Politická ekonomie 2025

Volume 73, Issue 1
https://doi.org/10.18267/j.polek.1450
Open Access

PRAGUE UNIVERSITY OF ECONOMICS AND BUSINESS

Effect of Resource Rent on Infrastructural Development in Africa: Moderating Role of Governance Institutions

Jonathan E. Ogbuabor, Ekene ThankGod Emeka, Anthony Orji

Jonathan E. Ogbuabor (email: jonathan.ogbuabor@unn.edu.ng), University of Nigeria, Department of Economics, Nsukka, Nigeria

Ekene ThankGod Emeka (*corresponding author*, email: ekenekeynes101@gmail.com), University of Nigeria, Department of Economics, Nsukka, Nigeria

Anthony Orji (email: anthony.orji@unn.edu.ng), University of Nigeria, Department of Economics, Nsukka, Nigeria

Abstract

This study investigates the effect of resource rent on infrastructural development in Africa and how governance institutions moderate this relationship. The pooled OLS and the dynamic system GMM estimation techniques are adopted with a panel of 52 African economies over the period 2005–2022. We find that resource rent significantly hampers infrastructural development in Africa, thereby reflecting the prevalence of the "natural resource curse" phenomenon. We also find that the unconditional effects of governance institutions are mainly negative and significant, which aptly reflects the presence of weak institutions in Africa. Interestingly, our results also show that low institutional quality in the region intensifies the adverse effect of resource rent, while a higher level of institutional quality in the region moderates the adverse effect of resource rent. These findings remain consistent with components of resource rent, such as forest rent, oil rent and coal rent. Consequently, we emphasize the policy implications of these findings, which mainly underscore the need for policymakers and leaders in Africa to embrace institutional reforms that will ensure transparent resource management, increased infrastructural investment and sustainable infrastructural development on the continent.

Keywords: Resource rent, infrastructural development, governance institutions, system GMM, Africa

JEL Classification: M13, Q30, H54, C23, N20

Citation: Ogbuabor, J. E., Emeka, E. T., Orji, A.: Effect of Resource Rent on Infrastructural Development in Africa: Moderating Role of Governance Institutions. *Politická ekonomie*, 2025, 73 (1), 31–57, https://doi.org/10.18267/j.polek.1450

1. Introduction

Infrastructural development is an emblematic representation of contemporary progress and an essential aspect of international relations (Emeka, Ogbuabor, Nwosu, 2024; Abdullahi and Sieng, 2023; van Noort, 2022; AfDB, 2021). Consequently, policymakers and governments in diverse economies have continued to develop policies aimed at augmenting investments in fundamental infrastructure as a means of bolstering long-term and sustainable economic performance. In Africa, the advancement of infrastructural development remains an essential aspect of the region's foreign and domestic policies. This commitment is manifest in Africa's establishment of various infrastructure financing entities within the region, such as the African Finance Corporation (AFC), as well as its active interactions with numerous global infrastructure development organizations, such as the International Development Association (IDA) and the International Bank for Reconstruction and Development (IBRD),[1] to name a few. Furthermore, it is worth noting that in the last two decades, there has been a notable increase in infrastructure development initiatives in Africa, driven by emerging economic powers, most notably China and Russia. These emerging sources of infrastructure financing, particularly those extended by China, have boosted infrastructure in Africa.

As evident in existing studies (see, for example, Emeka, Asongu, Ngoungou, 2024; Mabey *et al*., 2020; Maconachie and Conteh, 2020), an economy has a range of strategies at its disposal when striving for sustainable economic development. Among these strategies is the efficient management and utilization of its abundant resources. This choice is particularly pertinent for the African continent, given its wealth of natural resources, encompassing extensive reserves of bauxite, iron and phosphates, as well as plentiful resources such as oil, gold and diamonds (Pickering, 2021; Ahmed *et al*., 2021; Musibau *et al*., 2022). As noted by the African Development Bank (AfDB, 2022), the export of these resource endowments has collectively led to a noteworthy average real GDP growth rate of 3.5% for the region in 2021, signifying a rapid economic recovery in the aftermath of the COVID-19 pandemic. Statistical evidence from the OPEC Annual Statistical Bulletin (OPEC, 2021) has further revealed that economies such as Nigeria, Gabon, Algeria and Egypt have benefited from crude oil exports, which account for 90% of their foreign exchange earnings and 80% of their budgetary financing. According to Gelb *et al*. (1988), resource endowment is expected to address the conventional economic development constraints of domestic saving, fiscal revenue and foreign exchange, considering its associated benefits. However, despite Africa's resource endowment, the region still lags in well-developed infrastructure compared to other regions, posing a major challenge to its economic performance. Thus, a pertinent question arises: How have Africa's resource endowments contributed to the region's infrastructural

1 These international organizations have frequently aided the region in the form of loans, with a focus on financing various infrastructure projects within the region (WB, 2022).

development? Furthermore, considering the critical role of infrastructure in enhancing the quality of life for individuals and fostering sustainable and inclusive economic progress, it becomes crucial to investigate the factors that influence infrastructural development, especially in Africa.

Nevertheless, resource rent is a crucial aspect of natural resource economics and management; there are diverse views on its impact. For example, some previous studies have regarded natural resources and the resulting revenue as a means to address significant socio-economic challenges, including poverty, healthcare, education, unemployment and infrastructure (as evidenced in Zalle, 2019; Havranek *et al*., 2016). However, in stark contrast, other studies have described the possession of natural resources as a curse[2], as it breeds adverse consequences such as corruption, economic deterioration and autocratic governance (Cheng *et al*., 2022; Majumder *et al*., 2020). However, resource rent can fund infrastructural development and stimulate innovation. Yet, heavy reliance on resource rent can hinder diversification and pose challenges for overall growth and development. This underlines the need for effective management to foster infrastructural development and sustainable growth. We find an inverse relationship between resource rent and infrastructural development, suggesting that resource-dependent economies may face challenges in allocating resources towards infrastructure due to the resource curse phenomenon. It underscores the need for strategic policy interventions to promote economic diversification, good governance, transparency and effective resource revenue management to ensure sustained infrastructure development and overall economic growth.

In this study, we investigate how governance institutions moderate the relationship between natural resource rent and infrastructure development. This study adds valuable insights to the current understanding of the relationship between natural resources and infrastructure development. For instance, it addresses some limitations found in prior research that has utilized econometric approaches, as noted in studies by Torvik (2009), Mavrotas *et al*. (2011) and Huang *et al*. (2021). In this study, we employ a methodology that allows us to acknowledge that the connection between natural resources and infrastructure development is not a simple linear relationship. Instead, it is contingent on the distribution of the transitional variable, which is governance institutions in the context of this study. Furthermore, in comparison to the existing studies that have extensively failed to examine the moderating influence of governance institutions or outright ignored the role of governance institutions as an important mechanism (Huang *et al*., 2021; Ben-Salha *et al*., 2021), this study examines the effect of natural resources on infrastructural development by also controlling for the level

2 Auty (1994) introduced the concept of the “natural resource curse” to describe the observed adverse correlation between reliance on natural resources and economic deterioration.

of governance institutions[3] in the sampled economies. Vu (2022) emphasized that high-quality institutions are crucial for promoting economic activities through innovation, human capital development and productive capability acquisition. This highlights the dependence of infrastructural development in Africa on the presence of such institutions, emphasizing the need for the active involvement of governance institutions, as no economy operates in isolation.

Against the foregoing background, the broad objective of this study is to examine the effect of resource rent on infrastructural development in Africa. However, the specific objectives are to (i) to ascertain the effect of natural resource rent on infrastructural development in Africa; (ii) investigate the effects of the components of resource rent on infrastructural development in Africa; and (iii) ascertain whether governance institutions in Africa are significantly moderating the effect of resource rent on infrastructural development on the continent. To achieve these objectives, we adopt the pooled ordinary least squares (OLS) estimator and the dynamic panel system generalized method of moments (system GMM) modelling framework. The system GMM estimator enables us to avoid the potential problem of endogeneity that usually arises with the OLS estimator. The study employs data from 2005–2022 for 52 African countries. The selection of countries and the timeframe is driven solely by data availability, particularly regarding the infrastructural development variable, which serves as the outcome variable.

2. Overview of Empirical Literature

The review of literature in this section is presented in three folds, namely, resource rent-infrastructure nexus, resource rent-governance nexus and infrastructure-governance nexus. In examining the relationship between resource rent and infrastructure, Munemo (2022) noted that countries with resource rents exceeding 30% of GDP experience reduced productive activity, indicating the detrimental effects of high resource rents on economic performance due to increased rent-seeking behaviour. Asongu and Diop (2022) emphasized that the "natural resource curse" in developing nations attributes to low governance and infrastructure development. Alsagr and Ozturk (2024) advocated prioritizing institutional quality over resource rent to drive green investment. Dwumfour and Ntow-Gyamfi (2018) utilized the system GMM estimation procedure to analyse resource rent dynamics in Sub-Saharan Africa, revealing adverse developmental impacts. Ji *et al*. (2023) and Z. Khan *et al*. (2020), using FMOLS, found a negative relationship between resource rent and infrastructural development in China, corroborated by Ajide (2022) in African economies.

3 To ensure that policies are targeted at specific governance indicators, we employ the individual components of governance indicators in separate estimations of our model. We also compute an aggregate governance index through principal component analysis (PCA) so that the aggregate effect of governance institutions can be captured.

Nchofoung *et al*. (2021) highlighted a positive impact of natural resource rents on inclusive development in developing economies, contingent on governance quality. In contrast, Huang and Guo (2023) uncovered a negative impact of natural resources on infrastructure quality, including roads, ports, railroads, airports and electricity supply. This finding aligns with studies indicating that nations with higher corruption levels tend to have inferior infrastructure (Gillanders, 2014; Chen *et al*., 2022). Wu *et al*. (2018) argued for the pivotal role of natural resources in driving economic growth and infrastructure development, drawing from the Chinese experience. Redmond and Nasir (2020) identified a significantly positive impact of natural resource abundance on economic growth and a minor negative effect on human development. Similarly, Ofori and Grechyna (2021) found a significant positive association between forest rent and economic performance.

In analysing the resource rent-governance nexus, multiple studies have underscored the pivotal role of institutions in shaping the impact of natural resource rents on economic development (Bilal *et al*., 2022; M. At. Khan and Kishwar, 2020; M. At. Khan *et al*., 2020; Abdulahi *et al*., 2019; Bennett *et al*., 2017; Sarmidi *et al*., 2014; Mavrotas *et al*., 2011). Strong institutional quality is essential for socio-economic progress, particularly in contexts plagued by corruption and limited freedom of speech, where weak frameworks hinder economic advancement (Arvanitis and Weigert, 2017). While efficient institutions drive economic activities in developed nations, their effects on emerging economies vary, sometimes facilitating progress and sometimes impeding it. Batool *et al*. (2022) stressed the critical role of institutions in curbing the negative effects of resource rents by preventing rent-seeking behaviour, reducing the risk of conflicts and optimizing resource allocation. Some studies have suggested that enhanced institutional quality can mitigate the adverse impact of natural resources on infrastructure and economic performance (Sarmidi *et al*., 2014; Mavrotas *et al*., 2011). More specifically, Shi *et al*. (2023) confirmed a positive link between mineral rents, GDP growth and governance levels, assessed through corruption control measures. These studies often examine the Dutch disease hypothesis through interactive terms between resource abundance and institutional quality but may overlook non-linear relationships and fail to consider institutional quality as a moderating variable.

Previous research highlights the importance of governance quality and infrastructure (Ekeocha *et al*, 2022; AfDB, 2022). However, the relationship between institutions and infrastructure remains uncertain. Timilsina *et al*. (2020) found no correlation between infrastructure investment and governance quality in developed economies, with conflicting views on its impact on economic growth. Some studies have suggested a strong link between infrastructure development and economic growth (Akims and Danyil, 2018; Z. Khan *et al*., 2020). Funlayo *et al*. (2022) identified a positive association between quality institutions and infrastructural development. Ojonta and Ogbuabor (2024) found that governance institutions promote infrastructural development in Africa, particularly through government effectiveness and rule-of-law measures. Zergawu *et al*. (2020) noted a significant positive impact on economic growth from the interaction between infrastructure capital and institutional quality. Adam (2020) demonstrated relationships between e-government development, ICT development and institutional quality, as well as between ICT development and corruption. Appiah *et al*. (2022) emphasized the importance of governance and institutional quality in enhancing infrastructural development in Sub-Saharan Africa. Al-Zyoud *et al*. (2021) highlighted the positive influence of infrastructure and institutional quality on human capital development in the SAARC region. Furthermore, Fagbemi and Omowumi (2020) reported minimal impact of natural resource rents on governance indicators in Nigeria, suggesting limited progress in good governance development. In summary, the erosion of institutional quality caused by natural resources ultimately leads to a deterioration in infrastructure quality.

In summary, our review of existing empirical literature reveals a scarcity of studies exploring the relationship between resource rent and infrastructural development, especially in Africa. Moreover, most of these studies have focused on specific countries and neglected to analyse the dynamics at the regional level. Notably, none of the existing studies has considered the moderating influence of governance institutions on the relationship between resource rent and infrastructural development in Africa. Building on the insights of Badeep *et al*. (2017), it is imperative for studies on the resource curse to move beyond estimating the direct link between natural resources and economic performance and instead investigate transitional mechanisms. Unlike previous studies that have often overlooked the role of governance institutions (Huang *et al*., 2021; Ben-Salha *et al*., 2021), this study incorporates governance institutions as a crucial factor in examining the impact of natural resources on infrastructural development in sampled African economies. Therefore, this study not only contributes to expanding the literature but also addresses gaps identified in previous research.

To test the assertions of this study, the following hypotheses were formulated.

Hypothesis 1: *Natural resource rent does not significantly influence infrastructural development in Africa.*

Hypothesis 2: *Governance institutions in Africa do not significantly moderate the effect of resource rent on infrastructural development in Africa.*

While Hypothesis 1 posits that there are no considerable unconditional effects stemming from resource rent on infrastructural development in Africa, Hypothesis 2 suggests that governance institutions in Africa are not effectively moderating the effect of resource rent on infrastructure. Clearly, by reinvesting revenues from natural resources in infrastructure in sectors such as education and healthcare, Africa will be promoting human capital development, which is a critical factor in the economic growth process as posited by the endogenous and neoclassical growth models. Hence, the two hypotheses stated here are also rooted in economic theory.

3. Data and Method

3.1 Data

This study examines the effect of resource rent[4] on infrastructural development[5] in Africa and how governance institutions on the continent are moderating these relationships. The study uses a sample of 52 African countries over the period 2005–2022. Table A1 (in the Appendixes) shows a list of the countries adopted in the study. In this study, the outcome variable is infrastructural development. The independent variables are resource rent (measured as total natural resource rents as percentage of GDP), trade openness (measured as trade in percentage of GDP), foreign direct investment (*FDI*) inflow (measured as percentage of GDP), human capital development (measured as a standardized index reflecting health quality, knowledge and a satisfactory standard of living), real GDP growth[6] (which we use as a measure of economic growth) and institutional quality (a composite measure obtained from principal component analysis in order to account for the six World Governance Indicators simultaneously). All the variables in this study are logged prior to the estimation of the underlying models, except the institutional quality variable. The data for these variables were sourced from the African Development Bank's Africa Infrastructure Development Index, the World Bank's World Development Indicators and World Governance Indicators (WB, 2023a, b) and the United Nations Development Programme Index (UNDP, 2023). Some of the empirical studies that support the inclusion of these variables in this study are Ekeocha *et al*. (2021), Ogbuabor, Emeka, Nwosu (2023) and Ogbuabor, Emeka, *et al*. (2023). Table A2 (in the Appendixes) shows the summary statistics of all the variables, while Table A3 reports the correlation matrix.

3.2 Descriptive statistics and correlation matrix of variables

The summary statistics in Table A2 encompass key metrics such as the number of observations, mean, standard deviation, minimum and maximum values. Infrastructure has a mean value

4 Components of natural resource rent include oil rent (measured as net crude oil production after accounting for production costs at global price levels), coal rent (measured as net coal production after deducting production costs at global price levels) and forest rent (measured as roundwood harvest multiplied by the product of regional prices and a regional rental rate). This study uses these three components of natural resource rent as well as the aggregate measure in the analysis.

5 Infrastructure development is measured with the aggregate index and its four components, namely: transport infrastructure, electricity infrastructure, information and communication technology (ICT) infrastructure and water and sanitation infrastructure (WSS).

6 To obtain the real GDP growth, which we use as a measure for economic growth, we log the real GDP variable. This is consistent with studies such as Ogbonna *et al.* (2021) and Ogbuabor *et al.* (2019).

of 23.4454, while its minimum and maximum values stand at 1.1230 and 98.8811, respectively. This low mean value of infrastructure suggests inadequate access to essential services and resources, which hinders economic growth, quality of life, educational opportunities and investment prospects while potentially exacerbating rural-urban disparities in the region. Natural resource rent recorded mean, minimum and maximum values of 11.6592, 0.0023 and 66.0598, respectively. However, each individual governance institutional quality indicator recorded a negative mean value, which aptly reflects the weak institutions that characterize most African economies. As expected, all the variables exhibited some variations, as shown by the standard deviations. The correlation matrix of the variables is presented in Table A3, showing that the governance and institutional variables are highly correlated. According to Gujarati and Porter (2003), a problem of collinearity exists when the values are up to or exceed ±0.80. Thus, to avoid the problem of collinearity, we include these institutional variables in separate regressions. We follow recent literature in this regard (*e.g.*, Ekeocha *et al.*, 2023; Ogbonna *et al.*, 2021; 2022). Similarly, the aggregate infrastructure index is also highly correlated with its components. Hence, they are also included in separate regressions of the underlying model. We also treat the aggregate natural resource rent and its components in the same way. Nonetheless, we verify the presumption of a lack of collinearity in our models using the variance inflation factor (VIF). The VIF results show that collinearity is not a problem in our models since the general guideline suggests that in order to demonstrate uncorrelated regressors, the tolerance value should be higher than 2 but less than 5.

3.3 Model specification

Recall that the general objective of this study is to ascertain the effect of natural resource rent on infrastructural development in Africa and how governance institutions in Africa are moderating this effect. The functional form of these relationships is expressed as shown in Equation (1).

$$LINF = f\left(LNRR,\ LFDI,\ LTOP,\ LHCAP,\ LRGDP,\ INSTQ,\ INSTQ \times LNRR\right) \tag{1}$$

where the variables are as earlier defined in Section 3.1 and Table A2. However, to estimate Equation (1) using the pooled OLS technique, we express it as an econometric model of the form:

$$\begin{aligned} LINF_{i,t} &= \alpha_i + \delta_1 LNRR_{i,t} + \delta_2 LFDI_{i,t} + \delta_3 LTOP_{i,t} + \delta_4 LHCAP_{i,t} + \delta_5 LRGDP_{i,t} + \\ &+ \delta_6 INSTQ_{i,t} + \delta_7\left(INSTQ \times LNRR\right)_{i,t} + \varepsilon_{i,t} \end{aligned} \tag{2}$$

From the above equations, $\varepsilon_{i,t}$ is the error term; all the variables remain as earlier defined. In estimating the model in Equation (2), we include the four components of natural resource rent and the six components of institutional quality variables in separate estimations in order to avoid the problem of collinearity. However, Equation (2) above fails to deal with the problem of unobserved heterogeneity,[7] estimating time-invariant factors, reverse causality and measurement error (Kamguia *et al*., 2023). Given these shortcomings of the pooled OLS, we proceed to adopt the system GMM technique, which provides the advantage of addressing endogeneity in the regressors by employing internal instruments. Furthermore, the system GMM effectively addresses endogeneity arising from reverse causality and corrects for unobserved country-specific heterogeneity, a common phenomenon in African economies.

Accordingly, we formulate the dynamic model following Ogbonna *et al*. (2022) and Ekeocha, *et al*. (2023) as follows:

$$LINF_{i,t} = \alpha_i + \psi LINF_{i,t-1} + \delta_1 LNRR_{i,t} + \delta_2 LFDI_{i,t} + \delta_3 LTOP_{i,t} + \delta_4 LHCAP_{i,t} + \\ + \delta_5 LRGDP_{i,t} + \delta_6 INSTQ_{i,t} + \delta_7 \left(INSTQ \times LNRR\right)_{i,t} + \pi_{i,t} \tag{3}$$

where $\pi_{i,t} = \mu_i + \varepsilon_{i,t}$; so that μ_i is the country specific effect and the error term, $\varepsilon_{i,t} \sim iidN\,(0,\ \sigma_\varepsilon^2)$, shows no serial correlation, $E[\varepsilon'_{i,t}, \varepsilon_{i,s}] = 0$. The countries are the cross-sectional units so that $i = 1, 2, \ldots, 52$; while the time period $t = 1, 2, \ldots, 18$. Again, we include the four components of natural resource rent and the six components of institutional quality variables in separate estimations in order to avoid the problem of collinearity. It is important to note that the estimates are also subjected to the Hansen test of over-identifying restrictions, as suggested by Arellano and Bond (1991) and Hansen (1982), as well as the Arellano–Bond second-order (AR2) test for serial correlation.

3.4 Identification and exclusion restrictions

In the system GMM framework, we focus on identification, simultaneity and exclusion restrictions. Identification involves carefully selecting dependent, endogenous and strictly exogenous variables (Tchamyou *et al*., 2019). Following insights from Asongu and Acha-Anyi (2019)

7 The literature typically tackles endogeneity using instrumental variable techniques or the generalized method of moments (GMM) approach. In this study, we opt for the GMM approach over the instrumental variable two-stage least squares (2SLS) method. This decision is based on recognizing that the instrumental variable approach, although effective in addressing reverse causality (Kamguia *et al.,* 2023), faces challenges in identifying purely exogenous external instruments and may overlook potential endogeneity in other explanatory variables.

and Asongu and Odhiambo (2020), we categorize Equation (3) variables as predetermined and endogenous, using time-invariant indicators as strictly exogenous. This aligns with Roodman's (2009) view that such variables are less likely to become endogenous after differencing. For exclusion restrictions, crucial to identification, we recognize the influence of time-invariant variables on infrastructural development through their presumed impact on endogenous variables. We evaluate the statistical validity with the difference-in-Hansen test (DHT), following the principle of Asongu *et al*. (2017) that the exclusion restriction hypothesis remains valid if the null hypothesis of the DHT is not rejected. Our validation adheres to this principle at the conventional 5% significance level.

4. Empirical Results

This study analysed the impact of resource rent on infrastructure development in Africa while also considering how governance institutions moderate this impact. We utilized the dynamic panel data model in Equation (3), employing the system GMM regression approach for estimation, yielding the baseline results reported in Table 1. The system GMM estimator addressed endogeneity issues typical of pooled OLS estimation. Robustness checks on baseline estimates were conducted using pooled OLS estimations of Equation (2), reported in Table 2. Each table includes seven panels to accommodate six World Governance Indicators and an aggregate indicator from principal component analysis to mitigate collinearity. Aggregate measures of natural resource rent and infrastructure development index were utilized. Additionally, we explored the effects of resource rent components (oil, coal and forest rents) on infrastructure development through separate estimations, although detailed results for component-based estimations are not presented here due to space constraints. They align with baseline estimations and are available upon request. Before proceeding with the estimation of the system GMM models, we conducted a cross-sectional dependence test as recommended by Pesaran (2021) to ensure the accuracy of our estimates. This test is particularly important when the number of entities (N) exceeds the time period (T), as highlighted by Dong *et al*. (2018). Our panel exhibited no cross-sectional dependence according to the results. Although not included here for conciseness, the table containing the cross-sectional dependence test results is available upon request. It is worth mentioning that if cross-sectional dependence had been detected, our system GMM framework would have addressed it by incorporating time effects, as suggested by Tchamyou *et al*. (2019) and Asongu and Nting (2021).

The results in Tables 1 and 2 indicate that resource rent primarily exerts a negative and statistically noteworthy influence on infrastructure development in Africa. Indeed, this adverse impact remained consistent in our results, even when the components of resource rent were used in the model.[8] The results in Table 1 also indicate that foreign direct investment (FDI) inflow positively and significantly affects infrastructural development in Africa, while the role of trade openness (TOP) is mainly insignificant at the conventional 5% level. The finding that FDI inflow positively influences infrastructural development underscores the compelling role of international financial flows in invigorating infrastructural development across Africa. This finding aligns with recent scholarly investigations (*e.g.*, Ogbuabor, Emeka, Nwosu, 2023; Banday *et al*., 2021; Ogbonna *et al*., 2022; Ogbuabor *et al*., 2020) that collectively underscore the pivotal role of foreign direct investment as a substantial catalyst for economic endeavours. Thus, African economies should prioritize strategies to attract and retain foreign direct investments as a channel for boosting infrastructural development and overall economic progress in the region. Indeed, the positive link between FDI inflow and infrastructural development in this study also shows that FDI inflow contributes to various facets of economic development. It aids in capital formation, technology transfer, market expansion, skill and knowledge enhancement, competitive innovation, resource availability, economic diversification, knowledge spillovers and benefits from supportive policies. These factors collectively contribute to the development of robust infrastructure and foster overall economic growth. It is also noteworthy that this finding is in line with the conclusions reached by Njangang *et al*. (2021), Mlambo and Kapingura (2020) and Saadi (2020), all of whom have similarly established that FDI inflow plays a significant role in driving economic activities.

Remarkably, the outcomes in Tables 1 and 2 reveal that human capital development positively and significantly affects infrastructural development in Africa. This outcome aligns with economic theories such as endogenous growth and the neoclassical growth model, emphasizing the vital roles of human and physical capital in driving economic growth. It is also consistent with prior studies, such as Ogbuabor *et al*. (2019, 2020), highlighting the pivotal role of human capital in economic growth. The notable positive effect of human capital development on infrastructural development implies that investments in education and skills can create a more innovative, efficient and productive workforce. Therefore, to make use of these benefits, policymakers should focus on investing in education, training and lifelong learning, ensure that educational curricula meet labour market needs and encourage collaboration between the public and private sectors while closely monitoring the effectiveness of these policies. Tables 1 and 2 additionally indicate a predominantly positive and significant relationship between economic growth and infrastructural development. This observation finds support in recent studies by Irshad and Ghafoor (2023),

8 The negative correlation that we observe between forest rent and infrastructural development holds significant economic implications, emphasizing the importance of policymakers and society prioritizing biodiversity preservation. Recognizing the substantial social and private benefits of forest resources, stringent policies are needed to govern their use, including controlling deforestation and promoting green financing and initiatives. Innovative management of forest resources offers a sustainable solution to Africa's resource-related challenges.

Ji *et al*. (2023) and Rehman *et al*. (2023), who have similarly affirmed that heightened economic growth tends to correlate with increased infrastructural development. Therefore, the positive connection between economic growth and infrastructural development, as indicated in this study, signifies that growing African economies will lead to enhanced infrastructural development. This is not particularly surprising because economic progress is usually accompanied by improved productivity, increased job creation and overall expansion in economic activities and regional development.

Table 1 indicates a predominantly negative and significant impact of institutional quality on Africa's infrastructural development. This contrasts with studies by Vu (2022), M. As. Khan *et al*. (2019) and Ogbuabor *et al*. (2019), which emphasize positive effects on economic sophistication and growth in the West African sub-region. The negative effect suggests weak governance institutions in Africa, highlighting the need for robust institutions with effective governance, property right protection, reduced corruption and efficient regulations to drive infrastructural development. Policymakers should prioritize governance reform, strengthen legal frameworks, implement anti-corruption measures, invest in capacity building, enhance investor protection, uphold the rule of law and establish institutional monitoring mechanisms for overall economic progress.

However, this result leads us to the crucial gap that this study aims to address in the existing literature. Specifically, we investigated whether governance institutions in Africa are moderating the adverse effect of resource rent on infrastructural development in Africa. To do this, we used the coefficients obtained from interacting resource rent with institutional quality to compute the net effect (and, where necessary, the threshold effect) of resource rent. Hence, following Ogbonna *et al*. (2022) and Ogbuabor, Emeka, *et al*. (2023), we computed the net effect of resource rent on infrastructural development using a partial derivative of Equation (3) or Equation (2) with respect to resource rent (*NRR*) as follows:

$$\frac{\partial INF_{it}}{\partial NRR_{it}} = \delta_1 + \delta_7 INST_{i,t} \tag{4}$$

where δ_1 captures the unconditional effect of resource rent and δ_7 captures the marginal effect of resource rent obtained from the interaction term.[9] The net effects were computed for the minimum, average and maximum values of institutional quality taken from Table A2. These net effects and their corresponding threshold effects are reported in Tables 1 and 2.

9 The detailed procedure for computing the net effects (and threshold effects, where necessary) is well documented in the extant literature, such as Ogbonna *et al.* (2022), Ogbuabor, Emeka, Nwosu (2023) and Ogbonna *et al.* (2021). To conserve space, we do not repeat these details here.

At the minimum values of institutional quality, the results in Tables 1 and 2 show a predominantly negative net effect, which also results in a negative synergy between the net effect and the unconditional effect of resource rent. This finding shows that weak or low-quality governance institutions in Africa intensify the adverse effect of resource rent rather than moderate or diminish it. In fact, this finding shows the stark reality of the existence of the "natural resource curse" phenomenon in Africa. However, as we move towards the average and maximum levels of institutional quality, the net effect of resource rent becomes predominantly positive in Table 1, showing that higher levels of institutional quality in Africa moderate the adverse effect of resource rent on infrastructural development.[10] We find that institutional quality in Africa mitigates the negative impact of resource rent on infrastructural development, which is consistent with findings by Ogbonna *et al*. (2019; 2021). The threshold, where institutional quality begins moderating this effect, is identified as 25.13%, as shown in Panel 1 of Table 1. Notably, this threshold is generally lower than the average institutional quality level across the panels in Table 1, indicating that the continent's average institutional quality mitigates the adverse impact of resource rent on infrastructural development. Thus, the hypothesis that governance institutions in Africa are not significantly moderating the effect of resource rent on infrastructural development cannot be accepted.

The results remain consistent when components replace total natural resource rent in the models, with minor variations observed. For example, when forest rent replaces aggregate natural resource rent, the positive and significant impact of trade openness on infrastructural development persists, contrary to the muted effect found in the baseline analysis. Additionally, the unconditional effects of institutional quality indicators remain consistently subdued. In the model incorporating oil rent, exceptions include a mainly negative and significant role of FDI inflow, a mainly positive and significant role of trade openness and mainly positive and significant effects of institutional quality indicators. In the model with coal rent, a minor exception is noted: the effect of FDI inflow is negative and muted.

The diagnostic assessments validate the lack of serial correlation in all the models, as indicated by Arellano-Bond tests for AR(2). Hansen (1982) tests demonstrate that the instruments utilized meet the exogeneity condition, with no rejection of the hypothesis of jointly valid instruments across all cases, suggesting valid over-identifying restrictions. Additionally, exclusion restrictions are confirmed in all the models based on the difference-in-Hansen test at the standard 5% significance level.

10 The results of the pooled OLS regressions in Table 2 indicate that the negative net effects observed at the minimum level of institutional quality persist at the average and maximum levels of institutional quality. Hence, following the superiority of the system GMM estimator used in Table 1 over the pooled OLS estimator in Table 2 as earlier explained in Section 3, this study stresses the findings in Table 1.

Table 1: System GMM estimation results using natural resource rent (dependent variable is infrastructural development)

	Panel 1	Panel 2	Panel 3	Panel 4	Panel 5	Panel 6	Panel 7
One lag of infrastructure (L.INFR)	0.0284*** (0.000)	0.0280*** (0.000)	0.0289*** (0.000)	0.0282*** (0.000)	0.0288*** (0.000)	0.0281*** (0.000)	0.0283*** (0.000)
Resource rent (*NRR*)	−0.0194*** (0.031)	−0.0185*** (0.049)	−0.0190** (0.051)	−0.0151*** (0.046)	0.0036 (0.673)	−0.0282*** (0.002)	−0.0821*** (0.000)
Foreign direct investment (*FDI*)	0.0057*** (0.000)	0.0038*** (0.002)	0.0043*** (0.001)	0.0055*** (0.000)	0.0085*** (0.000)	0.0039*** (0.008)	0.0056*** (0.000)
Trade openness (*TOP*)	0.0002 (0.436)	−0.0001 (0.570)	0.006* (0.075)	0.0004*** (0.010)	0.0002* (0.097)	0.0008*** (0.007)	0.0002 (0.481)
Human capital (*HCAP*)	1.8555*** (0.000)	1.9428*** (0.000)	1.7759*** (0.000)	1.8355*** (0.000)	1.7643*** (0.000)	1.7139*** (0.000)	1.8649*** (0.000)
Economic growth (*LRGDP*)	0.0678*** (0.000)	0.0532*** (0.003)	0.0895*** (0.000)	0.0766*** (0.000)	0.0992*** (0.000)	0.0655*** (0.000)	0.0728*** (0.000)
GE	−0.1881*** (0.000)	–	–	–	–	–	–
GE* × *NRR	0.0772*** (0.000)	–	–	–	–	–	–
RL	–	−0.2209*** (0.000)	–	–	–	–	–
RL* × *NRR	–	0.0961*** (0.000)	–	–	–	–	–
RQ	–	–	−0.1881*** (0.000)	–	–	–	–
RQ* × *NRR	–	–	0.0729*** (0.000)	–	–	–	–
VC	–	–	–	−0.2068*** (0.000)	–	–	–
VC* × *NRR	–	–	–	0.0891*** (0.000)	–	–	–
CC	–	–	–	–	−0.3269*** (0.000)	–	–
CC* × *NRR	–	–	–	–	0.1372*** (0.000)	–	–
PS	–	–	–	–	–	−0.1986*** (0.000)	–
PS* × *NRR	–	–	–	–	–	0.1091*** (0.000)	–
PCA	–	–	–	–	–	–	−0.0596*** (0.000)

	Panel 1	Panel 2	Panel 3	Panel 4	Panel 5	Panel 6	Panel 7
PCA* × *NRR	–	–	–	–	–	–	0.0251*** (0.000)
Constant	−0.2695 (0.416)	0.0377 (0.921)	−0.7228** (0.032)	−0.4579 (0.183)	−1.0453** (0.015)	−0.0359 (0.916)	−0.2406 (0.483)
Instruments	29	29	29	29	29	29	29
AR(1) stat / *p*-value	–1.78 0.075*	–1.39 0.063*	–1.54 0.023**	–1.47 0.042**	–2.08 0.037**	–1.57 0.016**	–1.66 0.096*
AR(2) stat / *p*-value	2.22 0.205	2.42 0.103	3.57 0.321	2.60 0.311	2.62 0.222	1.70 0.189	3.26 0.211
Hansen	0.131	0.115	0.218	0.229	0.245	0.219	0.231
DHT for instruments	–	–	–	–	–	–	–
(a) Instruments in levels	–	–	–	–	–	–	–
H excluding group	0.124	0.110	0.120	0.121	0.140	0.130	0.125
Dif(null, H = exogenous)	0.551	0.799	0.194	0.932	0.358	0.179	0.502
(b) IV (years, eq(diff))	–	–	–	–	–	–	–
H excluding group	0.126	0.105	0.104	0.115	0.173	0.119	0.117
Dif(null, H = exogenous)	0.211	0.334	0.434	0.155	0.135	0.165	0.281
Net effect of resource rent at minimum INSTQ	−0.0099	−0.0064	−0.0158	−0.0102	0.0275	−0.0325	−0.0801
Threshold effect of resource rent at minimum INSTQ	Negative synergy	Negative synergy	Negative synergy	Negative synergy	−0.0262	Negative synergy	Negative synergy
Net effect of resource rent at average INSTQ	0.0078	0.0167	0.0074	0.0187	0.0555	0.0146	−0.0728
Net effect of resource rent at maximum INSTQ	0.0371	0.0492	0.0349	0.0468	0.1170	0.0526	−0.0635
Threshold effect of resource rent at average/ maximum INSTQ	0.2513	0.1925	0.2606	0.1695	−0.0262	0.2585	Negative synergy

Notes: *, ** and *** denote significance at 10%, 5% and 1% levels, respectively. In all the cases, *p*-values are in parentheses. PCA is the aggregate governance institutions indicator obtained from principal component analysis. Notice that the governance institution indicator variables are included in separate regressions to avoid the problem of collinearity.

Source: Authors' own calculations

Table 2: Pooled OLS estimation results using natural resource rent (dependent variable is infrastructural development)

	Panel 1	Panel 2	Panel 3	Panel 4	Panel 5	Panel 6	Panel 7
Resource rent (*LNRR*)	−0.0466*** (0.000)	−0.5275*** (0.000)	−0.0470*** (0.000)	−0.0589*** (0.000)	−0.0516*** (0.000)	−0.0936*** (0.000)	−0.0943*** (0.000)
Foreign direct investment (*FDI*)	−0.0824*** (0.000)	−0.0865*** (0.000)	−0.0822*** (0.000)	−0.0813*** (0.000)	−0.0801*** (0.000)	−0.0746*** (0.000)	−0.0837*** (0.000)
Trade openness (*TOP*)	0.0326 (0.390)	0.0399 (0.301)	0.0271 (0.491)	0.0313 (0.406)	0.0271 (0.479)	0.0589 (0.145)	0.0304 (0.422)
Human capital (*HCAP*)	4.8419*** (0.000)	4.9332*** (0.000)	5.0127*** (0.000)	5.2287*** (0.000)	5.0022*** (0.000)	5.1464*** (0.000)	5.0076*** (0.000)
Economic growth (*LRGDP*)	0.0218** (0.012)	0.0216** (0.015)	0.0270*** (0.002)	0.0220** (0.012)	0.0232*** (0.010)	0.0269*** (0.003)	0.0211** (0.017)
GE	0.0535 (0.207)	–	–	–	–	–	–
GE* × *NRR	0.0550*** (0.000)	–	–	–	–	–	–
RL	–	0.0077 (0.853)	–	–	–	–	–
RL* × *NRR	–	0.0610*** (0.000)	–	–	–	–	–
RQ	–	–	0.0339 (0.376)	–	–	–	–
RQ* × *NRR	–	–	0.0515*** (0.000)	–	–	–	–
VC	–	–	–	−0.0817** (0.019)	–	–	–
VC* × *NRR	–	–	–	0.0675*** (0.000)	–	–	–
CC	–	–	–	–	0.0124 (0.864)	–	–
CC* × *NRR	–	–	–	–	0.0465* (0.066)	–	–
PS	–	–	–	–		−0.1445*** (0.000)	–
PS* × *NRR	–	–	–	–	–	0.0585*** (0.000)	–

	Panel 1	Panel 2	Panel 3	Panel 4	Panel 5	Panel 6	Panel 7
PCA	–	–	–	–	–	–	−0.0011 (0.924)
PCA* × *NRR	–	–	–	–	–	–	0.0166*** (0.000)
Constant	−0.0494 (0.826)	−0.1401 (0.520)	−0.2745 (0.201)	−0.3144 (0.138)	−0.1957 (0.370)	−0.4926** (0.042)	−0.1334 (0.544)
Variance inflation factor (VIF)	1.72	1.79	1.64	1.73	1.99	2.11	1.95
No. of observations	808	808	808	808	808	808	808
R^2	0.7341	0.7337	0.7337	0.7330	0.7269	0.7258	0.7320
***F*-stat**	471.13*** (0.0000)	486.88*** (0.0000)	463.05*** (0.0000)	493.85*** (0.0000)	440.32*** (0.0000)	454.64*** (0.0000)	484.32*** (0.0000)
Net effect of resource rent at minimum INSTQ	−0.0399	−0.5198	−0.0448	−0.0552	−0.0435	−0.0959	−0.0930
Net effect of resource rent at average INSTQ	−0.0272	−0.5051	−0.0284	−0.0333	−0.0340	−0.0706	−0.0881
Net effect of resource rent at maximum INSTQ	−0.0063	−0.4845	−0.0089	−0.0120	−0.0132	−0.0503	−0.0820
Threshold effect of resource rent	Negative synergy	Negative synergy	Negative synergy	Negative synergy	Negative synergy	Negative synergy	Negative synergy

Notes: *, ** and *** denote significance at 10%, 5% and 1% levels, respectively. In all the cases, *p*-values are in parentheses. PCA is the aggregate governance institutions indicator obtained from principal component analysis. Notice that the governance institution indicator variables are included in separate regressions to avoid the problem of collinearity.

Source: Authors' own calculations

5. Concluding Remarks and Policy Recommendations

Given the dearth of empirical evidence on the effect of resource rent on infrastructural development in Africa as well as the moderating role of governance institutions in the resource rent-infrastructure relationship, this study raised three vital questions. Firstly, how is resource rent affecting infrastructural development in Africa? Secondly, how are the components of resource rent affecting infrastructural development in Africa? Thirdly, how are governance institutions moderating the effect of resource rent on infrastructural development in Africa? To answer these questions, the study used a panel of 52 African countries over the period 2005–2022. The estimation techniques adopted for this study were pooled OLS and dynamic system GMM regressions. The results indicate that resource rent significantly hampers infrastructural development in Africa, thereby reflecting the existence of the natural resource curse phenomenon in Africa. We find that the unconditional effects of governance on institutional quality indicators are mainly negative and significant. Interestingly, we also find that low-quality institutions intensify the adverse effect of resource rent, while higher levels of institutional quality in the region moderate the adverse effect of resource rent on infrastructure development. These findings remain robust for the components of resource rent, namely forest rent, oil rent and coal rent. Furthermore, our results show that FDI inflow, human capital development and overall economic growth are important drivers of infrastructural development in Africa.

These findings have a number of policy implications. Firstly, these findings suggest a need for institutional reforms in Africa to improve the utilization of natural resource revenues and counter the negative link between resource rent and infrastructural development. Such institutional reforms should mainly target economic diversification, human capital development, business-friendly regulations, innovation support and transparent resource management. These should be supported with a strong commitment to fight corruption and effective implementation and monitoring of government policies and programmes to achieve set targets. Secondly, to capitalize on the positive effects of FDI inflow, human capital development and economic growth on infrastructural development in Africa, policymakers and leaders in the region should prioritize infrastructure investment, streamline regulations to enhance access to infrastructure financing and technology, promote education and skill development to drive infrastructural development, maintain existing infrastructure and embrace regional cooperation towards greater infrastructural development in the region. More importantly, given that China has been wielding strong power on this continent, we recommend that African governments prioritize sustainable infrastructure investment in sectors such as education, healthcare, renewable energy and technology. This diversification beyond natural resources can foster long-term economic growth and innovation. Additionally, transparent governance and accountability mechanisms are vital. Implementing effective regulations can ensure that revenues from natural resources are reinvested in infrastructure for the benefit of the population. Furthermore, African governments should also promote diversification into non-resource sectors such as manufacturing, tourism and agriculture to reduce dependence on volatile commodity markets and create more sustainable revenue streams and job opportunities. However, for these recommendations to work, governments in the region should work together at the level of the African Union to address the persistent challenge of insecurity of lives and property that discourage the inflow of investments into the region. These strategies will collectively promote sustainable infrastructural development, economic growth and overall conducive business environment in the region. Finally, institutional reforms should specifically aim at enhancing each of the six dimensions of institutional quality, which include government effectiveness, voice and accountability, regulatory quality, rule of law, control of corruption and political stability. This will help ensure that the region takes full advantage of its natural resource abundance rather than wallow persistently in the so-called resource curse.

Acknowledgement

Funding: There was no funding, either externally or internally, towards this study.

Conflicts of interest: The authors hereby declare that this article was not submitted nor published elsewhere.

References

Abdulahi, M. E., Shu, Y., Khan, M. As. (2019). Resource rents, economic growth, and the role of institutional quality: A panel threshold analysis. *Resources Policy*, 61, 293–303. https://doi.org/10.1016/j.resourpol.2019.02.011

Abdullahi, A., Sieng, L. W. (2023). The effect of infrastructure development on economic growth: The case of sub-Saharan Africa. *Journal of Infrastructure, Policy and Development*, 7(2), 1994. https://doi.org/10.24294/jipd.v7i2.1994

Adam, I. O. (2020). Examining E-Government development effects on corruption in Africa: The mediating effects of ICT development and institutional quality. *Technology in Society*, *61*, 101245.

AFDB (2020). *The Africa Infrastructure Development Index*. Abidjan: African Development Bank. [Retrieved 2012-11-10] Available at: https://www.afdb.org/sites/default/files/documents/publications/economic_brief_-_the_africa_infrastructure_development_index_july_2020.pdf

AFDB (2021). *Annual Development Effectiveness Review 2021: A Resilient Continent Recovering from the Pandemic*. Abidjan: African Development Bank.

AFDB (2022). *African economic outlook 2021: Africa's macroeconomic performance and prospects*. Abidjan: African Development Bank.

Ahmed, A. I., Bryant, R. G., Edwards, D. P. (2021). Where are mines located in sub Saharan Africa and how have they expanded overtime? *Land Degradation & Development*, 32(1), 112–122. https://doi.org/10.1002/ldr.3706

Ajide, K. B. (2022). Is natural resource curse thesis an empirical regularity for economic complexity in Africa? *Resources Policy*, 76(C), 102755. https://doi.org/10.1016/j.resourpol.2022.102755

Akims, K. A., Danyil, C. J. (2018). Infrastructural development as a strategy for Nigeria's export promotion. *African Research Review*, 12(4), 40–49. https://doi.org/10.4314/afrrev.v12i4.4

Alsagr, N., Ozturk, I. (2024). Natural resources rent and green investment: Does institutional quality matter? *Resources Policy*, 90, 104709. https://doi.org/10.1016/j.resourpol.2024.104709

Al-Zyoud, H., Ali, S., Ahmad, N. (2021). Determinants of human capital development in SAARC countries: role of public infrastructure and institutional quality. *Pakistan Economic and Social Review*, 59(2), 179–202.

Appiah, M., Onifade, S. T., Gyamfi, B. A. (2022). Building critical infrastructures: Evaluating the roles of governance and institutions in infrastructural developments in Sub-Sahara African countries. *Evaluation Review*, 46(4), 391–415. https://doi.org/10.1177/0193841X221100370

Arellano, M., Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The Review of Economic Studies*, 58(2), 277–297. https://doi.org/10.2307/2297968

Arvanitis, Y., Weigert, M., (2017). Turning resource curse into development dividends in Guinea-Bissau. *Resources Policy*, 53, 226–237. https://doi.org/10.1016/j.resourpol.2017.06.018

Asongu, S. A., Le Roux, S. (2017). Enhancing ICT for inclusive human development in Sub-Saharan Africa. *Technological Forecasting and Social Change*, 118, 44–54. https://doi.org/10.1016/j.techfore.2017.01.026

Asongu, S. A., Acha-Anyi, P. N. (2019). The murder epidemic: A global comparative study. *International Criminal Justice Review*, 29(2), 105–120. https://doi.org/10.1177/1057567718759584

Asongu, S. A., Odhiambo, N. M. (2020). Foreign direct investment, information technology and economic growth dynamics in Sub-Saharan Africa. *Telecommunications Policy*, 44(1), 101838. https://doi.org/10.1016/j.telpol.2019.101838

Asongu, S., Nting, R. (2021). The comparative economics of financial access in gender economic inclusion. *African Journal of Economic and Management Studies*, 12(2), 193–207. https://doi.org/10.1108/AJEMS-06-2020-0268

Asongu, S., Diop, S. (2022). *Resource rents and economic growth: Governance and infrastructure thresholds*. European Xtramile Centre of African Studies WP/22/072.

Auty, R. M. (1994). Industrial policy reform in six large newly industrializing countries: The resource curse thesis. *World Development*, 22(1), 11–26. https://doi.org/10.1016/0305-750X(94)90165-1

Banday, U. J., Murugan, S., Maryam, J. (2021). Foreign direct investment, trade openness and economic growth in BRICS countries: evidence from panel data. *Transnational Corporations Review*, 13(2), 211–221. https://doi.org/10.1080/19186444.2020.1851162

Batool, Z., Raza, S. M. F., Ali, S., et al. (2022). ICT, renewable energy, financial development, and CO_2 emissions in developing countries of East and South Asia. *Environmental Science and Pollution Research*, 29(23), 35025–35035. https://doi.org/10.1007/s11356-022-18664-7

Bennett, D. L., Faria, H. J., Gwartney, J. D., et al. (2017). Economic institutions and comparative economic development: a post-colonial perspective. *World Development*, 96, 503–519. https://doi.org/10.1016/j.worlddev.2017.03.032

Ben-Salha, O., Dachraoui, H., Sebri, M. (2021). Natural resource rents and economic growth in the top resource-abundant countries: a PMG estimation. *Resources Policy*, 74, 101229. https://doi.org/10.1016/j.resourpol.2018.07.005

Bilal, S. M., Shah, S. Z. A., Rahman, S. U., et al. (2022). Impact of Resource Rents and Institutional Quality on Economic Growth: An Approach of Panel Threshold Analysis. *Competitive Education Research Journal*, 3(2), 195–208.

Chen, C., Liu, C., Lee, J. (2022). Corruption and the quality of transportation infrastructure: evidence from the US states. *International Review of Administrative Sciences*, 88(2), 552–569. https://doi.org/10.1177/0020852320953184

Dwumfour, R. A., Ntow-Gyamfi, M. (2018), Natural resources, financial development and institutional quality in Africa: is there a resource curse? *Resources Policy*, 59, 411–426, https://doi.org/10.1016/j.resourpol.2018.08.012

Ekeocha, D. O., Ogbuabor, J. E., Ogbonna, O. E., et al. (2023). Economic policy uncertainty, governance institutions and economic performance in Africa: are there regional differences? *Economic Change and Restructuring*, 56(3), 1367–1431. https://doi.org/10.1007/s10644-022-09472-7

Emeka, E. T., Asongu, S. A., Ngoungou, Y. E. (2024). Gender economic inclusion, governance institutions and economic complexity in Africa. *Sustainable Development*, 32(5), 5639–5658. https://doi.org/10.1002/sd.2992

Emeka, E. T., Ogbuabor, J. E., Nwosu, E. O. (2024). Effects of public infrastructural development and industrialization on economic complexity in Africa: Emerging insight from panel data analysis. *African Development Review*, 36(1), 97–110. https://doi.org/10.1111/1467-8268.12734

Fagbemi, F., Omowumi Adeoye, G. (2020). Nigerian governance challenge: exploring the role of natural resource rents. *Global Journal of Emerging Market Economies*, 12(3), 335–358. https://doi.org/10.1177/0974910120919001

Funlayo, A. K., Olusanjo, O. J., Akode, T. (2022). Impact of infrastructure and institutional quality on economic growth in ECOWAS countries. *International Journal of Social Sciences Perspectives*, 10(1), 9–16. https://doi.org/10.33094/ijssp.v10i1.530

Gelb, A., Associates (1988). *Oil windfalls: Blessing or curse*. Oxford: Oxford University Press.

Gillanders, R. (2014). Corruption and infrastructure at the country and regional level. *Journal of Development Studies*, 50(6), 803–819. https://doi.org/10.1080/00220388.2013.858126

Gujarati, D. N., Porter, D. (2003). Multicollinearity: What happens if the regressors are correlated. In: Gujarati, D. N. *Basic Econometrics*, 363. 4th edition. ISBN 978-0070597938.

Hansen, L. P. (1982). Large sample properties of generalized method of moments estimators. *Econometrica: Journal of the Econometric Society*, 50(4), 1029–1054. https://doi.org/10.2307/1912775

Havranek, T., Horvath, R., Zeynalov, A. (2016). Natural resources and economic growth: A meta-analysis. *World Development*, 88, 134–151. https://doi.org/10.1016/j.worlddev.2016.07.016

Huang, J., Guo, L. (2022). Analysis of the impact of natural resource rent, transportation infrastructure, innovation and financial development on China's carbon emission. *Energy & Environment*, 34(6), 1805–1825. https://doi.org/10.1177/0958305X221100526

Huang, S. Z., Sadiq, M., Chien, F. (2021). The impact of natural resource rent, financial development, and urbanization on carbon emission. *Environmental Science and Pollution Research*, 30, 42753–42765. https://doi.org/10.1007/s11356-021-16818-7

Irshad, R., Ghafoor, N. (2023). Infrastructure and economic growth: evidence from lower middle-income countries. *Journal of the Knowledge Economy*, 14(1), 161–179. https://doi.org/10.1007/s13132-021-00855-1

Ji, X., Song, T., Umar, M., et al. (2023). How is China mitigating resource curse through infrastructural development? *Resources Policy*, 82(C), 103590. 10.1016/j.resourpol.2023.103590

Kamguia, B., Ndjakwa, M., Tadadjeu, S. (2023). Does infrastructural development foster export upgrading in Africa? *African Development Review*, 35(1), 79–94. https://doi.org/10.1111/1467-8268.12684

Khan, M. At., Kishwar, A. (2020). Natural resource rent and financial development nexuses in Bangladesh: The role of institutional quality. *Financial Markets Institutions and Risks*, 4(2), 108–114. https://doi.org/10.21272/fmir.4(2).108-114.2020

Khan, M. At., Gu, L., Khan, M. A., et al. (2020). Natural resources and financial development: The role of institutional quality. *Journal of Multinational Financial Management*, 56(C), 100641. https://doi.org/10.1016/j.mulfin.2020.100641

Khan, M. As., Khan, M. At., Abdulahi, M. E., et al. (2019). Institutional quality and financial development: The United States perspective. *Journal of Multinational Financial Management*, 49(C), 67–80. https://doi.org/10.1016/j.mulfin.2019.01.001

Khan, Z., Hussain, M., Shahbaz, M., et al. (2020). Natural resource abundance, technological innovation, and human capital nexus with financial development: A case study of China. *Resources Policy*, 65, 101585. https://doi.org/10.1016/j.resourpol.2020.101585

Mabey, P. T., Li, W., Sundufu, A. J., et al. (2020). Environmental impacts: Local perspectives of selected mining edge communities in Sierra Leone. *Sustainability*, 12(14), 5525. https://doi.org/10.3390/su12145525

Maconachie, R., Conteh, F. M. (2020). Artisanal mining and the rationalisation of informality: critical reflections from Liberia. *Canadian Journal of Development Studies / Revue canadienne d'études du développement*, 41(3), 432–449. https://doi.org/10.1080/02255189.2019.1683520

Majumder, M. K., Raghavan, M., Vespignani, J. (2020). Oil curse, economic growth and trade openness. *Energy Economics*, 91, 104896. https://doi.org/10.1016/j.eneco.2020.104896

Mavrotas, G., Murshed, S. M., Torres, S. (2011). Natural resource dependence and economic performance in the 1970–2000 period. *Review of Development Economics*, 15(1), 124–138. https://doi.org/10.1111/j.1467-9361.2010.00597.x

Mlambo, C., Kapingura, F. (2020). Remittances and economic development: Evidence from SADC countries. *Eurasian Journal of Economics and Finance*, 8(4), 261–273.

Munemo, J. (2022). Do African resource rents promote rent-seeking at the expense of entrepreneurship? *Small Business Economics*, 58(3), 1647–1660. https://doi.org/10.1007/s11187-021-00461-0

Musibau, H. O., Shittu, W. O., Yanotti, M. (2022). Natural resources endowment: What more does West Africa need in order to grow? *Resources Policy*, 77, 102669. https://doi.org/10.1016/j.resourpol.2022.102669

Nchofoung, T. N., Achuo, E. D., Asongu, S. A. (2021). Resource rents and inclusive human development in developing countries. *Resources Policy*, 74, 102382. https://doi.org/10.1016/j.resourpol.2021.102382

Njangang, H., Asongu, S., Tadadjeu, S., et al. (2021). *Is financial development shaping or shaking economic sophistication in African countries?* European Xtramile Centre of African Studies WP/21/018.

Ofori, P. E., Grechyna, D. (2021), Remittances, natural resource rent and economic growth in Sub-Saharan Africa. *Congent Economics and Finance*, 9(1), https://doi.org/10.1080/23322039.2021.1979305

Ogbonna, O. E., Ogbuabor, J. E., Eze, A. A., et al. (2021). Moderating Effect of Institutional Quality on Relationship Between Foreign Aid and Economic Growth in Africa. *Politická ekonomie*, 69(4), 457–478. https://doi.org/10.18267/j.polek.1314

Ogbonna, O. E., Ogbuabor, J. E., Manasseh, C. O., et al. (2022). Global uncertainty, economic governance institutions and foreign direct investment inflow in Africa. *Economic Change and Restructuring*, 55(4), 2111–2136. https://doi.org/10.1007/s10644-021-09378-w

Ogbuabor, J. E., Anthony-Orji, O., Ogbonna, O. E., et al. (2019). Regional integration and Growth: New Empirical Evidence from WAEMU. *Progress in Development Studies*, 19(2), 123–143. https://doi.org/10.1177/1464993418822883

Ogbuabor, J. E., Emeka, E. T., Nwosu, E. O. (2023). Effects of terrorism and economic policy uncertainty on economic complexity in Africa: A study of the moderating role of governance institutions. *South African Journal of Economics*, 91(4), 528–557. https://doi.org/10.1111/saje.12353

Ogbuabor, J. E., Emeka, E. T., Orji, A., et al. (2023). The effects of international financial inflows on economic complexity in Africa: does institutional quality play a moderation role? *Journal of Economic Policy Reform*, 26(4), 348–369.

Ogbuabor, J. E., Orji, A., Manasseh, C. O., et al. (2020). Institutional Quality and Growth in West Africa: What happened after the Great Recession? *International Advances in Economic Research*, 26(4), 343–361. https://doi.org/10.1007/s11294-020-09805-0

Ojonta, O. I., Ogbuabor, J. E. (2024). Effects of tourism and institutional quality on infrastructural development in Africa: new evidence from the system GMM technique. *Business Economics*, 59(2), 101–117. https://doi.org/10.1057/s11369-024-00355-5

OPEC (2021). *Monthly Oil Market Report*. [Retrieved 2022-02-21] Available at: https://www.opec.org/opec_web/en/publications/338.htm

Pesaran, M. H. (2021). General Diagnostic Tests for Cross-Sectional Dependence in Panels. *Empirical Economics*, 60, 13–50. https://doi.org/10.1007/s00181-020-01875-7

Pickering, J. (2021). *Foreign Competition in Guinea: The Scramble for Natural Resources*. [Retrieved 2022-02-21] Available at: https://www.fpri.org/article/2021/09/foreign-competition-in-guinea-the-scramble-for-natural-resources/

Redmond, T., Nasir, M. A. (2020). Role of natural resource abundance, international trade and financial development in the economic development of selected countries. *Resources Policy*, 66, 101591. https://doi.org/10.1016/j.resourpol.2020.101591

Rehman, A., Alam, M. M., Ozturk, I., et al. (2023). Globalization and renewable energy use: how are they contributing to upsurge the CO_2 emissions? A global perspective. *Environmental Science and Pollution Research*, 30(4), 9699–9712. https://doi.org/10.1007/s11356-022-22775-6

Roodman, D. (2009). How to do Xtabond2: An introduction to difference and system GMM in Stata. *The Stata Journal*, 9(1), 86–136. https://doi.org/10.1177/1536867X0900900106

Saadi, M. (2020). Remittance inflows and export complexity: New evidence from developing and emerging countries. *The Journal of Development Studies*, 56(12), 2266–2292. https://doi.org/10.1080/00220388.2020.1755653

Sarmidi, T., Law S. H., Jafari, Y. (2014). Resource curse: new evidence on the role of institutions. *International Economic Journal*, 28(1), 191–206. https://doi.org/10.1080/10168737.2013.787110

Shi, J., Liu, Y., Sadowski, B. M., et al. (2023). The role of economic growth and governance on mineral rents in main critical minerals countries. *Resources Policy*, 83, 103718. https://doi.org/10.1016/j.resourpol.2023.103718

Tchamyou, V. S., Erreygers, G., Cassimon, D. (2019). Inequality, ICT and financial access in Africa. *Technological Forecasting and Social Change*, 139, 169–184. https://doi.org/10.1016/j.techfore.2018.11.004

Timilsina, G. R., Hochman, G., Song, Z. (2020). *Infrastructure, economic growth, and poverty: A review*. World Bank Policy Research Working Paper No. 9258.

Torvik, R. (2009). Why do some resource-abundant countries succeed while others do not? *Oxford Review of Economic Policy*, 25(2), 241–256.

van Noort, C. (2022). The Aesthetic Power of Ships in International Political Communication: Why Ships Matter in China's Communication of the Maritime Silk Road Initiative. *Global Society*, 36(4), 516–537. https://doi.org/10.1080/13600826.2021.1942801

Vu, T. V. (2022). Does institutional quality foster economic complexity? The fundamental drivers of productive capabilities. *Empirical Economics*, 63(3), 1571–1604. https://doi.org/10.1007/s00181-021-02175-4

WB (2022). *The World Bank Annual Report 2021: From Crises to Green, Resilient, and Inclusive Recovery*. Washington, D.C.: World Bank. ISBN 978-1-4648-1778-6.

Wu, S., Li, L., Li, S. (2018), Natural resource abundance, natural resource-oriented industry dependence, and economic growth: evidence from the provincial level in China. *Resources, Conservation and Recycling*, 139, 163–171, https://doi.org/10.1016/j.resconrec.2018.08.012

Zallé, O. (2019). Natural resources and economic growth in Africa: The role of institutional quality and human capital. *Resources Policy*, 62(C), 616–624. https://doi.org/10.1016/j.resourpol.2018.11.009

Zergawu, Y. Z., Walle, Y. M., Giménez-Gómez, J. M. (2020). The joint impact of infrastructure and institutions on economic growth. *Journal of Institutional Economics*, 16(4), 481–502. https://doi.org/10.1017/S1744137420000016

Appendixes

Table A1: List of countries included in study

No.	Country	No.	Country	No.	Country	No.	Country
1	Algeria	14	DR Congo	27	Lesotho	40	Rwanda
2	Angola	15	Egypt	28	Liberia	41	São Tomé and Príncipe
3	Benin	16	Equatorial Guinea	29	Libya	42	Senegal
4	Botswana	17	Eritrea	30	Madagascar	43	Seychelles
5	Burkina Faso	18	Eswatini	31	Malawi	44	Sierra Leone
6	Burundi	19	Ethiopia	32	Mali	45	South Africa
7	Cape Verde	20	Gabon	33	Mauritania	46	Sudan
8	Cameroon	21	Gambia	34	Mauritius	47	Tanzania
9	Central African Republic	22	Ghana	35	Morocco	48	Togo
10	Chad	23	Guinea	36	Mozambique	49	Tunisia
11	Comoros	24	Guinea-Bissau	37	Namibia	50	Uganda
12	Congo Republic	25	Ivory Coast	38	Niger	51	Zambia
13	Djibouti	26	Kenya	39	Nigeria	52	Zimbabwe

Source: Authors' own elaboration

Table A2: Descriptive statistics of variables

Variables	Observation	Mean	Std. dev.	Minimum	Maximum
Infrastructure (*INF*)	936	23.4454	19.8410	1.1230	98.8811
Resources endowment (*NRR*)	936	11.6592	11.3616	0.0023	66.0598
Forest rent (*FOREST*)	936	4.62392	5.13384	0	32.6579
Coal rent (*COAL*)	936	0.5739	3.3197	0	48.7224
Oil rent (*OIL*)	936	4.4741	10.7537	0	64.8164
Foreign direct investment (*FDI*)	936	4.3664	7.81281	–18.9177	103.3374
Trade (*TOP*)	936	66.8283	43.1468	0	347.9965
Human capital	936	0.5312	0.1108	0.2891	0.8171
Economic growth (*RGDP*)	936	23.2306	1.6114	18.7314	27.0762
Government effectiveness (*GE*)	936	–0.7390	0.6013	–1.8873	1.1609
Regulatory quality (*RQ*)	936	–0.6901	0.5996	–2.2822	1.1969
Rule of law (*RL*)	936	–0.6661	0.5944	–1.8700	1.0239
Voice and accountability (*VC*)	936	–0.6056	0.7275	–2.2260	0.9741
Control of corruption (*CC*)	936	–0.6099	0.6149	–1.6276	1.6333
Political stability (*PS*)	936	–0.5380	0.8444	–2.6991	1.2010
Institutional quality (*PCA*)	936	–0.6415	2.1696	–2.0987	1.1983

Source: Authors' own calculations

Table A3: Correlation matrix of variables

	INF	*NRR*	*FOREST*	*COAL*	*OIL*	*FDI*	*TOP*	*HCAP*	*HCAP*	*GE*	*RQ*	*RL*	*VC*	*CC*	*PS*	*PCA*
INF	1.0000	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
NRR	−0.1336	1.0000	–	–	–	–	–	–	–	–	–	–	–	–	–	–
FOREST	−0.4455	0.1854	1.0000	–	–	–	–	–	–	–	–	–	–	–	–	–
COAL	0.0997	0.1753	−0.1104	1.0000	–	–	–	–	–	–	–	–	–	–	–	–
OIL	0.0818	0.7959	0.2470	−0.0666	1.0000	–	–	–	–	–	–	–	–	–	–	–
FDI	−0.0232	0.0576	0.1306	0.0696	−0.0425	1.0000	–	–	–	–	–	–	–	–	–	–
TOP	0.2847	0.0773	−0.3187	0.0943	0.2005	0.0925	1.0000	–	–	–	–	–	–	–	–	–
HCAP	0.7825	−0.0214	−0.5224	0.1310	0.2038	0.0024	0.3020	1.0000	–	–	–	–	–	–	–	–
RGDP	0.0958	−0.1112	−0.3044	0.1466	−0.0686	0.1466	−0.0686	0.1881	1.0000	–	–	–	–	–	–	–
GE	0.5410	−0.4055	−0.3796	0.1728	−0.2253	0.1728	−0.2253	0.5318	0.1121	1.0000	–	–	–	–	–	–
RQ	0.3605	−0.4475	−0.2696	0.1258	−0.2939	0.1258	−0.2939	0.3505	0.0305	0.8696	1.0000	–	–	–	–	–
RL	0.4614	−0.4123	−0.3459	0.2363	−0.2710	0.2363	−0.2710	0.4720	0.0707	0.9100	0.8752	1.0000	–	–	–	–
VC	0.2695	−0.4002	−0.1229	0.2589	−0.3649	0.2589	−0.3649	0.2479	0.0622	0.6473	0.7147	0.7390	1.0000	–	–	–
CC	0.4136	−0.4300	−0.3174	0.2934	−0.3433	−0.3433	0.1125	0.3945	0.1619	0.8442	0.7626	0.8741	0.6839	1.0000	–	–
PS	0.2541	−0.1861	−0.3239	0.2038	−0.0701	0.1517	0.3144	0.3811	0.1787	0.6090	0.5792	0.7007	0.5653	0.9144	1.0000	–
PCA	0.4392	−0.4341	−0.3335	0.2418	−0.2981	0.0885	0.2541	0.4509	0.1138	0.9269	0.9103	0.9653	0.8153	0.6683	0.7661	1.0000

Source: Authors' own calculations