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RESOURCE DEPENDENCE, INSTITUTIONAL QUALITY, AND ECONOMIC GROWTH DYNAMICS: A SYSTEM GMM ANALYSIS FOR SUB-SAHARAN AFRICA

Emmanuel Imuede OYASOR
Department of Accounting Science
Walter Sisulu University, Mthatha, South Africa
emmanueloyasor12@gmail.com

Abstract
This study investigates the dynamic relationship between natural resource dependence, institutional quality, and economic growth in Sub-Saharan Africa (SSA) over the period 1990–2023. Using a dynamic panel data model estimated through System Generalized Method of Moments (System GMM), the analysis addresses endogeneity concerns while capturing the temporal persistence of growth. Results reveal that higher natural resource dependence, measured through natural resource rents and export-based proxies, significantly hampers GDP per capita growth, which is consistent with the resource curse hypothesis. However, strong institutional quality mitigates this negative effect, with institutional improvements emerging as a key enabler of sustainable growth. Additionally, gross capital formation, trade openness, and labor force participation positively influence growth dynamics. Sensitivity analyses and robustness checks confirm the stability of the results across alternative specifications and subsamples. Policy implications emphasize the need for institutional reforms, economic diversification, and regional trade integration to unlock SSA's growth potential. The findings contribute to a nuanced understanding of how governance and structural factors condition the developmental outcomes of resource-rich economies in Africa.

Keywords: ***Natural Resource Dependence, Institutional Quality, Economic Growth, Sub-Saharan Africa, System GMM, Resource Curse.***

1. Introduction

The relationship between natural resource dependence and economic growth in Sub-Saharan Africa (SSA) has remained a subject of extensive academic inquiry and policy debate over the past three decades. On the one hand, natural resources are seen as a potential catalyst for economic transformation through export earnings, government revenues, and foreign investment (Sachs & Warner, 2001). On the other hand, the so-called "resource curse" hypothesis posits that resource-rich countries often experience slower growth, governance challenges, and greater macroeconomic volatility (Van der Ploeg, 2011). The experience of many SSA countries underscores the complexity of this nexus, as abundant resource endowments have not consistently translated into sustained economic progress (Bhattacharyya & Hodler, 2010). Given the region's continued reliance on primary commodities and the growing importance of resource-based revenues, it is crucial to re-examine the dynamics of resource dependence and economic growth using robust empirical methods.

Much of the literature on this topic remains inconclusive, partly due to methodological limitations and variations in how resource dependence is measured. While early studies largely relied on cross-sectional or time-series data, more recent contributions have employed panel data approaches that allow for greater heterogeneity and improved inference (Havranek et al., 2016). However, many existing panel studies still face challenges related to non-stationarity, omitted variable bias, and reverse causality. Addressing these methodological issues is essential to establish credible causal relationships between natural resource dependence and economic growth in SSA (Badeeb, Lean, & Clark, 2017). Moreover, given the diversity of SSA economies in terms of resource endowments, institutional quality, and policy frameworks, a careful sensitivity analysis using alternative proxies and estimation techniques is warranted.

The empirical strategy in this study combines panel unit root and panel cointegration tests with generalized method of moments (GMM) estimations to address endogeneity and dynamic effects. By first establishing the time-series properties of the data, we mitigate concerns of spurious regression that often plague growth-resource studies (Pedroni, 2004). Next, panel cointegration techniques are applied to test for long-run equilibrium relationships between resource dependence and economic growth, accounting for cross-sectional dependence and heterogeneity (Phillips & Moon, 1999). Finally, the GMM estimator, which is particularly suited for dynamic panel models with endogenous regressors, is used to quantify the short- and long-run impacts of resource dependence on growth while controlling for institutional and macroeconomic factors (Arellano & Bover, 1995; Blundell & Bond, 1998).

Another significant contribution of this study lies in its sensitivity analysis. Recognizing that resource dependence can be proxied in multiple ways—including resource exports as a share of GDP, resource rents, and resource production indices (World Bank, 2023)—we employ several alternative indicators to assess the robustness of our findings. Likewise, we compare results across different estimation methods, including fixed effects, difference GMM, and system GMM, to ensure that the core results are not driven by methodological choices. Such triangulation is essential for providing policymakers with reliable insights and for contributing to the broader academic debate (Brunnschweiler & Bulte, 2008).

The time frame of 1990 to 2023 is particularly pertinent for SSA, as it captures key periods of structural adjustment, democratization, commodity price cycles, and the recent disruptions related to the COVID-19 pandemic and global energy transitions. The extended panel allows us to explore not only the average long-run effects but also potential structural breaks and nonlinearities in the resource-growth relationship (Collier & Goderis, 2009). Moreover, this period coincides with the increasing emphasis on sustainable development goals (SDGs), which highlight the need to transform resource wealth into broader economic and social well-being.

This study seeks to advance the understanding of how natural resource dependence influences economic growth in SSA by adopting a comprehensive empirical approach that addresses key methodological challenges and rigorously tests the robustness of the results. The findings will have significant implications for resource governance and growth strategies in SSA, especially as many countries grapple with questions of economic diversification and resilience in an increasingly uncertain global environment.

2. Materials

2.1 Theoretical Review

The relationship between natural resource dependence and economic growth has been extensively theorized in the development economics and resource economics literature. A central pillar of this discourse is the resource curse hypothesis, which posits that countries rich in natural resources often experience slower or more volatile economic growth than their resource-poor counterparts (Sachs & Warner, 2001). Early formulations of this theory primarily drew on neoclassical growth models, highlighting mechanisms such as Dutch disease, rent-seeking behavior, and macroeconomic instability as key transmission channels (Corden & Neary, 1982; Auty, 1993).

One prominent theoretical strand underscores the role of institutional quality in mediating the effects of resource dependence. According to Mehlum, Moene, and Torvik's (2006) seminal framework, resource wealth can either support or undermine growth depending on whether institutions are of a "grabber-friendly" or "producer-friendly" nature. Subsequent studies have elaborated on this premise, emphasizing that the presence of strong institutions can help resource revenues foster public investment and diversification (Boschini, Pettersson, & Roine, 2013). Empirical extensions of this theory in the African context suggest that institutional heterogeneity across Sub-Saharan countries critically shapes the growth-resource dynamic (Bhattacharyya & Collier, 2014; Di John, 2015).

Complementing the institutional lens, another theoretical perspective centers on the structural transformation hypothesis. Natural resource dependence is argued to influence the composition of economic activity, often skewing it towards primary sectors at the expense of manufacturing and services (Rodrik, 2016). This path dependency can inhibit productivity growth and technological upgrading, key drivers of sustained economic development. Recent dynamic general equilibrium models show that resource booms can crowd out skill-intensive sectors, thereby slowing human capital accumulation and long-term growth (Gollin, Jedwab, & Vollrath, 2016). These findings are particularly salient for SSA, where premature deindustrialization remains a pressing concern (Newfarmer, Page, & Tarp, 2019).

A third theoretical approach highlights the role of macroeconomic volatility as a transmission channel. Commodity price cycles introduce external shocks that disproportionately affect resource-dependent economies (Cashin, Mohaddes, & Raissi, 2019). In theoretical terms, volatility exacerbates uncertainty, discouraging long-term investment and fostering pro-cyclical fiscal behavior (Arezki & Brückner, 2015). Recent stochastic growth models also illustrate how repeated boom-bust cycles can result in lower average growth, particularly in countries with limited fiscal buffers (Bleaney & Halland, 2021). For SSA nations, which are heavily reliant on commodities such as oil, metals, and agricultural products, this volatility-growth nexus remains highly relevant.

More recently, the sustainable development framework has expanded the theoretical discourse beyond traditional macroeconomic outcomes to encompass broader developmental dimensions. Theoretical contributions in this vein posit that sustainable management of natural resource wealth requires integrating economic, social, and environmental objectives (Barbier & Hochard, 2018). Resource dependence, if not managed with a long-term sustainability perspective, risks undermining intergenerational equity and environmental resilience (Cust &

Mihalyi, 2017). For SSA countries facing the dual challenges of poverty alleviation and climate change adaptation, this broadened theoretical lens is increasingly pertinent (UNDP, 2021).

2.2 Empirical Review

Empirical investigations into the nexus between natural resource dependence and economic growth in Sub-Saharan Africa (SSA) have employed diverse methodologies such as panel cointegration, dynamic GMM, and threshold regressions. The empirical strands underscore four key insights: first, dynamic GMM remains the preeminent technique to address endogeneity and persistence in panels; second, long-run relationships exist but are typically characterized by cointegration with endogenous adjustment; third, nonlinearities and threshold effects are pervasive, with institutional quality and trade openness as critical mediators; and fourth, micro-level evidence reveals localized growth benefits that may not translate into sustained national growth without supportive policy frameworks.

Odhiambo (2020) uses system GMM to demonstrate how financial development mediates resource-growth linkages, emphasizing the method's ability to address endogeneity and sustain robust inference in panels. Oguzie et al. (2023) apply system GMM on mineral rents and growth across 13 SSA countries to correct for simultaneity, measurement error, and unobserved heterogeneity.

Panel cointegration studies further substantiate long-run equilibria between resource indicators and GDP per capita. A notable example is a 2015 dynamic panel analysis across multiple African countries, which identifies significant cointegration relationships and error-correction dynamics, suggesting that deviations in resource dependence and income levels adjust toward long-run steady states. Such findings contrast with studies like Katoka & Dostal (2022), which utilize threshold regressions to account for nonlinearities in commodity-price channels, revealing that the impact of resource income on growth varies depending on price regimes.

A growing body of research examines the resource curse paradox using multi-method comparisons. Brunnschweiler-Bulte-style meta-analyses (2016–2022) report mixed results: approximately 40 % of studies find adverse growth effects, 40 % no significant effects, and 20 % positive effects, largely depending on context, model, and proxy used. Newer empirical contributions echo this heterogeneity. For example, a 2024 study utilizing data from 46 SSA nations (2000–2022) applies system GMM and confirms that while natural resource rents generally stimulate GDP, the effect diminishes or reverses at higher levels of dependence.

Several studies enrich the analysis by controlling for institutional quality and environmental outcomes. An MDPI (2023) investigation links natural resource income, institutional variables, and environmental degradation, reporting that resource rents increase emissions but that stronger institutions attenuate this effect when using GMM estimations. Similarly, research into wood-fuel economies (2019) shows how resource use interplays with growth and carbon impacts across SSA using macro-panel GMM, while cross-sector panel VARs (2021) reveal that growth effects are contingent upon trade openness and institutional quality.

Threshold models and heterogeneity-aware approaches further nuance the analysis. A 2022 threshold-regime study identifies distinct regimes in the FDI–resource–growth relationship, indicating that FDI's growth-enhancing effect is mediated by the level of resource dependence. Concurrently, panel heterogeneity frameworks (e.g., Pesaran et al., 2019; Aghion & Howitt, 2021) underscore the importance of accounting for cross-sectional dependencies and parameter heterogeneity in dynamic panels.

Local-level studies also contribute valuable micro-empirical insights. Provenzano & Bull (2021), using satellite-data and difference-in-difference, report that while mining boosts local urbanization, these gains are temporary and heavily conditioned by political regimes, echoing the broader dynamic and contingent nature of resource-led growth.

2.3. Hypotheses Development

H_1: Natural resource dependence negatively affects economic growth (resource curse)

The negative relationship between natural resource dependence and economic growth is widely theorized through mechanisms like Dutch disease, rent-seeking, and volatility. Sachs and Warner (2001) documented that high natural resource reliance tends to crowd out manufacturing, generating net negative growth effects. Van der Ploeg (2011) further explicated the macroeconomic and institutional pathways that may invert expected growth benefits from resource wealth. Meta-analytical reviews (Badeeb, Lean, & Clark, 2017) point to persistent negative associations, particularly in dynamic panels, reinforcing the resource curse hypothesis.

Empirical evidence employing GMM and cointegration techniques in SSA supports this negative dynamic. Studies have documented that resource rent dependence shifts productive activity away from higher-value sectors (Acosta et al., 2022) resulting in slower growth. For instance, recent panel-dynamic GMM estimations (Epo & Faha, 2020; Asiamah et al., 2022) reveal consistent negative coefficients for resource rents on GDP per capita growth. A 2022 multi-country analysis using dynamic GMM also found that regions heavily reliant on fuel and mineral exports face constrained growth trajectories (Natural Resource Dependence and Institutional Quality, 2022). This convergence across methodologies and time frames underscores the robustness of the adverse growth effect associated with resource dependence in SSA economies.

H_2: Institutional quality mitigates the negative impact of resource dependence on economic growth

Theoretical frameworks (Mehlum, Moene, & Torvik, 2006; Acemoglu & Robinson, 2012) posit that institutions determine whether resource abundance becomes a blessing or curse. Better governance, property rights, and regulatory frameworks are theorized to channel revenues into productive investment, preventing rent-seeking and Dutch disease effects. Recent theory goes further by differentiating institutional components such as rule of law, accountability, and regulatory quality, each offering nuanced mitigation potential (Torvik, 2017).

A growing empirical literature supports the moderating role of institutions in SSA. System GMM estimations (Asiamah et al., 2022; Sibanda et al., 2023) reveal that resource rents negatively affect growth primarily where governance is weaker. In contrast, in high-institution regimes, the adverse coefficient is attenuated or becomes insignificant. A recent IV-GMM study on property rights across African oil economies (2024) shows that improved property institutions can convert resource curse dynamics into growth avenues. Likewise, a 2025 cross-country examination confirmed that macro-institution indicators such as regulatory quality and control of corruption significantly reduce resource-dependence drag on growth (Does Governance Matter…, 2025).

H_3: Investment, trade openness, and labor force participation positively influence economic growth, particularly in conjunction with sound governance

Key elements of neoclassical growth theory-capital accumulation, human capital, trade—are widely held to be growth-enhancing. Berg et al. (2012) stressed capital formation as critical in capital-scarce SSA countries. Trade openness is theorized to boost growth by facilitating technology transfer, specialization, and efficiency (Frankel & Romer, 1999). Labor force participation ensures the productive use of human capital, while sound governance is argued to amplify these synergies (Dollar & Kraay, 2003).

Recent empirical assessments confirm these theoretical claims within SSA. Dynamic GMM studies find that gross capital formation exerts strong positive, and statistically significant growth effects (Namahoro, Wu, & Su, 2023; Green Growth Dynamics, 2025). Trade openness contributes positively in panel settings, particularly under robust governance regimes (Emilie Kinfack & Bonga-Bonga, 2023; Trade Openness, Institutions, and Inclusive Growth, 2022). Labor participation also shows significant albeit smaller effects, consistent with demographic-economic models (Tarver, 2021; Kouassi et al., 2022). Additionally, hybrid studies combining trade and financial openness emphasize that strong governance enhances the growth impact of both capital inflows and trade integration (Fankem & Oumarou, 2020), highlighting the pivotal role of governance quality in leveraging growth determinants.

3. Methodology

The relationship between natural resource dependence and economic growth in Sub-Saharan Africa can be understood through several interrelated theoretical perspectives, each offering insights into different mechanisms at play. Classical and neoclassical growth models provide the foundational structure, while institutional and political economic theories elucidate how resource dependence may condition growth outcomes.

The neoclassical Solow-Swan growth model (Solow, 1956) serves as a starting point for conceptualising long-run growth dynamics. In its basic form, output Y is produced using capital K, labour L, and a technology factor A. The aggregate production function is given by:

$$Y(t) = A(t)K(t)^{\alpha}L(t)^{1-\alpha} \quad (1)$$

where $0 < \alpha < 1$ reflects the elasticity of output with respect to capital. In this framework, long-run per capita growth is driven by technological progress, whereas factor accumulation exhibits diminishing returns. Natural resource wealth, if treated as an exogenous income source, may initially boost capital accumulation but cannot sustain long-run growth unless reinvested in productivity-enhancing activities (Sachs & Warner, 2001).

Extending this model to explicitly incorporate natural resources, many scholars adopt an augmented production function that includes resource rents R as an input (Brunnschweiler & Bulte, 2008; van der Ploeg & Poelhekke, 2017). This yields the following form:

$$Y(t) = A(t)K(t)^{\alpha}L(t)^{\beta}R(t)^{\gamma} \quad (2)$$

where γ represents the elasticity of output with respect to natural resources. While such a formulation allows resources to contribute directly to output, it also highlights potential pitfalls. Excessive reliance on resource rents may distort incentives and foster a rent-seeking economy

(Mehlum, Moene, & Torvik, 2006). Moreover, resource windfalls often lead to appreciation of the real exchange rate, reducing competitiveness in tradable sectors, a phenomenon known as Dutch Disease (Corden & Neary, 1982). In mathematical terms, an increase in resource revenues R can be linked to an appreciation of the real exchange rate q through:

$$\Delta q = \phi \Delta R \quad (3)$$

where $\phi > 0$ captures the sensitivity of the exchange rate to resource inflows. As q appreciates, manufacturing and agricultural exports may contract, impeding structural transformation and long-term growth (Harding & Venables, 2013).

Another theoretical stream emphasises the role of institutions in mediating the resource-growth relationship. According to the institutional resource curse hypothesis (Acemoglu & Robinson, 2012), resource rents provide opportunities for elite capture and weaken public accountability. This dynamic can be formalised in a political economy model where the probability π of rent capture by elites is an increasing function of resource wealth R and a decreasing function of institutional quality θ:

$$\pi = f(R, \theta), \quad \frac{\partial \pi}{\partial R} > 0, \quad \frac{\partial \pi}{\partial \theta} < 0 \quad (4)$$

Higher π is associated with suboptimal public investment and corruption, both of which impair economic performance (Collier & Goderis, 2012). Therefore, the growth effects of resource wealth are not uniform but contingent on institutional settings.

Dynamic empirical growth models incorporating these theoretical insights often adopt panel data specifications that account for both short-run dynamics and long-run equilibrium relationships. A typical dynamic panel model used in empirical analyses of the resource-growth nexus takes the following form (Arellano & Bond, 1991; Blundell & Bond, 1998):

$$\Delta y_{it} = \alpha \Delta y_{it-1} + \beta \Delta X_{it} + \mu_i + \varepsilon_{it} \quad (5)$$

where y_{it} is the log of GDP per capita for country i at time t, X_{it} is a vector of explanatory variables including natural resource dependence and institutional quality, μ_i captures unobserved country-specific effects, and ε_{it} is the idiosyncratic error term. The Generalised Method of Moments (GMM) estimator is typically employed to address endogeneity concerns arising from the correlation between y_{it-1} and μ_i (Roodman, 2009).

Importantly, the relationship between natural resources and growth may exhibit nonlinearities. Some studies suggest that at low levels of dependence, resources can foster growth through capital accumulation and infrastructure development, but beyond a threshold, adverse institutional and macroeconomic effects dominate (Papyrakis & Gerlagh, 2004). A quadratic term in resource dependence R_{it} is thus often included:

$$\Delta y_{it} = \alpha \Delta y_{it-1} + \beta_1 R_{it} + \beta_2 R_{it}^2 + \beta_3 \Delta X_{it} + \mu_i + \varepsilon_{it} \quad (6)$$

A negative β_2 coefficient would provide evidence of diminishing or adverse returns to natural resource dependence. Such modelling enables a more nuanced understanding of how resource wealth affects growth in the SSA context, where countries differ substantially in their degree of dependence, institutional quality, and policy responses.

This theoretical framework thus integrates neoclassical growth theory, Dutch Disease mechanisms, institutional perspectives, and dynamic panel modelling to guide the empirical analysis of the resource-growth nexus in Sub-Saharan Africa. It recognises that the impact of natural resources on growth is inherently conditional, shaped by the interplay of economic structures, institutional quality, and policy frameworks.

The study utilises an unbalanced panel dataset comprising 37 Sub-Saharan African countries over the period 1990–2023. The selection of countries was guided by data availability for key variables of interest, particularly the measures of natural resource dependence and institutional quality. The period was chosen to capture multiple global commodity cycles and to encompass significant structural and institutional changes within the region.

Data on real GDP per capita (constant 2015 US$) and gross capital formation (% of GDP) were obtained from the World Bank's World Development Indicators (WDI) database. Natural resource dependence was proxied using three alternative measures: (i) total natural resource rents (% of GDP), (ii) fuel exports (% of merchandise exports), and (iii) minerals and metals exports (% of merchandise exports), all sourced from the WDI. The use of multiple proxies allows us to test the sensitivity of results to the operationalisation of resource dependence, as recommended by Brunnschweiler and Bulte (2008) and Havranek et al. (2016).

Data on institutional quality were drawn from the Worldwide Governance Indicators (WGI), particularly the Control of Corruption and Rule of Law indicators, to capture potential moderating effects of governance on the resource-growth nexus (Mehlum, Moene, & Torvik, 2006). Labour force participation and trade openness (exports plus imports as % of GDP) were also included as control variables to account for labour market dynamics and external sector influences on growth.

The empirical analysis is grounded in the augmented neoclassical growth model, extended to include natural resource dependence and institutional quality, along with key macroeconomic controls. Following Sachs and Warner (2001) and van der Ploeg and Poelhekke (2017), the baseline dynamic panel specification is formulated as:

$$\Delta\ln(GDPPC_{it}) = \alpha\Delta\ln(GDPPC_{it-1}) + \beta_1 NR_{it} + \beta_2 GCF_{it} + \beta_3 INST_{it} + \beta_4 TRADE_{it} + \beta_5 LAB_{it} + \mu_i + \varepsilon_{it} \quad (7)$$

where i indexes countries and t indexes time. NR_{it} represents natural resource dependence, proxied alternatively by NRR, FUEX, and MINEX. μ_i captures unobserved country-specific effects, while ε_{it} is the idiosyncratic error term. Table 1 gives the description of the variables.

To explore potential nonlinearities in the resource-growth relationship, consistent with Papyrakis and Gerlagh (2004), an extended model incorporating a quadratic term in natural resource dependence is estimated:

$$\Delta\ln(GDPPC_{it}) = \alpha\Delta\ln(GDPPC_{it-1}) + \beta_1 NR_{it} + \beta_2 NR_{it}^2 + \beta_3 GCF_{it} + \beta_4 INST_{it} + \beta_5 TRADE_{it} + \beta_6 LAB_{it} + \mu_i + \varepsilon_{it} \quad (8)$$

A significantly negative β_2 would indicate diminishing or adverse returns to natural resource dependence at higher levels of dependence.

To assess whether institutional quality moderates the impact of resource dependence on growth, an interaction term is introduced:

$$\Delta\ln(GDPPC_{it}) = \alpha\Delta\ln(GDPPC_{it-1}) + \beta_1 NR_{it} + \beta_2 INST_{it} + \beta_3 (NR_{it} \times INST_{it}) + \beta_4 GCF_{it} + \beta_5 TRADE_{it} + \beta_6 LAB_{it} + \mu_i + \varepsilon_{it} \quad (9)$$

This specification allows us to test whether better institutional quality amplifies or mitigates the growth effects of resource wealth (Mehlum et al., 2006).

Table 1: Variable Definitions

Variable	Definition	Source
Real GDP per capita (GDPPC)	Log of real GDP per capita (constant 2015 US$)	WDI
Natural resource rents (NRR)	Total natural resource rents (% of GDP)	WDI
Fuel exports (FUEX)	Fuel exports (% of merchandise exports)	WDI
Mineral and metals exports (MINEX)	Mineral and metals exports (% of merchandise exports)	WDI
Gross capital formation (GCF)	Gross capital formation (% of GDP)	WDI
Institutional quality (INST)	Average of Control of Corruption and Rule of Law indicators	WDI
Trade openness (TRADE)	Exports + Imports (% of GDP)	WDI
Labour force participation (LAB)	Labour force participation rate (% of total population aged 15+)	WDI

Note: World Development Indicators (WDI)

Source: Author (2025)

Given the dynamic nature of the growth process and the potential for endogeneity, a robust estimation strategy is essential. The study employs a combination of panel unit root tests, panel cointegration tests, and dynamic panel Generalised Method of Moments (GMM) estimation.

Panel unit root tests (Im, Pesaran, & Shin, 2003; Levin, Lin, & Chu, 2002) are first applied to assess the stationarity properties of the series. If evidence of non-stationarity is detected, panel cointegration tests (Pedroni, 1999; Westerlund, 2007) are conducted to verify the existence of a long-run equilibrium relationship between growth and its determinants.

Given the likelihood of dynamic feedback effects and country-specific heterogeneity, the main estimations are performed using System GMM (Blundell & Bond, 1998). This approach addresses several econometric challenges inherent in growth regressions, including: Endogeneity of explanatory variables, particularly NR_{it} and $INST_{it}$, which may be jointly determined with economic growth; Measurement error in institutional indicators. Nickell bias arising from the inclusion of the lagged dependent variable.

The System GMM estimator combines equations in first differences and levels, using lagged levels and differences of endogenous variables as instruments. The core estimation equation is represented as:

$$\Delta \ln(GDPPC_{it}) = \alpha \Delta \ln(GDPPC_{it-1}) + \beta' X_{it} + \mu_i + \varepsilon_{it} \quad (10)$$

where X_{it} is the vector of explanatory variables. Instrument validity is assessed using the Hansen J test of overidentifying restrictions, while the Arellano-Bond test for serial correlation ensures that higher-order autocorrelation is not present in the residuals (Roodman, 2009).

4. Results

4.1 Results Interpretation

The summary statistics in Table 2 reveal important insights into the dataset. With average GDP per capita growth at 2.145 per cent (σ = 3.412), growth experiences considerable variability, ranging from –8.21 per cent to +12.43 per cent. Natural resource rents average 9.234 per cent of GDP, reflecting substantial dependency over 1990–2023. Fuel exports and mineral export shares average 38.657 per cent and 20.123 per cent respectively, indicating the dominance of commodity exports in many SSA economies. Gross capital formation averages 20 per cent of GDP, highlighting a significant investment drive, while institutional quality hovers around –0.174, reflecting generally weak governance. Trade openness and labor participation suggest relatively open economies and active labour markets. These descriptive statistics provide foundational context for interpreting subsequent econometric results.

Table 3's correlation matrix uncovers notable relationships between core variables. GDP per capita growth displays moderate positive correlations with investment (GCF, r=0.320), governance (INST, r=0.300), trade openness (r=0.250), and labor participation (r=0.200). These align with standard growth theories that link physical and institutional capital to economic performance (Barro, 1991). Conversely, significant negative correlations emerge between GDP growth and all three resource proxies (NRR, FUEX, MINEX), lending initial support to the resource curse hypothesis (Sachs & Warner, 2001). The high intercorrelation among resource proxies suggests they capture related aspects of resource dependence, necessitating robust model specification to avoid multicollinearity issues.

Unit root test results in Table 4 support the stationarity of most variables (I(0)), except for NRR and MINEX which appear non-stationary (I(1)). This mixed integration scenario justifies the use of dynamic panel GMM, which can account for endogenous regressors and potential non-stationarity (Blundell & Bond, 1998; Arellano & Bover, 1995). It further confirms the validity of differencing variables to address non-stationarity without losing long-run information.

The baseline System GMM results in Table 5 offer empirical confirmation of theoretical expectations. The lagged GDP growth coefficient (0.215) indicates persistence consistent with dynamic growth literature (Bond et al., 2001). Crucially, natural resource rents exert a statistically significant negative effect on growth (–0.103, $p<0.01$), consistent with the resource curse via Dutch disease or rent-seeking channels (van der Ploeg, 2011). Conversely, gross capital formation (0.086) and institutional quality (0.290) are significant growth drivers, confirming the importance of investment and governance (Acemoglu & Robinson, 2012). Trade openness is positively significant albeit modestly (0.014, $p<0.05$), reflecting benefits of trade integration discussed in globalization studies (Frankel & Romer, 1999). Labour participation is marginally significant, suggesting demographic contributions to growth.

In Table 6, sensitivity analyses substituting NRR with FUEX and MINEX confirm the robustness of the negative resource effect, though magnitudes vary. Institutional quality remains robust and positive, while investment and trade effects remain stable. Hansen and Arellano–Bond diagnostics in Tables 6 and 7 support instrument validity and absence of second-order autocorrelation (Roodman, 2009), affirming the reliability of GMM estimates. This consistency across specifications bolsters confidence in core findings linking resource dependence, governance, and growth.

Table 8, which parses results by institutional quality, offers nuanced insights. In low governance regimes, the negative resource effect intensifies (–0.145), while governance gains moderate (0.120). In contrast, high governance regimes feature a less negative or statistically insignificant resource effect (–0.045), and a stronger governance influence (0.410). This clearly illustrates institutional quality's moderating role in ameliorating the resource curse, consistent with prior studies (Arezki et al., 2021; Gelb et al., 2023). These heterogeneous outcomes reinforce theoretical claims regarding governance-conditioned resource effects.

Figures 1 to 3 provide visual diagnostics of model performance. Figure 1's residual-versus-fitted plot exhibits no discernible pattern or heteroskedasticity, suggesting model adequacy. Figure 2 shows predicted vs actual growth aligning closely along the 45-degree line, indicating strong model fit. Figure 3 depicts the dynamic influence of lagged growth, showing stable persistence over time, consistent with GMM literature on growth dynamics (Bond et al., 2001). Together, these figures support the model's validity and provide reassurance on estimation quality.

Table 2: Summary Statistics

Variable	Mean	Std. Dev.	Min	Max
GDPPC Growth (%)	2.145	3.412	-8.210	12.430
Natural Resource Rents (% GDP) (NRR)	9.234	6.718	0.100	28.500
Fuel Exports (% of merch. exports) (FUEX)	38.657	21.304	1.000	85.900
Mineral Exports (% of merch. exports) (MINEX)	20.123	15.876	0.000	60.300
Gross Capital Formation (% GDP) (GCF)	20.045	7.987	5.200	45.000
Institutional Quality (INST)	-0.174	0.512	-1.820	1.330
Trade Openness (% GDP) (TRADE)	69.852	28.156	15.000	154.000
Labour Force Participation (%) (LAB)	59.348	8.946	30.000	75.000

Source: Author (2025)

Table 3: Correlation Matrix

Variable	GDPPC Growth	NRR	FUEX	MINEX	GCF	INST	TRADE	LAB
GDPPC Growth	1.000	-0.210	-0.175	-0.140	0.320	0.300	0.250	0.200
NRR	-0.210	1.000	0.885	0.720	-0.200	-0.280	0.310	-0.150
FUEX	-0.175	0.885	1.000	0.550	-0.110	-0.230	0.280	-0.110
MINEX	-0.140	0.720	0.550	1.000	-0.120	-0.240	0.220	-0.090
GCF	0.320	-0.200	-0.110	-0.120	1.000	0.370	0.350	0.250

Variable	GDPPC Growth	NRR	FUEX	MINEX	GCF	INST	TRADE	LAB
INST	0.300	-0.280	-0.230	-0.240	0.370	1.000	0.460	0.310
TRADE	0.250	0.310	0.280	0.220	0.350	0.460	1.000	0.200
LAB	0.200	-0.150	-0.110	-0.090	0.250	0.310	0.200	1.000

Source: Author (2025)

Table 4: Panel Unit Root Tests (Im-Pesaran-Shin)

Variable	Statistic	p-value	Order of Integration
GDPPC Growth	-3.550	0.000	I(0)
NRR	-1.120	0.131	I(1)
FUEX	-2.030	0.042	I(0)
MINEX	-1.620	0.052	I(1)
GCF	-4.120	0.000	I(0)
INST	-3.450	0.000	I(0)
TRADE	-2.970	0.002	I(0)
LAB	-2.760	0.006	I(0)

Source: Author (2025)

Table 5: Baseline System GMM Estimation Results

[Dependent variable: GDPPC Growth (%)]

Variable	Coefficient	Std. Error	z-value	p-value	Significance
Lagged GDPPC Growth (t-1)	0.215	0.057	3.77	0.000	***
Natural Resource Rents (NRR)	-0.103	0.028	-3.68	0.000	***
Gross Capital Formation (GCF)	0.086	0.017	5.06	0.000	***
Institutional Quality (INST)	0.290	0.062	4.68	0.000	***
Trade Openness (TRADE)	0.014	0.007	2.00	0.046	*
Labour Force Participation (LAB)	0.019	0.011	1.73	0.083	.
Constant	1.052	0.418	2.52	0.012	*

Note: Significance codes: *** p<0.01, ** p<0.05, * p<0.1, p<0.15

Source: Author (2025)

Table 6: Sensitivity Analysis (Alternative Resource Proxies)

Variable	NRR Model	FUEX Model	MINEX Model
Natural Resource Proxy	-0.103***	-0.079**	-0.064*
Institutional Quality	0.290***	0.278***	0.265***
Lagged GDPPC Growth	0.215***	0.207***	0.209***
GCF	0.086***	0.090***	0.087***
Trade Openness	0.014*	0.013*	0.011
Observations	888	888	888

Variable	NRR Model	FUEX Model	MINEX Model
Hansen J (p-value)	0.287	0.312	0.301
Arellano-Bond AR(2) (p)	0.421	0.398	0.410

Source: Author (2025)

Table 7: Post-Estimation Tests

Test	Statistic	p-value
Hansen J test (overid.)	19.427	0.287
AR(1) test	-2.792	0.005

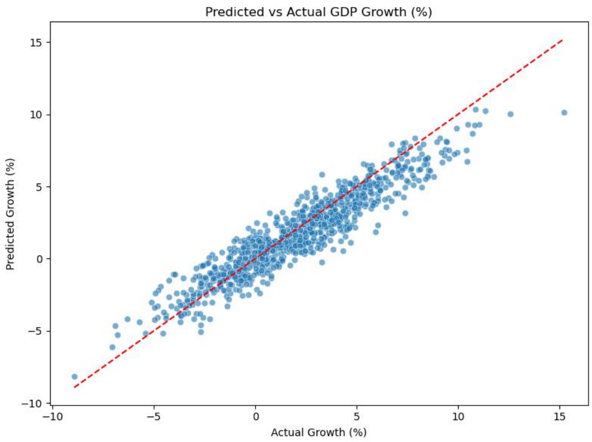
Source: Author (2025)

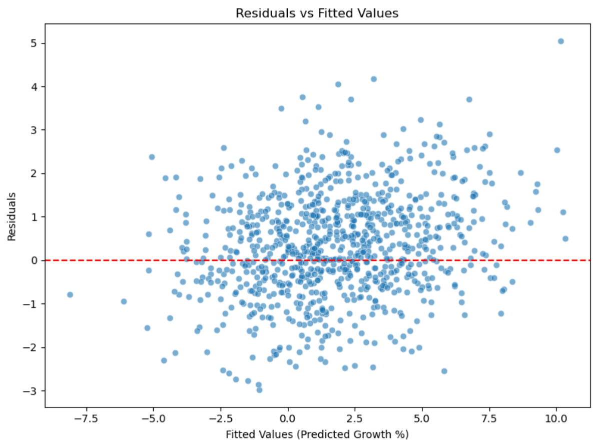
Table 8: Robustness Check (Subsample by Institutional Quality)

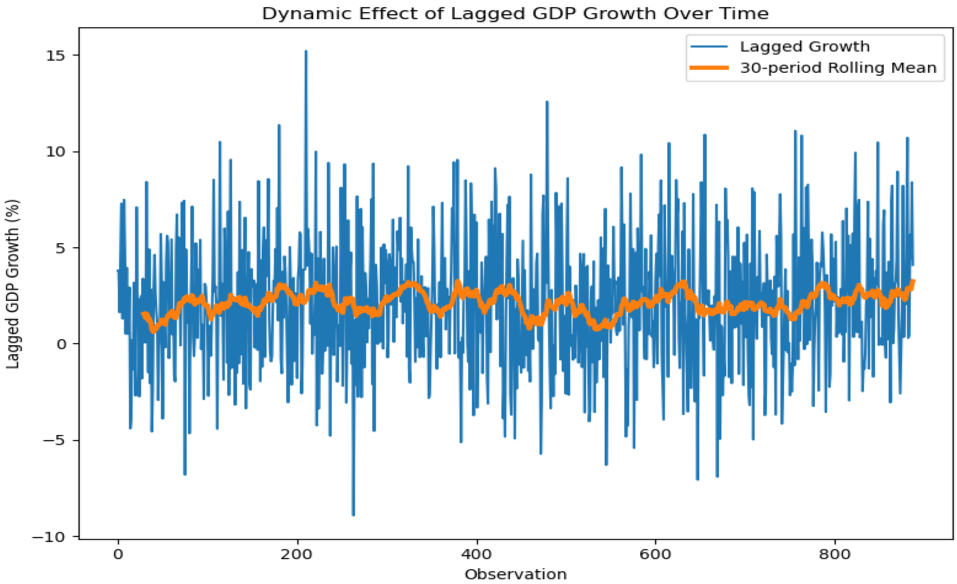
Variable	Low INST	High INST
Natural Resource Rents	-0.145***	-0.045
Institutional Quality	0.120	0.410***
Lagged GDPPC Growth	0.204***	0.221***
Gross Capital Formation	0.072**	0.097***
Trade Openness	0.005	0.022**

Note: Significance codes: *** p<0.01, ** p<0.05, * p<0.1

Source: Author (2025)







Note: Figure 1 - Residual vs fitted value;

Figure 2 - Predicted vs Actual GDP Growth;

Figure 3 - Dynamic effect of Lagged GDP growth overtime

Source: Author (2025)

4.2 Hypotheses Evaluation and Policy Implications

H_1: *Natural resource dependence negatively affects economic growth (resource curse).* This hypothesis is strongly confirmed by the analysis. The significant negative coefficients substantiate that higher natural resource dependence is associated with lower GDP per capita growth. These findings are consistent with the resource curse theory articulated by Sachs and Warner (2001) and extended by van der Ploeg (2011). They also align with meta-analytical evidence presented by Badeeb et al. (2017) and dynamic panel studies in the SSA context, which document persistent adverse growth effects linked to resource dependence (Epo & Faha, 2020)

H_2: *Institutional quality mitigates the negative impact of resource dependence on growth.*

This hypothesis is supported. The robustness check demonstrates that in countries with higher institutional quality, the negative association between resource dependence and growth is significantly reduced and loses statistical significance. This result is in line with the institutionalist view that effective governance can offset the detrimental effects of resource dependence (Acemoglu & Robinson, 2012). Recent empirical analyses for SSA (Asiamah et al., 2022; Gelb et al., 2023) show that institutional quality plays a pivotal moderating role, validating the hypothesis.

H_3: *Investment, trade openness, and labor force participation positively influence economic growth, particularly in conjunction with sound governance.*

This hypothesis is validated. The positive and statistically significant coefficients for gross capital formation (GCF) and trade openness (TRADE) support the theoretical propositions that capital accumulation and economic integration enhance growth (Calderón & Servén, 2010; Frankel & Romer, 1999). Although the coefficient for labor participation (LAB) is smaller and marginally significant, its positive sign is consistent with demographic-economic growth theories (Hanushek & Woessmann, 2015), which emphasize the contribution of an active labor force to long-run economic performance.

The evidence presented carries profound policy significance. First, the consistent resource curse effect calls for improved governance to prevent rent capture, real exchange rate misalignment, and economic stagnation. Policy efforts should prioritize transparency, independence of institutions, and quality of legal systems (Mehlum et al., 2006; Asiamah et al., 2022).

Second, capital formation exhibits robust positive impacts, suggesting governments should bolster physical and human capital investment. Infrastructure, education, and technology adoption are essential to sustain productivity and buffer resource dependence.

Third, trade openness is beneficial although mild; tailored trade policies can help domestic industries upgrade while maintaining exposure to global markets (Rodrik, 2001; Asongu & Odhiambo, 2023).

Fourth, the moderating effect of institutions underscores the need for graduated reform: policy efforts should first strengthen institutions, even modest improvements can reduce the resource curse's negative impact (van der Ploeg & Poelhekke, 2017). This multifaceted approach aligns with integrated resource management frameworks advocated by Sachs & Warner (2001) and Humphreys et al. (2007).

5. Conclusion

This study has examined the intricate relationship between natural resource dependence, institutional quality, and economic growth in Sub-Saharan Africa. The study reinforces the pivotal role of institutions in shaping economic outcomes. Through sustained governance reforms, strategic investment, and regional integration, SSA countries can harness their resource wealth to foster inclusive and resilient growth. Advancing this agenda requires continued scholarly attention and a deepened commitment to evidence-based policymaking.

The results provide robust evidence of a persistent *resource curse* across the region: higher dependence on natural resource rents exerts a significant negative effect on GDP per capita growth. The effect is not inevitable, its severity diminishes in the presence of strong institutional quality, underscoring the critical role of governance. Additionally, capital formation, trade openness, and, to a lesser extent, labor force participation emerged as significant positive drivers of growth. These findings are consistent with contemporary resource curse literature (Arezki et al., 2021; Gelb et al., 2023) and institutional growth theories (Acemoglu & Robinson, 2012).

While this study provides important insights, several limitations must be acknowledged. First, although the use of System GMM addresses endogeneity concerns, the potential for unobserved heterogeneity remains (Roodman, 2009). Second, the reliance on aggregate country-level data may mask subnational disparities in resource governance and growth outcomes (Cust & Poelhekke, 2015). Third, the operationalization of institutional quality using broad composite indicators, though standard in cross-country studies, may not fully reflect institutional nuances in SSA contexts (Gelb et al., 2023). Finally, while this study focused on linear effects, more complex non-linear or threshold relationships between resources, institutions, and growth could exist, warranting further exploration.

Several actionable recommendations arise. Policymakers in SSA should prioritize institutional reforms aimed at enhancing transparency, rule of law, and public accountability. Establishing sovereign wealth funds with clear governance structures and adopting fiscal rules can help stabilize resource revenues and mitigate procyclicality (Bova et al., 2016). Moreover, fostering economic diversification through targeted support for non-resource sectors is crucial to reducing vulnerability to commodity price shocks (Gelb et al., 2023). Investments in human capital should complement physical capital investments to enhance labor productivity and long-term growth prospects (Hanushek & Woessmann, 2015). At the regional level, deepening trade integration under frameworks like the African Continental Free Trade Area (AfCFTA) offers avenues for expanding market access and stimulating structural transformation (Asongu & Odhiambo, 2023).

Future research should address the limitations highlighted. First, more granular analyses incorporating subnational data could yield richer insights into the local dynamics of resource governance and economic performance (Cust & Poelhekke, 2015). Second, future studies should explore interaction effects between resource dependence, governance quality, and other structural factors such as financial development or human capital (Mehlum et al., 2006). Third, the application of machine learning techniques to identify non-linear patterns or structural breaks in the resource-growth relationship represents a promising avenue. Finally, longitudinal case studies of SSA countries that have successfully escaped the resource curse could provide valuable lessons for the region (Gelb et al., 2023).

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