

Promoting remittances for electricity access in Sub-Saharan Africa: the role of governance

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Abstract

Purpose – This study aims to examine the moderating role of governance in the relationship between migrant remittances and electricity access.

Design/methodology/approach – This study adopts the system-generalised method of moments (System-GMM) to examine how governance affects the connection between electricity access and migrant remittances in 40 sub-Saharan Africa between 1990 and 2022.

Findings – First, the analysis shows that migrant remittances have a positive impact on access to electricity based on the non-interactive regressions. Second, with interactive regressions, governance and political stability show thresholds for complementary policies with migrant remittances on access to electricity. However, regulatory quality has a negative synergy with remittances on access to electricity. In terms of the decomposition analysis, (1) minimum and maximum thresholds for access to electricity range from 0 to 1.608 and (2) the minimum and maximum range for governance is from 0.246 to 0.739.

Originality/value – Amid growing calls for inclusive energy transitions, this study sheds light on how migrant remittances when guided by sound governance can serve as catalytic tools for advancing sustainable electrification across Sub-Saharan Africa.

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Keywords Remittances, Electricity access, Net effects, Decomposition

Paper type Research article

1. Introduction

Access to contemporary, inexpensive and clean energy services is essential for public service delivery, technical advancement and socioeconomic development. These factors are directly related to employment, poverty alleviation and economic growth (Adelekan *et al.*, 2024; Ali *et al.*, 2023). Achieving universal access to contemporary, dependable and sustainable energy by 2030 is the aim of Sustainable Development Goal (SDG) 7. Households that have access to electricity are able to power essential services like communication devices and illumination (Mentel *et al.*, 2022; Schemikau *et al.*, 2022). Energy access in sub-Saharan Africa (SSA) has improved from 33% in 2010 to 46% in 2020, although it is still a major obstacle (Gamette *et al.*, 2024; Barry, 2022). Three-quarters of the 759 million individuals without electricity in SSA in 2019 were due to financial constraints, leaving many households without access to electricity (Dabla and Goldthau, 2023). This number is expected to increase by 4% in 2025 (Acheampong *et al.*, 2023).

JEL Classification — D31, O15, F24

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In the interest of transparency, data sharing, and reproducibility, the author(s) of this article have made the data underlying their research openly available. It can be accessed by following the link here: <https://databank.worldbank.org/source/world-development-indicators>



With migrant remittance accounting for 3–5% of SSA's Gross Domestic Product (GDP) and increasing from \$8.8 billion in 1990 to \$48 billion in 2019, it has become an essential source of funding (Sarkodie and Adams, 2020). The extreme energy poverty in SSA is addressed by these inflows, which are crisis-resilient (Onuonga, 2020) and increase rural households' capacity to purchase energy infrastructure (Blimpo *et al.*, 2020). Although remittance inflows offer short-term financial assistance to recipient households, over-reliance on remittances can also put recipient SSA economies at risk of structural dependency and economic viability (Muhammad *et al.*, 2024). These twin effects highlight the inherent intricacies associated with remittances (Sikhosana *et al.*, 2025; Didia and Tahir, 2022). From a political economy perspective, migrant remittances have also been shown to have a greater impact than foreign aid and other comparable development indicators (Mohammed, 2022). Further, despite the increasing inflow of remittances in SSA region, there is a gloomy argument that remittances are being directed mostly towards consumption than investment (Yiheyis and Woldemariam, 2020). This has the possibility of hurting the economy through higher inflation levels and lowering household incentives to work (Mohammed and Karagöl, 2023; Mohammed, 2022; Khan *et al.*, 2019). The three primary themes in policy and academic circles that drive the enquiry's orientation are the enormous potential of migrant remittances as an energy funding tool for energy scarcity, the multidisciplinary character of remittances and gaps in the body of existing literature. A more thorough analysis of these tendencies is provided below.

Unlike in regions such as America, Asia and Europe, remittances hold immense, yet underutilised potential as a financial instrument to address energy poverty in SSA (Barkat *et al.*, 2023; Hosan *et al.*, 2023; Djeunankan *et al.*, 2023). As private transfers that directly reach households, remittances bypass bureaucratic inefficiencies typically associated with development aid, enabling targeted investments in decentralised energy solutions like microgrids and solar home systems. These alternatives are increasingly seen as viable complements to centralised grid expansion. Harnessing remittances empowers communities, reduces reliance on external aid and promotes local ownership of energy development (Lei and Desai, 2021). This practical approach enhances resilience and aligns with locally defined energy needs. Rather than simply testing existing theories, this study aligns with calls for using functional econometric methods to generate theory, particularly in light of the urgent, context-specific challenges posed by the Sustainable Development Goals (SDGs) (Costantini and Lupi, 2005; Narayan *et al.*, 2011).

Second, migrant remittances create new avenues for interdisciplinary research, which allows for greater engagement with scholarship on the primary variable (remittances) (Delgado, 2024). Its intersections with disciplines like governance, energy studies and development economics allow for a comprehensive investigation of how institutional, technological and financial factors interact to increase access to electricity (Obasa, 2019; Ahlborg *et al.*, 2015; Acemoglu *et al.*, 2003). The enabling conditions required for this money to effectively support energy infrastructure, for instance, can be clarified by looking at migrant remittances in conjunction with governance quality and regulatory frameworks (Saud *et al.*, 2024).

The concept driving the investigation is that access to electricity is a spectrum rather than a binary variable, to augment insights bolstering the review covered in the preceding paragraphs (Munteanu *et al.*, 2024). This is made clear by the World Bank's Multi-Tier Framework for gauging energy access, which divides access to electricity into tiers according to capacity, quality, price and dependability (Jodensvi and Torstensson, 2020). In keeping with global goals like the United Nations Sustainable Development Goal 7, which is to ensure that everyone has access to recent, reasonably priced, dependable, and maintainable energy, the focus on electricity availability is appropriate. Reaching communities currently excluded by geographical barriers—the “last mile” of electrification—is necessary to achieve this goal. This sub-regional analysis is essential for comprehending the geographic obstacles facing SSA countries and suggesting practical solutions. Using a sub-regional data is essential from a policy standpoint for developing and assessing energy policy initiatives to close the energy access gap in SSA nations.

The focus of recent research on the connections between remittances and energy poverty is of two main strands. The first constituent (Barkat *et al.*, 2023; Hosan *et al.*, 2023; Agradi,

2023; Djeunankan *et al.*, 2023) examined the direct influence of remittances on energy poverty at the developmental bloc level. From the second constituent, studies (Murshed, 2023; Das and McFarlane, 2022a, b; Onuonga, 2020) have scrutinised the direct connection between electricity and remittances at household, country and regional bloc levels. However, both strands of studies have been oblivious to critical perspectives on the issue. First, existing studies have failed to undertake a sub-regional analysis of the connection between migrant remittances and electricity access particularly in SSA. This leaves room for the current study to undertake a sub-regional analysis of the connection between remittances and electricity access due to sub-regional idiosyncratic characteristics. Moreover, literature has yet to consider the role that governance plays in the connection between migrant remittances and access to electricity in SSA countries. Such an intervention could create an enabling institutional and policy environment that channels remittances into productive electricity usage (Acheampong *et al.*, 2025; Gamette *et al.*, 2025).

By using governance as the policy tool in the association between migrant remittances and access to electricity, this study closes the gaps that have been noted. Policymakers will be guided in their action towards enhancing electricity access in SSA. Households and diaspora networks will also be more inclined to spend migrant remittances on energy resources amidst openness, accountability and regulatory consistency (Murshed, 2023). Government-backed mechanisms can aggregate migrant remittance flows for public infrastructure investment, as demonstrated by models such as the diaspora bond project in Ethiopia and Kenya (Volz *et al.*, 2024; Mulat, 2020). These instances demonstrate that migrant remittances are more likely to be used as leverage for sustainable energy access in areas with excellent governance, which is characterised by low levels of corruption, stable institutions and participatory policy processes. This implies that better governance not only maximises migrant remittance flows but also amplifies their impact on other development needs particularly universal access to reasonably priced and dependable power. In order to determine the overall impact on access to electricity, migrant remittances are compared to the governance index and disaggregated governance variables. Both the conditional and unconditional effects of remittances are used to calculate the net impacts. Therefore, the investigation avoids contemporary remittance literature that has primarily concentrated on energy scarcity (Hosan *et al.*, 2023; Agradi, 2023; Djeunankan *et al.*, 2023), energy economic growth (Islam, 2022; Qutb, 2022; Nyasha and Odhiambo, 2022), and electricity consumption (Murshed, 2023; Das and McFarlane, 2022a, b; Sahoo and Sethi, 2022) at the country-specific, regional and development bloc levels. As a result, whereas migrant remittances and other foreign funding sources have been extensively recognised in scholarly circles, per the researchers' knowledge, there are scant studies that have acknowledged the relationships among migrant remittances, governance and energy access in SSA region. In light of the above discussions, the pertinent question that informs this current exposition within the context of achieving universal access to electricity in SSA countries is:

- (1) To what extent does governance amplify or weaken the influence of migrant remittances on electricity access in SSA countries?

Explaining the link between migrant remittances and energy access and sustainable development is crucial. According to Schoneveld (2020), inclusive development must be sustained over a fair amount of time in order to be sustainable and sustained development must be inclusive in order to be sustainable. According to the theory that migrant remittances can be utilised to improve access to electricity through a variety of mechanisms, including (1) funding decentralised energy solutions and (2) bolstering government capacity to provide renewable energy, there is a connection between sustainable development and power access. For example, migrant remittances give impoverished households a steadier financial incentive to buy grid power and occasionally renewable energy infrastructure (Matondo, 2023). Such efforts ultimately ensure that poor households have efficient and reliable electricity for daily living activities.

The remainder of the paper is organised as follows. The data sources and methodology employed in this study are reported in [section 2](#). The empirical analysis is offered in [Section 3](#), and the conclusion and policy implications are put out in [section 4](#) as the final part.

2. Data and methodology

2.1 Data

The study employs data from the World Bank based on 40 SSA nations. The study period runs from 1990 to 2022. Due to limitations in accessing electricity data throughout the study period, the number of nations and associated periodicity were restricted. To align the data structure with the empirical strategy utilised in this study, the data are organised into non-overlapping intervals, ensuring that the number of cross-sections exceeds the number of annual observations within each cross-section—a prerequisite for applying the GMM methodology ([Asongu et al., 2020](#)). However, GMM estimation is weakened by instrument proliferation leading to overfitting of the endogenous variables that appear valid even when it is not as well as in some cases the instruments may not be strongly correlated with the endogenous regressors, leading to inefficiency and bias. [Asongu and Amankwah-Amoah \(2016\)](#) recommend that data averages are required to limit instrument proliferation in GMM estimations. The study therefore generates seven non-overlapping averages spanning five years for six non-overlapping and one overlapping average with three years due to limited data. In many cases, limiting the lag depth of the instruments and collapsing the instrument matrix is employed to control instrument proliferation. Instead of using all available lags of the endogenous variables as instruments, only lag 1 of the outcome variable (access to electricity) is used as the restricted number of lags to prevent the number of instruments from exceeding the number of observations, which can weaken the Hansen test of instrument validity. Consequently, the analysis adopts 1990–1994; 1995–1999; 2000–2004; 2005–2009; 2010–2014; 2015–2019 and 2020–2022.

The study's primary independent variable, migrant remittances, is sourced from the World Bank Development Indicators and expressed as a percentage of GDP. Access to electricity—the dependent variable—is measured by the proportion of the population with electricity access. Governance quality, drawn from the World Bank Governance Indicators, is captured both as a composite index and through six dimensions: government effectiveness, regulatory quality, voice and accountability, rule of law, political stability, and control of corruption. Good governance plays a critical role in shaping outcome of migrant remittances like electricity access ([Murshred, 2023](#)). When governance structures are effective in instilling trust and transparency, migrant remittances are more likely to be invested in productive energy infrastructures ([Mohammed and Karagöl, 2023](#)). Moreover, well-governed states are better equipped to implement complementary policies that direct remittance inflows towards sectors with high developmental returns. Thus, governance acts as an enabling environment that transforms migrant remittances into sustainable sources for improving energy access. Additional explanatory variables include gross domestic product (GDP), food production index (FPI), domestic credit to the private sector (DCPS), and information and communication technology (ICT) indicators such as internet penetration, mobile phone usage, and broadband subscriptions. Gross domestic savings (GDS), calculated as GDP minus final consumption expenditure, are also incorporated. These variables are included based on their established relevance to electricity access, as supported by [Murshed \(2023\)](#), [Barkat et al. \(2023\)](#), [Hosan et al. \(2023\)](#), [Agradi \(2023\)](#), and [Djeunankan et al. \(2023\)](#). Details on the definitions and sources of the variables are provided in [Appendix 1](#), summary statistics are outlined in [Appendix 2](#), and the correlation matrix is presented in [Appendix 3](#).

2.2 Specification

The data section has already provided insights into the choice of the GMM empirical method, especially the need to restructure the data to satisfy a fundamental requirement for the adoption

of the estimation approach. Thus, after rearranging the dataset into five 6-year distinct intervals, the $N > T$ requirement—which is required for choosing the empirical technique—is met. Additional justifications for the technique's choice are as follows: since their level series and first difference have been associated to a height greater than 0.800—the threshold referred to as the “rule of thumb” in contemporary GMM-oriented research that determines persistence in an outcome indicator—there is (1) persistence in the dynamics of electricity access (Asongu and Le Roux, 2017; Tchamyou *et al.*, 2019a, b). (2) Because the data format is panel-oriented, the estimating exercise accounts for cross-country variability. (3) The endogeneity problem, which is crucial for a solid empirical study, is addressed by the following two main premises: Internal instruments are utilised to address reverse causality and time-invariant missing indicators are also used to account for the unobserved variability. Equation 1 estimates how migrant remittances (*RMIT*), governance (*GOV*) and their interaction influence access to electricity (*ACE*) while controlling for past *ACE* levels and relevant control variables. It also adjusts for individual heterogeneity and time shocks through fixed effects. Equation 2 represents a first-difference panel regression model designed to examine how changes over time in both migrant remittances (*RMIT*), governance (*GOV*) and other control variables influence access to electricity (*ACE*) across SSA countries over time.

$$ACE_{i,t} = \beta_0 + \beta_1 ACE_{i,t-\tau} + \beta_2 RMIT_{i,t} + \beta_3 GOV_{i,t} + \beta_4 RMITGOV_{i,t} + \sum_{h=1}^5 \delta_h W_{h,i,t-\tau} + n_i + \epsilon_t + \varepsilon_{i,t}, \quad (1)$$

$$ACE_{i,T} - ACE_{i,t-\tau} = \beta_1 (ACE_{i,t-\tau} - ACE_{i,t-2\tau}) + \beta_2 (RMIT_{i,t} - RMIT_{i,t-\tau}) + \beta_3 (GOV_{i,t} - GOV_{i,t-\tau}) + \beta_4 (RMITGOV_{i,t} - RMITGOV_{i,t-\tau}) + \sum_{h=1}^4 (W_{h,i,t-\tau} - W_{h,i,t-2\tau}) + (\epsilon_t - \epsilon_{t-\tau}) + (\varepsilon_{i,t} - \varepsilon_{i,t-\tau}) \quad (2)$$

where $ACE_{i,t}$ denotes percentage of population with access to electricity of country i in period t ; $RMIT_{i,t}$ represents migrant remittances; GOV is governance quality (governance index, government effectiveness, regulatory quality, voice and accountability, rule of law, political stability and level of corruption); $RMITGOV_{i,t}$ denotes the interaction between migrant remittances and governance; β_0 is a constant; τ is the level of auto-regression, which is recognised as one in this study since prior data must be captured using a one-period lag or a five-year non-overlapping interval; The vector of control variables is included in this. (Gross domestic product, Food Production Index, Domestic Credit to Private Sector, Information Communication technology and Gross domestic savings), n_i is the country-specific effect, ϵ_t is the time-specific constant and $\varepsilon_{i,t}$ is the error term. For both the specific governance indicators and the governance quality index, equations (1) and (2) are repeated. This investigation makes use of the GMM empirical technique with forward orthogonal deviations. Tchamyou *et al.* (2019) and Boateng *et al.* (2018) have demonstrated that this GMM option, which is an improved version of Roodman's (2009) and Arellano and Bover (1995) approaches, yields predicted coefficients that are more efficient than less recent difference and system GMM approaches.

3. Empirical results

3.1 Presentation of results

In this section, Table 1 presents the empirical results. Table 1 focuses on the relationships between migrant remittances, governance and electricity access. Table 1 has sub-sections on

(continued)

Table 1. Migrant remittances, governance and access to electricity

	ACE	GOV	CORR	POL	RQ	VA	RL	GE
GDP	–2.559*** (0.747)	–6.338*** (0.952)	0.621 (0.634)	–6.338*** (0.952)	–2.136*** (0.701)	–2.577*** (0.623)	–2.680*** (0.572)	–2.053*** (0.662)
FPI	0.0673*** (0.0240)	0.0264 (0.0163)	0.0776*** (0.0279)	0.,0264 (0.0163)	0.0667*** (0.0160)	0.0565*** (0.0131)	0.0639*** (0.0145)	0.0820*** (0.0172)
DCPS	0.335*** (0.0750)	0.438*** (0.0385)	0.122** (0.0454)	0.438*** (0.0385)	0.293*** (0.0376)	0.170*** (0.0394)	0.258*** (0.0324)	0.183*** (0.0433)
ICT	0.0332* (0.0169)	0.0870*** (0.0126)	0.0857*** (0.00984)	0.0870*** (0.0126)	0.0733*** (0.00852)	0.0806*** (0.00868)	0.0682*** (0.00891)	0.0722*** (0.00819)
GDS	0.171 (0.178)	0.313*** (0.112)	0.321*** (0.0950)	0.313*** (0.112)	0.411*** (0.0911)	0.372*** (0.0952)	0.331*** (0.113)	0.315*** (0.103)
ACE (1)	0.773*** (0.0693)	0.410*** (0.0313)	0.675*** (0.0304)	0.410*** (0.0313)	0.562*** (0.0260)	0.604*** (0.0310)	0.583*** (0.0259)	0.637*** (0.0276)
RMIT	1.616*** (0.272)	1.608*** (0.281)	0.366 (0.243)	0.561*** (0.204)	–0.554* (0.312)	0.199 (0.167)	0.0552 (0.181)	0.124 (0.232)
GOV		17.90*** (1.258)						
RMIT*GOV		–2.177*** (0.416)						
CORR			–6.055*** (2.034)					
REMIT*CORR			1.183** (0.440)					
POL				18.77*** (1.319)				
REMIT*POL				–2.283*** (0.436)				
RQ					3.754*** (1.241)			
RMIT*RQ					–1.347*** (0.343)			

Table 1. Continued

	ACE	GOV	CORR	POL	RQ	VA	RL	GE
VA						8.085*** (1.293)		
RMIT*VA						−0.966** (0.379)		
RL							6.281*** (1.431)	
RMT*RL							−0.825*** (0.289)	
GE								2.402** (1.172)
RMIT*GE								0.0656 (0.337)
Constant	8.116 (4.190)	40.78*** (5.758)	−9.850** (4.798)	49.39*** (6.026)	14.31*** (4.059)	19.39*** (3.100)	20.38*** (3.553)	13.40*** (3.096)
Observations	240	240	240	240	240	240	240	240
Number of Country	40	40	40	40	40	40	40	40
No. of Instruments	29	37	37	37	37	37	37	37
Fisher	12808.65***	16971.03***	9787.55***	16970.97***	32386.66***	54710.42***	34798.61***	98805.82***
AR (1)	0.017	0.016	0.009	0.016	0.016	0.023	0.019	0.016
AR (2)	0.062	0.182	0.076	0.182	0.064	0.059	0.059	0.080
Hansen <i>P</i> -value	0.542	0.605	0.565	0.605	0.434	0.513	0.347	0.298

Note(s): ***, ** and * shows significance levels at 1%, 5 and 10%, respectively. The significance of values is twofold. (1) The significance of estimated coefficients and the Fisher statistics. (2) The failure to reject the null hypotheses of: (a) no autocorrelation in the AR (1) and AR (2) tests. ACE is total population access to electricity, RMIT is remittances, GDP is gross domestic product, FPI is food production index, ICT is Information communication technology, GDS is gross domestic savings, DCPS is domestic credit to the private sector, GOV is governance index, CORR is the level of corruption, POL is political stability, RQ is regulatory quality, VA is Voice and accountability, RL is rule of law and GE is government effectiveness

Source(s): World Bank

migrant remittances, governance requirements and electricity access on the left and right, respectively.

There are eight main specifications in each sub-section, seven of which have a conditioning information set and one of which does not. It is a common practice to restrict items in the conditioning information set. It is crucial to remember that this is done to avoid the development of tools that can distort the calculated GMM models. Thus, even when the possibility of collapsing instruments is taken into consideration. It is clear that only one variable from the preconditioning data set can be employed in each regression. Examples of GMM-centric studies that have excluded control variables to avoid instrument proliferation include [Asongu and Nwachukwu \(2017\)](#) and [Osabuohien and Efobi \(2013\)](#). Four informational criteria influence the overall validity of models for each specification. According to these standards, the predicted models are predominantly valid with the following exceptions: It rejects the null hypothesis: (1) Hansen and (2) second-order Arellano and Bond autocorrelation in difference tests. Therefore, in order to evaluate the testable hypothesis that drives this, net impacts are not calculated for these incorrect models.

In [Table 1](#), column 2, at 1% significance level, a 1% increase in the migrant remittance leads to a 1.616% increase in access to electricity. Thus, an increase in migrant remittances results in more than a proportionate increase in access to electricity. In column 3, migrant remittance produces an unconditional effect of 1.608 on governance at 1% significance level. By implication, when migrant remittance surges by 1%, there is a corresponding 1.608 increase in the governance quality. Further, according to a recent study based on interactive regressions ([Agoba et al., 2020](#)), the hypothesis guiding this inquiry is assessed by computing the net effects of the conditional or interactive relationship between migrant remittances and electricity access as well as the unconditional relationship between migrant remittances. Net impacts are computed to examine the impact of increased migrant remittances on access to power in order to contextualise this computation. For example, the net effect of improving the governance index is $1.608 [(-2.177 \times 0) + [1.608]]$ in second column in [Table 1](#). The mean value of governance index is 0, the conditional effect of migrant remittances is -2.177 and the unconditional effect from migrant remittances is 1.608. This slight impact aligns with current research on improving governance for development results ([Murshed, 2023](#); [Agradi, 2023](#)). In the case of improving political stability, a net effect of $1.608 [(-2.283 \times -0.459) + [0.561]]$ is computed. Political stability has a mean value of -0.459 , the interaction effect is -2.283 , and the unconditional effect of migrant remittances is 0.561. In the case of regulatory quality, the net effect of improving regulatory quality is $0.344 [(-1.347 \times -0.667) + [-0.554]]$. For net effect, the mean value of regulatory quality is -0.667 , the interactive effect of migrant remittances is -1.347 and the unconditional effect from remittances is -0.554 . A similar finding aligns with [Shittu et al. \(2024\)](#) that regulatory quality intervenes to force remittances to increase access to electricity.

It is verified that migrant remittances are significantly influenced by the governance quality index and political stability which results in overall positive net effects on the population's access to power. In energy-poor regions like SSA, governance is considered a relevant strategy to encourage universal access to power, which is consistent with similar findings. Positive net impacts are consistently more noticeable in the literature on migrant remittances and energy availability when taking into account the different specifications involved ([Barkat et al., 2023](#); [Agradi, 2023](#); [Onuonga, 2020](#)). [Barkat et al. \(2023\)](#) tested the effectiveness of remittances in reducing energy poverty in low- and middle-income countries using 109 developing nations. This is consistent with a recent study on how remittances affect access to energy in SSA nations. Similar to this, remittances have a favourable impact on access to power. [Agradi \(2023\)](#) finds that remittances primarily encourage energy access and consumption through the complementary channels of investment and consumption. The ability to buy electricity for domestic usage is made possible by remittances in Kenya. This favourable result is consistent with the findings of the present investigation. Second, with the exception of GDP in relation to the degree of corruption, the control variables overwhelmingly show the expected signals.

3.2 Net effect decomposition

In spite of the conditional effects from interactive estimations between migrant remittances and electricity availability which are consistently positive, supporting the study's theoretical expectations and intuition, the study further engages in a net decomposition analysis.

3.2.1 Decomposing net effects in the nexuses between remittances, governance and access to electricity. Let y = access to electricity, x = average of governance (index and individual indicators).

Second specification of Table 1: $y = -2.177x + 1.608$ (when $x = 0$, $y = 1.608$).

Threshold for complementary policy: when $y = 0$, $x = 0.739$ (1.608/2.177).

Fourth specification of Table 1: $y = -2.283x + 0.561$ (when $x = -0.459$, $y = 1.608$).

Threshold for complementary policy: when $y = 0$, $x = 0.246$ (0.561/2.283).

Fifth specification of Table 1: $y = -1.347x + -0.554$ (when $x = -0.667$, $y = 0.344$).

Threshold for complementary policy: when $y = 0$, $x = 0.411$ (0.554/1.347).

From the computations above, for access to electricity, the established thresholds range from 0 to 1.608 and that of governance ranges from 0.246 to 0.739. Practically, the estimated electricity access thresholds suggest policy effects that migrant remittances may only significantly influence development outcomes when any SSA country's baseline access to electricity is within this interval. If electricity access is below 0 or above 1.608, policy impact may be negligible. The governance thresholds suggest that migrant remittances have stronger, more positive effects in SSA countries where governance indicators fall within this window. If governance is below 0.246, institutional weakness may absorb the benefits of migrant remittances. Conversely, governance above 0.739 may indicate diminishing returns to further improvements, suggesting the need for complementary reforms. Reaching these governance levels necessitates further policy actions to maintain and enhance the beneficial impact of migrant remittances on access to power. Even if governance is essential, this viewpoint emphasises that it is not enough to promote better access to power through remittances. The establishment of customised policies that improve market stability, regulatory effectiveness, and infrastructure development is made possible by reaching certain governance thresholds (Awad *et al.*, 2024). Governments could, for example, enact laws that encourage the investment of migrant remittances in renewable energy projects in SSA nations with governance systems that achieve moderate stable and institutionally effective levels. Additionally, SSA governments could provide tax exemptions or incentives to remittance-receiving families that purchase mini-grids or solar power installations (Guermond, 2022). This approach will increase access to electricity in underserved areas by converting remittance inflows from merely supporting consumption to providing developmental capital. In alternative situations, financial inclusion policies that support remittance-linked lending and savings plans could be implemented by governments in SSA nations (Guermond, 2022). In order to provide greater interest rates for migrant remittances deposit designated for energy projects, governments and financial institutions could work together to establish special energy development accounts. These accounts could be used to finance small-scale power projects or enhancements to residential electricity, resulting in long-term gains in energy access.

3.3 Robustness check

This section subjects our outcomes to a robustness test. We apply the Tobit estimation for panel robustness check. The Tobit model is employed as a robustness check because the dependent variable (access to electricity) is censored, meaning it is bounded at a specific limit (e.g. zero to hundred) (Amore and Murtinu, 2021). While the Ordinary least squares (OLS) models would yield biased and inconsistent estimates under such a limited dependent variable, alternative estimators such as Probit, Logit or fractional regression models, are better suited for binary or proportion outcomes rather than continuous but censored variables (Li *et al.*, 2022). Similarly, quantile or generalised linear models may not fully capture the censoring effect, making the

Tobit model a more theoretically appropriate choice for robustness verification. In this case, the use of system-GMM could be subject to biased and consistent results because it fails to justify for the censored nature of the outcome variable (access to electricity).

Table 2 displays the Tobit robustness figures for governance in influencing migrant remittances to affect access to electricity. From Table 2, column 7, the net effect on access to electricity in SSA countries from the importance of remittances in modulating the influence of rule of law on access to electricity is -0.157 ($[0.426 \times -0.676] + [0.131]$). As part of the estimation, the mean value of regulatory quality is -0.667 , the interactive effect of migrant remittances is 0.426 and the unconditional effect of migrant remittances is 0.131 . With the threshold analysis based on column 7; the decomposition of net effects is as follows;

The seventh specification of Table 2: $y = 0.426x + 0.131$ (when $x = 0.667$, $y = 0.156$).

Threshold for complementary policy: when $y = 0$, $x = 0.307(0.131/0.426)$.

From the computations above, the threshold range for access to electricity is from 0 to 0.156 and that of the range for rule of law is 0.307 – 0.667 . The Tobit result corroborates that there is a positive synergy between rule of law and migrant remittances on access to electricity in the selected SSA countries. However, there is a need to complement rule of law with other policies to achieve a sufficient effect on access to electricity.

4. Conclusion and implications

The study examines how governance affects migrant remittances' impact on power access in 40 SSA countries between 1990 and 2022. While governance is measured as an index on individual factors, such as the degree of corruption, political stability, regulatory quality, voice and accountability, rule of law, and government performance, the study used the overall population's access to power. The system-GMM serves as the foundation for the observed data. According to the study, migrant remittances are largely modulated by both the governance index and political stability which results in overall favourable net effects on the population's access to energy. Furthermore, the positive net effect is equally noticeable in governance index regression and political stability as a disaggregated governance indicator. Given the negative interacting impacts, net effects are broken down to identify the points at which other policy efforts should be complemented to governance policy variables to provide positive outcomes for electricity access. Thresholds, then, are places where there are no net effects and when more governance results in negative net effects. Governance must therefore be combined with other policy measures at the specified levels to adjust migrant remittances for favourable effects on access to electricity. First, the established thresholds for electricity access range from 0 to 1.608 representing no access to high access. Infrastructure in SSA countries below a certain threshold (e.g. 1.0) may be insufficient to support industrial activity or draw in companies, which could result in declining economic returns from electricity investments. For instance, low access could power items like phones while high access could power digital platforms, small-scale industry, and agricultural processing. Second, the computed thresholds for governance range from 0.246 to 0.739 . Metrics including government efficacy, regulatory quality and corruption control may be included in this governance index range. Weak institutions may negate the benefits associated with migrant remittances below 0.246 as a result of poor policy execution. Improved governance between 0.5 and 0.739 in some SSA countries could promote efficient public service delivery and confidence in the private sector towards sustainable energy. Since the set thresholds fall within the statistical ranges of the governance variables (both index and individual indicators) revealed in the summary data, they are both economically sound and susceptible to policy leverage. In addition, this suggests that governance is a required but not sufficient condition for enforcing migrant remittances to have a direct bearing on access to energy at the thresholds. According to Dash (2023) and Koczan *et al.* (2021), some of the established complementary policies that assist migrant remittances include increased institutional development, reduced transaction costs on migrant remittances and flexible channels of transfer.

Table 2. Robustness results using Tobit

ACES	GOV	CORR	GE	POL	RQ	RL	VA
RMIT	−0.236 (0.183)	−0.001 (0.123)	0.031 (0.128)	−0.167 (0.134)	0.192 (0.169)	0.131** (0.056)	−0.006 (0.151)
DCPS	0.135** (0.056)	0.139** (0.056)	0.11** (0.054)	0.135** (0.056)	0.114** (0.054)	−0.006 (0.015)	0.119** (0.055)
FPI	−0.005 (0.015)	−0.009 (0.015)	−0.008 (0.014)	−0.005 (0.015)	−0.009 (0.015)	0.031 (0.063)	−0.008 (0.015)
GDP	0.034 (0.063)	0.046 (0.063)	0.046 (0.063)	0.034 (0.063)	0.036 (0.063)	0.057 (0.016)	0.039 (0.063)
ICT	0.055*** (0.016)	0.054*** (0.016)	0.057*** (0.015)	0.055*** (0.016)	0.056*** (0.016)	0.057*** (0.016)	0.05*** (0.016)
GOV	1.665 (1.238)						
RMIT*GOV	0.144 (0.154)						
CORR		1.494 (2.013)					
RMIT*CORR		0.483** (0.227)					
GE			2.585 (2.057)				
RMIT*GE			0.494** (0.223)				
POL				1.746 (1.298)			
RMIT*POL				0.151 (0.162)			
RQ					−0.101 (2.025)		
RMIT*RQ					0.689** (0.3)		
RL						0.681 (2)	
RMIT*RL						0.426** (0.202)	
VA							3.014 (2.122)
RMIT*VA							0.178 (0.248)
Constant	13.426*** (3.533)	14.321*** (3.643)	16.018*** (3.776)	14.227*** (3.545)	13.956*** (3.855)	14.304*** (3.743)	15.238*** (3.758)
sigma_u	19.511*** (2.385)	19.183*** (2.37)	19.356 (2.2367)	19.511 (2.385)	20.199*** (2.449)	19.721*** (2.439)	19.413*** (2.375)
sigma_e	8.644*** (0.399)	8.618*** (0.398)	8.561 (0.395)	8.644 (0.399)	8.569*** (0.395)	8.604*** (0.398)	8.66*** (0.4)
Mean dependent var	17.269	17.269	17.269	17.269	17.269	17.269	17.269
Number of obs	280	280	280	280	280	280	280
Prob > χ^2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
SD dependent var	24.350	24.350	24.350	24.350	24.350	24.350	24.350
Chi-square	34.182	37.094	40.102	34.182	36.174	35.803	33.717
Akaike crit. (AIC)	2618.500	2165.733	2163.223	2168.500	2166.999	2167.120	2169.003

Note(s): ***, ** and * shows significance levels at 1%, 5 and 10%, respectively. sigma_u is the standard deviation of the unobserved individual-specific effects and sigma_e is the standard deviation of the idiosyncratic error term. ACE is total population access to electricity, RMIT is remittances, GDP is gross domestic product, FPI is food production index, ICT is Information communication technology, GDS is gross domestic savings, DCPS is domestic credit to the private sector, GOV is governance index, CORR is the level of corruption, POL is political stability, RQ is regulatory quality, VA is Voice and accountability, RL is rule of law and GE is government effectiveness

Source(s): World Bank

From a practical ramification, it is important to note that the results apply to SSA countries that were sampled since the relationship between migrant remittances and governance is expected to improve household access to electricity, alleviate energy poverty and increase company productivity. By tailoring the existing nexuses in light of the following, the net effects can be further enhanced. First, since the proposed strategy has the benefit of drawing migrant remittances that empower households and link them to the national grid, the established findings ought to be used as a more formal means of improving access to energy. The strategy should also be based on the relative competitiveness of the nations, the regions that are being targeted and the applicability of external funding that is in line with energy access in areas that lack energy. Furthermore, the positive net effect on the electricity-remittance relationship supports the post-2025 development agenda's findings that electricity is a crucial component in promoting sustainable development. In policy terms, the Ministries of Energy should collaborate with the Ministry of Finance to develop financial instruments such as diaspora bonds or energy investment funds to support household electrification and energy infrastructure in SSA countries. Furthermore, the Ministry of Energy should put in place open regulatory frameworks and anti-corruption measures in the energy sector to create a stable climate that draws remittance-backed investments in the electricity sector. Lastly, the Ministry of Energy in SSA nations should lower compliance expenses and expedite approval procedures for small-scale remittance-funded renewable energy projects for businesses and households.

By re-evaluating the problem statement from a comparative perspective from both developed and emerging economies, future research can enhance the current findings. This suggestion expands upon a disclaimer in the GMM estimation approach that excludes comparison effects due to their association with the lagged outcome variables, which can lead to endogeneity. It is also important to remember that future research may take into account additional governance metrics, such the Mo Ibrahim governance indicators. Research-based on development blocs might also be taken into consideration due to the availability of data on other governance measures.

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Data availability

Data is available at the site of the World Bank, World Development Indicators.

(The Appendix follows overleaf)

Appendix 1

Table A1. Variable definition

Variable	Definition	Expected Sign	Source
Total population access to electricity (ACE)	Percentage of population with access to electricity		World Bank (WDI)
Remittances (RMIT)	Remittances as percentage of GDP	+	World Bank (WDI)
Gross domestic product (GDP)	Sum of all value added by all resident producers in an economy	+	World Bank (WDI)
Food production index (FPI)	Changes in the production of food commodity in a given year relative to base year	+/-	World Bank (WDI)
Information Communication and Technology (ICT)	Measured by internet users per 100 people, mobile cellular subscription rate per 100 people, and fixed broadband subscription per 100 people	+	World Bank (WDI)
Gross domestic savings (GDS)	GDP minus final consumption expenditure	+	World Bank (WDI)
Domestic credit to private sector (DCPS)	Financial resources provided to the private sector by financial corporations	+	World Bank (WDI)
Governance index (GOV)	Institutional governance (corruption-control and the rule of law); Economic governance (government effectiveness and regulatory quality) and Political governance (political stability/no violence and “voice and accountability”)	+	World Bank (WDI)
Corruption (CORR)	the extent to which public power is exercised for private gain, including both petty and grand forms of corruption	-	World Bank (WDI)
Political stability (POL)	the likelihood of political instability and violence, including terrorism	+	World Bank (WDI)
Regulatory quality (RQ)	the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development	+	World Bank (WDI)
Voice and accountability (VA)	the extent to which a country’s citizens can participate in selecting their government, as well as their freedom of expression, freedom of association, and free media	+	World Bank (WDI)
Rule of Law (RL)	the extent to which agents have confidence in and abide by the rules of society	+	World Bank (WDI)
Government effectiveness (GE)	the quality of public services, the quality of the civil service, and the degree of its independence from political pressures	+	World Bank (WDI)

Table A2. Summary Statistics

Variable	Obs	Mean	Std. Dev	Min	Max
Total population access to electricity	308	34.35	27.129	1	99.99
Remittances	308	3.388	6.83	0.114	83.968
Gross domestic product	308	6.241	1.463	1.44	9.764
Food production index	308	62.039	38.693	1.13	171.396
Information Communication and Technology	308	32.261	41.315	0.115	179.353
Gross domestic savings	280	13.979	16.847	−33.255	74.364
Domestic credit to private sector	308	16.791	18.697	0.424	124.822
Governance index	308	0	1	−2.639	2.313
Corruption	308	−0.0625	0.693	−1.935	1.83
Political stability	308	−0.459	0.954	−2.976	1.748
Regulatory quality	308	−0.667	0.628	−2.714	1.683
Voice and accountability	308	−0.56	0.739	−1.953	0.967
Rule of Law	308	−0.676	0.684	−1.985	0.956
Government effectiveness	308	−0.755	0.639	−1.988	0.984

Note(s): Std. Dev. is standard deviation, Min is Minimum and Max is Maximum

Source(s): World Bank

Table A3. Correlation

Variables	ACE	CORR	DCPS	FPI	GDP	GE	GDS	ICT	RMIT	POL	RQ	RL	VA	GOV
ACE	1.000													
CORR	0.272 (0.000)	1.000												
DCPS	0.485 (0.000)	0.404 (0.000)	1.000											
FPI	0.042 (0.465)	0.066 (0.249)	0.044 (0.440)	1.000										
GDP	0.402 (0.000)	0.344 (0.000)	0.356 (0.000)	0.091 (0.111)	1.000									
GE	0.400 (0.000)	0.774 (0.000)	0.548 (0.000)	0.040 (0.485)	0.438 (0.000)	1.000								
GDS	0.339 (0.000)	−0.074 (0.215)	0.006 (0.921)	−0.009 (0.885)	0.232 (0.000)	0.030 (0.621)	1.000							
ICT	0.386 (0.000)	0.204 (0.000)	0.369 (0.000)	0.083 (0.146)	0.398 (0.000)	0.235 (0.000)	0.051 (0.394)	1.000						
RMIT	−0.016 (0.781)	0.118 (0.038)	−0.009 (0.871)	0.011 (0.854)	−0.097 (0.088)	0.009 (0.871)	−0.403 (0.000)	−0.014 (0.807)	1.000					
POL	0.389 (0.000)	0.658 (0.000)	0.298 (0.000)	−0.021 (0.714)	0.367 (0.000)	0.647 (0.000)	0.150 (0.012)	0.121 (0.033)	0.105 (0.065)	1.000				
RQ	0.313 (0.000)	0.679 (0.000)	0.476 (0.000)	0.045 (0.432)	0.323 (0.000)	0.824 (0.000)	0.016 (0.790)	0.227 (0.000)	−0.007 (0.906)	0.603 (0.000)	1.000			
RL	0.355 (0.000)	0.809 (0.000)	0.436 (0.000)	0.012 (0.829)	0.338 (0.000)	0.832 (0.000)	0.022 (0.711)	0.183 (0.001)	0.125 (0.028)	0.764 (0.000)	0.809 (0.000)	1.000		
VA	0.339 (0.000)	0.692 (0.000)	0.501 (0.000)	0.040 (0.479)	0.254 (0.000)	0.696 (0.000)	−0.099 (0.098)	0.239 (0.000)	0.091 (0.113)	0.625 (0.000)	0.681 (0.000)	0.753 (0.000)	1.000	
GOV	0.389 (0.000)	0.658 (0.000)	0.298 (0.000)	−0.021 (0.714)	0.367 (0.000)	0.647 (0.000)	0.150 (0.012)	0.121 (0.033)	0.105 (0.065)	1.000 (0.000)	0.603 (0.000)	0.764 (0.000)	0.625 (0.000)	1.000

Note(s): ACE is total population access to electricity, RMIT is remittances, GDP is gross domestic product, FPI is food production index, ICT is Information communication technology, GDS is gross domestic savings, DCPS is domestic credit to the private sector, GOV is governance index, CORR is the level of corruption, POL is political stability, RQ is regulatory quality, VA is Voice and accountability, RL is rule of law and GE is government effectiveness

Source(s): World Bank

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