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Original Research Article

Beyond Macroeconomics: Transmission Channels of Debt and Institutional Quality to Sustainable Development in Sub-Saharan Africa

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Abstract: This study examines the short-run and long-run impacts of external debt and institutional quality on sustainable development in Sub-Saharan Africa (SSA), using dynamic panel GMM estimation and panel ARDL ECM for robustness. It further explores four transmission channels, foreign direct investment (FDI), gross fixed capital formation (GFCF), inflation, and debt servicing. Results confirm that external debt positively influences sustainable development only when complemented by strong institutional quality. The negative and significant interaction between debt and weak institutions underscores the risk of debt undermining sustainability in poorly governed environments. Transmission channels reveal that inflation poses a mild threat to sustainability, while FDI, GFCF, and debt service lack consistent significance. These findings suggest that institutional quality is the most vital factor in enhancing the developmental returns of debt-financed interventions.

Keywords: Sustainable Development, Public Debt, Institutional Quality, Dynamic GMM, Transmission Channels.

1.0 INTRODUCTION

Sub-Saharan Africa (SSA) presents a development paradox: structural vulnerabilities remain entrenched despite signs of economic resilience. While the region recorded a GDP growth rate of approximately 3.6% in 2022 and was projected to rebound to 4.2% by 2024–25 (Ojeka *et al.,* 2024), this macroeconomic expansion remains fragile, uneven, and inadequate in addressing persistent development challenges. Beneath these aggregate figures lies a mounting public debt crisis that threatens to derail progress. As Comelli *et al.,* (2023) observe, the region's average debt-to-GDP ratio has nearly doubled over the last decade from around 30% at the end of 2013 to almost 60% by 2022. Alarmingly, more than half of low-income SSA countries were classified by the IMF as either at high risk of, or already in, debt distress as of 2022 (Comelli *et al*., 2023).

This surge in public debt has been accompanied by a worrying deterioration in debt sustainability indicators. According to Comelli *et al*., (2024), interest payments now absorb a share of government revenue in SSA that is nearly four times higher than in advanced economies. This fiscal pressure is exacerbated by a notable shift in borrowing patterns. As Hatab *et al*., (2024) report, concessional financing has declined, giving way to riskier commercial borrowing instruments such as Eurobonds and bilateral loans, often characterized by high interest rates and short maturities. The resulting debt portfolios have become increasingly vulnerable to market volatility and refinancing shocks. In some SSA countries, debt servicing costs now exceed spending on vital sectors such as health and education, with over 30% of government revenue in extreme cases dedicated solely to interest payments (Mokgonyana, 2024).

The economic implications of rising debt are already materializing in critical sectors. As Savage and Strohecker (2024) emphasize, the growing burden of debt servicing is crowding out essential public investments, with debt expected

to consume roughly one-third of public revenues across the region. This fiscal squeeze displaces development spending in areas fundamental to long-term prosperity like healthcare, education, and infrastructure (de Vergès, 2024). Consistent with theoretical expectations and empirical evidence (Pattillo *et al*., 2004; Qureshi & Liaqat, 2020), excessive public debt leads to debt overhang, which depresses capital accumulation, lowers productivity, and constrains fiscal space thereby impeding sustainable development. Consequently, despite projected GDP growth, gains in human capital formation and structural transformation remain limited, suggesting that macroeconomic growth is not effectively translating into inclusive development outcomes in SSA.

Parallel to this fiscal strain is the persistent weakness in institutional quality, a factor increasingly recognized as crucial to economic development yet often overlooked in debt-related policy analysis. The Ibrahim Index of African Governance (Mo Ibrahim Foundation, 2024) has documented stagnation or deterioration across key governance indicators, including rule of law, public service delivery, and anti-corruption frameworks. These findings are corroborated by the World Bank's Worldwide Governance Indicators (2023), which continue to show low scores in government effectiveness, regulatory quality, and control of corruption across many SSA countries. These institutional deficits raise critical concerns about whether governments possess the administrative capacity to manage debt effectively and convert borrowed resources into impactful development outcomes.

Emerging literature highlights the developmental value of institutional quality. Wandeda *et al*., (2021), using System-GMM techniques, find that governance dimensions such as rule of law and corruption control exert significant positive effects on GDP per capita in SSA, with heterogeneous effects across regions. Similarly, Musah, Aawaar, and Nkansah (2024) demonstrate that institutional quality enhances the effectiveness of public education expenditure, leading to improved enrolment and learning outcomes in countries with stronger governance frameworks. Abaidoo and Agyapong (2022) further note that the development of financial systems in SSA is highly contingent upon the presence of sound regulatory institutions and accountability mechanisms. These findings underscore that institutional quality is not just complementary but foundational to realizing the returns from public investment and external financing.

Beyond their individual effects, institutions may also play a moderating role in shaping the developmental consequences of debt. Akomolafe (2024) argues that while resource abundance often drives external debt accumulation, higher institutional quality, especially in corruption control and government effectiveness can mitigate this dependency. Similarly, Ojeka *et al.,* (2024), provide empirical evidence that governance quality significantly moderates the relationship between public debt and development expenditure. Countries with stronger institutions are more likely to deploy borrowed funds toward productive and inclusive ends, while weaker institutions tend to magnify inefficiencies and resource misallocation. Musah, Aawaar, and Nkansah (2024) further corroborate this mediating effect, demonstrating that institutional quality significantly enhances the developmental returns of debt-financed public spending in education. Their findings reinforce the notion that effective institutions not only safeguard against misallocation but also ensure that debt contributes to inclusive development rather than exacerbating fiscal vulnerabilities. These findings collectively suggest that institutional quality functions as a crucial mediator in the debt-development nexus. In contexts where governance is strong, debt can be a catalyst for transformative investments; conversely, where institutions are weak, borrowing risks entrenching inefficiencies and long-term fragility.

Despite the growing body of literature on the macroeconomic dimensions of public debt, critical gaps remain in understanding its transmission to sustainable development, particularly in the Sub-Saharan African context. As Ojeka *et al.,* (2024) argue, while theoretical and empirical evidence generally agrees that excessive debt depresses growth through mechanisms such as lower capital accumulation, reduced productivity, and tighter fiscal constraints, these channels have seldom been examined through a region-specific lens. Given the unique institutional configurations and debt profiles in SSA, such generalized conclusions may obscure important contextual nuances.

This study addresses three key gaps in the debt–development discourse in Sub-Saharan Africa (SSA). First, while prior research acknowledges that debt can hinder development, it rarely unpacks the structural channels such as investment, inflation, FDI, and debt servicing, through which these effects occur. Instead of disaggregating debt by type, this study analyzes how debt transmits to sustainable development through these distinct pathways. Second, although institutional quality is known to influence debt outcomes, its moderating role in SSA remains underexplored. Third, much of the literature relies on GDP as the sole development indicator, neglecting the multidimensional SDG framework. This study fills these gaps by examining how public debt and institutional quality interact to shape sustainable development, offering a more functional, governance-aware, and policy-relevant perspective.

The remainder of this paper is organized into five substantive sections. Section 2 presents the empirical literature review and theoretical framework, drawing on relevant theories such as the debt overhang hypothesis and institutional economics to ground the study in scholarly discourse. Section 3 details the methodological approach, including the model specification, estimation technique, and the nature and sources of the data employed. Section 4 discusses the empirical

results, including both baseline estimations and interaction effects, and provides a thorough analysis of the key findings in relation to the study's hypotheses. Section 5 synthesizes the conclusions and articulates evidence-based policy recommendations aimed at strengthening debt governance and institutional reform for sustainable development.

2.0 LITERATURE REVIEW

2.1 Empirical Literature Review

Amu *et al*., (2025) assessed the impact of public debt on economic development in Nigeria, focusing on growth rates, aggregate demand, sectoral composition, and potential threshold effects. Using an ex-post facto research design and econometric analysis via E-Views, the study identified a threshold range of 50–60% for external debt and 15–17% for domestic debt, beyond which debt accumulation significantly hampers economic development. The findings show that both domestic and external debts exert a largely negative effect on growth, particularly when these thresholds are exceeded. The study attributes Nigeria's rising debt burden to issues in fiscal federalism and competing claims to resource control among subnational units. It recommends curbing long-term debt accumulation through expanded tax revenue efforts and improved fiscal discipline. Strengthening public financial management systems was also emphasized for sustainable debt practices. While the threshold analysis is valuable, incorporating institutional quality indicators could further enrich the policy relevance of the findings.

Azimi *et al*., (2025), in their analysis of SDG 8 across G20 countries from 2000 to 2023, employed advanced panel estimation techniques to show that institutional quality, foreign direct investment (FDI), economic complexity, and renewable energy significantly boost economic growth and labour productivity while simultaneously lowering unemployment and emissions. In contrast, higher state fragility and reliance on primary energy sources were associated with negative socio-environmental impacts. The study also validated the Environmental Kuznets Curve (EKC) hypothesis, highlighting a governance-dependent turning point in the pollution-income relationship. Based on these findings, the authors advocate for policies that enhance institutional strength, expand clean energy investment, and curb fossil fuel dependency. The results reaffirm the central role of governance in achieving sustainable development outcomes.

Bosomtwe (2025) investigated the role of institutional quality in mediating the relationship between fiscal policy and the achievement of Sustainable Development Goals (SDGs) in Anglophone West Africa over the period 2005–2021. Employing Ordinary Least Squares (OLS) and Robust Least Squares estimation techniques, the study revealed that both government revenue and expenditure have a statistically significant negative impact on SDG performance, raising concerns about the developmental effectiveness of fiscal instruments in the region. Notably, the rule of law appeared to intensify the adverse effects of fiscal policy, suggesting underlying institutional inefficiencies and weak enforcement mechanisms. However, regulatory quality emerged as a positive moderator, improving the effectiveness of public finance in supporting SDG outcomes. This divergence in institutional effects underscores the complexity of governance dynamics in fiscal policy implementation. The findings suggest that not all institutional indicators contribute uniformly to development, and that improving the quality of regulation may be more impactful than legal formalism alone. The study calls for targeted institutional reforms that go beyond legal frameworks to enhance regulatory capacity, transparency, and accountability in fiscal governance.

Efayena & Olele (2024) examined the moderating role of institutional quality in the relationship between fiscal policy and economic growth across 38 Sub-Saharan African countries over the period 2006–2022. The researchers constructed a composite institutional quality index using principal component analysis (PCA) and applied the dynamic panel Generalized Method of Moments (GMM) to estimate the fiscal policy-growth model. The findings revealed that while fiscal policy alone positively influences economic growth, its interaction with institutional quality exerts a negative and statistically significant effect, suggesting that weak institutions may dampen the growth-enhancing potential of fiscal efforts. The study also confirmed a bidirectional causality between fiscal policy and growth, lending support to the feedback hypothesis. Based on these insights, the authors recommend policy reforms aimed at strengthening institutional quality alongside improved public resource mobilization and expenditure management. Although the study contributes to literature by integrating a moderating institutional dimension, further investigation could enhance understanding by accounting for variations in institutional effectiveness across countries and time.

Ojeka *et al*., (2024) examined the underexplored relationship between external debt and domestic investment in Sub-Saharan Africa, emphasizing the moderating role of institutional quality. Drawing on data from 47 countries between 1996 and 2021, the study employed both conventional and robust estimation techniques. The results reveal that external debt has a statistically significant negative effect on domestic investment, suggesting that rising debt burdens can crowd out productive investment. However, institutional quality was found to significantly moderate this relationship—only countries with institutional scores above −1.174 (on a −2.5 to 2.5 scale) are able to convert debt into productive investment. The analysis further highlights that strong institutions improve resource allocation and investor confidence. Based on these findings, the authors recommend institutional reforms aimed at reducing corruption, safeguarding property rights, and

reinforcing the rule of law. The study provides valuable guidance for aligning debt management with investment-led growth, though additional differentiation by debt type could strengthen the policy implications.

Mutascu *et al*., (2024) explored the relationship between public debt and income inequality across several Sub-Saharan African countries, with a particular focus on regional variations. Utilizing Bayesian Model Averaging (BMA) on data spanning 1997–2019, the study provides nuanced insights into how public debt influences inequality across income groups. It finds that in the WAEMU region, public debt tends to reduce inequality among the poor but adversely affects the rich, while in EMCCA countries, the effect is largely neutral unless moderated by strong corruption control, which can then improve equity among higher-income groups. The paper stands out as one of the first to disaggregate the inequality effects of public debt across different income strata in SSA. It further investigates the interplay between debt, corruption, and socio-economic characteristics in shaping distributional outcomes. The authors call for stronger anti-corruption measures and tailored fiscal strategies to optimize the equity effects of debt. While the regional differentiation enhances policy relevance, incorporating broader institutional dynamics could yield deeper insights.

Farooq *et al*., (2024) investigated the relationship between external debt and economic growth in South Asian economies, with a particular focus on the moderating role of governance. Using annual data from 2000 to 2019, the researchers employed Fully Modified Ordinary Least Squares (FMOLS) and Dynamic Ordinary Least Squares (DOLS) models for empirical estimation. The findings indicate that both long- and short-term external debt exert a significant negative effect on economic growth, while governance positively influences growth outcomes. Notably, governance also plays a positive moderating role, enhancing the capacity of external debt to contribute to economic progress. The study concludes that strengthening governance systems can transform debt from a burden into a development tool. Based on these results, policy recommendations include reducing external borrowing, improving institutional quality, and ensuring transparency in debt-financed development. While the South Asian context provides relevant insights, applying similar analysis to African economies could enrich comparative understanding.

Fengju and Wubishet (2024) found that in East Africa, financial development contributes more significantly to economic growth when supported by strong institutional frameworks. Using GMM estimations, they showed that indicators such as rule of law and corruption control strengthen the finance–growth relationship. Similarly, Chowdhury *et al*., (2024), analyzing data from 133 countries, reported that debt undermines macroeconomic stability unless institutional quality surpasses a critical threshold highlighting the necessity of governance reforms in debt-laden economies. Yousaf and Aziz (2024) identified a debt threshold at 56% of GDP, beyond which economic growth deteriorates, reinforcing the need for responsible borrowing and long-term fiscal policy reforms to ensure macroeconomic resilience.

Ramzan *et al*., (2023) conducted an in-depth analysis of Pakistan's economy from 1996 to 2020 to explore the dynamic effects of public debt on economic performance. Their findings reveal that public debt contributes positively to short-run economic growth, likely through increased government spending and demand stimulation. However, in the long run, debt accumulation imposes a drag on development by crowding out private investment, increasing fiscal pressure, and reducing policy flexibility. Crucially, the study highlights that strong institutional quality—particularly in areas like governance effectiveness, rule of law, and anti-corruption measures—can significantly cushion the adverse long-term effects of debt. Countries with stronger institutions were better positioned to channel debt into productive investments, thereby sustaining growth. These results emphasize that without robust institutional frameworks, public borrowing may lead to unsustainable fiscal trajectories. The authors advocate for comprehensive institutional reforms to enhance transparency, accountability, and efficiency in debt management as a prerequisite for long-term economic resilience.

2.2 Theoretical Framework

The relationship between debt, institutional quality, and sustainable development in Sub-Saharan Africa can be theoretically anchored in three complementary frameworks: the Debt Overhang Theory (Krugman, 1988), New Institutional Economics (NIE) (North, 1990), and the Endogenous Growth Theory (Romer, 1990). The Debt Overhang Theory posits that excessive public debt discourages investment and growth by creating uncertainty around future taxation and reducing investor incentives, as any returns are likely to be appropriated for debt servicing (Krugman, 1988). This theory explains why, in many SSA countries, rising debt burdens can constrain development by limiting fiscal space for productive expenditure. Complementing this, North's (1990) New Institutional Economics underscores the role of institutions—formal and informal rules, including governance quality, regulatory efficiency, and corruption control—in shaping economic performance. NIE helps explain how the effectiveness of debt-financed spending depends on the quality of institutions that manage and allocate resources. Finally, Romer's (1990) Endogenous Growth Theory emphasizes the role of human capital, technology, and institutional frameworks as internal drivers of long-term development, rather than mere capital accumulation. It reinforces the idea that public investment (often financed through debt) leads to sustainable growth only when institutions can facilitate innovation, education, and infrastructure efficiency. Together, these theories provide a comprehensive lens for understanding how debt interacts with institutional quality to influence sustainable

development outcomes, highlighting that not only the quantity of debt but also the quality of governance and policy implementation determines its developmental effectiveness in the SSA context.

3.0 METHODOLOGY AND MODEL SPECIFICATION

3.1 Methodology

This study adopts a quantitative panel econometric approach to examine the dynamic relationship between public debt, institutional quality, and sustainable development in Sub-Saharan Africa (SSA), while identifying the transmission channels through which debt influences development outcomes. In line with the research objective, that is to move beyond macroeconomic aggregates and explore structural pathways, the methodology integrates both interaction/moderation models and transmission (mediation) analysis.

The study employs the Sustainable Development Index (SDI) as the dependent variable, capturing multidimensional progress in health, education, environmental sustainability, and economic resilience. Key explanatory variables include Public Debt (as a percentage of GDP), representing the fiscal debt burden, and Institutional Quality (INSTQ), a composite index derived from World Governance Indicators, specifically rule of law, control of corruption, and regulatory quality constructed through normalization and weighted aggregation. An interaction term (Debt × Institutional Quality) is included to assess the moderating influence of governance on the debt–development relationship. The analysis also incorporates four structural transmission channels: Gross Fixed Capital Formation (investment, % of GDP), Foreign Direct Investment (FDI, % of GDP), Inflation Rate (annual CPI %), and Debt Servicing Costs (interest payments as % of government revenue). Control variables include Population Growth Rate and Exchange Rate, accounting for demographic and macroeconomic dynamics.

3.2 Estimation Technique

Given the dynamic nature of development processes and potential endogeneity concerns, this study employs the System Generalized Method of Moments (System GMM) estimator proposed by Arellano and Bover (1995) and Blundell and Bond (1998). This technique controls for: endogeneity of regressors, country-specific fixed effects, time effects, and autocorrelation and heteroskedasticity, while lagged dependent variables are used as instruments to avoid simultaneity bias.

3.3 Model Specification

Model 3.1: Baseline Dynamic Model (Direct Effects + Moderation)

$$SDI_{it} = \propto + \beta_1 SDI_{it-1} + \beta_2 EXDT_{it} + \beta_3 INSTQ_{it} + \beta_4 (EXDT_{it} \times INSTQ_{it}) + \beta_5 \boldsymbol{X}_{it} + \mu_i + \pi_t + \varepsilon_{it} \quad (3.1)$$

Where:

$\boldsymbol{X}_{it}$ = Vector of control variables

μ_i, π_t = Country and time effects

Other variables are as defined in 3.1

Model 3.2: Transmission Channel Models (Separate Equations)

To trace the transmission mechanism, four separate models are estimated, regressing each transmission variable on debt and institutions.

Model 3.2A: Investment Channel

$$GFCF_{it} = \propto + \omega_1 EXDT_{it} + \omega_2 INSTQ_{it} + \beta_4 (EXDT_{it} \times INSTQ_{it}) + \omega_5 \boldsymbol{Z}_{it} + \mu_i + \pi_t + \varepsilon_{it} \quad (3.2)$$

Model 3.2B: FDI Channel

$$FDI_{it} = \propto + \varphi_1 EXDT_{it} + \varphi_2 INSTQ_{it} + \varphi_4 (EXDT_{it} \times INSTQ_{it}) + \varphi_5 \boldsymbol{Z}_{it} + \mu_i + \pi_t + \varepsilon_{it} \quad (3.3)$$

Model 3.2C: Inflation Channel

$$INF_{it} = \propto + \gamma_1 EXDT_{it} + \gamma_2 INSTQ_{it} + \gamma_4 (EXDT_{it} \times INSTQ_{it}) + \gamma_5 \boldsymbol{Z}_{it} + \mu_i + \pi_t + \varepsilon_{it} \quad (3.4)$$

Model 3.2D: Debt Servicing Channel

$$DSERV_{it} = \propto + \vartheta_1 EXDT_{it} + \vartheta_2 INSTQ_{it} + \vartheta_4 (EXDT_{it} \times INSTQ_{it}) + \vartheta_5 \boldsymbol{Z}_{it} + \mu_i + \pi_t + \varepsilon_{it} \quad (3.5)$$

Then, in a second stage, each channel variable (GFCF, FDI, Inflation, DebtService) is included in the SDI equation one by one to test its mediating role, as:

$$SDI_{it} = \propto + \beta_1 SDI_{it-1} + \beta_2 \boldsymbol{Channels}_{it} + \beta_3 \boldsymbol{X}_{it} + \mu_i + \pi_t + \varepsilon_{it} \quad (3.6)$$

3.4 Diagnostic and Robustness Checks

The robustness checks will be carried out using Hansen J test to show the validity of instruments and combining all channels into one model to compare their relative strengths and Panel ARDL ECM.

3.4 Nature and Sources of Data

This work employed secondary data across 40 countries spanning 27 years from 1996 to 2023. The sources and measurements are indicated in table 3.1.

Table 3.1: Variables, Measurement, and Sources

Variable	Description / Measurement	Source
SDI (Sustainable Development Index)	Composite index incorporating social, economic, and environmental indicators to measure sustainable development	Samuel (2025)
EXDT (External Debt)	External debt stock as a percentage of Gross National Income (GNI)	World Bank (WDI)
DSERV (Debt Service)	Total debt service payments as a percentage of GNI	World Bank (WDI)
INSTQ (Institutional Quality)	Composite index of governance indicators including rule of law, government effectiveness, and corruption control	Samuel (2025)
EDBTINSTQ	Interaction term between external debt and institutional quality	Author's computation
FDI (Foreign Direct Investment)	Net inflows of FDI as a percentage of GDP	World Bank (WDI)
GFCF (Gross Fixed Capital Formation)	Investment measured as a percentage of GDP	World Bank (WDI)
INF (Inflation)	Annual consumer price inflation (%)	World Bank (WDI)
EXR (Exchange Rate)	Official exchange rate (LCU per US$, period average)	World Bank (WDI)
LENDR (Lending Interest Rate)	Lending interest rate (%)	World Bank (WDI)
POPG (Population Growth)	Annual population growth rate (%)	World Bank (WDI)

Source*: Authors-generated*

4.0 RESULTS AND ANALYSIS

The results and analysis section presents the empirical findings from the dynamic panel GMM estimation and the panel ARDL error correction models used to examine the effects of external debt and institutional quality on sustainable development in Sub-Saharan Africa (SSA). The section also explores the moderating roles of key transmission channels like foreign direct investment (FDI), gross fixed capital formation (GFCF), inflation, and debt servicing in shaping the debt–development nexus. The results are interpreted in light of theoretical expectations and existing literature, offering insights into both the direct and conditional impacts of debt and governance on sustainability outcomes in the region.

4.1 Panel Unit Root Test

To determine the stationarity properties of the variables and guide the appropriate estimation technique, four standard panel unit root tests were employed: Levin, Lin & Chu (LLC), Im, Pesaran and Shin (IPS), ADF-Fisher Chi-square, and PP-Fisher Chi-square. The tests were conducted at both levels and first differences, and the order of integration for each variable was determined accordingly as shown in table 4.1.

Table 4.1: Panel Unit Root test results

	At Level				At First Difference				
Variables	**Levin, Lin & Chu t***	**Im, Pesaran and Shin W-stat**	**ADF - Fisher Chi-square**	**PP - Fisher Chi-square**	**Levin, Lin & Chu t***	**Im, Pesaran and Shin W-stat**	**ADF - Fisher Chi-square**	**PP - Fisher Chi-square**	**Order of Int**
EDBT	0.0005	0.3288	0.6824	0.2938	0.0000	0.0000	0.0000	0.0000	I(1)
DSEV	1.0000	1.0000	0.5152	0.0017	0.0000	0.0000	0.0000	0.0000	I(1)
GFCF	0.0006	0.0047	0.0001	0.0037					I(0)
FDI	0.0000	0.0000	0.0000	0.0000					I(0)
LENDR	1.0000	0.2513	0.0295	0.0000	1.0000	0.0000	0.0000	0.0000	I(1)
POPG	0.0000	0.0000	0.0000	0.0000					I(0)
INF	0.0000	0.0000	0.0000	0.0000					I(0)
INSTQ	0.4023	0.9866	0.9945	0.9289	0.0000	0.0000	0.0000	0.0000	I(1)
EXR	0.9999	1.0000	0.9224	0.9772	0.0000	0.0000	0.0000	0.0000	I(1)
SDI	0.0000	1.0000	0.3482	0.3937	0.0000	0.0000	0.0000	0.0000	I(1)
EDBTINSTQ	0.0013	0.2853	0.5068	0.0958	0.0000	0.0000	0.0000	0.0000	I(1)

Source*: Authors-generated*

The results in table 4.1 indicate that the variables fall into two categories:

i. **Stationary at Level, I(0)**: Variables such as FDI, GFCF, POPG, and INF are found to be stationary at level across all tests. This suggests that their statistical properties do not exhibit time-dependent trends and are mean-reverting in nature.
ii. **Stationary at First Difference, I(1)**: Key macroeconomic and institutional variables like External Debt (EDBT), Debt Servicing (DSEV), Lending Rate (LENDR), Institutional Quality (INSTQ), Exchange Rate (EXR), Sustainable Development Index (SDI), and the interaction term between debt and institutions (EDBTINSTQ) are non-stationary at level but become stationary after first differencing. This confirms that these series are integrated of order one. The mixed order of integration (I(0) and I(1)) validates the use of dynamic panel techniques such as the System GMM estimator, which is robust to different orders of integration and effectively addresses potential endogeneity and autocorrelation issues.

4.2 Panel Cointegration Test

To assess the long-run equilibrium relationship among the core variables in the study—namely, external debt (EXDT), debt servicing (DSERV), institutional quality (INSTQ), the interaction term (EDBTINSTQ), gross fixed capital formation (GFCF), foreign direct investment (FDI), exchange rate (EXR), inflation (INF), population growth (POPG), and sustainable development index (SDI)—the Johansen Fisher panel cointegration test was employed using both the trace and maximum eigenvalue statistics.

Table 4.2: Panel Cointegration test results

Johansen Fisher Panel Cointegration Test				
Hypothesized	**Fisher Stat.***		**Fisher Stat.***	
No. of CE(s)	**(from trace test)**	**Prob.**	**(from max-eigen test)**	**Prob.**
None	54.07	0.9822	54.07	0.9822
At most 1	54.07	0.9822	54.07	0.9822
At most 2	52.68	0.9876	71.10	0.6970
At most 3	40.20	0.9999	224.4	0.0000
At most 4	12.48	1.0000	565.1	0.0000
At most 5	1.386	1.0000	701.4	0.0000
At most 6	0.000	0.0000	718.4	0.0000
At most 7	663.1	0.0000	718.4	0.0000
At most 8	1064.	0.0000	792.6	0.0000
At most 9	579.4	0.0000	453.5	0.0000
At most 10	306.3	0.0000	306.3	0.0000

Source: *Authors-generated*

The results in Table 4.2 indicate that cointegration exists among the variables. Specifically, beginning from "at most 3", the p-values become statistically significant, particularly with Fisher statistics (max-eigen) showing p = 0.0000 from that point onward. This suggests the existence of at least four cointegrating vectors, confirming the presence of a long-run relationship among the key macroeconomic, institutional, and sustainability variables in the model.

This result supports the theoretical assumption that public debt and its transmission through investment, FDI, inflation, and institutional channels exhibit long-term dynamic interactions with sustainable development in Sub-Saharan Africa. As such, the cointegration findings justify the subsequent use of the dynamic panel GMM approach and panel Autoregressive Distributed Lag model Error Correction Model, particularly in the context of short-run adjustments around a long-run equilibrium path (Baltagi, 2008).

4.3 DISCUSSION OF RESULTS

4.3.1 Channels of Transmission

To understand how public debt and institutional quality influence sustainable development in Sub-Saharan Africa, it is essential to investigate the intermediate transmission mechanisms. These mechanisms, which are gross capital formation (GFCF), foreign direct investment (FDI), inflation (INF), and debt servicing (DSERV) serve as key channels through which macroeconomic and governance variables exert their effects. Using panel GMM estimation across 40 countries from 1996 to 2023, the models assess the direct and interaction effects of external debt and institutional quality on these channels. Table 4.3 presents a consolidated summary of the empirical results.

Table 4.3: Aggregated GMM Estimates of Transmission Channels

Variable	GFCF (Investment)	FDI	INF (Inflation)	DSERV (Debt Service)
EXDT	+0.128***	-0.132***	+1.553***	-1.54E+08***
INSTQ	+25.67***	-25.73***	+270.38***	-2.85E+10***
EDBTINSTQ	-0.281***	+0.291***	-3.33***	+3.35E+08***
FDI	+0.954***	—	+10.23***	-1.11E+09***
GFCF	—	+1.001***	-10.41***	+1.12E+09***
DSERV	+6.69E-10***	-7.00E-10***	+7.51E-09***	—
INF	-0.077***	+0.080***	—	+9.32E+07***
EXR	Not significant	Not significant	Not significant	Not significant
POPG	+2.36***	-2.31***	+23.77***	-2.57E+09***
Prob(J-stat)	0.36	0.35	0.29	0.25

Source*: Authors-generated*

Note: Significance level: ***1%, **5%, *10%

4.3.2 Thematic Analysis

1. **External Debt (EXDT):** External debt produces a dual role in the model. It positively affects investment and inflation, suggesting debt-financed public spending may stimulate domestic capital formation and short-run demand pressures, as confirmed by (Pattillo *et al*., 2004; Qureshi & Liaqat, 2020). However, it reduces FDI inflows and increases debt service costs, confirming that high debt may deter external investors due to risks of default and fiscal crowd-out (Reinhart & Rogoff, 2010; Presbitero, 2012).
2. **Institutional Quality (INSTQ):** Higher institutional quality boosts investment but paradoxically reduces FDI and increases inflation. The negative effect on FDI could reflect policy tightening or rent-seeking reduction that deters speculative flows (Abaidoo & Agyapong, 2022). Its inflationary effect may be due to better reporting or monetized fiscal operations in more transparent systems. The negative effect on DSERV implies stronger institutions help contain debt repayment burdens (Kemoe & Zhan, 2018).
3. **Interaction Term (EDBTINSTQ):** This captures the moderating effect of institutional quality on debt. The interaction reduces investment and inflation but increases FDI and debt servicing. These mixed results imply that while strong institutions enhance the productivity of external finance for FDI, they may increase the formal compliance cost of debt service especially if debt is contractually bound. This aligns with Bosomtwe (2025), who found mixed institutional effects on fiscal policy.
4. **Transmission via Channels**: Investment (GFCF) and FDI are clearly shaped by both debt and institutions, indicating their centrality in the transmission mechanism. Inflation is significantly affected by nearly all variables, suggesting it's a sensitive macro channel. Debt service (DSERV**)** is the most directly affected by the debt-related variables, reaffirming its role as an outcome of poor debt dynamics. Population growth (POPG) plays a significant role across all models, enhancing investment and inflation but deterring FDI and increasing DSERV. Inflation (INF) also reciprocally influences other channels.

4.3.3 Moderating Roles of the Channels

In this section we have the aggregated summary table (Table 4.4) of the four GMM regression results examining the moderating roles of investment (GFCF), FDI, inflation (INF), and debt servicing (DSERV) in the debt–institutional quality–sustainable development (SDI) nexus, followed by interpretation and analysis.

1. Integrated Interpretation and Analysis of Transmission Channels of Debt to Sustainable Development in SSA

The dynamic GMM estimation results (Table 4.4) robustly illustrate the mechanisms through which debt and institutional quality interact and transmit to sustainable development in Sub-Saharan Africa (SSA). Across all four moderation models representing the transmission roles of Foreign Direct Investment (FDI), Gross Fixed Capital Formation (GFCF), inflation (INF), and debt servicing (DSERV), the lagged dependent variable (SDI(-1)) is consistently positive and highly significant, confirming strong inertia and persistence in sustainable development trends over time. This indicates that past performance significantly influences present outcomes, reinforcing the importance of continuity in policy implementation.

Table 4.4: GMM Regression Estimates – Moderation Channels to SDI

Variable	Model 1: FDI	Model 2: GFCF	Model 3: INF	Model 4: DSERV
SDI(-1)	0.972*** (0.008)	0.969*** (0.013)	0.971*** (0.008)	0.973*** (0.008)
FDI	0.00007 (0.0002)	–	–	–
GFCF	–	0.00012 (0.0003)	–	–
INF	–	–	-2.8E-09	–
DSERV	–	–	–	2.73E-14 (3.46E-13)

Variable	Model 1: FDI	Model 2: GFCF	Model 3: INF	Model 4: DSERV
EXDT	0.00032*** (0.00009)	0.00035*** (0.00013)	0.00038*** (0.00011)	0.00031*** (0.00009)
INSTQ	0.0328*** (0.0086)	0.0335*** (0.0092)	0.0347*** (0.0090)	0.0324*** (0.0085)
EDBTINSTQ	-0.00059*** (0.00017)	-0.00064*** (0.00024)	-0.00070*** (0.00020)	-0.00058*** (0.00016)
EXR	-2.98E-11** (1.28E-11)	-3.22E-11** (1.48E-11)	-3.18E-11** (1.33E-11)	-2.99E-11** (1.27E-11)
POPG	0.00018 (0.00069)	-0.00016 (0.00124)	0.00022 (0.00068)	0.00018 (0.00066)
J-stat (p-val)	0.514	0.542	0.752	0.744

Source*: Authors-generated*
Note: Significance level: ***1%, **5%, *10%

External debt (EXDT) maintains a consistently significant and positive effect on SDI across all four models, supporting the argument that debt, when well-managed, can be a catalyst for achieving Sustainable Development Goals (SDGs). This is in line with Asongu and Odhiambo (2020), who emphasized that external borrowing can enhance development when channelled through productive investments under credible institutional and macroeconomic frameworks.

Institutional quality (INSTQ) also displays a consistently positive and significant influence on SDI, echoing the seminal assertions of Acemoglu and Robinson (2012) on the foundational role of strong institutions in fostering inclusive and sustained development. However, the interaction term (EDBTINSTQ) is persistently negative and significant in all models, suggesting that in environments with weak institutions, the benefits of external debt are either diluted or reversed. This finding aligns with Bosomtwe (2025), Ramzan *et al*., (2023), and Musah *et al*., (2024), who caution that debt without governance reform could entrench vulnerabilities. The examination of the four transmission channels individually are as follows.

i. **FDI (Model 1)**: FDI's coefficient is positive but statistically insignificant (p = 0.73), suggesting that while foreign capital may complement development, it is not an autonomous driver of sustainability in SSA. This could stem from the enclave nature of FDI in extractive sectors or governance constraints that limit its developmental spillovers (Abaidoo & Agyapong, 2022).
ii. **GFCF (Model 2)**: Investment in physical capital also fails to achieve significance (p = 0.69). This supports arguments in Musah *et al*., (2024) that structural inefficiencies—such as corruption, misallocation, and poor project execution—undermine the development potential of capital accumulation.
iii. **Inflation (Model 3)**: INF emerges as weakly significant and negatively signed (p = 0.0735), indicating that macroeconomic instability erodes the effectiveness of development planning and debt utilization. This aligns with Chowdhury *et al*., (2024), who note that inflation beyond certain thresholds disrupts long-term fiscal sustainability and undermines SDG progress.
iv. **Debt Servicing (Model 4)**: DSERV is statistically insignificant, indicating that debt repayment pressures may not have a visible impact on SDI—possibly due to aid buffers, restructuring, or deferred servicing burdens. However, the insignificance warrants caution as it could mask long-term sustainability threats, especially as debt stocks rise.

Overall, the models support the central hypothesis of this study: that institutional quality is a crucial mediator in the debt-development relationship. Even where financial flows (FDI and GFCF) or macro-stability indicators (inflation and debt servicing) are present, their effectiveness in driving sustainable outcomes hinges critically on the quality of governance. These findings also respond directly to the research gaps identified earlier, by operationalizing the theoretical transmission pathways and empirically validating the conditions under which debt facilitates or hinders development.

Importantly, the analysis transcends macroeconomic aggregates to identify how governance shapes debt outcomes through real-sector channels. This lends strong support to a multidimensional policy approach that not only focuses on reducing debt levels but also simultaneously enhances governance, investment quality, price stability, and public financial management. In essence, the study confirms that sustainable development in SSA depends on the strategic alignment of debt strategy, institutional reform, and the optimization of transmission channels.

2. Model Diagnostics and Evaluation

i. R-squared and Adjusted R-Squared

Across all four GMM moderation models (FDI, GFCF, INF, DSERV), the R-squared values range between 0.892 and 0.897, with adjusted R-squared values following closely. This indicates that approximately 89.2% to 89.7% of the variation in sustainable development (SDI) is explained by the models' explanatory variables. These are notably high values for panel data and GMM models, which often include first-differenced or lagged variables. This strong explanatory power demonstrates that the selected independent variables, including debt, institutional quality, and their interaction terms, as well as the transmission channels are jointly important in shaping sustainable development outcomes in Sub-Saharan Africa. The consistent significance of the lagged SDI (SDI(-1)) also reinforces the model's dynamic structure and the persistence of development processes.

ii. J-Statistics

The J-statistic (Hansen test of overidentifying restrictions) tests the validity of the instruments used in GMM. The null hypothesis is that the instruments are valid (i.e., not correlated with the error term).

Table 4.5: J-Statistics and P-Values

J-Statistic and its P-value		
Model	**J-Statistic**	**Prob (J-statistic)**
Model 1 (FDI)	4.25	0.514
Model 2 (GFCF)	4.05	0.542
Model 3 (INF)	3.437	0.752
Model 4 (DSERV)	5.122	0.744

Source*: Authors-generated*

In all four models, the p-values of the J-statistics are well above 0.05, suggesting we fail to reject the null hypothesis, and thus, the instruments used are valid and uncorrelated with the residuals. This strengthens the internal validity of the estimations and enhances confidence in the model results.

iii. Addressing Endogeneity

Endogeneity is a key issue in estimating the effects of public debt and institutions on development and can arise due to reverse causality (e.g., higher SDI attracting more FDI or leading to lower debt), omitted variable bias, or measurement errors. This was addressed through System GMM estimation which uses internal instruments (lagged levels and lagged differences) to control for unobserved heterogeneity and potential endogeneity. The instrument list includes lagged values of key regressors such as EXDT(-1), INSTQ(-2), FDI(-2), DSERV(-2 to -3), and others. The validity of these instruments is confirmed via the J-statistic, as explained above. By using lagged variables as instruments and validating them through Hansen's test, the models effectively control for simultaneity bias and dynamic endogeneity, which is critical when analysing development, debt, and institutional interactions over time.

A combination of high R-squared values, statistically valid instruments (J-test), and the application of System GMM to control for endogeneity, the models are methodologically sound and statistically robust for the research objective. They successfully capture the dynamic behaviour of sustainable development, the interaction effect of debt and institutional quality and the moderating influence of economic and financial transmission channels.

4.4 Robustness Check using Panel ARDL ECM

To ensure the reliability and consistency of the GMM findings, a robustness check was conducted using the Panel Autoregressive Distributed Lag (ARDL) Error Correction Model (ECM) (Table 4.6). This approach is well-suited for datasets with variables integrated at mixed orders of I(0) and I(1), as established by the unit root tests. The Panel ARDL ECM not only captures both short-run dynamics and long-run equilibrium relationships but also provides an additional layer of validation by accounting for potential cointegration among variables. The inclusion of the error correction term (ECT) enables the assessment of the speed at which deviations from the long-run path are corrected, offering deeper insights into the sustainability of development outcomes in Sub-Saharan Africa.

Table 4.6: Aggregated Results of Panel ARDL ECM Models by Transmission Channels

Variable	Model 1 (FDI)	Model 2 (GFCF)	Model 3 (INF)	Model 4 (DSERV)
D(SDI(-1))	0.679***	0.676***	0.689***	0.677***
D(Channel Variable)	3.10E-06 (FDI)	0.000113 (GFCF)	-6.22E-06 (INF)	1.41E-13 (DSERV)
	(0.969)	(0.194)	(0.627)	(0.760)
D(EXDT(-1))	-4.59E-05	-4.22E-05	-4.86E-05	-4.61E-05
D(INSTQ(-1))	-0.0115	-0.0112	-0.0117	-0.0117
D(EDBTINSTQ(-1))	8.95E-05	8.12E-05	9.31E-05	9.00E-05
D(EXR(-1))	4.95E-13	5.65E-13	5.42E-13	4.95E-13
D(POPG(-1))	-0.00252***	-0.00257***	-0.00254***	-0.00254***
ECT(-1)	-1.193***	-1.188***	-1.205***	-1.191***
R-squared	0.226	0.227	0.228	0.226
Prob(F-statistic)	0.000	0.000	0.000	0.000
Durbin-Watson stat	~2.18	~2.18	~2.19	~2.19

Source*: Authors-generated*
Note: Significance level: ***1%, **5%, *10%

All four models in table 4.6 confirm statistically significant adjustment coefficients (ECTs) at the 1% level, with values around -1.19, meaning that 119% of the disequilibrium is corrected annually. This suggests strong convergence to long-run equilibrium, consistent with economic expectations. This high speed suggests that deviations from long-run sustainable development equilibrium are not only corrected quickly but may temporarily overshoot before stabilizing, potentially due to strong institutional responses or rigid policy corrections.

The lagged dependent variable D(SDI(-1)) is consistently significant across models, confirming the persistence of sustainable development dynamics in SSA, similar to what we obtained with The GMM estimations. Short-run effects of the individual channel variables (FDI, GFCF, INF, DSERV) are not statistically significant. This finding mirrors the GMM results, where the channels also failed to exert significant direct short-term effects on SDI. In both models, these transmission channels seem either weakly linked or dependent on complementary institutional or policy factors.

The consistent significance of population growth (negative) across all models and the insignificance of debt, institutional quality, and interaction terms in the short run suggest that SDI responds more to demographic pressures than financial indicators in the immediate term.

4.4.1 Comparison with GMM Results

i. Both GMM and Panel ARDL ECM confirm that SDI is persistent (significant lagged SDI) and that debt (EXDT) interacts with institutions (EDBTINSTQ), although the effects are more long-run in nature.
ii. In GMM, EXDT and INSTQ are individually significant, while the interaction term is negative and significant. In the ARDL short run, these effects are statistically insignificant, reinforcing that the debt-institution-development nexus unfolds more prominently over time.
iii. The ARDL models validate the robustness of GMM results by confirming the absence of immediate effects from the transmission channels and by demonstrating long-run convergence.

The Panel ARDL ECM serves as a valuable robustness check. It reinforces the core findings from the GMM estimations that sustainable development in SSA is driven by long-run factors such as institutional quality and properly managed debt. However, the short-term transmission via FDI, GFCF, inflation, or debt service is weak unless embedded within a strong institutional framework. This validates the central thesis that development outcomes are institutionally mediated and that financial flows alone are insufficient without long-run governance support.

5.0 CONCLUSION AND POLICY RECOMMENDATIONS

The findings of this work confirm that while debt can foster sustainable development in SSA, this effect is conditional on strong institutions. Weak governance undermines the benefits of debt, suggesting that debt alone is insufficient. Policymakers should prioritize institutional reforms to strengthen accountability, transparency, and regulatory effectiveness. Inflation control is critical to stabilize macroeconomic conditions and maximize the productivity of debt. Investment efficiency must be enhanced to align capital formation with sustainability priorities, while efforts should be made to improve the absorptive capacity for FDI. These policies must work in tandem to convert external borrowing into long-term sustainable gains.

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