Energy Consumption, Financial Development and Economic Growth in Sub-Saharan African Countries

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DOI: 10.56201/ijefm.v9.no4.2024.pg21.40

Abstract
This manuscript investigates the impact of energy consumption, financial development and economic growth in Sub-Saharan Africa from 2011 to 2022. The empirical paper employed a seven (7) Sub-Saharan Africa nations. The study considers panel data set for Real Gross Domestic Product (RGDP) and few economic variables that are theoretically expected to determine the economic growth in Sub Saharan Africa. The data used in the study were generated from World Bank indicators, while the data analysis was expedited by econometric views (E-views) statistical software 12. The variables for the study were subjected to stationary test using Im, Pesara n & Shin Test and Levin, Lin & Chu display that all variables were integrated at order zero I(0) and order one 1(1). The panel data were subjected to a colleration matrix in order to check for multicollinearity among the variables Therefore, the result finds absence of multicollinearity. The Hausman test were conducted to determine whether either fixed or random effect model is suitable for the study. While the two-system Generalized Method of moment (GMM) approach were also employed to test the hypotheses and the presence of a long-run co-integration connection was indicated. The finding reveals that energy consumption and Domestic Credit to Private Sector have a positive and significant effect on Real Gross Domestic Product of sub-Saharan Africa. While, electricity consumption and money supply have a joint negative and significant effect on Real Gross Domestic Product of sub-Saharan Africa. Based on the finding, the study concludes that energy consumption and financial development play a significant role in enhancing economic growth of sub-Saharan Africa. The paper highlights the need for sustainable population policies and energy strategies in Sub-Saharan Africa. It emphasizes the importance of investing in renewable and efficient energy sources to promote economic growth while minimizing environmental costs. The implications of these findings are significant for policymakers, researchers, and development practitioners in Sub-Saharan Africa.

Keywords: *Sub-Saharan Africa, Energy Consumption, Financial Development and Economic Growth*

Introduction

The relationship between energy consumption, financial development, and economic growth in sub-Saharan Africa is a complex and interconnected one. Energy consumption is a critical factor in driving economic growth, and financial development plays a crucial role in ensuring that there is adequate investment in the energy sector to support sustainable growth. Energy consumption is essential for driving economic growth in sub-Saharan Africa. As the region continues to develop and urbanize, there is a growing demand for energy to power industries, businesses, and households. Access to reliable and affordable energy is crucial for supporting economic activities and improving productivity. Therefore, increased energy consumption is often seen as a sign of economic development and expansion (Africa Development Bank Group 2022).

However, in order to meet the growing demand for energy, there is a need for significant investment in the energy sector. This is where financial development comes into play. A well-developed financial sector is essential for mobilizing the necessary capital to invest in energy infrastructure, such as power plants, transmission lines, and renewable energy projects. Without access to financing, the energy sector would struggle to expand and meet the increasing energy needs of the region. Conversely, the energy sector also plays a role in supporting financial development and economic growth. A reliable energy supply is essential for powering financial institutions, businesses, and industries, enabling them to operate efficiently and effectively. Additionally, investments in the energy sector can create jobs, stimulate economic activity, and attract foreign investment, all of which contribute to overall economic growth (Odhiambo, 2009).

Furthermore, the development of renewable energy sources, such as solar and wind power, has the potential to not only increase energy access but also drive sustainable economic growth. Investing in renewable energy can create new opportunities for employment, attract investment in clean energy technologies, and reduce reliance on expensive and environmentally damaging fossil fuels. However, it is important to acknowledge that there are also challenges associated with the relationship between energy consumption, financial development, and economic growth in sub-Saharan Africa. These include issues such as access to reliable and affordable energy, the need for improved energy infrastructure, and the importance of promoting sustainable and environmentally friendly energy solutions (Africa Development Bank Group 2022).

Sub-Saharan Africa is currently experiencing a period of economic growth, with many countries in the region making significant strides in areas such as GDP growth, infrastructure development, and foreign investment. This growth is being driven by a number of factors, including a growing middle class, increased political stability, and a focus on diversifying economies. One of the key drivers of economic growth in sub-Saharan Africa is the expanding middle class. As more people in the region move into the middle class, there is increased demand for goods and services, which in turn fuels economic growth. This has led to a rise in consumer spending and investment in a wide range of industries, from retail and manufacturing to technology and telecommunications.

Political stability has also played a role in sub-Saharan Africa's economic growth. Many countries in the region have made significant progress in establishing stable governments and reducing political violence, which has created a more conducive environment for business and investment. This has led to increased foreign investment in the region, as well as a rise in intra-African trade. Moreover, many countries in sub-Saharan Africa are working to diversify their economies away from traditional sectors such as agriculture and extractive industries. This has involved efforts to

build up the manufacturing and services sectors, as well as promoting innovation and entrepreneurship. As a result, countries in the region are becoming less reliant on a small number of commodities and are better positioned to weather market fluctuations. However, it is important to note that there are still significant challenges facing sub-Saharan Africa in its quest for sustained economic growth. These include issues such as poverty, unemployment, and income inequality, as well as infrastructure deficits and issues related to climate change. Additionally, the COVID-19 pandemic has posed a significant threat to the region's economic progress, leading to economic contractions in many countries Sichel and Eckstein (1974).

Empirically, the current economic growth in sub-Saharan Africa is driven by factors such as a growing middle class, political stability, and efforts to diversify economies. While there are still challenges and uncertainties, the overall trajectory of the region's economy is positive, with many countries making significant strides towards sustainable growth.

Financial development in sub-Saharan Africa shows a region that is experiencing significant progress and growth in its financial sector. This growth is driven by a number of factors, including improved access to financial services, the development of capital markets, and increased foreign investment. One of the key developments in the financial sector in sub-Saharan Africa is the improvement of access to financial services. Over the past decade, there has been a concerted effort to expand access to banking and financial services to the unbanked population in the region. This has been achieved through the expansion of mobile banking and the development of innovative financial products and services tailored to the needs of the population. As a result, more people in the region are able to access banking services, savings, credit, and insurance, which in turn has fueled economic growth and development Mohieldin, et al. (2019).

Furthermore, the region has seen significant progress in the development of capital markets. Many countries in sub-Saharan Africa have worked to develop and strengthen their stock exchanges and bond markets, which has facilitated greater access to capital for businesses and governments. This has also attracted foreign investors looking to invest in the region's growing and diverse economies. Another important aspect of the financial development in sub-Saharan Africa is the increase in foreign investment. Many international financial institutions and investors are recognizing the potential of the region and are increasing their investments in various sectors, such as infrastructure, energy, and consumer goods. This influx of foreign investment is contributing to the region's economic growth and development, as well as creating employment opportunities and fostering technological advancements Mohieldin, et al. (2019).

Despite these positive developments, there are still challenges that need to be addressed in the financial sector in sub-Saharan Africa. One of the main challenges is the need for improved regulatory frameworks and governance to ensure stability and integrity in the financial system. Additionally, there is a need for continued investment in financial education and literacy to ensure that people are equipped with the necessary knowledge and skills to make informed financial decisions. The current overview of financial development in sub-Saharan Africa is one of progress and growth, with improved access to financial services, the development of capital markets, and increased foreign investment contributing to the region's economic advancement. However, there are still challenges that need to be addressed to ensure sustainable and inclusive financial development in the region.

Theoretically, there is a strong relationship between energy consumption, financial development, and economic growth in sub-Saharan Africa. Energy consumption is a critical driver of economic growth, and financial development is essential for mobilizing the necessary investment to meet the growing demand for energy. Additionally, the energy sector plays a vital role in supporting financial development and stimulating economic activity. However, addressing the challenges associated with energy consumption and ensuring sustainable energy development will be crucial for the long-term economic growth and development of the region.

Literature Review

This section reviews the theoretical literature, conceptual literature, empirical literature and summary of reviewed literature.

Theoretical Framework

literature on energy consumption, financial development on economic growth provides some theoretical explanation on the relationship between energy consumption and financial development on economic growth in sub-saharan African countries. Thus, the theoretical framework is anchored on three theories namely: **Financial Repression Theory of Financial Development, Neoclassical Growth Theory of Economic Growth and Feedback Hypothesis Theory of Energy Consumption Theory**

Financial Repression Theory of Financial Development

The Financial Repression Theory is a concept that explains the hindrances to financial development caused by government regulations and policies that suppress interest rates, impose capital controls, and direct credit to the government or specific sectors of the economy. The Financial Repression Theory was first proposed by economists Edward Shaw and Ronald McKinnon in the early 1970s. According to the Financial Repression Theory, governments may implement policies that artificially lower interest rates, particularly on government securities, to reduce the cost of servicing government debt. This can discourage individuals and businesses from saving and investing in productive ventures, as the returns on their savings are diminished. As a result, there is less capital available for private investment, hindering economic growth and development Courakis, (1984).

In addition to lowering interest rates, financial repression may also involve the imposition of capital controls, which restrict the flow of funds across national borders. This limits the ability of individuals and businesses to diversify their investments internationally and access foreign sources of capital and investment opportunities. Capital controls can stifle economic growth by limiting access to external sources of financing and reducing the efficiency of capital allocation. Furthermore, the government may direct credit to favored sectors of the economy, such as state-owned enterprises or specific industries, through directed lending programs. This allocation of credit may not be based on market-driven assessments of risk and return, leading to misallocation of resources and inefficient use of capital. The Financial Repression Theory suggests that these policies and regulations lead to a lack of access to credit for individuals and businesses, stifling economic growth and development. By suppressing interest rates, imposing capital controls, and directing cre dit to favored sectors, financial repression can hinder the development of a robust and inclusive financial system Diaz-Alejandro, (1985).

To counter the effects of financial repression and promote financial development, policymakers can pursue reforms to liberalize financial markets, remove interest rate caps, and dismantle capital controls. By promoting free-market principles and providing a level playing field for all market participants, these reforms can foster competition, innovation, and efficiency in the financial sector. Additionally, promoting financial inclusion and expanding access to credit and financial services for underserved populations can help mitigate the negative effects of financial repression and promote overall financial development. The Financial Repression Theory highlights the negative impact of government regulations and policies on financial development, and emphasizes the importance of liberalizing financial markets and promoting financial inclusion to facilitate economic growth and development Courakis, (1984).

Neoclassical Growth Theory of Economic Growth

The neoclassical growth theory was first developed by economists Robert Solow and Trevor Swan in the 1950s and further expanded by Robert M. Solow in the 1980s.The theory explains economic growth through the interaction of technological progress, capital accumulation, and labor force growth. Technological progress is a key driver of economic growth in the neoclassical growth theory. It is the advancement in knowledge and technology that leads to increased productivity and efficiency in the production of goods and services. As new technologies are developed and implemented, the economy becomes more productive, leading to higher levels of output and economic growth Aspromourgos, T, (1986).

Capital accumulation is another important factor in the neoclassical growth theory. It refers to the process of increasing the stock of physical capital, such as machinery, equipment, and infrastructure. The theory suggests that as the level of capital in an economy increases, so does its productive capacity, leading to higher levels of output and economic growth. Labor force growth is also a significant contributor to economic growth in the neoclassical growth theory. As the labor force expands through population growth or increased participation in the workforce, the economy's capacity to produce goods and services also expands. This results in higher levels of output and economic growth Dequech, D, (2007). Empirically, the neoclassical growth theory posits that sustained economic growth is achieved through the interaction of technological progress, capital accumulation, and labor force growth. By investing in these factors, an economy can increase its productive capacity and output, leading to higher standards of living and overall economic prosperity.

Feedback Hypothesis Theory of Energy Consumption

The feedback hypothesis theory claims that there is a bidirectional fundamental association between energy utilisation and real gross domestic product. If this were an instance of energy policy efficiency, it would not unfavourably touch economic progress, while an upsurge in economic progress would likewise raise energy use. The feedback hypothesis theory suggests that this affiliation is monotonous. It follows that energy use stimulates economic progress, and faster economic evolution will also encourage greater energy utilization. A clarification in Apergis and Payne (2010) is that energy utilisation and economic evolution are reliant on the stage of economic progress in each nation. Feedback theory claims that the affiliation between energy use and economic progress is bidirectional, meaning that energy use leads to economic progress and economic development leads to an upsurge in energy utilisation.

The feedback hypothesis, explains the bidirectional association between electricity utilization and output. It is founded on the impression that electricity utilization and gross domestic product are two symbiotic variables. For this aim, an upsurge (decrease) in electricity use instigates a rise (decrease) in gross domestic product, and an upsurge (decrease) in gross domestic product causes an upsurge (decrease) in electricity utilization (Payne, 2010). That is to say, realizing policies that endorse one of them could cause an upsurge in both gross domestic product and electricity utilization; placing strategies into influence that hamper one could instigate a drop in both. With regards to this, placing procedures into force that are absorbed toward enhancements in energy might not have an opposing influence on gross domestic product; they might similar have a affirmative influence on it (Payne, 2010). Empirical confirmations that back the feedback theory include Jumbe (2004) and Odhiambo (2009) articles on Korea, Malawi, and South Africa, correspondingly.

However, the feedback theory is also sustained by the empirical discoveries in Yu and Hwang (1984) for Tunisia, and Dagher and Yacoubian (2012) for Lebanon, among others. Advocates of this feedback hypothesis advise the accomplishment of a twofold approach, which implies that economic progress would be related to waste-of-energy restrictions. Modification of energy foundations, comprising non-renewable fossil fuels and energy from renewable and sustainable energy sources, and the progress of new technology are the top illustrations of real energy utilisation and economic progress. Thus, this fundamental connection between energy utilisation and economic progress is exemplified by Hu, X., and Lin, X. (2013); Tang, C., and Tan, E. (2013). (2012); and Lee et al. (2008).

The attainable theories emerge to contradict each other, proposing an immaculate outline of the effect of population dynamics, energy consumption and supplanting on the economic growth of emerging economies, involving selected Sub Saharan Africa. It is hard to overgeneralize about SS Africa's possibility economic progress views given its expanding population dynamics in the appearance of spontaneous modification. Views differ on the appeal of population dynamics, energy consumption and economic growth theories. Various researchers perceive the theme as a real difficult, whereas others perceive it as anticipate benefit (Afzal, 2009).

Financial Development

Financial development refers to the process of improving and expanding the financial system within a country or region. This includes developing financial institutions, markets, and regulations to enhance the overall financial well-being of individuals, businesses, and the economy as a whole. Financial development is critical for the growth and stability of an economy. It promotes economic growth by facilitating the flow of funds from savers to borrowers, allowing businesses to invest in productive activities and create jobs. Additionally, well-developed financial systems provide access to credit and financial services for individuals and small businesses, enabling them to invest in education, healthcare, and entrepreneurship Albert, et al (2022).

There are several key components to financial development:

1. Financial institutions: These include banks, credit unions, insurance companies, and investment firms that provide various financial services such as lending, deposits, insurance, and investment management.

2. Financial markets: These include stock exchanges, bond markets, and currency markets where individuals and businesses can buy and sell financial assets. Well-functioning financial markets allow for the efficient allocation of capital and risk-sharing.

3. Regulations and governance: Strong regulations and oversight are necessary to ensure the stability and integrity of the financial system. This includes prudential regulations to safeguard against financial crises, consumer protection regulations to ensure fair and transparent financial services, and anti-money laundering regulations to prevent illicit financial activities.

4. Financial infrastructure: This includes payment systems, credit reporting agencies, and other financial infrastructure that support the smooth functioning of financial transactions.

Financial development can also promote financial inclusion, which refers to increasing access to financial services for undeserved and marginalized populations. This can be achieved through initiatives such as microfinance programs, mobile banking, and financial literacy education. Specifically, financial development is essential for fostering economic growth, reducing poverty, and promoting overall financial stability. It requires collaboration between governments, financial institutions, and regulatory bodies to create an environment conducive to the development of a robust and inclusive financial system Umar, et al,(2021).

Energy Consumption

Energy consumption refers to the amount of energy used by individuals, businesses, and societies for various purposes such as heating, cooling, transportation, manufacturing, and electricity generation. It is a crucial aspect of modern life and plays a significant role in determining the overall economic and environmental sustainability of a nation (Dash, 2013).

There are several forms of energy consumption, including:

1. Residential energy consumption: This includes the energy used in homes for heating, cooling, lighting, cooking, and appliances.

2. Commercial energy consumption: This refers to the energy used in commercial buildings and facilities for lighting, heating, cooling, and operating equipment and machinery.

3. Industrial energy consumption: Industrial energy consumption involves the use of energy for manufacturing and industrial processes, including the operation of machinery, heating, and cooling of industrial facilities.

4. Transportation energy consumption: This comprises the energy used for powering vehicles, including cars, trucks, buses, and planes.

5. Electricity generation: This is the energy consumed in the process of generating electricity, which can be derived from various sources such as coal, natural gas, nuclear, hydroelectric, wind, and solar power.

Efficient energy consumption is essential for both economic and environmental reasons. From an economic perspective, energy consumption is a significant component of production costs for businesses and household budgets. Therefore, reducing energy consumption through energy-

efficient technologies and practices can lead to cost savings for both businesses and individuals. From an environmental standpoint, energy consumption is a major contributor to carbon emissions and climate change. The burning of fossil fuels for energy production releases greenhouse gases such as carbon dioxide, contributing to global warming and environmental degradation. Therefore, reducing energy consumption and transitioning to renewable energy sources can help mitigate the negative impacts of energy production on the environment. Policies and initiatives aimed at promoting energy efficiency, renewable energy, and sustainable energy use play a crucial role in addressing the challenges of energy consumption. This includes energy efficiency standards for appliances and vehicles, subsidies for renewable energy development, and public awareness campaigns to promote energy conservation. Overall, understanding and managing energy consumption is essential for creating a sustainable and resilient energy system that supports economic growth while minimizing the environmental impact of energy production and consumption (International Energy Agency, 2020).

Economic Growth

Economic growth refers to the increase in the production and consumption of goods and services within an economy. It is typically measured by the increase in a country's gross domestic product (GDP) over time. Economic growth is a fundamental goal of most governments and is seen as a key indicator of a nation's overall economic health and prosperity Kemi and Dayo (2014)

There are several key factors that contribute to economic growth:

1. Increase in productivity: Economic growth often occurs when a country's workforce becomes more productive, either through technological advancements, improvements in education and skills, or better infrastructure. Higher productivity leads to increased output and GDP.

2. Investment in physical and human capital: Economic growth can be stimulated by investment in physical capital such as machinery, equipment, and infrastructure, as well as investment in human capital through education and training. These investments lead to increased efficiency and innovation, driving economic growth.

3. Innovation and technological progress: Advances in technology and innovation can lead to increased production efficiency, lower costs, and the development of new products and industries, all of which can drive economic growth.

4. Access to resources: Access to resources such as natural resources, labor, and capital can also contribute to economic growth. Efficient utilization of these resources can lead to increased production and economic development.

5. Economic policies: Sound economic policies such as fiscal and monetary policies, trade policies, and regulatory frameworks can create an environment conducive to economic growth.

Economic growth has several important benefits for a society, including:

- Increased standard of living: As an economy grows, incomes rise, and individuals have more resources to spend on goods and services, leading to an improved standard of living.

- Job creation: Economic growth often leads to increased employment opportunities as businesses expand and demand for labor grows.

- Poverty reduction: Economic growth can help lift people out of poverty by providing more opportunities for employment and income generation.

- Improved infrastructure and public services: As the economy grows, governments have more resources to invest in infrastructure, healthcare, education, and other public services. However, economic growth also has its drawbacks, such as increased environmental impact, income inequality, and stress on natural resources. Therefore, sustainable and inclusive economic growth that takes into account these externalities is essential for long-term prosperity. Overall, economic growth is a vital driver of societal progress and development, and understanding the factors that contribute to it is critical for policymakers, businesses, and individuals seeking to promote prosperity and well-being Samuelson and Nirdhaeus (2010).

Empirical Literature Review

Energy Consumption and Economic Growth

Uçan et al. (2022), adapted a Dumitrescu-Hurlin causality examination test from the period of 1986 to 2015 to examine the correlation between economic growth and energy utilisation in 15 certain advanced nations. . The empirical paper reveals that there is a bidirectional connection between affiliation and . As an outcome of the study, it has been determined that economic growth and energy utilisation are the reasons for each other within the period of study in 15 nominated advanced nations.

Ezebunwa J, et al, (2021), employed a Vector Error Correction approach from the period of 1980 to 2019 to examine the linkage between energy consumption, financial development and economic growth in Nigeria. The empirical paper uncovers a significant long run positive linkage between Energy Use (ENEG), financial development (FD) which is the proxy for domestic credit to private sector by banks (% of GDP) and natural resources (NATR) which has a positive significant impact on the energy consumption in Nigeria while economic growth (GDP) and Openness of trade (OPENNESS) has negative significant impact on energy consumption in Nigeria.

Adegoriola and Agbanuji (2020) employed the autoregressive distributed lag model (ARDL) approach to examine the impact of electricity use and economic growth in Nigeria from 1986 to 2018. The manuscripts found that electricity use and economic growth are positively and significantly linked in the short term, while in the long term, electricity use compressed negatively and insignificantly on economic growth in Nigeria. Furthermore, the result shows that the cost of fuel and gas exerts a positive but insignificant influence on economic growth in Nigeria within the period of study.

Fatima and Abdurrahman (2020) employed an OLS and Granger causality examination technique from the period of 1985 to 2017 to examine the linkage between electricity use and economic growth in Nigeria. The study uncovers a negative and inconsequential bond between electricity use and industrial growth. More so, the result implies that their lives depend on the existence of long-term connections among the variables.

Paper presented by Charfeddine and Kahia (2019) used a panel data approach to examine influence on financial advancement and renewable energy on economic growth for MENA countries from the period of 1980 to 2015. The paper uncovered that both financial advancement

and renewable energy are weakly significant to both carbon emissions and economic growth in MENA nations.

Marinaș et al. (2018) adopted an auto-regressive and distributed lag (ARDL) approach from the period of 1990–2014 to examine the association between economic growth and renewable energy use for 10 European Union (EU) countries from Central and Eastern Europe (CEE) to find that in the short term, the GDP and renewable energy use dynamics are independent in Bulgaria and Romania, whilst in Hungary, Lithuania, and Slovenia, rising renewable energy use advances economic growth. . Furthermore, the result found a bi-directional connection between renewable energy use and economic growth that is authenticated in the long term for both 10 European Union nations as well as in the case of 7 Central and Eastern European nations that were studied separately.

Financial Development and Economic Growth

Nkamnebe et al, (2023), investigated the impact of financial development on economic growth in Nigeria utilising annual data from 1985 to 202. The empirical paper employed a Auto-regressive Distributed Lag (ARDL) and the pairwise granger casualty test found that all share index, exchange rate and financial technology positively and significantly affects economic growth; credit to the private sector and gross savings positively but insignificantly impacts on economic growth. However, remittances reveal a negative and insignificant impact on economic growth in Nigeria. The Pairwise causality test shows that there are three unidirectional causality which runs from economic growth to credit to private sector, financial technology and gross savings in Nigeria.

Albert et al. (2022) studied the impact of financial development on economic growth in Nigeria (1980-2019) using Ordinary Least Squares. They explored four equations with GDP as the dependent variable. Results showed positive relations between economic growth and paired variables (real interest rate, gross domestic savings), (real interest rate, private sector credit), and (savings, private sector credit). However, combining all 3 variables, real interest rate and savings had an insignificant negative impact, while private sector credit had a significant positive impact on Nigeria's growth.

Umar et al. (2021) explored the impact of financial development on economic growth in Nigeria from 1980 to 2019. Using nonlinear autoregressive distributed lag analysis, they identified a lasting connection amid asymmetries. Results showed positive financial development shocks negatively impacted both short and long-term growth, with negative shocks having a similar effect. Inflation had a significant positive impact, while uncertain financial globalization exhibited no meaningful connection to Nigerian economic growth.

Okunlola et al. (2020). Investigated the causal relationship between financial development indicators and economic growth using the Toda and Yamamoto approach for the period 1985 to 2015. The Toda and Yamamoto approach is based on an augmented VAR modeling and the findings include that a bi-directional causality was found between financial markets indicators and economic growth while unilateral causality running from stock market indicators to GDP was established.

Imoagwu and Ezeanyeji (2019) studied the impact of financial development on economic growth from 1986 to 2017. They used error correction and Toda-Yamamoto tests, finding a short-term

positive link between financial development and growth, but a negative impact in the long-term. Causality was from finance to growth. Stock market cap bolstered short-term growth, but hindered it long-term. Interest rate had a slight short-term positive impact, but a significant negative effect long-term. Domestic credit ratio's positive impact was only long-term. Causality was observed from various sectors to financial development.`

Summary of Reviewed Literature

From the contemporary discussion on this review, this literature interrogation have observed the developments in composition analyses within the past years and have detected how empirical study in the arena of energy consumption, financial development on economic growth have transformed and is still transforming. Notwithstanding, from the present deliberation on earlier analyses on the arena of energy consumption and financial development on economic growth have predominantly showed that energy consumption and financial development exerts affirmative impact on economic growth. Only in rare cases arisen undesirable or null affects. To advance discover how those outcomes occurred, numerous arena connection with energy consumption, financial development and economic growth where deliberate and the analysis is going on, however there are gaps in the literature as no current study have considered the area of energy consumption and financial development on economic growth in sub-Saharan Africa. This instigates to arise as a zone that demands additional study and can be pondered in terms of support to theoretical expertise and the seeming usefulness for the domestic economy.

Model Specification

In order to achieve the objectives of this study and test of the hypotheses, a functional relationship in form of multiple linear regression models consisting of dependent and independent variables will be formulated. The regression models are presented as follows;

Thus, the estimated model is;

$$LnRGDPt = \alpha o + \alpha 1 LnENCM_{it} + \alpha 2\ \mathrm{LnELEC}_{it} + \alpha 3 \mathrm{LnMS}_{it} + \alpha 4 \mathrm{LnDCPS}_{it} + \mathrm{Ut} \quad (3.1)$$

Where; αo and b0 are the constant terms, α1 – α2 and b1-b2 are intercept parameters, Ln is Logarithm to base ten, RGDP is Real Gross Domestic Product, Energy Consumption, Electricity consumption, Money Supply and Domestic Credit to Private Sector U is the error term at time, Energy Consumption, and Electricity consumption at current form.

$$\mathrm{RGDP} = \beta_o + \beta_1\ \mathrm{ENCM}_{it} + \beta_2\ \mathrm{ELEC}_{it} + \beta_3\ \mathrm{MS}_{it} + \beta_4\ \mathrm{DCPS}_{it} + \mu_{it} \quad (3.1)$$

Where:

RGDP = Real Gross domestic product of the countries

ENCM = Energy Consumption

ELEC = Electricity consumption

MS = Money Supply

DCPS = Domestic Credit to Private Sector

$\varepsilon 1$ = Stochastic or disturbance/error term.

t = Time dimension of the variables

$\alpha 0$ = Constant or intercept

Data Analysis and Result Interpretation

Descriptive Analysis

The results of the descriptive analysis are presented as follow:

Table 1. Descriptive Data Analysis

	RGDP	ENCM	MS	ELEC	DCPS
Mean	5.143193	4.445454	25.99160	-0.501731	31513.68
Median	4.950000	4.451000	26.40000	-0.263000	8.670000
Maximum	19.68000	6.194000	38.10000	4.018000	910441.0
Minimum	0.110000	2.261000	11.00000	-9.399000	-5.690000
Std. Dev.	3.405715	1.005040	6.956092	2.863729	115128.7
Skewness	1.305694	-0.402620	-0.452236	-1.814291	5.229762
Kurtosis	5.839983	2.620325	3.069030	6.366301	35.16739
Jarque-Bera	73.80406	3.929806	4.079884	121.4722	5673.040
Probability	0.000000	0.140169	0.130036	0.000000	0.000000
Sum	612.0400	529.0090	3093.000	-59.70600	3750128.
Sum Sq. Dev.	1368.670	119.1923	5709.692	967.7115	1.56E+12
Observations	84	84	84	84	84

Source: Source: *E-views Output, 2024.*

Table 1. Exemplify the characteristics of the variables studied. It is known that the number of samples is 84, which is from seven (7) sub-Saharan African nations .above presents the descriptive statistics of descriptive statistics of research variables (Real Gross Domestic Product, fertility rate, mortality rate, net migration rate, energy consumption, electricity consumption and electricity per capital) over a period of eleven years from 2011 to 2022. As shown in the Table 1, Real Gross Domestic Product (RGDP) recorded over the period a mean value of 5.14 with a maximum of 19.68 and minimum of 0.11 per annum. The standard deviation of Real Gross Domestic Product (RGDP is 3.4 and this indicates that Real Gross Domestic Product (RGDP) has low deviation or dispersion from the mean over the study period.

Also, energy consumption (ENCM) recorded over the period a mean value of 4.45 with a maximum of 6.19 and minimum of 2.26 per annum. The standard deviation of energy consumption (ENCM) is 1.01 and this indicates that energy consumption (ENCM) has low deviation or dispersion from the mean over the study period.

In addition, money supply (MS) recorded over the period a mean value of 25.99 with a maximum of 38.1 and minimum of 11.0 per annum. The standard deviation of money supply (MS) is 6.95 and this indicates that money supply (MS) has high deviation or dispersion from the mean over the study period.

In furtherance, electricity consumption (ELEC) recorded over the period a mean value of -0.50 with a maximum of 4.02 and minimum of -9.40 per annum. The standard deviation of electricity consumption (ELEC) is 2.86 and this indicates that electricity consumption (ELEC) has high deviation or dispersion from the mean over the study period.

Moreover, Domestic Credit to Private Sector (DCPS) recorded over the period a mean value of 31513.68 with a maximum of 910441.0 and minimum of -5.69 per annum. The standard deviation of Domestic Credit to Private Sector (DCPS) is 115128.7 and this indicates that Domestic Credit to Private Sector (DCPS) has high deviation or dispersion from the mean over the study period.

Unit Root Test

Most time series data tend to contain infinite variances that are not mean-reverting and lie on the unit circle. It is, however, observed that results estimated from such series are usually resulting in spurious regression that makes little or no economic sense. Thus, the Im, Pesaran & Shin and Levin, Lin & Chu panel unit roots test were employed in this study to test for the time series properties of model variables. The results of the Im, Pesaran & Shin and Levin, Lin & Chu panel unit roots test are presented in Table 2 below:

Table 2. Summary of Im, Pesaran & Shin Test and Levin, Lin & Chu Test Panel Unit Roots Test Results

	IM, PESARAN AND SHIN W-STAT			LEVIN, LIN & CHU (LLC)TEST		
Variables	**Statistic**	**Prob.****	**Order of Integration**	**Statistic**	**Prob.****	**Order of Integration**
$RGDP_t$	-3.88262	0.0001	I(0)	-2.78945	0.0026	I(0)
$ENCM_t$	-2.65473	0.0040	I(0)	-4.84760	0.0000	I(0)
MS_t	-3.91774	0.0000	I(0)	2.86675	0.00033	I(0)
$ELEC_t$	-6.52805	0.0000	I(0)	-10.4512	0.0000	I(0)
$DCPS_t$	-3.83498	0.0001	I(0)	-4.09486	0.0000	I(0)

Source: *E-views Output, 2024.*

The results of panel unit root in Table 2. above show that all variables were stationary at level forms since the probability values of LLC are less than 0.05; thereby indicating that all variables were integrated of order zero, that is [I(0)]. In other words, after comparing the probability value of Levin, Lin and Chu t-statistics against the alpha value at 0.05 level of significance, it was ascertained that Real Gross Domestic Product (RGDP), Energy Consumption (ENCM), Money Supply (MS), Electricity Consumption (ELEC), and Domestic Credit to Private Sector (DCPS) were integrated at order I(0) and were as a result stationary at levels. However, since the variables were integrated of the same order I(0), we cannot test for cointegration but estimate the panel regression based on the order of integration of the model variables.

Table 3: Correlation Matrix

VARIABLES|	**RGDP**	**ENCE**	**MS**	**ELEC**	**DCPS**

RGDP|	1.0000				
ENCE|	0.4537	1.0000			
MS |	0.6371	0.6554	1.0000		
ELEC|	0.4648	0.4963	0.6065	1.0000	
DCPS|	0.4345	0.5543	0.6814	0.6917	1.0000

Source: Source: *E-views Output, 2024.*

Table 3. directly above displays the correlation statistics on both constructs simultaneously. It is the avenue of knowing if the data analyzed labelled any form of multicollinearity and to ascertain any possible association amongst the variables. Though, the summary of this Table 3. demonstrates that the correlation between construct does not exceed the 80% threshold. Therefore, the absence of multicollinearity.

Fixed Effect Model Analysis

The result of the fixed effect model analysis is presented in Table 3:

Table 4. Results of Fixed Effect Model Analysis

Dependent Variable: $RGDP_t$				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	-2.822969	1.944852	-1.451509	0.1494
$ENCM_t$	1.232517	0.521117	2.365144	0.0199
MS_t	-1.319080	0.517983	-2.546568	0.0122
$ELEC_t$	-0.040623	0.015866	-2.560369	0.0120
$DCPS_t$	0.090313	0.041945	2.153149	0.0338
Effects Specification				
Cross-Section Fixed (Dummy Variables)				

R-squared = 0.655833; Adjusted R-squared = 0.612022; F-statistic = 3.793090; Prob(F-statistic) = 0.000025; Durbin-Watson stat = 1.796094

Source: Source: *E-views Output, 2024.*

The result of the fixed effect model analysis in Table 4. shows that energy consumption (ENCM) has a positive (1.232517) and significant (0.0199) effect on Real Gross Domestic Product (RGDP). This means that Real Gross Domestic Product (RGDP) will increase by 123.3% given a unit percentage in energy consumption (ENCM) while Real Gross Domestic Product (RGDP) will decrease by 123.3% given a percentage decrease in energy consumption (ENCM).

Also, money supply (MS) has a negative (-1.319080) and significant (0.0122) effect on Real Gross Domestic Product (RGDP). This means that Real Gross Domestic Product (RGDP) will decrease by 131.9% given a percentage increase in money supply (MS) while Real Gross Domestic Product (RGDP) will increase by 0.0122 given a percentage decrease in money supply (MS).

In addition, electricity consumption (ELEC) has a negative (-0.040623) and significant (0.0120) effect on Real Gross Domestic Product (RGDP). This means that Real Gross Domestic Product (RGDP) will decrease by 4.1 % given a percentage increase in electricity consumption (ELEC) while Real Gross Domestic Product (RGDP) will increase by 4.1% given a percentage decrease in electricity consumption (ELEC).

Moreover, Domestic Credit to Private Sector (DCPS) has a positive (0.090313) and significant (0.0338) effect on Real Gross Domestic Product (RGDP). This means that Real

Gross Domestic Product (RGDP) will increase by 9% given a percentage increase in Domestic Credit to Private Sector (DCPS) while Real Gross Domestic Product (RGDP) will decrease by 9% given a percentage decrease in Domestic Credit to Private Sector (DCPS).
From the empirical result of the fixed effect model analysis presented in Table 4, the adjusted R-squared obtained is 0.612022. This shows that if the coefficient of determination is adjusted, approximately sixty-one percent (61%) of the changes in Real Gross Domestic Product are attributable to changes in energy consumption (ENCM), money supply (MS), electricity consumption (ELEC), and Domestic Credit to Private Sector (DCPS). while the remaining thirty-nine percent (39%) of the variation in the model is equally captured by the error term (unknown factors outside the fixed effect model).

Lastly, the prob(F-statistic) value of 0.000025 which is less than 0.05 shows that the fixed effect model estimated is statistically significant. This also means that energy consumption (ENCM), money supply (MS), electricity consumption (ELEC), and Domestic Credit to Private Sector (DCPS). have a joint significant effect on Real Gross Domestic Product.

Random Effect Model Analysis
The result of the random effect model analysis is presented in Table 4:
Table 5. Presentation of Random Effect Model Analysis Results

Dependent Variable: $RGDP_t$				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	-8.622354	4.082748	-2.111900	0.0371
$ENCM_t$	3.369741	2.766404	1.218094	0.2260
MS_t	-1.374673	2.243802	-0.612653	0.5415
$ELEC_t$	-0.056014	0.083920	-0.667467	0.5060
$DCPS_t$	0.099963	0.084757	1.179400	0.2410
Effects Specification				
Period random			38.15718	0.7538
Idiosyncratic random			21.80849	0.2462
Weighted Statistics				

R-squared = 0.199552; Adjusted R-squared = 0.199552; F-statistic = 5.902922;
Prob(F-statistic) = 0.000022; Durbin-Watson stat = 1.548488
Source: Source: *E-views Output, 2024.*

The result of the random effect model analysis in Table 5. shows that energy consumption (ENCM) has a positive (3.369741) and non-significant (0.2260) effect on Real Gross Domestic Product (RGDP). This means that Real Gross Domestic Product (RGDP) will increase by 337% given a unit percentage in fertility rate (FER) while Real Gross Domestic Product (RGDP) will decrease by 337% given a percentage decrease in energy consumption (ENCM).
Also, money supply (MS) has a negative (-1.374673) and non-significant (0.5415) effect on Real Gross Domestic Product (RGDP). This means that Real Gross Domestic Product (RGDP) will decrease by 137.5% given a percentage increase in money supply (MS) while Real Gross Domestic Product (RGDP) will increase by 137.5% given a percentage decrease in money supply (MS).

In addition, electricity consumption (ELEC) has a negative (-0.056014) and non-significant (0.5060) effect on Real Gross Domestic Product (RGDP). This means that Real Gross Domestic Product (RGDP) will decrease by 5.6% given a percentage increase in electricity consumption (ELEC) while Real Gross Domestic Product (RGDP) will increase by 5.6% given a percentage decrease in net electricity consumption (ELEC).
Moreover, Domestic Credit to Private Sector (DCPS) has a positive (0.099963) and non-significant (0.2410) effect on Real Gross Domestic Product (RGDP). This means that Real Gross Domestic Product (RGDP) will increase by 10% given a percentage increase in Domestic Credit to Private Sector (DCPS) while Real Gross Domestic Product (RGDP) will decrease by 10% given a percentage decrease in Domestic Credit to Private Sector (DCPS).
From the empirical result of the random effect model analysis presented in Table 5, the adjusted R-squared obtained is 0.199552. This shows that if the coefficient of determination is adjusted, approximately twenty percent (20%) of the changes in Real Gross Domestic Product are attributable to changes in energy consumption (ENCM), money supply (MS), electricity consumption (ELEC), and Domestic Credit to Private Sector (DCPS). while the remaining eighty percent (80%) of the variation in the model is equally captured by the error term (unknown factors outside the random effect model).

Lastly, the prob(F-statistic) value of 0.000022 which is less than 0.05 shows that the random effect model estimated is statistically significant. This also means that energy consumption (ENCM), money supply (MS), electricity consumption (ELEC), and Domestic Credit to Private Sector (DCPS) have a joint significant effect on Real Gross Domestic Product.

Hausman Test

The Hausman test was conducted to determine whether either fixed or random effect model is suitable for the study. Fixed effect model is applied to dominate for omitted variables that are constant over time but vary between observations while the Random effect model is used when some omitted variables is constant between observations but vary over time. The hypothesis for Hausman test is stated below:

H_0: Random effect model is appropriate
H_1: Fixed effect model is appropriate

Table 6. Results of Hausman's Test

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Period random	16.020176	6	0.0136

Source: Source: *E-views Output, 2024.*

The result of the Hausman test is shown in Table 6 From the Table, the chi-square statistic value (16.020176) with a probability value of 0.0136 suggests that the fixed effect model is appropriate and should be preferred over random effect model. Specifically, since the p-value of 0.0136 is less than 0.05, we therefore retain the null hypothesis and conclude that random effect model is appropriate for this study.

Table 7. Presentation of Dynamic Panel Data Two-Step System Generalized Method of Moment (GMM) Results

Variables	Corrected Coef.	Std. Err.	z	P>|z|	[95% Conf	. Interva
LNRGDP |						
L1. |	1.005355	.0218198	46.08	0.000	.9625886	1.048121
ENCE|	1.232517	.0030491	-12.85	0.000	-.0451637	-.0332114
MS|	-1.319080	.001985	-209.39	0.000	-.4195385	-.4117573
ELEC|	-0.040623	.0007211	-64.63	0.000	-.0480168	-.0451901
DCPS|	0.090313	.0026217	0.69	0.491	-.0033338	.0069431
_cons |	-.0466035	.0007211	-64.63	0.000	-.0480168	-.0451901

R-squared = 0.655833; Adjusted R-squared = 0.612022; Prob (F-statistic) = 0.000;
Note: *** p < 0.01, ** p < 0.05, * p < 0.1 show statistical significance at 1%, 5%, and 10% level, respectively. Robust Standard errors are in parentheses. P-value reported for A-Bond AR (2), Sargan, and Hansen test statistics. Yitayaw et al., Cogent Economics & Finance (2023).

Arellano-Bond test for AR(1) in first differences: z = 0.13 Pr > z = 0.000
Arellano-Bond test for AR(2) in first differences: z = -0.47 Pr > z = 0.637

Sargan test of overid. restrictions: chi2(5) = 64.42 Prob > chi2 = 0.135, (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(5) = 1.11 Prob > chi2 = 0.253, (Robust, but weakened by many instruments.)

Source: Source: E-views Output, 2024.

The result of the dynamics ordinary least squares analysis in Table 7. shows that energy consumption (ENCM) has a positive (1.232517) and significant (0.000) effect on Real Gross Domestic Product (RGDP). This means that Real Gross Domestic Product (RGDP) will increase by 123.3% given a unit percentage in energy consumption (ENCM) while Real Gross Domestic Product (RGDP) will decrease by 123.3% given a percentage decrease in energy consumption (ENCM).

Also, money supply (MS) has a negative (-1.319080) and significant (0.000) effect on Real Gross Domestic Product (RGDP). This means that Real Gross Domestic Product (RGDP) will decrease by 131.9% given a percentage increase in money supply (MS) while Real Gross Domestic Product (RGDP) will increase by 131.9% given a percentage decrease in money supply (MS).

In addition, electricity consumption (ELEC) has a negative (-0.040623) and significant (0.000) effect on Real Gross Domestic Product (RGDP). This means that Real Gross Domestic Product (RGDP) will decrease by 4.1 % given a percentage increase in electricity consumption (ELEC) while Real Gross Domestic Product (RGDP) will increase by 4.1% given a percentage decrease in electricity consumption (ELEC).

Moreover, Domestic Credit to Private Sector (DCPS) has a positive (0.090313) and significant (0.419) effect on Real Gross Domestic Product (RGDP). This means that Real Gross Domestic Product (RGDP) will increase by 9% given a percentage increase in Domestic Credit to Private Sector (DCPS) while Real Gross Domestic Product (RGDP) will decrease by 9% given a percentage decrease in Domestic Credit to Private Sector (DCPS).

From the empirical result of the dynamics ordinary least squares analysis presented in Table 6, the adjusted R-squared obtained is 0.612022. This shows that if the coefficient of determination

is adjusted, approximately sixty-one percent (61%) of the changes in Real Gross Domestic Product are attributable to changes in energy consumption, electricity consumption, money supply and Domestic Credit to Private Sector while the remaining thirty-nine percent (39%) of the variation in the model is equally captured by the error term (unknown factors outside the model).

Conclusion

This manuscript investigate the impact of energy consumption,financial development and economic growth in Sub-Saharan Africa from 2011 to 2022. The empirical paper employed a seven Sub-Saharan Africa nations. The study considers panel data set for Real Gross Domestic Product (RGDP) and several economic variables that are theoretically expected to determine the economic growth in Sub Saharan Africa. The data used in the study were generated from World Bank indicators, while the data analysis was expedited by econometric views (E-views) statistical software 12. The variables for the study were subjected to stationary test using Im, Pesara n & Shin Test and Levin, Lin & Chu display that all variables were integrated at order zero I(0) and order one 1(1). The panel data were subjected to a colleration matrix in order to check for multicollinearity among the variables Therefore, the result finds absence of multicollinearity. The Hausman test were conducted to determine whether either fixed or random effect model is suitable for the study. While the two-system Generalized Method of moment (GMM) approach were also employed to test the hypotheses and the presence of a long-run co-integration connection was indicated. The finding reveals that energy consumption and Domestic Credit to Private Sector have a positive and significant effect on Real Gross Domestic Product of sub-Saharan Africa.While, electricity consumption and money supply have a joint negative and significant effect on Real Gross Domestic Product of sub-Saharan Africa. The finding is related to the finding of Ismail et al (2016) who established that energy consumption had a long term cointegrating relationship with economic growth. Also, the finding is in agreement with the finding of Bekun and Agboola (2019) who found that there is a substantial and positive association between economic growth and Domestic Credit to Private Sector.

Based on the finding, the study concludes that energy consumption and financial development play a significant role in enhancing economic growth of sub-Saharan Africa. The paper highlights the need for sustainable population policies and energy strategies in Sub-Saharan Africa. It emphasizes the importance of investing in renewable and efficient energy sources to promote economic growth while minimizing environmental costs. The implications of these findings are significant for policymakers, researchers, and development practitioners in Sub-Saharan Africa.

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