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ELECTRICITY CONSUMPTION, GOVERNMENT SPENDING AND ECONOMIC GROWTH IN SUB-SAHARAN AFRICA

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ABSTRACT
Using panel data from 12 countries from 2000 to 2023, the study looks at how government spending and energy usage affect economic development in sub-Saharan Africa. In sub-Saharan Africa, millions of people lack access to a reliable electrical supply, according to the World Bank. The productivity of craftsmen and other micro, small, and medium-sized businesses, the yields and storage capacity of farmers and producers, which lead to economic growth, and the general well-being of the populace all depend on stable energy. To prevent erroneous findings, a panel unit roots test was performed as a first check to verify the series' stability. Panel co-integration tests indicate the presence of long-term correlations among the variables, whereas the findings reveal that all variables except electricity consumption are stationary at order I(0). The Autoregressive Distributed Lag (ARDL) approach is used in this work. The study's main conclusions are that government spending has a positive but negligible effect on economic growth over the long term, while electricity consumption has a negative effect. Gross fixed capital formation, on the other hand, has a significant effect on economic growth over the long term. Since most economic production activities rely on electricity, it is advised that governments in sub-Saharan African nations enhance their electricity supply. Increasing the amount of electricity produced will contribute to job creation and increase aggregate output, both of which will spur economic growth. If more public funds are released for development by combating corruption in the nation, government expenditure will have a greater influence on economic performance. Therefore, the nation should take a direct approach to combating corruption. It should go beyond government employees and political office holders who preach that corruption is not tolerated or that certain corruption-related situations are given preferential attention.

Keywords: Electricity Consumption, Innovation, Economic growth, Government expenditure

INTRODUCTION
Because of the region's developmental stage, the government of Sub-Saharan Africa has retained a key position in stabilizing the stakes that ensure economic progress. The majority of people in Sub-Saharan Africa, a predominantly developing region, rely heavily on the government to deliver public goods including roads, healthcare, education, and security, with a greater focus on defense, health, and education (Darkoh, 2014). Additionally, the area has been viewed as a growth

opportunity due to the influx of foreign direct investment (FDI) and the number of expatriates moving there.

The energy sector's supply and demand have continued to be worldwide concerns, especially in light of the low level of infrastructure development and the growing trends in population growth and technological advancements. Concerns about energy provide serious problems for governments' growth and development plans and create societal problems for human civilizations (Chen, Wu, Xu, Song & Liu 2019). The achievement of better living circumstances depends on a clean and dependable energy supply, which is also frequently seen as a key factor in steady economic growth and development. Almost no economic sector can operate efficiently without a steady and sufficient supply of energy, especially electricity. For example, the transportation, agricultural, and water resources sectors, as well as the preservation of economic stability, depend heavily on electric energy. Oil is essential for modern economies to survive as they strive for fast industrialization and as a key source of electric power (Basher and Sadorsky, 2006). The price of oil and the availability of electricity, which are proxies for energy consumption, are important inputs in the production process that can affect the competitiveness of the real sector and, therefore, the performance of the economy as a whole.

Due in part to a lack of capacity to satisfy consumer demand, the supply and price of power have remained controversial among the many energy sector stakeholders. The operational effectiveness of power producing systems is severely hampered by the inability to balance the supply and demand for energy in relation to population increase. These systems are frequently overloaded, resulting in frequent forced outage events. Electricity distribution firms' attempts to alleviate the situation through load shedding or power restriction have not proven to be very successful. The disparity in energy distribution between impoverished rural communities and industrialized commercial metropolitan areas also results from the supply gap. Rural regions turn to antiquated practices that have a negative impact on the economic and social lives of the populace, while metropolitan areas enjoy a more consistent supply of energy to power commercial and industrial operations and improve living circumstances.

In general, energy can come from both non-renewable and renewable sources. Despite their high carbon content, high maintenance costs, high capital intensity, high rate of depletion, inadequacy, and inconsistent supply, non-renewable energy sources like fossil fuels are frequently the more exploited option (Ajayi and Ajanaku, 2009). Renewable energy sources, including solar, wind, geothermal, hydropower, and biomass, provide clean, environmentally sustainable, cost-effective, and renewable energy alternatives. Inadequate non-fossil energy supply is the reason for the world's population's excessive reliance on alternative (non-renewable) energy sources (Egbichi, Abuh, Okafor, Godwin & Adedoyin 2018). Because of this approach, the ecosystem is more susceptible to serious environmental problems such pollution, ozone layer depletion, and deforestation. According to Alege, Oluwasogo, and Ogundipe (2016), non-fossil fuels lower the atmospheric concentration of carbon dioxide (CO2), whereas fossil fuels greatly increase carbon emissions.

In sub-Saharan Africa, 600 million people (70 percent of the population) lack access to a reliable electrical supply, according to the World Bank (World Bank, 2018). One of the main obstacles to economic growth and development in Africa and the developing world at large is inadequate access to contemporary energy services (Ude, 2020). The productivity of artisans and other

micro, small, and medium-sized businesses, the yields and storage capacities of farmers and producers, which lead to economic growth, and the general comfort and well-being of the populace all depend on stable electricity (Iyke, 2015).

Carpenters, hairdressers, electricians, shoemakers, restaurants, accountants, photographers, typing and photocopying centers, and other service or retail businesses are examples of small businesses in Nigeria and indeed sub-Saharan Africa (Ejimonye and Nwosu, 2018). To do their regular tasks, they frequently need access to power. Therefore, it is clear that the expansion of vital infrastructures like electricity has to receive fresh attention in order to enhance the economic fortunes of sub-Saharan African nations (Sankaran, Kumar, Arjun, and Das, 2019). With the added advantage of lowering carbon emissions, the development of more renewable energy sources can help close the electrical supply gap (Asogwa, Ugwuanyi, and Anumudu, 2018).

Additionally, the emergence of renewable energy sources like wind and solar might promote sustainable economic growth in addition to expanding access to electricity. Investing in renewable energy may lessen dependency on costly and ecologically harmful fossil fuels, attract investment in clean energy technology, and open up new job possibilities. But it's also critical to recognize that there are issues with the connection between sub-Saharan Africa's economic growth, government expenditure, and energy consumption. These include problems like the need for better energy infrastructure, the availability of inexpensive and dependable electricity, and the significance of encouraging ecologically friendly and sustainable energy sources (Africa Development Bank Group 2022).

Notwithstanding these encouraging advancements, the sub-Saharan African financial system still faces obstacles that must be overcome. The requirement for better governance and regulatory frameworks to guarantee the stability and integrity of the financial sector is one of the primary obstacles. In order to guarantee that individuals have the information and abilities needed to make wise financial decisions, there is also a need for ongoing investment in financial literacy and education. The present state of financial development in sub-Saharan Africa is one of growth and progress, with increasing foreign investment, capital market expansion, and better access to financial services all advancing the region's economy. To guarantee equitable and sustainable financial growth in the area, several issues must yet be resolved.

Theoretically, sub-Saharan Africa's economic development, government expenditure, and power usage are all closely related. Economic growth is meaningfully influenced by electricity consumption, and government expenditure is crucial for attracting the capital required to fulfill the rising demand for energy. ‘However, the region's long-term economic growth and development will depend on resolving the issues related to energy use and guaranteeing sustainable energy development. Considering that sub-Saharan Africa lags behind other parts of the globe (globe Bank, 2019) and the necessity of making significant upgrades to infrastructure, including power, to ensure long-term economic growth. The objective of this study is to examine the relationship between sub-regional economic development, government expenditure, and access to electricity. This investigation is contextualized within the framework of the existing literature that explores the causal links between economic growth and electricity provision, which is characterized by four distinct strands.

The primary aim of this research is to analyze the relationship between electricity consumption, government expenditure, and economic growth within the context of Sub-Saharan Africa. The specific objectives of the study include:

i. determine the impact of electricity consumption on economic growth in Sub-Saharan Africa.
ii. examine the impact of government spending on economic growth in Sub-Saharan Africa.

Conceptual Issues

Public authorities at the federal, state, and municipal levels are responsible for the allocation and expenditure of financial resources. In many countries, including Nigeria, government expenditures are categorized into economic and functional (sectoral) components. The economic component of government spending is further divided into two categories: capital expenditures and recurrent expenditures. Recurrent expenditures are payments for transactions that take place within a year, whereas capital expenditures are payments for non-financial assets utilized in the production process for more than a year (CBN, 2019). The phrase "capital expenditures" denotes the financial outlays related to the development of durable assets, including but not limited to facilities, airports, seaports, drainage systems, roadways, machinery, and equipment. In contrast, recurring expenses, often termed consumption expenditures, encompass transfers, interest payments on loans, salaries, and the acquisition of goods and services.

One of the most effective fiscal policy tools a government can use to control the amount of economic activity in the nation is government expenditure. When a nation's economic activity is low, which is typically reflected in a high unemployment rate, the government may boost it by increasing expenditure, which will increase output, aggregate demand, and job creation. On the other hand, the government may control economic activity by cutting back on spending when it is overstimulated, which is typically signaled by a high inflation rate. Therefore, expenditure by the government may be utilized to affect employment, national output, overall pricing levels, and income redistribution to the poor. It is crucial for promoting economic growth, stability, and the fight against poverty. (Udo, Inibeghe, & Ekere, 2022).

Electricity consumption is the quantity of electricity produced and utilized by people, companies, and society for a variety of uses, including industry, transportation, heating, and cooling. It is an essential component of contemporary living and has a big impact on a country's overall sustainability in terms of both the economy and the environment (Dash, 2013). It is crucial to use power efficiently for both financial and ecological reasons. Economically speaking, the cost of production for households and enterprises is largely determined by the amount of power used. Therefore, companies and people may save money by lowering power use through government involvement and policies.

Addressing the issues of power consumption requires policies and programs that support energy efficiency, renewable energy, and sustainable energy usage. This includes public awareness efforts to encourage energy saving, incentives for the development of renewable energy, and energy efficiency regulations for automobiles and appliances. In general, developing a sustainable power system that promotes economic expansion while reducing the environmental effect of energy production and consumption requires an awareness of and ability to manage electricity usage (International Energy Agency, 2020).

The term "economic growth" defines the rise in an economy's output and consumption of products and services. Usually, the growth in a nation's gross domestic product (GDP) over time is used to gauge it. According to Okunlola, Masade, Lukman, and Abiodun (2020), economic growth is a primary objective of the majority of governments and is regarded as a crucial sign of a country's general economic well-being. When a nation's workforce becomes more productive—either via improved infrastructure, education and skill levels, or technology advancements—economic development frequently follows. GDP and output rise in tandem with higher productivity. Both investments in human capital, such as education and training, and investments in physical capital, such as infrastructure, machinery, and equipment, can promote economic growth. Economic growth is fueled by these investments' greater efficiency and inventiveness.

Innovation and technological advancements may result in new businesses and products, reduced prices, and improved production efficiency—all of which can spur economic growth. Economic growth may also be facilitated by having access to resources including labor, capital, and natural resources (Pata & Terzi, 2017). Economic growth and higher productivity can result from the effective use of these resources. A favorable environment for economic growth can be produced by sound economic policies, including trade policies, regulatory frameworks, and fiscal and monetary policies. A society can benefit from economic expansion in a number of significant ways. A higher quality of living results from rising salaries and more money available for people to spend on products and services as an economy expands.

As businesses develop and the need for workers increases, economic expansion frequently results in more job possibilities. Poverty reduction: By increasing job and income-generating possibilities, economic growth may support in bringing people out of poverty. Governments have more money to spend on public services like healthcare, education, and infrastructure as the economy expands. However, there are disadvantages to economic growth as well, including a greater control on the environment, income disparity, and the strain on natural resources. Long-term prosperity thus depends on inclusive, sustainable economic growth that considers these externalities. All things considered, economic growth is a key force behind societal advancement and development, and governments, corporations, and people looking to advance prosperity and well-being must comprehend the elements that influence it (Pata and Terzi, 2017).

Theoretical Literature

The Harrod–Domar model is an economic growth model, which stresses that economic growth is achieved or depends on the level of savings and capital output ratio within the economy (Cypher & Dietz, 2008). Harrod–Domar model is given by $\Delta Y = \frac{S}{I - \delta K}$. Where S is savings I is investment δ is depreciation K is capital and ΔY denotes the change in economic growth or income. The Solow growth model provides the dynamic view of how savings, investment and population affect economic growth reflected by $Y_t = F(K_t; L_t * E) = A(K_t)^{\alpha} (L_t)^{1-\alpha}$ where Y economic growth L is labor K denotes capital, A indicates technological progress and E stands for efficiency of labour which indicates public knowledge about production methods; which is driven by the improvement in technology denoted by A. The subscript t in each of the model's variables indicates that the Solow growth model is dynamic. The proportion of production paid to labor and capital are represented by the exponential subscripts 1-α and α, respectively (N. G. Mankiw, 2014, 2019). The Solow

growth model, which postulates that technology is external in explaining economic progress, is filled in by the endogenous growth theory (Rajiv R. Thakur, 2010). Y = AK is the formula for the endogenous growth model, where A is a positive constant that represents the degree of technology. Additionally, it shows a consistent indicator of the amount of production generated for every unit of capital. In contrast to the Solow model, where capital K exclusively denoted equipment and fixed or physical capital, the subscript K stands for capital stock (Mankiw, 2019).

Empirical Review

Egbuwalo and Abere (2019) reviewed earlier empirical data and investigated the connection between government spending and economic development in Nigeria from 1970 to 2016. The study used the Error Correction Mechanism and found that, in contrast to recurring expenditures, which had a positive impact on economic growth, capital expenditures have a negative effect. Gumus and Mammadov (2019) looked studied the connection between government spending and economic development for three nations—Azerbaijan, Armenia, and Georgia—between 1990 and 2016. There is a bi-directional causal relationship between spending and growth, according to the study's analysis, which included pooled Ordinary Least Square, ECM, and causality approaches.

Using the MSDR method, Dinh Thanh and Canh (2019) examined the relationship between government spending and economic growth. It was discovered that the odds of remaining in state 1 are 87%, while the odds of remaining in state 2 are 85%. State 1 had a 0.303% change in government expenditure, whereas State 2 saw a 0.18% gain in economic growth. L (2020) discovered that government expenditure and production growth had an inverted U-shaped connection. According to the MSDR model, there is a 58% likelihood of leaving state 1 and going back to it. The likelihood of leaving state 2 and going back to state 2 is 32%. States 1 and 2 were scheduled to last 12 and 16 years, respectively.

Using the logistic smooth transition regression (LSTR) model, Phiri (2019) discovered an inverse U-shaped correlation between economic growth and military spending. The results of this study suggest that government investment in the military initially contributes to economic growth. However, over time, such expenditures may hinder further economic development. According to study by Nyasha and Odhiambo (2019), there are ambiguities in the connection between economic development and government spending. It may be beneficial or detrimental; some research has even been ambiguous and shown no impact.

Using the EVC model, Moses (2020) discovered that regional growth was negatively impacted by a 1% increase in government spending by 0.02%. It was discovered that there existed short-term, unidirectional causation between growth, capital, and recurring costs. The absence of a sustained causal relationship between economic growth and the components of expenditure suggests that macroeconomic policies aimed at fostering economic expansion can be pursued without adversely affecting government spending levels. Yang (2020) looked into how government spending on health affected economic growth in 21 emerging nations. It was shown that in emerging nations, health spending hinders economic development by 0.07%. Nonetheless, expenditures on health positively influence economic growth in contexts where human capital is elevated.

According to research by Anisaurrohmah, Rizali, and Rahmini (2020), the government spending variable has a negligible impact on economic growth. Nonetheless, it was pointed out that rising labor experience and investment will have an impact on rising economic growth. Anwar, Ahuja, and Pandit (2020) used panel data from 33 provinces and found that for every 1% rise in government spending, economic growth rises by 0.15%. Furthermore, the spatial Durbin model (SDM) shows that education and investment positively affect the economic growth of neighboring areas.

To ascertain the distribution of government spending on economic growth, Nartea and Hernandez (2020) examine a panel of data from 12 provinces. It was shown that there is a positive correlation concerning economic expansion and government spending. Chu, Hölscher, and McCarthy (2020) used the Generalized Methods of Moments (GMM) system method and OLS fixed effects to examine the impacts of both productive and nonproductive government spending on economic growth. It was clear that a 1% rise in both productivity and nonproductivity spending led to a 0.05% rise in economic growth and a 0.06% drop in it. Government spending in emerging economies has been shown to be moving away from ineffective spending and toward productive spending, which is linked to faster rates of growth.

According to Ahuja and Pandit (2020), there is a one-way causal relationship between public expenditure and GDP growth, and economic growth and public spending are causally related. Furthermore, economic growth is increased by 0.002% for every 1% rise in government spending.

Hlongwane et al. (2021) looked at how government spending affected South Africa's economic expansion. The Autoregressive Distributed Lag (ARDL) model indicates that a 1% increase in government expenditure in the short term is associated with a significant enhancement of 0.15% in South Africa's economic growth. Conversely, the long-term analysis reveals that, all else being equal, a 1% rise in government spending is correlated with a 0.117% decline in economic growth.

Government spending has a positive and statistically significant impact on economic growth, according to Mishra and Mohanty (2021). Government expenditure and economic growth are causally connected in both directions, as shown by the Dumitrescu-Hurlin paired causality test. It was underlined that lower interest rates and an expansionary fiscal policy—which includes building infrastructure and investing in the productive sector—will help the nation achieve quicker economic development.

Like Gurdal, Aydin and Inal (2021) used time series data from 1980 to 2016 to find long-run bidirectional causation between government spending and economic development in the G7 countries. To sustain its positive influence on the growth of these economies, it has been recommended that public expenditure be encouraged within the G7 nations.

Sankaran, Kumar, Arjun, and Das (2019) used import and export, real exchange rates, and per capita income as control variables to investigate how power usage affected industrial output. To determine the causality between the series, they used the Toda-Yamamoto test and the ARDL limits testing approach. To determine the short-term associations, they also used the error correction technique (ECM). The study discovered favorable correlations between economic growth and power usage as well as long-term associations between the variables.

Abokyi, Appiah-Konadu, Sikayena, and Oteng-Abayie (2018) looked at the connection between Ghana's industrial growth and energy usage. The study used the ARDL bounds econometric

testing approach and covered the years 1971–2014. One of the study's main conclusions was that, in contrast to the general belief that electricity use boosts productivity, there was a negative correlation between Ghana's industrial sector's production and power usage.

Using panel data analysis, Esen and Bayrak (2017) investigated how energy use affected the economic development of 75 energy-importing nations between 1990 and 2012. Depending on the extent of reliance on imported energy, they divided the nations into groups and subgroups. According to their findings, energy consumption and both national and collective economic growth are positively and significantly correlated. They also discovered that when the degree of reliance on imported energy declines, energy consumption increases economic growth.

Iyke (2015) used a trivariate vector error correction model (VECM) to analyze the association between Nigeria's economic development and power usage between 1971 and 2011. According to the study's findings, there is a correlation concerning Nigeria's economic growth and power usage, both in the short and long term. In order to stimulate economic growth, the report suggested that more power be generated and used nationwide.

Kasperowicz (2014) examined the connection between Poland's economic expansion and power usage during a twelve-year span, from 2000 to 2012. Using the ordinary least squares (OLS) regression approach and the Granger Causality test, the study discovered a two-way causal link between Poland's economic development and electricity consumption.

Balsalobre-Lorente, Bekun, Etokakpan, and Driha (2019) used quarterly data from 1990 (Q1) to 2017 (Q4) to investigate the relationship between Iran's natural gas consumption and economic development. To make the model more robust, gross fixed capital creation and oil revenue were added. then estimated the transmission of causality between the variables using Toda and Yamamoto's (1995) Modified Wald test, and then estimated the long-term impact of the explanatory factors on GDP using Fully Modified OLS (FMOLS), Dynamic OLS (DOLS), and Canonical Co-integration Regression (CCR). The findings indicate that the utilization of natural gas exerts a substantial positive influence on output growth. Furthermore, the results reveal a unidirectional causal relationship between gas consumption and production growth, thereby reinforcing the notion that energy consumption serves as a catalyst for economic development.

Esen and Bayrak (2017) investigated the relationship between economic development and energy consumption using panel data collected from 75 net energy importing nations between 1990 and 2012. First, the nations were divided into two categories based on whether they were more or less dependent on imports ($>$ or $<$50%). The classification of economies into low income, lower middle income, upper middle income, and high income categories provides a framework for understanding their respective income levels. Furthermore, energy consumption plays a significant and positive role in fostering economic growth, according to panel and country-level assessments, with the effect being greater in nations that rely less on imports. The study also demonstrates that income level has a negative impact on growth caused by energy consumption, suggesting that the energy-led growth theory is more resilient as income levels decline.

The relationship between energy consumption and economic growth in Pakistan, Bangladesh, India, and Sri Lanka between 1981 and 2015 was examined by Tariq, Sun, Haris, Javaid, and Kong (2018). The instrumental variable regression approach served as the foundation for the data analysis. The outcome shows that economic expansion has a strong beneficial impact on energy usage. It also demonstrates how heavily dependent the examined nations are on energy and how

vulnerable they are to disruptions in its supply. Lastly, the analysis shows that commerce has a negative impact on energy use by bringing in energy-saving technologies.

Gozgor, Lau, and Lu (2018) used a modified growth model that takes economic complexity (a stand-in for productivity and economic structure) into account to investigate the relationship between energy consumption and economic growth in a panel of 29 OECD nations. Data for 1990–2013 were analyzed using panel quantile regression (PQR) and ARDL techniques. According to the study, economic complexity and energy, both renewable and non-renewable, have a significant beneficial impact on economic growth.

Ezebunwa, Araniyar, and Kpagih (2021) employed a Vector Error Correction methodology to examine the interrelationship among energy consumption, financial development, and economic growth in Nigeria from 1980 to 2019. Their empirical findings indicate that, contrary to the negative significant effects observed for economic growth (GDP) and trade openness (OPENNESS) on energy consumption, there exists a substantial long-term positive correlation between Energy Use (ENEG), Financial Development (FD)—measured as domestic credit to the private sector by banks as a percentage of GDP—and Natural Resources (NATR).

Using the autoregressive distributed lag model (ARDL) technique, Adegoriola and Agbanuji (2020) investigated the relationship between economic development and power consumption in Nigeria between 1986 and 2018. According to the papers, there is a short-term, positive, and substantial correlation between power consumption and economic growth, but over the long run, electricity use has a negligible, negative impact on Nigeria's economic growth. Additionally, the findings indicate that during the research period, the price of gas and gasoline had a slight but favorable impact on Nigeria's economic development.

From 1985 to 2017, Fatima and Abdurrahman (2020) used an OLS and Granger causality investigation approach to investigate the relationship between Nigeria's economic development and power usage. The study finds a negligible and unfavorable correlation between industrial expansion and power usage. Furthermore, the outcome suggests that the presence of enduring relationships between the factors is essential to their lives.

While most research show positive causal links between government expenditure, economic growth, and energy consumption, other studies imply the opposite, according to the empirical literature review summary. This essay will try to provide further insight on the variables' relationships, particularly as they pertain to sub-Saharan Africa.

METHODOLOGY

Theoretical framework

The Solow growth model was first introduced in 1956 and provides a dynamic view of how savings, investment and population affect economic growth (N. Mankiw, 2010; 2012). The Solow growth model is specified in Equation (1).

$$Yt = F(K_t, L_t*E) = A(K_t)^{\alpha}(L_t)^{1-\alpha} \quad (1)$$

Where Y¼GDPP economic growth L=AOLR is labor K=AOKR denotes capital A indicates technological progress and E stands for efficiency of labour which indicates public knowledge about production methods, which is triggered by the improvement in technology denoted by A. The subscript t in each of the model's variables indicates that the Solow growth model is dynamic. In Equation (1), the exponential subscripts 1-α represent the proportion of production paid to

labor, whereas α represents the proportion of output paid to capital.' The Solow growth model's presumptions. In the Solow growth model, it is rationalised that the economy will reach the steady state, which is a value of per capital-capital k* such that, if the economy has $k_0=k^*$ then $k_t=k^*\vartheta t>1$ (Kung & Schmid, 2015). According to the Solow model, savings at steady state should equal the amount required to supply the equipment (investment) required for any more workers n and to offset the depreciation of equipment d, as determined by $sf(k) = (n+d)k$. As f(k) meets the Inada condition and n and d are constant, the consumption is proportional to the output, $c=(1-s)\ f(k)$. The golden rule savings rate is the maximum steady state value for c that can be obtained from the different options for s one (N. Mankiw, 2010, 2012).

Model Specifications

In this paper, the model utilized is derived from the foundational principles of the Cobb-Douglas method, specifically adapted from the research conducted by Matthew, Miebaka-Ogan, Popoola, Olawande, Osabohien, Urhie, Adediran, and Ogunbiyi (2019). The model is specified as:

GDPR = f (GEXP, ELECT, GFCF, INF)

The model can be express econometrically as:

$GDPR = \alpha_0 + \alpha_1 GEXP + \alpha_2 ELECT + \alpha_3 GFCF + \alpha_4 INF + \varepsilon$

Where: GDPR is Gross Domestic Product Rate

GEXP is Government capital expenditure,

ELECT is Electricity Consumption

GFCF is Gross fixed capital formation,

INF is Inflation.

ε is error term

$\alpha_1 - \alpha_4$ is the parameters to be estimated

Estimation Techniques

Auto-Regressive Distributed Lag (ARDL) technique bounds testing approach to cointegration was developed by Pesaran and Shin (1999) to be preferred to the Johansen and Juselius (1990) approach to cointegration because it can handle low power problems related with cointegration analysis. Moreover, the Autoregressive Distributed Lag (ARDL) methodology is favored for long-term analysis, particularly in scenarios where there exists a mixed order of integration at both the level and first difference. The ARDL analysis is supplemented by a range of diagnostic and post-estimation tests, including assessments for serial correlation and heteroskedasticity, among others.

Sources and Data Collection

Reputable global organizations that offer thorough and trustworthy economic statistics are the source of the data used in this research. The World Bank provided the data for this investigation. These organizations frequently release reports and data that are extensively utilized in policy analysis and economic study. This study uses data from 2000 to 2023 and focused on the following Sub-Saharan Africa Countries; Angola, Cameron, Cote d'Ivoire, Ethiopia, Gabon, Ghana, Kenya, Libya, Morocco, Nigeria, Senegal and South Africa.

DATA ANALYSIS AND DISCUSSION OF RESULTS

Descriptive statistics

Table 1: Descriptive Statistics Results

	GDPR	ELECT	GEXP	GFCF	INF
Mean	4.220280	58.19028	11.61508	4.684169	9.891237
Median	4.209758	58.50000	13.59765	2.666379	5.270234
Maximum	86.82675	100.0000	30.63431	81.65164	324.9969
Minimum	-50.33852	0.000000	0.000000	-49.01197	-9.797647
Std. Dev.	7.876613	25.03776	9.500567	12.54776	23.60794
Skewness	2.610778	-0.427266	-0.055180	1.235437	9.555789
Kurtosis	53.38464	2.571224	1.472095	12.78196	117.4986
Jarque-Bera	30790.52	10.96888	28.16007	1221.504	161702.2
Probability	0.000000	0.004151	0.000001	0.000000	0.000000
Sum	1215.441	16758.80	3345.144	1349.041	2848.676
Sum Sq. Dev.	17805.78	179917.3	25904.84	45187.10	159955.1
Observations	288	288	288	288	288

Source; Author's Compilation

Giving the descriptive of the variables studied, the number of observation is 288, which is from twelve (12) sub-Saharan African nations. Table 1 present the descriptive statistics of research variables (Gross Domestic Product rate, electricity consumption, government capital expenditure, gross fixed capital formation, and inflation). According to the result, Gross Domestic Product rate (GDPR) recorded over the period a mean value of 4.22 with a maximum of 86.82 and minimum of -50.33. The standard deviation of is 7.87 and this indicates that GDPR has low deviation or dispersion from the mean over the study period.

Electricity consumption (ELECT) recorded over the period a mean value of 58.19 with a maximum of 100 and minimum of 0.00. The standard deviation of electricity consumption is 25.03 and this indicates that it has her deviation or dispersion from the mean over the study period. In addition, government expenditure (GEXP), gross fixed capital formation (GFCF) and inflation (INF) recorded over the period a mean value of 11.61, 4.68 and 9.89 with respective maximum of 30.63, 81.65 and 324.99. The standard deviations are 9.50, 12.54 and 23.60 this it has higher deviation or dispersion from the mean over the study period. All variables exhibited a positive skew. Despite this, the symmetry of each series around the mean indicates that the coefficient of skewness implies a proximity to a normal distribution. Furthermore, the kurtosis values for each variable exceeded 3, indicating a relatively normal distribution. At the 5% significance level, the Jarque-Bera statistics for the series demonstrated that all variables conformed to a normal distribution, as the p-value was less than 0.05.

Unit root test Result

Table 2: Unit root Result

	ADF		
Variables	Levels	First Diff.	Remarks
GDPR	59.3049 (0.0001)	-	1(0)
ELECT	19.784 (0.7090)	43.0302 (0.0099)	1(1)
GEXP	34.1694 (0.0472)	-	1(0)
GFCF	88.1176 (0.0000)	-	1(0)
INF	67.6107 (0.0000)	-	1(0)

Source: Extracted from E-views result

Using the Augmented Dickey Fuller test to perform the unit root test for the regression estimate, and the findings are shown in Table 2. As observed from the result that electricity consumption was integrated after the first difference that is 1(1). The the unit root test also showed that all other variables were integrated at level I(0). The mix of the cointegration order indicates that the Bounce technique must be used to assess the cointegration.

ARDL Bounds Test

A Bounds Test analysis can be conducted on the series due to the fact that the selected variables for this study exhibit different integration orders. The Autoregressive Distributed Lag (ARDL) Bounds Test will determine whether there exists a long-term relationship among the variables.

Table 3: ARDL Bounds Test

ARDL Bounds Test

Null Hypothesis: No long-run relationships exist

Test Statistic	Value	K
F-statistic	78.51404	4
	Critical Value Bounds	
Significance	I0 Bound	I1 Bound
10%	2.2	3.09
5%	2.56	3.49
2.5%	2.88	3.87
1%	3.29	4.37

Source: Extracted from E-view result

Table 3 above displays the model's findings from the ARDL Bounds Test. The co-integration analysis presented in Table 3 indicates that the F-statistic for the estimated model exceeds the

upper bound critical value at the 5% significance level. This finding suggests the existence of co-integration among the variables included in the model. Furthermore, the study provides both long-run and short-run regression estimates derived from the Autoregressive Distributed Lag (ARDL) approach.

ARDL Regression Estimates

Table 4. Long Run ARDL Regression Estimates

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDPR(-1)	-0.292980	0.059699	-4.907639	0.0000
ELECT	-0.008907	0.027818	-0.320203	0.7491
ELECT(-1)	-0.044247	0.031346	-1.411584	0.1593
GEXP	0.033683	0.046246	0.728355	0.4671
GFCF	0.253682	0.033857	7.492637	0.0000
GFCF(-1)	0.031603	0.038120	0.829039	0.4079
GFCF(-2)	-0.079850	0.033677	-2.371074	0.0185
INF	-0.072868	0.073636	-0.989574	0.3233
INF(-1)	0.115107	0.057527	2.000923	0.0465
C	6.989596	1.717970	4.068520	0.0001

Source: Compiled from E-views

The long-run impact of electricity consumption and government spending on economic growth is presented in table 4 above. The results show that electricity consumption exerted a negative relationship which is in line with Matthew, Miebaka-Ogan, Popoola, Olawande, Osabohien, Urhie, Adediran, & Ogunbiyi (2019) findings of negative relationship and was also no significant. This can be attributed to the fact that a lot has not been done to ravage the menace that is going on the electricity and majority of Africans don't have access to electricity. Government expenditure has positive impact on economic growth, complimenting the findings of Mishra and Mohanty (2021), which shows that there a substantial relationship with economic growth. Consequently, capital expenditures that have been allocated in documentation may not necessarily result in actual economic growth due to the misallocation of these funds. The research indicates that the ongoing presence of such financial leakage, under the guise of capital spending, could render capital expenditure a harmful factor in the context of economic growth. Put another way, the fact that capital expenditures in Sub-Saharan Africa have not resulted in economic growth suggests that they have been redirected to other purposes that do not contribute to economic progress, particularly for the private benefit of public servants. This might be related to the fact that throughout the study period, a sizable amount of government spending is allocated to debt service payments. Gross fixed capital formation exerts a positive and statistically significant influence on economic growth. Similarly, inflation, when considered in its first lag, demonstrates a significant and positive correlation with economic growth.

Table 5. Short Run ARDL Regression Estimates

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(ELECT)	-0.008907	0.026526	-0.335801	0.7373
D(GFCF)	0.253682	0.026796	9.466984	0.0000
D(GFCF(-1))	0.079850	0.026742	2.985963	0.0031
D(INF)	-0.072868	0.055826	-1.305282	0.1930
CointEq(-1)*	-1.292980	0.058990	-21.91874	0.0000

Source: Compiled from E-views

The findings displayed in Table 5 indicate that gross fixed capital formation exerts a beneficial influence on economic growth in both lag periods. Electricity consumption and inflation had negative impact on economic growth. The potential for inflation, which may result from rising wages and incomes, is one important cause for this. Put another way, inflation starts to set in when recurring spending is raised without a corresponding rise in economic growth, which has a negative impact on economic growth. The outcome demonstrates that ECT(-), the ECM variable, is substantial and negative. It demonstrates that there is an adjustment rate of 12.9% from the short-run equilibrium to the long-run equilibrium. This suggests that in each time period, the system will be changed by 12.9% if there is any distortion.

CONCLUSION AND RECOMMENDATIONS

Conclusion

This research investigated the connection between electricity usage, government spending, and economic growth in Sub-Saharan Africa, utilizing the ARDL econometric method based on the Solow growth model for the years 2000 to 2023. A unit root test was performed to determine the stationarity of the data series; it was found that all series were stationary at level, except for electricity consumption, which was stationary at the first difference. The study identified a co-integrating relationship among all variables in the model. The ARDL analysis indicated the potential for long-term convergence with a rapid rate of error correction. The results showed that there is no significant relationship between electricity consumption and economic growth. The research indicates that there is a one-way causal relationship between economic development and power consumption. It suggests that government expenditure and energy usage in Africa will influence future economic growth. To reduce the frequent power outages experienced in Africa, it is essential to enhance the efficiency of energy production agencies by regularly updating outdated equipment and other practical tools.

Recommendations

Base on the findings of the study, the following recommendations are made.

Since electricity is used in the majority of economic production activities, the government should improve its electricity supply. Increasing the amount of electricity produced will help create jobs and increase aggregate output, both of which will contribute to economic growth.

If more public funds are released for development by combating corruption in the nation, government spending will have a more significant impact on economic performance. Therefore, the nation should take a direct approach to combating corruption. It should go beyond

government employees and political office holders who preach that corruption is not tolerated or that certain corruption-related situations are given preferential attention.

In order for the sub-region to benefit from electricity as much as the world's developed nations do, international development organizations, aid and grant providers, the World Bank, and the International Monetary Fund (IMF) should also focus their interventions on ensuring a steady supply of electricity in the area.

Furthermore, it is essential for the government to ensure that public expenditure is monitored and assessed. Spending by the government must be allocated to initiatives that will boost economic expansion.

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