the total energy mix. For instance, Bhattacharya et al. (2017) indicate that the growth of renewable energy has a positive effect on economic growth and a negative effect on CO_2 emissions. Kahia et al. (2017) empirical result using error correction method reveals the existence of bidirectional causality between renewable energy and non-renewable energy and economic growth. Narayan and Doytch, (2017) reported a neutral effect of clean energy on economic growth while Rahman (2017) hinted that energy consumption adversely affect environmental quality in the long-run but unidirectional causality runs from energy consumption to economic growth in the short-run.

This paper extends clean electricity and related literature of sub-Saharan Africa that examines electricity planning and implementation in sub-Saharan Africa (Totter et al., 2017); Municipal waste for electricity (Amoo and Fagbenle, 2013); renewable readiness in Africa (Mas'ud et al., 2015); determinants of renewable energy in sub-Saharan Africa (Silva et al., 2018); biomass - economic growth - carbon emissions nexus (Ozturk and Bilgili, 2015; Adewuyi and Awodumi, 2017) by including political stability to measure institutional quality and other conditional variables. Institutional quality especially political stability has an important role in the economic growth of sub-Saharan Africa

Methods

Empirical model

This paper rest on the new endogenous growth theory which assumes (i) that energy consumption is endogenous to the growth process of an economy and (ii) current year economic growth is conditional on previous year economic growth. As such, the new growth theory considered the dynamic nature of economic data by including lagged dependent variable. The new growth theory further provides ground for the application of the Generalized Method of Moments (GMM) which is the empirical model of this study.

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To capture the dynamic nature of panel data, Arellano and Bond (1991) have put forward a GMM approach that produces unbiased and consistent estimators. The GMM model includes the lagged dependent variable which helps to address the problem of serial correlation, heteroscedasticity and endogeneity of explanatory variable in a panel data which neither the fixed effects nor the random effects models can address. Additional instruments can be generated from a dynamic panel data when the orthogonality conditions that exist between lagged dependent values and the error terms are utilized (Arellano and Bond, 1991). So that the problem of country and time-specific effects are addressed using the first differencing and instrumental variables.

Recent literature in this area has employed the GMM in a panel investigation (Adewuyi and Awodumi, 2017; Sulaiman et al. 2017; Polat, 2018). Thus, the standard new growth model is specified in equation form as follows.

$$Y_{i,t} = \sigma_o + Y_{i,t-1} + \sum_{m=1}^{n} X_{i,t} + \emptyset_i + \nu_{i,t}$$

(1)

Based on equation (1), the summarized GMM model for the variable of interest is presented in a level form (2) and first difference (3) with the two-way residual component.

$$Y_{i,t} = \varphi_o + \varphi_1 Y_{i,t-1} + \varphi_2 REE_{i,t} + \varphi_3 PLS_{i,t} + \sum_{p=1}^{2} \varphi_4 Z_{i,t-1} + \upsilon_{i,t}$$

(2)

$$Y_{i,t} - Y_{i,t-1} = \varphi_o + \varphi_1 (Y_{i,t-1} - Y_{i,t-2}) + \varphi_2 (REE_{i,t} - REE_{i,t-1}) + \varphi_3 (PLS_{i,t} - PLS_{i,t-1}) + \sum_{p=1}^{2} \varphi_4 (Z_{i,t-1} - Z_{i,t-2}) + (\upsilon_{i,t} - \upsilon_{i,t-1})$$

(3)

$$\upsilon_{i,t} = n_i + \epsilon_t + \varepsilon_{i,t}$$

(4)

$$\upsilon_{i,t} - \upsilon_{i,t-1} = (\epsilon_t - \epsilon_{t-1}) + (\varepsilon_{i,t} - \varepsilon_{i,t})$$

(5)

Where $Y_{i,t}$ is the green growth indicator of country i at period t; φ_o is the intercept, REE represent clean electricity energy, PLS represent political stability, Z is the vector of control variables (job creation and urbanization); $\upsilon_{i,t}$ is the two-way residual, n_i is the country-specific effect, ϵ_t is the time-specific effect while $\varepsilon_{i,t}$ is the residual term. We anticipate a positive relationship between the two hypothesized variables (clean electricity and political stability) and the two control variables (job creation and urbanization) with green growth.

Data

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The data for this study was collected from African Development Indicators (ADI), World Governance Indicators (WGI) and World Development Indicators (WDI). It includes a sample of 45 sub-Saharan African countries for the period of 2008-2016. Green growth is measured by Gross Domestic Product (GDP) per capita, clean electricity is measured by renewable electricity output (% of total electricity output): it is the share of electricity generated by renewable power plants out of total electricity generated by all types of plants (WDI, 2017); political stability is measured by political stability and absence of violence/terrorism (estimate); job creation variable is proxy by Employment to population ratio, 15+(% of total) while urbanization is measured by Urban population (% of total).

The list of the sub-Saharan African countries included in the study as presented in Appendix 1. The descriptive statistics of the data and the correlation matrix are presented in Table 1 and 2. The descriptive statistics which include the mean, standard deviation, minimum and maximum show that the observation is normally described around the mean. The correlation matrix, on the other hand, indicates that the correlation coefficient of variables is less than 0.80, the rule of thumb for coefficient persistence, as such, the variables do not suffer from multicollinearity problem.

Table 1. Summary statistics

Variables	Mean	Std. Deviation	Minimum	Maximum	Observation
Economic growth	7.058	1.088	5.386	9.920	405
Clean electricity	3.379	1.575	-3.390	4.605	405
Political stability	-1.292	1.216	-4.850	0.183	405
Job creation	4.122	0.203	3.667	4.475	405
Urbanization	3.645	0.462	2.314	4.484	405

Table 2. Correlation matrix

Variables	Economic growth	Renewable energy	Political stability	Job creation	Urbanization
Economic growth	1.000				
Clean electricity	-0.203	1.000			
Political stability	0.420	-0.158	1.000		

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Job creation	-0.418	0.343	-0.293	1.000	
Urbanization	0.575	-0.316	0.383	-0.540	1.000

Empirical results

Four main criteria are used to evaluate the validity of the GGM model. First, the null hypothesis for second-order (AR2) Arellano and Bond (1991) for the absence of autocorrelation in the error term is not rejected. Second, the null hypothesis of the Hansen test for over-identification restriction that instruments are not correlated with the error term was accepted. Third, the coefficients of the lagged dependent variable of green growth are significant and persistent for all the models. Fourth, the use of GMM was further informed with the nature of the data which has a large cross-section and a small-time period.

The results of the impact of clean electricity and political stability on green growth were estimated and presented in Table 3 in two categories. Model 1 without interactive term and models (2-4) with the interaction of clean electricity and political stability. The non-interactive result reveals that clean electricity does not have an impact on green growth but political stability has a positive and significant impact on green growth. However, the interactive result of clean electricity and political stability shows that renewable electricity has a positive and significant impact on economic growth. On the overall, clean electricity has a positive impact on green growth in sub-Saharan Africa. This suggests that renewable electricity development in the presence of sound political stability enhances sustainable economic growth and development. The policy implication of this is that for clean electricity to have a meaningful effect on green growth in the region, a stable political environment needs to be in place. Furthermore, the conditional variable (job creation and urbanization) have both revealed a positive and significant impact on green growth. The implication of this is two-fold: first, clean electricity development can create clean jobs that impact positively on growth. Second, the development of new urban areas that has the facilities to use clean energy will further impact positively on green growth. The null hypothesis of the post-estimation test for second-order autocorrelation (AR2) and Hansen test of over-identification of an instrument are also presented in the lower part of Table 3.

Table 3. Impact of clean electricity and political stability on green growth

Variables	Dependent variable = Green growth			
	1	2	3	4
Economic Gr	0.729***	0.738***	0.699***	0.738***
	(0.074)	(0.071)	(0.092)	(0.066)

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Clean electricity	0.008 (0.012)	0.009 (0.013)	-	-
Political stability	0.001 * (0.005)	-	-0.062 (0.039)	-
Job creation	0.233** (0.105)	0.226** (0.097)	-0.310 (1.109)	0.231** (0.096)
Urbanization	0.348*** (0.137)	0.334*** (0.117)	0.504* (0.289)	0.325*** (011 1)
Clean electricity* Political stability	-	0.223** (0.001)	0.021* (0.011)	0.003** (0.001)
AR(2) tests p-value	0.226	0.234	0.152	0.235
Hansen test p-value	0.911	0.595	0.469	0.421
Number of instruments	21	19	11	16
Number of groups	45	45	45	45

Note: ***, ** and * indicate significance at 1%, 5% and 10% respectively. Values in parenthesis are standard errors. Clean electricity*Political stability is the interaction terms of the variables.

CONCLUSION AND POLICY IMPLICATIONS

The paper examines the impact of clean electricity in the presence of a stable political environment on green growth in sub-Saharan Africa using the new endogenous growth theory as the theoretical background. The Generalized Method of Moments (GMM) was used to estimate data for a sample of 45 sub-Saharan countries from 2008 to 2016. Four models were used to estimate the impact of clean electricity and political stability on green growth.

The non-interactive result reveals an insignificant effect of clean electricity on green growth, however, the interactive result posits that clean electricity has a positive and significant effect on green growth. We conclude that clean electricity has a positive effect on green growth in sub-Saharan Africa. The implication of this for policymakers is that to achieve sustainable economic growth and development in the region, a stable political environment should not be compromised. Moreover, the result suggests that job creation and opening of new cities enhance green growth in the region. The policy implication is that clean electricity development can instantaneously encourage the development of smart cities and job creation in the region.

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Appendix

Appendix A1. List of countries in the panel

Angola	Eritrea	Mozambique
Benin	Ethiopia	Namibia