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Research Article
External Debt, Investment and Economic Performance in Sub-Saharan Africa

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Abstract

Background and Objective: External debt has been identified as a key source of finance for many countries in sub-Saharan Africa (SSA) due to inadequate funds from other sources. Many countries relied on external debt to finance their investment with the expectation of spurring economic growth. Therefore, this study investigates the effect of external debt and investment on economic performance. **Materials and Methods:** The study utilized a panel of 26 sub-Saharan Africa (SSA) countries between 1999 and 2014 using system General Method of Moments (GMM). **Results:** The estimated results showed that the growth effect of external debt is negative while positive for investment. Also, the result of the interaction between external debt and investment is negative. The growth effect of inflation is negative while that of trade openness is positive. In addition, the growth effects of the interactions are positive and statistically significant for inflation and external debt, trade openness and external debt and crisis and external debt. More so, the non-linear effect of external debt is positive. **Conclusion:** This study, therefore, concludes that inflation, financial crisis and the interaction between external debt and financial crisis negatively influenced growth while the impact of trade openness is equivocal. The impact of the interaction between external debt and inflation on economic growth is positive. It is recommended that countries should monitor their debt level when raising funds for investment to prevent debt crisis in the future. In addition, the efficient use of the resources from external debt is very important for the countries in SSA to prevent crowding out effect. Given the unstable nature of global economy, there is need for countries to create economic resilience for the external debt to foster investment and economic performance in the sub-Saharan African countries. The SSA countries is encouraged to work towards these recommendations to promote investment expansion and better economic performance.

Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Meeting the needs of the present generation without compromising the needs of the future generation is one of the most fundamental economic objective of any country in achieving sustainable growth and development. To achieve both generational needs there is the need to attain certain macroeconomic objectives such as undertaking viable investments that are capital intensive in nature. However, most developing countries such as sub-Saharan African (SSA) countries are characterized by low revenue. This is evident in the huge infrastructure gaps in the region. According to IMF[1], there is financing gap of 4% of GDP in SSA region. However, Coulibaly and Gandhi[2] argued that historical experience of the region shows that many countries need huge investment for the region's development. This suggests that the region needs to bridge the average annual funding gap of 12% of GDP. Given the low saving behavior of the people in the region, it may be difficult to raise close to $230 billion annually. In addressing the huge challenge, many countries in the region have explored external financing means to raise needed resources for their country's investment. Therefore, the rationale for borrowing is to bridge the domestic resources gap to accelerate economic growth and development. Countries explore external debt as a result of the inadequate funds on the part of the government to execute many capital projects.

A critical examination of budget of the SSA's countries revealed that it is counterproductive to see several duplicated items in their budget without tangible effects on the populace which are classified as "capital projects". As a result, debt should be tied to capital projects[3]. Nonetheless, this historical progress has in the recent past witnessed falling income per head, rising hunger and accelerating environmental degradation in the SSA region[3]. These are all indicators that economic growth has not created opportunities for citizens to benefit. While many Asian countries (such as "Asian Tigers") and other developing countries have been addressing these problems and making remarkable progress with the reduction in external debt burdens, a different scenario played out for developing regions such as SSA region. Generally, debt burden of poor countries had continued to pile up coupled with devastating environmental degradation, low level of infrastructures, chronic poverty and civil conflicts amongst others, culminating in lethargic economic growth[4].

Furthermore, the socio-economic challenges facing the region are worsened by mismanagement of loan which has not judiciously utilized by most governments in the region. The mounting debt of many sub-Saharan African countries continues to raise concerns on their development given that this borrowing has not yielded expected results in terms investment expansion necessary for growth. Consequently, rising debt service levels severely limit the ability of these countries to finance critical imports and new development projects. The continuous reliance on external debt by many SSA countries to finance their budget deficit has generated a lot of concerns which has led to the ongoing debate on the growth effects of external debt and investment. This has resulted in alarming debt distress threatening the region. For instance, the total external stock rose from US$213.44 billion in 2010 to US$367.51 billion in 2013. According to the IMF[5] World Economic Outlook, the general gross government debt (GDP %) rose from 23% in 2013 to 62% in 2016. Despite the huge borrowing by many of these SSA countries, the investment gap in infrastructure and other key areas has not changed substantially.

External debt can enhance the developmental objectives by sustaining economic and financial liquidity while making external funds available to facilitate trade. However, it can also pose some challenges thereby making it difficult to ascertain its full contribution to economic growth. Thus, there is a challenge of debt optimization by the region to foster individual development. Credendo[6] identified 3 problems with rapid growth of public debt in SSA: lack of transparency which may lead to high risk with respect to public finance sustainability, a high proportion of non-concessional borrowing resulting in high-cost lending and significant risk of rollover and currency fluctuation. Thus, maintaining a balance between investment and management of public finances is key to achieving developmental objectives. Despite the efforts by many sub-Saharan African countries in devoting significant portion of their external debt to invest in infrastructural projects, their inherent attributes such as poverty, corruption, infrastructural deficiency, low level of investment among others limit their ability to achieve the desired level of growth and development. Extensive works have been done on debt and growth in SSA however, little attention has been given to how external debt enhances investment to foster economic performance. Therefore, the study seeks to provide answers to the following questions: what is the impact of external debt on economic growth in SSA? Is there a non-linear relationship between external debt and economic growth? What is the impact of investment on economic growth in SSA? To what extent can external debt influences investment-growth relationship?

The study utilizes the General Method of Moments (GMM) to investigate the relationship among external debt, investment and economic growth in 26 sub-Saharan African

countries between 1999 and 2014. The paper is organized as follows. Section two gives a brief review of the literature while section three presents methodology and model specification. Section four focuses on result presentation and discussion. Section five contains the summary and conclusion.

MATERIALS AND METHODS

This study employed the efficient GMM estimation approach in a balanced panel data to examine the relationship among external debt, investment on economic performance in the SSA between 1999 and 2014. The study control for other explanatory variables using panel data regression techniques. In the context of panel data analysis, the unobserved heterogeneity is deal with by transforming (demeaning) the dynamic panel model, in case of fixed-effects models or by taking first difference if the second dimension of the panel is a proper time series[7]. The method of first differencing to remove unobserved heterogeneity underlies the family of estimators that have been developed for dynamic panel data (DPD) models which contains at least one lagged dependent variables[8].

The choice of the system/efficient GMM approach was informed by some robust advantages over difference GMM, pooled OLS, fixed and random effects. Blundell and Bond[9] showed that there is additional mild stationarity restriction on the initial conditions process which allows the use of an extended (system) GMM estimation that uses the lagged differences of the dependent variable as instruments for equations at levels, in addition to lagged levels of the dependent variable as instruments for equations in first differences[10]. The presence of a lagged dependent variable increases the presence of autocorrelation and the presence of endogenous variables in the model creates correlation between the error terms and the regressors[8]. In this case, the fixed effect treatment becomes inconsistent because the mean of the lagged dependent variable contains observations 0 through (T-1) on Y and the mean error which is being conceptually subtracted from each ϵ it contains contemporaneous values of ϵ for t = 1 ······T[4]. The resulting correlation creates a bias in the estimate of the coefficient of the lagged dependent variable which is not mitigated by increasing N, the number of individual units[11].

However, first-differencing the dynamic panel model removes the u_i, thus eliminating the fixed effect. However, differencing variables that are predetermined but not strictly exogenous makes them endogenous. Following Holtz-Eakin *et al.*[12] and Arellano and Bond[7] developed a generalized method of moments estimator that instruments

the differenced variables that are not strictly exogenous with all their available lags in levels. Arellano and Bond[7] also developed an appropriate test for autocorrelation, which, if present, can render some lags invalid as instruments. The procedure for first differencing and eliminating the fixed effect is demonstrated in each of the models below:

Model 1: (No structural breaks, interactive terms and quadratic terms): The study shows the effect of external debt on economic growth while considering each of the variables in their linear terms in the external debt-growth nexus as follows:

$$RPCI = f\left(EXTD, GCF, INF, TOP\right)$$

$$\ln RPCI_{i,t} = \alpha_1 \ln RPCI_{i,t-1} + \alpha_2 EXTD_{i,t} + \alpha_3 GCF_{i,t} + \alpha_4 INF_{i,t} + \alpha_5 TOP_{i,t} + \varepsilon_{1i,t} \quad (1)$$

The lagged equation of model 1 (Eq. 1) above, is stated as follows:

$$\ln RPCI_{i,t-1} = \alpha_1 \ln RPCI_{i,t-2} + \alpha_2 EXTD_{i,t-1} + \alpha_3 GCF_{i,t-1} + \alpha_4 INF_{i,t-1} + \alpha_5 TOP_{i,t-1} + u_1 + \eta_{1t-1} \quad (2)$$

Subtracting Eq. 2 from 1:

$$\ln RPCI_{i,t} - \ln RPCI_{i,t-1} = \alpha_1 \left(\ln RPCI_{i,t-1} - \ln RPCI_{i,t-2}\right) + \alpha_2 \left(EXTD_{i,t} - EXTD_{i,t-1}\right) + \alpha_3 \left(GCF_{i,t} - GCF_{i,t-1}\right) + \alpha_4 \left(INF_{i,t} - INF_{i,t-1}\right) + \alpha_5 \left(TOP_{i,t} - TOP_{i,t-1}\right) + \left(u1 - u1\right) + \left(\eta_{1,t} - \eta_{1,t-1}\right) \quad (3)$$

$$\ln RPCI_{i,t} - \ln RPCI_{i,t-1} = \alpha_1 \left(\ln RPCI_{i,t-1} - \ln RPCI_{i,t-2}\right) + \alpha_2 \left(EXTD_{i,t} - EXTD_{i,t-1}\right) + \alpha_3 \left(GCF_{i,t} - GCF_{i,t-1}\right) + \alpha_4 \left(INF_{i,t} - INF_{i,t-1}\right) + \alpha_5 \left(TOP_{i,t} - TOP_{i,t-1}\right) + \left(\eta_{1,t} - \eta_{1,t-1}\right) \quad (4)$$

$$\Delta \ln RPCI_{i,t} = \alpha_1 \Delta \ln RPCI_{i,t-1} + \alpha_2 \Delta EXTD_{i,t} + \alpha_3 \Delta GCF_{i,t} + \alpha_4 \Delta INF_{i,t} + \alpha_5 \Delta TOP_{i,t} + \Delta \eta_{1,t} \quad (5)$$

Alternative models: This section provides an extension of the initial growth model specifications accounting for the interactions between external debt and investment, external debt and inflation, external debt and role of the recent global financial crisis and the non-linear effect of external debt on growth is presented below:

Model 2 (Interactive effect of external debt and domestic investment on growth): To empirically investigate if external debt enhances the inclusion of gross capital formation (a

proxy for domestic investment) in the growth process of SSA, we interact gross capital accumulation with external debt as follows:

$$RPCI = f\left(EXTD, GCF, EXTD*GCF, INF, TOP\right)$$

$$\ln RPCI_{i,t} = \psi_1 \ln RPCI_{i,t-1} + \psi_2 EXTD_{i,t} + \psi_3 GCF_{i,t} + \psi_4\left(EXTD_{i,t}*GCF_{i,t}\right) + \psi_5 INF_{i,t} + \psi_6 TOP_{i,t} + \varepsilon_{2i,t} \qquad (6)$$

The lagged equation of model 2 (Eq. 6) above, is stated as follows:

$$\ln RPCI_{i,t-1} = \psi_1 \ln RPCI_{i,t-2} + \psi_2 EXTD_{i,t-1} + \psi_3 GCF_{i,t-1} + \psi_4\left(EXTD_{i,t-1}*GCF_{i,t-1}\right) + \psi_5 INF_{i,t-1} + \psi_6 TOP_{i,t-1} + u_2 + \eta_{2t-1} \qquad (7)$$

Subtracting Eq. 7 from 6:

$$\ln RPCI_{i,t} - \ln RPCI_{i,t-1} = \psi_1\left(\ln RPCI_{i,t-1} - \ln RPCI_{i,t-2}\right) + \psi_2\left(EXTD_{i,t} - EXTD_{i,t-1}\right) + \psi_3\left(GCF_{i,t} - GCF_{i,t-1}\right) + \psi_4\{\left(EXTD_{i,t}*GCF_{i,t}\right) - \left(EXTD_{i,t-1}*GCF_{i,t-1}\right)\} + \psi_5\left(INF_{i,t} - INF_{i,t-1}\right) + \psi_6\left(TOP_{i,t} - TOP_{i,t-1}\right) + \left(u_2 - u_2\right) + \left(\eta_{2,t} - \eta_{2,t-1}\right) \qquad (8)$$

$$\ln RPCI_{i,t} - \ln RPCI_{i,t-1} = \psi_1\left(\ln RPCI_{i,t-1} - \ln RPCI_{i,t-2}\right) + \psi_2\left(EXTD_{i,t} - EXTD_{i,t-1}\right) + \psi_3\left(GCF_{i,t} - GCF_{i,t-1}\right) + \psi_4\{\left(EXTD_{i,t}*GCF_{i,t}\right) - \left(EXTD_{i,t-1}*GCF_{i,t-1}\right)\} + \psi_5\left(INF_{i,t} - INF_{i,t-1}\right) + \psi_6\left(TOP_{i,t} - TOP_{i,t-1}\right) + \left(\eta_{2,t} - \eta_{2,t-1}\right) \qquad (9)$$

$$\Delta \ln RPCI_{i,t} = \psi_1 \Delta \ln RPCI_{i,t-1} + \psi_2 \Delta EXTD_{i,t} + \psi_3 \Delta GCF_{i,t} + \psi_4 \Delta\left(EXTD_{i,t}*GCF_{i,t}\right) + \psi_5 \Delta INF_{i,t} + \psi_6 \Delta TOP_{i,t} + \Delta\eta_{2,t} \qquad (10)$$

Model 3 (non-linear effect of external debt on growth): The study shows the effect of external debt on economic growth while capturing the non-linear effect of external debt in the external debt-growth nexus as follows:

$$RPCI = f\left(EXTD, GCF, EXTD^2, INF, TOP\right)$$

$$\ln RPCI_{i,t} = \beta_1 \ln RPCI_{i,t-1} + \beta_2 EXTD_{i,t} + \beta_3 GCF_{i,t} + \beta_4 EXTD^2_{i,t} + \beta_5 INF_{i,t} + \beta_6 TOP_{i,t} + \varepsilon_{3i,t} \qquad (11)$$

The lagged equation of model 3 (Eq. 11) above, is stated as follows:

$$\ln RPCI_{i,t-1} = \beta_1 \ln RPCI_{i,t-2} + \beta_2 EXTD_{i,t-1} + \beta_3 GCF_{i,t-1} + \beta_4 EXTD^2_{i,t-1} + \beta_5 INF_{i,t-1} + \beta_6 TOP_{i,t-1} + u_3 + \eta_{3t-1} \qquad (12)$$

Subtracting Eq. 12 from 11:

$$\ln RPCI_{i,t} - \ln RPCI_{i,t-1} = _1 \beta_1\left(\ln RPCI_{i,t-1} - \ln RPCI_{i,t-2}\right) + \beta_2\left(EXTD_{i,t} - EXTD_{i,t-1}\right) + \beta_3\left(GCF_{i,t} - GCF_{i,t-1}\right) + \beta_4\left(EXTD^2_{i,t} - EXTD^2_{i,t-1}\right) + \beta_5\left(INF_{i,t} - INF_{i,t-1}\right) + \beta_6\left(TOP_{i,t} - TOP_{i,t-1}\right) + \left(u_3 - u_3\right) + \left(\eta_{3t} - \eta_{3t-1}\right) \qquad (13)$$

$$\ln RPCI_{i,t} - \ln RPCI_{i,t-1} = _1 \beta_1\left(\ln RPCI_{i,t-1} - \ln RPCI_{i,t-2}\right) + \beta_2\left(EXTD_{i,t} - EXTD_{i,t-1}\right) + \beta_3\left(GCF_{i,t} - GCF_{i,t-1}\right) + \beta_4\left(EXTD^2_{i,t} - EXTD^2_{i,t-1}\right) + \beta_5\left(INF_{i,t} - INF_{i,t-1}\right) + \beta_6\left(TOP_{i,t} - TOP_{i,t-1}\right) + \left(\eta_{3t} - \eta_{3t-1}\right) \qquad (14)$$

$$\Delta \ln RPCI_{i,t} = \beta_1 \Delta \ln RPCI_{i,t-1} + \beta_2 \Delta EXTD_{i,t} + \beta_3 \Delta GCF_{i,t} + \beta_4 \Delta EXTD^2_{i,t} + \beta_5 \Delta INF_{i,t} + \beta_6 \Delta TOP_{i,t} + \Delta\eta_{3t} \qquad (15)$$

Models 4 (interactive effect of external debt and inflation on growth): The study shows the effect of external debt on economic growth while capturing the possible role of inflation in the external debt-growth nexus by interacting external debt indicators with inflation variable as follows:

$$RPCI = f\left(EXTD, INF, EXTD*INF, TOP\right)$$

$$\ln RPCI_{i,t} = \gamma_1 \ln RPCI_{i,t-1} + \gamma_2 EXTD_{i,t} + \gamma_3 INF_{i,t} + \gamma_4\left(EXTD_{i,t}*INF_{i,t}\right) + \gamma_5 TOP_{i,t} + \varepsilon_{4i,t} \qquad (16)$$

The lagged equation of model 4 (Eq. 16) above, is stated as follows:

$$\ln RPCI_{i,t-1} = \gamma_1 \ln RPCI_{i,t-2} + \gamma_2 EXTD_{i,t-1} + \gamma_3 INF_{i,t-1} + \gamma_4\left(EXTD_{i,t-1}*INF_{i,t-1}\right) + \gamma_5 TOP_{i,t-1} + u_4 + \eta_{4t-1} \qquad (17)$$

Subtracting Eq. 17 from 16:

$$\ln RPCI_{i,t} - \ln RPCI_{i,t-1} = \gamma_1\left(\ln RPCI_{i,t-1} - \ln RPCI_{i,t-2}\right) + \gamma_2\left(EXTD_{i,t} - EXTD_{i,t-1}\right) + \gamma_3\left(INF_{i,t} - INF_{i,t-1}\right) + \gamma_4\{\left(EXTD_{i,t}*INF_{i,t}\right) - \left(EXTD_{i,t-1}*INF_{i,t-1}\right)\} + \gamma_5\left(TOP_{i,t} - TOP_{i,t-1}\right) + \left(u_4 - u_4\right) + \left(\eta_{4t} - \eta_{4t-1}\right) \qquad (18)$$

$$\ln RPCI_{i,t} - \ln RPCI_{i,t-1} = \gamma_1\left(\ln RPCI_{i,t-1} - \ln RPCI_{i,t-2}\right) + \gamma_2\left(EXTD_{i,t} - EXTD_{i,t-1}\right) + \gamma_3\left(INF_{i,t} - INF_{i,t-1}\right) + \gamma_4\{\left(EXTD_{i,t}*INF_{i,t}\right) - \left(EXTD_{i,t-1}*INF_{i,t-1}\right)\} + \gamma_5\left(TOP_{i,t} - TOP_{i,t-1}\right) + \left(\eta_{4t} - \eta_{4t-1}\right) \qquad (19)$$

$$\Delta \ln RPCI_{i,t} = \gamma_1 \Delta \ln RPCI_{i,t-1} + \gamma_2 \Delta EXTD_{i,t} + \gamma_3 \Delta INF_{i,t} + \gamma_4 \Delta\left(EXTD_{i,t}*INF_{i,t}\right) + \gamma_5 \Delta TOP_{i,t} + \left(u_i - u_i\right) + \Delta\eta_{4t} \qquad (20)$$

Models 5 (role of the recent global financial crisis in external debt-growth nexus): The study shows the effect of external debt on economic growth, while capturing the possible role of the 2008/09 global financial crisis in the external debt-growth nexus by interacting external debt indicators with CRISIS dummy variable as follows:

$$RPCI = f\left(EXTD, GCF, Crisis, INF, TOP\right)$$

$$lnRPCI_{i,t} = \phi_1 lnRPCI_{i,t-1} + \phi_2 EXTD_{i,t} + \phi_3 GCF_{i,t} + \\ \phi_4 CRISIS_{i,t} + \phi_5\left(EXTD_{i,t} * CRISIS_{i,t}\right) + \phi_6 INF_{i,t} + \phi_7 TOP_{i,t} + \varepsilon_{5i,t} \tag{21}$$

The lagged equation of model 5 (Eq. 21) above, is stated as follows:

$$lnRPCI_{i,t-1} = \phi_1 lnRPCI_{i,t-2} + \phi_2 EXTD_{i,t-1} + \phi_3 GCF_{i,t-1} + \\ \phi_4 CRISIS_{i,t-1} + \phi_5(EXTD_{i,t-1} * CRISIS_{i,t-1}) + \phi_6 INF_{i,t-1} \\ + \phi_7 TOP_{i,t-1} + u_5 + \eta_{5t-1} \tag{22}$$

Subtracting Eq. 22 from 21:

$$lnRPCI_{i,t} - lnRPCI_{i,t-1} = \phi_1(lnRPCI_{i,t-1} - lnRPCI_{i,t-2}) + \phi_2(EXTD_{i,t} - EXTD_{i,t-1}) + \phi_3(GCF_{i,t} - GCF_{i,t-1}) + \phi_4(CRISIS_{i,t} - CRISIS_{i,t-1}) \\ + \phi_5\{(EXTD_{i,t} * CRISIS_{i,t}) - (EXTD_{i,t-1} * CRISIS_{i,t-1})\} \\ + \phi_6(INF_{i,t} - INF_{i,t-1}) + \phi_7(TOP_{i,t} - TOP_{i,t-1}) + (u_5 - u_5) + (\eta_{5t} - \eta_{5t-1}) \tag{23}$$

$$lnRPCI_{i,t} - lnRPCI_{i,t-1} = \phi_1(lnRPCI_{i,t-1} - lnRPCI_{i,t-2}) + \phi_2(EXTD_{i,t} - EXTD_{i,t-1}) + \phi_3(GCF_{i,t} - GCF_{i,t-1}) + \phi_4(CRISIS_{i,t} - CRISIS_{i,t-1}) \\ \phi_5\{(EXTD_{i,t} * CRISIS_{i,t}) - (EXTD_{i,t-1} * CRISIS_{i,t-1})\} + \\ \phi_6(INF_{i,t} - INF_{i,t-1}) + \phi_7(TOP_{i,t} - TOP_{i,t-1}) + (\eta_{5t} - \eta_{5t-1}) \tag{24}$$

$$\Delta lnRPCI_{i,t} = \phi_1 \Delta lnRPCI_{i,t-1} + \phi_2 \Delta EXTD_{i,t} + \\ \phi_3 \Delta GCF_{i,t} + \phi_4 \Delta CRISIS_{i,t} + \phi_5 \Delta(EXTD_{i,t} \\ * CRISIS_{i,t}) + \phi_6 \Delta INF_{i,t} + \phi_7 \Delta TOP_{i,t} + \Delta\eta_{5t} \tag{25}$$

In the Eq. 1-25 above:

i $= 1 \cdots\cdots\cdots N$

t $= 1\cdots\cdots\cdots\cdots.T$

$\varepsilon_{ki,t}$ $= u_i + \eta_{it}$; for k = i = 1-5

Thus, the component u_i is the individual (i.e., country-specific) fixed effects that are time-invariant and η_{it} is the country-specific shocks and varies over time. The latter shocks are heteroskedastic and are correlated over time within individuals but not among them. Also, there is an assumption that:

$$E\left(u_i\right) = E\left(\eta_{it}\right) = E\left(u_i, \eta_{it}\right) = 0 \tag{26}$$

In Eq. 26, E $(\eta_{it}, \eta_{js}) = 0$ for each i, j, t, s with strictly exogenous variables that are uncorrelated with current and past errors. Thus by first-differencing, the equation u_i is removed. This implies that a potential source of exogeneity problem (that is, country-specific effect) in the estimation is eliminated. The number of countries used in this study is captured by $i = 1 \cdots N$ and the period or years is captured by $t = 1 \cdots T$. Table 1 captures the a prior expectation drawn from theoretical proposition. The definitions of variables and data sources are presented in Table 2.

RESULTS AND DISCUSSION

This section describes the data on all the variables used throughout the study with particular reference made to the mean, maximum, minimum and standard deviation of each of the 5 variables, all of which are presented in Table 3. From the table, it is clearly shown that all the series have positive mean values, which implies that all the series have increasing trends; the variable with the highest mean value is trade openness (78.07%) and the series with the lowest mean value is the log of real/capita income (6.57). The maximum and minimum values in the current sample for log of real/capita income, external debt (% of GNI), gross capital

Table 1: Expected results

Models	Expected sign(s) of coefficients
1	$\alpha_2 >$ or <0, $\alpha_3 > 0$, $\alpha_4 >$ or <0, $\alpha_5 < 0$
2	$\psi_2 >$ or <0, $\psi_3 > 0$, $\psi_4 >$ or < 0, $\psi_5 >$ or < 0, $\psi_6 < 0$
3	$\beta_2 >$ or <0, $\beta_3 > 0$, $\beta_4 < 0$, $\beta_5 >$ or <0, $\beta_6 < 0$
4	$\gamma_2 >$ or <0, $\gamma_3 >$ or <0, $\gamma_4 >$ or <0, $\gamma_5 < 0$
5	$\phi_2 >$ or <0, $\phi_3 > 0$, $\phi_4 >$ or <0. $\phi_5 >$ or <0, $\phi_6 >$ or <0, $\phi_7 < 0$

Source: Compiled by the author

Table 2: Summary of data description and data sources

Variables	Description	Sources of data
ln RGDP	Natural log of real GDP: a proxy for economic growth	World development indicator[13]
EXTD	External debt (% of GNI)	World development indicator[13]
GCF	Gross capital formation (% of GDP): a proxy for domestic investment	World development indicator[13]
INF	Inflation, consumer prices (annual %): a proxy for economic instability and uncertainty	World development indicator[13]
TOP	Trade openness (trade as % of GDP): a proxy for macroeconomic environment	World development indicator[13]
CRISIS	A dummy variable to capture the role of the 2008-09 global financial crisis among the variables under the study. It takes the value of 0 for pre-crisis period (1999-2007) and the value of 1 for crisis and post-crisis period (2008-2014)	Author's computation

Source: Compiled by the author

Table 3: Summary of descriptive statistics

Variables	No. of observation	Mean	Maximum	Minimum	Standard deviation
lnRPCI	416	6.57	8.92	4.95	1.03
EXTD	416	56.12	343.43	4.12	46.98
GCF	416	21.94	60.16	2.78	8.87
TOP	416	78.07	371.21	15.03	45.90
INF	416	8.44	513.91	-8.97	33.69

Source: Author's computation

Table 4: System GMM regression

Dependent variable: RPCI	Models				
	1	2	3	4	5
C	0.109 (0.102)	106 (0.101)	0.080 (0.301)	-0.111 (0.239)	0.120* (0.063)
lnRPCI (-1)	0.983*** (0.017)	0.983*** (0.017)	0.991*** (0.043)	1.014*** (0.039)	0.982*** (0.010)
EXTD	-0.0001* (0.0001)	-0.00004 (0.0002)		-0.002 (0.002)	-0.0002*** (0.00007)
GCF	0.001 (0.0007)	0.0014 (0.001)	0.0015 (0.0001)		0.0014*** (0.0005)
INF	-0.0002*** (0.00001)	0.0002*** (0.00007)		-0.0002* (0.0001)	-0.0002 (0.00004)
TOP			-0.0002 (0.0006)	0.002 (0.002)	
CRISIS					-0.0051 (0.0054)
EXTD^2			0.00001 (0.00002)		
EXTD*GCF		0.00005 (0.00008)			
EXTD*INF				0.00001 (0.00005)	
EXTD*CRISIS					-0.0001 (0.0001)
Observation	390	390	390	390	390
AR (1)	-2.072	-2.059	-1.993	-2.068	-2.104
AR (1) p-value	0.038	0.040	0.046	0.039	0.035
AR (2)	-0.515	-0.521	-0.577	-0.637	-0.513
AR (2) p-value	0.606	0.603	0.564	0.524	0.608
Hansen test	11.60	11.41	2.794	10.03	12.25
Hansen prob	0.395	0.410	0.424	0.123	0.345
No of instruments	16	17	9	12	18

Author's computation, Robust standard errors in parentheses ***p<0.01, **p<0.05, *p<0.1

formation (% of GDP), trade openness (% of GDP) and inflation are 8.92 and 4.95, 343.43 and 4.12, 60.16 and 2.78, 371.21 and 15.03, 513.91 and -8.97, respectively. In terms of volatility, the standard deviation provides an adequate measure of volatility. The least volatile variable is real/capita income, which implies that there is stability in its series amongst the other variables; while the most volatile variable is external debt (% of GNI), which has developmental implications. This may be associated with fluctuations of funds for some important indicators such as developmental projects, which may hinder the economic performance of SSA. The domestic investment seems to be fairly stable compared to trade openness and inflation, which are also highly volatile.

Table 4 presents the empirical results from a system GMM estimation across the 5 models considered in this study. The result from model 1 shows that the current value of real/capita income is significantly responsive to its previous values as reflected by the positive coefficient of 0.98, which is statistically significant at 1% level of significance. This implies that the determination of real/capita income in sub-Saharan Africa follows an adaptive expectation. It also revealed an inverse relationship between external debt (as a

percentage of GNI) and real/capita income, as the coefficient -0.000013 implies that for every 1 percentage point increase in external debt (as a percentage of GNI), real/capita income negligibly declines on average by 0.001%. Also, the coefficient is statistically significant at 10% level of significance. The implication is that external debt (as a percentage of GNI) has a dampening effect on economic performance of the SSA region. Though, the impact is negligible as indicated by the coefficient. Although, this result suggests that external debt of SSA has not attained a scary threshold but caution should be taken because excessive amount of external debt is seen by domestic and foreign investors as a tax on their future returns, hence a reduction in total domestic investment which in turn dampens output growth. This result validates theoretical prediction and the claim is supported by the low coefficients of external debt across the models. This finding is similar to Claderon and Fuentes[14], Ada *et al.*[15] and Al Kharusi and Ada[16].

In addition, a positive relationship exists between domestic investment and real/capita income, as its coefficient implies that for every 1 percentage point increase in domestic investment, real/capita income

negligibly increases on average by 0.001%. This concurs with the theoretical prediction that the expected positive relationship exists between domestic investment and output. However, the coefficient is not statistically significant at any level of significance. The implication of this result is that due to peculiar features of countries within the SSA, in terms of corruption, political instability, low level of savings, high unemployment rate (although of different magnitude), contributes adversely to the low level of investment. The study, therefore, infers that capital stock in sub-Saharan Africa (SSA) is not sufficient enough to spur necessary investment drive that will raise the level of economic growth within the SSA region. This supports the findings of Safadari and Mehrizi[17] that explored the role investment.

Furthermore, a negative relationship exists between inflation and real/capita income as indicated by the sign of the coefficient (-0.000173%), this implies that for every 1% increase in inflation, real/capita income decreases on average by 0.02% keeping other variables constant. This result implies that real GDP responds negatively to the immediate increase in inflation and the coefficient of inflation is statistically significant at 1% level of significance. In addition, the negative growth effect of inflation is usually transmitted via a change in the nominal interest rate. Theoretically, an increase in inflation leads to a rise in the nominal interest rate, which in turn reduces private investment and domestic output and lastly, trade openness is treated as an instrumental variable because of its degree of association with the error term. As a result, trade openness was automatically excluded from the baseline model. This is consistent with the results of Akinkunmi[18].

In model 2, as in the previous model, controlling for the interactive effect of external debt and domestic investment does not seem to change the result of: first, the real/capita income, as it generates an adaptive expectation in its determination, as reflected in the positive and significant coefficients of its first lag; second, external debt, as it still exerts negligible negative influence on real GDP/capita growth of the sub-Saharan African economy, with its coefficient implying that for every 1 percentage point increase in the external debt, real GDP/capita decreases on average by 0.004%. This result reinforces the conclusion in model 1 above, on the relationship between external debt and real/capita income, 3rd, domestic investment, as it still exerts negligible positive influence on real GDP/capita of the sub-Saharan African economy with the coefficient 0.00153 implying that for every 1 percentage point increase in the investment, real GDP/capita increases on average by 0.153% and four, inflation, which exerts negligible negative influence

on real GDP/capita in the SSA economy, with the coefficient on inflation -0.000181, implies that for every 1 percentage point in inflation (% of GDP), real GDP/capita decreases on average by 0.018%. More so, the interaction of external debt with domestic investment produces a rather negative growth effect of 0.0005%, implying that external debt has worked to crowd-out domestic investment with its attendant negative growth effect. Excessive external debt seems to have discouraged new domestic investment as investors believe in the fact that returns realized on their funds that should have been paid to them would be used to redeem foreign borrowing later, which in turn hinders output growth in the economy; while trade openness is also treated as an instrumental variable because of its degree of association with the error term. As a result, trade openness was automatically excluded from the baseline model. This is in line with the findings of Zouhaier and Fatma[19] who also established negative effect of interaction between debt measures and investment on economic growth.

Also, in model 3, controlling for the non-linear effect of external debt does not seem to change the result of: first, real/capita income, as its current value is positive and significantly associated with its previous values (first lag of real/capita income), thereby reinforcing the adaptive nature of expectations about output movement in SSA and second, domestic investment, as it still exerts negligible positive influence on real GDP/capita growth of the sub-Saharan African economy, with the coefficient 0.00148 implying that for every 1 percentage point increase in the investment, real GDP/capita increases on average by 0.148%. Unlike model 4, trade openness exerts a negligible negative influence on real GDP growth in the SSA economy, with the coefficient on trade openness, implies that for every 1 percentage point increase in trade openness (% of GDP), real GDP/capita growth decreases on average by 0.04%. This implies that countries of sub-Saharan Africa are more vulnerable to external shocks.

Theoretically, it is expected that the coefficient on the non-linear term (read as "external debt squared") should be negative; implying that there is a considerable limit to which external debt can increase output i.e. diminishing returns of growth to external debt (that is, inverted U-shaped external debt-growth relation). However, the coefficient of the non-linear term is positive in the SSA context and it is not statistically significant. The implication of this is that external debt is yet to reach a troublesome/nettlesome threshold and thereby refuting the theoretical argument of diminishing returns of growth to external debt (that is, inverted U-shaped external debt-growth relation) and finally, accounting for the

non-linear effect of external debt on real GDP/capita growth does not seem to alter the zero growth effects of domestic investment and trade openness; judging from their approximate respective coefficient of 0.001 and -0.0004, except for slight differences in magnitudes of impact of investment in comparison with model (2). This result is against the empirical works of Ward *et al.*[20,21] and Schclarek[22] that the relationship between external debt and economic growth is nonlinear.

In model 4, controlling for the interactive effect of external debt and inflation does not seem to change the result of: the real/capita income, as the initial stance from the previous models on the real/capita is still intact and the current value of real GDP/capita remains determined by its previous values as shown by the positive and significant coefficient of 1.014, with respect to the first lag of real GDP/capita, thereby confirming the fact that expectations about output changes in sub-Saharan African countries are of the adaptive nature; external debt, like model 2, is also not statistically significant or different from zero, maintaining negative relationship with real/capita income, which conforms with the apriori expectation and further corroborate the initial stance taken on model 2. The coefficient of -0.002 implies that for every 1 percentage point increase in the external debt, real GDP/capita decreases on average by 0.2% and inflation, like other models exerts negligible negative influence on real GDP/capita growth of the sub-Saharan African economy but at a 10% level of significant, with the coefficient -0.0002 implying that for every 1 percentage point increase in the inflation, real GDP/capita decreases on average by 0.02%.

Contrary to model 3, for trade openness, the interaction between inflation and external debt exerts a negligible positive influence on real GDP/capita growth of the sub-Saharan African economy, with the coefficient 0.002 implying that for every 1 percentage point increase in the trade openness, real GDP/capita increases on average by 0.2%. This implies that countries in sub-Saharan Africa are less vulnerable to external shocks and finally, the interaction between inflation and external debt on growth is positive, as indicated by the sign of the coefficient 0.000001, although not statistically significant but conforms with theoretical predictions. Inflation can be used to erode external debt[23], also higher inflation can help reduce public debt[24,25]. However, when there is an increase in inflation, external debt decreases results in two effects. The first is the effect of increasing inflation to reduce growth and the second is the effect of decreasing external debt to foster growth. In this case, the second effect outweighs the first. Thus, since the resultant

effect is to increase growth, therefore the interaction between external debt and inflation has a significantly positive effect on economic growth.

Finally, in model 4, accounting for the role of the recent global financial crisis in external debt-growth nexus, does not seem to change the result of: the real/capita income, as the current value of real GDP remains determined by its previous values as shown by the positive and significant coefficient of 0.982 with respect to the first lag of real GDP/capita, thereby confirming the fact that expectations about output changes in sub-Saharan African countries are of the adaptive nature, this remains affirmative to the previous conclusions in the other models, external debt, like model I, is also significant but at 1% level of significance, maintaining a negative relationship with the real/capita income, this conforms with the apriori expectation. Its coefficient implies that for every 1 percentage point increase in the external debt, real/capita income decreases on average by 0.02%, thus reinforcing the conclusion reached earlier in the other models; domestic investment, as obtained earlier, domestic investment is positively related to real GDP/capita, as the trivial coefficient 0.001 shows that for every 1 percentage point increase in the domestic investment ratio, real GDP/capita increases on average by 0.1% which is statistically significant at 1% level of significance. The coefficient conforms with the theoretical prediction that investment argument growth. The peculiarities of sub-Saharan Africa countries in terms of corruption, political instability, etc. contribute adversely to the insignificant relationship between investment and economic performance in the SSA. We can infer that capital stock in SSA is not sufficient enough to spur necessary investment drive that raises the level of economic growth within the SSA and inflation, which is negatively related to real GDP/capita, as the impact coefficient -0.0002% shows that for every 1 percentage point increase in the inflation, real GDP/capita decreases on average by 0.018%. This result conforms with theoretical prediction but is statistically significant at 1% level of significance thus reinforcing the conclusion reached earlier in the other models.

In summary, accounting for the role of the crisis shows the mean value of real GDP/capita decreased following the crisis compared to the pre-crisis period level by a magnitude of 0.005%. The coefficient is not statistically significant. Also, considering the effect of the crisis on real GDP/capita growth indicates that the growth effect of the external debt of sub-Saharan Africa reduced following the crisis by a magnitude of -0.0001% and this coefficient is also not statistically significant or not different from zero. These results both imply that the 2008-09 global financial crisis and its

interaction with external debt have a negative impact on the level and growth of real/capita income. This study discovers the minimal external debt and high investment which can be beneficial for economic performance in SSA. This study helps the researchers to uncover the critical factors of high external debt challenges as well as importance of investment that are necessary for economic performance. Thus, a new theory on the determinants of economic performance within the SSA region context may be arrived at.

CONCLUSION

This study examined the relationship between external debt, investment and economic performance in sub-Saharan Africa between 1999 and 2014 employing the system panel GMM. The result concluded that external debt (as a percentage of GNI) has a significant negative effect on the economic performance of the sub-Saharan African countries, the impact of investment on economic growth is positive, whereas the interaction between external debt and investment of the sub-Saharan Africa countries is negative. Furthermore, domestic investment exerts a positive but insignificant influence on growth even when the role of the interaction between external debt and domestic investment was considered. Also, after accounting for the non-linear effects, investment still remains an insignificant contributor to the growth process in sub-Saharan Africa. The interaction between external debt and domestic investment has an insignificant negative effect on economic growth of sub-Saharan Africa. Also, the interactive effect of external debt and crisis yielded an insignificant negative effect on growth. This study also refuted the inverted U-shaped relation between external debt and economic growth in SSA over the short term, because there is a long-run relationship between external debt and economic growth.

Based on the findings and conclusion, the government of the sub-Saharan Africa countries should ensure optimal utilization of external debt to avoid crowding out of investments and also any possible existence of debt overhang. Also, government of the SSA should continue to strive towards attaining minimal debt burden through economic and political stability. The productivity of the sub-Saharan Africa countries can greatly be enhanced, when external debt is acquired for economic reasons rather than social or political reasons. Also, the government through its monetary authorities should put measures in place to curtail the inflationary trend in the economy. More so, countries of sub-Saharan Africa should diversify their export base so as to increase export earnings and promote industrialization in order to reduce import dependence.

SIGNIFICANCE STATEMENTS

This study discovers the minimal external debt and high investment which can be beneficial for economic performance in SSA. This study helps the researchers to uncover the critical factors of high external debt challenges as well as importance of investment that are necessary for economic performance. Thus, a new theory on the determinants of economic performance within the SSA region context may be arrived at.

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