External debt and economic growth in Sub-Saharan Africa: does heterogeneity in the quality of public sector management make a difference?

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HIGHLIGHTS

- External debt in Sub-Saharan Africa influences (SSA) growth negatively.
- Public sector management (PSM) complements external debt to boost growth in SSA.
- SSA economies with strong PSM experience higher growth than those with weak PSM.
- Improving the quality of PSM will strengthen debt management capacity to ensure positive growth effects of external debt.

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ABSTRACT

This study empirically examines the effect of external debt on economic growth, taking into account heterogeneity in public sector management (PSM) across 31 selected sub-Saharan African (SSA) countries spanning 2005 to 2017. In this study, we contributed to existing studies by examining how differences in PSM quality complement external debt to influence economic growth. We employ the system-generalized method of moment (system-GMM) and the panel smooth transition regression (PSTR) methods for the analysis. The results without differences in PSM quality show that external debt has a significant negative effect on economic growth in SSA. However, the effect of external debt on economic growth tends to be positive for SSA countries with strong PSM quality when external debt interacts with PSM quality. Furthermore, the results show that countries with strong PSM quality experienced higher economic growth than those with weak PSM quality. The PSTR also showed strong evidence of a nonlinear relationship between external debt and economic growth and estimated the indebtedness threshold value at 45% for the selected SSA countries. The implication of the findings calls for governments in SSA to strengthen the quality of public sector management via structural reforms aimed at public sector reform, tax reforms and strengthening debt management capacity to ensure positive growth effects of external debt.

1. Introduction

Although increasing external borrowing in recent times is considered a global phenomenon, developing countries' debt stock accumulation has shown signs of future debt unsustainability. According to UNCTAD\(^1\) (2019), the ratio of global debt to GDP was about three times higher at the beginning of 2018 than at the start of the global financial crisis in 2007/2008. In the case of developing countries, the ratio of external debt to GDP is even worse, increasing from its lowest level of 23.3% in 2011 to 29.1% in 2018. Muhanji and Ojah (2011) argued that the external debt of African countries has remained unsustainable since the inception of the multi-national debt crisis in the early 1980s, and these countries bear the attendant growth-reducing effects of increased indebtedness.

Existing empirical research on external debt and economic growth is wide-ranging. Studies, such as Fincke and Greiner (2015), Jilenga et al. (2016), Eberhardt (2019), Turan and Yanikkaya (2021), and Baidoo et al. (2021), have examined questions regarding whether external debt is an...
obstacle to economic growth, what level of external debt has a negative impact on growth, and the channels through which the impact is likely to occur (Hassan and Meyer, 2021). Despite the general efforts, the answer to the question of whether external debt is beneficial or harmful to economic growth remains uncertain. On the one hand, external debt can reduce liquidity constraints and provide an additional source of funding to meet the infrastructural and growth needs of an economy (Deshpande, 1997; Makun, 2021). On the other hand, an exceptionally high external debt stock could adversely affect economic growth through the “disincentive effect” on private investment due to the expectation that the government might increase taxes in the future to service the debt (Mohd et al., 2013).

As a consequence, potential investors (both local and foreign) would be scared away from investing in the debtor’s country, and that could lead to a decline in economic growth (see Pattillo et al., 2002; Nguyen et al., 2003; Frimpong and Oteng-Abayie, 2006; Olajoye, 2019).

In the search for settled answers to the relationship between external debt and economic growth, the role of institutional quality, including the quality of public sector management (PSM), has generated research interest, especially in the context of developing countries. Countries with high-quality PSM are expected to engender efficient use of external resources such as public debt (Megersa and Cassimon, 2015). Therefore, differences in the quality of PSMs are expected to produce an equally diverse impact of external debt on growth in different economies. However, one common feature of empirical studies on the economic growth effects of external debt is the failure to account for heterogeneity in PSM across countries. This is because countries’ differences in PSM quality could produce different outcomes in the debt-growth relationship between countries. For example, Megersa and Cassimon (2015) concluded that external debt in the case of 57 developing countries has a significant negative effect on growth in developing countries with weak PSM quality but positive effects in developing countries with sound PSM quality. Bouchrara et al. (2020) and Kourtelles et al. (2013) also found that public debt leads to a negative growth rate in countries with weak institutional quality. They argued that countries with weak institutional quality (i.e., ineffective PSM) might borrow more than those with sound institutional quality. Furthermore, Law et al. (2021) documented that economies with institutional quality above the 26.98 threshold value tend to restrain the adverse effect of debt on economic growth compared to those below the threshold.

In most cases, countries with weak institutional quality may tend to redirect external debt from its intended purpose to areas more conducive to misappropriation. This implies that the inflow of external debt alone cannot guarantee sustainable growth without sound PSM quality, which will act as a catalyst for growth (see Qayyum and Haider, 2012; Kourtelles et al., 2013; Butkus and Seputiene, 2018; Bouchrara et al., 2020; Duodu and Baidoo, 2022). Thus, as long as the PSM quality differs across countries, the homogenous growth rate as assumed in most studies such as Senadza et al., 2017). For example, Ouedraogo (2015) concluded the role of institutions without considering the nonlinear relationship between debt and growth (see Senadza et al., 2017). For example, Ouedraogo (2015) failed to estimate the simultaneous effect of debt and institutional quality on economic growth. Furthermore, Ouedraogo (2015) tested the presence of nonlinearity using a quadratic specification. However, such a specification can suffer from the exogenous determination of the indebtedness threshold, as it only identifies the turning point and not the actual thresholds (Karadam, 2018; Law et al., 2021). To the best of our knowledge, Megersa and Cassimon (2015) is the only known study that accounted for differences in PSM quality in developing countries and none so far in SSA.

Considering the assertion by most studies (see, Muhannji and Ojah, 2011; Qayyum and Haider, 2012; Megersa and Cassimon, 2015; Eberhardt, 2019), that PSM is key in ascertaining the positive impact of debt on economic growth and the fact that there are no empirical studies in SSA to substantiate this claim, we contribute to the extant literature in SSA by incorporating the PSM quality. Including this variable will help us understand how the quality of PSM in SSA economies interacts with external borrowing (debt) to influence economic growth in SSA. For the first time in SSA, the study also seeks to examine how PSM quality affects economic growth and its moderating effect on debt to economic growth. In doing so, the study also considers the differences in PSM quality between SSA countries (heterogeneity effect). To account for the heterogeneity in PSM quality, we used a dummy variable, in which countries with sound PSM quality assume a value of 1 and zero otherwise.

This paper is categorized as follows. Section 2 provides a survey of the recent literature. Section 3 describes the data and methodology. Section 4 discusses the findings. Section 5 concludes the article with policy implications.

2. Literature review

There is vast and voluminous literature available to explain the theoretical and empirical basis for external debt and economic growth relationships. In most cases, studies conducted in developing countries indicate that external debt is a potential culprit of public debt unsustainability. However, as far as most developed countries are concerned, evidence of external debt being responsible for unsustainable debt and reduced growth is less significant. The study broadly classified the literature review into three sections: PSM, theoretical and empirical review.

2.1. Public sector management quality

The public sector is the segment of an economy controlled by the government and responsible for macroeconomic decision-making, while PSM involves productivity management, financial management, and the management of other state resources. PSM is also defined as an array of activities ranging from planning, formulation, and implementation of government policies and projects (UNDP). The PSM has five main subcomponents: property rights and rule-based governance; quality of budgetary and financial management; efficiency of revenue mobilization; quality of public administration; and transparency, accountability, and corruption in the public sector. The PSM is compiled by the Country Policy and Institutional Assessment (CPIA) database of the World Bank. The CPIA exercise is often intended to assess the quality of countries’ policies and institutional arrangements, focusing on key elements under the countries’ control (World Bank, 2018). In the broadest sense, the CPIA index measures the extent to which a country’s policy and institutional framework support the effective use of development assistance, sustainable growth, and poverty reduction. The CPIA index rates the quality of PSM on a scale of 1 (low) to 6 (high), in which a median score

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of 3.5 is used as a threshold score. Countries with scores above the threshold score are considered better in performance. In this study, the PSM variable is considered to ascertain the role of debt or financial management capacity in mitigating the adverse effects of external debt on economic growth in SSA. Arguably, the economic recovery in SSA will continue with growth rates of 3% and 3.5% as before in 2018 and 2019, respectively, if the region strengthens its institutional quality (IMF, 2019). The report also said that the region's more diverse economies could even support growth rates of 5 percent or more. This implies that strengthening the capacity for debt management would promote the growth effect of external debt in SSA without recourse to debt rescheduling and its attendant effects, such as rollover risk. According to Smits (2006), the difference in growth rates between developed and developing countries is partly due to differences in the quality of their institutions.

2.2. Theoretical review

The theoretical basis for the link between debt and economic growth is widely rooted in the debt overhang theory presented by Krugman (1988), where investment is identified as the primary channel through which the impact of debt on economic growth occurs. The debt overhang theory opines that if the future debt stock is expected to be larger than a country’s repayment ability, then the expected debt service obligations will likely be an increasing function of the country’s output. This theory implies that large accumulated debt stocks can discourage investment and reduce growth due to external creditors' imposition of high marginal taxes (Krugman, 1988). The theory has been extensively explored by Pattillo et al. (2002), Nguyen et al. (2003), Frimpong and Oteng-Abayie (2006), and Turan and Yanikkaya (2021). Pattillo et al. (2002) argued that a higher debt stock does not lead to higher growth; instead, lower debt levels result in higher growth through increased private investment, especially in developing countries. Frimpong and Oteng-Abayie (2006) showed that excessive borrowing leads to a negative spiral and that if the costs of debt service are not internalized, then new loans serve as debt repayment without any significant positive impact on growth. It is also argued in most theoretical models that reasonably low levels of debt inflows are growth-enhancing. Specifically, the neoclassical and endogenous growth models showed that there is an incentive for every capital-scarse country to borrow and invest, especially when the marginal product of capital is greater than the interest payment on debt (see: Pattillo et al., 2002; Nguyen et al., 2003).

Another theoretical ground to explain external debt and its impact on economic growth is the theory of public choice. The theory assumes that every society is characterized by self-interested individuals who seek to maximize their benefits at the expense of society. This explains why public officials often inflate their departmental budgets (see: Ayee, 2005; Blum et al., 2012). In line with this theory, Megersa and Cassimom (2015) argued that there is a high tendency among public servants in developing countries to redirect public funds for private benefits, which can lead to unsustainable debt and reduced growth.

2.3. Empirical review

External debt, whether in SSA or elsewhere, primarily aims to provide additional funding to meet infrastructural and growth needs. Therefore, various studies have been conducted within the last decade to assess external debt’s impact on economic growth. However, the findings have been mixed and conflicting.

Frimpong and Oteng-Abayie (2006) studied the impact of external debt on Ghana's economic growth from 1970 to 1999. The authors used a Johansen-Juselius multivariate approach to cointegration and error correction model. They argued that GDP growth is positively influenced by external debt inflows and negatively by debt servicing, indicating a crowding-out effect of debt in the Ghanaian economy. Consequently, Tuffour (2012) extended the literature by analyzing the crowding-out effect of private investment and debt overhang in Ghana from 1970 to 2009 and concluded that external debt negatively affects economic growth through a reduced investment channel. However, most studies (see, for instance: Owusu-Nantwi and Erickson, 2016; Solomon, 2017; Matuka and Asafo, 2018) did not find evidence of a crowding-out effect in Ghana. They argue that public debt has a positive and statistically significant impact on economic growth in Ghana.

In Nigeria, Adepoju et al. (2007) reviewed the role of debt management practices on sustainable economic growth and argued that access to external finance strongly influences economic growth. The authors concluded that debt is an important resource for sustainable growth. Jilenga et al. (2016) also employed an autoregressive distributed lag (ARDL) model and found a similar positive impact of external debt on economic growth in Tanzania. However, Onafowora and Owoye (2019) used structural vector autoregression (SVAR) to estimate a generalized growth model and found a significant negative impact of external debt on economic growth in Nigeria. A study by Fincke and Greiner (2015) investigated the relationship between public debt and economic growth for eight emerging market economies (Brazil, India, Indonesia, Malaysia, Mexico, South Africa, Thailand, and Turkey) for the period 1980 to 2011. Fixed effect and random effect estimators were employed, and the results indicated that debt has a positive impact on the emerging market economies, but no significant evidence of nonlinear effects was found in these economies. In a related study, Senadza et al. (2017) investigated the economic growth effect of external debt in 39 SSA from 1990 to 2013. The generalized method of moments (GMM) technique revealed that external debt negatively affects economic growth in SSA and found no evidence of a nonlinear relationship. Yoloo Karadam (2018) conducted a cross-country study to examine the nonlinear relationship between external debt and economic growth for an unbalanced panel of 24 industrialized and 111 developing countries. He used the panel smooth transition regression (PSTR) technique and found an interesting result: the effect of external debt on economic growth changes from positive to negative as indebtedness increases, contrary to Fincke and Greiner (2015) and Senadza et al. (2017). The sustainable indebtedness threshold was lower for the selected developing countries than for industrialized countries. This implies that public debt can hurt developing economies with a much lower debt stock than advanced economies. In support of this finding, Presbitero (2012) revealed that public debt would promote economic growth in developing countries as long as the indebtedness threshold does not exceed 90% of GDP.

In almost all studies reviewed, there was little or no discussion on institutional quality (PSM). The shortcomings of these studies are that institutions can help promote a positive growth effect of external debt and, in most cases, mitigate the adverse effect of external debt stock on economic growth. Megersa and Cassimom (2015) explored the relationship between public debt, economic growth, and PSM in developing countries from 2005–2011. The results indicate a negative relationship between debt and economic growth. However, different results were found when the dataset was split into `weak’ and `strong’ country clusters based on PSM quality. While public debt still retained a negative relationship with growth in countries with a ‘weak’ quality of PSM, it showed a positive relationship with growth in the latter group. Qayyum and Haider (2012) empirically investigated the role of institutions in the relationship between external debt and economic growth for the period 1984 to 2010. The empirical model was estimated using the fixed-effect method, and the results showed that institutions (i.e., sound governance) stimulate output growth in developing countries. Quedraogo (2015) used the GMM to study the relationship between external debt, quality of institutions, and economic growth in West African Economic and Monetary Union (WAEMU) member states for the period 1970 to 2001. The results show that rigorous public resource management and social and political stability, among others, result from sound institutional quality, which drives growth.

The reviewed literature highlighted a broad picture of existing work in external debt and economic growth and what else could be done (e.g., differences in PSM quality) to refine this relationship further. Moreover,
in SSA, a lot has not been done on the subject. Therefore, the present study investigates the growth effect of external debt while accounting for heterogeneity in PSM quality across SSA countries.

3. Data and methodology

In this section, we focused on the methodological approaches to assess the external debt-growth relationship while considering the heterogeneity in PSM quality. The section comprises data and variable descriptions, empirical model specifications, and the econometric approach employed to ascertain the empirical estimates.

3.1. Data and variable description

The study used a balanced panel data sample of 31 SSA countries spanning 2005 to 2017 for the empirical analysis. The selection of periods and variables was influenced by data availability. Data for all variables, namely, external debt to GDP ratio (external debt), the ratio of imports plus exports to GDP (trade openness), secondary school enrollment rate (schooling), real GDP per capita (economic growth), net lending as a percentage of GDP (government fiscal balance), and population growth are obtained from the World Bank’s World Development Indicators (World Bank, 2018). We include schooling to capture the impact of human capital accumulation. In addition, we included government fiscal balance to reflect the impact of macroeconomic stability on economic growth (see Pattillo et al., 2002; Nguyen et al., 2003).

Table 1 provides a brief description of the variables and their expected signs. Except for population growth rate and fiscal balance, all variables are expressed in natural logarithms. The institutional variable, the PSM quality index, is obtained from the World Bank, 2018 Country Policy and Institutional Assessment (CPIA). To determine the divergence in the debt-growth relationship between SSA countries, we split our sample into country clusters based on the scores of the PSM indices. We used the CPIA threshold value of 3.5 on a scale of 1–6 to group countries as ‘weak’ and ‘strong’ performers. To obtain the robustness of our country clustering, we also employed a generalized Hansen’s novel threshold regression technique based on Gonzalez et al. (2005).

3.2. Empirical model specification

To empirically analyse the effect of external debt on economic growth, the baseline model assumes a linear specification following Pattillo et al. (2002) and Yolcu Karadam (2018). The baseline model is specified in Eq. (1).

\[ Y_{it} = \alpha_0 + \phi_0 ED_{it} + \beta_0 X_{it} + \eta_i + \epsilon_{it} \] (1)

where \( Y_{it} \) is the growth of real per capita GDP for country \( i \) at time \( t \), \( ED_{it} \) denotes total external debt as a percentage of GDP, \( X_{it} \) denotes a vector of control variables (such as population growth, fiscal balance, schooling, and trade openness) and includes a lagged dependent variable \( (Y_{it-1}) \) to test for convergence across countries. \( \beta_0 \) is the intercept term and \( \epsilon \) is the error term.

The interaction between PSM and external debt \( (ED \times PSM) \) is included in the model to analyse the simultaneous effect of external debt and PSM on growth as follows:

\[ Y_{it} = \alpha_0 + \phi_0 ED_{it} + \phi_1 (ED_{it} \times PSM_i) + \beta_0 X_{it} + \eta_i + \epsilon_{it} \] (2)

Eq. (2) aims to test the hypothesis that the impact of debt on growth with ‘strong’ PSM quality is different from those with ‘weak’ PSM quality. Consequently, we used PSM as a dummy variable, which takes the value 1 for countries with strong PSM quality (those with a value above 3.5) and zeros otherwise.

As indicated above, when differences in PSM quality are duly accounted for, the effects of debt on economic growth would be equal to \( \phi_0 + \phi_1 \) in countries with ‘strong’ PSM quality (since PSM = 1) and \( \phi_0 \) for those with ‘weak’ PSM. This is shown in Eq. (3).

\[ \frac{\partial Y_{it}}{\partial ED_{it}} = \phi_0 + \phi_1 PSM \] (3)

Arguably, linear specifications may be inadequate to unravel the true effect of external debt on growth. This is because the debt-growth relationship can also be nonlinear in which debt can positively affect growth up to a certain threshold and beyond which its impact becomes negative (see: Presbitero, 2012; Ouyang and Rajan, 2014; Yolcu Karadam, 2018). Most studies (see Fosu, 1996; Iyoha, 1999; Pattillo et al., 2002; Nguyen et al., 2003; Muhanji and Ojah, 2011) augment the linear specification (i.e., the baseline model) with a quadratic term to analyse the nonlinear effects. It is a common practice to use a quadratic form model to satisfy the nonlinear assumption if the estimated coefficient of external debt is significantly positive and the coefficient of the squared term of external debt is significantly negative. However, such quadratic form models suffer from the exogenous determination of the indebtedness threshold as it only identifies the turning point and not the actual thresholds (see Yolcu Karadam, 2018). To address this issue, we employed a data-driven threshold methodology—the panel smooth transition threshold regression (PSTR) model to identify indebtedness thresholds without arbitrarily fixing them exogenously. The use of PSTR can allow the regression parameters to vary across countries and time (Gonzalez et al., 2005). This helps resolve the heterogeneity among countries and the temporal instability of the coefficients. Thus, the PSTR model gives more flexibility and consistency in determining the threshold level. Again, Béreau et al. (2012) indicated that the temporal flexibility of coefficients in the PSTR
allows one to deal with potential endogeneity problems. Given these advantages of the PSTR, it is appropriate to employ the PSTR model to assess the nonlinear relationship between external debt and economic growth.

To this end, we assume there are two regimes and specify the PSTR model in Eq. (4).

\[ Y_{it} = \alpha_0 + \phi_0 ED_{it} + \phi_1 ED_{it} \lambda(q_{it} ; \gamma, c) + \beta X_{it} + \eta_i + \epsilon_{it} \]  

(4)

Furthermore, following Gonzalez et al. (2005), a logistic transition function is specified as follows:

\[ \lambda(q_{it} ; \gamma, c) = \frac{1}{1 + \exp(-\gamma(q_{it} - c))} > 0 \]  

(5)

where \( q_{it} \) is the threshold variable (i.e., external debt), \( c \) is the threshold or location parameter, \( \gamma \) is the slope of the transition function and captures the speed of transition from one regime to another and \( \lambda(q_{it} ; \gamma, c) \) is a continuous transition function bounded between 0 and 1. From the logistic transition function, the impact of external debt on economic growth will be equal to \( \phi_0 \) if the threshold variable, \( q_{it} \) is less than the threshold parameter, \( c \), but will be equal to \( (\phi_0 + \phi_1) \) if the threshold variable is either greater than or equal to the threshold parameter.

### 3.3. Econometric approach

We estimated the linear models (i.e., Eqs. (1) and (2)) using the generalized method of moment (system GMM) approach. Arellano and Bond (1991) introduced the concept of difference GMM to tackle various problems associated with estimating dynamic panel data models. Examples include the occurrence of endogeneity due to the feedback relationship between debt and economic growth; the correlation between country-specific effects (i.e., demographics and geography), which are often embedded in error terms and regressors; and autocorrelation due to the presence of lag-dependent variable (\( Y_l, l \geq 1 \)) as a regressor. To solve the first problem, Arellano and Bond (1991) used both exogenous variables and the lag levels of endogenous variables as valid instruments. They tackled the second problem through the first difference equation to remove country-specific effects and used more lags of the dependent variable to solve the third problem. However, weak instruments remain a challenge, and the lagged variables can be poor instruments of the first difference equation (Ishad and Mohsin, 2015).

Consequently, Blundell and Bond (1998) proposed a system-GMM, which uses level equations and the difference equation to give an efficient estimation for dynamic panel data models seemingly. The two-stage least squares (2SLS) method can also be applied to tackle all these problems in dynamic models, but the level variables used as instruments may raise the issue of weak instruments (Ishad and Mohsin, 2015). To ensure the efficiency and consistency of the system-GMM estimates, the Hansen (1982) test is adopted to check for suitable instruments, whereas the Arellano-Bond test is also employed to check for second-order serial correlations [AR (2)]. Both tests indicate that the failure to reject the null hypothesis of valid instruments (for the Hansen test) and the absence of second-order serial correlation [for the Arellano-Bond AR (2) test] show that the estimated linear model is efficient and consistent.

Also, we use the panel smooth transition regression (PSTR) method to estimate the nonlinear part of our empirical model. The PSTR estimation requires prior testing of linearity against nonlinearity as proposed by Gonzalez et al. (2005):

\[ H_0 : \phi_1 = 0 \]  

(6)

In Eq. (6), the null hypothesis may contain certain unidentified nuisance parameters. Hence, Gonzalez and others proposed the transition function \( \lambda(q_{it} ; \gamma, c) \) in Eq. (5) be replaced with its first-order Taylor expansion around \( \gamma = 0 \) as shown in Eq. (7).

\[ Y_{it} = \alpha_0 + \theta_0 ED_{it} + \theta_1 q_{it} ED_{it} + \theta_2 q_{it}^2 ED_{it} + \ldots + \theta_n q_{it}^n ED_{it} + \beta X_{it} + \eta_i + \epsilon_{it} \]  

(7)

where \( \theta_0 \) denotes parameters proportional to the slope parameter of the transition function. Now the test of linearity against the PSTR model (i.e., nonlinearity) is defined in Eq. (8).

\[ H_0 : \theta_1 = \theta_2 = \ldots = \theta_n = 0, \quad H_1 : \theta_i \neq 0, \quad i = 1, 2 \ldots m \]  

(8)

The corresponding F-version of Lagrange Multiplier statistic (LMF) of the linearity test is expressed in Eq. (9).

\[ LMF = \frac{(SSR_0 - SSR_1)/(K)}{(SSR_0)/(TN - N - K)} \]  

(9)

where \( T \) is the time dimension (number of years), \( N \) is the number of countries included in the study, \( K \) is the number of explanatory variables, \( SSR_0 \) is the sum of squares residuals under the \( H_0 \) and \( SSR_1 \) is the sum of squares residuals under \( H_1 \). The rejection of the null hypothesis will imply strong evidence of a nonlinear relationship between external debt and economic growth in our sample.

The next important test proposed by Gonzalez et al. (2005) is the linearity test to determine the number of transition functions (\( r \)). That is, is there one transition function (\( H_0 : r = 1 \)) or two transition functions (\( H_1 : r = 2 \)). If we assume a PSTR model with two transition functions, then the model can be expressed from Eq. (5) as given below in Eq. (10).

\[ Y_{it} = \alpha_0 + \phi_0 ED_{it} + \phi_1 ED_{it} \lambda_1(q_{it} ; \gamma_1, c_1) + \phi_2 ED_{it} \lambda_2(q_{it} ; \gamma_2, c_2) + \beta X_{it} + \eta_i + \epsilon_{it} \]  

(10)

where \( \lambda_1(q_{it} ; \gamma_1, c_1) \) and \( \lambda_2(q_{it} ; \gamma_2, c_2) \) are two different transition functions and replacing the second transition function with its first-order Taylor expansion around \( \gamma_2 = 0 \) gives Eq. (11).

\[ Y_{it} = \alpha_0 + \phi_0 ED_{it} + \phi_1 ED_{it} \lambda_1(q_{it} ; \gamma_1, c_1) + \theta_1 q_{it} ED_{it} + \beta X_{it} + \eta_i + \epsilon_{it} \]  

(11)

here, the test of only one transition function or no remaining nonlinearity consists of testing the null hypothesis given in Eq. (12).

\[ H_0 : \theta_1 = 0 \]  

(12)

If we fail to reject the null hypothesis above, then there is only one transition function to explain the debt-growth relationship in the selected countries.

### 4. Estimated results and discussion

This section of the study is devoted to the analysis of the estimated results. It starts the discussion with descriptive statistics and the existing correlation among the variables. Next is the discussion of linear results, and following that, that of nonlinear results.

#### 4.1. Descriptive statistics

The descriptive statistics considered are mean, standard deviation, minimum, and maximum values of the relevant variables used in the study, as shown in Table 2. The mean indicates the average value of a variable, while the standard deviation captures how variables are distributed around their mean values.

The real GDP per capita growth for the selected SSA countries has a mean value of 1.77 percent during the study period, representing the average well-being of individuals in the subregion. Also, SSA’s highest and lowest real GDP per capita were 27.83 percent and –25.27 percent, respectively. The mean (maximum and minimum) of external debt as a percentage of GDP is 3.52 (6.91 and 1.42). The mean value indicates the average external borrowing for selected SSA countries to supplement low domestic revenue between 2005 and 2017. The average score for PSM
absence of multicollinearity in the dataset (Kennedy, 2008).

The correlation among the variables is observed to be less than 0.70, providing evidence of the external debt, it is negative. All in all, the correlation coefficients among the variables are observed to be less than 0.70, providing evidence of the absence of multicollinearity in the dataset (Kennedy, 2008).

Table 2. Descriptive statistics and correlation.

| Variable   | Mean   | Standard deviation | Maximum value | Minimum value |
|------------|--------|--------------------|---------------|---------------|
| lnRGDP     | 1.7729 | 5.1586             | −25.2711      | 27.8249       |
| lnED       | 3.5184 | 0.6965             | 1.4184        | 6.9094        |
| PSM        | 3.0460 | 0.4749             | 1.6           | 4.1           |
| PoP        | 16.2935| 1.3211             | 13.0702       | 19.0625       |
| FB         | −1.4290| 3.2541             | −11.9451      | 27.2599       |
| lnSCH      | 3.5836 | 0.3545             | 2.2714        | 4.4926        |
| lnTO       | 4.2394 | 0.3603             | 3.0312        | 5.7469        |

Correlation Among Variables

|          | lnRGDP | lnED | PSM | PoP | FB | lnSCH | lnTO |
|----------|--------|------|-----|-----|----|-------|------|
| lnRGDP   | 1      |      |     |     |    |       |      |
| lnED     | −0.2139| 1    |     |     |    |       |      |
| PSM      | 0.1432 | −0.1322| 1 |     |    |       |      |
| PoP      | 0.1444 | −0.4627| 0.0259| 1 |    |       |      |
| FB       | 0.0837 | 0.0118| −0.1623| −0.1135| 1 |       |      |
| lnSCH    | 0.1063 | 0.0784| 0.0804| −0.2944| −0.0379| 1 |      |
| lnTO     | 0.0204 | 0.4282| −0.1228| −0.3725| 0.1513| 0.1513| 1 |

Note: lnRGDP, lnED, PSM, PoP, FB, InSCH, and InTO denote income (real GDP per capita), external debt, public sector management, population growth, fiscal balance, schooling, and trade openness respectively.

Table 3. The GMM results.

| Variable   | Model 1 Coefficient | Model 2 Coefficient | Model 1 Coefficient | Model 2 Coefficient |
|------------|----------------------|----------------------|----------------------|----------------------|
| lnED      | 0.0939 (0.0432)      | 0.1671 (0.0618)      | −1.0256 (0.4348)     | −1.6483 (0.8482)     |
| PSM       | 1.1831 (0.2705)      | −0.4627 (0.3792)     | 0.4513 (0.2672)      | 0.5664 (0.3972)      |
| PoP       | 0.2014 (0.0913)      | 0.0997 (0.0433)      | 0.1444 (0.0939)      | 0.1671 (0.0618)      |
| FB        | 0.2894 (7.5443)      | 0.2894 (7.5443)      | −13.1280 (7.6300)    | 0.2894 (7.5443)      |
| lnSCH     | 1.0256** (0.0913)    | 1.6483* (0.8482)     | 25.2711              | 27.8249              |
| lnTO      | 0.5976* (0.3466)     | 0.5976* (0.3466)     | 0.5976* (0.3466)     | 0.5976* (0.3466)     |
| lnED*PSM  | 0.1334*** (0.0052)   | 0.1334*** (0.0052)   | 0.1334*** (0.0052)   | 0.1334*** (0.0052)   |
| Constant  | −13.1280 (7.6300)    | 0.2894 (7.5443)      | 0.2894 (7.5443)      | 0.2894 (7.5443)      |

Note: lnRGDP, lnED, PSM, PoP, FB, lnSCH, lnTO and lnED*PSM denote initial income, external debt, public sector management, population growth, fiscal balance, schooling, trade openness and the interaction respectively. ***, ** and * represent a 1%, 5% and 10% significance level respectively. In the parenthesis are the standard errors. Model 2 is the estimation with the introduction of PSM as well as its interaction with ED.

4.2. The linear results

Table 3 presents the results of the baseline regressions and the interactive effects. Model 1 in Table 3 is the model without PSM and its interactive term with external debt, while Model 2 is the model estimated with PSM and the interactive term between PSM quality and external debt, respectively.

It is noticed from both models (1 and 2) in Table 3 that the coefficient of the lag-dependent variable (initial income) is significantly positive and does not satisfy the conditional convergence hypothesis. In other words, this implies that there exists no convergence across countries towards a common level of real per capita income. This outcome contradicts the findings of some early studies (see Pattillo et al., 2002; Nguyen et al., 2003; Yolcu Karadam, 2018).

In Model 1 of Table 3, the baseline model is estimated to check whether external debt can positively affect economic growth or not, and it is clearly shown that external debt negatively affects economic growth for the selected SSA countries and is significant at the 5% significance level. One possible reason for the negative relationship could be the high tendency to redirect external funds from their intended purpose to areas favourable for misappropriation in the selected countries. The negative coefficient of external debt shows that for every one percent increase in external debt, the real GDP per capita growth in SSA economies falls by about 1.03 percent, holding constant all other factors. This result is consistent with other empirical findings on the subject (see: Pattillo et al., 2002; Nguyen et al., 2003; Frimpong and Oteng-Abayie, 2006; Onafowora and Owoye, 2019; Onafowora and Owoye, 2019) that the unproductive use of external debt is detrimental to growth, especially in developing economies. Onafowora and Owoye (2019) argued that debt could become a destructive force when not invested wisely and productively in an economy.

In Model 2 of Table 3, PSM is introduced and interacted with external debt. The PSM is introduced to assess how economies with strong PSM quality influence their economic growth compared to those with weak PSM quality. Additionally, the interaction is included to assess the simultaneous effect of external debt and PSM quality on economic growth. In that regard, we tested the hypothesis that the growth effect of external debt is positive in countries with ‘strong’ PSM quality and negative in countries with ‘weak’ PSM quality. As revealed in Model 2, the coefficient of PSM indicates that countries with strong PSM quality increase their economic growth by about 1.18 percent compared to
economies with weak PSM quality. This result shows that institutional quality cannot be overlooked when considering economic growth in SSA countries. Qayyum and Haider (2012), Megersa and Cassimon (2015), Quedraogo (2015), and Duodu and Baidoo (2022) reported similar results that PSM or institutional variable promotes economic growth.

Turning to the interaction (external debt and PSM quality), which assesses how strong PSM quality influences the growth effect of external debt in countries with strong PSM quality, it is noticed that the interactive term is significantly positive at a 1% error level. This shows that for economies to experience the positive growth effect of external debt, PSM must be effective and strengthened to complement external borrowing. The coefficient indicates that as external debt increases by 1 percent combined with PSM quality, economic growth (real GDP per capita) goes up by approximately 0.13 percent for countries with strong PSM quality. This finding suggests that differences in PSM quality are one of the main reasons why countries with similar borrowing rates and infrastructure needs often have different growth rates.

Therefore, it is clear that external debt inflows alone cannot guarantee sustainable growth without sound institutional (PSM) quality, which will act as a catalyst for growth (see Muhanji and Ojah, 2011; Qayyum and Haider, 2012; Butkus and Seputiene, 2018; Bouchrara et al., 2020). Most researchers (for example, Megersa and Cassimon 2015; Quedraogo 2015) and Eberhardt 2019) acknowledged the importance of sound institutions in the debt-growth relationship. Megersa and Cassimon (2015) observed that sound institutions prevent the tendency to redirect external funds from productive investments and ascertain the positive growth effect of external debt, especially in developing economies. As Quedraogo (2015) explained, sound institutional quality in terms of public resource management and social and political stability, among others, are key drivers of economic growth.

Regarding the control variables, the results show that fiscal balance and trade openness (in models 1 and 2) exert a significant positive impact on economic growth in SSA. The coefficient of fiscal balance (trade openness) in model 1 shows that a point (percent) increase in fiscal balance (trade openness) induced economic growth in SSA countries by about 0.20 (1.54) percent at a 5% (1%) significance level. These findings connote that fiscal balance (proxied as macroeconomic stability) and trade openness are key drivers of economic growth within SSA economies. However, the study further revealed that educational growth and schooling in both models (1 and 2) do not significantly affect growth in SSA.

The difficulty of getting external instruments seemingly places the system-GMM as an appropriate estimator for dynamic panel data models since it uses the lag values of regressors as valid instruments. We employed the Hansen technique to test the validity of instruments. This is important because GMM becomes inefficient when instruments exceed endogenous variables (overidentification effect) in a model. In this case, GMM will produce efficient estimates only if the over-identification effect is valid. From Table 3, the p-values of the Hansen test are greater than the 5% significance level in both models (1 and 2), so we failed to reject the null hypothesis that the overidentification effect is valid in the models. Another important diagnostic test of dynamic panel data is the test for autocorrelation of the error terms. Whereas first-order autocorrelation, AR (1), does not pose much of a problem, a significant AR (2) means that the second lag of endogenous variables cannot be valid instruments. We applied the autoregressive test and, clearly, from Table 3, AR (2) is greater than the 5% error level in both models (1 and 2). This means that at the 5% significance level, the null hypothesis that there is no second-order autocorrelation (AR (2)) is not rejected.

### 4.3. The nonlinear results

Table 4 presents the Lagrange multiplier statistic ($LM_\theta$) for the linearity test ($H_0: \theta_1 = 0$ vs $H_1: \theta_1 \neq 0$) and for the test of no remaining nonlinearity ($H_0: r = 1$ vs $H_1: r \neq 1$).

From Table 4, the null hypothesis of linearity against the alternative PSTR (nonlinearity) is strongly rejected at the 1% significance level. The rejection of the linearity assumption implies sufficient evidence of a nonlinear relationship between external debt and economic growth in the selected SSA countries for the period 2005–2017. Gonzalez et al. (2005) further proposed another important test to determine the number of transition functions, r (i.e., the remaining nonlinearity tests). As shown in Table 4, the null hypothesis of only one transition function (no

| Table 4. Linearity and no Remaining Nonlinearity Test Results. |
|---------------------------------------------------------------|
| Threshold variable:                                           |
| $H_0: \theta_1 = 0$ vs                                        |
| $H_1: \theta_1 \neq 0$                                        |
| $H_0: r = 1$ vs                                               |
| $H_1: r \neq 1$                                               |
| External debt:                                                |
| $8.094 (0.004)$                                               |
| $0.011 (0.916)$                                               |

Note: P-values are in the parenthesis and r is the number of transition functions.

Figure 1. The PSTR response function.
removing nonlinearity) cannot be rejected at the 5% error level. This means that one transition function with a two-regime PSTR model is enough to capture the nonlinear impact of external debt on economic growth in our sample countries. Table 5 shows the results of the two-regime PSTR.

As shown in Table 5, the threshold level of indebtedness (or debt) for the external debt-to-GDP ratio is estimated to be 45% for the selected SSA countries. The implication is that when the external debt is lower than this threshold, such that, \( \lambda(q_{it}; x, c) \) approaches zero, then the coefficient of external debt is significantly positive (i.e., \( \phi_0 = 6.672 \)). However, when the external debt is greater than or equal to the threshold such that, \( \lambda(q_{it}; x, c) \) approaches one, the coefficient of external debt is significantly negative. This finding implies that the impact of external debt on economic growth changes from positive to negative after a certain threshold (in this case, 45%) has been reached. This also means that the positive effects of external debt on economic growth diminish and eventually become negative as indebtedness increases in SSA. This result is consistent with most empirical literature (Patillo et al., 2002; Presbitero, 2012; Ouyang and Rajan, 2014; Yolcu Karadam, 2018), arguing that the relationship between debt and growth could be positive at lower levels of debt and negative as debt increases. Onafowora and Owoye (2019) observed that large accumulated debt scares potential investors from investing in the debtor’s country due to the expectation that the government could resort to distortional taxes to pay off the debt.

Consequently, investment would be discouraged, which would lead to a decline in economic growth. The estimated slope parameter of the transition function is relatively small (1.01) and, therefore, allows a smooth transition from one regime to another. That is, the effect of external debt on economic growth changes smoothly from positive (6.7) to negative (−7.9).

Figure 1 shows the response function of the PSTR estimates.

Indeed, Figure 1 demonstrates that external debt and economic growth exhibit a nonlinear relationship. We observed a smooth transition from positive to negative due to the presence of a continuum of regimes between the extreme regimes (2 and 5). It can be seen that between the extreme regimes, economic growth response to external debt is not linear. Although economic growth responds positively in the lower regime, the response smoothly changes to negative after a certain threshold in the upper regime. Thus, the figure confirms the nonlinear relationship examined in this study.

5. Conclusion and policy recommendations

This study has examined how differences between countries PSM quality affect the debt-growth relationship in sub-Saharan Africa (SSA). We employed the system-GMM and PSTR techniques to estimate the dynamic panel model for 31 SSA countries covering 2005 to 2017. The results without differences in PSM quality indicate that external debt negatively affects economic growth in SSA. However, when the differences in PSM quality was accounted for in the estimation (model 2), the results turned out to be different, as external debt affects economic growth positively in countries with strong PSM quality. Thus, it would be wrong and misleading to expect external debt to exert the same impact in countries with weak PSM quality as in countries with strong PSM quality. Furthermore, the results revealed that countries with strong PSM quality experienced higher economic growth compared to economies with weak PSM quality (those below the threshold value of 3.5). Furthermore, the PSTR model showed a nonlinear relationship between external debt and economic growth in SSA. The indebtedness threshold level for external debt-to-GDP ratio was estimated to be 45% for the selected SSA countries. Given this, the study concludes that countries’ heterogeneity (differences) in public sector management is worthy of consideration in the debt-growth relationship as it reveals the differential growth effect of external debt in countries with sound (strong) PSM quality from those with weak PSM quality.

Given that sound PSM quality complements external debt to influence economic growth in SSA economies, the study recommends that governments undertake structural reforms aimed at public sector reforms and effective debt management practices in SSA. That is, reforms or policies that ensure the quality of budgetary and financial management, efficiency of revenue mobilization via an effective tax system, quality of public administration, and rule-based governance. Taking these reforms into account will strengthen the quality of public sector management and, in effect, ensure debt sustainability and positive growth as expected over the years. Furthermore, such reforms will ensure that the funds borrowed are devoid of corrupt practices and are channelled to productive sectors of the economy, increasing productivity and hence economic growth in sub-Saharan African countries.

While this study has examined the complementary effects of PSM and external debt on economic growth, it is important to note that the findings cannot be generalized across other developing countries since the data used for the study is directly for SSA. So, we suggest that future studies expand the sample size to other developing countries while considering differences in the quality of PSM so that the results can be used in other places.

Declarations

Author contribution statement

Joshua Nsanyan Sandow, Eric Fosu Oteng-Abayie, Emmanuel Duodu; Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

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Data availability statement

Data will be made available on request.

Declaration of interests statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

Appendix

List of countries

| Angola       | Gambia                   | Mauritania   |
|--------------|--------------------------|--------------|
| Benin        | Ghana                    | Mozambique   |
| Burkina Faso | Guinea                   | Niger        |

(continued on next column)
### List of countries

| Country       | Region     |
|---------------|------------|
| Cabo Verde    |            |
| Cameroon      |            |
| Chad          |            |
| Comoros       |            |
| Congo, Dem. Rep. |        |
| Côte d'Ivoire |            |
| Ethiopia      |            |
| Gabon         |            |
| Ghana         |            |
| Guinea-Bissau |            |
| Kenya         |            |
| Lesotho       |            |
| Liberia       |            |
| Madagascar    |            |
| Malawi        |            |
| Mali          |            |
| Malawi        |            |
| Mauritania    |            |
| Mozambique    |            |
| Nigeria       |            |
| Rwanda        |            |
| Senegal       |            |
| Sierra Leone  |            |
| Tanzania      |            |
| Togo          |            |
| Uganda        |            |
| Zimbabwe      |            |

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