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Nexus of Access to Electricity and Financial Development in Namibia: Application of Fourier Cointegration and Frequency Domain Causality

Teboho Jeremiah Mosikari*

Department of Economics, North-West University, Mafikeng, South Africa.
*Email: tebohomosikari@gmail.com

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ABSTRACT

This work investigates the relationship between access to electricity and financial development in Namibia. Three different forms of electricity access have been used in the analysis and the data is collected from World Development Indicators (WDI) for the span 1992-2022. The paper used the Fourie cointegration and frequency domain causality analysis to determine cointegration and direction of the causality at different frequencies. Based on three equations measuring access to electricity by different receipts it was determined that there is cointegration among access to electricity and financial development. Overall results shown a positive connection among financial development and access to electricity. Long-run findings indicate that there is causality moving from access to electricity for total population will lead to financial development. These findings suggest that as more people in Namibia have access to electricity this will lead to financial development. Policy implication suggested is that financial sectors must develop a reasonable and enabling energy loans (capitals) via tax holidays on sustainable energy connections for urban and rural areas.

Keywords: Financial Development, Electricity Access, Cointegration, Frequency Domain Causality Test, Namibia
JEL Classifications: G50, Q43, C51, C22

1. INTRODUCTION

Recently many developing countries are trying to find ways to achieve sustainable energy services, which is important to lift people out of poverty. However, the challenge remains on providing access for all population. Energy plays critical role for most functions in modern economy. It should be noted that the study of energy economics pertains to the utilisation of electricity by humans, including how it is generated. Energy provides a valuable impact in our lives, and it helps to fulfil some of the needs, such as heating, and cooking. According to UN perspective: Sustainable Development Goal 7: "Ensure access to affordable, reliable, sustainable and modern energy for all." Understanding different energy bases is essential. As it is mentioned earlier, various aspects of quality of life, including poverty reduction, economic growth, and living standards are heavily dependent on electricity supply. Therefore, determining the population with electricity access is a crucial socio-economic indicator. The most significant economic obstacle is the absence of electricity, which obstructs people's participation in the economy (Pan et al., 2023).

The availability of electricity in Namibia is crucial for manufacturing, as it provides energy to machines and technologies used to manufacture physical products (Owolabi et al., 2021). Energy in Namibia is largely dependent on imports. All fossil fuels, including coal and other forms of energy, must be imported. Although it has a small population and only produces around 40% of the country's electricity, this power source is only capable enough to meet the 56% electricity demand, International Energy Agency (2022).

Theoretically, many scholars have argued that financial development could be used to improve access to electricity. Owolabi et al. (2021) described financial development as "the advancement of an economy in terms of measurable indicators capturing the extent to which individuals access financial services." Financial development is also one of the essential factors to economic development, but how financial development is associated with electricity access is complex. Financial development can influence electricity access directly, where financial development could make consumers effortlessly borrow money to pay for electricity connection fees to subscribe for electrification if there is no government intervention to connect the population to power grid (Sadorsky, 2010).

Numerous applied research has evaluated the connection in relation to financial development and electricity access through diverse frameworks. This paper is outstanding from the existing literature and contributes to the debate in various ways. Firstly, in view of existing evidence, this might be earliest paper to investigate the role of financial development on electricity access in developing economy like Namibia. The choice of the Namibia as a country was inspired by the fact that it is among the lowest countries with low electricity access. Namibia electricity access for 2021 was 55.23%, a 2.93% increase from 2020. Secondly, the paper intent to provide insight on the impact of financial development on electricity access in three approaches; the percentage of the aggregate population with access to electricity and the proportion of the urban and rural population with access to electricity. By comparing the role of financial development on electricity availability across different locations, this method can determine which residents benefit among urban and rural areas. The statistics from World Bank (2023) indicate that urban electricity access is 74.8% in 2022, and rural access is 32.2% in 2022. Therefore, the comparison between urban and rural it makes an interesting case to analyse these vast inequalities between the population. This approach will suggest a more specific energy policy recommendation. Finally, from an econometric standpoint, our paper enriches the literature by applying the Fourier cointegration and frequency domain causality. This robust estimation method considers the role of structural breaks either sharp or smooth in the data and frequency domain causality that enables the researcher to establish causality in different frequencies such as short-, medium- and long-term periods.

Hence, the general the purpose of our investigation is to probe the role of financial development electricity access in Namibia. The paper intends to respond to the following questions: (1) What is the effect of financial development on electricity access in urban and rural areas of Namibia? (2) Is there causal relation among electricity access and financial development in long, medium and short term? Therefore, this investigation is structure as follows: Section 2 offers the survey on past studies. Following is the strategy of estimation and data description. Part 4 is the empirical results. The last section provides the conclusion of the paper.

2. PAST STUDIES

The empirical studies between financial development and electricity access have conducted in cross country studies. The studies include the work of Ma and Fu (2020), Tinta et al. (2021) and Thebuho et al. (2022) just to mention the few. Khan and Majeed (2023) used econometric methods like pooled ordinary least squares (OLS), fixed effects (FE) and random effects (RE) models to examine the role of financial development on energy poverty. The paper found that using the data for the period 1990-2020 for 110 developing countries, financial sector development projects a positive link on energy poverty. The suggestion of this results is that, as financial development increase this will amplify energy poverty. Ma and Fu (2020) explode the impact of financial development on energy spending worldwide. The study applied a sample of 120 economies and employing the generalised method moments (GMM). An investigation concluded that financial development increase energy spending in the long run. Tinta et al. (2021) studied the correlation among economic growth, financial development, and energy spending in Sub-Saharan African countries. The paper used a panel of 48 economies over the span 2000-2019. The paper concluded that financial development directly influences renewable energy spending in Sub-Saharan Africa. The study further inferenced that a 1% rise of financial development accelerate renewable energy spending by 0.275%. Matar (2020) study investigated the time–frequency dependencies among financial development and electrical power spending for the period 1980-2017. The study incudes the sample of Gulf Cooperation Council (GCC) countries which are Qatar, Saudi Arabia, Kuwait, the United Arab Emirates, Oman, and Bahrain. The results from a wavelet analysis demonstrated that energy spending is strongly associated to financial development over many high frequency periods. Liu and Li (2020) explored the spatial influence of financial development on energy spending in China. The paper used a panel of 278 cities in China to investigate the phenomena. For the period 2005-2016 the study established that financial development has greater influence on residential energy spending in larger cities.

Thebuho et al. (2022) analysed the symmetric and asymmetric association among financial development and energy spending in 21 sub-Saharan Africa economies. Research applied ARDL panel estimator for the span 1990-2016. Findings indicates that in the long run cointegration exist between financial development and exogenous control factors and energy spending. The study concluded that a 1% rise in financial development amplifies energy spending by 0.12%. Asngar (2022) investigated the influence of financial development on access to electricity in 45 sub-Saharan Africa countries for the period 1997-2018. The study applied generalised method of moments (GMM) and concluded that, financial development directly impacts agrregate population with access to electricity. Furthermore, confirmed a direct influence of financial development on urban and rural populations with access to electricity. Adom (2021) studied the influence of financial development on electricity consumption in 45 African countries. The paper employed system GMM estimator for the 2000-2015. The result of the examination shows that financial has a significant indirect effect on electricity spending in the long run. The paper concluded that a percentage change in financial system reduce electricity consumption to by 0.11%.

It can be observed from cross sectional studies that there is overwhelming support for positive connection among financial development and access to electricity. Furthermore, the existing evidence in cross country studies especially in Africa shows conflicting results on studies related to financial development and access to electricity. It shows that Asngar (2022) and Thebuho et al. (2022) support the view, whereas Adom (2021) has the contradicting view on the connection among financial development and electricity access. Current studies on cross country studies applied panel methods which assumes common economic structures. Therefore, these studies lack to provide the unique analysis for Namibia as the interested case study.

The second strand of studies is the country specific studies, which most applied time series methods. Rafindadi and Ozturk (2016) observed the connection among economic growth and electricity spending, financial development in Japan. The study used ARDL for the period of 1970-2012. The study concluded that a 1% rise in financial development will accelerate electricity spending by 0.24%. Sbia et al. (2017) studied the nexus among economic growth, financial development, urbanisation and electricity consumption in United Arab Emirates (UAE). The paper applied a time series data for the period 1975-2011 by using ARDL model. Research confirms a direct relationship between financial development along with electricity spending. The inference of the paper concludes that a 1% increase financial development translate into electricity spending by 0.13%. Khan et al. (2021) studied the connection among financial development, access to electricity, and emissions in Pakistan. The study applied data for the period 1990-2015 using VECM granger causality. The confirmed that there is no causality existing among access to electricity and financial development. Ansu-Mensah and Kwakwa (2021) modelled the inluence of financial development on electricity spending in Ghana. The paper used ARDL for the period 1971-2019 to examine the phenomena. The study established that financial development indicators show an indirect impact on electricity spending in the long run. Sekantsi et al. (2016) investigated the impact of financial development, industrialisation, and urbanisation in Lesotho's energy-growth nexus. The paper applied a fully modified ordinary least square (FMOLS) for 1973-2012 for analysis. The paper established a direct connection among financial development and energy spending. Kassian and Innocents (2019) explored the link among financial development and renewable energy in Namibia. The study used a cross-sector data on renewable energy in Namibia. An investigation established that improvement in financial sectors is a paramount determining factor for renewable energy disposition in Namibia.

It can be observed from country specific studies a convincing conflicting correlation among financial development and access to electricity. It can be witnessed that studies such as Rafindadi and Ozturk (2016), Sbia et al. (2017), Sekantsi et al. (2016) and Kassian and Innocents (2019). Whereas, Khan et al. (2021) and Ansu-Mensah and Kwakwa (2021) support the different view on the connection among financial development and electricity access. Also, this conflicting evidence lack to provide the evidence on electricity access specifically since most are concern about the energy consumption. These existing studies most applied the methods that do not cater for structural break in the data. It is argued by the current study that it is necessary to use methods that can cater for structural changes since the variables such as access to electricity are influenced through government intervention as economic development goal.

3. ESTIMATION STRATEGY AND DATA

The reason of this research is to investigate the connection among financial development and access to electricity in Namibia. The study is interested to explore three components of electricity access which is total population, urban population, and rural population. Relative to the other control factors, the paper adopts the use of these variables: government expenditure and oil cost. Therefore, the study develops three variation of equations and are derived as follows:

$$LAT_t = \alpha_i + \alpha_1 LGDPP_t + \alpha_2 LDCP_t + \alpha_3 LGE_t + \alpha_4 LOIL_t + \varpi_t \quad (1)$$

$$LAU_t = \beta_i + \beta_1 LGDPP_t + \beta_2 LDCP_{it} + \beta_3 LGE_{it} + \beta_4 LOIL_t + \propto_t \quad (2)$$

$$LAR_t = \delta_1 + \delta_2 LGDPP_t + \delta_3 LDCP_t + \delta_4 LGE_t + \delta_5 LOIL_t + V_t \quad (3)$$

Where:
LAT_t is access to electricity for the total population.
LAU_t is access to electricity for urban population.
LAR_t is access to electricity for the rural population.
$LGDPP$ is gross domestic product per capita.
$LDCP_t$ is financial development.
LGE_t captures government expenditure.
$LOIL_t$ captures oil cost to the country.
V_t, ϖ_t, $\propto_t$ captures the error terms.

To estimate model (1) to (3), the research applies a time series data spanning from 1992 to 2022. The preference for this dates is completely centered on the obtainability of data. The explanation of variable under study are represented in Table 1 and all the data is obtained from World Development Indicator (WDI).

The paper estimates equation (1) to (3) using the Fourie cointegration developed by Yilanci (2019). Fourie cointegration is the "residuals augmented least squares" (RALS) techniques which allows for the estimation of cointegration in the presence of structural breaks. It is therefore, represented as follows:

$$LAT_t = \alpha_1 + \alpha_2 \sin\left(\frac{2\pi Kt}{T}\right) + \alpha_3 \cos\left(\frac{2\pi Kt}{T}\right) + \beta_i X_i + e_t \quad (4)$$

$$LAU_t = \alpha_1 + \alpha_2 \sin\left(\frac{2\pi Kt}{T}\right) + \alpha_3 \cos\left(\frac{2\pi Kt}{T}\right) + \beta_i X_i + e_t \quad (5)$$

$$LAR_t = \alpha_1 + \alpha_2 \sin\left(\frac{2\pi Kt}{T}\right) + \alpha_3 \cos\left(\frac{2\pi Kt}{T}\right) + \beta_i X_i + e_t \quad (6)$$

Where LAT_t, LAU_t, and LAR_t represent the dependent variables for each model and the $\beta_t X_i$ is independent variables for each model (already described in equation 1-3). The t and T terms represent the trend and sample size. The frequency K it is attained by residual sum of squares (RSS) with the lowest value.

Following, we therefore determine the existence of cointegration by testing for unit root features of the residuals of equation (4) to (6). It is therefore, described as the autoregressive model in equation (7):

$$\Delta e_t = \rho e_{t-1} + \sum \varphi_i e_{t-1} + \in_t \tag{7}$$

then we allow τ_{FEG} to display the t-statistics of the null proposition of no cointegration for each equation and presented as:

$$\tau_{FEG} = \frac{\rho}{se(\rho)} \tag{8}$$

Where ρ present the OLS estimator of ρ and $se(\rho)$ is the standard error of ρ. Furthermore, the paper used canonical regression to approximate the coefficients of the study. The canonical regression assumes the presence of cointegration, and it was developed by Park's (1992) which allows for a mixture normal distribution which is free of non-scalar nuisance parameters and permits asymptotic Chi-square testing.

In addition, the study following the work of Breitung and Candelon (2006), determined the asymmetric causality between access to electricity and financial development. This asymmetric frequency domain causality test is an effort to understand the causal direction between in different frequencies such as short run, medium term and long term. The study by Geweke (1982) and Hosoya (1991) advocated a causality dimension for the frequencies having an attribute based on the decomposition of the spectral density functions. According to Breitung and Candelon (2006) frequency domain causality intends to decompose variability in a time series into its periodic components, allowing a researcher to determine relatively more influential frequencies that influence to variations in the variables. Frequency domain causality determines if causal links between access to electricity and financial development change according to frequency at short, medium, and long term. For more theoretical framework for frequency domain causality follow the work of Breitung and Candelon (2006).

Modeling procedure: The paper firstly assesses the descriptive of the data, to understand the moments of the data employed. After the presentation on moments of data the paper applied the Mc. Leodi linearity test developed by McLeod and Li (1983) with a purpose to determine nonlinearities in the data employed. After, the paper conducts the nonlinear unit root tests such as KSS unit root established by Kapetanios et al. (2003).

4. EMPIRICAL RESULTS

Figure 1 shows the trends of LAR, LAT, LAU, LDCP, LGDPP, LOIL and LGE from 1992 to 2022 in Namibia.The plots of LAR, LAT, LDCP and LGDPP shows that over time there is upward trend, even thought that during 2020 there was some small shocks due to COVID. The plots LGE, LAU and LOIL the variables shows that overtime there some cyclical pattern in the data.

Table 2 offers a descriptive analysis of all variables of the study. The average value of access to electricity for total population (LAT) is 3.70, for urban population (LAU) is 4.28 and rural population (LAR) is 3.04. Financial development is 3.83, LGDPP is 8.23, government expenditure is 3.18, and. in terms of volatility, it shows that LDCP, LGDPP, LAT, LAR and LOIL they are more volatile compared to other variables.

Table 3 present Mc. Leodi test for nonlinearity. The results show that for all the variables used in the study they have nonlinear form. These results suggest that the data is suitable to be estimated using nonlinear models.

After testing for linearity, the paper applies the KSS test. Table 4 provides the results of this test. The null proposition is nonlinear unit root in LAT, LAR, LAU, LGDPP, LDCP, LGE and LOIL is

Table 1: Explanation of variables

Abbreviation	Unit of measure
LAT_t	Access to electricity (% of population)
LAU_t	Access to electricity, urban (% of urban population)
LAR_t	Access to electricity, rural (% of rural population)
LGDPP	GDP per capita (constant LCU)
$LDCP_t$	Domestic credit to private sector by banks (% of GDP)
LGE_t	General government final consumption expenditure (% of GDP)
$LOIL_t$	Oil rents (% of GDP)

Table 2: Descriptive results of the study

Variables	Mean	Standard deviation	Minimum	Maximum
LAT	3.705	0.220	3.273	4.011
LAR	3.041	0.357	2.217	3.502
LAU	4.284	0.032	4.189	4.361
LDCP	3.836	0.150	3.450	4.104
LGDPP	8.234	0.190	7.977	8.510
LGE	3.182	0.096	2.958	3.333
LOIL	−1.422	0.798	−4.889	−0.491

Table 3: Mc-Leodi linearity test

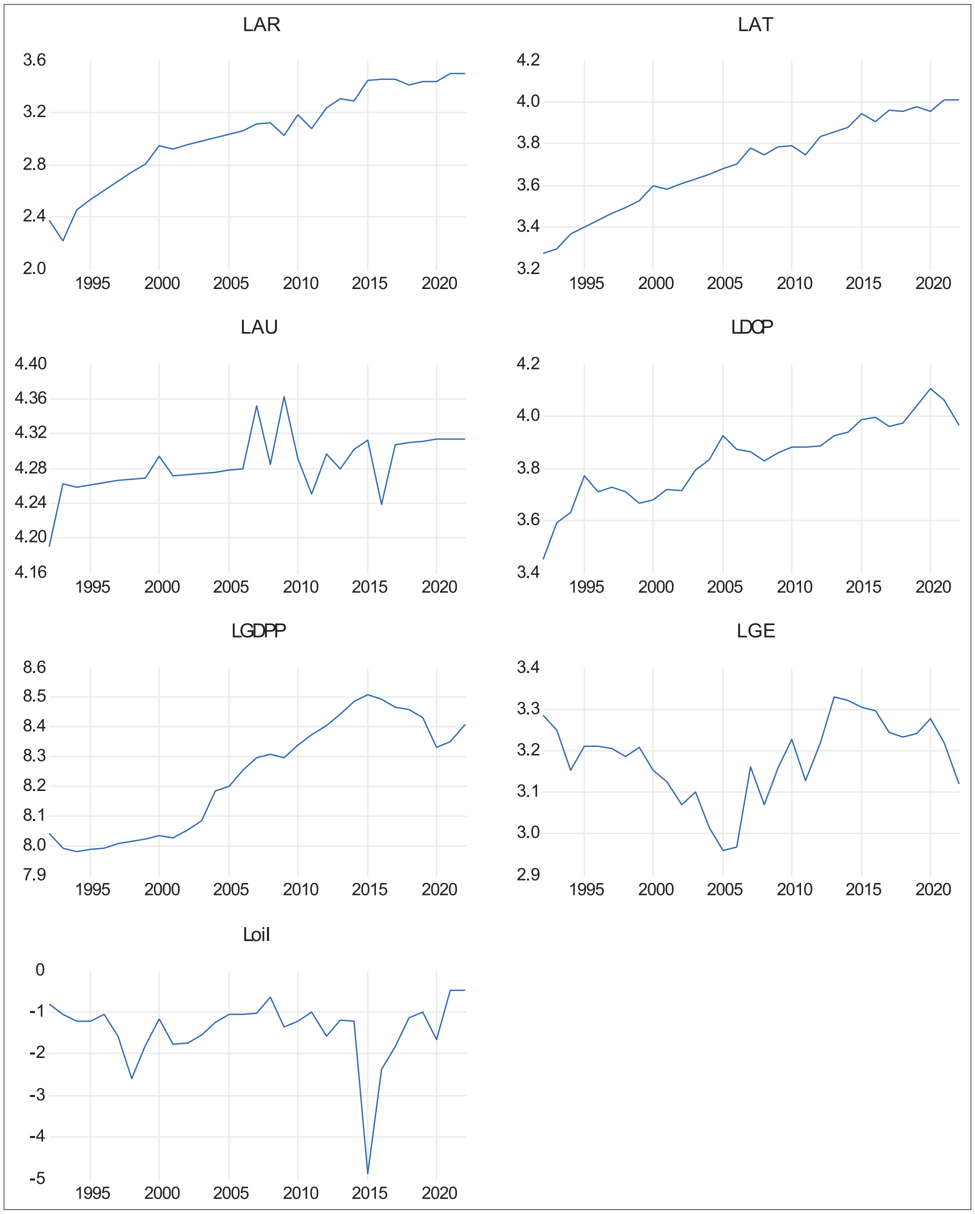
Variable	Lag	Mc-Leodi t-statistics	P-value
LAT	2	2001.826	0.000***
LAR	2	1985.68	0.000***
LAU	2	198.1037	0.000***
LGDP	2	2004.637	0.000***
LDCP	2	200.4746	0.000***
LGE	2	187.6923	0.000***
LOIL	2	202.5459	0.000***

Significance level: 1%, 5%, and 10%, ****/**/*

Table 4: KSS nonlinear unit root test

Variable	Lag length	KSS t-statistics	P-value
LAT	3	0.332	0.944
ΔLAT	0	−6.251	0.000***
LAR	0	0.393	0.949
ΔLAR	2	−3.374	0.016**
LAU	0	−3.348	0.017**
ΔLAU	0	−6.959	0.000***
LGDPP	1	−1.080	0.682
ΔLGDPP	0	−4.180	0.003***
LDCP	0	−1.346	0.558
ΔLDCP	0	−3.206	0.022**
LGE	0	−1.777	0.332
ΔLGE	0	−3.923	0.005***
LOIL	0	−2.759	0.056**
ΔOIL	0	−6.172	0.000***

Figure 1: Line graphs of variables in the study



rejected since the P-values are statistically significant at either 5 or 1%. Therefore, the paper concludes that all variables exhibit asymmetric and nonlinear stationarity.

The study presents the results for FALS-FADL cointegration in Table 5. The results are presented for model (1), (2) and (3). In model (1) for access of electricity in total population and financial development there is an existence of long run equilibrium. This can be confirmed by higher RALS-FADL statistics compared to critical value at 1%. In addition, the paper finds that for Model (2) and (3) there is also a occurrence of cointegration among access to electricity for rural population and financial development. Also, the results show cointegration among access to electricity by urban population and financial development. Since then, cointegration exist for all models (1), (2) and (3), then the paper estimate parameters using canonical regression.

Table 6 provides the parameters estimates. It indicates that for access to electricity for rural population in Namibia, financial development indicates a direct and robust impact. The same results are also witnessed for model (1) i.e., access of electricity for total population in Namibia. For Model (1), the outcomes demonstrate that there is a direct connection among GDP per capita and access to electricity for aggregate population. A 1% change increase on GDP per capita, will translate to 0.5% increase on access to electricity for aggregate population. These results confirms that energy demand can be regarded as a normal good. Because as individuals will desire more of it every time, they observer a rise in their disposal income. The motive is that electricity is indirectly demanded to meet certain needs such as cooking and internet services. Also, a 1% rise on financial development will increase to 0.8% increase on access to electricity for total population. Furthermore, the results show that government expenditure and oil costs have insignificant effect on total population energy

Table 5: Fourier cointegration results

Equation	Optimal frequency	RALS-FADL test statistics	Rho
Model 1	5	1.3162	0.4655
Model 2	4	1.0664	0.8953
Model 3	1	−2.0163	0.7933

The critical value at the 1%, 5%, and 10% levels for the FADL tests are: −4.75, −4.02, and−3.65, respectively

Table 6: Parameter estimates using Canonical regression

Variables	Model (1) Dependent: LAT	Model (2) Dependent: LAU	Model (3) Dependent: LAR
$LDCP_t$	0.839 (4.859)***	0.134 (2.442)***	1.423 (4.069)***
$LGDPP_t$	0.515 (3.449)***	−0.009 (−0.210)	0.736 (2.435)***
LGE_t	−0.150 (−0.845)	−0.049 (−0.926)	−0.415 (−1.149)
$LOIL_t$	−0.011 (−0.533)	0.004 (0.491)	−0.068 (−1.521)
Intercept	−3.291 (−4.765)***	4.015 (19.392)***	−7.252 (−5.114)***
R-squared	0.912	0.175	0.865

Significance level: 1%, 5%, and 10%, ****/**/*

demand. The results for model (3), demonstrate that a 1% rise on financial development has a 1.42% rise on access for electricity for rural population. For model (2), it shows that GDP per capita, government expenditure and oil costs have insignificant influence on access to electricity for urban population. In all models the observed outcomes exhibit that financial development has a meaningful direct impact on access to electricity. These findings are in collaboration with the work of Asngar (2022).

Table 7 shows the results for error correction model. The main interest in this table is the parameter of ECT to be negative and statistically significant. It can be observed from above that ECT for each model is negative and statistically significant. For model (1) and (2) it point out that it takes around 25% to adjust to the equilibrium and for Model (3) it is over adjusting. This is to confirm the speed of adjustment in all models.

In the following part of empirical results, we examine the frequency domain causality among access to electricity and financial development in Namibia. The causality is investigated at different frequencies ŵ = 0.5 (long term), ŵ = 1.5 (medium term) and ŵ = 2.5 (short term). Table 8 demonstrate that in the short term there is causality running from access to electricity in total population to oil price, bilateral causality running between GDP per capita and access to electricity in urban areas. In short run also, causality is moving from government expenditure to access to electricity in rural areas. In medium term causality is running from access to total population to oil price, causality from GDP per capita to access to urban population, causality from oil price to access to electricity in urban areas, causality from access to electricity for urban population to GDP per capita, also causality is running from access to electricity in rural areas to oil prices.

Table 7: Error correction model results

Model (1) Dependent: D (LAT)	Model (2) Dependent: D (LAU)	Model (3) Dependent: D (LAR)
D (LDCP [−1])– 0.154 (−1.093)	D (LAU [−1]) 0.036 (0.239)	D (LDCP) 0.224 (0.826)
D (LGDPP [−1])– 0.274 (−1.639)	D (LDCP [−1]) −0.238 (−2.816)***	D (LGDPP) 0.334 (0.921)
D (LGE) 0.067 (0.721)	D (LGDPP [−1]) −0.143 (−1.239)	D (LGE) −0.099 (−0.513)
D (LOIL) −0.012 (−1.996)**	D (LGE [−1]) −0.014 (−0.203)	D (LOIL) −0.021 (−1.561)
ECT (−1) −0.255 (−2.121)***	ECT (−1) −1.150 (−4.713)***	ECT (−1) −0.325 (−2.947)***
Intercept 0.028 (4.334)***	Intercept 0.005 (1.175)	Intercept 0.030 (2.096)***
R-squared=0.349	R-squared=0.711	R-squared=0.325
Normality=0.038 (0.980)	Normality=2.641 (0.266)	Normality=1.035 (0.595)

Significance level: 1%, 5%, and 10%, ****/**/*

Table 8: Frequency domain causality among variables

Granger causality from	Long term ŵ=0.5	Medium term ŵ=1.5	Short term ŵ=2.5
LGDPP to LAT	0.4296	0.9731	0.9675
LDCP to LAT	0.4747	0.2491	0.4857
LGE to LAT	0.9649	0.9497	0.8507
LOIL to LAT	0.9706	0.6964	0.6481
LAT to LGDPP	0.5228	0.8600	0.7651
LAT to LDCP	0.0833*	0.9691	0.7125
LAT to LGE	0.7061	0.7526	0.7218
LAT to LOIL	0.0042***	0.0035***	0.0436**
LGDPP to LAU	0.0080***	0.0343**	0.0209**
LDCP to LAU	0.0024***	0.4938	0.2641
LGE to LAU	0.7161	0.9228	0.3581
LOIL to LAU	0.1714	0.0694*	0.2296
LAU to LGDPP	0.0080***	0.0343***	0.0209**
LAU to LDCP	0.7591	0.4297	0.5739
LAU to LGE	0.7892	0.6988	0.8102
LAU to LOIL	0.7843	0.5623	0.4392
LGDPP to LAR	0.3133	0.9724	0.9906
LDCP to LAR	0.4095	0.9481	0.6576
LGE to LAR	0.1613	0.6609	0.0103***
LOIL to LAR	0.2863	0.2233	0.6074
LAR to LGDPP	0.5603	0.8239	0.8867
LAR to LDCP	0.0196**	0.2502	0.2591
LAR to LGE	0.9086	0.9380	0.9521
LAR to LOIL	0.0196**	0.0104**	0.1496

Significance level: 1%, 5%, and 10%, ****/**/*

In the long-term causality is moving from access to electricity for total population to financial development, causality running from access for total population to oil prices, causality also is moving from GDP per capita to access of electricity in urban population, causality moving from financial development to access in urban population. Causality is running from access in urban population to GDP per capita, causality also is running from access in rural areas to financial development. Lastly, in the long run there is evidence that causality is running from access in rural areas to oil prices.

5. CONCLUSION

Energy plays a critical role for any society especially for poverty alleviation and developmental purpose. The current paper investigated the connection among access to electricity and financial development in Namibia. The study used three variations of equations to determine access to electricity in terms of total population, urban population, and rural population. The paper intended to answer two main questions, which are (1) Is there a long run connection among access to electricity and financial development? (2) Is there a causal existence concerning access to electricity and financial development in short, medium, and long run? To answer these two main research questions of the study, the two main techniques which is Fourie cointegration was applied to estimate the long run. Following the method was causality in frequency domain to determine causal effect in the short, medium, and long term. Based on three equations measuring access to electricity by different receipts it was determined that there is cointegration among access to electricity and financial development. Furthermore, study estimated the parameters of financial development on access to electricity using the canonical regression. The advantage of these regression is that it assumes the presumption of cointegration. For equation (1), where access is measured in total population, the findings illustrated that financial development has a direct influence on access to electricity for total population. This result implies that 1% change of financial development will result in a 1.42% on access to electricity to all population. The conclusions on positive connection among financial development and access to electricity to total population are like the study of Liu and Li (2020). In equation (2) and (3) referring to access to electricity for urban and rural population respectively. In both equations the paper found that there is a positive connection among access to electricity and financial development and is significant. Since the establishment of long run cointegration the paper also estimated short run error correction models. The results show that in all the models, there is adjustment in the long run as the term for error correction performed as expected with negative and significant coefficient.

Regarding the findings on causality analysis, the study only emphasis the main results among financial development and access to electricity. It was found that in the short run and medium term, there was no causality between access to electricity and financial development in all the models. In the long run the findings indicated that there is causality moving from access to electricity for total population will lead to financial development. These findings suggest that as more people in Namibia have access to electricity this will lead to financial development. In the long run also, causality was determined moving from financial development to access for electricity in urban population. These findings suggest that as urban population of Namibian have access to various financial resources which mainly the finance this will give them opportunity to pay for electricity connection if the government does not provide free connection. Lastly, causality was confirmed running from access to electricity in rural areas will determine financial development in Namibia. This interesting result implies that as rural population in Namibia have access to electricity this enables them to access various forms of financial assistance. This can be internet services to access credit and opening of bank accounts. Government expenditure shown not to display any robust influence on access to electricity in all models of the study. However, the causality results shown that in the short term, there is a causal effect running from government expenditure to access to electricity in total population in Namibia. These findings are expected as Namibia is a small developing economy it is expected that government through expenditure will provide access to electricity as public provision. Constructed on empirical results, the following policy implications are suggested:

- The establishment of a well-developed financial sector in Namibia is important to finance investment in accessing electricity. This can be via the internet banking services to pay for electricity bills, financial services being close to rural and urban areas
- Financial sectors must develop a reasonable and enabling energy loans (capitals) via tax holidays on sustainable energy connections.
- Energy policy makers in Namibia can also deregulate electricity systems to support off-grid financing for rural and urban population for electricity access
- Namibian monetary policy should be used for development interest to ensure that financial instruments are used to boost financial development with a view that it will stimulate access to electricity to rural and urban population.

The suggestion for further studies is that they should consider a more survey study to identify some of microeconomic factor's which are barriers to electricity access. Those factors might be household size, household head whether male or female and dependents of the household head.

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