

# Empirical Analysis of the Impact of External Debt on Capital Formation in Sub-Saharan Africa: The Moderating Role of Institutional Quality

Yusuf Shamsuddeen Nadabo, Muhammad Mustapha Abdullahi

Department of Economics, Umaru Musa Yar'adua University, Katsina

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## ABSTRACT

This study examines the nexus between external debt and capital formation in sub-Saharan African countries, with a focus on the role of institutional quality as a moderator. The analysis covered from 1998 to 2023, using two-step system GMM, panel quantile regression, dynamic threshold estimator and cross-sectional dependence test. The results showed that external debt has a negative impact on capital formation, but this effect is moderated by institutional quality. The study also found that the benefits of debt can be realized in sub-Saharan Africa when the average institutional quality is above a certain threshold. Specifically, countries with strong institutional quality can use debt effectively to promote efficient resource allocation and attract further investment. Therefore, policymakers are encouraged to implement debt management strategies and institutional reforms, such as reducing corruption, improving effective governance, and strengthening the rule of law, to ensure transparency in debt utilization and maintain a sustainable debt level. This will create a more favorable environment for both domestic and foreign investment.

**Keywords:** Capital formation, External debt, Institutional quality, dynamic threshold

**JEL. Code:** B52; C21; E22; F34

## INTRODUCTION

Economic growth in sub-Saharan Africa (SSA) depends on robust capital formation in physical and human capital. Capital formation creates an environment that empowers workforce to be more efficient, productive, and innovative, leading to increased production capacity, improved economic competitiveness, and ultimately, a higher standard of living for citizens (Afonso & Rodrigues, 2024). Improved infrastructure reduces transportation costs, enhances connectivity, and attracts further investment in various sectors (Oli, 2024; Nadabo, 2023). The Sub-Saharan Africa (SSA) region is struggling to achieve sustained and inclusive economic growth due to a lack of capital formation. To address this issue, countries in the region have been accumulating debt to create a conducive environment for business. As a result, external debt levels have increased in the SSA region over the past decade (Nguimkeu & Okou, 2021).

According to the IMF, Sub-Saharan Africa's total external debt to multilateral, bilateral, and commercial creditors, including bondholders, increased by 22.27% from \$658.79 billion in 2018 to \$805.51 billion in 2023. The IMF estimates this debt to rise to \$867.67 billion in 2025, representing 44.88% of the region's GDP. This rising debt burden raises concerns about debt sustainability, especially for countries with weaker economies. Twenty-two SSA countries were classified as being at high risk of external debt distress or already in debt distress (IMF, 2023). Despite accumulating significant debt in recent years, sub-Saharan African nations continue to grapple with low capital formation, hindering long-term growth prospects (Amoh et al. 2024; Nadabo, Abdullahi, & Salisu, 2024).

The connection between external debt and capital formation is complex and has been a subject of debate among economists and policymakers. In one view, some theories argue that high debt levels can crowd-out private investment by competing for resources, resulting in higher interest rates and reduced access to credit (Penzi, et

al. 2022; Agbo & Nwadiolor, 2020; Egbetunde & Akinlo 2019). However, others suggest that debt can signal future growth prospects and attract investment. (Fonchamnyo, et al., 2021; Turan & Yanikkaya, 2021). When governments borrow to finance productive sectors, it shows commitment to economic expansion, boosting investor confidence and stimulating economic activity. In this scenario, external debt can play a proactive role in promoting long-term capital formation and economic growth (Khan & Tariq, 2020; Nadabo, & Salisu, 2023).

Moreover, few studies exist on how institutional quality influences the external debt and capital formation nexus (Akinlo, 2024; Amoh et al. 2024). Institutional quality refers to the effectiveness of a country's governance, including the rule of law, corruption control, regulatory quality, and government effectiveness. While its role in shaping the relationship between external debt and capital formation is important, it has not been fully explored (Kemoe & Lartey, 2022). Strong institutional quality (e.g., effective governance, rule of law, regulatory quality, political stability, Voice and accountability and control of corruption), external debt tends to be more productive. Well-functioning institutional quality can channel borrowed resources into productive investments, which in turn contributes to capital formation and economic growth (Nadabo, et al. 2024; Brou & Thiam, 2023).

This study contributes significantly to the literature on external debt, institutional quality, and capital formation nexus in the SSA region in five ways. Firstly, it employs a two-step system GMM to address endogeneity issues and improve the estimation of model parameters. Secondly, it explores the moderating role of institutional quality on the relationship between external debt and capital formation in Sub-Saharan Africa. Thirdly, it captures the interaction effect between external debt and institutional quality on capital formation in Sub-Saharan Africa. Fourthly, it uses a dynamic panel threshold estimator in line with Seo and Shin (2016), to identify external debt and institutional quality thresholds that can either mar or accelerate capital formation in the region. Lastly, the study utilizes panel quantile regression to analyze the distributional effects of external debt and institutional quality on capital formation. Concurrently, it applied the Driscoll and Kraay estimator that accounts for cross-sectional dependence in the panel (Driscoll & Kraay, 1998). By examining these mechanisms, this study provides valuable insights into debt management strategies to promote capital formation and foster economic growth in SSA.

After this introduction, the rest of the paper is structured as follows: Section 2 of this study reviews theoretical and empirical literature which is followed by methodology and data description in section 3. Section 4 deals with the discussion of empirical results. While section 5 conclude the study and provide policy implications and suggestions.

## LITERATURE REVIEW

### Theoretical literature

The debt overhang theory, proposed by Krugman (1988), explains a situation in which the expected repayment on external debt is lower than the contractual value of the debt. The concept of debt overhang refers to the shortfall in the anticipated current value of potential resource allocation compared to the outstanding debts. Several scholars, including Sachs (1988), have supported the theoretical argument for debt overhang. The crowding-out theory suggests that excessive debt accumulation can reduce capital formation through several channels. As debt rises and servicing costs increase, the government's interest payments and budget deficit grow, reducing public savings. This, in turn, raises interest rates or limits credit availability for private investment. Claessens et al. (1996) found that the decrease in investment is caused by a reduction in a country's available assets for financing investment and macroeconomic activities. This reduction in the nation's ability to sustain its debt is due to the crowding out effect. This leaves little capital for capital formation as the country focuses on meeting its obligations (Okutimiren et al., 2024; Abdullahi, Bakar, & Hassan, 2016).

### Empirical Literature

#### *External debt and capital formation nexus*

Egbetunde and Akinlo (2019) utilized the generalized method of moments (GMM) to analyze the relationship between debt, capital formation, and economic growth in the sub-Saharan African (SSA) region. They found

that corruption, political instability, and weak institutions hinder the effectiveness of debt in stimulating investment in the region. In a study by Fonchamnyo et al. (2021) focusing on the SSA region, the authors provided evidence supporting the crowding-out hypothesis, showing that debt negatively impacts capital formation. The study highlighted the adverse effects of debt, including exchange rate fluctuations, high debt servicing costs, and macroeconomic instability.

Agbo and Nwadiolor (2020) used a panel estimator to study the factors behind debt crises in Africa and found that debt, when used properly, can have positive effects on the economy. However, misallocation of funds into large projects without thorough cost-benefit analysis by experts is a major reason for high debt levels without corresponding investment and growth. Joy and Panda (2020) analyzed quarterly data to examine the impact of Portuguese external debt on their macroeconomic performance from 1999 to 2019. The study revealed that while total external debt hampers private investment, public debt promotes investment in infrastructure and technology. In contrary, Mabula and Mutasa (2019) argued that public debt restricts important areas like business investment and research and development spending. Existing literature also suggests a U-shaped relationship between debt and investment.

Lau et al. (2019) suggested that in the early stages of debt accumulation, when debt service is low, economies benefit from debt up to a certain point. However, beyond this threshold, the efficiency of capital and return on investment diminish, leading to higher debt servicing costs compared to the returns from investment. Picarelli et al. (2019) analyzed panel data from 26 EU countries between 1995 and 2015 using the GMM estimation technique, revealing that foreign debt has a negative impact on public investment. In a study on the influence of public debt on private investment in Sri Lanka from 1978 to 2015, the authors applied a vector error-correction model. Benayed et al. (2015) also identified threshold effects in the relationship between debt and investment, concluding that while debt may provide short-term benefits, its long-term effects are negative and statistically significant. Crowding effects arise from higher interest rates and liquidity constraints due to government borrowing to meet debt obligations.

Nadabo et al. (2024) explore the impact of external debt on capital formation in Nigeria from 1981 to 2022 using the Quantile Autoregressive Distributed Lag (QARDL) model. Their findings indicate that external debt has a notable adverse effect on capital formation in Nigeria, suggesting that increased levels of external debt impede capital formation by disrupting investment choices and distorting economic growth prospects. Apere (2014) conducted a time series analysis in Nigeria and discovered that domestic debt has a positive linear effect on private investment. The study also identified a debt ceiling of 124.69% of GDP, after which the impact of external debt on private investment turns negative. Bai et al. (2024) investigated the relationship between multilateral lending and capital accumulation using data from 175 countries spanning from 1970 to 2017. They utilized the GMM estimation technique and their results indicate a favorable impact of multilateral lending on capital accumulation.

In a study conducted by Fumey, Bekoe, and Imru (2022) using time series data from 1980 to 2019, an ARDL model was applied to analyze the impact of external debt servicing on capital formation in Ghana. The findings indicated a negative effect of external debt servicing in both the short and long term. Serin and Demir (2023) explored the relationship between public debt, public investment, and private investment in Turkey from 1975 to 2020 using the ARDL method. The results revealed that public investment, domestic public debt stock, and external debt service tend to crowd out private investment, while public external debt stock has a crowding-in effect on private sector investments. Dinga, Fonchamnyo, and Afumbom (2024) investigated the impact of external debt and domestic capital formation on economic development in 35 Sub-Saharan African (SSA) countries from 1995 to 2018. Through the use of the Dynamic Common Correlation Effects (DCCE) and Driscoll and Kraay fixed-effect techniques, the study demonstrated a positive relationship between domestic investment and external debt.

### ***Institutional quality, External debt, and capital formation nexus***

Chukwu et al. (2023) investigated how institutional quality moderates the impact of external debt on sectoral growth in 17 developing countries using panel data. The study utilized fully modified ordinary least squares (FMOLS) and concluded that countries with strong institutional frameworks are better able to manage their debt

levels effectively, thereby reducing negative effects on capital formation. Similarly, Harsono et al. (2023) conducted a panel regression analysis on five ASEAN countries, showing that good governance and institutional quality boost investor confidence, lower perceived risks of high external debt, and promote higher levels of capital formation. Strong institutions play a crucial role in managing debt accumulation to stimulate capital formation. Aman et al. (2024) analyzed data from 133 countries using the GMM approach, highlighting that strong institutional quality facilitates efficient allocation of financial resources. Their findings suggest that well-functioning institutions ensure borrowed funds are used effectively for productive investments, enhancing returns and investor confidence.

Akinlo (2024) emphasized the importance of strong institutional quality in maintaining credibility and responsible fiscal policies. Their research indicates that a history of fiscal responsibility and adherence to debt obligations improve a country's creditworthiness, leading to better borrowing terms and reduced debt risks. In contrast, Ashogbon et al. (2023) studied time series data from Nigeria and found that weak institutional quality exacerbates the negative impact of external debt on capital formation. Research conducted by Kaya and Kaya (2020) revealed that in emerging economies, countries with poor governance and weak institutional frameworks are more susceptible to the negative consequences of excessive external debt, resulting in reduced capital formation. In such contexts, investors perceive higher levels of political and economic risk, discouraging both domestic and foreign investment. According to Dollar and Kraay (2003), robust institutions, including accountability, legal enforcement, and anti-corruption measures, help prevent misappropriation of government loans, preserving the positive impacts of debt.

In a comparative analysis of 118 developing economies, Eberhardt and Presbitero (2015) found that countries with the fastest-growing economies and investment levels had an average institutional quality score of 1.06. Furthermore, Egbetunde and Akinlo (2019) utilized the system GMM method in sub-Saharan Africa and concluded that while debt can have crowding-out effects, strong institutions, characterized by effective legal contract enforcement and risk mitigation, help mitigate these negative impacts. Mabula and Mutasa (2019) highlighted that countries with weak rule of law and political instability, coupled with high levels of corruption, undermine the efficacy of contracts and legal safeguards, increasing the risks associated with debt. Benayed et al. (2015) noted that political instability and regulatory uncertainty create unpredictability in the investment climate, leading to increased investment risks and potentially hindering investment schedules, even when borrowed funds are allocated to infrastructure projects and other business facilitators.

The existing literature provides mixed findings on the relationship between debt, institutional quality, and capital formation, indicating the need for a more comprehensive analysis that considers the links between these factors in the context of Sub-Saharan Africa. This study seeks to fill these gaps by investigating how institutional quality influences the relationship between external debt and capital formation in the region, providing valuable insights for policymakers and stakeholders seeking to enhance the impact of debt on economic development.

## METHODOLOGY

This study is based on the debt overhang theory by Krugman (1988) and Sachs (1989). According to this theory, a country's ability to repay its debts improves with increasing debt levels, but reaches a point where further debt accumulation hinders repayment capacity, known as debt overhang. This can hinder capital formation and lead to a poverty trap or investment stagnation. This nexus is represented mathematically as shown in equation (1).

$$I = \max(0, V - D) \quad (1)$$

This suggests that if the debt ( $D$ ) exceeds the value of the new investment ( $V$ ), no new investment will occur (i.e.,  $I=0$ ). However, if ( $D$ ) is less than ( $V$ ), new investment will be feasible, and the investment amount is equal to ( $V-D$ ), which indicates how much of the new value is not consumed by debt repayment. Alternatively, the debt overhang viewed in terms of expected returns from new investments. Suppose the returns from a new investment are ( $r \cdot I$ ). If the debt is too large, the returns might simply go toward paying off debt, leading to under-investment. Debt overhang theory emphasizes the negative impact that excessive debt can have on capital formation. It suggests that when the burden of debt becomes too large, it can prevent new investments from occurring, even if those investments are profitable, because the returns from future investments would largely

be used to pay off existing debt. This study expands equation 1 and incorporates other control variables in equation 2.

$$CFM = f (EXD + INQ + EXR + INR + TOP) \quad (2)$$

We convert the mathematical model in equation 2 into the empirical model that illustrates the influence of external debt on capital formation, with the role of institutional quality represented in equation 3:

$$CFM_{it} = \beta_0 + \beta_1 CFM_{it-1} + \beta_2 EXD_{it-1} + \beta_3 INQ_{it-1} + \beta_4 EXR_{it-1} + \beta_5 INR_{it-1} + \beta_6 TOP_{it-1} + \epsilon_i + \mu_{it} \quad (3)$$

In this study,  $CFM_{it}$  represents capital formation,  $CFM_{it-1}$  represents the dynamic effects of capital formation,  $EXD$  stands for external debt,  $INQ$  represents institutional quality,  $EXR$  stands for the exchange rate,  $INR$  denotes the interest rate, and  $TOP$  indicates trade openness. The constant term and country fixed effect are denoted by  $\epsilon_i$ , and  $t$  is the time index, while the subscripts  $i$  index countries. The stochastic error term,  $\mu_{it}$ , is assumed to follow a normal distribution with a mean of zero and a constant variance of 0. That is,  $\mu_{it} \sim N(\sigma^2, 0)$ . The parameters to be estimated are denoted by  $\beta_0, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ , and  $\beta_6$ , respectively.

Extending Equation 3, the interaction term between institutional quality ( $INQ$ ) and external debt ( $EXD$ ) on capital formation ( $CFM$ ), this interaction effect captures the moderating effect of institutional quality on the relationship between external debt and capital formation. We incorporated the interactive term into the model and re-specified it as follows:

$$CFM_{it} = \beta_0 + \beta_1 CFM_{it-1} + \beta_2 EXD_{it-1} + \beta_3 INQ_{it-1} + \beta_4 (EXD * INQ_{it-1}) + \beta_5 EXR_{it-1} + \beta_6 INR_{it-1} + \beta_7 TOP_{it-1} + \epsilon_i + \mu_{it} \quad (4)$$

Equation 4 enables the study to explore the distinct impact of the interaction between external debt and institutional quality on capital formation in the Sub-Saharan Africa region. We estimate the marginal effect of external debt ( $EXD$ ) on capital formation by taking the partial derivative of Equation 4 with respect to  $EXD$ . This led to the formulation of Equation 5, expressed as follows:

$$\partial CFM_{it} / \partial EXD_{it} = \beta_2 + \beta_3 INQ_{it} \quad (5)$$

The coefficients  $\beta_2$  and  $\beta_3$  capture the interaction effect between external debt ( $EXD$ ) and institutional quality ( $INQ$ ) on capital formation. The signs and magnitudes of these coefficients will determine the specific nature of this interaction.

The signs and magnitudes of these coefficients will determine the specific nature of this interaction. Four possible scenarios can emerge based on the estimated values of  $\beta_2$  and  $\beta_3$ .

- i. If  $\beta_2 > 0$  and  $\beta_3 > 0$ , it implies that external debt has a positive impact on capital formation, and institutional quality acts as a complementary factor that strengthens this positive effect.
- ii. If  $\beta_2 > 0$  and  $\beta_3 < 0$ , it suggests that external debt positively influences capital formation, but institutional quality weakens this positive effect.
- iii. If  $\beta_2 < 0$  and  $\beta_3 > 0$ , it indicates that the negative impact of external debt on capital formation is mitigated and reduced by institutional quality.
- iv. If  $\beta_2 < 0$  and  $\beta_3 < 0$ , it implies that external debt crowds out capital formation, and institutional quality worsens the negative effect of external debt on capital formation.

Previous studies have identified potential bias in estimates from traditional pooled OLS, fixed, and random effects models for dynamic panel data with country specific effects ( $\epsilon_i$ ) and lagged dependent variables ( $CFM_{it-1}$ ) (Akinlo, 2024; Manasseh et al. 2022; Ring et al. 2021). This bias arises because the country specific effects may be correlated with the lagged dependent variable ( $(CFM_{it-1}, \epsilon_i) \neq 0$ ). To overcome these limitations, this study recommends using the first-difference transformation. This technique removes the country specific

effects ( $\epsilon_i$ ) by differencing Equation 2. The transformed equation is shown below:

$$\Delta CF_{Mit} = \beta_0 + \beta_1 \Delta CF_{Mit-1} + \beta_2 \Delta EXD_{it-1} + \beta_3 \Delta INQ_{it-1} + \beta_4 (\Delta EXD * INQ_{it-1}) + \beta_5 \Delta EXR_{it-1} + \beta_6 \Delta INR_{it-1} + \beta_7 \Delta TOP_{it-1} + \Delta \mu_{it} \quad (6)$$

Equation 6 in traditional models can lead to simultaneity bias and endogeneity from omitted variables like financial development and inflation. The first-difference transformation removes country specific effects but introduces new endogeneity. To address this, we use dynamic GMM with instrumental variables to mitigate endogeneity. Moment restrictions are applied to ensure consistent estimates. This method requires  $N > T$ , which is satisfied in our study with 47 countries over 25 years.

### Data and variable measurement Source

Table 1 Data and variable measurement Source

Definition	Variable	Measurement	Expected sign	Sources
Capital Formation	CFM	Gross fixed capital formation (%GDP)	DV	WDI
External debt	EXD	External debt stock (%GDP)	-	WDI
Interest rate	INR	Real interest rate	-	WDI
Exchange rate	EXR	Real exchange rate	-	WDI
Trade openness	TOP	Trade(% GDP)	+	WDI
Institutional quality	INQ	Average of six indicators of INQ	+	WGI
Interactive term	INQ*EXD			AC

– and + denote negative and positive effect of the regressor on capital formation, respectively, while DV is the dependent variable. WDI is World Development Indicators; WGI is World Governance Indicators and AC Authors Computation.

## RESULTS AND DISCUSSION

This section uses robust econometric analyses to examine the connection between debt, institutional quality, and capital formation. It begins with summary statistics and correlation analysis, and then presents estimators. Table 2 Panel A, presents summary statistics results. The data indicates that the average capital formation value (% of GDP) in the study is 18.560, suggesting low investment prevalence in sub-Saharan Africa. This could be due to economic uncertainties, weak institutions marked by high corruption levels, and governance inefficiencies. The mean values for external debt, exchange rate, trade openness, debt service, interest rate, and institutional quality are 76.661, 97.303, 62.422, 8.906, and -0.755, respectively. Institutional quality in SSA, measured on a scale from -2.5 to 2.5, has a concerning mean value of -0.755, indicating issues like corruption, disregard for the rule of law, and political instability (Kaya & Kaya, 2020). The low standard deviation values suggest data proximity to the means. Botswana has the lowest debt burden at 3.786, while Liberia has the highest at 611.322. Sierra Leone and the Republic of Congo show contrasting capital formation levels in SSA. Institutional quality ranges from Congo, Dem. Rep. with the weakest (-1.96) to Mauritius with the strongest (0.88) institutional quality in the panel.

Table 2 Summary statistics and correlation analysis

Variable	CFM	EXD	EXR	OPN	INR	INQ
Mean	18.56	76.661	97.302	62.422	8.906	-0.755

Std. Dev.	8.233	78.768	45.646	43.645	13.317	0.688
Min	-3.444	3.786	64.771	3.892	-84.713	-2.657
Max	91.033	611.322	501.051	352.712	62.407	0.876
CFM	1					
EXD	-0.461	1				
EXR	-0.087	0.083	1			
OPN	0.458	-0.309	-0.303	1		
INR	-0.133	-0.043	0.234	-0.088	1	
INQ	0.195	-0.335	-0.386	0.379	-0.074	1

Std. Dev. Is the standard deviation; Min is the minimum value and Max is the maximum value.

Table 2, Panel B, provides a summary of the correlation matrix. The findings reveal a negative relationship between external debt, and exchange rate on capital formation in Sub-Saharan Africa (SSA). This suggests that higher external debt levels are associated with lower capital formation levels. On the other hand, trade openness and institutional quality exhibit a positive correlation with capital formation, indicating that an increase in these factors could boost investment in Africa. The correlation analysis aims to identify and address variables with strong correlations to avoid multicollinearity issues.

Table 3 summarizes that all models agree that external debt significantly hinders capital formation in sub-Saharan Africa. This finding is consistent with existing literature (Ezeabasili, & Nwakoby, 2013; Oli, 2024) and supports the argument of Thilanka and Ranjith (2018) that excessive debt leads to liquidity constraints, interest rate hikes, and difficulty in borrowing for investors, thus crowding out investment. However, Ogunjimi (2019) found a positive relationship between debt and capital formation, suggesting that external debt can help bridge the financing gap for productive capital formation in developing countries with limited domestic savings. These debts can be utilized for infrastructure projects, technology acquisition, or business expansion, leading to economic growth and attracting further investment. Nadabo et al. (2024) also emphasized that external debt enables investors to access global markets and diversify risks through external finance, allowing them to spread risks across portfolios and nations.

In this study, we argue that external debt can be a valuable tool for financing capital formation, but its effectiveness depends on the quality of a region institutional quality. Africa's weak rule of law and high corruption often lead to misallocation of borrowed funds, reducing the amount available for productive investment in the region (Okora & Bello, 2024; Van-Bon, 2022). Our findings support the institutional school of thought, showing that institutions significantly predict capital formation outcomes when other variables are held constant.

Table 3 external debt, institutional quality and capital formation results from 2-SGMM, Drisc/Kraay and random effects

	2-SGMM		Random effects		Driscoll-Kraay regression	
CFM(-1)	-0.093*** (0.000)	-0.072*** (0.000)				
EXD	-0.027**	-0.022**	-0.029***	-0.018**	-0.027***	-0.026**
	-0.026	-0.044	0	-0.045	-0.008	-0.027
EXR	0.177*	0.144*	0.153*	0.005**	0.177	0.19

	-0.064	-0.062	-0.055	-0.057	-0.163	-0.137
INR	-0.046**	0.031*	0.011*	0.009**	0.018	0.013
	-0.043	-0.089	-0.082	-0.032	-0.756	-0.89
OPN	0.079	0.049	0.047	0.059	0.053	0.057
	0	0	0	0	-0.157	-0.159
INQ	2.456***	1.134**	1.678***	1.309**	1.481**	1.793*
	-0.002	-0.038	-0.004	-0.084	-0.04	-0.042
EXD*INQ		0.033**				
	-0.035	0.014*				
	-0.086	0.004*				
	-0.075					
Cons	18.837***	18.645***	17.133***	16.755***	16.774***	16.758***
	0	0	0	0	0	0
Tests						
AR(1)	-2.476** (0.013)	-2.423** (0.017)				
AR(2)	-1.423					
	-0.188	-1.177				
	-0.234					
Hansen test	26.198 (0.437)	19.516 (0.435)				
Hausman test			5.761 (0.563)	7.461 (0.32)		

Note: \*, \*\*, and \*\*\* indicate significance levels of  $p < 0.1$ ,  $p < 0.05$ , and  $p < 0.01$ , respectively. The 2-SGMM refers to the two-step system GMM. AR(1) and AR(2) tests assess first and second-order serial correlation. The Hansen test examines instrument validity. The Hausman test probabilities for both the baseline and main models suggest that the random effects model outperformed the fixed effects model.

Our empirical results are consistent with previous studies (Khan & Tariq, 2020; Nguyen, 2022), suggesting that strong institutional quality facilitates access to credit and capital, builds trust, and influences investment decisions. The interaction terms indicate that corruption's negative impact on debt benefits diminishes when strong institutional quality is present. However, our study suggests that the benefits of debt in the SSA region are only realized when institutional quality exceeds a certain threshold on the scale of -2.5 to 2.5, as supported by existing literature (Harsono et al., 2023; Kemoe & Lartey, 2022).

Consistent with theoretical expectations, investment is negatively affected by exchange rate depreciation and interest rate hikes (Batu, 2016; Fonchamnyo et al., 2021; Mensah et al., 2021). These effects result from increased borrowing costs, reduced loan demand, higher production costs, and output prices, leading to decreased demand for firms' output (Nadabo & Abdullahi, 2024; Serin & Demir, 2023). Exchange rate depreciation raises industrial input costs, reduces industrial output competitiveness, increases capital flight, lowers investor confidence, and ultimately reduces capital formation (Tang & Issahaku, 2024; Nadabo, 2023).



Table 4 Distributional effects from generalized panel quantile regression

	0.1	0.25	0.5	0.75	0.9
EXD	-0.066*	-0.065 **	-0.039	0.128**	0.222***
	(0.073)	(0.041)	(0.267)	(0.044)	(0.003)
EXR	-0.082	-0.092	-0.083	-0.067	0.083
	(0.000)	(0.000)	(0.004)	(0.043)	(0.007)
INR	-0.044	-0.036	-0.125	-0.113	-0.177
	(0.332)	(0.356)	(0.058)	(0.195)	(0.085)
OPN	0.127	0.133	0.085	0.053	0.039
	(0.000)	(0.000)	(0.000)	(0.087)	(0.304)
INQ	-0.786	-1.263	-1.545	-5.484	-6.786
	(0.574)	(0.255)	(0.373)	(0.036)	(0.018)
EXD*INQ	0.013	0.023	0.019	0.139	0.237
	(0.788)	(0.333)	(0.670)	(0.008)	(0.000)
Cons	17.364	17.736	21.233	21.707	9.876
	(0.000)	(0.000)	(0.000)	(0.000)	(0.059)

\*, \*\*, and \*\*\*, implies  $p < 0.1$ ,  $p < 0.05$  and  $p < 0.1$ , respectively

Table 4 displays the results of the impact of external debt and institutional quality on capital formation in the SSA region at various quantiles using panel quantile regression. The findings reveal that external debt has a negative effect on capital formation in countries with low initial investment (10th to 50th quantiles) but shows a positive influence in countries with higher capital formation (75th and 90th quantiles). This is consistent with previous research using two-step GMM and random effect estimators. The results suggest that the relationship between external debt and capital formation varies across countries in the SSA region, depending on their initial investment levels. In countries with low investment levels, external debt hinders capital formation, reflecting the traditional crowding-out effect. Conversely, in countries with high investment levels, additional debt can serve as a financing source for further investment projects.

Additionally, institutional quality has a positive impact on capital formation in countries with low to moderate investment levels (10th to 50th quantiles), but this effect turns negative and significant in countries with higher investment levels (75th and 90th quantiles). These contrasting results indicate that weak institutional quality may lead to instability and hinder long-term investment planning. Strong institutions, on the other hand, provide legal certainty, protect investor rights, ensure transparent governance, and reduce bureaucracy, creating a conducive environment for long-term investments and driving capital formation.

Table 5 Output of dynamic threshold estimator

Regime dependent variables	External debt	Institutional quality
EXD_0/INQ_0	0.133*	-1.773
	(0.093)	(0.888)

EXD_1/INQ_1	-0.177***	23.778
	(0.008)	(0.084)*
EXD_0		0.0174
		(0.079)*
EXD_1		0.075
		(0.000)**
Constant	-3.936*	-6.936
	(0.074)	(0.813)
Threshold value	45.715*	-1.183
	(0.096)	(0.048)**
Test of Threshold	0.000***	0.000***

\*, \*\*, and \*\*\* imply  $p < 0.1$ ,  $p < 0.05$ , and  $p < 0.01$ , respectively. EXD\_0/INQ\_0 and EXD\_1/INQ\_1 denote lower and upper regime, respectively. The test for linearity was done using 100.

The impact of external debt and institutional quality on capital formation is influenced by a threshold effect. The findings presented in Table 5 reveal important insights. In the lower range, external debt has a negative and significant effect on capital formation at the 10% level, supporting the crowding-in hypothesis. Conversely, in the upper range, the crowding-out hypothesis is confirmed at the 1% level. This suggests that surpassing an external debt threshold of 45.715 has a detrimental effect on capital formation in the SSA region, reflecting the diminishing returns associated with high debt levels.

Furthermore, in the lower range, institutional quality has a slightly negative impact on capital formation. However, in the upper range, institutional quality becomes a positive and significant driver of capital formation at the 1% level. This highlights that institutional quality above -1.183 on a scale of -2.5 to 2.5 enhances investment. This argument is supported by previous studies (Agbo & Nwadiolor, 2020; Kaya & Kaya, 2020). Conversely, in the higher range of institutional quality, external debt significantly negatively impacts capital formation at the 1% level. In contrast, in the lower range, debt stimulates investment at the 10% level, contradicting some existing literature (Mohsin, et al. 2021; Nadabo, 2023). The findings of this study make a significant contribution to the existing knowledge on the relationship between debt, institutional quality, and capital formation.

## CONCLUSIONS AND POLICY IMPLICATIONS

The impact of external debt on capital formation remains an area that requires further exploration. This study adds to the existing studies by investigating how institutional quality moderates the relationship between external debt and capital formation in Sub-Saharan African countries. We utilized robust econometric methods, including two-step GMM and the Driscoll/Kraay estimator, to account for endogeneity and cross-sectional dependence in panel data. Our analysis shows that external debt in SSA countries hinders capital formation, with the strength of this effect influenced by institutional quality. Strong institutions boost investor confidence, creating a favorable environment for investment and mitigating the negative effects of external debt. These findings highlight the importance of enhancing institutional quality in SSA to foster sustainable economic growth and investment. Moreover, our dynamic threshold estimator indicates that capital formation thrives when institutional quality surpasses a threshold of -1.183. The varying impacts of debt suggest that short-term benefits on capital formation exist, while medium and long-term effects are predominantly adverse.

The policy implications of our study are twofold. Firstly, governments in SSA should establish debt ceilings

based on identified thresholds to prevent excessive borrowing that could impede capital formation. Additionally, prioritizing institutional quality improvements, such as combating corruption, strengthening the rule of law, and ensuring political stability, can enhance the investment climate and attract both domestic and foreign investors. Transparency in debt usage and inclusive development initiatives can further bolster institutional quality. Policymakers should also conduct cost-benefit analyses before acquiring new debt and explore alternative financing options like public-private partnerships and domestic resource mobilization to diversify funding sources and reduce vulnerability to external shocks.

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