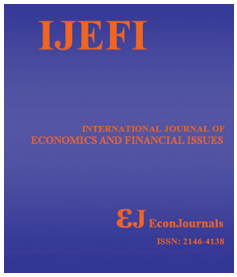

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Public Debt and Economic Growth: Evidence from Africa

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ABSTRACT

There is no doubt that every country needs funding to foster economic growth and development. However, such funding needs to be at levels deemed sustainable and closely in line with the government's fiscal and monetary policies. To this end, there is an urgent need for policymakers in governments, central banks, and international policy organizations to understand the effects of public debt on economic growth. This study used 50 African countries from 1980 to 2015 to assess the impact of public debt on economic growth. The study employed an ordinary least square estimation technique for a static panel regression model and the generalised method of moment estimation technique for a dynamic panel regression model for the analysis. The empirical results from both estimation techniques suggest a statistically significant negative relationship between public debt and economic growth. The results also provide evidence that the relationship between public debt and economic growth is non-linear. The study also found that inflation and government consumption expenditure have a statistically significant negative relationship with economic growth whereas capital formulation, population growth and openness of trade have a statistically significant positive relationship with economic growth.

Keywords: Public Debt, Economic Growth, Ordinary Least Square, Generalized Method of Moment
JEL Classifications: F33, F34, F35, O11

1. INTRODUCTION

The last 50 years have witnessed significant developments in economies of several African countries. These developments have been partly driven by huge infrastructural investments, health, social welfare and education as well as different areas of the economies. Owusu-Nantwi and Erickson (2016) assert that tax revenues are insufficient to fund the investments with their concomitant significant expenditures, which mostly lead to high budget deficits.

Huge budget deficits have created a burden on governments and policy makers on the mechanisms to finance them. Rosen and Gayer (2008) have suggested that public finance proffers three ways of financing such deficits. These include increase in taxes, user fees and debts. With most developing economies bedeviled with weak tax systems and low-income levels, borrowing has increasingly become the most suitable option for financing government deficits. To this end, many African countries consider borrowing as an indispensable tool in financing development in their economies (Doğan and Bilgili, 2014). Siddique et al. (2016) agree that debts' role as a supplementary medium of financing to internally generated funds for supporting development and other government budgetary needs, cannot be underestimated. Countries which face challenges regarding substantial revenue generation usually borrow to meet their capital and recurrent expenditures.

The sectors of the economy where the borrowings are invested affect the repayment ability of these countries; if this borrowing is not used in the productive sectors of the economy and in income generating activities, it affects the country's ability to settle its obligations when they are due, thereby causing debt accumulation which is argued as a key constraint to economic growth and poverty reduction (Siddique et al., 2016). The relationship between public debt and economic growth has thus become a great concern to governments all over the world. Eberhardt and Presbitero (2015)

posit that the relationship between public debt and economic growth has become one of the topical issues in academia and among policy makers.

In recent times, many studies have been conducted to emphasize the significance of public debt to economic growth. While some researchers, including Bakar and Hassan (2008), Owusu-Nantwi and Erickson (2016) and Umutlu et al. (2011), conclude that debt has a positive impact on economic growth, others including Doğan and Bilgili, (2014) Eberhardt and Presbitero (2015), Egert (2015) and Kourtellos et al. (2015), conclude that the debt levels of a country has a negative association with its economic growth. While many of these studies have been conducted in developed economies, few researchers have focused on developing economies.

The issue of debt accumulation in developing countries cannot be overemphasized. Many countries in Africa devote significant portion of their annual revenues to interest payments leaving only a handful of domestic resources for other sectors of the economy. For example, Ghana projected a total of Globally Harmonized System 9.6 billion as interest payments in 2016. This accounted for about 27% of domestic revenues. The situation in other African countries is no different from the Ghanaian situation. In most of these African countries, interest and debt repayments are financed through additional borrowings. The increasing need for African economies to grow amidst the vicious borrowing cycle has ignited the debate on whether debt stock impacts economic growth.

There has been a growing concern that debt trajectories in most developing economies, such as Ghana, are not sustainable and this poses serious threats to the long-term growth and stability of these economies. For instance, in 2000, Ghana recorded a debt to gross domestic product (GDP) ratio of 111%, the highest the country has recorded in the past half century. Similarly, Liberia's debt to GDP ratio in the early 2000s soared above 600% due to increased debt accumulation with no sustained growth in the country. These economic situations between Ghana and Liberia have shown that debt to GDP ratio in Sub-Saharan Africa has an impact on economic growth (World Bank, 2005). Debt management has thus become a key area for governments and policy makers since many countries are recording ballooning budget deficits and increasingly borrowing to finance these deficits.

Over the past 50 years, foreign debts servicing has assumed a serious dimension for developing countries in their quest to advancing growth and accelerating development (Panizza and Presbitero, 2013). Even though the menace of debts servicing is predominant the developing countries such as Ghana, the advanced countries are not excluded from this quagmire. The recent global economic recession and financial crisis coupled with the expansionary public policies pursued by governments all over the world have increased the borrowing levels of economies. The recent examples of Greece, Portugal and Ireland where they recorded unsustainable public debts have rekindled interest in research relating to public debt for academicians and policy makers.

Owusu-Nantwi and Erickson (2016) assert that the issue of public debts remains very vital to economic development. Unfortunately, little attention has been given to it in terms of empirical study, especially in developing economies. All these circumstances and inefficiencies have contributed to the huge debt overhang in many African countries such as Ghana, which has stifled growth. More so, there have been few studies which indicate the importance of how public debt impacts economic growth. Some of these studies include (Buchanan, 1958; Diamond, 1965; Meade, 1958; Modigliani, 1961). However, empirical studies on public debt's impact on growth with a focus on the entire African continent are rarely available. Given this background, this study has been necessitated by the growing need for governments and policy makers in African countries to understand public debt and its management in the context of economic growth. Generally, this study seeks to examine how public debt influences economic growth among African countries.

Africa as a continent has experienced many challenges with respect to debt management and economic growth. It is therefore prudent to understand the variables needed to address the problem and its significance to the various stakeholders. The study has significant implications on practice, policy and academic literature.

This study contribute to the existing body of research on Africa's public debt and economic growth and provide some guidance for public debt managers by making some recommendations concerning the impact government expenditure and inflation dynamics and other macroeconomic variables have on the public debt in Africa. The study also uses a combination of ordinary least squares (OLS) and generalised method of moment (GMM) to analyses data unlike previous studies that used one method.

As a contribution to policy and practice, the findings provide better guidelines to respective governments and policy makers in developing countries in the process of fiscal policy formulation and implementation. Governments and policy makers can recognize the threshold above which debt accumulation becomes detrimental to the economic growth of a country. The study will serve as a baseline for future evaluation of the impact on debt levels on economic growth in Africa. Other researchers working on similar areas of interest can also make references to the findings of the study.

The general knowledge on public debt and economic growth in Africa is of great importance to investors as this affects the general investment climate. The study will be of great help to investors since governments' debt as a percent of GDP is used by financial analysts to measure nations' ability to make good their future debt obligations and consequently impacting the country cost of obtaining financing.

2. EMPIRICAL STUDIES ON PUBLIC DEBT AND GROWTH

2.1. Models Used in the Studies of Public Debt and Economic Growth

There are a number of estimation techniques employed in empirical studies of growth and public debt. Some of these econometric

models include OLS, Instrumental Variables, GMM and the vector auto regressive (VAR) framework. Depending on the type of data involved, one of these models is usually preferred to the others. Another key factor that is considered when choosing the type of estimation technique to employ in a study is the basic limitations and strengths of each estimation technique. For instance, when modeling time series data, especially macroeconomic variables, Johansen (1988) argues that the VAR framework has an advantage over other alternative estimators. The possible reason for this conclusion is that the VAR framework is able to cater for trending of data, the feedback effects between past and present values, and the stochastic behavior of data (main guide). VAR is a popular forecasting model because it relies on the observed outcomes of the past to predict the expected future values.

OLS has also been employed in most empirical studies (example Deshpande (1990), Fosu (1996), Sheikh et al. (2010) to study the relationship between debt and economic growth. However, Engle and Granger (1987) note that the application of OLS to analyse time series data and in particular public debt and economic growth variables which are highly endogenous could render the result biased even though consistent with theory.

The GMM estimation technique uses a GMM estimator which was developed by (Arellano and Bond, 1991 and Blundell and Bond, 1998). The GMM works very well with panel data and is the most widely used estimation technique, employed in studies (including this study) of debt and economic growth.

Arellano and Bond (1991) argue that the advantage of GMM lies in its robustness to standard errors. The use of instrumental variables also helps to reduce the endogeneity effects of regressors, particularly the debt and growth variables. Kumar and Woo (2010) examined the relationship amongst debt and growth from 1970 to 2007 in 30 countries. They used different estimation techniques and argued that the GMM estimator allows them to address the issue of endogeneity.

2.2. Empirical Evidence on Public Debt and Growth

Siddique et al. (2015) examine the extent to which foreign debt impacts on a nation's GDP over a 37-year period from 1970 to 2007, focusing on Heavily Indebted Poor Countries. The findings indicate that in both the short and long run, growth performance of the indebted nations significantly increases as debt stock reduces. This implies a negative relationship between the countries' debt stock and their economic performance. The empirical results further indicate that capital formation and Population growth (POPG) positively affect GDP in the short term.

However, Jayaraman and Lau (2009) in their study identify whether external debt has any contribution to economic growth for six Pacific Island Countries. Jayaraman and Lau found that in the short run, external borrowing contributes positively to growth. The study, however, found no long-term relationship. Employing the completely altered conventional minimum squares, they found that a 1% growth in the public debt stock triggers a 0.25% increase in the economic growth. Unlike Jayaraman and Lau (2009), Putunoi and Mutuku's (2013) findings establish that the relationship between domestic debt and economic growth was positive in the long run.

In conformity with Jayaraman and Lau's (2009) findings above, Putunoi and Mutuku (2013) also found a positive relationship between domestic debt and economic growth in Kenya from 2000 to 2010. The objective of the study was to examine the impact of domestic debt on economic growth in Kenya. Panizza and Presbitero (2012) analyzed the effect of debt on the growth of the economy for a number of Organisation for Economic Co-operation and Development nations, utilizing the instrumental variable approach. A negative connection was established between public debt and economic growth.

Their findings are in line with existing studies that have found a negative relationship between debt and growth. It is worth noting that the authors further found that once debt is instrumented with a variable that captures valuation effects brought about by the interaction between foreign currency debt and exchange rates, there are diminishing linkages between debt and growth.

Rabia and Kamran (2012) also examined the effect of local debt and foreign debt independently on the financial development of Pakistan over the period 1980–2010. The outcome of their work demonstrates that there is a measurably huge negative connection between domestic debt and growth and furthermore the connection between foreign debt and growth was observed to be negative. Their findings additionally indicate that external debt had a more detrimental effect than domestic debt stock. The authors attributed the increased impact of external debt stock to the fact that external debt servicing is denominated in foreign currency coupled with the weak value of Pakistani Rupee as compared to the creditors' countries' currencies.

In line with the findings of Rabia and Kamran (2012) where the impact of external debt on economic growth was found to be stronger than domestic debt, a recent study by Mousa and Shawawreh (2017) also confirms public debt's negative relationship with economic growth, especially with external debts. Using a dynamic panel data model to assess the effect of debt on economic growth, Fatma and Zouhaier (2014) studied 19 developing countries over the period 1990–2011. The results confirm Rabia and Kamran's (2012) earlier findings which suggest a negative and statistically significant relationship between external public debt (which measured as public debt as a percentage of GDP and gross national income) and economic growth. Also, the study equally investigated the impact that public debt has on the contribution of investment to economic growth. Similarly, the findings indicate that as external public debt increased, investment in the 19 countries decreased.

To examine the impact of public debt on economic growth in Nigeria, Obademi (2012) employed an improved Cobb Douglas model to capture the long-run impact of debt variables on economic growth. The results show that in the short run debts stock and budget deficit showed a positive coefficient but the long run effect show a negative and statistically significant relationship. Obademi (2012) attributed the long run negative relationship to

a possible lack of skill in debt management. The result shows that the joint impact of debt on growth is negative and exceptionally immense as time goes on. Nonetheless, in the short-run the impact of borrowings and coefficient of budget deficit are positive.

From the above literature it is clear that the debt-economic growth nexus is not clearly unraveled. This is evident from the mixed empirical findings in the numerous studies. The majority of the findings establish that there exists a negative relationship between debt and economic growth; only few of them found positive relationship between debt and growth. Moreover, most studies about the effect of public debt on economic growth have focused either on cross-sectional analysis or are country specific. Specifically, a number of the cross-country investigations were done on developed economies. The few ones that have been conducted in Africa have largely focused on either the effect of external debt or domestic debt on economic growth but not the combined effect (public debt) of external and domestic debt on growth. Therefore, this study aimed to fill that gap by examining the impact of public debt and economic growth in Africa.

Methodologically, a number of econometric estimation techniques have been employed to examine the relationship between debt and growth. These estimation techniques include OLS; Engle-Granger Co-integration test and Johansen Maximum Likelihood Co-integration test specified under a VEC and GMM technique which have been applied in econometric analysis. Among these estimation techniques, the GMM technique is the most widely used in studies (including this study) examining the relationship between public debt and economic growth using panel data. As discussed earlier, the GMM technique works very well with panel data. Bazzi and Clemens (2009) have confirmed this by explaining that the dynamic panel GMM estimator solves the issue of biases such as the omitted-variable bias, measurement errors and endogeneity.

3. METHODOLOGY

In line with our objectives, the study employed panel data across 50 African countries which span from 1980 to 2015. A total of eight macroeconomic variables were employed in the analysis. The data were primarily sourced from the World Bank World Development Indicators, World Economic Outlook (IMF) and other development agencies.

Kothari (2004) has explained sampling as the picking of some piece of a total or of a totality based on which a judgment about the piece or the totality is made. Moreover, it is a method for getting data about an entire population by looking at only a piece of it. This study adopted the purposive sampling approach by using countries in sub Saharan Africa as a case study due to their perennial budget deficits and the need to borrow to finance such deficits.

3.1. Model Specification and Estimation Techniques

Following Owusu-Nantwi and Erickson (2016), the study builds on their approach to employ the panel econometric regression model below in assessing the relationship and impact of public debt and economic growth.

Panel data estimation technique procedure was adopted to analyse the relationship between Africa's public debt and economic growth. Panel estimation technique deals with heterogeneity that is in relation with the individual countries which additionally takes into consideration singular particular factors. Once more, panel data consolidates both time series and cross-sectional information which in this manner gives precise and instructive information, greater changeability, less collinearity among factors, more degree of flexibility and more effectiveness. It additionally increases the value of exact work such as may not be conceivable if either just time series information or cross-sectional information is utilized (Ogboi and Unuafe, 2013)

3.2. Regression Model

$$GDPG_{i,t}=\alpha_{i,t}+\beta_1 GOVD_{i,t}+\beta_2 GOVD^2_{i,t}+\beta_3 GOVE_{i,t}+\beta_4 CAPF_{i,t}+\beta_5 INFL_{i,t}+\beta_6 POPG_{i,t}+\beta_7 OPEN_{i,t}+\beta_8 FDI_{i,t}+\varepsilon_{i,t} \quad (1)$$

$$GDPG_{i,t}=\alpha_{i,t}+\beta_1 GDPG_{i,t-1}+\beta_2 GOVD_{i,t}+\beta_3 GOVD^2_{i,t}+\beta_4 GOVE_{i,t}+\beta_5 CAPF_{i,t}+\beta_6 INFL_{i,t}+\beta_7 POPG_{i,t}+\beta_8 OPEN_{i,t}+\beta_9 FDI_{i,t}+\varepsilon_{i,t} \quad (2)$$

Where i and t denotes country and year respectively; $GDPG_{i,t-1}$ is the lag of the dependent variable. The definitions of the variables are presented in Table 1.

The study explored the appropriate panel data estimation techniques (fixed effect, random effect) for static model in equation 1 and GMM technique for the dynamic model in equation 2 for estimating the regression equation.

3.3. Variable Description and Measurement

3.3.1. Dependent variable

3.3.1.1. Real GDP growth rate

The Real GDP Growth rate refers to the final market value of goods and services within a given year when valued at constant prices (Burda and Wyplosz, 2009). By extension, it is the annual percentage change in GDP at market price. It offers much relevance as a measure of economic growth as it draws in the inputs of inflation on economic growth. An assessment of the GPDG is essential in calculating economic growth, particularly for the purposes of economic welfare comparisons, international welfare comparisons and business cycle forecasts within an economy. It was measured as the annual percentage growth rate of GDP at market prices based on constant local currency.

Table 1: Variables definition

Variables	Definition	Source
GDPG	Real GDP growth rate	World Bank
GOVD	GOVD as a percentage of GDP (as a proxy for public debt)	IMF
$GOVD^2$	Quadratic term for government debt	IMF
GOVE	Government consumption expenditure as a percentage of GDP	IMF
CAPF	CAPF as a percentage of GDP	World Bank
INFL	INFL (consumer prices) in percentage	World Bank
POPG	POPG in percentage	World Bank
OPEN	OPEN as a percentage of GDP	UNCTAD
FDI	FDI as a percentage of GDP	World Bank

GDPG: Real Gross domestic product growth rate, IMF: World Economic Outlook, FDI: Foreign direct investment, INFL: Inflation, POPG: Population growth, OPEN: Sum of exports and imports, GDP: Gross domestic product, GOVD: Gross government debt, GOVE: Government consumption expenditure, CAPF: Gross capital formation

3.3.2. Independent variables

3.3.2.1. Past level of GDP growth rate ($GDPG_{i,t-1}$)

To investigate the long term effect of growth in countries, it is important to include the lag of the dependent variable among the independent variables. It is expected that the current level of economic growth in a country will influence future growth levels in the country. This is because potential for future growth depends on the level of growth achieved by the countries based on which the country can produce more goods and services. Today's growth, would therefore serve as a catalyst for growth levels in subsequent years and hence we hypothesize a positive relationship between lagged GDP and current year's GDP.

3.3.2.2. Gross government debt

Gross Government debt is explained as government fixed term legally binding commitments to others' outstanding on a specific date. It was measured as all public and publicly guaranteed debts as a percentage of GDP. Theoretical assumptions hold that a decline in economic growth results in increased levels of government debt as a compensatory response to economic sustenance (Reinhart et al., 2012). Spilioti and Vamvoukas (2015), using Greece as a case study, concluded that the relationship between debt and economic growth is statistically significant and argues that this relationship is positive for debt-to-GDP levels about 110%. This is explained by the accumulation of interest payments as debt increases thereby leaving little or no resources for productive sectors of the economy. Against this backdrop, this study hypothesized a negative relationship between the Gross Government debt and economic growth.

3.3.2.3. Government consumption expenditure

Government consumption expenditures are the official government measure of its aggregate spending on goods and services for direct benefit of individuals and households. Contrary to the Keynesian model where government spending increases economic growth, the neo- classical growth model argues that government spending has no effect on economic growth. Generally, there has been a consensus on the relationship between government spending and economic growth but the direction and magnitude of the relationship has always been debatable.

While some researchers, including Abdullah (2000), Al-Yousif (2000), Ranjan (2008) and Cooray (2009), argue that government spending performs the functions of protection and provision of certain public good and thus increases economic growth, other scholars, including Laudau (1986), Barro (1991), Engen (1992) and Fölster (2001), argue that government spending financed from borrowings crowds out private sector investment and thus reduces growth. The latter argues further that governments may spend in unproductive ventures and in areas of the economy that can be more efficiently handled by the private sector. This results in a situation where government spending produces misallocation of resources.

The popular "Wagner's ([1883] 1958) law" states that government spending is income elastic and that government spending tends to grow with economic development. Suggest that Wagner's law may be more applicable to developed countries than to developing countries. We therefore hypothesize a negative relationship between government consumption expenditure and economic growth.

3.3.2.4. Gross capital formation

Gross capital formation (CAPF) is a summation of all new capital goods in a given period. It is also defined as the fraction of the GDP invested to augment future output and income (Ugochukwu and Chinyere, 2013). That is, the CAPF illustrates how much of the newly added value to the economy is invested rather than consumed (Kumar and Woo, 2013).

The CAPF is a key determinant of economic growth as its fluctuations over a period is instructive of the growth or otherwise of the economy. Most studies have affirmed the positive impact of CAPF on economic growth, particularly in developing economies. Ali (2015) itemizes the contributions of the CAPF as being the creation of a larger market pool and economies of scale as well as the transfer of information, communication and technology across frontiers. This in effect maximizes the utilization of resources for economic growth, especially in a fast paced technological world. We hypothesize a positive relationship between CAPF and economic growth.

3.3.2.5. Inflation

Inflation is the annual percentage change in the cost of goods and services measured over a period of time. Economists have argued that fostering economic growth and keeping inflation on a low level are central to every country's macroeconomic policy objectives. Generally, it is recognized that economic growth is hampered in countries with high and volatile inflation. Empirically, there has been mixed conclusions in recent years on the relationship between inflation and growth.

In 1993, Fisher first identified a positive non-linear relationship between low inflation rates and growth. Bruno and Easterly (1998) confirm this finding with their conclusion of a negative effect for high inflation rates though they do not provide evidence to support the fact that low inflation rates enhance growth. Judson and Orphanides (1999) in concluding on a negative relationship between inflation and economic growth suggested that a good macroeconomic policy should aim both at reducing inflation and at stabilizing it with a greater focus on stability of inflation. More recently, Bittencourt (2012) concluded on the detrimental effect of inflation on growth in his panel time series analysis of four Latin American countries. We therefore hypothesize a negative relationship between inflation and economic growth.

3.3.2.6. Population growth

This refers to the growth of a population from a period t to a period t+1. It was measured by the reported percentage of annual population growth. Generally, empirical evidence supports that a growth in population is likely to increase the strength of the working force and also the consumers within a region even though some studies have found a negative relationship between population group and economic growth. Chang et al. (2014) in his study of 21 countries for the period 1870–2014 confirmed a positive relationship between POPG and economic growth even though a few countries showed a negative relationship. He identifies as key production, consumption and savings as the factors responsible for such positive drive. We therefore hypothesize a positive relationship between POPG and economic growth.

3.3.2.7. Exports and imports

This is the sum of all imports as well as exports of goods and services as a percentage of GDP used as a proxy to measure openness of trade. Generally, empirical evidence suggest that trade openness affects economic growth positively (Romer, 1993). Winter (2004) supports this by arguing that international trade is a driver for increased competition and consequently, increased productivity, innovation and consumer satisfaction. In addition, Chang et al. (2005) in their study on the relevance of openness for growth concluded that trade openness allows efficient resource allocation through comparative advantage and promotes competition in domestic and international markets. This study, therefore, hypothesizes a positive relationship between trade openness and economic growth.

3.3.2.8. Foreign direct investment

Foreign Direct Investment in the neoclassical growth model is known to promote economic growth through the increase in the volume of investment and/or the efficiency of such investments (Li and Liu, 2005). FDI promotes economic growth through various channels. Firstly, Dimelis (2005) and Schneider (2005) note that FDI promotes economic growth through technology transfer and diffusion. Secondly, economic growth is bolstered through increased productivity and investment in new products, human capital and expertise to host countries (Girma, 2005; Li and Liu, 2005; Lin and Yeh, 2005). Lastly, by incorporating new inputs and technologies in the production process, FDI is deemed growth enhancing through capital accumulation in the countries in which they are received.

In spite of all these, several studies including suggest that country or region specific factors may influence the interaction between FDI and economic factors. Hermes and Lensink and Morrissey (2006) in confirming this have indicated that circumstances including previously achieved wealth, education and financial development of the host or receiving countries determine the growth effect of FDI. We expect a positive relationship between FDI and economic growth.

3.3.2.9. Descriptive analysis

The descriptive statistics shows that the mean growth rate of real GDP of African countries is 3.83% with a minimum GDP growth rate of negative 62% while the maximum is 150% (Table 2). The results suggest that the growth rate for the 50 African countries selected for the study average 3.83% over the study period. The mean growth rate is lower compared to similar results based on a sample of sub-Saharan countries in a study by Hussain et al. (2015).

The second variable (GOVDEBT) which measured government debt as a percentage of GDP showed an average of 78% with a minimum debt to GDP ratio of <1% and a maximum of 523%. The results suggest a higher debt to GDP ratio considering the fact that the majority of the countries are developing countries and the World Bank threshold for debt to GDP is 70%. The average debt to GDP ratio is, however, lower than that reported in a study by Ndieupa (2018) on six selected central African countries where the mean debt to GDP ratio was over 300%. On the other hand, the debt to GDP ratio is higher than the findings of Bon (2015) who reported an average debt to GDP ratio of 68% using a sample of 60 developing countries across the globe. The 78% is also lower compared to the findings of Fofano's (2018) study where the mean debt to GDP ratio for Cote d'Ivoire' was 91%.

The next variable (GOVEXP) measured government consumption expenditure as a percentage of GDP and showed an average mean score of 16%. The minimum score for this ratio is 2% while the maximum score is 85%. The next control variable measured Capital formation as a percentage of GDP (CAP). The study period showed an average CAP of 22% with minimum and maximum values of negative 2% and 219% respectively.

The next variable measured the average inflation rate over the study period and the results in Table 3 shows an average inflation rate of 56% with the minimum inflation rate reported over the study period as negative 35% and the maximum of over 2000%. The results show that inflation rates in African countries are among the highest in the world which is a cause for concern. The results are similar to the findings of Fofana (2018) who reported an average inflation rate of 55% based on data on Cote d'Ivoire'. The results are significantly different from the findings of Bon's (2015) study of 60 developing countries where the minimum inflation rate was 13%.

The next variable POPG looked at population growth rate (POPGR) and showed a mean score of 2.55% over the study period. The maximum POPGR over the study period was almost 8% while the minimum was negative 6%. The result is similar to those of Ndieupa (2018) who reported an average POPG of 2.92% based on a sample of six central African countries.

The next variable (OPEN) measured the openness of the economies, which is based on imports and exports. The results show average trade openness as a percentage of GDP of 71% with a minimum of 8.1% and a maximum of 315%. These results are similar to those of other studies on developing countries including

Table 2: Descriptive statistics

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???	Mean	Median	Standard deviation	Min	Max	N
GDP	3.830771	3.9	7.934637	−62.076	150	1784
GOVDEBT	78.06916	63.97	62.76358	0.47	523	1716
GOVEXP	16.23877	15.09	7.678344	2.05	84.5	1634
CAP	21.96036	20	15.36445	−2.42	219	1632
INFL	56.19794	7.19	865.1467	−35.84	24411	1621
POPGR	2.54863	2.697	1.096559	−6.185	7.918	1940
OPEN	71.03821	61	40.07932	8.1	315	1731
FDI	3.53863	1.5	8.927015	−82.89	161.8	1740

FDI: Foreign direct investment, INFL: Inflation, POPGR: Population growth rate, OPEN: Sum of exports and imports, GDP: Gross domestic product

Table 3: Correlation matrix

???	GDP	GOVDEBT	GOVDEBT^2	GOVEXP	CAP	INFL	POPGR	OPEN	FDI
GDP	1.000								
GOVDEBT	−0.099	1.000							
	(0.000)								
GOVDEBT^2	−0.056	0.071	1.000						
	(0.026)	(0.005)							
GOVEXP	−0.060	−0.008	0.925	1.000					
	(0.017)	(0.771)	(0.000)						
CAP	0.396	0.019	0.178	0.190	1.000				
	(0.000)	(0.459)	(0.000)	(0.000)					
INFL	−0.055	0.036	−0.027	−0.063	−0.046	1.000			
	(0.028)	(0.152)	(0.300)	(0.017)	(0.083)				
POPGROWTH	0.227	0.064	−0.040	−0.079	0.125	0.012	1.000		
	(0.000)	(0.008)	(0.108)	(0.001)	(0.000)	(0.643)			
OPEN	0.211	−0.043	0.239	0.280	0.438	−0.005	−0.152	1.000	
	(0.000)	(0.087)	(0.000)	(0.000)	(0.000)	(0.836)	(0.000)		
FDI	0.227	0.063	0.058	0.058	0.538	−0.014	0.036	0.467	1.000
	(0.000)	(0.011)	(0.022)	(0.022)	(0.000)	(0.571)	(0.137)	(0.000)	

FDI: Foreign direct investment, INFL: Inflation, POPG: Population growth, OPEN: Sum of exports and imports, GDP: Gross Domestic Product

Africa. For instance, study on developing countries has reported a mean of 78%. A study like Fofana (2018) has reported a mean score of 27%. The higher the mean score, the more open the economy of the country and vice versa.

The last variable measured foreign direct investment as a percentage of GDP. The results show an average FDI as a percentage of GDP of 3.54% with a maximum of 161% and a minimum of negative 83%. The mean score reported in this study is lower than the 5.15% reported by Hussain et al.'s (2015) study based on a sample of Sub-Saharan African countries.

3.3.2.10. Correlation analysis

The correlation analysis shows two debt variables, which include the ratio of government debt to GDP and the natural logarithm of government debt. The correlation results in Table 3 show that there is negative correlation between debt to GDP ratio and economic growth measured by GDP growth rate. The result is statistically significant at 1% significance level. This result shows that an increase in a country's debt to GDP ratio reduces its economic growth rate and vice versa. The second measure of debt which relied on the natural logarithm of government debt also showed a negative correlation with economic growth but is statistically significant at 5% significance level. The result shows that an increase in a country's debt levels reduces economic growth of the country. Our finding is consistent with the expectations of the study and the hypothesis of the study. It is also consistent with the findings of previous studies. For instance, Hassain et al.'s (2015) study on Sub-Saharan countries has reported a negative correlation between public debt and economic growth. Bon's (2015) study on selected developing countries across the globe reported a negative correlation between government debt and economic growth. A negative correlation has also been reported by Ndieupa's (2018) study on selected Central African countries. In the nutshell, our finding is consistent with findings in Africa and other developing countries where similar studies have been conducted.

On the control variables, the results show a statistically significant negative correlation between government consumption expenditure and economic growth in Africa. The results suggest that increase in government consumption expenditure reduces economic growth in Africa. This means that public spending in African countries does not translate into economic growth and as such has to be re-examined. These results confirm the findings of Bon (2015) and other similar studies on developing countries.

The results in Table 3 also reveal that there is a positive and statistically significant correlation between capital formation and economic growth in Africa. This means that an increase in capital expenditure in an economy will translate into higher economic growth. Our findings are consistent with the hypothesis of the study and confirm earlier studies including Yusuf and Anoruo (2000).

The correlation results also show a negative and statistically significant relationship between inflation and economic growth. This relationship was statistically significant at 5% significance level. These results suggest that an increase in the rate of inflation reduces economic growth in Africa and vice versa. Our finding is consistent with the findings of Bon (2015), Ndieupa (2018) as well as other similar studies that included inflation in their studies. These results confirm the assertion that inflation rate is a major determinant of economic growth in Africa.

The correlation results also reveal that there was a positive and statistically significant correlation between POPGR and economic growth in Africa. The results were statistically significant at 5% significance level. The results confirm the proposition that countries with higher POPGR translate into improvements in their economic growth. Our finding is consistent with the findings of Ndieupa (2018) reveals that there is a positive correlation between POPG and economic growth in Central Africa.

The correlation results also show a positive correlation between an openness of trade and economic growth in Africa. The results were also statistically significant at 1% significance level. These results suggest that countries with a more open economy are able to leverage on their comparative advantage to propel growth. The finding is consistent with the findings of Ndieupa (2018) who

also reported a positive correlation between the two variables. The results are also consistent with the findings of Bon (2015) who also found a positive correlation between open economy and economic growth.

Finally, the correlation results show that there is a positive correlation between foreign direct investment and economic growth in Africa. The results show the increase in foreign direct inflows improves economic growth in Africa. Our findings are consistent with several studies on the subject. For instance, the finding is consistent with the findings of Hussain et al. (2015) and other similar studies.

3.3.2.11. Analysis of regression results

The Table 4 shows regression results from the fixed effect (FE) model. The decision to choose between random effect (RE) and FE models depends on the statistical significance of the standard deviation of this random coefficient. If this standard deviation is statistically different from zero, RE is the preferred model structure; otherwise FE is the preferred model. Since our Hausman test (using the P-value) shows that we reject the null hypothesis that the results are random, we interpret the results of the FE model.

The R-square for the model of 19% shows that the independent variables can explain 19% of the variations in the dependent variable. The probability of the model was statistically significant at 1% significance level suggesting that the models are well fit.

The panel regression results form Table 4 above show that there is a negative association between debt to GDP ratio and economic growth in Africa. The relationship is also statistically significant at 1% significance level. The findings confirm the results of the correlation analysis and the hypothesis of the study, which suggest that there is a negative association between public debt and economic growth in Africa.

The test for the non - linearity of the relationship between debt and growth was found to be statistically significant at 1%. The results indicate that there is a non-linear relationship between debt and economic growth. These findings are consistent with many studies including Kourtellos et al. (2013), Egert (2012), Checherita-Westphal and Rother (2012) who concluded on the existence of a non-linear relationship between debt and economic growth in their studies.

On the control variables, the regression results reveal that there was a negative association between government consumption expenditure and economic growth. These findings confirm the results of the correlation analysis and are statistically significant at 1% significance level. The results show that higher government consumption expenditure by African countries reduces their level of economic growth and vice versa. The results suggest that increase in government spending does not translate into economic growth in Africa but rather reduces economic growth.

The next variable of interest is capital formation. The results of the panel regression on this variable reveal a positive association between gross capital investments levels and economic growth in Africa. The association is statistically significant at 1% significance level. The results show that spending on capital expenditure projects and infrastructure translates into higher economic growth in Africa.

The analysis from Table 4 also reveals that there is a negative association between inflation rate and economic growth in Africa. The association is statistically significant at 5% significance level. The results suggest that an increase in a country's inflation rate reduces economic growth and vice versa.

The next variable that showed a significant association with economic growth was population growth. The regression results in Table 4 confirm the correlation analysis, which reveal that there is a positive association between POPG and economic growth in Africa. The association is statistically significant at 1% significance level and indicates that increase in POPG translates into improvement in economic growth.

Table 4: Regression results - Fixed effect

Variables	Model 1			Model 2		
	Coefficient	Standard error	P>t	Coefficient.	Standard error	P>z
Constant	−0.457	1.514	0.763	−3.470	1.1427	0.002
GOVDEBT	−0.011***	0.004	0.006			
$GOVDEBT^2$				−0.000***	0.000	0.002
GOVEXP	−0.487***	0.120	0.000	−0.181***	0.044	0.000
CAP	0.191***	0.020	0.000	0.192***	0.020	0.000
INFL	0.000**	0.000	0.025	−0.000**	0.000	0.049
POPGROWTH	1.019***	0.226	0.000	0.981***	0.226	0.000
OPEN	0.057***	0.010	0.000	0.058***	0.010	0.000
FDI	0.026	0.032	0.421	−0.034	0.032	0.292
Inflection Point	0.7245			1.2235		
F/Wald χ^2	37.11			41.66		
Prob>F/Wald χ^2	0.000			0.0000		
R-squared	0.1892			0.1864		
Hausman	37.77			34.22		
Prob>χ^2	0.000			0.0000		
Countries	50			50		
Observations	1330			1330		

*** Significant at 1%, **Significant at 5%, * significant at 10%, OPEN: Sum of exports and imports, FDI: Foreign direct investment, INFL: Inflation, POPG: Population growth

The last but one variable measured the openness of trade. The results of the panel regression suggest that there is a positive association between the level of openness of an economy and economic growth in Africa. The results are statistically significant at 1% significance level. These results indicate that an open economy drives economic growth and suggest that African countries with more open trade policies are likely to have improved economic growth.

Finally, the last variable in the model analysed the relationship between foreign direct investment and economic growth in Africa. The results suggest a positive association between foreign direct investment and economic growth in Africa. However, the relationship is statistically insignificant. These results suggest that foreign direct inflows do not significantly influence the level of economic growth in Africa even though the association is positive.

3.3.2.12. Robustness check

To check for consistency of the results produced from the FE model (an OLS estimation technique) the GMM techniques was used to estimate the regression results shown in Table 5. The results for both estimation techniques are similar, which reinforces the reliability of the findings.

The results of the dynamic model using the GMM estimation techniques are consistent with the results of the static model using the FE model (an OLSs estimation technique). As shown in the static model, the results from the dynamic model also indicate that government debt, government consumption expenditure and inflation have a negative and statistically significant relationship with economic growth.

Similarly, the results of the dynamic panel regression model indicate that capital formation, POPG and openness of trade have a positive and statistically significant relationship with economic growth. This is consistent with the results of the static model as shown in Table 4. The additional control variable introduced in the dynamic model, past level of GDP growth rate ($GDPG_{i,t-1}$), shows a positive and statistically significant relationship with economic growth. The finding is consistent with our expectation and the hypothesis of the study. The results are also consistent with those of other studies, including Eberhardt and Presbitero (2015) who reported a positive relationship between the lagged GDP variable and economic growth in their study of the long-run relationship between public debt and growth in a large panel of countries.

Table 5: Regression results - GMM

Variables	Coefficient	Standard error	P>t
Constant	−0.440	1.952	0.823
($GDPG_{i,t-1}$)	0.163***	0.040	0.000
GOVDEBT	−0.009***	0.003	0.002
GOVEXP	−0.135**	0.052	0.013
CAP	0.148***	0.034	0.000
INFL	−0.000***	0.000	0.000
POPGROWTH	0.751**	0.304	0.017
OPEN	0.019**	0.009	0.038
FDI	0.019	0.035	0.584
Observations	1305		
No of instruments	637		
AR(1):P-values	0.028		
AR(2):P-values	0.245		
No. of Groups	50		
P-value	0.0000		
Hansen J	43		
Prob>χ^2	0.000		
F	81.69		

***Significant at 1%, **significant at 5%, *significant at 10%, OPEN: Sum of exports and imports, FDI: Foreign direct investment, INFL: Inflation, POPG: Population growth, GMM: Generalised method of moment

The results indicate that the current levels of growth influence the potential for future growth. Thus, countries with high growth rates are expected to have a strong base to produce more goods and services to increase their growth rates.

4. DISCUSSION OF FINDINGS

The main objective of the study was to establish the impact of public debt on economic growth in Africa. Public debt has been measured using the ratio of public debt to GDP and a test for non-linearity of the relationship between public debt and economic growth has been performed using the natural logarithm of public debt. The regression results and correlation analysis show that public debt had a negative association with economic growth in Africa. The results of the analysis were also statistically significant. The results show that increase in debt to GDP ratio or increase in debt levels reduces economic growth in Africa. The results confirm the expectation of the study especially the hypothesis and show that high debt levels increase the risk of repayment and high interest burden on the country which affects the country's ability to invest in sectors that will propel economic growth.

The high debt levels means that a significant amount of the country's domestic revenue will be used in repayment of principals and interest accruing on those debts. This will always put a strain on government budget and its ability to implement programs that will improve economic growth. This is especially the case as the average debt level in Africa is above the 70% international benchmark for sustainable debt levels. Fofana's (2018) study reveals that a debt level beyond 42.9% will have negative impact on economic growth. Our results are consistent with the findings of several previous studies in Africa and in other jurisdiction. They are consistent, for instance, with the findings of Hussain et al. (2015) has reported that there was a negative relationship between debt and economic growth of Sub-Saharan countries at the time of his study. The results also confirm the findings of Bon (2015) on 60 developing countries where it was reported that there is a negative association between debt levels and economic growth.

Moreover, Checherita-Westphal and Rother's (2010) study of European countries on the subject also has reported a negative association between public debt and economic growth consistent with the findings of this study. The results are equally consistent with the findings of Ndieupa (2018) who reported an adverse effect of debt on economic growth using a sample of countries from the Central Africa Economic and Monetary Committee. The results are however inconsistent with the findings of some studies. For instance, the result is inconsistent with the findings of Owusu-Antwi and Erickson's (2016) study which reported a positive

association between public debt and economic growth in the long run in Ghana. Similarly, Fofana (2018) has reported a positive association between public debt and economic growth but at a level not above 48% of GDP. Similarly, Spilioti and Vamvoukas (2015) have reported a positive association between public debt and economic growth.

The contrasting results show a pattern where all the single country studies reported a positive association between debt and economic growth while the cross-country studies report a negative association between public debt and economic growth. What is common among the studies that found a positive association is the fact that they all cautioned an acceptable debt levels that must be maintained to ensure sustainable economic growth. It has generally been confirmed that debt level beyond 70%, especially for developing countries like those in Africa, are unsustainable and must be managed to ensure sustainable economic growth. Overall, irrespective of the findings, African countries must be cautious about their debt levels as it has serious implications on budget deficit and on government spending on critical sectors of the economy.

On the control variable, the results of the correlation and regression show that there is a negative association between government consumption and economic growth. The results suggest a significant proportion of government spending in Africa does not translate into economic growth but rather reduces economic growth. These results are consistent with several studies in Africa and other jurisdictions (Bon, 2015; Hussain et al. 2015; Ndieupa, 2018; Spilioti and Vamvoukas, 2015).

Closely related to government consumption spending is capital expenditure of government. The results show a positive association between capital expenditure and economic growth in Africa. The results show that even though government consumption spending is negatively associated with economic growth, government spending in the area of capital expenditure improves economic growth in Africa. The results emphasize the long held proposition in literature that for government to bolster growth, its spending should be targeted towards capital expenditure deemed to generate enough income for the economy.

The next control variable that also had a significant influence on economic growth is inflation. However, the results show that higher inflation reduces economic growth in Africa. The results suggest that African countries that want to improve on their economic growth must take the necessary steps to reduce inflation in their countries to foster economic growth. This result is also consistent with the findings of several previous studies on the subject matter (Fofana, 2018; Hussain et al., 2015; Owusu-Nantwi and Erickson, 2016).

The results of the study have also revealed a positive and significant association between POPG and economic growth. This shows that increase in the population of countries in Africa is linked to increase in economic growth rate. The results showed that POPG is a major determinant of economic growth which should be managed well by African countries. The results are inconsistent with the findings of Spilioti and Vamvoukas (2015) study based on a sample of European countries.

Another variable that was also a significant determinant of economic growth in Africa is the openness of the economy and external competitiveness. The correlation and regression results revealed a positive and significant association between open economy and economic growth in Africa. The results show that African economies that open up to the rest of the world in terms of trade and other forms of engagement are able to improve their economic growth. The result is consistent with the findings of Spilioti and Vamvoukas (2015) who reported a positive association between the two variable using data from Greek market. Similarly, Bon (2015) also reported a positive association between open economy and economic growth using a sample of 60 developing countries. The last variable was foreign direct investment; but the results show that it had a positive but statistically insignificant association with economic growth in Africa.

Overall, almost all of the variables included in the model were significant determinants on economic growth but affect economic growth in different ways. It is imperative that managers of African economies examine how these factors affect growth in their respective countries so that they can determine the appropriate strategy to manage them.

5. CONCLUSION

Debt levels in Africa have become a big issue as most African countries try to boost infrastructure as well as provide other social amenities to alleviate poverty in their countries. The study objective was to assess the relationship and impact of public debt on economic growth. Using secondary data from 50 African countries from 1980 to 2015, this study has revealed through its findings that the public debts in African countries are generally high and are at unsustainable levels. The study has shown that higher debt levels, especially above the sustainable threshold, reduce economic growth.

It can be inferred from the results that interest repayments for high debt countries put a strain on national budgets and therefore incapacitates governments from investing in sectors of the economy, which enhance growth. The results have revealed that an increase in general government consumption spending reduces economic growth but an increase in capital expenditure improves economic growth. We find evidence that POPGR, openness of trade and capital formations have statistically significant positive impact on economic growth, whereas inflation rate and government consumption expenditure have statistically significant negative impact on economic growth. As recommendations for policy implementation, governments and policy makers across Africa should view public debt management in the broader framework of prudent economic management and seek to minimize borrowing cost and reduce risks associated with debt within acceptable levels. We also recommend that policy should encourage investment in capital especially that which supports productive industries in the economy. Lastly, governments' macroeconomic policies should be targeted towards keeping inflationary levels low and at the same time stabilizing it.

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