

# Quality Governance, The Spice for Quality Infrastructure Development in Africa

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## ABSTRACT

This article examines the relationship between quality governance and infrastructure development. Quality governance is measured through government effectiveness (GE). GE measures the perceptions of the quality of public services, civil service and the degree of its independence from political pressures. It also captures the quality of policy formulation and implementation, as well as the credibility of the government's commitment to such policies. Similarly, infrastructure development is measured through infrastructure composite index. The study is anchored by the positivism philosophical underpinnings, with an ontological view of reality exists independent of the researcher and the epistemological view of the researcher does not influence the study since the truth can be ascertained through the measurable indicators. Furthermore, the research design is descriptive and regression in nature. The study employs secondary data accessed from world governance indicators and world bank data respectively. Their methods of data collection are upheld as is. The data was retrieved, cleaned, sorted, normalized, and analyzed using STATA. The findings indicate a positive relationship between infrastructure development and quality governance. This article highlights the need for the African continent to improve quality governance for it to attain better infrastructure development. Given that, it was only Mauritius and Seychelles with positive indicative measures above 50%.

Paper type; Research Paper

**KEY WORDS:** Infrastructure, Quality governance, Infrastructure governance

## Introduction and motivation of the study

Literature supports, the importance of infrastructure development to economic and social growth (Alexandro and Basrowi 2024:Nadu 2024). 16 out of 17 studies find a positive impact between

infrastructure development and growth (Bond 2016). Various scholars argue that growth is positively affected by the volume of infrastructure stocks and the quality of infrastructure services (Bond 2016; Khanna and Sharma 2018; Timilsina, Stern, and Das 2024). There is a duo relationship in literature with some scholars suggesting that good infrastructure improves governance (Baird 2012; Khanna and Sharma 2018; Segoro and Mutakin 2017) while, others argue that quality governance improves infrastructure development (Appiah, Onifade, and Gyamfi 2024; Asongu and le Roux 2024; Mensah and Traore 2024; Opoku, Acheampong, and Aluko 2024).

Various scholars suggest a statistical relationship between infrastructure development and quality governance (Anjani, Syafri, and Rusfiana 2024; Ogwang and Vanclay 2021). In reality, the realization of quality governance and infrastructure development in Africa, takes indescribable commitment, good administrative capabilities, diligent dedication to their framework's development, implementation and evaluation. Purposefully addressing corruption, effectiveness, efficiency, quality of public services, and acting in people's best interest at all times (Asongu and le Roux 2024).

**Infrastructure development**, has been a topic of a trending interest, attracting different definitions from different scholars. Hirschman (1958), defined infrastructure as essential services, encompassing all public amenities such as transportation, communication, power, healthcare, water supply, and irrigation systems. Again, (Fioravanti, Lembo, and Deep 2019) define infrastructure as a fixed asset whose life span exceeds a year and is expected to bring an economic return. They further, categorized it into soft, physical, Economic, social, and Civic infrastructure. Additionally, Infrastructure is defined as a fundamental, physical, organizational structures and facilities needed for the functioning of a society or enterprise, typically characterized by long-term durability and essential services provision (African Development Bank Group 2022; Bond 2016; Tuhaise et al 2024).

Soft infrastructure refers to development of human beings and systems (Tandrayen-Ragoobur, Ongono, and Gong 2023). Whereas, physical infrastructure takes on the tangible infrastructure like the houses, roads, energy generation equipment (Timilsina et al. 2024). Additionally, economic infrastructure empowers economic activities like the transport systems' contribution to the trade activities (Appiah et al. 2024; Fioravanti et al. 2019), while, the social infrastructure anchors the welfare of the society that includes and not limited to schools and hospitals. Lastly yet not least is the civic infrastructure that is mainly called so, because it is developed by the civil society (Tandrayen-Ragoobur et al. 2023). Evidently, it is not possible to categorically ringfence one type of infrastructure to a certain class, some of them can fall into two or more categories (Getter and Gnanarajah 2016; Timilsina et al. 2024). The relevance and contribution of infrastructure to the human capital, economy, social and financial health is indescribable (Meka'a, Fotso, and Guemdjo Kamdem 2024).

On the other hand, low-quality infrastructure can result into inefficiencies, risks to public safety, and adverse human and environmental effects (Bond 2016; Ogwang and Vanclay 2021). This is contrary to the sustainable development goals (SDGs), whose major aim is enhanced well-being of both the human and their environment (Bhatnagar and Sharma 2022; Bond 2016). Sustainable development goals' actualization is impossible without quality infrastructure. Furthermore, the role of Infrastructure development in facilitating primary, secondary, and tertiary economic activities cannot go unnoticed. However, developing nations lack adequate resources to finance all their infrastructure needs. This is worsened by lack of quality governance in developing nations (Butkus and Seputiene 2018; Mensah and Traore 2024).

**Quality governance** is defined to mean accountability procedures, regulatory compliance, quality standards, governance procedures, guidelines, and practices that control the design, execution, and upkeep of infrastructure projects (Butkus and Seputiene 2018; Mensah and Traore 2024). Where as (Kaufmann, Kraay, and Mastruzzi 2017) define it as effective management and oversight of processes, systems, and institutions to ensure the delivery of high-quality outcomes. It involves the establishment of frameworks, standards, mechanisms that promote transparency, accountability, efficiency in decision-making and resource allocation (Appiah et al. 2024; Opoku et al. 2024). One of the measures of quality governance adopted for this study is government effectiveness (GE) (Appiah et al. 2024). Some scholars argue that private investors are attracted to invest in various infrastructure if there is effective governance. This leads to quality infrastructure development and it is in line with the preferred habitat theory.

**The preferred habitat theory**, assumes that there are willing investors, much as preference mismatches exist between investors and issuers (Vayanos and Vila 2021). This arises, when the investors prefer to invest in a certain zone. An example is when investors prefer a green investment yet issuers wish to raise finances for budget support activities (Vayanos and Vila 2021). However, once the needs of the investors are matched with those of the issuers, amidst quality governance, infrastructure development becomes a close reality (Odongo, Mukoki, and Ojah 2023a). Much as infrastructure development and quality governance are highly desired, they have remained a dream that is farfetched for the African continent.

Various interventions have been set up to enable infrastructure development and policy formulations that promote better governance. These include: Africa infrastructure Knowledge program (AIKP), it shares Africa's infrastructure updates (Bond 2016). Africa infrastructure development Bank, whose purpose of existence involves supporting private participation in infrastructure (AfDB 2018a). It also, set up an Africa infrastructure development index, to report on the progress and status of infrastructure development, guide and monitor policy formulations amongst others (African Development Bank Group 2022). Africa fund 50 initiative, its main role is to innovatively raise funds for transformative regional projects (Kararach ,2017). Also, there is a Public Infrastructure Development Assistance (PIDA, that supports African countries to interconnect, integrate, prioritize, prepare bankable projects. As well as identify the necessary stakeholders both public and private that can successfully implement Africa's infrastructure financing and development (AfDB 2023). In spite of the various interventions, infrastructure gaps and quality governance remain an outcry for many countries in Africa. Thus, the statement of the problem.

### **Research problem and justification**

Globally, about 800 million people do not access electricity, 4.5 billion people lack access to safe and clean water, and 2.2 billion people lack access to adequate paved roads. The biggest percentage is in the African continent (Bagenda, 2023). This is amidst a very weak quality governance in the entire continent with the exception of Mauritius and Seychelles and only 7 had a positive measurement indicator (Authors calculations: Calderón and Servén 2014) While the remaining 46 countries had varying weak government effectiveness indicated through negative indicators for the period between 2013 to 2022 (Authors analysis : Straub 2008)

Various scholars studied infrastructure development (AfDB 2018; Chen 2018; Woetzel et al. 2017) while those that interested themselves in quality governance included (Ahmed, Musonda, and Pretorius 2023; Kristensen et al. 2019; N'zue and Komenan 2023; Twesigye 2022; Wen 2010). Those that actually looked at both quality governance and infrastructure development examined their relationship in the manufacturing sector of Indonesia (Ahmed et al. 2023; Appiah et al. 2024). Yet this study is looking at the

relationship between quality governance and infrastructure development in Africa. our study differs from theirs in terms of scope, content and study variables. To the researcher’s best knowledge, this is the first study to examine infrastructure development using portfolio investment bonds in Africa anchored by the preferred habitat theory.

The preferred habitat theory agrees with this study and other scholars that argue for perceived quality governance’s ability to deter or promote infrastructure development. The previous studies that examined the relationship between infrastructure and quality governance used the theory of unbalanced growth (Butkus and Seputiene 2018). While those that used the preferred habitat perspective, used it on interest structure (Vayanos and Vila 2021). This is the first study to apply the theory of the preferred habitat perspective in examining the relationship between infrastructure development measured through infrastructure composite index and quality governance measured through government effectiveness to the best of the researcher’s knowledge.

**Main Purpose and the hypothesis;**

The main purpose of the study is to examine the relationship between infrastructure development and quality governance.

The hypothesis

H<sub>a</sub> There is a positive statistical relationship between infrastructure development and quality governance.

**Contribution and significance of the paper**

This paper is based on facts published by reputable entities: world bank and African Infrastructure development bank, thus they can be relied on for making and improving on quality governance policies.

The various infrastructure development partners and stakeholders can refer to this paper for decision making in relation to the need for quality governance for infrastructure development in Africa.

Lastly, yet critical are the academicians and their students, they can refer to this paper for future research guidance and references.

**Conceptual framework.**

**Independent variable**

**Dependent variable**



**Mukoki et al 2023**, in the study entitled Infrastructure financing and bond market development in Sub-Saharan Africa. Through a system GMM estimator, established a negative nonlinear relationship between bond market development and Infrastructure deficit financing. The authors further noted that, Weak governance can distort the efficiency of resource allocation that can lead to misallocation and leakages in infrastructure development. This study contributes to both variables under study, that is infrastructure

development and the consequences of weak governance. However, it differs from our study through the different geographical scope of Africa instead of Sub-Saharan Africa. Secondly, its major variables under study are Bond market development and Infrastructure financing gap whereas ours is infrastructure development and quality governance.

**Anis Chowdhury and Jomo Kwame Sundaram 2023**, in the article titled Chronicles of debt foretold, argue that debt crises in developing nations often focuses on corruption and bad governance disregarding geopolitical considerations. The article attributes the actual problem to the austerity measures of the International Monetary Fund (IMF) and the world bank one shoe fits all approaches to external debt borrowing and management. Additionally, the authors point out the exaggerated blame on bad governance and corruption instead of reviewing the austerity measures for debt development. Similar to the current study is the concept of quality Governance that is measured through government effectiveness. To differ from our study's argument, which examines the relationship between infrastructure development and quality governance in Africa. Theirs, argues for a less blame on corruption but rather the need to review the measures for debt crises.

**The study by Zue and Komenan, 2023**, entitled Governance issues and the COVID -19 Pandemic in west Africa: are there any linkages? This study highlighted the six dimensions of quality governance measures. These six dimensions include voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law, and control of corruption. The study concluded on existence of a positive and significant correlation between all the governance variables, except political stability dimension. In the same spirit with our study, is the concept of governance and one of its dimensions of measurement which is government effectiveness. Albeit our outcome variable differs from theirs by bringing on board the variable of infrastructure development instead of Covid -19 deaths.

**Amed et al 2022**, in the study entitled Dynamics of private public partnerships (PPP) investment in energy and country governance: evidence from Sub-Saharan Africa. This paper investigates the link between governance and energy investment in Public-Private Partnerships (PPP). It finds that increased accountability, prioritizing the voice of the masses, and disabusing the rule of laws boost PPP investments in the energy sector. However, the study found no positive influence from corruption control on PPP investment. The authors suggest that low control of corruption is responsible for inadequate PPP investments and suggested redefining anti-corruption laws to accommodate severe sanctions. This study is similar to ours by bringing out the concepts of infrastructure but in this case, it was specific to energy sector and the concept of governance tagged to each country. While, ours is working with the general infrastructure development and quality governance.

**Ehlers 2014**, a paper entitled; The Understanding of the challenges for infrastructure finance, prospects for new sources of private sector finance. The paper argued for the lack of investable projects and poorly drafted contracts as two major barriers of the many barriers to infrastructure investment. Similar to our study is the concept of infrastructure finance which is a stage of infrastructure development but it differs from our study in various perspectives like the period covered, the concepts covered that is infrastructure financing while, ours considered infrastructure development and quality governance.

**Johnson (2020)**, in his article entitled the new governance infrastructure. He examined how technology is influencing governance infrastructure, with a particular emphasis on creating intelligent governance systems that make the most of the abilities and zeal of the governed. The study established that future needs and challenges could be predicted by new governance infrastructures using decision-making mechanisms like intraorganizational auctions or prediction markets. This article contributes to the concept

of governance infrastructures in prediction of infrastructure future needs and challenges. Yet our study is examining the relationship between infrastructure development measured through composite index and quality governance through government effectiveness.

**Khann and Sharma (2017)** examined the impact of infrastructure and governance quality on manufacturing productivity. They investigated the relationship between long-term productivity, growth, and governance quality as discussed in neoclassical and endogenous growth frameworks. The study focused on Indian states, assessing how infrastructure and governance quality affect Total Factor Productivity (TFP) in the manufacturing sector at the state level. Using various analytical techniques, the authors analyzed the influence of a composite governance index on industrial TFP and ranked Indian states based on governance quality. They found that TFP is significantly affected by the quality of public service delivery related to economic, social, and financial infrastructure, showing notable disparities among states. Notably, their study shares similarities with our research which examines the relationship between infrastructure development and governance quality, but with significant differences in timeframe (2012-2023 vs. 2008-2011), theoretical approach (neoclassical vs. preferred habitat theory), geographical focus (India vs. Africa), and scope (manufacturing sector vs. four sectors of ICT, Transport, energy and water and sanitation based on the African Infrastructure Development Index).

**The study by Pan 2024**, looked at impacts of governance on infrastructure provision and institutional innovations. The book chapter emphasized a quote by Deng Xiaoping about the role of governance by saying that, a good governance system can prevent bad people from doing bad things, while a bad system can prevent good people from doing good things, and may even turn good people into bad people. This study Applied the ordinary least squares method in analyzing the impact of governance through corruption control and the findings were that, curbing corruption positively influenced infrastructure growth. This is through increased private participation in infrastructure provision. Similar to our study is the concept and role of governance in infrastructure development. To differ from our study, the book chapter examines the relationship between 3 variables, that is governance, infrastructure and institutional innovations while ours examines the relationship between infrastructure development and quality governance in Africa and does not include institutional innovations. Whereas, the Pan measured quality governance based on corruption control, our study measures the same with government effectiveness. Furthermore, the context of our study is the African continent and not China.

**Appiah et al 2024**, Analyzing governance-led infrastructural development nexus in sub-Saharan Africa: Does the moderating role of institutional quality matter?

The paper sought to address the challenges associated with the infrastructure deficit. In order to examine the governance-led infrastructural development hypothesis in Sub-Saharan Africa (SSA) while controlling for financial development, economic growth, and industrialization in the region, a combination of sophisticated panel economic techniques was applied to data collected from the African Development Bank, World Bank, World Development Indicator, and International Monetary Fund (IMF). The results demonstrate how infrastructure in SSA is strongly and favorably induced by the interaction of institutional quality metrics and governance indicators. Similar to our study, Appiah et al 2024, analyzed governance led infrastructure development in the south of the Saharan Africa. Their study combines the current study variables in to one variable. However, our study examines the relationship between governance and Infrastructure development in the entire African countries subject to data availability.

**Wegrich et al 2016**, studied the challenges of infrastructure governance; the authors worked with infrastructure governance as a process that starts from planning, contract signing, evaluation of performance, and maintenance of the infrastructure. To compare with our study, this study also combines the two study variables in to a single variable and analyzed challenges of infrastructure governance. Yet ours is examining the relationship between infrastructure development and quality governance. The periodical scope is also different, with ours starting from 2012 to 2023 instead of the one for 2016.

**Opoku et al 2023**, studied the impact of rural urban energy equality on environmental sustainability and the role of governance in 47 Sub-Saharan African nations. The study examines the effects of disparities in rural-urban energy access on environmental deterioration between 2000 and 2020. The findings indicate that closing this gap, is linked to less environmental deterioration. The study also discovered varying effects of variables related to governance, indicating that enhancing the quality of governance and guaranteeing equal access to energy for rural and urban areas could help lessen environmental degradation in developing nations. Similar to our study, is the governance concept and infrastructure. Much as their study of infrastructure was more specific to energy as well as the Geographical scope of Africa instead of the Sub-Saharan Africa.

**Efogo 2020, *Financial Development and African Participation in Global value Chains GVCs*,**

The study conducted extensive statistical and economic analysis across 36 countries from 2000 to 2018, along with theoretical discussions, focusing on the progress and challenges of infrastructure development in Africa, particularly within the ECOWAS subregion. Despite some projects in Africa reaching financial closure, totaling over \$8 billion since 2013, this amount falls significantly short of the estimated cost of \$1464 billion annually for addressing infrastructure gaps in sectors like transportation, power, ICT, water, and sanitation. However, the above mentioned financial is beyond the capacity of ECOWAS member states with fluctuating national revenues. This calls on the urgency to tap into private capital given its benefits of risk-sharing between the government and private sector, which could help free up public resources for allocation to other sectors. This study contributes to the concept of infrastructure development in Africa but doesn't take into account the governance matters as well as the scope is Africa in ours and not limited to ECOWAS members. It also indicates the need for tapping into more innovative financing options beyond the inadequate national revenues where as ours is emphasizing the need for quality governance.

**Brunet, 2019** Governance as practice for major public infrastructure projects: A case of multilevel project governing. This article aims to advance a conceptualization for governance as practice, based on processual and practice studies. The research strategy is a multiple case study of four major public infrastructure projects in Quebec, Canada. The results reveal a process of multilevel project governing, as performative practices are enacted against the ostensive ones. The theoretical contribution is to unfold the knowledge articulation process of a project governance framework, while the practical contribution is to understand and document governmental practices to gain deeper insights about project governance. The research strategy is qualitative, heuristic, and based on case studies purposefully sampled according to maximum variation sampling. Similarly, both studies covered a governance concept. However, this study conceptualized governance in Canada while our study examines the relationship between governance and infrastructure development, in Africa

**Mensah and Traore, 2024**, This paper investigated how foreign direct investment (FDI) in developing economies is influenced by the quality of infrastructure. It shows that FDI in Africa is stimulated by high-speed internet, especially from submarine cables, specifically in the retail, health, technology, and finance

sectors. According to the study, having access to fast internet also raises the likelihood of receiving FDI as well as the amount and value of FDI in these industries. The paper also suggests that increased market expansion and better governance, which result in higher returns on investments, could be mechanisms by which high-speed internet connectivity encourages foreign direct investment (FDI). Similar to our study, is the concept of quality infrastructure and its role in economic development. To differ from ours, the study examined the relationship between FDI and the quality of infrastructure while ours examined the relationship between infrastructure and government effectiveness in Africa.

**Asongu and Roux 2024**, Governance, debt service, information technology and access to electricity in Africa; In 52 African nations, the study looks at how governance affects short-term debt servicing and infrastructure development between 2002 and 2021. with data from 2002 to 2021, using World Development Indicators (WDI) and World Governance Indicators (WGI) to analyze governance variables particularly political governance, economic governance, and institutional governance variables consistent with Kaufmann et al. (2007). The outcome variable is infrastructure, proxied by telephone penetration and electricity access, and external debt service is used as the main independent variable of interest. Results indicate that debt service has a negative impact on the availability of energy and telecommunications infrastructure, and that regulatory quality and corruption control have a moderating effect on governance dynamics. Similarly, our study is working with government effectiveness, one of the governance indicators and infrastructure development in Africa. However, the two differ in relationships examined, ours is infrastructure development and governance effectiveness while theirs is governance and debt service management.

### Methodology

The study is anchored by the positivism philosophical underpinnings, holding on to the ontological view of reality exists independent of the researcher and the epistemological view of the researcher does not influence the study since the truth can be ascertained through the measurable indicators (Daniel 2016). The research approach is quantitative, Furthermore, the research design is descriptive and regression in nature. This is because descriptive designs give detailed analysis for the variables under study (Baškarada and Koronios 2018). Whereas regression design examines existing relationship between study variables (Kanapickiene and Keliuotyte-Staniuleniene 2019). The targeted population and sample are the 53 African countries that have infrastructure development data as well as quality governance measures. The data sources are databases by world bank and African Infrastructure development Bank. Thus, it was secondary data accessed from two credible sources indicated above. The data was retrieved, cleaned, sorted, normalized and analyzed using STATA. Their methods of data collection are upheld as is and elaborated below.

### Infrastructure composite index development, the measure for infrastructure development

**Standardization Process also called Normalization.** Given that the elements of the AIDI are initially measured using different units, a normalization process is employed to facilitate averaging. This process involves standardizing or normalizing the observations, allowing for their amalgamation into a composite index. The normalization technique utilized is the min-max formula applied to all observed values of each element during the timeframe of 2010–2012. This adjustment ensures that the "normalized component" falls within the range of 0 to 100 over the specified period. **Step 2: Computation of Composite Indices:** A composite index is computed for each element through a weighted average of indicators, particularly



for those elements comprising multiple indicators. The weighting scheme is determined by factors such as the significance or relevance of each indicator within its respective component. The calculation of the composite indices in step 2 relies on the reciprocal of the standard deviation of each normalized component, represented as follows:  $y_t = (\sigma_{tot}/\sigma_x) * x_t$ ; where  $\sigma_{tot}$  is determined by  $1/\sigma_{tot} = \sum x (1/\sigma_x)$  and  $\sigma_x$  signifies the standard deviation of the normalized component  $x$ . The objective behind step 2 is to mitigate the influence of the most volatile components on the composite index and subsequently stabilize the rankings. **Moving on to step 3, the AIDI composite index is generated** by utilizing the sub-indexes of the four components and applying the same methodology outlined in step 2. **In step 4, the sub-regional AIDI is generated.** These indices for each sub-region are computed as a weighted average of the normalized components of the countries within that sub-region. The selection of weighting variables is as follows: population size is employed for assessing electricity, water, sanitation, and ICT subscriptions (phone and internet), while the size of the road network is utilized for evaluating paved roads (African Development Bank Group 2022; Nchube and Lufumpa 2017). Furthermore, documentation and details about methodology and analysis can be accessed on the website for Africa Infrastructure development Bank (AFDB, 2018)

**Quality governance measured through Government Effectiveness.** While the Governance indicators, measured through Government Effectiveness (GE). This captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. The estimate gives the country's score on the aggregate indicator, in units of a standard normal distribution, i.e. ranging from approximately -2.5 to 2.5. Kaufmann, Daniel, Aart Kraay and Massimo Mastruzzi (2010). The Worldwide Governance Indicators (WGI) are a research dataset summarizing the views on the quality of governance provided by a large number of enterprise, citizen and expert survey respondents in industrial and developing countries. These data are gathered from a number of survey institutes, think tanks, non-governmental organizations, international organizations, and private sector firms. Detailed documentation of the WGI, interactive tools for exploring the data, and full access to the underlying source data available at [www.govindicators.org](http://www.govindicators.org). The WGI are produced by Daniel Kaufmann (Natural Resource Governance Institute and Brookings Institution) and (World Bank Development Research Group).

### **Econometrics.**

Econometrics are used to ascertain relationships between study variables and for models that predict the future needs, challenges or relations (Calderón and Cantú 2021; Senanda et al. 2023).

### **Linear regression**

A linear regression offers a more precise method to explore the relationship between variables compared to correlations, as it provides measures such as goodness of fit (Adjusted R Square) and statistical testing for the variables (Li et al. 2020; Vintilă, Gherghina, and Toader 2019). In one-variable regressions, the formula is  $y = ax + b$ , while for multiple regressions, it is  $y = ax_1 + bx_2 + c$ . In the equation  $y = ax + b$ ,  $y$  represents the dependent variable,  $x$  the causal variable, and  $a$ , the intercept, which signifies the correlation between  $x$  and  $y$ . and " $b$ " represents the  $y$ -intercept of the line. It is the value of  $y$  when  $x$  is equal to 0. Essentially, it indicates the starting point of the line on the  $y$ -axis (Chowdhury and Salema 2023). For

instance, if "a" is 0.6, it implies that when the x variable increases by 1 unit, y increases by 0.6 units. If "a" is negative, it indicates that y decreases as x increases.

The General linear model contextualized for this study.

$$Y = AX + B$$

Where Y= infrastructure development

A=  $\beta$ , the measure of correlation between infrastructure development and quality governance.

X = The presence of quality governance measured through government effectiveness.

B= The value of infrastructure when government effectiveness is at zero.

**This can also be represented as follows:**

$$Y_{it} = \beta_0 + \alpha y_{i,t-2} + \alpha_{it} \beta_1 + \mu_i + \varepsilon_{it}$$

Where  $Y_{it}$  equals to infrastructure development measured through infrastructure composite index at time t in a country i.

i is the unit of observation, in this case it is the country.

t is the time period in the year

$\beta_0$  equals to the infrastructure development in the absentia of quality governance measured through government effectiveness

$\alpha y_{i,t-2}$  = The change in infrastructure due to the previous years' infrastructure status and development.

$\alpha_{it}$  = Quality governance measured in terms of government effectiveness.

$\beta_1$  = represents the Auto regressive coefficient parameter

$\mu_i$  = is the unobserved individual country fixed effect for i

$\varepsilon_{it}$  is the unobserved error term.

## Presentation and Discussion of results

### Linear regression

LNINFRA	Coef.	St.Err.	t-value	p-value	[95% Conf Interval]	Sig
LNGE	.483	.039	12.27	0	.405	.56 ***
Constant	.609	.197	3.10	.002	.223	.996 ***
Mean dependent var		2.991	SD dependent var		0.817	
R-squared		0.222	Number of obs		530	
F-test		150.555	Prob > F		0.000	
Akaike crit. (AIC)		1159.303	Bayesian crit. (BIC)		1167.849	

\*\*\*  $p < .01$ , \*\*  $p < .05$ , \*  $p < .1$

### Random effects Regression results

LNINFRA	Coef.	St.Err.	t-value	p-value	[95% Conf Interval]	Sig
LNGE	.479	.039	12.19	0	.402	.556 ***
Constant	.624	.196	3.18	.001	.239	1.009 ***
Mean dependent var		2.986	SD dependent var		0.814	
Overall r-squared		0.220	Number of obs		528	
Chi-square		148.581	Prob > chi2		0.000	
R-squared within		0.188	R-squared between		0.517	

\*\*\*  $p < .01$ , \*\*  $p < .05$ , \*  $p < .1$

Fixed effects Regression results							
LNINFRA	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
LNGE	.409	.041	9.96	0	.329	.49	***
Constant	.967	.205	4.71	0	.564	1.37	***
Mean dependent var		2.986	SD dependent var			0.814	
R-squared		0.188	Number of obs			528	
F-test		99.205	Prob > F			0.000	
Akaike crit. (AIC)		1052.293	Bayesian crit. (BIC)			1060.831	

\*\*\*  $p < .01$ , \*\*  $p < .05$ , \*  $p < .1$

## Presentation and analysis of data

### Results interpretation

**The paper applied three models that is linear regression, random effects and fixed effects model.**

This linear regression analysis aims to predict the natural logarithm of infrastructure composite index (LNINFRA) based on the natural logarithm of government effectiveness (LNGE).

Random effects model: In a random effects model, individual-specific effects are treated as random variables. These effects are assumed to be uncorrelated with the independent variables. Random effects models estimate both the individual-specific effects and the coefficients of the independent variables simultaneously, using techniques like Generalized Least Squares (GLS). Random effects models are appropriate when the individual-specific effects are uncorrelated with the independent variables.

Fixed effects model: In a fixed effects model, individual-specific effects are included in the estimation process as fixed parameters. These effects are typically dummy variables representing each individual or entity in the panel. Fixed effects capture time-invariant heterogeneity across individuals. The estimation of fixed effects typically involves subtracting the individual means from each observation, effectively differencing out the individual-specific effects. Fixed effects models are appropriate when there are unobserved individual-specific characteristics that are correlated with the independent variables.

## ANALYSIS DISCUSSION

The analysis is based on 530 observations for the linear regression and the random effects model while it had 528 for the fixed effects model.

The LNGE coefficient in the three models is 0.483, 0.483 and 0.409 for linear regression, random effects and fixed effects respectively. This indicates that for a one-unit increase in quality governance measured through government effectiveness (LNGE), the infrastructure development measured through infrastructure composite index (LNINFRA) is expected to increase by 0.483 and 0.409 units respectively holding all other variables constant.

The standard error is 0.197, 0.0393 and 0.0411 for the linear regression, random effects and fixed effects model. The coefficient is significant at the 1% level (\*\*\*), indicating a strong relationship between LNGE and LNINFRA.

The constant coefficient: The constant term is 0.609, 0.609, 0.967, representing the expected value of infrastructure development (LNINFRA) when quality governance (LNGE) is zero in the three models respectively.

R-squared: The coefficient of determination (R-squared) is 0.222, 0.222, 0.188 indicating that approximately 22.2% and 18.8 % of the variance in LNINFRA is explained by the independent variable (LNGE) in the model.

The significance levels (\*\*\*, \*\*, \*) indicate the probability of observing the estimated coefficient given that the true coefficient is zero. In this case, both the coefficient for LNGE and the constant term are highly significant, suggesting that they are unlikely to be zero in the population.

The model used for linear regression was proved to be fit based on the F- test, which was further supported by the Bayesian information criteria. F-test: The F-test tests the overall significance of the model. Here, F-value is 150.555, with a very low p-value ( $p = 0.000$ ), indicating that the model is statistically significant. Bayesian Information Criterion (BIC): BIC is 1167.849, also used for model selection with lower values indicating better fit. Overall, the results suggest that LNGE is a statistically significant predictor of LNINFRA, even after accounting for fixed effects. The model explains a modest proportion of the variance in LNINFRA, as indicated by the R-squared value of 18.8%.

The visual analysis revealed that it was only 6 out of the 53 countries that managed to secure a positive measure from the standard normal distribution curve. Only 10.8% of the 53 African countries had a positive governance measure. The countries that had a positive and weak quality governance measure that is below 0.5 included South Africa, Rwanda, Namibia, Carbo Verde, and Botswana. It is only Seychelles and Mauritius that were consistently above 0.5 for the normal distribution but when normalized out of 100%, the countries that were above 50% are only 2.

It is an average of 14 African countries annually, representing 26% that issued Portfolio investment bonds for the period between 2013 to 2022. This can be attributed to the generally weak governance in Africa. Only 7 countries out of the 53 African countries have a positive government effectiveness measure and that is Carbo Verde, Botswana, Rwanda, Namibia, Mauritius, Seychelles and South Africa. The remaining 46 are on the negative side of the normal distribution curve throughout the 9 years under review.

The weak governance implies high corruption perception, high losses resulting from inefficiency, lack of commitment to frameworks set, a lot of political influence that certain remedial steps are halted that benefit the public at large, a low perception about the quality of public services, the low quality of the civil service and a low degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.

The stated hypothesis is accepted, as there is a positive relationship between infrastructure development and quality governance as highlighted by previous scholars.

### **Conclusion and recommendations.**

The role of strong governance that is above 0.5, is very instrumental for the development of infrastructure in Africa.

There is need for the rest of the African countries to benchmark with Mauritius and Seychelles that stood out through all the years with a strong positive yield towards governance effectiveness. It is also important to draw lessons from countries that have improved from a negative to a weak positive like Botswana, Mozambique, Namibia, Rwanda and Tunisia.

There is need to arise against corruption as Africans, whereas it fronts short term gains, the long-term side effects are heavy, relying on the principles of prevention, through awareness campaigns and committing to zero tolerance for corruption will not only support our governance levels to go up, but the infrastructure, the public and civil servants' services, will be enhanced as well.

There is need for early detection and recovery of proceeds from the corrupt entities or individuals, this will do a lot in preventing corruption and lifting the bar of African countries' governance high. Lastly, we

can explore the ubuntu theory, as Africans, acknowledging that we need to go beyond individualism and consider the generations after us. Knowing that we are, because other people were.

Policy makers need to benchmark with Mauritius, Seychelles, Botswana, Mozambique, Namibia, Rwanda and Tunisia in order to improve their quality governance and more specifically government effectiveness which has showed a positive impact on infrastructure development of .483 per unit increase in government effectiveness.

In conclusion, even without adding more finances, if the general quality governance of African countries improved, the infrastructure status and development would improve by 48.3 % holding other factors constant.

### **Areas for Future research.**

This study limited itself to African countries issuing Portfolio investment bonds and the composite infrastructure index. This was the best suited study at the time due to the researcher's data accessibility, knowledge and time. Other studies can extend to other continents, or specific infrastructure types like the energy sector.

### **Funding**

The research is financed by the Government of Uganda through Makerere University.

### **Institutional Review Board Statement.**

This study does not involve human beings or animals, thus no need for an institutional review board statement.

### **Informed Consent Statement**

The study does not involve human resource participation, hence no need for informed consent.

### **Data availability statement.**

The data used are available from the corresponding author upon request.

### **Conflicts of interest**

The authors declare no conflict of interest.

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