

Analysing governance-led infrastructural development nexus in sub-Saharan Africa: Does the moderating role of institutional quality matter?

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Abstract

Governments engage in infrastructural developments across the globe, and the level of success often colligates with institutional quality levels. However, despite the presence of governance, the lack of well-developed infrastructure has bedevilled sub-Saharan African (SSA) countries for decades. Therefore, this study investigates the governance-led infrastructural development hypothesis for the SSA region from an institutional quality perspective towards addressing the infrastructural deficit challenges of the region. A combination of advanced panel econometric techniques was applied to data collected from the African Development Bank, World Bank World Development Indicator, and International Monetary Fund (IMF) to investigate the governance-led infrastructural development hypothesis in SSA while controlling for financial development, economic growth, and industrialization in the region. The findings show that the interaction of institutional quality measures and governance indicators significantly and positively induces infrastructure in sub-Saharan Africa (SSA). Additionally, while economic growth and financial development yield no expected significant influence on infrastructural developments, industrialization plays a crucial role, as its spillover effects are not confined to boosting economic growth alone but also to infrastructural

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transformations. Thus, the provision of policy frameworks by authorities to strengthen institutions and promote good governance is vital for articulating and facilitating infrastructural development plans for SSA.

KEYWORDS

economic development, governance, infrastructures, institutions, sub-Saharan Africa

1 | INTRODUCTION

The provision of public infrastructure is a crucial aspect of governance and public sector activities across the globe. It is the fourth-largest area of government spending in sub-Saharan African (SSA) nations, while public and private spending in OECD countries combined accounted for 3.2% of GDP on average in 2014 (OECD, 2016). When correctly planned and executed, infrastructure such as roads, railways, energy grids, water systems, and communication lines not only supply necessary public goods for societal welfare but are also critical for economic growth and productivity (Owusu-Manu et al., 2019). However, providing high-quality infrastructure at a reasonable cost while avoiding project delays and abandonments, cost overruns, and poor quality is a difficult task (Fedderke et al., 2006). In fact, due to weak governance and the cumulative effect of greater expectations and goals combined with complicated technology and changing political and institutional backdrops, infrastructural development plans have increasingly become much more difficult in the 21st century across the globe, especially in sub-Saharan Africa (SSA) (Ismail et al., 2022; Kodongo & Ojah, 2016).

Infrastructure today entails more than just the provision of physical assets. It encompasses creating complex infrastructure systems that rely on modern and sometimes rapidly developing technologies, such as offshore wind farms and smart grids (Khan et al., 2020). Fiscal restrictions and the technological complexity of today's infrastructure may also require a greater involvement of private sector actors, which brings a plethora of benefits and hazards that must be controlled (De, 2012). These developments have occurred against the backdrop of shifting and frequently increasing demand patterns in areas such as energy and broadband access, where maintaining the status quo indefinitely would not be sufficient to meet the expectations of a data-driven economy or climate change policy targets (In Lodge & Wegrich, 2014). In addition, historically 'low politics' infrastructure programmes have become politicized due to a changing cultural environment against a genuine drive for quality infrastructure.

As such, the link between governance and infrastructure development has been a topic of much research and fierce controversy (Dixit, 2009; Kaufmann et al., 2004, 2010). Given the prevailing level of governance indicators in SSA, economic growth in the region has increased over the last decade. Meanwhile, some improvements in infrastructure were also noted by Owusu-Manu et al. (2019) and Appiah et al. (2019). However, SSA is home to about a sixth of the world's population, and much of the population still lives in poverty, with increasing wealth gaps and acute lack of access to basic infrastructure (Appiah et al., 2020; Onifade, 2023; Taiwo et al., 2022). Based on the prevailing indicators, the question thus becomes whether governance in the region has impacted SSA countries' infrastructure advancements and if the economic growth in SSA is in any way beneficial to the level of infrastructure development in the region. Despite economic growth in SSA over the past decade, the region still faces significant challenges in terms of infrastructure development. This is evident in

the widespread poverty, increasing wealth gaps, and acute lack of access to basic infrastructure that still plagues much of the region's population. Therefore, the question arises as to whether governance in the region has had a tangible impact on infrastructure advancements and whether economic growth has translated into meaningful infrastructure development. As a result, our research is designed to examine the influence of governance on SSA infrastructure development through the lens of obtainable institutional quality measures. Considering the preceding, this study tries to determine whether governance is essential for infrastructure development in SSA countries. Second, the article investigates the distinctive role of institutions in SSA's infrastructure development. Third, while the analysis in the study creates a distinction between governance indicators and institutional quality measures, the study further explores how the interaction between both components (institutions and governance) has influenced infrastructure in SSA countries, a major link that has hitherto been omitted from the SSA literature.

While several studies have focussed on isolated aspects of governance or specific sectors of infrastructure development, a conspicuous gap exists in synthesizing these disparate lines of inquiry into a cohesive framework. This gap is particularly critical given the multidimensional nature of governance and the intersectionality of various infrastructure sectors—from transport to energy to digital technologies—which individually and collectively impact a broad spectrum of sustainable development goals (SDGs). Moreover, the paucity of such integrative studies becomes more glaring when considering the urgency imposed by climate change and rapid technological advancements. These pressing global challenges necessitate a comprehensive understanding of how governance mechanisms can either facilitate or hinder adaptive, resilient, and sustainable infrastructure systems in SSA (Appiah, Ashraf, et al., 2023; Naeem, Appiah, Taden, et al., 2023).

The impact of governance on infrastructure development has been pointed out in some past research (Dixit, 2009; Kaufmann et al., 2004, 2010). Depending on the level of governance, infrastructure can be enhanced through various approaches and channels, including production facilitation, trade mobilization that promotes more competitiveness, more job provision, and a decrease in trade logistics and other supply chain costs (Dixit, 2009; Kenny, 2007, 2009). Inadequate infrastructure may be a stumbling block to prosperity and poverty alleviation despite its positive impact on economic development (Appiah et al., 2020; Malah Kuete & Asongu, 2022; Onifade et al., 2020), and the lack of well-developed infrastructure has been identified as a clog in the wheel of development as worsening poverty in SSA countries (Kodongo & Ojah, 2016; Çevik et al., 2020).

There is still a lack of comprehensive studies on the governance–infrastructure nexus in SSA, as the extant literature is often directed to addressing infrastructure issues mainly in the transport sector (Bouraima et al., 2023; Owusu-Manu et al., 2019). A few indices of infrastructure, such as roads, energy use, and information technologies, have also been used in some studies, leaving out other infrastructural areas that could undermine accurate development planning (Fedderke et al., 2006). In addition, infrastructural expenditure is often an indicator of the development level of countries, and this may not accurately reflect the state of the countries. It has been argued that corruption and poor institutions have bedevilled SSA countries, affecting infrastructure investments (Appiah, Onifade, & Gyamfi, 2022; Li et al., 2023). Hence, a focus on infrastructure spending alone as an indicator of development can create problems with the accuracy and reliability of results. In addition, endogeneity problems and other limitations were not addressed in previous related studies that have been conducted for many countries.

Moreover, it is imperative to understand the intricate dynamics between governance, institutions, and infrastructure development in the context of SSA, especially in an era marked by increased foreign direct investment and international development funding. Studies have revealed that without effective governance, even substantial financial investments can lead to suboptimal outcomes, thereby

exacerbating existing inequalities and vulnerabilities (Appiah, Onifade, & Gyamfi, 2022; Naeem, Appiah, Taden, et al., 2023). Therefore, assessing the specific roles and interactions of governance and institutions in infrastructure development not only fills an academic gap but also provides actionable insights for policymakers, international organizations, and private sector stakeholders who aim to catalyse meaningful, equitable development in SSA.

Therefore, to address the foregoing issues, this study uses an index that considers wider indices of infrastructure, including the infrastructure access measure, the African Infrastructure Development Index (AIDI), which puts more emphasis on infrastructure stock and infrastructure quality and covers indicators consisting of or relating to transport and energy as well as those relating to finance and information and communication technology (ICT) infrastructure. This study aims to address this critical question by examining the influence of governance on infrastructure development in SSA countries, taking into account the role of institutional quality. This research is particularly relevant given the lack of comprehensive studies on the governance–infrastructure nexus in SSA. Prior studies have often focussed on infrastructure issues in the transport sector alone or have used limited infrastructure indices, potentially overlooking crucial aspects of infrastructure development. Additionally, this study employs more robust empirical estimators to provide more reliable and insightful policy recommendations. In addition, more efficient and robust empirical estimators were used, including the augmented mean group (AMG), common correlated effect mean group (CCEMG), and dynamic CCEMG estimators. These approaches present a better understanding of the government-led infrastructure hypothesis. Similarly, we investigate the government-led infrastructure hypothesis by including the moderating effects of institutional quality. Additionally, the current study provides more insightful policy directive-oriented estimates from the adopted techniques that are known to be better than the fixed-effects estimation approach, given that their applications are robust to endogeneity flaws (Bond & Eberhardt, 2013; Chudik & Pesaran, 2015; Eberhardt & Bond, 2009). The study is subdivided into other sections. Section 2 contains a review of facts about governance and infrastructure, and the third section shows the data sources, models, and methodology. The study was concluded in Section 5, after analysing the findings in the fourth section.

2 | LITERATURE REVIEW

Good governance is critical to sustainable development. Economic, corporate, international, regional, national, and local governance are examples of governance (Dixit, 2009). For effective governance, a proper institutional and policy framework is required. As Dixit (2009) points out, good economic governance is required to ensure three essential prerequisites: (i) collective action, (ii) contract enforcement, and (iii) property rights security. It ensures that corruption is minimized, minorities' opinions are heard, and the voices of societies' most vulnerable are heard in decision-making. The United Nations has made it a strategic priority to assist developing countries in improving their governance. The African Union respects the region's diversity of political systems and institutional cultures. Nonetheless, it identifies four criteria of good governance that all governments should consider.

- (i) **Accountability:** Officials should be accountable to the entity that gave them authority, work should be carried out according to agreed-upon rules and standards, and data should be reported relatively and adequately.
- (ii) **Participation:** Citizens, particularly the impoverished, are empowered through advancing their rights to access and secure control over essential entitlements that enable them to earn a living.
- (iii) **Predictability:** Laws and policies are implemented consistently and fairly.

- (iv) Transparency: Citizens are given access to low-cost, easily understandable, and relevant information to promote effective accountability and clarity about laws, regulations, and policies.

Participatory, consensus-oriented, accountable, transparent, responsive, effective, efficient, equitable and inclusive, and cognizant of the rule of law are the eight major characteristics of good governance. The infrastructure network of an area, in basic terms, is the socio-economic atmosphere formed by the institutions that function as trade and investment conduits. Some of these establishments are public, while others are private. In either scenario, their contributions to integration are transformative, assisting in converting resources into outputs or facilitating trade by reducing barriers. As a result, improving regional infrastructure is one of the most important aspects determining a region's long-term growth and infrastructure.

2.1 | Governance and socio-economic development relations

Africa's infrastructure connection has improved in some areas, but it continues to be fragmented both within and across countries, and in most cases, the available infrastructural facilities are of poor quality compared with the rest of the world. Therefore, much work must be done if Africa aspires to witness a seamless transformation for improved infrastructure development. Weak institutions and policies are significant obstacles to Africa's regional infrastructure connectivity, as noted by Owusu-Manu et al. (2019) and Fedderke et al. (2006). Effective institutions and policies require good governance. The amount of literature on the impact of governance on infrastructure in sub-Saharan Africa is generally scarce, but a few studies have shown the importance of governance in encouraging infrastructure development.

Some studies have investigated the relationship between government and infrastructure at the national level. Examining the industry's corruption costs reveals the relevance of institutions and good governance in infrastructure performance. According to some studies (Appiah, Onifade, & Gyamfi, 2022; Asongu et al., 2023; Kenny, 2007, 2009), corruption is a symptom of poor governance itself, but it can also damage the governance environment, thereby creating several socio-economic challenges. Corruption raises the cost of infrastructure and lowers quality and economic returns on investment in infrastructure. Failed governance can result in the wrong infrastructure being built, poor construction and quality of provision, insufficient maintenance, worrisome bureaucratic processes in project approval and execution, and high theft and loss rates (Ebekozi et al., 2023). This can result in lower levels and less efficient infrastructure provision, not just for individual projects but also for the entire infrastructure stock. This consequence has been empirically demonstrated in several studies (Kaufmann et al., 2004). As a result, even if an infrastructure project is carefully chosen, well designed, and free of corruption, governance failings can drastically limit its macroeconomic impact (De Groot et al., 2004).

According to Dixit (2009), good economic governance is required to ensure three essential prerequisites: (a) collective action, (b) contract enforcement, and (c) property rights security. It ensures that corruption is minimized, minorities' perspectives are considered, and society's most vulnerable voices are heard in decision-making. Proper economic governance also responds to society's current and future requirements (UN, 2009). Furthermore, international trade expenses can be reduced by combining strong institutional coordination with enhanced infrastructure to boost local productivity for a strong export base (Francois et al., 2009).

The relationship between institutions and organizations shapes an economy's (or region's) institutional evolution. Institutional quality and good governance are comparable to trade tariff liberalization.

Both improve regional and national integration, economic growth, and infrastructure. According to the empirical evidence from Barro (1999), good governance and growth are positively connected. Furthermore, the quality of institutions and good policies matter for long-term economic progress (Knack & Keefer, 1995; Lee & Kim, 2009). Good regional governance has a direct and positive impact on the local governance of each country in the region, and it has been noted that a lack of sufficient regulation and institutions leads to poor regional infrastructural provision (OECD, 2016). As a result, excellent institutional governance is critical for attaining integrated infrastructure. The public sector regulates and supplies most of the national and regional infrastructure. Hence, regional public policy is more significant.

Governance is crucial in laying the groundwork for creating resilient critical infrastructure (Murdock et al., 2018). Sectoral regulation must ensure the establishment of acceptable risk and resilience standards through the application of financial incentives (compensation to end users) and non-financial incentives (transparency requirements), as noted by Vallejo and Mullan (2017). For example, requiring end-user compensation in a service disruption can encourage operators to invest appropriately in resilience while allowing them to choose. On the other hand, transparency standards may cause operators to be concerned about their reputation in the event of a service failure. According to some authors, the concept of reflexive governance is associated with the term resilience, which is defined as the ability to thrive and adapt to shocks by generating new approaches (Boin & McConnell, 2007; Crichton et al., 2009). However, in the context of sustainability, reflexive governance is commonly used to address socio-ecological vulnerabilities, and it has been noted that this dynamic and polycentric governance paradigm may lead to more effective and long-term public service delivery (Appiah, Onifade, & Gyamfi, 2022).

3 | MODEL, METHODS, AND DATA

To look at the moderating influence of institutions in the governance–infrastructure nexus in SSA countries, we utilized augmented mean group (AMG), common correlated effect mean group (CCEMG), and dynamic common correlated effect mean group (DCCEMG) estimators to obtain the long-run connection among the variables. The study also included a panel causality heterogeneity test to determine the direction of causation.

$$INFRADEV_{IT} = (IQ, GOV, MODVAR, FD, IND, GR) \quad (1)$$

where *INFRADEV* stands for AIDI in Equation 1 and IQ for institutional quality as obtained from country policy and institutional assessment (CPIA). The IQ indicator following the CPIA encompasses about 16 criteria that address matters of public sector management, institutions, economic management, policies for equity and social inclusion, and other structural policies. GOV for Governance (index), *MODVAR* for the interplay between IQ and GOV (*i.e.*, *IQ*GOV*), FD for financial development (index), IND for industrialization (percentage), and GR for economic growth (percentage). The World Bank, International Monetary Fund (IMF), and African Development Bank provided relevant data and statistics for all variables from 1990 to 2017. Table 1 shows the descriptive statistics for the variables. We developed an econometric model by considering the functional form in Equation (2).

$$INFRADEV_{IT} = a_0 + \delta_1 IQ_{it} + \delta_2 GOV_{it} + \delta_3 MODVAR_{it} + \delta_4 FD_{it} + \delta_5 IND_{it} + \delta_6 GR_{it} + \varepsilon_{it} \quad (2)$$

The subscript *t* denotes the time-series nature of the data, the cross-sections are denoted by subscript *i*, the intercept is denoted by subscript *s*, and the numbers $\delta_1, \delta_2, \dots, \delta_6$ denote the variables' unknown parameters, which must be estimated.

TABLE 1 Descriptive statistics.

VAR	MEAN	MEAN	STD. DEV.	MIN	MAX	Unit	Source
INFRADEV	12.3933	12.3933	5.5856	0.37	28.16	Index	AfDB
IQ	3.2067	3.2067	0.6730	1.5	4.5	Index	WB
GOV	-0.7471	-0.7471	0.4311	-1.7457	0.26685	Index	WB
MODVAR	-2.2775	-2.2775	1.2232	-5.5164	1.2008	Index	WB
FD	0.7536	0.7536	0.2853	0.2173	1.7956	Index	IMF
IND	20.917	20.917	7.8582	3.3894	44.1079	Percentage	WB
GR	2.8810	2.8810	7.1310	4.8708	5.6811	Percentage	WB

Note: AfDB represents African Development Bank while, IMF—the International Monetary Fund, and the WB stands for the World Bank.

TABLE 2 Correlation stats.

Variables	INFRADEV	IQ	GOV	MODVAR	FD	IND	GR
INFRADEV	1.0000						
IQ	0.1435	1.0000					
GOV	0.2927	0.4077	1.0000				
MODVAR	0.2705	0.1345	0.9314	1.0000			
FD	0.1559	-0.1032	-0.1053	-0.1158	1.0000		
IND	0.2345	0.0749	-0.2827	-0.3098	-0.1327	1.0000	
GR	0.1560	0.0043	-0.1001	-0.1177	0.5062	0.1056	1.0000

The statistical characteristics of the variables included in the study are listed in Table 2: observations, mean, standard deviations, and maximum and lowest values. Each variable has 375 observations, with a maximum value of 44.1079 and a minimum of -5.5164. The moderating variable (MODVAR) has a mean of -2.2775, a maximum value of 1.2008, and a minimum of -5.5164. The average INFRADEV index is around 12.3933, whereas the average institutional quality index is 3.2067. The industry's entire value added to GDP, on the other hand, is 20.917%. With standard deviations of 0.2853% and 7.1310%, financial development and growth averaged 0.7536% and 2.8810%, respectively.

3.1 | Econometric estimation procedures

In the econometric estimation procedures for this study, four steps were taken. The cross-section dependence (CD), slope homogeneity (SH), and autocorrelation tests were performed across the panels in the first state. In the second phase, we looked for unit roots in the variables. We used the Pesaran augmented with cross-section dependence unit root (CIPS and CADF) to capture cross-panel dependencies if they were present in the data. In the third phase, panel co-integration tests were used to examine the co-integration relationships between the variables. This test is based on Westerlund and Edgerton (2007) error component-based co-integration tests, which consider the data's cross-section dependence. We discovered a long-term association between the variables in the third phase. Moving on, we computed the necessary impacts of the variables on infrastructure development in the SSA region using three distinct estimators: AMG, CCEMG, and DCCMG.

According to numerous studies (Erdoğan et al., 2023; Gyamfi, Bekun, et al., 2022; Haouas et al., 2021; Kapetanios et al., 2011; Onifade, 2022), cross-section reliance in data is a severe issue, and disregarding it can lead to inefficient and inaccurate outcomes. We employed Pesaran's (2004) CD model to examine this problem. The cross-section dependence in the data was disclosed in the data series, and traditional unit root tests have little power to discover cross-section dependence in the data. To resolve this issue, Pesaran et al. (2008) created the Pesaran CIPS panel test of a unit root, which allowed for cross-section dependence in the data. Finally, because the causal direction is critical in empirical research, we employed Dumitrescu and Hurlin's (2012) panel causality test in this work. Unlike traditional unit root tests, which utilize the averages of each cross-section to level and the first difference for each cross-section unit in the data, this test does not presume cross-section dependence and has gained acceptance in contemporary studies (Alola & Onifade, 2022; Gyamfi, Onifade, et al., 2022). Traditional co-integration tests lack the power to detect cross-section dependence and can lead to biased conclusions (Appiah, Ashraf, et al., 2023; Gyamfi et al., 2023; Onifade & Alola, 2022). Because the current data is cross-sectionally dependent, we adopted Westerlund and Edgerton's (2007) error correction-based co-integration test in this work. Four tests (Ga, Gt, Pa, and Pt) were used in the Westerlund co-integration. There are two panel-specific tests and two group-specific tests. The null in-panel test explains that there is co-integration across the board. In contrast, the group-specific tests show that rejecting the null in-group test explains co-integration across at least one group in the panels.

3.2 | Long-term relationship

After evaluating co-integration, we employed AMG, CCEMG, and DCCEMG to identify the long-run elasticities for a panel of SSA nations. These approaches have the advantage of providing useful estimates when data contain cross-section dependence. Pesaran (2004) proposed this assessment, which was later advanced by Kapetanios et al. (2011). The cross-sectional average of the augmented mean group proposed by Eberhardt and Bond (2009), the pooled effect proposed by Bond and Eberhardt (2013), and the DCCEMG estimator proposed by Pesaran (2006) and Pesaran and Smith (1995) are among these estimators. Furthermore, a causal interpretation is required in empirical analysis to make policy recommendations. Because other standard tests of causality lack the power to provide unbiased causality conclusions when cross-section dependence in the data is considered, we adopted Dumitrescu and Hurlin's (2012) heterogeneous panel causality in this study.

4 | RESULTS AND DISCUSSION

The findings of the pairwise correlation analysis among the variables of interest are presented in Table 2. It can be deduced that the infrastructure development (INFRADEV) index positively correlates with all measures, including institutional quality, governance, *MODVAR*, financial development, industrialization, and wealth level. There is also a negative association between financial development and institutional quality, governance, and *MODVAR*. However, there is a negative link between manufacturing sector value added (IND) and governance, *MODVAR*, and financial development, whereas there is a positive correlation between governance and institutional quality. Institutional quality, financial development, and industrialization have a good link with the growth indicator. The correlations between the regressors are moderate, with varying degrees of signs. This indicates that multicollinearity among the regressors is not an issue.

TABLE 3 Test of CSI, SH and AC.

Test	T. Stats	Significance level
Test of CSI	30.781	***
Test of AC	550.016	***
Test of SH	8.195	***
Test for SH (Adj)	11.996	***

***Signifies $p < 0.01$.

TABLE 4 Test for unit roots.

	LEVEL CIPS	1 st DIF CIPS	Integration order	Level CADF	1 st DIFF CADF	Integration order
INFRADEV	-2.467***	-4.067***	I (0) and I (1)	-2.438***	-6.012***	I (0) and I (1)
IQ	-1.953	-3.051***	I (1)	-3.429***	-1.705**	I (0) and I (1)
GOV	-2.014	-3.962***	I (1)	0.197	-2.445***	I (1)
MODVAR	-2.447***	-3.409***	I (0) and I (1)	-5.319***	-4.178***	I (0) and I (1)
FD	-2.532***	-3.714***	I (0) and I (1)	-3.241***	-5.102***	I (0) and I (1)
IND	-1.409	-3.647***	I (1)	1.636	-3.711***	I (1)
GR	-1.525	-3.300***	I (1)	0.968	-3.113***	I (1)

***, **, *Signifies $p < 0.01$; $p < 0.05$; $p < 0.1$.

The dataset's CSD, auto-serial correlation, and heterogeneity criteria are crucial for the most consistent and accurate unit root and co-integration testing. The data demonstrated that cross-sectional independence exists between *INFRADEV*, institutional quality, *MODVAR*, financial development, industrialization, and growth. Analysing cross-section independence properties was possible using Pesaran (2004), Breusch and Pagan (1980), and Pesaran et al.'s (2008) techniques. The SH test was done using Pesaran and Yamagata's (2008) technique. The outcomes, as seen in Table 3, were in favour of rejecting the null hypothesis. As a result, the co-integration coefficients were heterogeneous. The study's variables passed the auto-serial correlation test, indicating no serial correlation.

The test of the long-term nexus is made possible by the integration order of the variables. When the CIPS method is used, the result posits that three of the variables were both stationary at I (0) and I (1), with the other variables being I (1). In a similar vein, when the CADF method is used, four of the variables under discussion are seen as I (0) and I (1), with the rest of the variables being I (1). Table 4 displays the results of the stationarity testing.

Table 5 records the test's findings of the co-integration. The outcome reveals that all variables are co-integrated and that there are long-term relationships, indicating that the study can assess long-term effects.

Table 6 shows the long-term results of the AMG, CCEMG, and DCCEMG methodologies; a few results are noteworthy. First, institutional quality is linked to infrastructure development in a good and meaningful way, as the IQ variable shows a positive drive towards infrastructure development in SSA countries. This implies that institutional performance is at the root of infrastructural growth in the SSA region. Increased institutional performance is linked to institutions' abilities to respond to citizens' needs and expectations and to design and implement policies that reflect these demands and expectations. However, the positive effect of institutions on infrastructure is not significant, reflecting the need to further strengthen institutions to boost their expected roles in the general development of SSA. This result varies from what can be seen in studies by Francois et al. (2009), Baldi et al. (2016),

TABLE 5 Test of cointegration.

	G_t	G_a	P_t	P_a	Cointegration decision
IQ	-15.862***	-16.777***	-3.857***	-14.871***	Cointegrated
GOV	-12.328***	-14.293***	-4.741***	-17.575***	Cointegrated
MODVAR	-15.399***	-21.786***	-5.075***	-19.084***	Cointegrated
FD	-4.196***	-9.804***	-1.879***	-10.268***	Cointegrated
IND	-2.702***	-5.013***	-5.846***	-12.731***	Cointegrated
GR	-0.204	-9.651***	2.086	-4.098***	Cointegrated

***Signifies $p < 0.01$.

TABLE 6 Test for long run results.

Variable	AMG test results		CCEMG test results		DCCEMG test results	
	Coef	Z	Coef	Z	Coef	Z
IQ	0.3519	0.59	1.8934	1.14	3.3704	0.74
GOV	-2.0997	-0.89	-3.4013	-0.67	-9.8193	-0.44
MODVAR	0.8509	3.20***	7.0048	2.99**	4.1444	2.47**
FD	0.1706	0.51	1.6637	0.65	3.1827	1.25
IND	0.0264	1.75*	0.05218	2.57**	0.1567	2.13**
GR	1.2412	-0.06	1.0287	0.66	7.6011	0.16
_cons	6.4122	2.81***	-5.2925	-0.18	4.5973	0.95

***, **, *Signifies $p < 0.01$; $p < 0.05$; $p < 0.1$.

Coviello et al. (2018), and Finocchiaro Castro et al. (2018). However, these studies concentrate on a single component of the institutional environment's quality—corruption—without considering other potentially significant indices of institutions. Different characteristics of institutional quality can influence institutional performance, especially in implementing public projects.

The governance indicator harms infrastructure development, and this association is consistent across all estimations. According to the findings, the level of governance in the SSA region has no positive impact on infrastructure development, which implies that the governance provided has yet to achieve the desired level of infrastructural development in SSA countries. In general, good governance facilitates infrastructure development, but unconventional results like this can only be attributed to bad governance, inadequate corruption control mechanisms, and the influences of political instability in SSA countries. Simply put, countries with poor governance are more likely to fail to improve their regional or national infrastructure. Poor governance certainly increases uncertainty, causing private investors (both local and foreign) to raise the risk premium for infrastructure initiatives, reducing overall investment and lowering economic development prospects. This observation is refreshing, as it is informative (Dutta, 2001; Easterly & Levine, 1997). These studies indicate that there has been modest to no impact of governance on improving human development conditions in many developing nations. This is one reason why the strengthening of governance institutions has become a vital millennium development goal for international development agencies.

On the other hand, the estimated coefficient for *MODVAR* is highly significant and positive, indicating that excellent governance and effective institutional performance benefit SSA countries' infrastructure development. For example, a 1% improvement in government and institutional quality in all three estimating methodologies raises the infrastructural development index. To summarize, the

TABLE 7 Test of causality.

Causal assessment	W-bar stats	Z-bar tilde stats	Causal route
INFRADEV→IQ	1.8821	1.5971	No route
IQ→INFRADEV	1.5447	0.5860	
INFRADEV→GOV	2.1001	2.1246**	Dual route
GOV→INFRADEV	4.1396	7.0607***	
INFRADEV→MODVAR	2.0031	1.8900*	Dual route
MODVAR→INFRADEV	2.0630	2.0348**	
INFRADEV→FD	1.7291	1.2267	Single route
FD→INFRADEV	5.1269	9.4501***	
INFRADEV→IND	1.8324	1.4768	Single route
IND→INFRADEV	3.8630	6.3912***	
INFRADEV→GR	1.1850	-0.0901	No route
GR→INFRADEV	1.1541	-0.1650	

***, **, *Signifies $p < 0.01$; $p < 0.05$; $p < 0.1$.

effects of government and institutional quality on infrastructure development are numerous and complicated. The provision of regional infrastructure will be inadequate and unsustainable without proper governance and institutional quality. As a result, one of the most important variables influencing infrastructure development is governance and institutional quality reforms. Some parallel studies in middle-income nations, sub-Saharan Africa, and Europe support this idea (Jessop, 2018; Kaufmann et al., 1999; Kazancigil, 1998; Leftwich, 1995). They stated in numerous studies that governance has a good impact on socio-economic growth, using several measures.

In terms of the other variables, econometric analysis revealed that the estimated coefficients of economic growth (GR) and financial development (FD) are mainly positive but insignificant in all models, indicating that increasing growth and financial development can stimulate infrastructure development in the sample countries. This shows that infrastructural reforms were not sustained by sufficient financing and growth-targeted expenditures. To put it another way, African countries must invest most of their profits from increased finance and growth in infrastructure transformation. On the other hand, the estimated coefficient of industrialization demonstrates that it enhances INFRADEV in the sample positively and significantly. According to the three estimation techniques, the results reveal that a percentage rise in industrialization increases INFRADEV by 0.0264%, 0.05218%, and 0.1567% in the panel nations. The importance of the industrialization variable strongly suggests that its spillover effects are not confined to increasing economic growth alone but extend to infrastructural transformations in the SSA.

The results of the DH panel Granger causality tests are presented in Table 7, with the scheme of direction shown in Figure 1. In a heterogeneous panel framework, this analysis is required to determine the Granger noncausality from each independent variable to INFRADEV. According to the findings, *GOV*, *MODVAR*, and *INFRADEV* all have feedback causality that suggest that infrastructure development is influenced by governance and the quality of institutions. A one-way causality is established for *INFRADEV* with a 1% level of significance in the case of financial development and industrialization. This conclusion is instructive for stakeholders in SSA economies. They infer that institutional quality and growth do not have the interaction and causal link that would be expected in SSA economies to enhance infrastructure. This finding is evident and suggestive for policymakers and economists in SSA nations, especially as it is well established in the literature that economic growth is

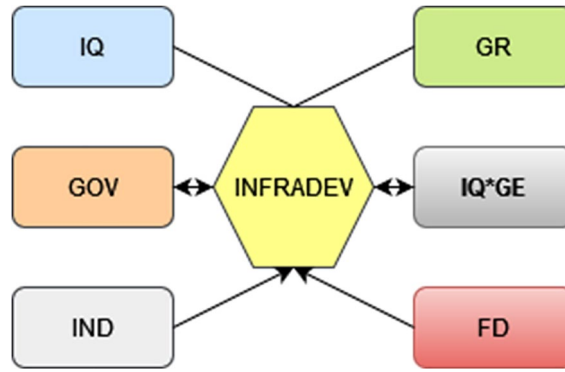


FIGURE 1 The causality scheme.

a vital source for *INFRADEV*. Measures should be geared towards reinforcing the favourable impact of financial development and industrialization on infrastructure.

5 | CONCLUSION AND POLICY RECOMMENDATIONS

This research examined the moderating effects of institutional quality on the relationship between governance and infrastructural development within SSA countries. The results confirm that the moderating effects of institutional quality and governance matter in the quest to achieve infrastructure development, as its interaction with governance produced a positive impact on infrastructure. Moreover, higher levels of industrialization relate to significantly better performance in infrastructure. The findings in this paper confirm the belief that concerted efforts to increase institutional quality and governance in developing countries are a step in the right direction. This buttresses the need to further strengthen institutions to boost their expected roles in improving the quality of infrastructure and the general development of SSA.

Notably, in many SSA countries, poor public infrastructure is a crucial barrier to economic development. Therefore, to be relevant in a globalized world, SSA countries must modernize and invest in infrastructures such as energy, transportation, ICT, and the financial sector. Authorities in the SSA must do more to enhance the institutions and governance in these countries by further strengthening the rule of law to contribute significantly towards the acceleration of sustainable socio-economic development and the consequent integration of these countries into the global economy. In addition, the government must put proper policies in place to ensure that financial development is further deepened in order to foster the benefits that can be reaped from extensive proper governance.

Historically, poor governance (coupled with dictatorial regimes) has been a significant characteristic of SSA countries. Most of these countries have traditionally turned to the ‘West’ (Europe or North America) for foreign aid (sometimes referred to as ‘hand out’) to address problems of poor infrastructure through loans as a step to resolving their infrastructural deficits. However, aid alone is not sufficient to tackle developmental challenges in SSA countries. This study sets forth the proposition that the broad diffusion of good governance and institutional quality performance may be at least a good starting point or perhaps a necessary condition for the sustainable improvement of infrastructure in developing countries. We do not claim that institutional quality and governance will instantly transform nations with infrastructural deficits into role models of exceptional infrastructure development nations. However, we can posit from the study that good institutional capabilities (such

as proper corruption control mechanisms, sound judicial systems, and proper and well-based reporting of government spending) can facilitate expected infrastructural developments in developing countries including those in SSA.

Hence, it is further recommended that strategic steps be taken to strengthen institutions across SSA to enhance prompt and appropriate implementation of public policies on infrastructural development programmes. This will help to guide against bad institutional arrangements that often produce haphazardly drafted infrastructural agendas, worrisome bureaucratic processes in project approval and executions, poor construction and lack of adequate supervision, insufficient maintenance, and theft of state-owned infrastructural facilities.

Lastly, without adequate infrastructure, the SSA will continue to lag behind in the comity of nations as far as the attainment of infrastructure-related SDGs is concerned. Therefore, SSA countries need to also explore the possibility of entering into beneficial agreements with other international development partners across the globe to facilitate the needed technology transfer for the execution of new infrastructural projects and further engage in training of the locals on how best to ensure the maintenance of the existing infrastructure.

6 | LIMITATIONS AND DIRECTIONS FOR FUTURE STUDIES

Although the current study has provided a solid ground for understanding the moderating effects of institutional quality in the relationship between governance and infrastructural development within SSA countries, the study can be said to be limited in certain respects, especially in terms of the degree of generalization. Although the majority of SSA suffer infrastructural deficits on the aggregate level, there could still be a possibility of having minor divergence points due to country-specific characteristics across the region. Therefore, future studies can first expand on the present scope while also exploring the extent to which each SSA country conforms to the current findings by focussing mainly on a country-specific analysis.

AUTHORS CONTRIBUTIONS

The first author (Michael Appiah) alongside the second author (Stephen Taiwo Onifade) were responsible for the conceptual construction of the study's idea. The second author (Stephen Taiwo Onifade) alongside the third author (Bright Akwasi Gyamfi) handled the introduction and literature sections. The data gathering, preliminary analysis, simulation, and interpretation of the simulated results were carried out by the first and third authors while the policy framework, proofreading, general manuscript editing, and correspondence were carried out by the second author.

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CONFLICT OF INTEREST STATEMENT

The authors wish to disclose here that there are no potential conflicts of interest at any level of this study.

DATA AVAILABILITY STATEMENT

The data for this present study are sourced from the database of the World Development Indicators (<https://data.worldbank.org>), International Monetary Fund (www.imf.org), African Development Bank AfDB (www.afdb.org).

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