Modelling the nexus between finance, government revenue, institutional quality and sustainable energy supply in West Africa

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Abstract

The present study examined the relationship between finance, government revenue, institutional quality and sustainable energy supply in West Africa countries over annual frequency period from 2012 to 2020. To achieve the outlined nexus between study variables, the present study leverages on a battery of panel analysis for robust inferences. The econometric estimators employed are panel random effect regression, generalized method of moment technique. Furthermore, panel Granger causality test is utilized to analyze the direction of flow among the variables for the study. Empirical results revealed that financial development is a significant determinant of energy supply in West Africa countries while a negligible effect was reported for institutional quality and sustainable energy supply. Thus, the present study concludes that finance from financial sector is important in ensuring sufficient energy supply. To this end, this study therefore, recommends that incentives should be given to financial institutions that fund energy generation and transmission as financial development is seen to be significant on energy supply.

Keywords: Finance, Government revenue, Institutional quality, Sustainable energy supply, Panel econometrics, West Africa

1 Introduction

In recent years, the literature on economics has begun to pay more attention to sustainable energy infrastructure as a key tool in the development process (Ekeocha et al. 2021; Mohsin et al. 2021; Baita 2020; Fan & Hao 2020). It is well acknowledged that the development of the energy sector is essential for economic expansion. For economic activity as well as for the general health and wellbeing of communities, access to a sufficient energy supply is essential (African Development Bank 2023). Furthermore, development and expansion of energy infrastructure, expansion of energy access and high-quality energy infrastructure enhances country's regional and global competitiveness as well as economic productivity, reduces production costs and promotes economic modernization (Dong et al. 2021). Improved infrastructural facilities boost intra-regional trade and investment flows, which are essential for the development of markets, accelerating

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growth, and eliminating poverty (Dong et al. 2021; United Nations Conference on Trade and Development UNCTAD 2013).

To achieve the Millennium Development Goals (MDGs), reliable, affordable, and fundamental energy must be provided. The International Energy Agency World Energy Outlook (2004) projects that between 2002 and 2030, energy demand would increase by 60%. Energy will be needed and demanded in particular by developing nations like those in Africa as they continue to industrialize and start to prosper. In addition, some African economies operate as weak and ineffective systems as a result of their deteriorating infrastructure. Some of the power plants in Africa were constructed in the 1970s and are still in use today without any significant renovations or upgrades. Additionally, under the monopoly of a government agency, power generation, production, and distribution have been ineffectively and badly managed (Babatunde et al. 2023). Sub-Saharan Africa is still experiencing a power crisis with insufficient, unstable, and expensive electrical supplies. Energy supply in sub-Saharan Africa has remained low and mostly unstable over the past two decades, while the rest of the world's energy supply has improved (International Monetary Fund 2014; Musibau et al. 2019; Energy Information Administration 2018). Additionally, the average cost of providing electricity in Africa is astronomically expensive; it can occasionally reach US$0.15 per kilowatt-hour. Governments around the world have realized the problems associated with poor energy supply and have put in place measures to improve the supply of energy both at global and regional levels. An important element in addressing these infrastructure needs is funding, which has been highly constrained. Mobilizing financing often proves difficult because the government revenue base is limited. According to Mutua (2016), funds from the government have been used throughout history to embark on various activities. Some of which are costs incurred for maintenance of law and order, the safeguarding of private property and public economic infrastructure, and similar activities.

Modern civilization comes from development and in order to carry out development across any society, the responsibility lies with the government to provide direct development to people. The plan of improving energy infrastructure in Africa depends on depth evaluation of how fiscal resources are allocated and financed for the fact that government bears the brunt of financing while private participation remains limited (Africa Energy Outlook 2022). Therefore, the importance of government funds in promoting infrastructural facilities and development of any nation cannot be overemphasized.

Similarly, there is a need to consider the funding from financial institutions. According to Hall et al. (2017), financial sectors are germane for enhancing energy transitions of any nation. Kolawole et al., (2022) asserts that the financial sector is crucial to the transformation of the supply-side structure and that banks should keep lending to eligible infrastructure enterprises while stopping to fund "zombie" industries. Savings rates, investment choices, technical advancement, and ultimately production choices for energy firms may all be influenced by financial systems. Furthermore, institutional strength and infrastructure can have a significant impact on a country's trading performance (Borojo and Yushi 2020). These demonstrate how organizations can impact the availability of electricity. This merely raises the issue of how reliable the institutions that set the laws for the nation's public sector are. Strong institutions should prevent corruption from occurring and ensure that all participants in economic transactions operate on

an even playing field. Improvement of economic output, strong institutions are thought to set up an incentive structure that minimizes risk and maximizes productivity (Surya et al. 2021). This in itself can improve the supply of electricity and its reliability. Strong institutions can stimulate economic growth because they set transaction costs, encourage contract formation, and ensure that contracts are upheld (Akeju et al. 2022).

Several studies (Prempeh 2023; Lefatsa et al. 2021; Ali et al. 2015) have considered the effect of finance on energy facility using stock market capitalization while ignoring the effect of other non-banking institutions and financial market on energy provision. However, this study uniquely considered financial development index thereby considering the effect of both banking institutions and non-banking institutions as well as the effect of financial market development on energy supply in West Africa. Furthermore, incidents of poor performance persist in the banking business of West African countries. However, despite the government's efforts to direct credit to the productive sector through deposit money banks, a large share of credit transactions in the region continued to occur in the informal markets (Nnanna 2014). Similarly, West Africa countries is the worst region with crises of energy and also the region with underdeveloped financial system in the world. According to World Bank (2023), two hundred and ten million people in West Africa do not have access to power, and the region also has some of the highest electricity bills in all of sub-Saharan Africa. In addition, this study also considered the effect of government revenue on energy supply in West Africa as the financing of infrastructure is a major brunt of government. Hence, the need to consider the impact of government revenue on energy supply in West Africa. Similarly, there is a need to consider the impact of institutional quality on energy supply as a poor institutional quality can be a bane of energy instability because all investments to energy supply can be diverted. Hence, this study constructed an institutional quality index by using institutional quality variables such as rule of law, regulatory quality, political stability, government effectiveness, voice and accountability and control of corruption. In addition, this study also considered the role of interest rates on energy supply. Interest rates as assumed by classical theory of interest serve as an underpinning factor in financial development. Therefore, there is a need to consider the impact of interest rates on energy supply in West Africa. Finally, this study also made use of panel data analysis unlike the previous studies that considered times series analysis. This study considered panel Generalized Method of Moment (GMM) technique. The motivation of this study was necessitated from the need to reduce energy crises in West Africa which has served as an inhibiting factor to the development of the region.

The remainder of the study proceed with conceptual and empirical review of related literature on the theme under review in Sect. 2 while Sect. 3 deals with the data and method section. Subsequently, Sect. 4 presents the results and discussion. Finally, Sect. 5 concludes the study with policy synopsis.

2 Literature review

2.1 Fiscal federation theory

The theoretical underpinning for fiscal federation theory is the theory of public goods that establishes the framework as well as explains the important role played state in the economy (Arrow 1970; Musgrave 1959). The purpose of this research is to examine the

function of government in addressing market failures. When the market fails to provide for some types of public goods, the government is required to step in. Since the private provider will under-invest in the supply of public goods since the advantages accruable to the firms would be significantly lower than the entire benefit to society. Economics teaches us that public goods will be underprovided if left to private market mechanisms.

It was believed that governments and their officials would act as guardians of the public interest, prioritizing social welfare out of altruism or, in democracies, a desire to win votes. The underlying theory in question is a Keynesian one that argues for a more active state engagement in the economy and provision of social welfare.

2.2 Supply leading hypothesis

Schumpeter in (1911) proposed this theory which received support from other scholars such as Shaw (1973), McKinnon (1973), and Gupta (1984). According to the supply-leading theory, progress in the financial sector is the key to economic growth. There would be no need for financial middlemen in a world without transactions, information, and monitoring costs. It is impossible for economic agents to deal with one another if the costs of doing so (transaction, information, and monitoring) are too high.

Financial institutions and markets were therefore established to facilitate exchanges and lower transaction costs. According to supply leading hypothesis, intermediation efficiency can be improved and transaction, information, and monitoring costs can be lowered if the financial industry is adequately developed. It encourages money to be pooled, beneficial company ideas to be identified and funded, management effectiveness to be tracked, trading to be facilitated, risks to be diversified, and goods and services to be freely traded. Faster technical innovation, improved energy supply, more efficiency in resource allocation, and faster buildup of physical and human capital are all outcomes of financial development.

2.3 Financial development and energy/electricity supply

The works of Prempeh (2023), Lefatsa et al. (2021), Ali et al. (2015) revealed that economic growth and financial development affect the use of electricity. According to Prempeh's (2023) findings, there is a positive, long-term and short-term link between energy consumption and development of financial sector. The relationship is unidirectional, and consumption of energy results from development of financial sector and it was also revealed that the increase in prices of energy impacts negatively on supply of electricity. However, Ali et al. (2015), revealed from their study that over time the negative impact from both increase in price and financial development becomes negligible on energy consumption.

Globally, development of financial sector has a considerable beneficial effect on the use of electricity, and its two components; the financial market and financial institutions have a similar impact (Sun et al. 2023; Ma and Fu 2020). According to Ma and Fu's (2020) analysis of national disparities, the financial development additionally has a favorable impact on usage of energy in emerging nations, although not in a way that is readily apparent in developed ones. While the work of Sun et al. (2023) reported that financial development does not have favorable impact in emerging nations. As a result, from a global viewpoint, financial development cannot be utilized to curb rising energy

consumption, and policymakers in emerging nations must strike an appropriate equilibrium between the growth of the financial sector and increased consumption of energy (Ma and Fu 2020). For instance, in West Africa, Kolawole et al (2022) affirmed that appropriate power generation increase investment in any country, it is clear that access to energy has an immense effect on domestic investment.

In the short run, the energy consumption across China is positively related with economic and financial development. Although in the long term it has a negative relationship with financial development in western China, it has a positive relationship in eastern China over the long run. It must also be noted that the positive relationship in Eastern China is causal in nature. The financial development of China has been boosting electricity from energies unilaterally in both eastern and western China (Guan et al. 2021).

2.4 Institutional quality and financial development

Several studies have reported institutional qualities to have a major impact on financial development (Abaidoo and Agyapong 2022; Alawi et al. 2022; Batila Ngouala Kombo and Bongo Koumou 2021; Negash & Hongbing 2021; Khan et al. 2020; Fagbemi & Ajibike 2018). Consequently, when the individual elements of the institutional quality indicators are considered, namely: regulatory quality, voice and accountability, governance effectiveness, rule of law seem to have a very favorable impact on financial development (Abaidoo & Agyapong 2022). Khan et al. (2020) refuted the findings of Abaidoo and Agyapong (2022) by pointing at the rule of law as a negative index of financial development in most of the countries around the world with a very weak rule of law, but affirmed the control of corruption as an indicator of a beneficial effect on financial development. Additionally, political stability and the quality of regulation typically have a negative impact on the degree of financial development, whereas the control of corruption and adherence to legal requirements have a positive impact (Batila Ngouala Kombo and Bongo Koumou 2021).

Furthermore, Fagbemi and Ajibike (2018) argued that weak institutional frameworks, particularly in Nigeria, make it less likely for regulatory effectiveness and governance systems to support financial development. According to Alawi et al. (2022), low institutional quality harms financial development in an emerging market. In a nutshell, financial development can be encouraged by effective institutions. Countries with high-quality governance and institutions have more developed financial sectors. Thus, when they are improved in unit, the institutional quality has a significant and favorable effect on financial development (Negash et al. 2021).

2.5 Institutional quality and electricity/energy supply

A dependable and efficient electricity sector is a true engine of growth in an economy. Institutional quality has an impact on how electricity is supplied and accessibility (Mahmood et al. 2021; Pavlyk 2020; Anwana 2016). According to Pavlyk (2020), improving political stability and governmental effectiveness by one mind unit each results in a decline in the energy effectiveness gap of 0.47 and 0.54 dm. units, respectively. Also, Pavlyk (2020) further confirmed that institutional factors have a substantial statistical effect on the energy effectiveness gap by proving statistically that enhancing the general level

of regulatory compliance and enhancing the rule of law, respectively, results in energy usage increases of 0.34 and 0.41 dm units.

Mahmood et al. (2021) also pointed out that regulatory quality indicators raise accessibility to all forms of electricity, both renewable and non-renewable. Governance effectiveness impacts positively on various energy supply aside the generation from natural gas that rule of law impacts negatively. The lessening of corruption benefits the use of natural gas (Mahmood et al. 2021). Renewable energy sources benefit from political stability, while non-renewable energy sources suffer. On non-renewable sources, the impacts of economic growth and the majority of governance variables are shown to be more pronounced than on renewable sources. To maintain a long-term solution between renewable and non-renewable energy sources accessibility, Mahmood et al.'s (2021) findings suggest that countries should concentrate on enhancing political stability, rule of law, governance effectiveness, corruption control, and regulatory quality. Contrary to Mahmood et al.'s (2021) findings, Anwana (2016) confirmed that institutional qualities do not favorably influence the development of the electrical supply. Hence, he came to the conclusion that institutional quality has a negative impact on the supply of electricity and consequently restrains the steady growth of the electricity supply.

2.6 Financial development and government revenue

Hussein and Abdallah (2022) and Samira and Toufik (2021) revealed from their study that financial development has an unintended effect on government revenue through channels for trade and economic expansion. The findings of Samira and Toufik (2021) demonstrate a favorable relationship between financial development and revenue from taxes for the government. Therefore, Hussein and Abdallah (2022) claimed that financial development is a useful aid instrument at the government's disposal to increase the amount of tax collection and consequently, economic growth. In order to collect taxes, financial system parameters such as banking development, stock market development, banking crises, and financial inclusion variables are crucial (Ajide and Bankefa 2017).

Furthermore, the financial sector in general, and financial markets and institutions in particular, play a crucial influence in economic development. A breakdown of the two indicates that the comprehensiveness of financial institutions is what contributes most for government revenue, with a 1% change projected to result in a 0.26% shift in government revenue collections (Nnyanzi et al. 2018).

3 Methodology sequence and data

This study employed the use of secondary data obtained from World Development Indicators, World Governance Indicators and International Monetary Fund to achieve the stated study objective over the period of 2012 to 2020. The data for energy supply, interest rates, exchange rates, government revenue were obtained from World Development Indicators while the data for institutional quality were obtained from World Governance Indicators. Finally, the data for financial development were obtained from International Monetary Fund. The countries considered in the study are 16 West African countries namely, Benin, Burkina Faso, Cape Verde, Guinea, Gambia, Senegal, Guinea Bissau, Nigeria, Niger, Togo, Côte D'Ivoire, Ghana, Liberia, Mali, Mauritania, Sierra Leone, To

achieve these objectives, the study employs panel random effect regression, dynamic panel Generalized Method of Moments and panel Granger causality test. Panel data estimation, according to Kolawole (2020), produces more substantial (positive) impacts than time-series estimation per individual country. Random effects regression model is important because it can be used to estimate the effect of individual-specific characteristics that are inherently unmeasurable. Similarly, dynamic panel Generalized Method of Moments helps to remove biasness from unobserved firm specific effects as well as eliminates effects from simultaneity bias.

3.1 Model specification

To achieve the objective of the study which is to examine the impact of finance, government revenue, institutional quality and sustainable energy supply in West Africa, the following model is specified:

$$\text{ES} = f(\text{FD, GR, INSTQ, INT, EXR}) \tag{1}$$

Econometrically Eq. 1 is expressed as:

$$\Delta \text{ES}_{it} = \beta 0 + \beta_1 \Delta \ln \text{ES}_{it-1} + \beta_2 \Delta \text{FD}_{it} + \beta_3 \Delta \text{GR}_{it} + \beta_4 \Delta \text{INSTQ}_{it} \\ + \beta_5 \Delta \text{INT}_{it} + \beta_6 \Delta \text{EXR}_{it} + \mu_i + \varepsilon_{it} \tag{2}$$

where ES is the energy supply, FD is the financial development, GR is the government revenue, INSTQ is the institutional quality (proxy with rule of law, regulatory quality, political stability, government effectiveness, voice and accountability and control of corruption), INT is the interest rates, EXR is the exchange rates, ε_{it} is the error term which account for other possible factors that could affect energy supply.

In order to examine the direction of causality between the dependent and independent variables, the following granger causality model is specified:

$$Y_{it} = \sum_{i=1}^{n} \alpha_{11i} X_{t-i} + \sum_{j=1}^{n} \beta_{11i} Y_{t-j} + \mu_{11t}, \tag{3}$$

$$X_{it} = \sum_{i=1}^{n} \alpha_{21i} Y_{t-i} + \sum_{j=1}^{n} \beta_{21i} X_{t-j} + \mu_{21t}. \tag{4}$$

Equations 3 and 4 represent the main Granger causality models for this study.

4 Empirical interpretation and discussion

This section proceeds with preliminary analysis which comprises basic summary statistics and correlation. The summary data from the all the countries are presented in Table 1.

Descriptive statistics are presented in Table 1 to show the nature of the data used over the period of 2012 to 2020. The results showed that, on the average, energy supply (ES), financial development (FD), government revenue (GR), institutional quality (INSTQ), interest rate (INT) and exchange rate (EXR) are 43.68996, 0.3975295, 5.734186, 6.2e-09, 5.27696 and 1233.239, respectively. The standard deviations are 22.01112, 1.332264,

Table 1 Descriptive statistics. Source: Author's computation (2023)

Variables	(1)	(2)	(3)	(4)	(5)
	N	Mean	Std. Dev	Min	Max
ES	144	43.68996	22.01112	9.107472	94.16174
FD	144	0.3975295	1.332264	0	8
GR	144	5.734186	8.355381	0	31.11348
INSTQ	144	6.2e−09	1.00002	− 1.578411	2.483667
INT	144	5.27696	6.448172	− 6.197769	32.76795
EXR	144	1233.239	2430.184	1.824867	829.927

8.355381, 1.00002, 6.448172 and 2430.184 for the variables, respectively. While the minimum and the maximum for the variables are as follows: the minimum and maximum for energy supply is 9.107472 and 94.16174. Financial development varies from 0 to 8 while that of government revenue varies from 0 to 31.11348. The minimum value for institutional quality is -1.578411 and the maximum is 2.483667. Also, INT has a minimum of -6.197769 and maximum of 32.76795. Finally, EXR varies from 1.824867 to 9829.927 across West Africa countries over the period considered. This revealed enormous variation of the variables for the covered period, thereby it worth investigation.

The existence of multicollinearity will make the results of multiple regressions unreliable because they are based on inaccurate estimates. This study performed a correlation test to look for evidence of multicollinearity. Table 2 presents the results of the correlation and multicollinearity. All tests, however, showed that the independent variables were significantly lower than 0.5. Similarly, the vector inflation factor (VIF) shows financial development, government revenue, institutional quality, interest rate and exchange rate to be 1.04, 1.30, 1.29, 1.08 and 1.17, respectively. As a result, there exist no multicollinearity among the variables.

Panel data regression was used to investigate the effects of finance, government revenue, institutional quality and energy supply in West Africa. The result is displayed in the Table 3. The dependent variable is energy supply while energy supply while financial development, government revenue, institutional quality, interest rates and exchange rates are the independent variables.

To check the validity of the result, diagnostic tests were conducted and the results are presented in as follows. The Wald Chi2 statistic 171,379.75 with probability value 0.003 indicates that the model has a good fit. Moreover, the Sargan test statistic is 35.96 with probability value 0.377. The null hypothesis of the test that over identifying restrictions are valid therefore cannot be rejected. Furthermore, the Arellano–Bond test for zero autocorrelation in first-differenced errors shows that the Z-statistic of the second order (AR 2) is 1.84 with probability value 0.165. Hence, the null hypothesis of the test, no autocorrelation, cannot be rejected. Hence, there is no problem of autocorrelation in the model.

In addition, the Breuschh–Pagan test is run to decide which method between pooled OLS or random effect model is more suited, and the results demonstrate that the latter is. When both the fixed and random effects models provide a satisfactory fit, however, the Hausman test is utilized to compare and contrast the two. The

Table 2 Correlations matrix of panel analysis variables. Source: Author's computation (2023)

Variables	FD	GR	INSTQ	INT	EXR	VIF
FD	1.000					1.04
GR	0.160	1.000				1.30
INSTQ	− 0.028	0.417	1.000			1.29
INT	− 0.078	− 0.160	− 0.040	1.000		1.08
EXR	− 0.074	− 0.235	− 0.308	− 0.157	1.000	1.17

Table 3 Regression for West Africa countries

	Energy supply			
	OLS	FE	RE	GMM
ES-L1	–	–	–	0.99145*** (0.01898)
FD	− 1.62108** (0.11611)	− 1.47898*** (0.48477)	− 1.49983*** (0.49783)	0.42324*** (0.08969)
GR	0.447291** (0.199405)	0.07714 (0.07508)	0.10801 (0.07681)	− 0.01474 (0.03066)
INSTQ	11.3402** (1.65857)	− 1.87873 (1.23340)	− 0.92777 (1.23765)	0.31459 (0.46837)
INT	0.20353 (0.23505)	− 0.26015*** (0.08579)	− 0.26157*** (0.08832)	− 0.02366 (0.029089)
EXR	− 0.00048 (0.00065)	−0.00220*** (0.00070)	0.00173** (0.00068)	8.89021*** (0.00005)
Constant	41.28902*** (2.63576)	42.48634*** (1.18461)	42.90545*** (5.14086)	2.06972*** (.95597)
Diagnostic tests				
Wald Chi2 statistic	171,379.75(0.000)			
Sargan test statistic	35.96 (0.377)			
Autocorrelation test (Arellano–Bond test) AR(2)	1.84 (0.065)			
Hausman test	10.44 (7.49)			
Breusch–Pagan/Cook–Weisberg test	13.48 (0.0193)			

Standard errors in parentheses, *** and ** denote 1% and 5% levels of significance, respectively

Chi-square statistics for energy supply for West Africa countries in the Hausman test is 10.44, with P-values of 7.49. Since, the P-value is greater than 5% level of significance, the null hypothesis is not rejected, and the result of the random effect model supersedes. The results of random effect model revealed that financial development, interest rates and exchange rates are significant determinant of energy supply in West Africa countries at 1% and 5% level of significance. This is due to the fact that half the values of the coefficients of these variables are greater than the standard errors of the coefficients. Therefore, funds from financial sector to energy sector in West Africa will improve the accessibility of energy by the people of that region. Similarly, reduction in interest rates and exchange rates will improve accessibility of energy in West Africa. The coefficient value of financial development is 1.49983 while the standard error shows 0.49783. The coefficients of interest rates and exchange rates are − 0.26157 and − 0.00173 while the standard errors are 0.08832 and 0.00068, respectively. Although, financial development shows a positive relationship while interest

rates and exchange rates show negative relationship with energy supply in West Africa countries. This demonstrates that funds from financial sector to energy sector have helped to improve the accessibility of energy in West Africa with more investment in generating and distribution of energy. Therefore, there is a chance that energy supply will improve as a result of rising financial development as well as reduction in interest rates and exchange rates.

Similarly, the results of the Generalized Method of Moments revealed that lag of energy supply, financial development and exchange rates are significant determinant of energy supply in West Africa countries. This is because the half of the value of coefficients lag of energy supply, financial development and exchange rates are greater than the standard errors. The value of the coefficients of lag of energy supply, financial development and exchange rates are 0.99145, 0.42324 and 8.89021, respectively, therefore the half of the coefficients are greater the standard errors of lag of energy supply, financial development and exchange rates which are 0.01898, 0.08969 and 0.00005, respectively. Hence, lag of energy supply, financial development and exchange rates are significant determinant of energy supply in West Africa countries. Energy supply was found to be positively related to lag of energy provision and financial development, but negatively

Table 4 Panel causality for West Africa countries. Source: '≠>' implies that there is no Granger causality between the variables

Null hypothesis	Obs	*F*-Statistics	Prob
FD≠>ES	144	3.10786	0.0488
ES≠>FD		0.67773	0.5099
GR≠>ES	144	1.79361	0.1713
ES≠>GR		0.15864	0.8535
INSTQ≠>ES	144	1.75248	0.1783
ES≠>INSTQ		0.15864	0.0050
INT≠>ES	144	0.19655	0.8219
ES≠>INT		0.65941	0.5192
EXR≠>ES	144	0.13065	0.8777
ES≠>EXR		0.38273	0.6829
GR≠>FD	144	0.84019	0.4345
FD≠>GR		0.41050	0.6644
INSTQ≠>FD	144	0.42289	0.6562
FD≠>INSTQ		0.21113	0.8100
INT≠>FD	144	0.07090	0.9316
FD≠>INT		0.16230	0.8504
EXR≠>FD	144	0.04475	0.9316
FD≠>EXR		0.01800	0.9822
INSTQ≠>GR	144	3.36277	0.0383
GR≠>INSTQ		6.41813	0.0023
INT≠>GR	144	0.49187	0.6129
GR≠>INT		0.38319	0.6826
EXR≠>GR	144	0.19320	0.8246
GR≠>EXR		0.26473	0.7679
INT≠>INSTQ	144	1.18541	0.3096
INSTQ≠>INT		0.62261	0.5385
EXR≠>INSTQ	144	0.00545	0.9946
INSTQ≠>EXR		0.16520	0.8479
EXR≠>INT	144	0.12578	0.8819
INT≠>EXR		0.72627	0.4861

related to the exchange rate in West African countries. Thus, an improved financial services to energy sector will improve accessibility of energy in West Africa.

To investigate the direction of causality between finance, government revenue, institutional quality and sustainable energy supply in West Africa countries, Granger causality test was used and the result for all the countries considered in the study. The outcome of the results is presented in Table 4. According to the results of the causality relationship of all the variables, there is a unidirectional causality from financial development to energy supply in West Africa countries. Similarly, there exists a unidirectional causality from energy supply to institutional quality, while there exists a bi-directional causality between institutional quality and revenue generation in West Africa countries.

4.1 Discussion of findings

The study revealed that there exist a positive and significant relationship between financial development and energy supply. This is consistent with the works of Sun et al. 2023; Ma and Fu 2020. Hence, the null hypothesis that there is no significant relationship between financial development and energy supply should be rejected. Therefore, the development of financial sector will lead to more finance to energy supply.

Government revenue shows non-significant relationship with energy supply, this buttress the fact that the energy crises in West Africa countries was as a result of poor revenue generation from governments of the region. Hence, governments from the region must as a matter of urgency look for ways of generating more revenue so as to have enough funds in financing energy supply of the region. This study is consistent with fiscal federation theory which states that government influences the development of infrastructures. The underlying theory in question is a Keynesian one that argues for a more active state engagement in the economy and provision of social welfare. It was also revealed that institutional quality seems to have negligible impact on energy supply. Therefore, strong institutions must be built in order to ensure that the little funds are judiciously utilize in funding energy supply. This is consistent with the study of Mahmood et al. (2021) and Anwana 2016.

5 Conclusion and policy recommendations

The role of financing in eliminating the energy crises cannot be overemphasized. The study concluded that finance; both from governments and financial sector are important in ensuring sufficient energy supply in West Africa countries. This study recommends that incentives should be given to financial institutions that fund energy generation and transmission in West Africa countries as financial development is seen to be significant on energy supply. Furthermore, this study recommends that governments of West Africa countries should seek for ways to improve their revenue generation as funding of energy supply is an onus that must be taken by government. In addition, poor institutions are seen as a bane to development of energy supply hence institutions in West Africa must be built so as to guide against wasting the little resources committed to energy supply. The need for data processing and the use of proxies, the data's accuracy might have been compromised. However, this study carefully considered and ensured adequate compliance with all the necessary tests. Hence, the policy recommendations of this study are

needed for improved energy supply in West. Future studies should try to consider the impact of government expenditure on energy supply.

Declarations

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