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Nexus between Domestic Debt and Capital Formation in Sub-Saharan African Countries: A Panel Quantile Regression Approach

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Abstract: The study explored the influence of domestic debt on capital formation in Sub-Saharan African (SSA) countries, using panel data spanning from 1990 to 2020. Panel Quantile Regression techniques were employed to analyse the data. Results from panel non-linear unit root tests indicated the presence of both stationary and non-stationary variables after differencing. The panel quantile regression revealed a negative and statistically significant relationship between capital formation and domestic debt at the lower 75th percentile, while at the 90th percentile, the impact was negative but statistically insignificant. Similarly, similar negative effects were observed for the PUBD and TROP variables. The study also identified that external debt (EXTD), GDP, inflation (INFR), and interest rates (INTR) positively influence capital formation (CAPF), with the strongest effects seen at the 50th, 75th, and 90th quantiles compared to OLS results. Quantile regression further confirmed that capital formation decreases as domestic debt increases, a trend that was consistent across both OLS and WLS models, as well as the panel quantile regression outcomes. The study suggests that the rising domestic debt in SSA countries negatively affects capital formation, hindering economic growth. To foster greater capital formation and integration into the global economy, SSA countries should focus on comprehensive tax reforms. Such reforms could help boost tax revenues, similar to advanced and emerging economies, which tend to generate double the average tax income of SSA nations.

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Introduction

The connection between debt and the development of capital funds for investment has been widely discussed in theoretical, and empirical studies worldwide. Renewed attention on the subject of Sub-Saharan African (SSA) has been sparked by recent disclosures regarding the theory of the debt component of domestic debt. Global studies by Lerner (1943), Khan & Reinhart (1990), Ben-David (1998), Batrancea (2021), and Pegkas (2018) have shown that debt financing models help bridge fiscal spending gaps. These debt arrangements can be financed with debt capital that comes within the domestic economic. Similar to this, debt is one of the financing shortfall's sources, and the government uses consumption and investment to make up the shortfall in order to close the enormous gap between saving and investment. This is because there are not enough reserve funds and fiscal buffers to consider raising the necessary funds for supported government policies on capital expenditure. Most nations received reserve capital remotely to lessen the problem of the savings-investment gap. The neoclassical growth models, which recommend debt for countries with limited capital to enhance their capital formation and steady-state level of production per capita, are the basis for the justification for domestic debt on capital formation nexus. Global economic crises have given nations (particularly those in SSA) more motivation to borrow since they frequently force them to choose between raising spending levels and seeing a decline in capital inflows (Sumba et al., 2024).

This is obvious in nations with high debt ratios of above 60% in 2021, such as Ghana (98.72%), South Africa (72.31%), Kenya (66.65%), and Angola (63.27%). It came close to exceeding 100 percent of total economy in Cabo Verde (120.18%), Eritrea (146.32%), and Zimbabwe (100.0%) in the same time frame. Policymakers and analysts have remained curious about the degree of domestic debt accumulation that is beneficial for capital formation in SSA economies as a result of these rising debt levels. The domestic debt is a significant macroeconomic variable in SSA nations' efforts to close their budget deficits, and investors also take it into account when making investment decisions because it has an impact on capital formation and return on capital invested. This study examines five SSA countries, focusing on Nigeria, Ghana, Ethiopia, Cameroon, and South Africa. Nigeria and South Africa dominate the region's economic size, with Nigeria accounting for 41 percent of the total. Ghana and Ethiopia are the fastest-growing economies, with Cameroon accounting for 29 percent of the sub-region's economy. Nigeria has 211.401 million inhabitants, while Ghana has 31.282 million. Ethiopia is in the eastern section of the African continent, while Cameroon is in the middle region. South Africa is in the southern region. The five countries have made several economic reforms in the past, including various adjustments to fiscal and monetary policies as well as trade and investment reforms that intended to encourage the saving-investment gap for capital formation.

As a result of these reforms, SSA is now listed as the eighth-fastest growing economy in the world out of twenty. This study reveals that the relationship between domestic debt and capital formation remains a contentious topic in both empirical and theoretical underpinnings. Studies on domestic debt post-Covid-2019 and economic recession 2020 indicates inadequate resolution of government financing needs in SSA. This study is motivated by various empirical and theoretical investigations and conclusions on these issues. Therefore, more studies into these issues of SSA's regional economy would provide a clearer picture and possibly aid the region's policymakers in choosing better economic policies. Numerous studies have examined the nexus of external debt relationship visa viz economic growth, but few have explored the nexus of domestic debt visa viz capital formation in relation to SSA. The results are often inconclusive and mixed, with some finding negative results and others positive. The study, primarily focusing on SSA, employs a robust panel quantile regression approach to examine the relationship between domestic debt and capital formation, specifically affecting the regional bloc of SSA countries. Studies on nexus between domestic debt and capital formation has yielded conflicting results due to weak and non-rigorous analytical techniques, highlighting a gap in the literature and requiring a more comprehensive and specific study on the subject matter. The study aims to be one of the few to specifically investigate these interconnections for the countries in the SSA region. The study findings will assist policymakers in assessing the extent to which domestic debt affects a region's capital fund requirement deficit. This study is divided into five sections: Background to the study, literature at theoretical, conceptual, and empirical levels, then methodology of the study, empirical analysis of the results and findings, finally, Section five concludes with a summary of results and findings.

Literature Review

Previous studies have conducted a panel dataset methodology on developing countries for the time frame of 1990-2007. This study found that domestic debt negatively impacts capital formation. However, considering an investigation in the domestic debt reveals the true relationship which will help to identify to the policy makers the possible fiscal challenges and the fiscal opportunities in planned deficit of public sectors. Similarly, Musa et al. (2023) explained in their studies that emerging economies as well as developing nations experience saving-investment gap in their domestic economy. However, this decreases the volume of capital formation and investment growth in most of the regions' financial system. This, therefore, requires external resources to bridge the deficit of domestic savings for the improved capital formation and economic growth. Yimer & Geda (2024) employed GMM analysis from 15 emerging market economies found that domestic debt accumulation is negatively related to both capital formation and investment more than the external debt over the period of the study. Similarly, the same outcome results based on the findings of Borensztein et al. (2008). However, identified an outcome of results from SSA nations that dispute with the findings of Nguepi, Ngouhouo, & Bilan (2024) applied both the techniques of OLS method and system GMM of panel investigation for 17 West African countries. The results concluded that domestic debt stock does not significantly impact capital formation and hence reduces investment frontiers with deposit money banks short maturity.

However, Ibrahim & Khan (2019), in a study of Nigeria revealed that domestic debt hurts the overall economy and negatively affect the investment opportunities of developing countries. Similarly, O. Akpansung (2018), in a developing country investigation applied a multivariate vector auto regression approach and annual time series data analysis of Nigeria in West African Nations. The study found that government domestic debt significantly impacted negative effect on Nigeria's capital fund and real output during the study period. The results contradict

Agbaeze, Onoh, & Efanga (2023) show contrary findings that available domestic debt leads to positive economic growth and subsequently accumulates more capital funds, up until recently utilized inefficiently in many nations. Bayar & Sakar (2021) applied panel co-integration and Granger causality techniques on 11 EU countries during the period 1996-2017 to study the relationship between public domestic debt and capital formation. Findings suggested that domestic debt does have significant positive impact on capital formation of EU economies. Furthermore, their results also revealed a unidirectional causality relationship from domestic borrowing to financial development. The crowding-out effect theory, based on Yusuf & Mohd (2023) and Hicks (1937) studies, suggests that debt stock can influence capital formation and stimulate economic growth. However, this theory is not justified if the public sector doesn't adopt expansionary fiscal policies, as it could potentially benefit the economy.

The theory assumes that debt stock could influence capital formation. In any case, it suggests that the theory of crowding out prompts a decrease of private sector growth, which is regularly more significant in investment growth of the economy. An expansion in budget plan of the public sector can be beneficial and can positively affect stock of capital formation to the private entity of the economy. However, it might likewise hinder the capital formation and impede the economy. At the point when the connection is inverse, influencing either the demand or the supply side of the economy, theorists and scholars talk about this peculiarity as “crowding out effect theory” *(*Hicks, 1937*)*. However, Saud et al. (2023) and Ampah & Kiss (2019) explained the theoretical relationship between domestic debt and capital formation. These studies argued that crowding out effects typically happens because of unnecessary high frequency cost of debt and weak return of investment while the balance of trade and payment of debt burden nations decline when the creditor nations and institutions may not really be accessible for the needed fiscal expansion plan of government. De de Mendonça & Brito (2021) equally suggested that inadequacy of country's capacity of keeping up with its debt management policy and spending plan due to the crowding out effect; and hence, as it endeavours to meet up its commitments, thus causes minimal capital fund for improving investment and growth opportunities in the economy.

Methodology

Sources of Data

This analysis used panel data from 1990 to 2020 (for 31 years as t = 31) to examine The model focuses on capital formation (*CAPF*) as the dependent variable and independent variables such as domestic debt (*DOMD*), public debt (*PUBD*), external debt (*EXTD*), inflation rate (*INFR*), trade openness (*TROP*), population growth (*POPG*), growth domestic product (*GDP*) and interest rate (*INTR*) as the independent variables. The data was sourced from the World Economic Outlook Database of the International Monetary Fund, and Central Bank of Nigeria statistical bulletin release 2021.

Model Specification

Friedman's crowding out effect theory suggests that if the public sector does not adopt expansionary fiscal policies amid budget deficits and monetary needs, it would not be justified, as it could potentially boost economic growth by influencing the stock of capital formation. The crowding out effect theory further explains that private sector growth decreases, affecting investment growth. An expansion in public sector budgets can positively affect capital formation for private entities, but it can also hinder capital formation and hinder the economy. This phenomenon occurs when the connection is inverse, affecting either the demand or supply side of the economy. Theorists and scholars refer to this phenomenon as "crowding out effect theory" (Hicks, 1937). According to the objectives of the study and theoretical framework outline the basic panel models used, as illustrated in Equation (1).

$$CAPF_{i,t} = \alpha + \beta_1 DOMD_{i,t} + \beta_2 PUBD_{i,t} + \beta_3 EXTD_{i,t} + \beta_4 INFR_{i,t} + \beta_5 TROP_{i,t} + \beta_6 POPG_{i,t} + \beta_7 GDP_{i,t} + \beta_8 INTR_{i,t} + \varepsilon_{i,t} \quad (1)$$

Where: $\alpha_0 = \text{Intercept}$, t= dimensions of the time-series, i= dimensions of the cross section, and $\varepsilon_{i,t}$ = error term is assumed to be *iid*.

Stationarity Test

The unit root or stationarity test is crucial in econometrics for proper modelling and analysis of panel time series data, as it determines whether variables are stationary or non-stationary and has significant economic implications. Board time series information frequently needs stationarity, causing issues in observational examination. Regression results that are not validated when non-stationary variables are used can make it hard to conclude with valid recommendations (Nelson & Plosser, 1982). Therefore, it's crucial to determine if the series is stationary at level 1(0) or first difference I (1). The LM test of Hadri & Larsson (2005) show that panel stationarity tests are consistent if the proportion of individual variables with a The study expands to include structural breaks under the null, demonstrating that the unit root differs from zero under an alternative, and measure individual time series in the model specification.

$$\text{n}i,T,k(\omega_i) = \frac{\sum_{t=1}^{T} S_{it}^2}{T^2 \hat{\sigma}_{\epsilon},i}, \quad (2)$$

where *k* represents 0; 1; 2; 3. The statistics of the models applied in this study are denoted. $S_{it} = \sum_{j=1}^{t} \hat{\epsilon} ij$ denotes partial sum process, while $\hat{}^2_{l,}$ the estimator of its long run variance (LRV) is denoted by

$$\frac{2}{\epsilon i} = \lim_{T \to \infty} T^{-1} E(S_{i,T}^2). \quad (3)$$

Hadri & Larsson (2005) states that when panel data is heterogeneous, it results in the reported panel statistic below:

$$\text{LM}T,N,k(\omega) = \frac{1}{N} \sum_{N} i,T,k(\omega_i). \quad (4)$$

The *i* indicates the statistic's specific breakpoint location value, which can vary the test is not invariant at break-even points and under the null, OLS residuals from regressing yit on the appropriate set of repressors represent OLS residuals.

The Panel Quantile Regression Techniques

The Panel Quantile regression technique is an extension of linear regression used when linearity, homoscedasticity, and normality conditions are not met. Chernozhukov & Hansen (2006, 2008) estimated the technique using fixed effects, ensuring consistency and asymptotically normality as *n* and *T* develop. Numerous studies have utilized panel quantile regression techniques, including Buthelezi &

Nyatanga (2023), Pesaran (2015), Cao, Li, & Zhang (2023), Geraci & Bottai (2007), and Koenker (2004). The model accounts for unobserved heterogeneity and covariates effects, while panel data can potentially include fixed effects to control for some unobserved covariates (Canay, 2011). Panel quantile regression techniques can be seen as a group of statistical techniques intended to calculate a conditional quantile regression model with latent individual heterogeneity. For subject i = 1, 2, . . ., n across time t = 1, 2, . . ., T, panel data consists of multiple observations on the response variables, y_{it}, and a p-dimensional vector of repressor's, X_{it}.

Equation (3.57) is the panel Quantile function model:

$$y_{it} = X'_{it}(U_{it}) + \alpha_i, \; t = 1, 2\ldots, T, \; i = 1, 2\ldots, N, \quad (5)$$

where the statement states that observable variables are defined by (y_{it}, X'_{it}) while, unobservable variables are (U_{it}, α_i). The assumption that $U_{it} \sim U(0,1)$ conditional on $X_i = (X'_{i1}, \ldots, X'_{iT})'$ and α_i.

For the fixed effects panel data Quantile regression assessment, Koenker (2004) suggests that for the, $1 \le i \le n$, which are thought to be location shift effects, Koenker jointly estimates β while the individual effects α_i. By simultaneously estimating m quantiles in Equation (3.77).

$$\text{argmin} \sum_{j=1}^{m} \sum_{i=1}^{n} \sum_{t=1}^{T} \omega j \rho \tau j(yit - x'it\beta(\tau j) - \alpha i), \quad (6)$$

$$\beta, \alpha \in A \times B$$

where the j-th quantile is assigned, a relative weight called ω_j. The weight regulates how the m quantiles affect the estimation of the model's parameters. According to Koenker (2004), choosing the vector of weights, $\omega = (\omega_1, \ldots, \omega_m)'$, is comparable to selecting discretely weighted L-statistics. The standard ad-hoc optimal vector of weights options are $\omega_j = 1/m$ *for* $1 \le j \le m$ or 0.25, 0.5, and 0.25 for the quartiles.

Discussions of Empirical Results

Table 1 reveals that all variables in panels are level non-stationary and stationary after the first difference. The study discusses the Hadri LM test for panel stationarity, which assumes the null hypothesis and allows for panel-specific means and temporal trends. The test is motivated by a high T and low N.

Table 1: Panel Unit Root Test: Hadri Z- statistics Test of Panel Non-Linearity Stationarity.

Hadri Z- Statistics		
Variable	Level	First Difference
CAPF	6.759	1.291*
PUBD	4.010	-0.530*
PUBD+	1.769	-1.990*
PUBD-	4.321	-1.916*
EXTD	4.976	-0.548*
DOMD	5.515	1.178*
GDP	7.339	1.272*
INFR	3.241	-0.739*
TROP	4.027	1.583*
POPG	11.005	-0.932*
INTR	5.016	1.352*

Note: * imply 5% level of significance respectively.

Table 2 presents the results of panel quantile regression models analysing the impact of *DOMD* on *CAPF* using five SSA countries' data. The findings were analysed using fixed effects method estimates of 10th, 25th, 50th, 75th, and 90th quantiles. The fixed effects panel quantile regression model for domestic debt is also presented.

Table 2: Panel Quantile Fixed Effects Regression Results.

Quantiles	Variables	Coefficient	Std. Error	*t*-statistics	*P>t*
0.10 Quantile regression	*DOMD*	-0.420	0.202	-2.08	0.037*
	EXTD	0.043	0.200	0.21	0.831
	PUBD	-0.262	0.144	-1.81	0.070**
	INFR	0.004	0.093	0.04	0.969
	TROP	-0.333	0.317	-1.05	0.293
	POPG	-0.140	0.343	-0.41	0.682
	GDP	1.152	3.912	0.29	0.768
	INTR	0.292	0.150	1.95	0.051**
0.25 Quantile regression	*DOMD*	-0.332	0.127	-2.60	0.009*
	EXTD	0.105	0.126	0.83	0.405
	PUBD	-0.263	0.091	-2.88	0.003*
	INFR	0.024	0.059	0.41	0.681
	TROP	-0.334	0.201	-1.66	0.096**
	POPG	-0.093	0.217	-0.43	0.669
	GDP	1.777	2.473	0.72	0.472
	INTR	0.236	0.095	2.50	0.013*
0.50 Quantile regression	*DOMD*	-0.247	0.078	-3.16	0.002*
	EXTD	0.165	0.077	2.14	0.032*
	PUBD	-0.264	0.055	-4.76	0.000*
	INFR	0.044	0.036	1.23	0.220
	TROP	-0.334	0.122	-2.74	0.006*
	POPG	-0.047	0.132	-0.36	0.722
	GDP	2.375	1.504	1.58	0.114
	INTR	0.183	0.058	3.17	0.002*
0.75 Quantile regression	*DOMD*	-0.176	0.085	-2.07	0.039*
	EXTD	0.215	0.084	2.54	0.011*
	PUBD	0.265	0.061	-4.35	0.000*
	INFR	0.060	0.039	1.53	0.125
	TROP	-0.335	0.134	-2.50	0.012*
	POPG	-0.009	0.145	-0.06	0.951
	GDP	2.872	1.652	1.74	0.082**
	INTR	0.139	0.063	2.19	0.028*
0.90 Quantile regression	*DOMD*	-0.127	0.114	-1.12	0.263
	EXTD	0.249	0.113	2.19	0.028*
	PUBD	-0.265	0.082	-3.22	0.001*
	INFR	0.072	0.053	1.35	0.177
	TROP	-0.335	0.181	-1.85	0.065**
	POPG	0.017	0.195	0.09	0.929
	GDP	3.215	2.232	1.44	0.150
	INTR	0.108	0.0184	1.28	0.202

Note: * and ** indicate the null hypothesis, *Ho*: $\beta i = 0$ being rejected at the five percent and 10 percent levels of significance, respectively.

From the estimated model in Table 2, the quantiles p-value show statistically significant results effects of *DOMD* on *CAPF* with negative coefficients except at the 90 percent quantile (τ = 0.90), with the insignificant p-value. This indicates that the quantile regression on the effect of *CAPF* were statistically significant and inversely related when *DOMD* threshold is lower than 75 percent quantile. The estimation is then considered using the fixed effects technique, and the outcomes are displayed in τ = 0.10, 0.25, 0.50, and 0.75 percent quantile. The results of technique reveal that *DOMD* has negative influence on *CAPF* at all the first four tails of the *CAPF* (τ = 0.10, 0.25, 0.50, 0.75). This finding is in line with the previous studies of Ekanayake & Thaver (2021), Daher Alshammary et al. (2020) and Batrancea (2021). Similarly, *PUBD* shows statistically significant negative elasticity at the three tails 0.25, 0.50, and 0.90 of the panel quantiles results, while positive and statistically significant output at 0.75.

However, at the upper tails of the *CAPF* (τ = 0.50, 0.75, and 0.90), *EXTD* showed positive coefficients with statistically significant results. The impact of other control variables like *EXTD*, *PUBD*, *TROP*, and *INTR* was more pronounced in the upper quantiles when compared to the *DOMD* at the lower quantiles of the *CAPF*. This shows that there is an inverse relationship between *DOMD* and *CAPF*, which leads to lower *CAPF*. This suggests that increasing *DOMD* will negatively decrease the development of *CAPF* in SSA nations. Table 3 exhibits the results of alternative hypothesis which is that erogeneity is accepted if the residual is found to be none significant, while the null hypothesis rejects erogeneity if residual is significant. Therefore, it can be seen from Table 3 that there are no erogeneity issues with any of the independent variables.

Table 3: Block Erogeneity Test.

DV: CAPF SSA Countries Excluded	X^2	*P*-value
DOMD	1.510	0.443
EXTD	1.576	0.548
PUBD	0.545	0.787
GDP	0.449	0.702
INFR	2.841	0.189
TROP	1.679	0.583
POPG	0.862	0.606
INTR	2.416	0.352

Note: Column two present the chi-square values of the block erogeneity Wald test for five selected SSA countries. The p-values attached to the values indicate the significance of the test statistics.

Heterogeneity of quantile coefficients is given in Table 4. The results of the estimation of equality of different quantiles were conducted against the median of (0.5) quantile coefficient. This study estimates the 0.10-0.50, 0.25-0.50, 0.75-0.50 and 0.90-0.50 quantile levels. The study employs Wald tests to verify the equality of slopes across the quantiles of domestic debt and other independent variables, as suggested by Koenker & Bassett Jr (1982). The results, as presented in Table 4, the study rejects the Ho hypothesis that variables' coefficients are identical at most quantile levels, revealing significant differences at different levels, highlighting the need for panel quantile regression analysis over the ordinary least-squares model. Domestic debt coefficients also show similar results, confirming the significant differences in estimated results.

Table 4: Estimation of Wald Test for Equality of Slopes across Quantiles Dependent Variable: CAPF.

Variable	0.10-0.50	0.25-0.50	0.75-0.50	0.90-0.50
DOMD	5.154*	6.206*	3.043*	0.298
EXTD	3.120 *	3.117*	2.753*	1.305
PUBD	3.015*	3.152*	4.300*	0.133
GDP	2.951*	2.628*	2.286*	2.402
INFR	4.371*	5.538*	4.258*	4.364*
TROP	5.248*	6.429*	2.963*	3.729*
POPG	6.472*	7.554*	5.548*	4.839*
INTR	4.614*	3.521*	3.701*	3.183*

Note: The Wald test results indicate that the quantile coefficients are equal in Table 4, rejecting the Ho of constant values at a * 5 percent level of significance.

Robustness Test

The study utilized linear regression (OLS) and Weighted Least Squares (WLS) models to assess the robustness of *DOMD* on *CAPF* and the impact of other control variables as shown in Table 5. These models were used to compare and confirm the robustness against the results of the panel quantile regression model are presented in Tables 5 and 6.

Table 5: Linear Regression (OLS) and Weighted Least Squares (WLS) Test.

DV: *CAPF* SSA Countries Variables	OLS	WLS
DOMD	-0.177	-0.114
EXTD	0.155	0.223
PUBD	-0.122	-0.153
GDP	2.077	3.090
INFR	0.074	0.102
TROP	-0.265	-0.206
POPG	0.229	0.319
INTR	0.081	0.024

Note: Column two and three present both the linear regression (OLS) and Weighted Least Squares (WLS) respectively. The values attached indicated on the table are the coefficients of the test statistics.

Table 6: Panel Quantile Results.

Variables	10^{th}	25^{th}	50^{th}	75^{th}	90^{th}
DOMD	-0.420	-0.332	-0.247	-0.176	-0.127
EXTD	0.043	0.105	0.165	0.215	0.249
PUBD	-0.262	-0.263	-0.264	0.265	-0.265
GDP	1.152	1.777	2.375	2.872	3.215
INFR	0.004	0.024	0.044	0.060	0.072
TROP	-0.333	-0.334	-0.334	-0.335	-0.335
POPG	-0.140	-0.093	-0.047	-0.009	0.017
INTR	0.292	0.236	0.183	0.139	0.108

Note: The table present the coefficient values of the panel quantile regression models τ = 0.1, τ = 0.25, τ = 0.5, τ = 0.75, and τ = 0.90.

Tables 5 and 6 show that *DOMD* negatively impacts *CAPF* in conditional quantile coverage for various values such as τ = 0.10, 0.25, 0.5, 0.75, and 0.90, as well as the OLS and WLS models. This implies that *CAPF* decreases as the *DOMD* increases, as shown in the robustness results of OLS and WLS models and the results of panel quantile. These results confirm the assertion, providing a deeper understanding of the underlying covariate's relationship. The relationship at the 0.10, 0.25, and 0.50 quantiles appears stronger than the OLS and WLS, with estimates of -0.177 and -0.114 respectively. The relationship drops slightly on the negative influence with estimates (0.75) = -0.176 and sharply drop to a much weaker influence at the 0.90 quantile = -0.127 as against the OLS and WLS coefficients respectively. This information is completely lost if one considers strictly the result given by both OLS and WLS. Similarly, *PUBD* and *TROP* variables suggest the same negative influence on *CAPF* in all the three models and coefficient estimates of panel quantile regression have stronger results compared with the OLS and the WLS coefficients.

The OLS and WLS indicate a positive impact of *EXTD*, *GDP*, *INFR*, and *INTR* on *CAPF*, as supported by the quantile regression coefficient. According to the findings of these robustness test, the increase in *EXTD*, *GDP*, *INFR*, and *INTR* results in an increase in *CAPF*, with a stronger influence at the 0.50, 0.75, and 0.90 quantiles over the OLS. However, the study indicates that the lower quantiles of 0.10 and 0.25 of the relationship is weak indicated by the coefficient values of (0.10) = 0.043 and (0.25) = 0.105. This shows that the coefficient of these estimates of the control variables, *EXTD*, *GDP*, *INFR*, and *INTR* have a positive relationship on *CAPF*. Also, the panel quantiles regression estimates show that the *POPG* has a positive relationship on *CAPF* at τ = 0.10, 0.25, 0.5, and 0.75, but a negative relationship at 0.90. The OLS and WLS coefficient values

showed a positive relationship between *POPG* and *CAPF*, but the influence of *POPG* on *CAPF* is ambiguous depending on the panel quantile. Therefore, generalizing the effect of *POPG* on *CAPF* cannot be achieved from both OLS and WLS results. The study indicated that the OLS and WLS estimates could be misleading due to ambiguity, making it difficult to generalize the results to the influence of *DOMD* on *CAPF*.

Summary of Findings, Policy Implications and Conclusions

This study examines the relationships between domestic debt and capital formation in five selected SSA countries using panel quantile regression techniques. Panel data series spanning 31 years from 1990 to 2020 were used for the estimations of the results in this study. This study used panel quantile regression. Results from the panel unit root test indicates stationarity after the first difference, and the Hadri & Larsson (2005) Lagrange multiplier assumes all panels are stationary, rejecting the null hypothesis. The panel quantile regression estimation confirmed the statistically significant results effects of domestic debt on capital formation with negative coefficients. This indicates that there is a negative relationship between capital formation and domestic debt at below 75 percent quantile, while domestic debt at the 90 percent quantile shows a negative and statistically insignificant impact on capital formation. Similarly, *PUBD* and *TROP* variables suggest the same negative influence on *CAPF*.

The findings indicate a positive impact of *EXTD*, *GDP*, *INFR*, and *INTR* on *CAPF*, as supported by the quantile regression coefficient. According to the results of these robustness test, the increase in *EXTD*, *GDP*, *INFR*, and *INTR* results in an increase in *CAPF*, with a stronger influence at the 0.50, 0.75, and 0.90 quantiles over the OLS. The robustness test used linear regression and Weighted Least Squares models to assess the influence of domestic debt, capital formation, and control variables. Quantile regression results showed that capital formation decreases with increasing domestic debt, as confirmed by both OLS and WLS models and the outcomes of the quantile regression. The results confirm the assertion, providing a deeper understanding of the underlying covariate relationship. The external debt showed positive coefficients with statistically significant results. The impact of other control variables like external debt, public debt, trade openness, and interest rate was more pronounced in the upper quantiles when compared to the domestic debt at the lower quantiles of the capital formation. This shows that there is an inverse relationship between domestic debt and capital formation, which leads to lower capital formation. This suggests that increasing domestic debt will negatively decrease the development of capital formation in SSA nations.

The findings indicate an inverse and significant impact relationship between domestic debt and capital formation. Findings revealed that there is a negative relationship between capital formation and domestic debt below 75 percent quantile, while domestic debt at the 90 percent quantile shows a negative and statistically insignificant impact on capital formation. In a debt-driven Sub-Saharan African (SSA) economy, fiscal policy tends to focus excessively on short-term goals instead of being guided by a well-defined medium-term plan. This lack of long-term direction has led to frequent violations of budgetary laws and a growing domestic debt burden. If SSA countries seek full integration into the global economy, they would likely need to reform tax levels significantly to support a government role like that of advanced and emerging economies, which typically generate double the average tax income.

African countries must significantly decrease their dependence on international trade tariffs, and they should also establish economic disincentives, especially by increasing revenue through tax reform. To address these challenges, policymakers in these nations must set clear policy priorities and gather the political determination to implement crucial reforms and reduce the balance of payment deficit. In addition to the essential policy reforms, tax administrations need to be strengthened. This is a challenge for both fiscal and monetary authorities in the Sub-Saharan African economy. Governments of these nations need to take specific monetary and fiscal measures to promote capital formation and accumulation strategies. These measures should be aimed at controlling the problems of debt overhang and crowding out effects in developing economies. Additionally, they should work to improve the development of capital formation and interest rate, as well as the general cost of funds on the economy.

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