Does energy poverty moderate the impact of economic freedom on quality of life in Africa? A panel quantile via moment approach

Abstract

Economic freedom is known to be positively correlated with nations' prosperity and growth. However, in some countries, we believe the prevalence of energy poverty may inhibit the potential impact of economic freedom. Consequently, we examine the interaction effects of economic freedom and energy poverty across different conditional distributions of quality of life in Africa. While some of our results reinforce existing positions in the literature, we also reveal several interesting facts. Our findings show significantly strong interaction effects, especially in the low-income regions where energy poverty is rampant. Coincidentally, countries who fall under this category are geographically located in the West, Central and East of Africa. The findings of this study provide crucial policy guidance to governments, national and multinational bodies. In the light of the current deplorable living standards in most parts of Africa, our study advocates for more investments in energy infrastructure for the rapid realization of the gains of economic freedom.

JEL classification: C22, Q4, Q43

Keywords: Economic freedom, energy poverty, quality of life, Africa, quantile regression

1. Introduction

Several studies have explained the effects of economic freedom on the well-being of a nation's populace (Stroup, 2007; Nikolaev, 2014; Okunlola & Akinlo, 2021). These studies, however, reveal mixed outcomes which suggest that improving the conditions of economic freedom, such as trade openness or investment freedom do not generally enhance the quality of life. The conflicting outcomes in the literature run parallel to the conventional wisdom that free-market economies promote basic institutions that guarantee individual development and prosperity. Theoretically, institutional economists are of the opinion that the quality of institutions shapes human prosperity and matters for national development due to its ability to enhance growth and income per capita (North, 1990; Nikolaev, 2014).

A free-market oriented institution is therefore expected to strengthen quality of life (North, 1990; Okunlola & Akinlo, 2021; Henri & Mveng, 2023). The channels by which this can happen include income growth (Vega-Gordillo & Álvarez-Arce, 2003; Cebula, 2013), income equality (Perez-Moreno & Angulo-Guerrero, 2016), domestic foreign direct investment (Quazi, 2007), and entrepreneurial development (Vargas, 2008; Ajide, 2021; Johan & Valenzuela, 2021). However, one of the channels by which economic freedom could influence quality of life, but neglected in the literature is access to electricity whose acute shortage is termed energy poverty (Zhang et al., 2021). Energy poverty is inability to get adequate access to clean and modern energy technologies at affordable costs. Households are said to be energy poor if there is persistent inability to meet energy needs.

Many households in Africa do not have access to constant electricity and cannot afford energy bills due to low or irregular income. The evidence in Figures 1-3, which displays the average HDI scores for Africa and the world, as well as access to electricity (as % of population) over our sample period, confirms that both variables are much

lower in African countries than the world average. The incidence of energy poverty has deleterious consequences on health, education, and income. As noted by Shobande (2023), lack of access to electricity reduces the extent of life satisfaction. Energy deprivation may increase mortality rate because it increases overreliance on solid fuels for households' survival which may increase the level of carbon emission with adverse impacts on human health. Energy poverty can cause malnutrition given that natural and processed food get spoilt due to inadequate access to energy required to power refrigerators and other preservation appliances (Banerjee et al., 2021). Furthermore, energy poverty could deter opportunities to generate income required to improve households' standard of living and quality of life (Elias & Victor, 2005; Nawaz, 2021; Shobande, 2023).

Please Insert Figure 1 here

There is a considerable number of empirical studies on the importance of economic freedom. Among them is Sweidan (2022) who applied fixed effect with panel-corrected standard errors and generalised method of moments to explain that economic freedom is germane to support economic growth and enhance entrepreneurial activities in the US. Other related studies of this nature include Henri and Mveng (2023) and Alola et al., (2022), in which they conclude that economic freedom indicators are keys to attaining sustainable outcome, especially when combined with effective frameworks such as subsidy, tax exemption among others. Despite the plethora of studies documenting the benefits of economic freedom in improving the conditions of a nation, the reality in several countries where there is a vast poor quality of life, suggests otherwise.

Perhaps, the prevalence of energy poverty in Africa restricts the potential impact of economic freedom on its prosperity. According to IEA (2019), about 905

million households lack access to constant electricity required for cooking and meeting other households' needs in Africa. Households rely heavily on coal and fuels for lighting their homes and cooking services (Shobande, 2023). World Energy Council (2019) also reports that most African households die of highly pollutant energy use, which accounts for about 1.5million deaths yearly. This suggests that energy poverty has deep connections with quality of life. Given that steady electricity is inextricably linked to the development of individuals, households, and institutions, we anchor on the prevalence of energy poverty in Africa to investigate its effects on the quality of life in the region, as measured by Human Development Index (HDI), comprising educational attainment, life expectancy and decent standard of living.

Please Insert Figure 2 here

Against this backdrop, this study improves upon the related literature to examine the interactive effects of energy poverty and economic freedom on quality of life in 54 developing countries located in Africa from 2005 to 2019. The empirical strategy follows the panel quantile regression via moment approach, recently proposed by Machado and Silva (2019) which allows functional estimation of different quantiles of quality of life. The empirical findings provide four important conclusions. First, the results show a strong positive association between access to electricity and quality of life, implying that access to modern energy technologies can enhance quality of life in Africa. Second, there is strong evidence that that the joint effect of interaction between economic freedom and access to modern energy services enhances quality of life in all quantiles. The coefficient of the interaction effect is slightly stronger in countries with lesser life quality than the higher ones. Third, the effectiveness of economic freedom policy and access to electricity is more noticeable among countries with lesser quality of life, thus suggesting that if the qualities of institution in poor African countries are strengthened and there is constant supply of energy, vast

majority of Africans will prosper. Finally, the interaction variables are positive for Western, Central and Northern Africa, but negative relationship is documented for Eastern and Southern Africa.

This study offers important contributions to the frontier of knowledge (Okunlola & Akinlo, 2021; Ajide, 2021). It is the first study that examines the impact of economic freedom on quality of life within the panel quantile regression framework. Consequently, it documents the impact of economic freedom on the conditional distributions of quality of life. Our study offers a new perspective that could assist policymakers in developing nations to develop a comprehensive policy package in addressing the standard of living and quality of life of their citizens. Access to modern energy services is the key to socioeconomic freedom. The interactive effect of economic freedom and energy poverty also provides a solid foundation for the need to improve energy infrastructure in African continents to boost the quality of life.

The study is organized into five sections. In section 2, we document the conceptual framework and hypothesis. In section 3, we explain methods and data used for the study. In section 4, we present the empirical results while section 5 presents the conclusion and policy perspectives of the study.

2. Literature review and hypothesis development

Literature documents that poor access to modern energy and lack of economic freedom have serious implications on quality of life. The link between energy poverty, economic freedom and quality of life can be anchored on theoretical explanations of "Amartya Sens' capability approach to freedom and development" as well as the "energy transition theory". Studies indicate that economic freedom plays a dominant role in reducing the prevalence of income and energy poverty in the economy (Nikolaev, 2014; Henri & Mveng, 2023). Since economic freedom allows economic resources to be effectively utilised and encourages healthy competition among

households, lack of access to affordable and uninterrupted energy supply may restrict the full potentials of economic freedom. This position is buttressed by Okunola and Akinlo (2021) who document that economic freedom improves quality of life. Other studies on economic freedom also include Henri and Mveng (2023) whose study examined the relationship between economic freedom and productivity growth of African countries from 2003 to 2017. Adopting the sub-components of economic freedom, they found that economic freedom has significant effect on the productivity growth in Africa. They also concluded that economic freedom can best enhance productivity strategies. In another vein, Alola et al., (2022) investigate the link between economic freedom and environmental sustainability of G-20 economies spanning from 2000 to 2016. Adopting the generalised method of moments, they found that economic freedom significantly affects environmental quality. These studies and a myriad of others indicate that a limitation to economic freedom may reduce a country's ability to reduce poverty and sustainable growth. Consequently, we hypothesize that economic freedom is essential in improving quality of life in Africa.

H1: Economic freedom has significant positive impact on quality of life in Africa.

One of the indicators of quality of life is the human development index, comprising educational attainment, life expectancy and decent standard of living. The proponents of energy transition theory suggests that there is a connection between the nature and access to energy and income per head which is a key determinant of quality of life (Hosier & Dowd, 1987; Leach, 1992). Energy deprivation exacerbates challenges faced by households including poor health, illiteracy, and low income per head. According to Sen (2000), inadequate access to modern and clean energy sources relates to deprivation of "freedom and capability approach to development". Therefore, lack of access to affordable modern energy sources is a form of such deprivation. With access to electricity and modern energy, households would enjoy improved standard of living.

Any households experiencing energy poverty may likely have physical health challenges and worsening well-being. Consequently, we hypothesize that access to modern energy sources in conjunction with economic freedom can guarantee essential services for the improvement of quality of life.

H2: Energy poverty has a significant negative effect on quality of life in Africa.

3. Methods and data

3.1 Data description

We use country level data for fifty-four (54) African countries and due to data availability, our sample covers the period 2005 to 2019. We focus on African countries due to the region's inequitable electricity supply which has driven residents and businesses to rely more on alternative power sources, which are very expensive to operate. Our proxy for the dependent variable is quality of life while our set of regressors are economic freedom and energy poverty. Quality of life has multifarious perception depending on consumption and material goods' possession (Rokicka, 2014). Quality of life, as defined by some authors, is the sum of objective and subjective conditions in terms of life experienced by individuals (Felce & Perry 1995). Both subjective and objective measures have been widely employed in literature. In this study, we employ one of the objective indicators commonly used in literature - the human development index (HDI) (Okunlola & Akinlo, 2021). HDI consists of some important components including longevity and the extent of healthy living, decency of life, and being knowledgeable (Jonker & Harmsen, 2012).

Please Insert Figure 3 here

Following the approach of Saha and Su (2012), we control for some macroeconomic indicators in the model such as GDP per capita, infrastructure, inflation, and population growth as control variables. We define energy poverty as the absence of affordable and steady power supply. We therefore proxy energy poverty

with data relating to access to electricity for each country. Data for HDI, access to electricity and the control variables are obtained from World Development Indicators database (World Bank) while data for economic freedom is obtained from Heritage Foundation.

3.2 Empirical strategies

3.2.1 Accounting for cross-sectional dependence and unit root in the panel

Given the presence of unit root and cross-sectional dependency among the individual series in the panel data, we test for series stationarity (or lack thereof) and cross-sectional dependence caused by unobserved shocks. The presence of the duo calls into question the veracity of the obtained results, as they may be biased (Menyah et al., 2014; Tiwari et al., 2021). We employ the Pesaran (2015) test to account for cross-sectional dependence (CD) in the series, and the Cross-sectional Augmented Im-Pesaran-Shin (CIPS) unit root test to account for unit root at both the level and first-difference forms. The empirical model is described further below.

$$CIPS(N,T) = N^{-1}\sum_{i=1}^{N} t_i \ (N\ ,T\ ) \qquad (1)$$

3.2.2 Accounting for long-run relationship: panel cointegration tests

To determine how the variables cointegrate in the long run, we test for the presence of long-run cointegration among the series. We choose the Westerlund and Edgerton (2008) test in particular because it helps us to understand regional heterogeneity and the proclivity for macroeconomic factors to influence the link between economic freedom and quality of life as modified by energy poverty. The cointegration test regression equation is shown below:

$$y_{i,t} = \alpha_i + \delta_{i,t} + \beta_1 x_{1i,t} + \beta_2 x_{2i,t} + \ldots + \beta_k x_{ki,t} + \varepsilon_{i,t} \qquad (2)$$

3.2.3 Main estimation technique

We start our estimation with a simple panel OLS and later introduce series of robustness checks to cater for the shortfalls associated with OLS such as outliers and normality of distribution (Uddin et al., 2017). The panel OLS regression equation is specified below:

$$Y_{it} = \alpha_0 + \beta_1 X_{it} + \varepsilon_{it} \quad (3)$$

Where Y_{it} is the HDI, α_0 is the intercept, β_1 is the slope of the equation, X_{it} represents the predictors (economic freedom, access to electricity, GDP per capita, infrastructure, inflation, and population growth) and ε_i is the error term.

3.2.4 Robustness analysis

Considering that some of the observed variation in the estimates of economic freedom may reflect heterogenous country-characteristics across a given distribution of quality of life, we use quantile regression developed by Machado and Silva (2019) to explain the impact of the regressors on quality of life at different quantiles.

$$Q_{Y_{it}}(\tau_j / X_{it}) = (\sigma_i + \gamma_{iq}(\tau)) + X'\beta(\tau_i) + \emptyset_i(\tau_j) + U_t(\tau_j), \tau_j \epsilon (0,1) \quad (4)$$

Where y_{it} is the dependent variable (quality of life) represented by HDI for each country, x is a vector of regressors, β is the vector of parameters to be estimated, and u is a vector of residuals. $Q_\theta(y_{it}|x_{it})$ denotes the θ^{th}conditional quantile of y_{it} given x_{it}. The advantage of using this technique includes its ability to address conditional heterogeneous covariance impact of the factors influencing quality of life, thus producing precise outcomes about the total distributions. This method also addresses the issue of endogeneity and is effective in dealing with normality issues in panel data analysis. In addition, the technique can yield non-crossing values of panel regression outcomes. To further validate our baseline results, we perform additional analysis

using Prais-Winstein regression. To that end, we also address issues involving autocorrelation, cross-sectional dependence, endogeneity, missing data points, and panel heteroscedasticity. Essentially, the Prais-Winsten regression is appropriate for both balanced and asymmetrical panel data. Our regression equation is similar to equation 3 above.

4. Empirical Findings

Table 1 illustrates the summary statistics of all the variables under study. The average values of our variable of interest show that Africa can be tagged as a moderately free economy with paltry access to electricity (mean value of 54 and 46 respectively). These values are also in tandem with the previous literature (Andersen & Dalgaard, 2013).

Please Insert Table 1 here

Table 2 shows the results of the cross-sectional dependence (CD), unit root, and cointegration tests. The results in the table show that the data series of the variables in our investigation display considerable cross-sectional dependence, resulting in the null hypothesis being rejected at high significance levels. We believe the sampled regions exhibit cross-sectional dependence as a result of spillover effects from common characteristics such as macroeconomic conditions, geographical location, and political atmosphere. For example, underlying issues such as migration owing to climate change, social upheaval, and terrorism can impact the quality of life across countries within a region. Other issues may include poverty, deterioration of infrastructure, and a lack of access to basic necessities.

Concerning the unit root tests, the output of the CIPS tests indicates the presence of unit root in the variables, providing sufficient evidence to reject the null hypothesis of stationarity. The results of panel cointegration tests indicate that the variables have a cointegrating connection. As a result, the null hypothesis that there is no cointegration

is rejected. Overall, our data suggests that economic freedom has long-term effects on quality of life in Africa.

Please Insert Table 2 here

Table 3 presents the result of OLS estimates which show the mean effect of our baseline model. This is compared with the quantile regression (given θ= 0.25, 0.50, 0.75 and 0.90) which provides a conditional distribution of the dependent variable (quality of life). Both the OLS (at the conditional mean) and Quantile regression (at the conditional median) results establish that the interaction effect of economic freedom and access to electricity augments the quality of life at 1% significant levels across all the parameters. This implies that high level of economic liberalisation with adequate access to electricity would improve the socio-economic well-being of the economic units in Africa. This is consistent with prior studies such as Saha & Su (2012) and Okunlola & Akinlo (2021). Moreover, the quantile results show that the joint interactive effect of the variables enhances quality of life in all quantiles. Interestingly, the coefficient of the interaction effect is slightly stronger in countries with lesser life quality than the higher ones (at θ= 0.25 is β=0.0046 and at θ= 0.90 is β=0.0045). Likewise, the individual effectiveness of economic freedom and access to electricity is more noticeable among countries with lesser quality of life. Invariably, it is evident that economic freedom in the presence of adequate access to electricity will spur human quality of life in countries experiencing lower HDI.

Please Insert Table 3 here

To account for the disparity in the sample characteristics, we subdivide the countries based on region and income-level using the World Bank classification. In table 4, the regression results of the interaction variable are positive for only Western, Central and

Northern Africa. However, negative but insignificant relationship is reported for Eastern and Southern Africa. This signifies that the tendency of the joint effect of economic freedom and access to modern energy in affecting the quality of life is more pronounced in nations with higher quality of life. This may be attributed to the fact that the distributional impacts of economic freedom differ according to the development level of the economy, the form of economic freedom, political system, and other types of heterogeneous features (Scully 2002; Bergh & Nilsson 2010; Bennett & Nikolaev 2017). It is well acknowledged that democratic political system is more suitable for economic freedom than autocratic system. In Eastern and southern Africa, the extant of democratic system varies among the countries in the regions which reflects their political transitional experiences and difficulty of consolidating and inculcating democracy. Tran (2019), for instance, also finds that trade freedom reduces per capita income growth due to excessive regulation by some Asian countries.

Please Insert Table 4 here

Furthermore, Table 5 (for income classification) shows that the effect of the interaction is positive and significant for lower-income countries. In contrast, the joint effect has the ability of reducing quality of life in higher income countries. Noticeably, nations that are classified as higher income countries are from the Southern and Eastern regions of Africa. Thus, the results of region and income classification further buttress the fact that the effect of economic freedom in improving quality of life is much stronger in nations with lesser quality of life but have high level of access to electricity.

Please Insert Table 5 here

5. Conclusion

World Bank (2018) reports that by 2030, if appropriate policy is not implemented, 9 out of 10 persons would be living in poor quality of life in Africa. In this study, we

investigate the interaction effects of economic freedom and energy poverty on the quality of life in Africa. We find that free market economies with adequate supply of electricity significantly improves quality of life in the region. The findings also show that the interaction effect between economic freedom and energy poverty is more pronounced for low-income countries.

The findings of this study provide crucial policy guidance to national and multinational bodies. In addition to contributing to scholarly literature, our findings are also significant for the policy strategies of international development organisations (such as IMF and World Bank) regarding the improvement of energy provision and human development in Africa. Given the extent of our study, we believe that future research can draw on our findings to investigate new research pathways, such as how energy justice affects quality of life. Future research may also include other indices of human development. Finally, we urge African governments to begin implementing several economic policies to ensure regional economic freedom and to enhance investments in energy infrastructure to reap the benefits of economic freedom.

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Table 1: Summary statistics

Variable	Mean	Std. Dev.	Min	Max
Human Development Index	0.527	0.111	0.294	0.800
Economic Freedom	54.227	7.603	21.400	77.000
Access to Electricity	46.000	28.897	1.279	100.000
GDP Per capita	3.162	0.533	1.430	4.937
Infrastructure	1.253	2.899	-2.446	36.965
Inflation	0.068	0.113	-0.090	2.554
Population growth	2.452	0.946	0.126	6.281

Table 2: The Breusch-Pagan CD tests, CIPS unit root test and Westerlund & Edgerton cointegration test for individual variables

Variable	Breusch-Pagan	CIPS	Westerlund &Edgerton
HDI	251.92**	-2.90*	-1.34*
Economic freedom	113.60**	-0.56*	-3.05*
Access to electricity	111.00**	-2.03	-2.19*
GDP per capita	183.12**	-0.45*	-2.25*
Infrastructure	120.34**	-2.09*	-1.34*
Inflation	134.23**	-1.34*	-1.01*
Population growth	106.04**	-1.09*	-1.21*

Notes: This table shows the Breusch-Pagan CD tests, CIPS unit root test and Westerlund & Edgerton cointegration test for individual variables. H_0: The variable is not dependent (not correlated) across the cross-sections. H_0 is rejected if the coefficient is significant.

Table 3: Interactive impact of Economic Freedom and Access to Electricity on Quality of Life

VARIABLES	(1) OLS	(2) QR 0.25	(3) QR 0.50	(4) QR 0.75	(5) QR 0.90
EF*Access	0.0040***	0.0046***	0.0036***	0.0041***	0.0045***
	(0.0004)	(0.0004)	(0.0003)	(0.0006)	(0.0005)
EF	0.0648***	0.0995***	0.1017***	0.0451	0.0650**
	(0.0209)	(0.0219)	(0.0213)	(0.0281)	(0.0271)
Access	0.0025	0.0196**	0.0181***	0.0184*	0.0090
	(0.0077)	(0.0091)	(0.0049)	(0.0104)	(0.0108)
GDP per capita	0.0440***	0.0706***	0.0805***	0.0591***	0.0394***
	(0.0088)	(0.0049)	(0.0061)	(0.0084)	(0.0066)
Inflation	0.0782**	0.1127**	0.1537***	0.2197***	0.1716
	(0.0396)	(0.0515)	(0.0205)	(0.0264)	(0.1242)
Infrastructure	0.0031***	0.0024***	0.0036	0.0058***	0.0015
	(0.0011)	(0.0008)	(0.0023)	(0.0013)	(0.0018)
Population	-0.0131***	-0.0073**	-0.0226***	-0.0188***	-0.0198***
	(0.0034)	(0.0031)	(0.0025)	(0.0029)	(0.0044)
Observations	624	624	624	624	624
Pseudo R^2	0.77	0.51	0.53	0.57	0.58

Note: The table reports Ordinary Least Square (OLS) versus Quantile regression (QR) results of the interactive variable on the quality of life. Lower quantiles (e.g. QR 0.25; 0.50) signify less quality of life. Robust standard errors are in parentheses. For explanation of the variables see description of variables table in the appendix. ***, ** and * denote the statistical significance level at 1 percent, 5 percent and 10 percent respectively.

Table 4: Interactive impact of Economic Freedom and Access to Electricity on Quality of Life (sub-region)

VARIABLES	(1) OLS	(2) QR 0.25	(3) QR 0.50	(4) QR 0.75	(5) QR 0.90
Western					
EF*Access	0.0035***	0.0040***	0.0043***	0.0035***	0.0036***
	(0.0006)	(0.0011)	(0.0006)	(0.0006)	(0.0008)
EF	0.1305***	0.1529*	0.1734***	0.1354***	0.1401**
	(0.0479)	(0.0857)	(0.0501)	(0.0488)	(0.0619)
Access	0.0194**	0.0073	0.0384***	0.0288***	0.0253**
	(0.0098)	(0.0175)	(0.0103)	(0.0100)	(0.0127)
GDP per capita	0.0556***	0.0246	0.0633***	0.0812***	0.0930***
	(0.0108)	(0.0194)	(0.0113)	(0.0110)	(0.0140)
Inflation	0.0522	0.0308	0.0489	0.0264	0.0097
	(0.0545)	(0.0975)	(0.0571)	(0.0556)	(0.0705)
Infrastructure	-0.0039	-0.0006	-0.0091*	-0.0113**	-0.0092
	(0.0052)	(0.0093)	(0.0054)	(0.0053)	(0.0067)
Population	-0.0513***	-0.0527***	-0.0560***	-0.0546***	-0.0358***
	(0.0071)	(0.0128)	(0.0075)	(0.0073)	(0.0092)
Constant	0.9610***	1.0786***	1.1811***	0.9719***	0.9018***
	(0.1870)	(0.3348)	(0.1958)	(0.1907)	(0.2419)
Observations	197	197	197	197	197
Pseudo R^2	0.79	0.51	0.55	0.63	0.68
Central					
EF*Access	0.0060***	0.0085***	0.0073***	0.0052***	0.0022
	(0.0008)	(0.0008)	(0.0010)	(0.0013)	(0.0016)
EF	0.2342***	0.3442***	0.2738***	0.1757*	0.0432
	(0.0566)	(0.0594)	(0.0695)	(0.0941)	(0.1155)
Access	-0.0083	0.0165	0.0054	-0.0329*	-0.0826***
	(0.0108)	(0.0113)	(0.0133)	(0.0180)	(0.0221)
GDP per capita	0.0143	0.0025	-0.0015	-0.0138	-0.0122
	(0.0123)	(0.0130)	(0.0152)	(0.0205)	(0.0252)
Inflation	0.2135***	0.0776	0.2967***	0.1998*	0.0562
	(0.0617)	(0.0648)	(0.0759)	(0.1027)	(0.1260)
Infrastructure	0.0183**	0.0162*	0.0086	0.0335**	0.0195
	(0.0083)	(0.0087)	(0.0102)	(0.0138)	(0.0169)
Population	0.0035	0.0043	0.0044	0.0084	0.0023
	(0.0046)	(0.0049)	(0.0057)	(0.0077)	(0.0095)
Constant	1.1892***	1.6728***	1.4106***	0.9800**	0.4039
	(0.2430)	(0.2552)	(0.2987)	(0.4042)	(0.4959)
Observations	86	86	86	86	86
F-statistic	0.93	0.80	0.76	0.73	0.73
Northern					
EF*Access	0.0085**	0.0014	0.0045	0.0105***	0.0218***
	(0.0038)	(0.0046)	(0.0039)	(0.0039)	(0.0055)
EF	0.6299***	0.2687	0.3841**	0.6550***	1.2592***
	(0.1754)	(0.2172)	(0.1822)	(0.1807)	(0.2579)
Access	-0.0258	-0.3500*	-0.1743	0.1114	0.6117***
	(0.1521)	(0.1884)	(0.1580)	(0.1567)	(0.2236)
GDP per capita	0.0824***	0.0971***	0.1226***	0.1270***	0.1168***
	(0.0159)	(0.0197)	(0.0165)	(0.0164)	(0.0234)
Inflation	0.1011**	0.0845	0.1782***	0.1217**	0.0095
	(0.0456)	(0.0565)	(0.0474)	(0.0470)	(0.0671)
Infrastructure	0.0054***	0.0046**	0.0055***	0.0045***	0.0047*
	(0.0017)	(0.0020)	(0.0017)	(0.0017)	(0.0024)
Population	-0.0090	-0.0151	-0.0138*	-0.0032	-0.0070

	(0.0078)	(0.0097)	(0.0081)	(0.0080)	(0.0115)
Constant	2.3390*	-0.2566	0.7546	2.8049**	6.9579***
	(1.1886)	(1.4720)	(1.2344)	(1.2244)	(1.7477)
Observations	83	83	83	83	83
Pseudo R^2c	0.93	0.81	0.77	0.73	0.70
Eastern					
EF*Access	-0.0007	0.0006	-0.0013*	-0.0005	-0.0002
	(0.0007)	(0.0015)	(0.0008)	(0.0007)	(0.0014)
EF	-0.1432***	-0.0713	-0.1551***	-0.1600***	-0.1654***
	(0.0318)	(0.0658)	(0.0354)	(0.0299)	(0.0618)
Access	-0.0293**	-0.0050	-0.0370***	-0.0332***	-0.0319
	(0.0113)	(0.0233)	(0.0125)	(0.0106)	(0.0219)
GDP per capita	0.0120*	0.0247*	0.0097	0.0088	0.0147
	(0.0070)	(0.0144)	(0.0078)	(0.0066)	(0.0136)
Inflation	-0.0139	0.0054	-0.0110	-0.0213	-0.0246
	(0.0183)	(0.0377)	(0.0203)	(0.0172)	(0.0355)
Infrastructure	0.0010	0.0022	0.0013	-0.0005	-0.0005
	(0.0011)	(0.0024)	(0.0013)	(0.0011)	(0.0022)
Population	-0.0938***	-0.0747***	-0.0911***	-0.0947***	-0.0899***
	(0.0090)	(0.0186)	(0.0100)	(0.0085)	(0.0175)
Constant	0.0595	0.2866	0.0044	0.0211	-0.0164
	(0.1303)	(0.2692)	(0.1449)	(0.1224)	(0.2530)
Observations	174	174	174	174	174
Pseudo R^2	0.84	0.48	0.58	0.70	0.70
Southern					
EF*Access	-0.0003	-0.0021**	-0.0009	0.0002	0.0005
	(0.0007)	(0.0009)	(0.0009)	(0.0009)	(0.0009)
EF	-0.4469***	-0.5256***	-0.5036***	-0.4203***	-0.4262***
	(0.0381)	(0.0492)	(0.0527)	(0.0495)	(0.0504)
Access	-0.1096***	-0.1717***	-0.1281***	-0.0894***	-0.0930***
	(0.0209)	(0.0270)	(0.0289)	(0.0271)	(0.0277)
GDP per capita	0.0002	0.0148	0.0016	-0.0059	-0.0376**
	(0.0126)	(0.0162)	(0.0174)	(0.0163)	(0.0166)
Inflation	-0.0906	0.0701	-0.0191	-0.0641	-0.0851
	(0.0867)	(0.1118)	(0.1198)	(0.1124)	(0.1146)
Infrastructure	0.0222***	0.0186***	0.0195***	0.0246***	0.0308***
	(0.0034)	(0.0043)	(0.0046)	(0.0044)	(0.0044)
Population	0.0216***	0.0301***	0.0274***	0.0184***	0.0222***
	(0.0033)	(0.0043)	(0.0046)	(0.0043)	(0.0044)
Constant	-1.7093***	-2.3049***	-2.0175***	-1.5014***	-1.4360***
	(0.1808)	(0.2332)	(0.2499)	(0.2346)	(0.2391)
Observations	84	84	84	84	84
Pseudo R^2	0.93	0.78	0.77	0.77	0.75

Note: The table reports Ordinary Least Square (OLS) versus Quantile regression (QR) results of the interactive variable on quality of life based on regions in Africa. Lower quantiles (e.g. QR 0.25; 0.50) signify less quality of life. Standard errors are in parentheses. For explanation of the variables see description of variables table in the appendix. ***, ** and * denote the statistical significance level at 1 percent, 5 percent and 10 percent respectively.

Table 5: Interactive impact of Economic Freedom and Access to Electricity on Quality of Life (Income Classification)

VARIABLES	(1) OLS	(2) QR 0.25	(3) QR 0.50	(4) QR 0.75	(5) QR 0.90
Low income countries					
EF*Access	0.0031***	0.0044***	0.0036***	0.0024***	0.0011
	(0.0004)	(0.0005)	(0.0006)	(0.0006)	(0.0007)
EF	0.0300	0.0974***	0.0874***	0.0140	-0.0695**
	(0.0204)	(0.0240)	(0.0273)	(0.0286)	(0.0335)
Access	0.0118	0.0179**	0.0200**	0.0108	0.0008
	(0.0075)	(0.0088)	(0.0100)	(0.0105)	(0.0123)
GDP per capita	0.0743***	0.0674***	0.0765***	0.0919***	0.1210***
	(0.0075)	(0.0088)	(0.0100)	(0.0105)	(0.0123)
Inflation	0.0514***	0.0428**	0.0598***	0.0817***	0.0337
	(0.0165)	(0.0194)	(0.0221)	(0.0231)	(0.0271)
Infrastructure	0.0157***	0.0145***	0.0157***	0.0147***	0.0141***
	(0.0021)	(0.0025)	(0.0028)	(0.0030)	(0.0035)
Population	-0.0054*	0.0022	-0.0046	-0.0140***	-0.0251***
	(0.0032)	(0.0038)	(0.0043)	(0.0045)	(0.0053)
Constant	0.3625***	0.5930***	0.6012***	0.3147**	-0.0515
	(0.0906)	(0.1065)	(0.1212)	(0.1266)	(0.1484)
Observations	519	519	519	519	519
Pseudo R^2	0.74	0.44	0.47	0.54	0.61
High income countries					
EF*Access	-0.0041**	0.0012	-0.0035*	-0.0085***	-0.0123***
	(0.0019)	(0.0028)	(0.0019)	(0.0028)	(0.0022)
EF	-0.1551*	-0.0048	-0.1855**	-0.3710***	-0.5186***
	(0.0851)	(0.1283)	(0.0881)	(0.1294)	(0.1000)
Access	-0.3069***	-0.1062	-0.2685***	-0.4952***	-0.6526***
	(0.0799)	(0.1204)	(0.0827)	(0.1214)	(0.0938)
GDP per capita	0.0119*	-0.0189*	-0.0070	0.0079	0.0185**
	(0.0066)	(0.0099)	(0.0068)	(0.0100)	(0.0077)
Inflation	0.1613	0.1610	0.1396	0.0853	0.0450
	(0.1087)	(0.1638)	(0.1125)	(0.1653)	(0.1277)
Infrastructure	0.0022**	0.0041***	0.0038***	0.0025*	0.0023**
	(0.0009)	(0.0013)	(0.0009)	(0.0013)	(0.0010)
Population	-0.0328***	-0.0080	-0.0239***	-0.0371***	-0.0483***
	(0.0041)	(0.0061)	(0.0042)	(0.0062)	(0.0048)
Constant	-1.0785*	0.1875	-1.0169	-2.5154***	-3.6179***
	(0.6075)	(0.9158)	(0.6288)	(0.9239)	(0.7137)
Observations	105	105	105	105	105
Pseudo R^2	0.78	0.58	0.62	0.59	0.56

Note: The table reports Ordinary Least Square (OLS) versus Quantile regression (QR) results of the interactive variable on quality of life based on income levels of countries in Africa. Lower quantiles (e.g. QR 0.25; 0.50) signify less quality of life. Standard errors are in parentheses. For explanation of the variables see description of variables table in the appendix. ***, ** and * denote the statistical significance level at 1 percent, 5 percent and 10 percent respectively.

Table 6: Economic freedom and quality of life in Africa using Prais-Winstein regression

DV = HDI	Western	Eastern	Southern	Northern	Central
EF*Access	0.021*	0.231*	0.225	0.316*	0.321*
	(0.001)	(0.015)	(0.003)	(0.021)	(0.012)
EF	0.212*	0.231*	0.239*	0.236	0.168*
	(0.001)	(0.025)	(0.041)	(0.022)	(0.021)
Access	0.305*	0.314	0.346	0.376*	0.302*
	(0.023)	(0.029)	(0.124)	(0.130)	(0.019)
GDP per capita	0.245*	0.137*	0.291*	0.543	0.351*
	(0.010)	(0.018)	(0.003)	(0.002)	(0.011)
Inflation	0.361**	0.245	0.243*	0.361*	0.347*
	(0.023)	(0.015)	(0.031)	(0.004)	(0.021)
Infrastructure	0.019*	0.322*	0.276	0.450	0.491
	(0.011)	(0.012)	(0.015)	(0.013)	(0.004)
Population	0.337	0.300*	0.214*	0.276**	0.244*
	(0.001)	(0.029)	(0.002)	(0.010)	(0.015)
R^2	0.361	0.385	0.342	0.410	0.402

Notes: This table presents the main regression results for the nexus between climate change and quality of life in Africa. Estimation is performed using Prais-Winstein regression, with coefficients computed using standard errors robust to heteroskedasticity and clustered at the firm level. Standard errors are shown in parentheses. The outcome variable is HDI which is a proxy for quality of life. *, **, and *** denote significance at 10%, 5% and 1%, respectively.

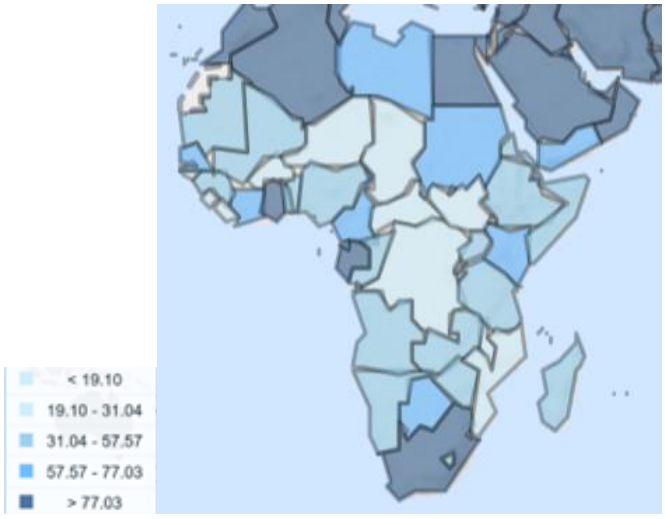

Figure 1: Access to electricity (Percentage of population) in Sub-Saharan Africa in 2019. *The Energy Progress Report. World Bank, Washington DC. World Bank*

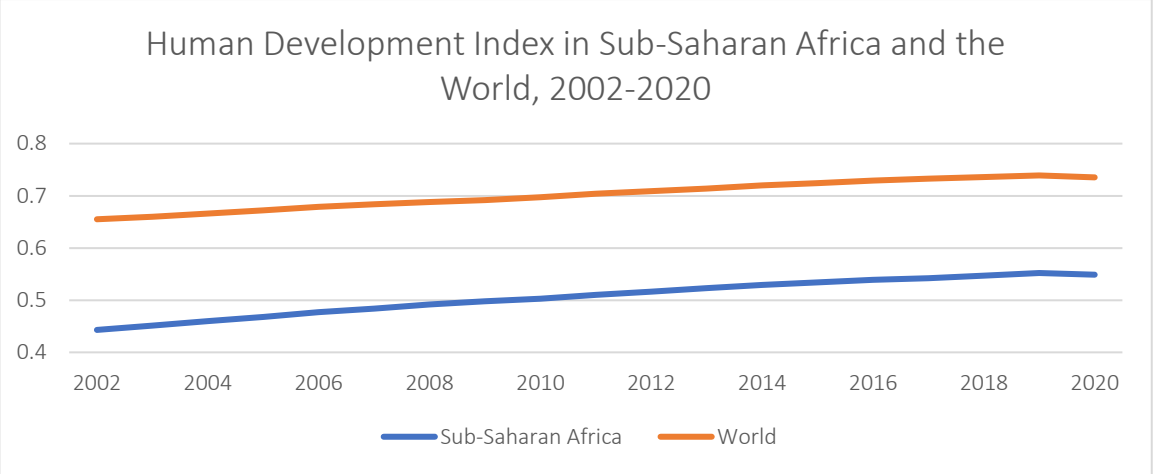

Figure 2: Human Development Index in Sub-Saharan Africa and the world, sourced from *The United Nations Development Programme (UNDP) Report, United Nations, New York, USA*

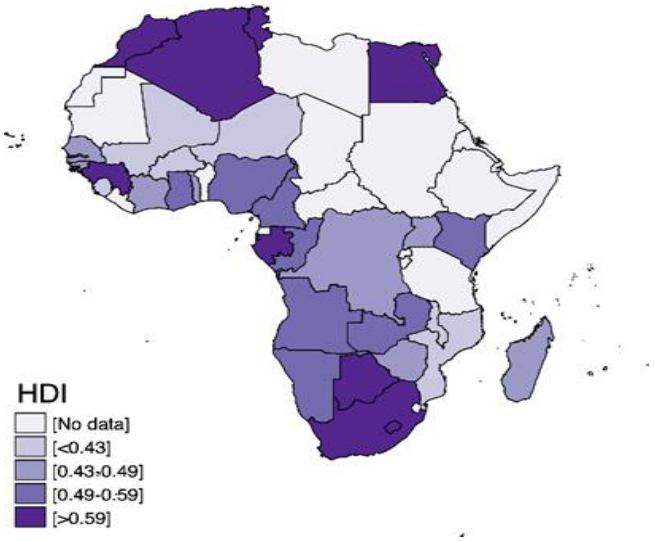

Figure 3: Human development index (HDI) in Africa in 2019, sourced from *The United Nations Development Programme (UNDP) Report, United Nations, New York, USA*