



Energy justice and economic growth: Does democracy matter?

Eric Evans Osei Opoku^{a,*}, Alex O. Acheampong^{b,c}

^a Nottingham University Business School China, University of Nottingham, 199 Taikang East Road, Ningbo 315100, China

^b Bond Business School, Bond University, Gold Coast, Australia

^c Centre for Data Analytics, Bond University, Gold Coast, Australia

Received 12 October 2022; Received in revised form 23 December 2022; Accepted 12 January 2023

Available online 21 January 2023

Abstract

Can economies sustain economic growth within an energy justice and democratization framework? In the literature, the role of equity in energy access and the conditional effect of democracy on economic growth in developing countries is not empirically explored. Drawing on the theory of Distributive Justice and Capability Approach to Development, we contribute to the knowledge and policy discussions by examining whether energy justice and democracy synergistically affect economic growth in a panel of 47 sub-Saharan Africa (SSA) countries from 2000 to 2020 using Driscoll-Kraay and the instrumental variable generalized method of moments estimators. We operationalized and measured energy justice using rural-urban equality in access to electricity and clean cooking fuels and technologies while participatory, deliberative, egalitarian, liberal, and electoral democracy indices were used to capture the different forms of democracy. The findings suggest energy justice and the democracy variables are positively related to economic growth. We also found evidence from the conditional effect analysis that when there is an improvement in democratic practices, the economic growth-enhancing effect of energy justice deepens. These findings are robust after controlling endogeneity and differ among the sub-regions within SSA. We recommend that policies that facilitate equity in energy access and democratic practices would contribute to sustainable economic growth in SSA.

© 2023 The Authors. Published by Elsevier Inc. on behalf of The Society for Policy Modeling. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

* Corresponding author.

E-mail addresses: eric-evans-osei.opoku@nottingham.edu.cn, eekoopoku@gmail.com (E.E.O. Opoku), aacheamp@bond.edu.au (A.O. Acheampong).

<https://doi.org/10.1016/j.jpolmod.2023.01.005>

0161-8938/© 2023 The Authors. Published by Elsevier Inc. on behalf of The Society for Policy Modeling. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

JEL Classification: O43; O55; Q43

Keywords: Energy Justice; Economic growth; Sustainable Development; Political Economy; Democracy; Sub-Saharan Africa

1. Introduction

The sustainable development agenda emphasizes inclusive and sustainable growth/development for all. In realizing this, energy is considered one of the major inputs, forming the crux of the Sustainable Development Goals (SDGs). Sustainable Energy for All (SE4ALL) is championed as the way forward. This is buttressed by Goal 7 of the SDGs, which seeks to “ensure access to affordable, reliable, sustainable and modern energy for all.” Essentially, both the SE4ALL initiative and the SDG Goal 7 emphasize energy justice. Energy justice refers to “the goal of achieving equity in both the social and economic participation in the energy system...” (Baker, DeVar, & Prakash, 2019, p. 5). Energy justice principally aims to make energy accessible, affordable, clean, and democratically managed for all communities and individuals (Baker et al., 2019). Energy justice enables all to have access to modern energy to contribute meaningfully to economic growth. Energy justice and energy democracy are entrenched in the overarching political democratic tenets of countries. The provision of modern energy in many (particularly developing) countries is considered governments’ responsibility, hence making electricity a public service regardless of its private good nature (Scott & Seth, 2013). Therefore, universal access to modern energy has become a development objective in many countries.

Access to modern energy by all is also a way in which governments become responsible and accountable to their citizens. This accountability is noted to be more enhanced in democracies (Deacon, 2009; Li & Reuveny, 2006). Energy justice is, therefore, more attainable in societies – democracies – where political agents can be held responsible and accountable. Considering the political responsibility, accountability, and freedom that come with democracy, economic activities are noted to be boosted in democracies. Some scholars suggest that as a country democratizes or improves democracy, the economy grows faster (Heo & Tan, 2001; Jaunky, 2012; Leblang, 1997; Minier, 1998). The probable positive effect of democracy on economic growth is largely seen from the effect of the former on property rights protection, the economic freedom to do business, and the enhancement of investment in the process (Ghardallou & Sridi, 2019; Knutsen, 2012; Minier, 1998). In contrast, some scholars have argued that, particularly in developing countries, a non-democratic/authoritarian regime is required to promote economic growth (Knutsen, 2012; Krieckhaus, 2006; Landau, 1986).

In this study, we revisit the effect of energy and democracy on economic growth. Specifically, we employ data from 47 SSA countries from 2000 to 2020 to examine the effect of energy justice and democracy on economic growth. Our contributions to the existing literature are clear and manifold. Firstly, regarding the approximation for energy, we focus on energy justice (measured as rural-urban equality in access to electricity and clean cooking fuels and technologies). The existing literature is mainly flooded with the use of total energy consumption/use (Apergis & Payne, 2009a, 2009b; Kebede, Kagochi, & Jolly, 2010; Lee & Chang, 2008; Tang, Tan, & Ozturk, 2016; Wolde-Rufael, 2005) that makes no clear distinction between sustainable and non-sustainable energy. A couple of studies have also considered the effect of access to electricity on economic growth (Akinlo, 2009; Bah & Azam, 2017; Bella, Massidda, & Mattana, 2014; Ikegami & Wang, 2016); however, this proxy for energy does not portray energy justice.

To the best of our knowledge, this study is the first to examine the effect of energy justice in both electricity and clean cooking fuels and technologies on economic growth. Our measure of energy justice – rural-urban equality in access to electricity and clean cooking fuels and technologies – portrays the inequity, inequality, and discrepancy between rural and urban settings. In many developing regions, particularly SSA, where access to modern energy is not universal, there exists a huge access gap between rural and urban settings. Nearly 80% and 75% of the world's and SSA's rural populations, respectively, lack access to electricity (IEA et al., 2022). This amounts to about 440 million persons in rural SSA without electricity. Furthermore, about 93% of the rural population does not have access to clean cooking fuels and technologies (IEA et al., 2022). We argue that achieving rural-urban access parity in modern energy (measured by our equality index) portrays, in a great sense, energy equity and access by all. In championing inclusive and sustainable economic growth, energy justice which promotes equity, is important.

Secondly, we examine how democracy affects economic growth. Though this study is not the first to examine the democracy-growth nexus, we depart from the previous studies by employing more current and most comprehensive proxies for democracy. Democracy indicators (mainly the Polity Project and Freedom House indices) mostly employed in the previous literature have been criticized among others on the premise of description/definition, accuracy, coverage, aggregation, and reliability (Coppedge et al., 2011, 2019; Coppedge, Lindberg, Skaaning, & Teorell, 2016). These indicators mainly emphasize elections, relegating other important non-election aspects of democracy (Coppedge et al., 2016). In this study, we employ democracy proxies based on the Varieties of Democracy (V-DEM) project. These are considered the most comprehensive indicators of democracy because they are multidimensional, greatly disaggregated, and follow procedures that foster precision, validity, transparency, and legitimacy (Coppedge et al. (2019). Essentially, the V-Dem encapsulates electoral, liberal, majoritarian, consensual, participatory, deliberative, and egalitarian democracy.

Thirdly, we investigate the interactive effect of energy justice and democracy on economic growth. To the best of our knowledge, this is the first study to do this. We do this in cognizance that energy justice is embedded and strives in political democracy. The more politically democratic a country is, the more energy justice or energy democracy can be enforced and enhanced, and with this, equality in access to electricity and clean cooking fuels and technologies would increase to affect economic growth. Lastly, we focus on SSA, the region with the least modern energy accessibility and most nascent democratic credentials in the world. SSA hence provides a fascinating milieu for studying the effect of energy justice and democracy on economic growth. The sections following the introduction cover the literature review, data and methodology, results and discussion, and conclusion, respectively.

2. Literature review

2.1. Energy and Economic Growth

The energy-growth nexus has attracted much attention in the literature due to energy's practical and theorized effect on economic activities, which translates to economic growth. The quality of energy services is considered an important input of production (Lee & Chang, 2008; Wolde-Rufael, 2005). Energy services ease and facilitate the efficiency of other inputs of production to attain optimum productivity (Adams, Klobodu, & Opoku, 2016; Best & Burke, 2018). As Stern (2019) argues, all production requires the conversion of matter or transformation of matter from one state to the other, and it is energy that powers the conversion. Apart from the

relevance of energy in the production mix, it is also essential for individuals and households considering its effect on transportation, health, education, entertainment, communication, security, lighting and heating homes, job creation, time-saving, etc. (Apergis & Payne, 2009b; Best & Burke, 2018; Kebede et al., 2010; Lee & Chang, 2008; Opoku, Kufuor, & Manu, 2021). With its benefits to livelihoods, energy is considered an important resource that enhances one's productivity and enables one to engage in activities that contribute meaningfully to society and economic growth. The empirical literature largely supports the thesis that energy consumption enhances economic growth (see Table 1 for a summary review of some empirical studies).

Access to energy has become an important element of survival. This makes access to energy by all a right, and just as everyone deserves justice, everyone deserves modern energy. Energy, as right, reflects the energy justice phenomenon. Justice principally entails the distribution of what John Rawls calls the "primary goods" of rights and liberties, powers and opportunities, and income and wealth (Rawls, 1971, 1999). In his "justice as fairness" work, Rawls (1971) offers a distributive theory of justice in which a just distribution of benefits and burdens of social life is determined by what rational individuals would prefer from the standpoint of ignorance (behind a 'veil of ignorance'), that excludes them from the knowledge of the abilities, desires, parentage, or social class in which they are. Rawls argues that people in such position would embrace what he named the "difference principle." The difference principle emphasizes that primary goods, not just income and opportunity, but also pedestals of self-respect shall be distributed to the greatest benefit of a typical member of the least privileged social stratum. Rawls stresses that the difference principle does not preach for simple egalitarianism, instead efforts to guarantee meeting the fundamental needs (including rights, privileges, freedoms, resources, etc.) of all citizens to be able to participate fully in political and social endeavors. Rawls considers an allocation to be just if it maximizes the gains of one with the least resources, opportunities, abilities, etc. (Rawls, 1999). In considering energy as a resource and access as a right, energy justice becomes an attempt to improve the quality of life for all people, given their capabilities, to enable them to participate in all spheres of life (Sovacool & Dworkin, 2015).

Energy justice is engrained in the environmental and climate justice tenets, which stress the "recognition and remediation of the disproportionately high and adverse human health or environmental effects ..." (Baker et al., 2019, p. 14). Energy justice champions individuals' voluble rights and freedoms about their energy and environmental demands. The ethos of energy justice is rooted in energy democracy, which propagates the notion that individuals should have a voice, representation, and support in modeling their current and future energy exigencies (Baker et al., 2019). Energy justice aligns with other energy connotations, such as energy democracy, energy security, and energy transition (Qian, Xu, Gou, & Škare, 2022). Though the crux of energy justice is eliminating energy poverty, it transcends energy poverty and encapsulates other aspects, such as fair treatment of different populations and social groups regarding energy matters (Heffron & McCauley, 2017; Sovacool & Dworkin, 2015). Energy justice emphasizes the problem of inequality in the distribution, supply, and access to energy resources to all people (Pellegrini-Masini, Pimi, & Maran, 2020; Qian et al., 2022). Equality is proposed as a ubiquitous conceptual basis for energy justice definitions (Pellegrini-Masini et al., 2020).

McCauley, Heffron, Stephan, and Jenkins (2013) gauge energy justice as hinging on three pillars of justice; distributive justice, procedural justice, and recognition justice. Distributive justice relates to the even distribution of energy infrastructure and the benefits/costs of energy to the whole population. Procedural justice implies all stakeholders' equitable participation in the decision-making concerning energy access and infrastructure. Recognition justice emphasizes the need to recognize all individuals' energy needs and eliminate situations of deprivation, such

Table 1
Selected empirical Papers on energy, democracy, and economic growth.

| Author (s) | Sample | Dep. Var. | Indep. Var. | Method | Results |
|--------------------------------------|--|-----------------|---------------------------------------|--|--|
| Energy and Economic Growth | | | | | |
| Ikegami and Wang (2016) | Japan and Germany, 1960Q4–2015Q2 | Economic growth | Electricity consumption | Granger causality, ARDL | Electricity causes growth (Japan), growth causes electricity consumption |
| Akinlo (2009) | Nigeria, 1980–2006 | Economic growth | Electricity consumption | Cointegration (Johansen–Juselius) | Positive |
| Wolde-Rufael (2005) | 19 African countries, 1971–2001 | Economic growth | Energy use | Granger causality (Toda–Yamamoto) | Bidirectional causality for some countries and no causality for some |
| Bah and Azam (2017) | South Africa, 1971–2012 | Economic growth | Electricity consumption | ARDL, Toda–Yamamoto | No causality |
| Lee and Chang (2008) | 16 Asian countries, 1971–2002 | Economic growth | Energy consumption | Granger causality, FMOLS | Causality from energy consumption to economic growth |
| Apergis & Payne (2009a) | 6 Central American countries, 1980–2004 | Economic growth | Energy consumption | Cointegration, FMOLS | Causality from energy consumption to economic growth |
| Apergis & Payne (2009b) | 11 Commonwealth of Independent States, 1991–2005 | Economic growth | Energy consumption | Cointegration, FMOLS | Bidirectional causality |
| Kebade et al. (2010) | 20 SSA countries, 1980–2004 | Economic growth | Energy consumption | Parks model | Positive |
| Tang et al. (2016) | Vietnam, 1971–2011 | Economic growth | Energy consumption | Cointegration (Johansen–Juselius), Toda–Yamamoto | Causality from energy consumption to economic growth |
| Democracy and Economic Growth | | | | | |
| Helliwell (2009) | 125 countries, 1960–1985 | Economic growth | Democracy | OLS, Instrumental variable | Insignificant |
| Leblang (1997) | Global sample, 1960–1989 (10-year periods) | Economic growth | Democracy | OLS with Robust SE. | Positive |
| Leblang (1996) | Global sample, 1960–1990 | Economic growth | Property rights protection, democracy | OLS with Robust SE. | Positive |
| Heo and Tan (2001) | 32 developing countries, 1950–1982 | Economic growth | Democracy | Granger causality | Democracy “Granger causes” economic growth in 10 countries |
| Narayan, Narayan, and Smyth (2011) | 30 SSA countries, 1972–2001 | Economic growth | Democracy | Cointegration, Granger causality, FMOLS, DOLS | Mixed |
| Jaunky (2012) | 28 SSA countries, 1980–2005 | Economic Growth | Democracy | System GMM | Positive |
| Krickehaus (2006) | 1960–2000 | Economic Growth | Democracy | OLS, GLS | Negative in Latin America and Asia, positive in Africa |
| Remmer (1990) | 11 Latin American countries, 1982–1988 | Economic growth | Democracy | OLS | Insignificant |
| Grier and Tullock (1989) | 59 countries, 1961–1980 | Economic growth | Democracy | Pooled regression | Positive in Africa and Latin America, no effect in Asia |
| Landau (1986) | 65 countries | Economic growth | Democracy | OLS | Negative |

Source: Constructed by Authors. OLS=ordinary least squares, GLS=generalised least squares, FMOLS=fully modified ordinary least squares, ARDL=autoregressive distributed lag model, GMM=generalised method of moments, S.E.=standard errors

as energy poverty. [McCauley et al. \(2013\)](#) argue that energy justice essentially aims to provide all individuals, everywhere in society, with safe, affordable, and sustainable energy. Energy justice is hence people-centered propagating fairness in the distribution of energy services and infrastructure to ensure that all people enjoy the benefits thereof to improve their lives. This is in line with Amartya Sen's Capability Approach (CA) to development that focuses on people and the quality of their lives ([Sen, 1980, 1999](#)). The CA is a normative evaluation approach for comprehending well-being and justice. The CA argues that policies to boost growth and development should focus on expanding the capabilities and freedom of individuals rather than resources. Access to essential goods like modern energy is imperative in expanding the capabilities and freedoms of people.

2.2. Democracy and economic growth

The literature on the effect of democracy on economic growth is divided. Proponents of democracy argue that the protection of human and property rights in democracies gives people the leeway to be industrious ([Ghardallou & Sridi, 2019; Leblang, 1996, 1997; Peev & Mueller, 2012](#)). Property rights give people the right to ownership, and others do not trespass ([Leblang, 1996](#)). As [Heo and Tan \(2001\)](#) put it, "individuals want to be confident that property they accumulate will be respected, and only democratic societies provide such confidence." An economy is likely to rake in all possible gains from investments and long-term transactional commitments if governments and people can be restrained from violating individual rights to property and rights to contract enforcement. [Leblang \(1996\)](#) argues that property rights precede economic growth, as property rights provide the motivation needed for production and exchange and help secure individual expectations about the conduct of others. Some scholars also believe that democracy enhances competition, and competition among pressure groups and political parties will generate efficient policies ([Acemoglu, Johnson, & Robinson, 2005](#)). [Deacon \(2009\)](#) asserts that a country's political system (whether democratic or autocratic) is important in the distribution of resources. Democracy is perceived to lead to collective goods allocation. The quest for re-election in democracies makes governments more responsive and accountable, causing them to enact policies promoting the private sector ([Minier, 1998](#)). [Knutsen \(2012\)](#) also pinpoints that democracies could enhance technological change. This may be due to the fact that democracies display greater dispersion of authority, and this enhances individuals' collection of new information, creation of new knowledge, learning and adoption of knowledge from other countries, and inclusive debates on the most efficient ways of fixing problems ([Ghardallou & Sridi, 2019; Knutsen, 2012](#)). These factors enhance technological change. [Przeworski et al. \(2000\)](#), [Faust \(2007\)](#), and [Rivera-Batiz \(2002\)](#) find some evidence that democracy enhances technological change, and as well established, technological change is pivotal to economic growth ([Acemoglu, 2012; Romer, 1990](#)).

In contrast, some scholars argue that democracy could be inimical to economic growth as it enhances pressures for immediate consumption ([Przeworski & Limongi, 1993](#)), which happens at the expense of investment. An increase in current consumption threatens profits, thereby reducing investments and retarding growth. [Przeworski and Limongi \(1993\)](#) explain the reasoning behind this as follows; i) the poor want to consume immediately, and when they can organize themselves, which is enhanced in democracies, they drive up wages. This reduces

profits and hence investment. However, autocratic regimes suppress the independent organization of unions, leading to lower wages and allowing capital owners to take a chunk of the total revenue (Knutsen, 2012; Krieckhaus, 2006). With higher income, they can save more and invest more. ii) In democracies where people can vote, governments distribute incomes away from investment. In democracies, governments are more accountable to citizens and may feel pressure to spend heavily on immediate public consumption (Krieckhaus, 2006). However, in autocracies, political accountability is lower, lessening the demands for governments to spend on immediate public consumption (Knutsen, 2012). With this, governments can commit to long-term investments without kowtowing to the exigencies of electorates (Przeworski & Limongi, 1993). Tavares and Wacziarg (2001) show that democratic institutions are responsive to the demands of the poor by increasing access to education and reducing income inequality but do so at the expense of physical capital accumulation. Przeworski and Limongi (1993) further argue that dictatorships are protected from particularistic pressures. Democracies may be susceptible to exploitation from certain special interest groups. These special groups may come about due to their ability to fund politicians or determine election outcomes. In the quest to please these groups as payback or to be re-elected, governments may attend to their particularistic interests at the expense of the larger population. Economic growth may hence be sacrificed for the protection of only some sectors or groups of people (Knutsen, 2012). Autocratic governments are, however free from these pressures and may act for the good of the whole country (Przeworski & Limongi, 1993).

On the empirical front, the evidence has been mixed (see Table 1 for a snapshot of the empirical literature), and as Knutsen (2012) indicates, there are empirical examples of democracies and of autocracies with both good and poor economic growth records. The mixed results of the democracy-growth nexus led Przeworski and Limongi (1993) to conclude: "... we do not know whether democracy fosters or hinders economic growth". Some scholars also find evidence of democracy having no effect on economic growth (see for example, Helliwell, 2009; Remmer, 1990). Most empirical studies have used the Polity Project and Freedom House indices of democracy (Helliwell, 2009; Jaunky, 2012; Krieckhaus, 2006; Narayan et al., 2011) which mainly focus on an electoral aspect of democracy. Following the criticisms of these indices (Coppedge et al., 2011, 2016, 2019), in this study, we employ the comprehensive V-Dem indices of democracy that capture electoral, liberal, majoritarian, consensual, participatory, deliberative, and egalitarian democracy. More importantly, different from the existing literature, we examine how democracy moderates the effect of energy justice on economic growth. To the best of our knowledge, this is the first study to consider this. Specifically, we employ data from 47 SSA countries from 2000 to 2020. By using the Driscoll-Kraay and the instrumental variable generalized method of moments techniques, the results generally suggest that energy justice and democracy enhance economic growth and that improvement in democracy stimulates the effect of energy justice on economic growth.

3. Methodology and data

3.1. Empirical models and estimation techniques

We test the effect of energy justice and democracy on economic growth in SSA. To model such an effect, we follow the Acemoglu, Naidu, Restrepo, and Robinson (2019) empirical growth model as specified in Equation (1):

$$\lnrgdpc_{i,t} = \alpha_0 + \beta_1 DEMO_{i,t} + \beta_2 EJ_{it} + \beta_3 X_{i,t} + \varepsilon_{i,t} \quad (1)$$

where $\lnrgdpc_{i,t}$ is the log of GDP per capita of country i at year t . $DEMO_{i,t}$ are the democracy variables (electoral, liberal, participatory, deliberative, and egalitarian democracy) of country i at year t . $EJ_{i,t}$ is the energy justice variables (rural-urban equality in access to electricity and rural-urban equality in access to clean cooking fuels and technologies) of country i at year t . $X_{i,t}$ is a set of control variables (physical capital, trade openness, foreign direct investment, education, and foreign aid) included in the economic growth model. α_0 , β_1 , β_2 and β_3 are the unknown coefficients to be estimated. $\varepsilon_{i,t}$ is the disturbance error term.

We extend Equation (1) to include the interaction term of democracy and energy justice. The interaction term is important to test if democracy conditions the impact of energy justice on economic growth. This specification is based on the assumption that democratic regimes make governments more responsive and accountable, causing them to enact policies that ensure fair distribution of public goods, including energy infrastructure and services (Markussen, 2011; Miller, 2004; Min, 2008).

$$\begin{aligned} \lnrgdpc_{i,t} = & \alpha_0 + \beta_1 DEMO_{i,t} + \beta_2 EJ_{it} + \theta_1 (DEMO \times EJ)_{i,t} \\ & + \beta_3 X_{i,t} + \varepsilon_{i,t} \end{aligned} \quad (2)$$

From Equation (2), we differentiate GDP per capita with respect to energy justice. As displayed in Equation (3), the differential equation helped to evaluate if improvement in democracy enhances the impact of energy justice on economic growth. In other words, Equation (3) is used to determine the marginal effect of energy justice on economic growth conditioned by democracy.

$$\frac{\partial \lnrgdpc}{\partial EJ} = \beta_2 + \theta_1 DEMO \quad (3)$$

We estimate the above equations using the Driscoll and Kraay (1998) estimator. The Driscoll and Kraay (1998) estimator assumes that the error structure of Eq. (1) is heteroscedastic, autocorrelated up to some lag, and perhaps correlated between the panels. This suggests that the Driscoll and Kraay (1998) estimator is essential for capturing autocorrelation and heteroskedasticity. Also, the Driscoll–Kraay estimator generates robust estimates of both cross-sectional and temporal dependence (Hoechle, 2007). Further, the Driscoll and Kraay (1998) estimator can handle missing data series and works with balanced and unbalanced panels (Hoechle, 2007). We also applied the (Baum, Schaer, & Stillman, 2002) instrumental variable generalized method of moments (IV-GMM) to check the robustness of our results. The IV-GMM technique helps to cater for endogeneity, which is one of the significant challenges in applied research.¹ In addition to catering for the endogeneity issue, the IV-GMM estimator allows consistent estimations in the presence of autocorrelation (AR, (1)) within panels and heteroscedasticity (Baum et al., 2002). Also, the IV-GMM estimator is consistent with Driscoll and Kraay (1998) standard errors that are robust to ‘spatial’ and temporal cross-sectional dependence even when the time dimension becomes relatively large.

¹ We used lag one of the democracy variables and the years as instruments to cater for endogeneity.

3.2. Data description and sources

To examine the effect of energy justice and democracy on economic growth, we used panel data from 47 SSA countries for the period between 2000 and 2020 in this study.²

3.2.1. Dependent variable

Economic growth (GDP per capita) is measured with GDP per capita (constant 2015 US\$). The data on this variable is obtained from the World Development Indicators (WDI) of the World Bank.

3.2.2. Independent variables of interest

One of the independent variables of interest is energy justice. We operationalized energy justice to be equal energy access between rural and urban areas. The first measure, rural-urban equality in access to clean cooking fuels and technologies, is computed as the ratio of rural access to clean cooking fuels and technologies to urban access to clean cooking fuels and technologies. In the same manner, rural-urban equality in access to electricity is calculated as the ratio of rural access to electricity to urban access to electricity. The higher the value for rural-urban equality in access to clean cooking fuels and technologies, and electricity, the high energy justice, and vice versa. The approach for calculating the measures is consistent with the literature (for instance, see [Trotter, 2016](#)). The access to electricity, clean cooking fuels, and technology variables used for the computation were sourced from WDI.

The second independent variable of interest is democracy. In this study, democracy is measured with five high-level indices, comprising participatory, deliberative, liberal, electoral, and egalitarian democracy. Participatory democracy represents the values of direct rule and active participation by citizens in all political procedures. The deliberative democracy is the value that political decisions that go into the activities of public interest or good should be based on reverential and rational discourse at all levels instead of being driven by emotional requests, solidary attachments, parochial interests, or force. Egalitarian democracy measures the idea of power disseminated evenly among all citizens irrespective of class, ethnicity, and orientation of any form or other social group. Liberal democracy captures the intrinsic value of protecting individual and minority rights against potential domination by the majority and state tyranny generally. Finally, electoral democracy measures the core value of political rulers being responsible toward citizens through sporadic elections ([Coppedge et al., 2011](#)). All the democracy variables and their conceptualization/definitions were sourced from the [Coppedge et al. \(2018\)](#) Variety of Democracy (V-DEM) database.

3.2.3. Control variables

Following the standard economic literature, physical capital, trade openness, foreign direct investment, education, and foreign aid, were included in the economic growth model as control covariates ([Adams, 2009](#); [Boateng, Agbola, & Mahmood, 2021](#); [Eregba & Mesagan, 2016](#); [Ibrahim & Alagidede, 2018](#)). Physical capital is measured with Gross fixed capital formation

² Angola, Benin, Botswana, Burkina Faso, Burundi, Cabo Verde, Cameroon, Central African Republic, Chad, Comoros, Congo, Dem. Rep., Congo, Rep., Cote d'Ivoire, Equatorial Guinea, Eritrea, Eswatini, Ethiopia, Gabon, Gambia, The, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, Sudan, Tanzania, Togo, Uganda, Zambia and Zimbabwe.

Table 2
Descriptive statistics.

| Definition | Variable | Mean | Std. Dev. | Min | Max |
|--|-----------|--------|-----------|--------|--------|
| GDP per capita | Inrgdpc | 7.110 | 0.970 | 5.555 | 9.740 |
| Electoral democracy | Polyarchy | 0.434 | 0.193 | 0.067 | 0.840 |
| Liberal democracy | Libdem | 0.303 | 0.191 | 0.005 | 0.730 |
| Participatory democracy | Partipdem | 0.258 | 0.128 | 0.008 | 0.545 |
| Deliberative democracy | Delibdem | 0.328 | 0.190 | 0.019 | 0.789 |
| Egalitarian democracy | Egaldem | 0.294 | 0.155 | 0.045 | 0.698 |
| Rural-urban equality in access to clean cooking fuels and technologies | Clean_dis | 0.220 | 0.260 | 0.000 | 2.000 |
| Rural-urban equality in access to electricity | Elec_dis | 0.304 | 0.266 | 0.008 | 1.036 |
| Physical Capital | Ingfcf | 21.601 | 1.730 | 17.399 | 27.343 |
| Trade openness | Intrade | 4.111 | 0.577 | -0.243 | 5.416 |
| Foreign direct investment | Infdi | 0.880 | 1.348 | -6.166 | 4.638 |
| Foreign aid | Inoda | 19.738 | 1.378 | 12.794 | 23.208 |
| Education | Insse | 3.628 | 0.588 | 1.780 | 4.695 |

(constant 2015 US\$). Trade openness is proxied with trade (Export+Import) (% of GDP), and foreign direct investment is measured with net inflows of foreign direct investment (% of GDP). Foreign aid is measured with net official development assistance and official aid received. Education is measured with secondary school enrollment (% gross). Data on these control variables are obtained from the WDI database. The summary statistics for the variables are presented in Table 2. For estimation, the variables were log-transformed except the democracy and energy justice variables. Figures 1 and 2 show that democracy and energy justice variables positively correlate with GDP per capita, respectively.

4. Results

Table 3 presents the unconditional estimates from the Driscoll-Kraay estimator. From Table 3, the findings generally show a positive association between energy justice and economic

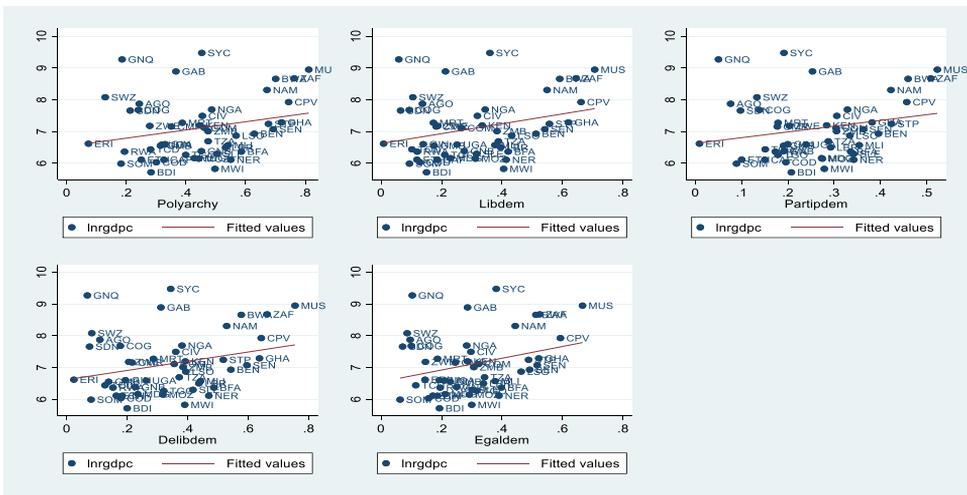


Figure 1. Bivariate relationship between democracy variables and GDP per capita.

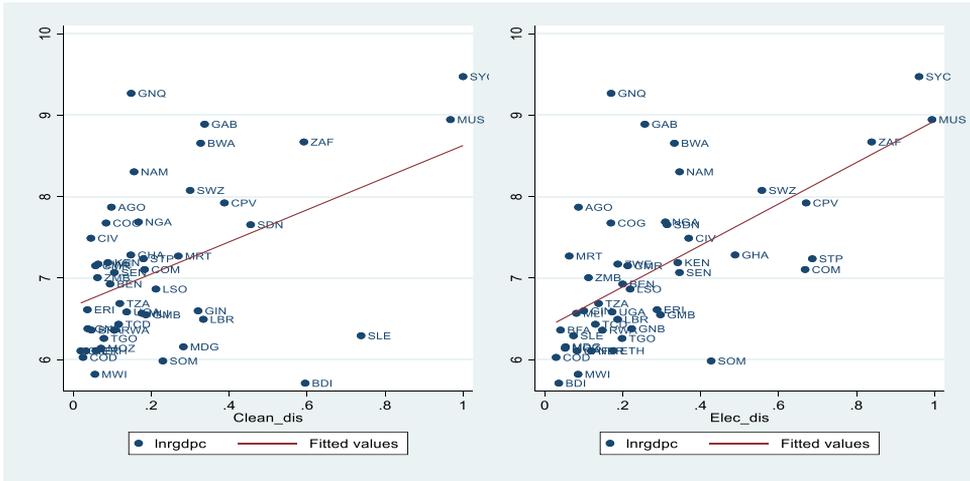


Figure 2. Bivariate relationship between energy justice variables and GDP per capita.

growth. Specifically, the coefficients of rural-urban equality in access to clean cooking fuels and technologies are positive and statistically significant at a 5% level or better. Thus, a 1% increase in rural-urban equality in access to clean cooking fuels and technologies increases GDP per capita by 0.150–0.190% points, ceteris paribus. Also, rural-urban equality in access to electricity is positive and statistically significant at a 1% level. From the estimated elasticity, GDP per capita increases by 1.084–1.214% points when rural-urban equality in access to electricity rises by 1%, ceteris paribus.

The results suggest that, generally, democracy is positively related to economic growth, ceteris paribus. For instance, participatory, deliberative, egalitarian, liberal, and electoral democracy have a positive and statistically significant effect on GDP per capita. The estimates show that GDP per capita increases by 0.789 points when there is 1 point increase in electoral democracy. In addition, 1 point improvement in liberal democracy is associated with a 0.419–0.969 points increase in GDP per capita, ceteris paribus. GDP per capita rises by 0.582–1.285 points when participatory democracy increases by 1 point, ceteris paribus. Also, GDP per capita increases by 0.350–0.908 points when deliberative democracy increases by 1 point, ceteris paribus. In addition, 1 point increase in egalitarian democracy increases GDP per capita by 0.219–0.968 points, ceteris paribus.

Regarding the control variables, physical capital formation has a statistically significant positive association with GDP per capita at a 1% level. Secondary school enrollment has a statistically significant positive association with GDP per capita at a 1% level. It is observed that foreign aid has a statistically significant negative association with GDP per capita. It is also observed that trade openness and foreign direct investment have statistically insignificant coefficients.

4.1. Conditional effect of energy justice and democracy on economic growth

We present the conditional effect of energy and democracy on GDP per capita in Table 4. From Table 4, the evidence shows that the interaction between electoral democracy and rural-urban equality in access to clean cooking fuels and technologies has a statistically significant

Table 3
Unconditional effect of Energy Justice and Democracy on Economic Growth [Driscoll-Kraay estimates].

| Variables | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|--------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| lnGfcf | 0.326*** (0.043) | 0.260*** (0.023) | 0.322*** (0.041) | 0.262*** (0.023) | 0.330*** (0.045) | 0.262*** (0.024) | 0.324*** (0.042) | 0.262*** (0.024) | 0.335*** (0.043) | 0.260*** (0.025) |
| Intrade | 0.056 (0.066) | 0.101 (0.064) | 0.035 (0.068) | 0.084 (0.063) | 0.047 (0.072) | 0.091 (0.069) | 0.034 (0.069) | 0.089 (0.066) | 0.053 (0.072) | 0.107 (0.068) |
| lnfdii | -0.030* (0.016) | -0.021 (0.021) | -0.025 (0.017) | -0.022 (0.021) | -0.024 (0.018) | -0.019 (0.022) | -0.022 (0.017) | -0.019 (0.021) | -0.025 (0.017) | -0.019 (0.021) |
| lnoda | -0.434*** (0.073) | -0.318*** (0.034) | -0.433*** (0.074) | -0.326*** (0.034) | -0.440*** (0.040) | -0.323*** (0.035) | -0.435*** (0.074) | -0.323*** (0.032) | -0.430*** (0.077) | -0.312*** (0.039) |
| Insse | 0.476*** (0.038) | 0.296*** (0.047) | 0.455*** (0.029) | 0.300*** (0.046) | 0.459*** (0.040) | 0.288*** (0.045) | 0.471*** (0.032) | 0.304*** (0.046) | 0.467*** (0.028) | 0.293*** (0.047) |
| Clean_dis | 0.190*** (0.060) | | 0.165*** (0.057) | | 0.150*** (0.060) | | 0.163*** (0.050) | | 0.183*** (0.060) | |
| Elec_dis | | 1.172*** (0.152) | | 1.084*** (0.153) | | 1.131*** (0.137) | | 1.115*** (0.138) | | 1.214*** (0.121) |
| Polyarchy | 0.789*** (0.094) | 0.275 (0.163) | | | | | | | | |
| Libdem | | | 0.969*** (0.084) | 0.419*** (0.152) | | | | | | |
| Partipdem | | | | | 1.285*** (0.147) | 0.582*** (0.195) | | | | |
| Delibdem | | | | | | | 0.908*** (0.060) | 0.350** (0.125) | | |
| Egaldem | | | | | | | | | 0.968*** (0.083) | 0.219* (0.118) |
| Constant | 6.355*** (0.749) | 5.918*** (0.571) | 6.622*** (0.816) | 6.087*** (0.564) | 6.477*** (0.755) | 5.988*** (0.583) | 6.555*** (0.809) | 6.002*** (0.593) | 6.187*** (0.852) | 5.818*** (0.618) |
| Observations | 393 | 336 | 393 | 336 | 393 | 336 | 393 | 336 | 393 | 336 |
| R2 | 0.786 | 0.824 | 0.798 | 0.827 | 0.787 | 0.826 | 0.795 | 0.825 | 0.786 | 0.822 |

Standard errors are in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01

Table 4
Conditional effect of Energy Justice and Democracy on Economic growth in SSA [Driscoll-Kraay estimates].

| Variables | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|-----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| Ingfcf | 0.305*** (0.036) | 0.265*** (0.025) | 0.305*** (0.035) | 0.267*** (0.024) | 0.312*** (0.039) | 0.267*** (0.025) | 0.307*** (0.035) | 0.266*** (0.025) | 0.316*** (0.037) | 0.265*** (0.026) |
| Intrate | 0.003 (0.081) | 0.117 (0.069) | -0.012 (0.085) | 0.105 (0.071) | -0.011 (0.091) | 0.105 (0.073) | -0.024 (0.085) | 0.110 (0.073) | -0.001 (0.086) | 0.122 (0.076) |
| Infidi | -0.031* (0.015) | -0.021 (0.017) | -0.025 (0.016) | -0.021 (0.017) | -0.022 (0.016) | -0.021 (0.020) | -0.026 (0.016) | -0.019 (0.017) | -0.027 (0.016) | -0.018 (0.019) |
| Inoda | -0.400*** (0.061) | -0.320*** (0.038) | -0.404*** (0.062) | -0.327*** (0.038) | -0.411*** (0.066) | -0.326*** (0.038) | -0.405*** (0.063) | -0.325*** (0.040) | -0.400*** (0.065) | -0.317*** (0.042) |
| Insse | 0.480*** (0.035) | 0.282*** (0.042) | 0.459*** (0.026) | 0.285*** (0.040) | 0.468*** (0.038) | 0.273*** (0.045) | 0.483*** (0.028) | 0.289*** (0.041) | 0.482*** (0.028) | 0.275*** (0.044) |
| Clean_dis | -0.750** (0.334) | | -0.407 (0.271) | | -0.696** (0.320) | | -0.586** (0.222) | | -0.511* (0.272) | |
| Elec_dis | | 1.871*** (0.107) | | 1.621*** (0.094) | | 1.584*** (0.096) | | 1.724*** (0.135) | | 1.702*** (0.132) |
| Polyarchy | 0.191 (0.239) | 0.668*** (0.206) | | | | | | | | |
| Polyarchy × Clean_dis | 1.836*** (0.489) | | | | | | | | | |
| Polyarchy × Elec_dis | | -1.117*** (0.284) | | | | | | | | |
| Libdem | | | 0.443* (0.251) | 0.785*** (0.213) | | | | | | |
| Libdem × Clean_dis | | | 1.519*** (0.525) | | | | | | | |
| Libdem × Elec_dis | | | | -1.064*** (0.323) | | | | | | |
| Partipdem | | | | | 0.406 (0.365) | 0.978*** (0.260) | | | | |
| Partipdem × Clean_dis | | | | | 2.589*** (0.729) | | | | | |
| Partipdem × Elec_dis | | | | | | -1.129*** (0.360) | | | | |
| Delibdem | | | | | | | 0.326 (0.194) | 0.747*** (0.200) | | |
| Delibdem × Clean_dis | | | | | | | 1.703*** (0.431) | | | |
| Delibdem × Elec_dis | | | | | | | | -1.136*** | | |

(continued on next page)

Table 4 (continued)

| Variables | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|-------------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| Egaldem | | | | | | | | | 0.297 (0.249) | 0.611*** (0.208) |
| Egaldem × Clean_dis | | | | | | | | | 1.850*** (0.517) | |
| Egaldem × Elec_dis | | | | | | | | | | -1.059** (0.405) |
| Marginal/Total effects | | | | | | | | | | |
| Constant | 0.792*** (0.101) | 0.933*** (0.161) | 0.702*** (0.133) | 0.844*** (0.170) | 0.715*** (0.104) | 0.969*** (0.146) | 0.757*** (0.134) | 0.828*** (0.168) | 0.780*** (0.110) | 0.963*** (0.167) |
| Observations | 6.601*** (0.782) | 5.619*** (0.584) | 6.760*** (0.834) | 5.827*** (0.608) | 6.733*** (0.826) | 5.830*** (0.612) | 6.736*** (0.819) | 5.746*** (0.639) | 6.363*** (0.834) | 5.677*** (0.672) |
| R2 | 393 | 336 | 393 | 336 | 393 | 336 | 393 | 336 | 393 | 336 |
| | 0.800 | 0.828 | 0.808 | 0.831 | 0.797 | 0.828 | 0.807 | 0.830 | 0.796 | 0.825 |

Standard errors in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01

positive effect on GDP per capita at a 1% level [see Column 1]. The total/marginal effects analysis shows that at the maximum value of electoral democracy (0.840), rural-urban equality in access to clean cooking fuels and technologies contributes to a 0.792% point increase in GDP per capita, *ceteris paribus*. As displayed in Column 2, the interaction between electoral democracy and rural-urban equality in access to electricity has a statistically significant negative effect on GDP per capita at a 1% level. Despite the negative interaction term, the total/marginal effects analysis shows that rural-urban equality in access to electricity increase GDP per capita by 0.933% points at the maximum value of electoral democracy (0.840), *ceteris paribus*. It is observed from Column 3 that the interaction between liberal democracy and rural-urban equality in access to clean cooking fuels and technologies has a statistically significant positive effect on GDP per capita at a 1% level. The total/marginal effects analysis shows that at the maximum value of liberal democracy (0.730), rural-urban equality in access to clean cooking fuels and technologies contributes to a 0.702% point increase in GDP per capita, *ceteris paribus*. Also, the interaction between liberal democracy and rural-urban equality in access to electricity has a statistically significant negative effect on GDP per capita at a 1% level [see Column 4]. The total/marginal effects analysis suggests that at the maximum value of electoral democracy (0.730), rural-urban equality in access to electricity increase GDP per capita by 0.844% points, *ceteris paribus*.

Column 5 shows that the interaction between participatory democracy and rural-urban equality in access to clean cooking fuels and technologies has a statistically significant positive effect on GDP per capita at a 1% level. The total/marginal effects analysis shows that at the maximum value of participatory democracy (0.545), rural-urban equality in access to clean cooking fuels and technologies contributes to a 0.715% point increase in GDP per capita, *ceteris paribus*. Also, the interaction between participatory democracy and rural-urban equality in access to electricity has a statistically significant negative effect on GDP per capita at a 1% level [see Column 6]. The total/marginal effects analysis suggests that at the maximum value of participatory democracy (0.545), rural-urban equality in access to electricity increases GDP per capita by 0.969% points, *ceteris paribus*. Further, as presented in Column 7, the interaction between deliberative democracy and rural-urban equality in access to clean cooking fuels and technologies has a statistically significant positive effect on GDP per capita at a 1% level. Based on the total/marginal effects analysis, it is observed that at the maximum value of deliberative democracy (0.789), rural-urban equality in access to clean cooking fuels and technologies contributes to a 0.757% point increase in GDP per capita, *ceteris paribus*. From Column 8, the interaction between deliberative democracy and rural-urban equality in access to electricity has a statistically significant negative effect on GDP per capita at a 1% level. Evidence from the total/marginal effects analysis indicates that at the maximum value of deliberative democracy (0.789), rural-urban equality in access to electricity increases GDP per capita by 0.828% points, *ceteris paribus*.

The results presented in Column 9 depict that the interaction between egalitarian democracy and rural-urban equality in access to clean cooking fuels and technologies has a statistically significant positive effect on GDP per capita at a 1% level. Based on the total/marginal effects analysis, it is observed that at the maximum value of egalitarian democracy (0.698), rural-urban equality in access to clean cooking fuels and technologies contributes to a 0.780% point increase in GDP per capita, *ceteris paribus*. Also, in Column 10, the interaction between egalitarian democracy and rural-urban equality in access to electricity has a statistically significant negative effect on GDP per capita at a 1% level. Evidence from the total/marginal effects

analysis indicates that at the maximum value of egalitarian democracy (0.698), rural-urban equality in access to electricity increase GDP per capita by 0.963% points.

4.2. Sensitivity analysis

We argue that the impact of energy justice and democracy on economic growth differ among the sub-regions within SSA due to differences in energy access and democratic practices among these regions. We, therefore, test this argument by grouping our sample into four (4) main geographical regions—West, Central, Eastern, and Southern—within SSA. In [Table 5A](#), Columns 1–10 present the results for West African countries, while Columns 11–20 show the results for East Africa countries. Also, In [Table 5B](#), Columns 1–10 present the results for Eastern African countries, while Columns 11–20 show the results for Southern Africa countries.

As shown in [Tables 5A](#) and [5B](#), the evidence shows that rural-urban equality in access to clean cooking fuels and technologies has a statistically insignificant effect on GDP per capita in West and Southern Africa. However, the coefficient of rural-urban equality in access to clean cooking fuels and technologies is negative and statistically significant at 1% in Eastern Africa while being positive and statistically significant in Central Africa. The findings also suggest that rural-urban equality in access to electricity has a statistically significant positive effect on GDP per capita in West, Eastern, and Southern Africa while having statistically insignificant in Central Africa.

The findings show that in West Africa, participatory, deliberative, egalitarian, liberal, and electoral democracy have a negative and statistically significant effect on GDP per capita. It is observed that participatory, deliberative, egalitarian, liberal, and electoral democracy have a positive and statistically significant effect on GDP per capita in Eastern Africa. The evidence shows that in Central Africa, while electoral, liberal, and participatory democracies have statistically significant negative effects on GDP per capita, deliberative and egalitarian democracies have an insignificant effect. In Southern Africa, participatory, deliberative, egalitarian, liberal, and electoral democracy have a negative and statistically significant effect on GDP per capita.

4.3. Robustness check with alternative estimator

[Table 6](#) presents the unconditional estimates from the IV-GMM estimator. The IV-GMM results essentially confirm the results from the Driscoll-Kraay estimator. From [Table 6](#), findings indicate that rural-urban equality in access to clean cooking fuels and technologies positively affects GDP per capita but is statistically insignificant in Column 1 only. Also, the impact of rural-urban equality in access to electricity on GDP per capita is positive and statistically significant at a 1% level. From the estimated elasticity, GDP per capita increases by 1.124–1.253% points when rural-urban equality in access to electricity rises by 1%. The IV estimator also confirms that participatory, deliberative, egalitarian, liberal, and electoral democracy has a positive and statistically significant effect on GDP per capita at a 1% level. The estimates show that GDP per capita increases by 0.260–0.798 points when there is 1 point increase in electoral democracy, *ceteris paribus*. In addition, 1 point improvement in liberal democracy is associated with a 0.390–0.991 points increase in GDP per capita. GDP per capita rises by 0.588–1.320 points when participatory democracy increases by 1 point, *ceteris paribus*. Also, GDP per capita increases by 0.323–0.927 points when deliberative democracy increases

Table 5A
Unconditional effect of Energy Justice, and Democracy on Economic Growth in West and Eastern Africa [Driscoll-Kraay estimates].

| Variables | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|--------------------|---------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|---------------------|---------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| West Africa | | | | | | | | | | | | | | | | | | | | |
| lngrcf | 0.299*** (0.067) | 0.210*** (0.035) | 0.297*** (0.065) | 0.212*** (0.035) | 0.292*** (0.062) | 0.230*** (0.035) | 0.297*** (0.065) | 0.218*** (0.033) | 0.286*** (0.070) | 0.181*** (0.042) | 0.276*** (0.034) | 0.205*** (0.017) | 0.277*** (0.025) | 0.213*** (0.013) | 0.315*** (0.035) | 0.225*** (0.017) | 0.281*** (0.026) | 0.221*** (0.013) | 0.309*** (0.024) | 0.235*** (0.012) |
| lntrate | 0.196* (0.103) | 0.211* (0.108) | 0.199** (0.093) | 0.216* (0.111) | 0.169* (0.081) | 0.106 (0.100) | 0.243** (0.104) | 0.287** (0.121) | 0.219** (0.096) | 0.285** (0.133) | -0.143*** (0.020) | -0.025 (0.020) | -0.222*** (0.021) | -0.062*** (0.016) | -0.237*** (0.022) | -0.071*** (0.004) | -0.243*** (0.029) | -0.089*** (0.020) | -0.268*** (0.016) | -0.095*** (0.015) |
| lnfdi | -0.057 (0.036) | -0.101* (0.051) | -0.061* (0.035) | -0.100** (0.048) | -0.058** (0.026) | -0.080 (0.048) | -0.065* (0.033) | -0.109** (0.045) | -0.066* (0.032) | -0.118*** (0.039) | 0.014 (0.009) | 0.014 (0.033) | 0.005 (0.008) | 0.014 (0.032) | 0.001 (0.007) | 0.004 (0.033) | 0.029** (0.013) | 0.020 (0.025) | 0.000 (0.007) | 0.008 (0.031) |
| lnoda | -0.091 (0.135) | 0.057 (0.081) | -0.069 (0.126) | 0.059 (0.082) | -0.008 (0.133) | 0.056 (0.098) | -0.054 (0.133) | 0.065 (0.081) | -0.052 (0.138) | 0.081 (0.086) | -0.390*** (0.032) | -0.124*** (0.039) | -0.367*** (0.026) | -0.150*** (0.033) | -0.369*** (0.031) | -0.117*** (0.034) | -0.335*** (0.018) | -0.151*** (0.035) | -0.330*** (0.023) | -0.155*** (0.032) |
| lnsse | 0.245*** (0.054) | 0.154 (0.103) | 0.253*** (0.056) | 0.136 (0.106) | 0.263*** (0.058) | 0.201** (0.089) | 0.240*** (0.060) | 0.127 (0.100) | 0.264*** (0.056) | 0.129 (0.106) | 0.489*** (0.118) | 0.074 (0.104) | 0.467*** (0.075) | 0.108 (0.092) | 0.505*** (0.103) | 0.086 (0.090) | 0.398*** (0.095) | 0.098 (0.117) | 0.399*** (0.065) | 0.113 (0.085) |
| Clean_dis | 0.294 (0.313) | 0.238 (0.286) | 0.238 (0.286) | 0.236 (0.267) | 0.150 (0.254) | 0.150 (0.254) | 0.236 (0.267) | 0.179 (0.297) | 0.179 (0.297) | 0.179 (0.297) | -0.135 (0.098) | -0.135 (0.098) | -0.240** (0.111) | -0.240** (0.111) | -0.256*** (0.087) | -0.256*** (0.087) | -0.086 (0.080) | -0.086 (0.080) | -0.255** (0.089) | -0.255** (0.089) |
| Elec_dis | 1.042*** (0.132) | 1.160*** (0.168) | 1.042*** (0.132) | 1.160*** (0.168) | 1.049*** (0.139) | 0.773*** (0.103) | 1.049*** (0.139) | 1.049*** (0.139) | 1.297*** (0.223) | 1.297*** (0.223) | 1.954*** (0.179) | 1.954*** (0.179) | 1.702*** (0.135) | 1.702*** (0.135) | 1.853*** (0.153) | 1.853*** (0.153) | 1.600*** (0.188) | 1.600*** (0.188) | 1.514*** (0.097) | 1.514*** (0.097) |
| Polynarchy | -0.162 (0.218) | -0.872*** (0.217) | -0.872*** (0.217) | -0.872*** (0.217) | -1.408*** (0.345) | -1.426*** (0.483) | -1.426*** (0.483) | -0.486** (0.209) | -0.486** (0.209) | -0.486** (0.209) | 1.877*** (0.162) | 1.877*** (0.162) | 0.734*** (0.184) | 0.734*** (0.184) | 3.867*** (0.228) | 3.867*** (0.228) | 1.701*** (0.267) | 1.701*** (0.267) | 3.466*** (0.142) | 3.466*** (0.142) |
| Libdem | | | -0.369* (0.180) | -0.933*** (0.246) | | | | | | | | | | | | | | | | |
| Partipdem | | | | | | | | | | | | | | | | | | | | |
| Delibdem | | | | | | | | | | | | | | | | | | | | |
| Egaldem | | | | | | | | | | | | | | | | | | | | |
| Constant | 0.655 (1.328) | 0.072 (0.985) | 0.281 (1.226) | -0.108 (1.004) | -0.469 (1.396) | -0.067 (1.267) | -0.090 (1.391) | -0.532 (1.087) | 0.186 (1.303) | 0.029 (0.963) | 6.851*** (1.287) | 3.949*** (0.445) | 6.863*** (1.053) | 4.401*** (0.439) | 5.664*** (1.410) | 3.390*** (0.495) | 6.320*** (0.976) | 4.349*** (0.415) | 5.542*** (0.804) | 4.020*** (0.415) |
| Observations | 154 | 128 | 154 | 128 | 154 | 128 | 154 | 128 | 154 | 128 | 113 | 95 | 113 | 95 | 113 | 95 | 113 | 95 | 113 | 95 |
| R2 | 0.705 | 0.774 | 0.710 | 0.779 | 0.731 | 0.782 | 0.712 | 0.778 | 0.717 | 0.797 | 0.887 | 0.956 | 0.925 | 0.961 | 0.901 | 0.960 | 0.930 | 0.964 | 0.944 | 0.963 |

Standard errors in parentheses* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5B
Unconditional effect of Energy Justice, and Democracy on Economic Growth in Central and Southern Africa [Driscoll-Kraay estimates].

| Variables | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|--------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| | Southern Africa | | | | | | | | | | | | | | | | | | | |
| lngrcf | 0.207*** (0.067) | 0.477*** (0.121) | 0.208*** (0.064) | 0.477*** (0.115) | 0.198** (0.069) | 0.480*** (0.125) | 0.208*** (0.059) | 0.482*** (0.109) | 0.217*** (0.059) | 0.469*** (0.107) | 0.285*** (0.024) | 0.267*** (0.033) | 0.285*** (0.024) | 0.260*** (0.032) | 0.281*** (0.022) | 0.266*** (0.029) | 0.287*** (0.024) | 0.262*** (0.031) | 0.276*** (0.024) | 0.271*** (0.029) |
| lntrate | -0.381*** (0.055) | -0.240** (0.113) | -0.373*** (0.056) | -0.203 (0.118) | -0.356*** (0.062) | -0.240* (0.117) | -0.358*** (0.062) | -0.192 (0.120) | -0.358*** (0.074) | -0.100 (0.144) | -0.694*** (0.166) | -0.666*** (0.188) | -0.694*** (0.184) | -0.650*** (0.203) | -0.726*** (0.177) | -0.687*** (0.187) | -0.715*** (0.191) | -0.666*** (0.209) | -0.666*** (0.146) | -0.654*** (0.165) |
| lnfdi | 0.011 (0.037) | -0.144*** (0.022) | 0.012 (0.038) | -0.140*** (0.022) | 0.011 (0.035) | -0.147*** (0.022) | 0.011 (0.037) | -0.137*** (0.022) | 0.012 (0.036) | -0.128*** (0.026) | -0.008 (0.037) | 0.007 (0.043) | -0.011 (0.037) | 0.010 (0.042) | -0.004 (0.036) | 0.009 (0.041) | -0.009 (0.036) | 0.010 (0.041) | -0.004 (0.037) | 0.001 (0.042) |
| lnoda | -0.287*** (0.043) | -0.694*** (0.092) | -0.295*** (0.040) | -0.691*** (0.089) | -0.268*** (0.049) | -0.691*** (0.095) | -0.294*** (0.037) | -0.690*** (0.088) | -0.301*** (0.038) | -0.679*** (0.082) | -0.447*** (0.047) | -0.442*** (0.036) | -0.457*** (0.049) | -0.449*** (0.034) | -0.452*** (0.049) | -0.447*** (0.039) | -0.457*** (0.049) | -0.450*** (0.035) | -0.436*** (0.046) | -0.431*** (0.042) |
| lnsse | -0.085 (0.201) | 0.222 (0.233) | -0.097 (0.198) | 0.215 (0.224) | -0.063 (0.208) | 0.231 (0.236) | -0.085 (0.187) | 0.194 (0.206) | -0.101 (0.187) | 0.182 (0.198) | 0.668*** (0.051) | 0.672*** (0.109) | 0.657*** (0.044) | 0.623*** (0.112) | 0.679*** (0.049) | 0.681*** (0.101) | 0.661*** (0.044) | 0.631*** (0.096) | 0.686*** (0.059) | 0.750*** (0.103) |
| Clean_dis | 12.991*** (1.621) | 13.006*** (1.647) | 13.006*** (1.647) | 13.077*** (1.610) | 13.077*** (1.610) | 13.077*** (1.610) | 12.998*** (1.720) | 12.998*** (1.720) | 12.892*** (1.738) | 12.892*** (1.738) | 0.138 (0.209) | 0.138 (0.209) | 0.131 (0.196) | 0.177 (0.208) | 0.177 (0.208) | 0.177 (0.208) | 0.126 (0.189) | 0.126 (0.189) | 0.232 (0.237) | 0.232 (0.237) |
| Elec_dis | 0.339 (0.804) | 0.339 (0.804) | 0.339 (0.804) | 0.381 (0.839) | 0.284 (0.775) | 0.284 (0.775) | 0.398 (0.839) | 0.398 (0.839) | 0.398 (0.839) | 0.426 (0.884) | 0.247 (0.192) | 0.247 (0.192) | 0.247 (0.192) | 0.345* (0.192) | 0.263 (0.168) | 0.263 (0.168) | 0.328* (0.174) | 0.328* (0.174) | 0.328* (0.174) | 0.328* (0.174) |
| Polyarchy | -0.496** (0.214) | -0.361** (0.148) | -0.278* (0.157) |
| Libdem | -0.315* (0.159) | -0.315* (0.159) | -0.315* (0.159) | 0.140 (0.152) |
| Partipdem | -0.524 (0.490) |
| Delibdem | -0.524 (0.490) |
| Egaldem | -0.524 (0.490) |
| Constant | 9.589*** (0.523) | 10.856*** (1.268) | 9.613*** (0.553) | 10.583*** (1.291) | 9.260*** (0.502) | 10.753*** (1.303) | 9.517*** (0.519) | 10.430*** (1.309) | 9.473*** (0.571) | 10.050*** (1.331) | 10.885*** (1.587) | 10.905*** (1.831) | 11.046*** (1.677) | 11.213*** (1.831) | 11.167*** (1.684) | 11.082*** (1.878) | 11.101*** (1.698) | 11.227*** (1.813) | 11.061*** (1.509) | 10.344*** (1.856) |
| Observations | 44 | 35 | 44 | 35 | 44 | 35 | 44 | 35 | 44 | 35 | 82 | 78 | 82 | 78 | 82 | 78 | 82 | 78 | 82 | 78 |
| R2 | 0.905 | 0.751 | 0.904 | 0.751 | 0.908 | 0.752 | 0.904 | 0.752 | 0.903 | 0.757 | 0.909 | 0.899 | 0.907 | 0.898 | 0.909 | 0.899 | 0.908 | 0.898 | 0.912 | 0.903 |

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6
Unconditional effect of Energy Justice and Democracy on Economic growth in SSA [IV-GMM estimates].

| Variables | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|--------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| lnGfcf | 0.324*** (0.022) | 0.264*** (0.022) | 0.331*** (0.022) | 0.267*** (0.022) | 0.340*** (0.023) | 0.267*** (0.022) | 0.333*** (0.022) | 0.266*** (0.022) | 0.343*** (0.023) | 0.264*** (0.023) |
| Intrade | 0.052 (0.040) | 0.101** (0.045) | 0.032 (0.042) | 0.086* (0.046) | 0.045 (0.046) | 0.091* (0.048) | 0.032 (0.044) | 0.091** (0.046) | 0.051 (0.044) | 0.108** (0.046) |
| Infidi | -0.036** (0.017) | -0.020 (0.022) | -0.025 (0.018) | -0.021 (0.046) | -0.024 (0.018) | -0.019 (0.022) | -0.022 (0.018) | -0.019 (0.022) | -0.025 (0.018) | -0.018 (0.023) |
| Inoda | -0.431*** (0.034) | -0.324*** (0.038) | -0.446*** (0.036) | -0.332*** (0.037) | -0.452*** (0.037) | -0.329*** (0.037) | -0.447*** (0.036) | -0.328*** (0.037) | -0.442*** (0.038) | -0.317*** (0.038) |
| Insse | 0.487*** (0.052) | 0.278*** (0.065) | 0.444*** (0.053) | 0.281*** (0.064) | 0.452*** (0.055) | 0.270*** (0.064) | 0.462*** (0.054) | 0.285*** (0.065) | 0.461*** (0.055) | 0.276*** (0.065) |
| Clean_dis | 0.233** (0.101) | | 0.155 (0.100) | | 0.137 (0.107) | | 0.154 (0.102) | | 0.173 (0.106) | |
| Elec_dis | | 1.205*** (0.160) | | 1.124*** (0.166) | | 1.163*** (0.159) | | 1.155*** (0.167) | | 1.253*** (0.170) |
| Polyarchy | 0.798*** (0.134) | 0.260* (0.134) | | | | | | | | |
| Libdem | | | 0.991*** (0.131) | 0.390*** (0.150) | | | | | | |
| Partipdem | | | | | 1.320*** (0.227) | 0.558** (0.242) | | | | |
| Delibdem | | | | | | | 0.927*** (0.131) | 0.323** (0.140) | | |
| Egaldem | | | | | | | | | 0.977*** (0.165) | 0.183 (0.169) |
| Constant | 6.288*** (0.534) | 5.985*** (0.570) | 6.736*** (0.552) | 6.150*** (0.562) | 6.551*** (0.559) | 6.055*** (0.558) | 6.635*** (0.566) | 6.064*** (0.571) | 6.264*** (0.585) | 5.882*** (0.574) |
| Observations | 376 | 324 | 376 | 324 | 376 | 324 | 376 | 324 | 376 | 324 |
| R2 | 0.785 | 0.829 | 0.798 | 0.832 | 0.787 | 0.832 | 0.795 | 0.831 | 0.787 | 0.828 |
| Hansen | 12.621 | 29.360 | 11.096 | 28.011 | 11.670 | 28.550 | 11.499 | 28.590 | 12.109 | 30.640 |
| Hansen (p-values) | 0.814 | 0.044 | 0.890 | 0.062 | 0.864 | 0.054 | 0.872 | 0.054 | 0.842 | 0.032 |
| F-statistics | 893.760 | 85.1182 | 1014.104 | 1051.582 | 461.570 | 399.611 | 937.636 | 820.972 | 928.893 | 666.937 |
| No. of instruments | 26 | 26 | 26 | 26 | 26 | 26 | 26 | 26 | 26 | 26 |
| No. of countries | 47 | 47 | 47 | 47 | 47 | 47 | 47 | 47 | 47 | 47 |

Heteroscedasticity robust standard errors in parentheses. F-statistics is the Kleibergen-Paap rk Wald F statistic for weak instrument identification. * p < 0.10, ** p < 0.05, *** p < 0.01

by 1 point, *ceteris paribus*. In addition, 1 point increase in egalitarian democracy increases GDP per capita by 0.977 points, *ceteris paribus*.

Table 7 presents the interactive results from the IV-GMM estimator, and the marginal effect analysis is consistent with marginal effect estimates based on the Driscoll-Kraay estimator. From Table 7, the marginal effects analysis based on the interaction results suggests that at the maximum value of electoral democracy (0.840), rural-urban equality in access to clean cooking fuels and technologies contributes to a 0.841% point increase in GDP per capita, while rural-urban equality in access to electricity increase GDP per capita by 0.954% point, *ceteris paribus*. Also, the total/marginal effects analysis shows that at the maximum value of liberal democracy (0.730), rural-urban equality in access to clean cooking fuels and technologies contributes to a 0.706% point increase in GDP per capita and rural-urban equality in access to electricity increase GDP per capita by 0.883% points, *ceteris paribus*. The evidence consistently indicates that at the maximum value of participatory democracy (0.545), rural-urban equality in access to clean cooking fuels and technologies contributes to a 0.719% point increase in GDP per capita, rural-urban equality in access to electricity increase GDP per capita by 1.000% point, *ceteris paribus*. Clearly, at the maximum value of deliberative democracy (0.789), rural-urban equality in access to clean cooking fuels and technologies contributes to a 0.766% point increase in GDP per capita, and rural-urban equality in access to electricity increase GDP per capita by 0.871% points, *ceteris paribus*. Finally, total/marginal effects analysis based on the moderation results suggests that at the maximum value of egalitarian democracy (0.698), rural-urban equality in access to clean cooking fuels and technologies contributes to a 0.797% point increase in GDP per capita, and rural-urban equality in access to electricity increase GDP per capita by 1.1011% points, *ceteris paribus*.

5. Discussion and policy implications

Our study contributes significantly to the energy justice and economic growth literature by providing empirical evidence on the role of democracy and rural-urban equality in access to electricity and clean cooking fuels and technologies on economic growth in SSA. In doing so, we address three key research questions important for policy formulation. These key questions are: (i) *Does energy justice facilitate economic growth in SSA?* (ii) *Does democracy promote economic growth in SSA?* (iii) *Does democracy condition the effect of energy justice on economic growth in SSA?* In this section, we present and discuss the results from the Driscoll-Kraay, which are consistent with the instrumental variable generalized method of moments technique estimator. The policy implications drawn from the findings are also discussed in this section.

First, our findings indicate that energy justice measured with rural-urban equality in access to electricity and clean cooking fuels and technologies promotes economic growth, *ceteris paribus* in the full sample. These findings show that closing the inequality in access to energy between rural and urban populations could contribute substantially to economic growth. With reference to John Rawls' theory of Distributive Justice and Amartya Sen's CA, we suggest that equal allocation of energy infrastructure and services between urban and rural populations would enhance the rural population capacity to function effectively to achieve their economic developmental needs. In other words, we argue that achieving equality in energy access between rural and urban populations would drive economic growth by improving health, human capital, entrepreneurship, and asset accumulation among the rural population. Climate change and environmental degradation can impede economic growth (Alestra, Cette, Chouard, & Lecat, 2022; Nordhaus, 2019, 1977; Stern, 2007). The rural population depends enormously on

Table 7
Conditional effect of Energy Justice and Democracy on Economic growth in SSA [IV-GMM estimates].

| Variables | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|-----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| lnGfcf | 0.305*** (0.021) | 0.270*** (0.022) | 0.313*** (0.022) | 0.272*** (0.022) | 0.320*** (0.023) | 0.272*** (0.022) | 0.315*** (0.021) | 0.271*** (0.022) | 0.323*** (0.023) | 0.269*** (0.022) |
| Intrade | -0.004 (0.041) | 0.116*** (0.044) | -0.014 (0.043) | 0.104** (0.046) | -0.013 (0.048) | 0.104** (0.048) | -0.026 (0.043) | 0.109** (0.046) | -0.003 (0.044) | 0.121*** (0.046) |
| lnfdi | -0.038** (0.016) | -0.021 (0.021) | -0.025 (0.017) | -0.021 (0.021) | -0.021 (0.018) | -0.021 (0.022) | -0.025 (0.017) | -0.019 (0.021) | -0.026 (0.017) | -0.017 (0.022) |
| lnoda | -0.398*** (0.035) | -0.326*** (0.037) | -0.415*** (0.037) | -0.333*** (0.036) | -0.421*** (0.037) | -0.333*** (0.036) | -0.415*** (0.037) | -0.331*** (0.037) | -0.409*** (0.039) | -0.323*** (0.038) |
| Insse | 0.489*** (0.052) | 0.263*** (0.064) | 0.447*** (0.053) | 0.267*** (0.064) | 0.461*** (0.055) | 0.255*** (0.065) | 0.475*** (0.054) | 0.270*** (0.065) | 0.476*** (0.056) | 0.259*** (0.065) |
| Clean_dis | -0.759*** (0.245) | | -0.410** (0.190) | | -0.707*** (0.258) | | -0.595*** (0.158) | | -0.530** (0.206) | |
| Elec_dis | | 1.903*** (0.293) | | 1.629*** (0.273) | | 1.598*** (0.327) | | 1.724*** (0.270) | | 1.698*** (0.276) |
| Polyarchy | 0.162 (0.156) | 0.669*** (0.198) | | | | | | | | |
| Polyarchy × Clean_dis | 1.905*** (0.376) | | | | | | | | | |
| Polyarchy × Elec_dis | | -1.130*** (0.380) | | | | | | | | |
| Libdem | | | 0.451*** (0.161) | 0.755*** (0.205) | | | | | | |
| Libdem × Clean_dis | | | 1.529*** (0.358) | | | | | | | |
| Libdem × Elec_dis | | | | -1.023** (0.402) | | | | | | |
| Partipdem | | | | | 0.405 (0.295) | 0.952*** (0.361) | | | | |
| Partipdem × Clean_dis | | | | | 2.617*** (0.628) | | | | | |
| Partipdem × Elec_dis | | | | | | -1.097 (0.675) | | | | |
| Delibdem | | | | | | | 0.330** | 0.714*** | | |

(continued on next page)

Table 7 (continued)

| Variables | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|-------------------------------|----------|----------|----------|----------|----------|----------|----------|-----------|----------|----------|
| Delibdem × Clean_dis | | | | | | | (0.154) | (0.191) | | |
| | | | | | | | 1.724*** | | | |
| | | | | | | | (0.322) | | | |
| Delibdem × Elec_dis | | | | | | | | -1.082*** | | |
| | | | | | | | | (0.378) | | |
| Egaldem | | | | | | | | | 0.276 | 0.561** |
| | | | | | | | | | (0.204) | (0.244) |
| Egaldem × Clean_dis | | | | | | | | | 1.901*** | |
| | | | | | | | | | (0.427) | |
| Egaldem × Elec_dis | | | | | | | | | | -0.984** |
| | | | | | | | | | | (0.465) |
| Marginal/Total effects | | | | | | | | | | |
| Constant | 0.841*** | 0.954*** | 0.706*** | 0.883*** | 0.719*** | 1.000*** | 0.766*** | 0.871*** | 0.797*** | 1.011*** |
| | (0.141) | (0.171) | (0.145) | (0.178) | (0.152) | (0.176) | (0.149) | (0.183) | (0.161) | (0.199) |
| | 6.548*** | 5.685*** | 6.856*** | 5.908*** | 6.797*** | 5.904*** | 6.811*** | 5.824*** | 6.426*** | 5.757*** |
| | (0.527) | (0.563) | (0.548) | (0.555) | (0.553) | (0.559) | (0.554) | (0.560) | (0.574) | (0.564) |
| Observations | 376 | 324 | 376 | 324 | 376 | 324 | 376 | 324 | 376 | 324 |
| R2 | 0.800 | 0.834 | 0.808 | 0.836 | 0.798 | 0.833 | 0.808 | 0.835 | 0.797 | 0.831 |
| Hansen | 13.866 | 30.678 | 12.322 | 29.359 | 12.796 | 30.042 | 12.318 | 29.977 | 14.166 | 30.747 |
| Hansen (p-values) | 0.738 | 0.031 | 0.830 | 0.044 | 0.804 | 0.037 | 0.830 | 0.038 | 0.718 | 0.031 |
| F-statistics | 305.137 | 227.389 | 433.432 | 269.274 | 159.689 | 100.592 | 346.548 | 200.132 | 268.604 | 161.110 |
| No. of instruments | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 |
| No. of countries | 47 | 47 | 47 | 47 | 47 | 47 | 47 | 47 | 47 | 47 |

Heteroscedasticity robust standard errors in parentheses. F-statistics is the Kleibergen-Paap rk Wald F statistic for weak instrument identification. * p < 0.10, ** p < 0.05, *** p < 0.01

biofuels such as firewood and charcoal for their household activities, leading to massive destruction of forest reserves. Since forest stores massive carbon emissions (Griscom et al., 2017; Popkin, 2019), depletion of forest reserves due to poor access to electricity and clean cooking technologies among the rural population increases carbon emissions and climate change impeding agricultural productivity and economic growth. Our empirical findings add to prior studies that have revealed that access to energy promotes economic growth and human development (Acheampong, Dzator, & Shahbaz, 2021; Acheampong, Dzator, Savage et al., 2021; Acheampong, Erdiaw-Kwasie, & Abunyewah, 2021; Awaworyi Churchill & Smyth, 2021; Nawaz, 2021; Pan, Biru, & Lettu, 2021).

Second, the results reveal a significant positive link between democracy and economic growth for the full sample. Specifically, participatory, deliberative, egalitarian, liberal, and electoral democracies contribute to economic growth, *ceteris paribus*. This finding aligns with the view that democracy is fundamental for sustaining economic growth. Theoretically, democracy is argued to promote economic growth by ensuring the protection of property rights and people's freedom (Ghardallou & Sridi, 2019; Leblang, 1996, 1997; Peev & Mueller, 2012). Property right protection is seen as an engine of entrepreneurship and technological innovation. Additionally, property right protection in democratic regimes reduces transaction costs and promotes production and exchange, facilitating market functioning and economic growth (Leblang, 1996). Furthermore, democracy promotes economic growth by ensuring the design of growth-supportive policies. Democracy is argued to drive efficient policies through competition among political parties and pressure groups (Acemoglu et al., 2005). Our findings are consistent with the findings of Acemoglu et al. (2019), Knutsen (2012, 2013), Mathonnat and Minea (2019), and Malikane and Chitambara (2017), revealing that democracy is associated with increased economic growth.

Third, we observe from the marginal effect analysis that when participatory, deliberative, egalitarian, liberal, and electoral democracies improve, rural-urban equality in access to electricity and clean cooking fuels and technologies contributes substantially to economic growth. This evidence confirms the resource allocation effects of democracy. Deacon (2009) argues that the allocation or distribution of resources depends on the political system. Scholars and political commentators have maintained that democracy leads to a collective distribution of goods because the quest for re-election in democratic regimes makes governments more responsive and accountable, causing them to enact policies that ensure fair distribution of public goods, including energy infrastructure (Markussen, 2011; Miller, 2004; Min, 2008). A study by Trotter (2016) indicated that democracy promotes equal access to electricity between rural and urban populations in SSA. In summary, the conditional effect findings show that improving democratic practices would ensure fair access to electricity and clean cooking fuels and technologies between rural and urban populations, thereby sustaining economic growth.

Fourth, we observe variations in the impact of energy justice and democracy on economic growth across the sub-regions in SSA. From the regional perspective, rural-urban equality in access to clean cooking fuels and technologies does not explain economic growth in West and Southern Africa. However, rural-urban equality in access to clean cooking fuels and technologies has negative effect on economic growth in Eastern Africa while contributing substantially to economic growth in Central Africa. In addition, rural-urban equality in access to electricity is found to enhance economic growth in West, Eastern, and Southern Africa while not impacting Central Africa. This evidence confirms our argument that energy justice would have a disparate effect on the region's economic growth due to differences in access to energy among the sub-regions within SSA. In addition, we also found evidence that participatory, deliberative,

egalitarian, liberal, and electoral democracies do not enhance economic growth in West, Central, and Southern Africa; they contribute significantly to economic growth in Eastern Africa. These mixed effects of democracy variables on the sub-regions' economic growth align with the argument and findings of previous studies such as [Krieckhaus \(2006\)](#), [Grier and Tullock \(1989\)](#), and [Narayan et al. \(2011\)](#) that democracy could affect a regions' economic growth differently.

From a policy perspective, the role of energy justice in promoting economic growth call for distributional policies for achieving energy justice by closing the inequality in access between rural and urban areas in SSA. Over the years, rural areas have faced injustice when policy-makers allocate infrastructural facilities. For instance, about 80% of the global rural population lacking electricity are based in SSA ([IEA et al., 2022](#)). Besides, almost 93% of SSA's rural population lacks access to clean cooking fuels and technologies ([IEA et al., 2022](#)). We recommend that policymakers prioritize the energy infrastructure needs of the rural population during the design of energy policies. Many SSA countries have designed rural electrification and clean cooking technologies policies; however, there are many bottlenecks that challenge the implementation of these energy policies. Some of these bottlenecks include corruption and human capital in managing energy infrastructure. Policymakers should make it a priority to appropriately address these bottlenecks in order to close the energy access gap between rural and urban populations in SSA. In addition, political commitment, capacity enhancement, up-grading, and extension of rural infrastructure facilities are needed to reduce the disparity in access to energy between rural and urban population. We also recommend that to achieve energy justice and make the rural population adopt and sustain the usage of clean fuels and technologies for cooking demand, policymakers should design and implement rebate policies that would make these technologies less affordable than dirty fuels.

Also, our findings that democracy is growth-enhancing in SSA call on policymakers to sustain democratic practices that ensure direct rule and active participation by citizens in political decisions; protections of individual and minority rights against majority domination and state tyranny; freedom of expression, association, and voting; distribution of political power equally to citizens, and political decisions relating to activities that are of public interest. These democratic practices would provide the enabling environment for promoting and attracting entrepreneurship, foreign investment, and technological innovations needed to promote SSA's economic growth. Finally, given that democracy conditions energy justice to stimulate economic growth, policymakers should consider the efficacy of democratic practices within countries when designing energy justice policies in SSA. In summary, we suggest that policies that enhance democratization and energy justice between rural and urban populations would contribute to economic growth in SSA.

6. Conclusion

In this study, we contribute to the literature by examining whether energy justice and democracy synergistically affect economic growth in a panel of 47 sub-Saharan Africa (SSA) countries from 2000 to 2020 using Driscoll-Kraay and the instrumental variable generalized method of moments estimators. Energy justice is captured using rural-urban equality in access to electricity and clean cooking fuels and technologies. In addition, participatory, deliberative, egalitarian, liberal, and electoral democracy indices were used to capture the different forms of democracy. The evidence from the instrumental variable estimations show that: (i) Rural-urban equality in access to electricity and clean cooking fuels and technologies contributes

significantly to economic growth in SSA. (ii) Participatory, deliberative, egalitarian, liberal, and electoral democracy contribute significantly to SSA's economic growth. (iii) Energy justice and democracy were found to have a heterogenous effect on economic growth among the sub-regions in SSA. (iv) When there is an improvement in democratic practices in SSA, the economic growth-enhancing effect of energy justice deepens. We recommend that policies that facilitate equity in energy access and democratic practices would contribute to sustainable economic growth in SSA.

References

- Acemoglu, D. (2012). Introduction to economic growth. *Journal of Economic Theory*, 147(2), 545–550. <https://doi.org/10.1016/j.jet.2012.01.023>
- Acemoglu, D., Johnson, S., & Robinson, J. A. (2005). Institutions as a fundamental cause of long-run growth. *Handbook of economic Growth*, 1, 385–472.
- Acemoglu, D., Naidu, S., Restrepo, P., & Robinson, J. A. (2019). Democracy does cause growth. *Journal of Political Economy*, 127(1), 47–100.
- Acheampong, A. O., Dzator, J., & Savage, D. A. (2021). Renewable energy, CO₂ emissions and economic growth in sub-Saharan Africa: Does institutional quality matter? *Journal of Policy Modeling*, 43(5), 1070–1093. <https://doi.org/10.1016/j.jpolmod.2021.03.011>
- Acheampong, A. O., Dzator, J., & Shahbaz, M. (2021). Empowering the powerless: Does access to energy improve income inequality? *Energy Economics*, 99, Article 105288. <https://doi.org/10.1016/j.eneco.2021.105288>
- Acheampong, A. O., Erdiaw-Kwasie, M. O., & Abunyewah, M. (2021). Does energy accessibility improve human development? Evidence from energy-poor regions. *Energy Economics*, 96, Article 105165. <https://doi.org/10.1016/j.eneco.2021.105165>
- Adams, S. (2009). Foreign Direct investment, domestic investment, and economic growth in Sub-Saharan Africa. *Journal of Policy Modeling*, 31(6), 939–949. <https://doi.org/10.1016/j.jpolmod.2009.03.003>
- Adams, S., Klobodu, E. K. M., & Opoku, E. E. O. (2016). Energy consumption, political regime and economic growth in sub-Saharan Africa. *Energy Policy*, 96, 36–44.
- Akinlo, A. E. (2009). Electricity consumption and economic growth in Nigeria: Evidence from cointegration and co-feature analysis. *Journal of Policy Modeling*, 31(5), 681–693. <https://doi.org/10.1016/j.jpolmod.2009.03.004>
- Alestra, C., Cette, G., Chouard, V., & Lecat, R. (2022). Growth impact of climate change and response policies: The advanced climate change long-term (ACCL) model1. *Journal of Policy Modeling*, 44(1), 96–112. <https://doi.org/10.1016/j.jpolmod.2021.10.001>
- Apergis, N., & Payne, J. E. (2009aaa). Energy consumption and economic growth in Central America: Evidence from a panel cointegration and error correction model. *Energy Economics*, 31(2), 211–216. <https://doi.org/10.1016/j.eneco.2008.09.002>
- Apergis, N., & Payne, J. E. (2009bbb). Energy consumption and economic growth: Evidence from the commonwealth of independent states. *Energy Economics*, 31(5), 641–647. <https://doi.org/10.1016/j.eneco.2009.01.011>
- Awaworyi Churchill, S., & Smyth, R. (2021). Energy poverty and health: Panel data evidence from Australia. *Energy Economics*, 97, Article 105219. <https://doi.org/10.1016/j.eneco.2021.105219>
- Bah, M. M., & Azam, M. (2017). Investigating the relationship between electricity consumption and economic growth: Evidence from South Africa. *Renewable and Sustainable Energy Reviews*, 80, 531–537. <https://doi.org/10.1016/j.rser.2017.05.251>
- Baker, S., DeVar, S., & Prakash, S. (2019). The Energy Justice Workbook. Retrieved from <https://iejusa.org/wp-content/uploads/2019/12/The-Energy-Justice-Workbook-2019-web.pdf>.
- Baum, C.F., Schaer, M.E., & Stillman, S. (2002). *Instrumental variables and GMM: Estimation and testing*. Working Paper. Boston College Economics.
- Bella, G., Massidda, C., & Mattana, P. (2014). The relationship among CO₂ emissions, electricity power consumption and GDP in OECD countries. *Journal of Policy Modeling*, 36(6), 970–985. <https://doi.org/10.1016/j.jpolmod.2014.08.006>
- Best, R., & Burke, P. J. (2018). Electricity availability: A precondition for faster economic growth? *Energy Economics*, 74, 321–329. <https://doi.org/10.1016/j.eneco.2018.06.018>
- Boateng, E., Agbola, F. W., & Mahmood, A. (2021). Foreign aid volatility and economic growth in Sub-Saharan Africa: Does institutional quality matter? *Economic Modelling*, 96, 111–127. <https://doi.org/10.1016/j.econmod.2020.12.032>
- Coppedge, M., Gerring, J., Altman, D., Bernhard, M., Fish, S., Hicken, A., & Paxton, P. (2011). Conceptualizing and measuring democracy: A new approach. *Perspectives on Politics*, 9(2), 247–267.

- Coppedge, M., Gerring, J., Knutsen, C. H., Krusell, J., Medzihorsky, J., Pernes, J., & Tzelgov, E. (2019). The methodology of “varieties of democracy”(V-Dem). *Bulletin of Sociological Methodology/Bulletin Deletött Methodologie Sociologique*, 143(1), 107–133.
- Coppedge, M., Gerring, J., Lindberg, S.I., Skaaning, S.-E., Teorell, J., Altman, D., Hicken, A. (2018). V-Dem [Country-Year/Country-Date] Dataset v8. Varieties of Democracy (V-Dem) Project. *Find this resource*.
- Coppedge, M., Lindberg, S., Skaaning, S.-E., & Teorell, J. (2016). Measuring high level democratic principles using the V-Dem data. *International Political Science Review*, 37(5), 580–593.
- Deacon, R. T. (2009). Public good provision under dictatorship and democracy. *Public Choice*, 139(1), 241–262.
- Driscoll, J. C., & Kraay, A. C. (1998). Consistent covariance matrix estimation with spatially dependent panel data. *Review of Economics and Statistics*, 80(4), 549–560.
- Eregba, P. B., & Mesagan, E. P. (2016). Oil resource abundance, institutions and growth: Evidence from oil producing African countries. *Journal of Policy Modeling*, 38(3), 603–619. <https://doi.org/10.1016/j.jpolmod.2016.03.013>
- Faust, J. (2007). Democracy’s dividend: Political order and economic productivity. *World Political Science*, 3(2).
- Ghardallou, W., & Sridi, D. (2019). Democracy and economic growth: A Literature Review. *Journal of the Knowledge Economy*, 11(3), 982–1002. <https://doi.org/10.1007/s13132-019-00594-4>
- Grier, K. B., & Tullock, G. (1989). An empirical analysis of cross-national economic growth, 1951–1980. *Journal of monetary Economics*, 24(2), 259–276.
- Griscom, B. W., Adams, J., Ellis, P. W., Houghton, R. A., Lomax, G., Miteva, D. A., & Smith, P. (2017). Natural climate solutions. *Proceedings of the National Academy of Sciences*, 114(44), 11645–11650.
- Heffron, R. J., & McCauley, D. (2017). The concept of energy justice across the disciplines. *Energy Policy*, 105, 658–667. <https://doi.org/10.1016/j.enpol.2017.03.018>
- Helliwell, J. F. (2009). Empirical linkages between democracy and economic growth. *British Journal of Political Science*, 24(2), 225–248. <https://doi.org/10.1017/s0007123400009790>
- Heo, U., & Tan, A. C. (2001). Democracy and economic growth: A causal analysis. *Comparative politics*, 2001, 463–473.
- Hoechle, D. (2007). Robust standard errors for panel regressions with cross-sectional dependence. *The stata Journal*, 7(3), 281–312.
- Ibrahim, M., & Alagidede, P. (2018). Effect of financial development on economic growth in Sub-Saharan Africa. *Journal of Policy Modeling*, 40(6), 1104–1125. <https://doi.org/10.1016/j.jpolmod.2018.08.001>
- IEA, IRENA, UNSD, WorldBank, & WHO. (2022). Tracking sdg 7: The energy progress report. In. Washington, DC, USA: World Bank.
- Ikegami, M., & Wang, Z. (2016). The long-run causal relationship between electricity consumption and real GDP: Evidence from Japan and Germany. *Journal of Policy Modeling*, 38(5), 767–784. <https://doi.org/10.1016/j.jpolmod.2016.10.007>
- Jaunky, V. C. (2012). Democracy and economic growth in Sub-Saharan Africa: a panel data approach. *Empirical Economics*, 45(2), 987–1008. <https://doi.org/10.1007/s00181-012-0633-x>
- Kebede, E., Kagochi, J., & Jolly, C. M. (2010). Energy consumption and economic development in Sub-Sahara Africa. *Energy Economics*, 32(3), 532–537. <https://doi.org/10.1016/j.eneco.2010.02.003>
- Knutsen, C. H. (2012). Democracy and economic growth: A survey of arguments and results. *International Area Studies Review*, 15(4), 393–415. <https://doi.org/10.1177/2233865912455268>
- Knutsen, C. H. (2013). Democracy, state capacity, and economic growth. *World Development*, 43, 1–18. <https://doi.org/10.1016/j.worlddev.2012.10.014>
- Krieckhaus, J. (2006). Democracy and economic growth: How regional context influences regime effects. *British Journal of Political Science*, 36(2), 317–340. <https://doi.org/10.1017/s0007123406000172>
- Landau, D. (1986). Government and economic growth in the less developed countries: an empirical study for 1960–1980. *Economic Development and Cultural Change*, 35(1), 35–75.
- Leblang, D. A. (1996). Property rights, democracy and economic growth. *Political Research Quarterly*, 49(1), 5–26.
- Leblang, D. A. (1997). Political democracy and economic growth: Pooled cross-sectional and time-series evidence. *British Journal of Political Science*, 27(3), 453–472. <https://doi.org/10.1017/s0007123497210215>
- Lee, C.-C., & Chang, C.-P. (2008). Energy consumption and economic growth in Asian economies: A more comprehensive analysis using panel data. *Resource and Energy Economics*, 30(1), 50–65. <https://doi.org/10.1016/j.reseneeco.2007.03.003>
- Li, Q., & Reuveny, R. (2006). Democracy and environmental degradation. *International Studies Quarterly*, 50(4), 935–956. <https://doi.org/10.1111/j.1468-2478.2006.00432.x>
- Malikane, C., & Chitambar, P. (2017). Foreign direct investment, democracy and economic growth in Southern Africa. *African Development Review*, 29(1), 92–102. <https://doi.org/10.1111/1467-8268.12242>
- Markussen, T. (2011). Democracy, redistributive taxation and the private provision of public goods. *European Journal of Political Economy*, 27(1), 201–213.
- Mathonnat, C., & Minea, A. (2019). Forms of democracy and economic growth volatility. *Economic Modelling*, 81, 594–603. <https://doi.org/10.1016/j.econmod.2018.07.013>

- McCauley, D. A., Heffron, R. J., Stephan, H., & Jenkins, K. (2013). Advancing energy justice: The triumvirate of tenets. *International Energy Law Review*, 32(3), 107–110.
- Miller, D. (2004). Justice, democracy and public goods. *Justice and Democracy: Essays for Brian Barry*, 127–149.
- Min, B. (2008). Who Gets Public Goods? Democracy and the Provision of Electrification in the Developing World. Paper presented at the University of California-Los Angeles Political Methods Workshop.
- Minier, J. A. (1998). Democracy and growth: Alternative approaches. *Journal of economic Growth*, 3(3), 241–266.
- Narayan, P. K., Narayan, S., & Smyth, R. (2011). Does democracy facilitate economic growth or does economic growth facilitate democracy? An empirical study of Sub-Saharan Africa. *Economic Modelling*, 28(3), 900–910. <https://doi.org/10.1016/j.econmod.2010.11.004>
- Nawaz, S. (2021). Energy poverty, climate shocks, and health deprivations. *Energy Economics*, 100, Article 105338. <https://doi.org/10.1016/j.eneco.2021.105338>
- Nordhaus, W. (2019). Climate change: The ultimate challenge for economics. *American Economic Review*, 109(6), 1991–2014.
- Nordhaus, W. D. (1977). Economic growth and climate: The carbon dioxide problem. *The American Economic Review*, 67(1), 341–346.
- Opoku, E. E. O., Kufuor, N. K., & Manu, S. A. (2021). Gender, electricity access, renewable energy consumption and energy efficiency. *Technological Forecasting and Social Change*, 173. <https://doi.org/10.1016/j.techfore.2021.121121>
- Pan, L., Biru, A., & Lettu, S. (2021). Energy poverty and public health: Global evidence. *Energy Economics*, 101, Article 105423. <https://doi.org/10.1016/j.eneco.2021.105423>
- Peev, E., & Mueller, D. C. (2012). Democracy, economic freedom and growth in transition economies. *Kyklos*, 65(3), 371–407. <https://doi.org/10.1111/j.1467-6435.2012.00543.x>
- Pellegrini-Masini, G., Pirmi, A., & Maran, S. (2020). Energy justice revisited: A critical review on the philosophical and political origins of equality. *Energy Research & Social Science*, 59. <https://doi.org/10.1016/j.erss.2019.101310>
- Popkin, G. (2019). How much can forests fight climate change? *Nature*, 565(7737), 280–283.
- Przeworski, A., Alvarez, R. M., Alvarez, M. E., Cheibub, J. A., Limongi, F., & Neto, F. P. L. (2000). *Democracy and development: Political institutions and well-being in the world*. Cambridge University Press 1950–1990.
- Przeworski, A., & Limongi, F. (1993). Political Regimes. *The Journal of Economic Perspectives*, 7(3), 51–69.
- Qian, Y., Xu, Z., Gou, X., & Škare, M. (2022). A survey on energy justice: A critical review of the literature. *Economic Research-Ekonomska Istraživanja*, 1–30. <https://doi.org/10.1080/1331677x.2022.2155860>
- Rawls, J. (1971). *A theory of justice*. Cambridge (Mass.).
- Rawls, J. (1999). *A theory of justice (revised edition)*. Oxford: Oxford University Press.
- Remmer, K. L. (1990). Democracy and economic crisis: The Latin American experience. *World Politics*, 42(3), 315–335.
- Rivera-Batiz, F. L. (2002). Democracy, governance, and economic growth: Theory and evidence. *Review of Development Economics*, 6(2), 225–247. <https://doi.org/10.1111/1467-9361.00151>
- Romer, P. M. (1990). Endogenous technological change. *Journal of Political Economy*, 98(5, Part 2), S71–S102.
- Scott, A., & Seth, P. (2013). *The political economy of electricity distribution in developing countries: A review of the literature*. Retrieved from.
- Sen, A. (1980). Equality of what? *The Tanner lecture on Human values*, 1, 197–220.
- Sen, A. (1999). *Development as freedom*. New York: Oxford University Press.
- Sovacool, B. K., & Dworkin, M. H. (2015). Energy justice: Conceptual insights and practical applications. *Applied Energy*, 142, 435–444. <https://doi.org/10.1016/j.apenergy.2015.01.002>
- Stern, D. I. (2019). *Energy and economic growth*. Routledge handbook of Energy economics. Routledge 28–46.
- Stern, N. (2007). *The economics of climate change: The Stern review*. UK: Cambridge University Press.
- Tang, C. F., Tan, B. W., & Ozturk, I. (2016). Energy consumption and economic growth in Vietnam. *Renewable and Sustainable Energy Reviews*, 54, 1506–1514.
- Tavares, J., & Wacziarg, R. (2001). How democracy affects growth. *European Economic Review*, 45(8), 1341–1378.
- Trotter, P. A. (2016). Rural electrification, electrification inequality and democratic institutions in sub-Saharan Africa. *Energy for Sustainable Development*, 34, 111–129. <https://doi.org/10.1016/j.esd.2016.07.008>
- Wolde-Rufael, Y. (2005). Energy demand and economic growth: The African experience. *Journal of Policy Modeling*, 27(8), 891–903. <https://doi.org/10.1016/j.jpolmod.2005.06.003>