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The external debt burden and economic growth in Africa: a panel data analysis

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Abstract. *Motivation for the study: External debt is a serious problem that needs to be addressed, and hence there is a need for further empirical studies investigating the effect of external debt on African countries' growth, leading to policy formulation that would address external debt burden in Africa.*
Research purpose: This paper examined the effect of external debt on economic growth and public investment in Africa, covering 45 African countries over the 1990 to 2017 period. The paper also examined the im-pact of external debt and debt services on public investment, which in turn affects growth.
Design/methodology/approach: For inferential analysis, this paper used fixed effects (FE) and random effects (RE) panel data models. The Hausman test was used to determine the preferred model. For the growth model, the fixed effects regression is appropriate while for the public investment analysis, we applies the random effects model.
Main findings: Based on the preferred models, it is revealed that relative-ly low levels of external debt-to-GDP ratio have a positive effect on eco-nomic growth and public investment in Africa. However, considerably high levels of external debt are likely to hamper both economic growth and public investment. Similarly, the debt service-to-export ratio tends to have a deleterious effect on public investment, which consequently results in lower economic growth.
Practical/managerial implications: The burden of external debt and debt payments has been a remarkable cause of insufficient funds for public investments and growth, thus African countries need to expedite effective and efficient external debt management strategies that will favour timely repayment. The fact that trade has a positive impact on both investment and economic growth; growth activities in African countries should be financed through increased export earnings spearheaded by export-led-growth strategy as these would be the best alternative to external debt in the long-run. Pursuing policies that strengthen exports, sound exchange rate, and effective use of the labour force will lead to an improvement in economic growth.
Contribution/value-add: The paper provides insight to policy-makers in Africa in making sound and relevant decisions on external borrowings, debt payments, and public investment.

Keywords: economic growth, external debt, debt service, public investment.

JEL Classification: F34, O4.

1. Introduction

External debt is one of the main economic challenges facing African countries. According to Gohar *et al*. (2012) debt servicing creates problems for many countries especially for developing countries since the debt has to be serviced in a greater amount than the actual amount taken or borrowed[(1)]. This indicates that debt serving or repayment imposes a great burden on the country's growth. It drains and restricts financial resources that would have been used in developing a country.

African countries are unable to mobilize sufficient domestic revenue to meet their expenditures and therefore resort to borrowing to finance annual budget deficits. When tax revenue is limited and the government does not want to compromise macroeconomic stability by printing more money, then borrowing becomes the only available avenue that the government can explore (Ogunmuyiwa, 2011). Moreover, even though the government's borrowing from the domestic capital market creates less debt crisis, positive externality in the domestic capital market and prevents capital outflow, most African countries prefer external borrowing to the domestic one, which later imposes the burden of loan repayment (Nyawata, 2012). Due to lack of a strong private sector and a well-established banking system, the amount of money domestically available are very insignificant, as a result, many poor countries borrow extensively from international lenders and other external sources. According to Chenery & Strout (1966), Babu et *al.* (2014), Kharusi & Ada (2018), and Guei (2019), the fundamental reason why developing and emerging countries amass external debt is a lack of saving and investment. Countries with insufficient savings will approach the international debt market to borrow money for consumption smoothing and maintaining economic growth. The debt burden of external debt, which is increased by unstable and weak local currencies, however, is likely to retard economic growth in Africa. Certainly, there has been a belief that high debt results in low savings and slow growth in Africa, with many countries failing to service their debt in the past decades (Ahmed, 2012). For all developing countries, the ratio of debt service-to-exports rose from 8.7 per cent in 2011 to 15.4 per cent in 2016, and, in poorer developing countries, debt service-to-government revenue ratio also climbed up steadily, from 5.7 per cent in 2008 to over 14 per cent by 2016 (Bonizzi, *et al*., (2017). This increase in debt service burdens has hit the most vulnerable developing countries the hardest, including commodity exporters (Bonizzi, *et al*., (2017). Indeed, the size of external debt might be huge in relation to the size of the economy of the borrowing nation leading to capital flight while discouraging private investment. Similarly, servicing debt by export earnings may adversely affect economic growth through depleting available income from social service activities.

Over the 1990-2017 period, external debt as percent of Gross National Income in some countries such as Liberia, Guinea-Bissau, Congo Republic, and Mauritania was, on average, more that 100 percent but it was less than 30 percent in some countries such as Botswana, Eswatini, and South Africa (Appendix 1A). Similarly, African countries such as Mauritius, Angola, Zambia, Tunisia, Algeria, Cote d'Ivoire, Liberia, Gabon, Morocco, Congo Republic, Zimbabwe, and Mauritania have been servicing debt by more than 5 percent of their Gross National Income (GNI) (Appendix 2A). Indeed, Mauritius and

Angola used, on average, more than 10 percent of their GNI to service debt (Appendix 2A). By contrast, however, some African countries such as Somalia, Eritrea, Sudan, Comoro, and Rwanda use less than 1 percent of their GNI to service debt.

This suggests that debt distribution and debt services among African counties are not homogeneous. In addition, Appendix 3A reports a simple correlation of external debt and economic growth in Africa. In general, the figure indicates that countries with relatively low external debt such as Botswana, Burkina Faso, and Rwanda, seem to have relatively high economic growth than countries with high external debt such as the Republic of Congo, Sierra Leone, and The Democratic Republic of Congo, suggesting that external debt has a negative impact on economic growth in Africa. Generally, external debt may affect economic growth through debt overhang and debt crowding effects. In the case of debt overhang, accumulated debts, discourage and overhang investment, mainly private investment; as private investors expect an increase in tax by governments to pay the accumulated debt, whereas in the case of debt crowding out effect, income from export is used to pay the accumulated debt, which in turn may affect investment. It is worth noting that, debt service payments reduce amounts available for infrastructure development, human capital formation and imports that are critical for production reducing growth further (Aizenman & Lee, 2007; Soydan & Bedir, 2015). Moreover, for low income countries, debt service payments can have adverse effects on governments' ability to fund social expenditure programmes such as health, education and social programmes, while for countries that rely on minerals and agricultural products debt service may result in an increasing rate of depletion of natural resources (Clements *et al*., 2003). In general, sustainable economic growth is a concern for developing economies that face burgeoning fiscal deficits mainly driven by higher levels of debt service (Reinhart *et al*., 2012).

While Africa's current external debt ratios appear manageable, the rapid growth in several countries is of concern (UNCTAD, 2016). Africa's external debt payments have increased dramatically in the last few years. Between 2015 and 2017, they doubled, rising from an average of 5.9 percent of government revenue in 2015 to 11.8 percent of government revenue in 2017 (Jubilee Debt Campaign, 2018). This means African government debt payments are at the highest level since 2001. Key causes of this dramatic change are increases in lending since 2008 from multiple lenders, followed by falls in commodity prices in 2014, and rising US dollar interest rates and the value of the US dollar in recent years (Jubilee Debt Campaign, 2018).

Thus, unquestionably, external debt is a serious problem that needs to be addressed, and hence there is a need for further empirical studies investigating the effect of external debt on African countries' growth, leading to policy formulation that would address external debt burden in Africa. Studies that have been done on developing economies, their attention has been centered on Latin America, and few selected countries in Africa such as Senadza *et al.* (2017) and Chiminya *et al.* (2018) for 39 and 37 sub-Saharan African countries respectively; Cohen (1995) for 81 developing countries, and Pattillo *et al.* (2002) for 93 developing countries. Other studies for specific countries include Kasidi & Makame (2013) for Tanzania; Elwasila (2018) for Sudan; Festus *et al.* (2019) and Adegbite *et al.* (2008) for Nigeria. Empirical evidence on the relationship between external debt and economic

growth, however, is mixed and inconclusive. For example, some studies support the debt overhang hypothesis (Serven & Solimano, 1993; Elbadawi *et al.,* 1997; Choudhury, 2001 and Shabbir, 2013) whereas other studies reveal that debt overhang neither exists nor matters for growth (Cordella *et al.,* 2005). Similarly, some studies, for example, Chowdhury (2001); Cohen (1995) and Elbandawi *et al.* (1997) support the crowding-out effect, as debt service is negatively affecting investment whereas other studies, for example, Pattillo *et al.* (2003) and Clements *et al.* (2003) do not find any support for the crowding-out effect. In fact, the importance of external debt cannot be overemphasized as it is an ardent booster of growth and thus improves living standards thereby alleviating poverty (Eswaran & Meenakshisundaram, 2017, and Utomi, 2014). External debt is used by countries to bridge their deficits and carry out economic projects that are able to increase the standard of living of the citizenry and promote sustainable growth and development. External debt also improves total factor productivity through an increase in output, which in turn enhances the GDP growth of a nation (Utomi, 2014). Hameed *et al.* (2008) argue that external borrowing ought to accelerate economic growth especially when domestic financing is inadequate.

This paper is built in the way that contemplates the differences shown in previous studies. The paper uses Barro (1991) study on possible variables that affect economic growth, together with Solow's (1956) economic growth theory in econometrics modeling. Moreover, the paper applies both fixed effects and random effects approaches to analyse the effect of external debt-to-GDP and debt service-to-export ratios on real GDP per capita and the ratio of public investment-to-GDP in Africa. The paper adds to the literature on the subject matter by applying a panel data approach to more recent data covering the period spanning from 1990 to 2017. This is very important because first, Africa as a whole has not received fair attention relative to its counterparts, especially industrialized economies. Second, studies on the relationship between external debt and economic growth have been contentious, some studies have found negative relationship, others conclude that there is a positive relationship while others observed no relationship, making it somewhat difficult for policy decision making. Notably, a few countries were excluded from inferential analysis mainly because of a lack of data.

2. Literature review

2.1. Theoretical literature review

Any government can raise money for funding public expenditures thorough either printing of money, taxation, or borrowing. According to the monetarist school of thought, printing of more money can put an economy on inflationary pressure. Likewise, taxation has been proving to be weak in many African countries. In 2017, the ratio of tax revenue-to-GDP was, on average, 17.2 percent, while in Latin America and the Caribbean (LAC), and Organisation for Economic Co-operation and Development (OECD), were 22.8 percent and 34.2 percent respectively (OECD, 2019). Moreover, total non-tax revenues are lower than tax revenues in all countries except Botswana, the Republic of the Congo, and Equatorial Guinea. In 2017, the highest shares were 18.7 percent of GDP in Botswana, 14.3

percent of GDP in Eswatini, both of which are net recipients of funds from the Southern African Customs Union (SACU), and 13 percent of GDP in the Republic of the Congo. Non-tax revenues in many African countries are below 5 percent of GDP (OECD, 2019). According to Gill & Pinto (2005), the issue of stability, equity, and smoothing justifies the choice of public debt over taxation and printing of money.

Debt allows more equitable use of investment opportunities with long gestation periods to fund projects that will benefit future generations and that debt financing is helpful in meeting urgent spending needs whereas, fluctuations in the tax rate create economic uncertainty. Gill & Pinto (2005) however, did not expose the effect that external borrowing can cause the growth of the country's economy.

Much available theoretical literature shows the effect of public debt on economic growth in which some conclude a negative relationship. Modigliani (1961); Buchanan (1958); and Meade (1958), argue that public debt is a burden to future generations because it reduces the stock of private capital, which in turn reduces the flow of income. If the proportion of government operations funded through debt is significantly high, interest rates may substantially increase in the long-run. An increase in debt will cost future generations despite benefiting the current generation. The interest on the borrowed funds is normally paid through taxes, which tends to reduce savings, capital stock and economic growth (Modigliani, 1961). Modigliani (1961) points out that public debt can only be offset if funds borrowed are used to finance productive public capital formation. Similarly, Krugman (1988) argues that debt affects economic growth through its adverse effects on investments. Krugman (1988) uses a debt overhang hypothesis to describe the negative relationship between external debt and economic growth. Debt overhang is when the debt stocks surpass the country repayment ability. According to Claessens *et al.,* (1996), accumulated debt stock reduces economic performance through debt overhang effect, that is, tax disincentive and macroeconomic instability. Tax disincentive means that large debt stocks discourage investment due to the sense that potential investors assume that there would be taxes on future income to enable debt repayment. At the same time, since macro-economic instability relates to an increase in the fiscal deficit, there is a great possibility of monetary expansion and anticipated inflation (Claessens *et al.,* 1996). Nevertheless, the debt overhang hypothesis fails to explain or suggest the better source that the government should use instead, other than external debt, which it points out to have a negative impact on growth. Interestingly, Eaton (1993) suggests that external debt is a complement to domestic savings and investment and thus have a positive effect on economic growth.

The liquidity constraints is another key hypothesis, which explains the relationship between external debt and growth. According to this hypothesis, an increase in external debt servicing reduces funds available for growth and investment, a situation that lowers the ability of a country to service its debt and thus affect their future borrowing from external sources. This puts pressure on domestic borrowing and leads to a crowding-out effect. To shed light on liquidity constraints, Taylor (1993) argues that debt servicing reduces government expenditure in the economy through debt-induced liquidity constraints. These liquidity constraints arise because of debt service requirements, which shift the focus from developing the domestic economy to repayments of the debt. Public expenditure on social

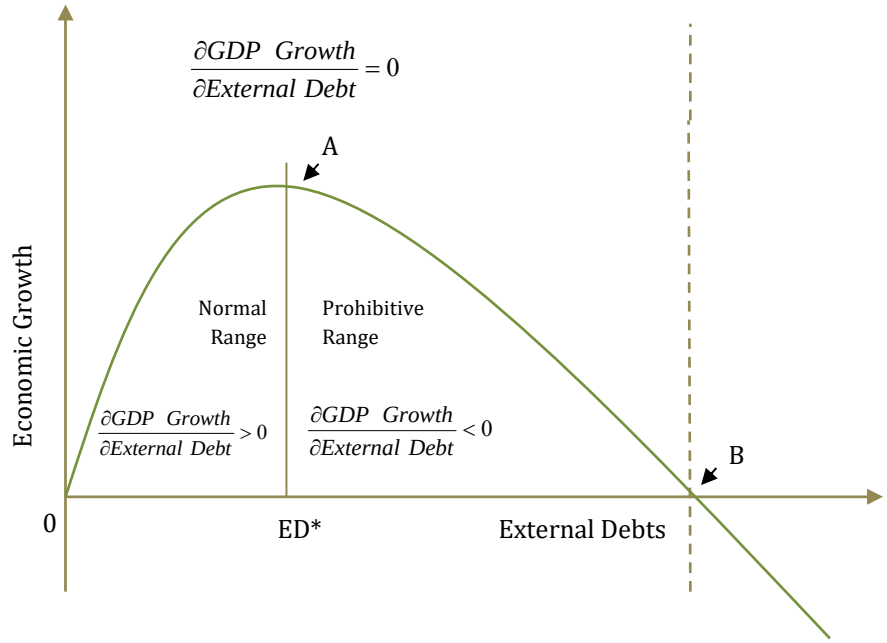
infrastructure is reduced substantially and this affects the level of public investment in the economy. Crowding out effect postulates that national revenues obtained from foreign exchange earnings are used to pay debts.

This limits resources available for domestic economy or growth since most of it is soaked up by external debt service burden, which in turn reduces the level of investment (Utomi, 2014). According to Were (2001) if a greater portion of export revenue is used for external debt servicing, then very little amount remains for investment and growth.

Furthermore, Sachs (1989) analyses the debt Laffer curve in the context of debt overhang, which was perfected by Krugman (1988). Sachs (1989) shows that debt forgiveness leads not only to maintain the current market value of securities but also to increase the expected value of monetary flows related to repayment of obligations of debtor countries. When a country is borrowing too much, its ability to finance decreases and thus the risk of default occurs. Creditors calculate the expected value of reimbursements they receive according to the risk of default. If the expected value is less than the face value of the debt, reducing the nominal or face value of debt reduces the risk of default and leads to an increase in the expected value of future repayments. According to this theory, external debt could have a positive impact on investment and growth, but if a country borrows, too much beyond a certain threshold level of debt, then it may result in a negative impact on economic growth. Laffer Curve also implies that there is a limit at which debt accumulation stimulates growth (Pattillo *et al*., 2002 and Elbadawi *et al.,* 1997). When a country first opens up to foreign capital and start borrowing, the impact of the debt on growth will likely be positive that is, moving from zero indebtedness to point A (Figure 1). Nevertheless, as debt increases beyond point A, any additional debt will eventually slow down growth although the overall debt level continues to make a positive contribution to the growth and when the debt reaches point B the whole contribution of debt turns negative.

Sachs (1989) and Krugman (1988) point out that at low levels of external debt; creditors expect that the nominal claims will be paid in full. At higher levels of debt, however, the possibility of partial repayment grows as the country has fewer incentives to invest and the market value falls. At point A, the debt overhang becomes so large and the nominal debt acts as such a large disincentive on the debtor's efforts to adjust, reform, and invest, that the market value of debt starts to fall when the face value of debt increases further (Claessens, 1990). Krugman (1988) shows that there is a link between a country's ability to service debt and the current level of public debt. When a country accumulates too much debt, or when payment obligations exceed its ability to pay, payment obligations act as a marginal tax rate: if the state succeeds to obtain better results than those expected, benefits will return to creditors and not to the state Krugman (1988). In these circumstances, the government may be discouraged to improve economic performances because the benefits are going rather to creditors than to the country (Tatu, 2014).

Figure 1. *Laffer Curve Hypothesis*



Source: Authors' construction.

In the same vein, a growth-cum-debt model developed by Solis & Zedillo (1985) and used by Ajayi (1991); Mbire & Atingi (1997), and Titus (2016) focuses on how debt affects the growth prospects of a debtor country. The fundamental argument of growth-cum-debt model is that a country will be able to service its debt provided the debt leads to more growth. The model postulates that external borrowing is determined by the effect of debt in the economy rather than the amount of funds borrowed. Indeed, the growth-cum-debt model considers debt capacity in terms of the benefits and costs of borrowing in the process of economic growth.

The model establishes a relationship between growth (output level, *Y*) and debt (capital, *K*) to explain how debt affects the growth prospects of a debtor country. That is

$$Y = \sigma K \tag{1}$$

where σ is the efficiency parameter of capital, *K*.

Change in *Y* is attributed to change in *K*. Thus,

$$\Delta Y = \sigma(\Delta K) \tag{2}$$

Now, considering change in capital, *K*, as the positive difference between current investment, I_t, and the level of immediate preceding capital stock, K_{t-1}, the right hand side of equation (2) becomes:

$$\Delta K = I_t - \delta K_{t-1} \tag{3}$$

where $\delta$is infinitesimal change in immediate preceding capital stock K_{t-1} .Subsequently, current output level, Y_t, can be expressed as the sum of current investment, I_t, and immediate preceding output level, Y_{t-1}. Thus, equation (1) becomes:

$$Y_t = \sigma I_t + (1-\delta)Y_{t-1} \quad (4)$$

Given the national output cum income identities:

$$Y_t = C_t + I_t + (X_t - M_t) \quad (5)$$

$$Y_t = C_t + S_t + r_t D_t \quad (6)$$

where
C_t = Current consumption expenditure
$(X_t - M_t)$ = Net export
S_t = Current savings
D_t = The immediate preceding debt stock with its growth rate
r_t = Debt service rate during time period, *t*.

then, the sum of net export and demand for investible funds, d_t is expressed as

$$d_t = (X_t - M_t) + r_t D_{t-1} \quad (7)$$

Consequently,

$$I_t = S_t + d_t \quad (8)$$

Let the savings function be

$$S_t = s(Y_t - r_t D_{t-1}) \quad (9)$$

Using equation (4), investment can be expressed as

$$I_t = \left[\frac{s(1-\delta)}{1-s\sigma}\right] Y_{t-1} - \left(\frac{s}{1-s\sigma}\right) r_t D_{t-1} + \left(\frac{1}{1-s\sigma}\right) d_t \quad (10)$$

Equations (4) and (10) can be solved for a number of possible paths of D and r_t. The rule used for D_t is the growth dynamic equation (11) (Also, see Solis & Zedillo, 1985 and Ajayi, 1991).

$$D_t = D_{t-1}(1+\gamma) \quad (11)$$

Where
D_t = The total external debt
γ = The constant that is varied in each scenario

The emphasis of the growth-cum-model is based on foreign borrowing for investment purposes, which is meant for filling the gap between domestic investment and savings (Avramovic, *et. al.*, 1964; Solomon, 1977; Oluseyi, 2013; Ijirshar *et al*., 2016; Adamu & Rasiah, 2016). The basic argument is that a country will maintain its capacity to service debt provided that additions to its debt over time contribute sufficiently to growth. The

model states that to maintain debt service capacity over time, the growth rate of output should equal or exceed the cost of borrowing, measured by the rate of interest (Hjertholm, 1999; Ejigayehu, 2013; Van, *et al.,* 2019; Omodero & Alpheaus, 2019 and Senadza *et al*., 2017). The model concludes that any debt strategy will only work, ultimately, if there is sufficient economic growth to support it. A particular weakness of the model is that the model focuses solely on the savings-investment gap in the sense that investment is a function of saving. Since the level of domestic savings in developing countries is inadequate for generating the level of investment required for growth and development, therefore the amount of borrowed funds is needed to finance such investments. In addition, Todaro & Smith (2009) and Kaltenbrunner & Painceira (2014) argue that the issue of external borrowing for developing countries is important at their early stage of development provided that domestic capital is insufficient for investments. The model also suffers from conceptual problems relating to its theoretical underpinnings and the rigidity of its basic assumptions. For instance, the assumption of perfect capital mobility is unrealistic, since countries may not be able to borrow freely because of the risk of debt repudiation or moral hazard (Gertler & Rogoff, 1990).

The existing literature on the analysis of external debt and economic growth tends to indicate a negative relationship. External debt tends to reduce the stock of private capital, through crowding out private investments, which in turn reduces the flow of income (Modigliani, 1961; Buchanan, 1958; Meade, 1958; Ejigayehu, 2013; Van, *et al.,* 2019). It is worth noting that if the proportion of government operations funded through debt is significantly high, interest rates may substantially increase in the long-run. The interest accruing from external debt is often paid through taxes leading to a reduction in consumption of taxpayers and their savings, which in turn reduces capital stock and economic growth. The gross burden of external debt can be offset in part or in total if borrowed funds are used to finance productive public capital formation, which in turn, improves the real income (Modigliani, 1961; Ibrahim, 2015; Moh'd & Jaradat, 2019). Nevertheless, similar to the debt Laffer curve hypothesis, Cohen (1993); Dao & Oanh (2017); Shkolnyk & Koilo (2018), and Ehikioya *et al.* (2020) argue that the relationship between external debt and economic growth is non-linear. This means that an increase in external debt promotes investment up to a certain level, beyond which debt overhang will discourage investors from providing capital to the government. Thus, high long-term interest rates can crowd out private investment, thereby reducing potential output growth. Extreme cases of the debt crisis can also trigger a banking or currency crisis; thus, causing a reduction in economic growth (Ibrahim, 2015).

Another significant theoretical exposition growth and its main determinants is the Solow model. The Solow model (Solow, 1956; and Swan, 1956) is based on Cobb-Douglass production function given by the form:

$$Y(t) = F[A(t), K(t), L(t)] = A(t)K(t)^{\alpha}L(t)^{1-\alpha} \quad (12)$$

where
$Y(t)$= Total production (output)at time *t*
$K(t)$= Capital input
$L(t)$= Labour input

$A(t)$= A shifter of the production function or technology. Technology is free and publicly available.
α and $1-\alpha$ = Are output elasticities of capital and labour respectively.
Notice that $0 < \alpha < 1$.

$A(t)L(t)$ represents effective labour. Assuming all factors are fully employed, if the production function is expressed with the corresponding output per worker, $y = Y/L$and capital per worker, $k = K/L$, equation (12) becomes:

$$y(t) = k(t)^{\alpha} \quad (13)$$

Equation (12) suggests that the country that uses more capital per worker will produce more output per worker, subjected to the law of diminishing returns to capital per worker (Also see Jones, 2002). The other key equation of the Solow model is an equation that describes how capital accumulates. The capital accumulation equation is expressed in the form:

$$\dot{K}(t) = sY(t) - dK(t) \quad (14)$$

where
$\dot{K}(t)$= Change in capital stock
$sY(t)$ = Gross investment
$dK(t)$ = depreciation during the production process

According to equation (14), the change in the capital stock is equal to the amount of gross investment less than the amount of depreciation that occurs during the production process. Assuming a constant growth rate of the labour force,$n = \dot{L}(t)/L(t)$, and with mathematical manipulation (see Jones, 2002), the capital accumulation equation in per worker terms can be expressed as follows:

$$\dot{k}(t) = sy(t) - (n+d)k(t) \quad (15)$$

where

$$\frac{\dot{k}(t)}{k(t)} = \frac{sy(t)}{k(t)} - n - d$$

Equation (15) says that the change in capital per worker each period is determined by investment per worker, depreciation per worker and population growth. Investment per worker, $sy(t)$ tends to increase $k(t)$, while depreciation per worker, $dk(t)$ reduces $k(t)$. Similarly, population growth, $nk(t)$ tends to reduce $k(t)$. If there were no new investment and no depreciation, capital per worker would decline because of the increase in the labour force (Jones, 2002),

Some empirical works on external debt used the Solow growth model as a base to investigate its impact on economic growth. Since the Solow growth model is built on a closed economy, which uses labour and capital as means of production, the implication of foreign debt on growth can be seen using its effect on the public saving which in turn, used as an investment in a closed model (Ejigayehu, 2013). As has been discussed, if the government, in an attempt to pay the accumulated debt, raises the tax rate on the private

sector, it will discourage private sector investment; and more government public spending on infrastructure will decrease. As a result, the overall investment will decrease in the economy shifting both the investment and production function curves in Solow growth model downward. Likewise, when governments are forced to pay part of their external debt from export will discourage public investment, which will shift both the investment and production function curves in Solow growth model downward.

2.2. Empirical literature review

Since the 1980s, many empirical studies have been carried out to establish the relationship between economic growth and external debt; however, there still are varied and contradictory findings on the causal relationship between public debt and GDP growth rate across countries and regions. Some studies reveal a positive relationship (Jayaraman & Choong, 2008; Jayaraman & Evan, 2009; Warner, 1992), others confirm a negative relationship (Senadza *et al*., 2017; Reinhart & Rogoff, 2010a; Geiger, 1990), while others conclude a nonlinear relationship the two variables (Geiger, 1990; Cohen, 1993; Cunningham, 1993; Chowdhury, 1994; Rockerbie, 1994; Fosu, 1996; Elbadawi *et al*., 1997; lyoha, 1999; Checherita & Rother, 2010).

The basic argument on the nonlinear relationship between external debt and growth is that debt below a certain threshold can promote economic growth while debt well above this threshold could retard growth. For example, Miller & Foster (2012) report that the negative effect of external debt on growth starts when the debt-to-GDP ratio is 35 percent, while debt levels can be high as 90 percent in developed countries. Similarly, Rother (2010) shows that external debt of 90-100 percent of GDP exerts a damaging impact on long-term growth for Euro-zone countries. Moreover, using a sample of 93 developing countries over the1969–1998 period, Pattillo *et al.* (2002) find that the average impact of external debt on per capita GDP growth is negative for the net present value of debt levels above 160-170 percent of exports and 35–40 percent of GDP. These results, according to Pattillo *et al.* (2002), suggest that doubling debt level slows down annual per capita growth by about half to a full percentage point.

In addition, Pattillo *et al.,* (2003) while applying a growth accounting framework to 61 developing countries in sub-Saharan Africa, Asia, Latin America, and the Middle East over the period 1969–98 suggest that on average, doubling debt reduces by almost 1 percentage point both growths in per capita physical capital and growth in total factor productivity. Thus, high debt stocks tend to affect growth through their dampening effects on both physical capital accumulation and total factor productivity growth (see Clements *et al.,* 2003). Nonetheless, some studies, for example (Nersisyan & Wray, 2010) show that excessive sovereign debt does not necessarily hurt growth while other studies, for example, Kasidi & Makame (2013) reveal no long run relationship among the two variables.

In general, findings from previous empirical studies on the relationship between external debt and economic growth are complex and inconclusive. In an extreme case, Warner (1992), while carrying out an experiment on 13 less developed countries characterized by a debt crisis for the 1982-1989 period, concludes that there is a positive relationship between external debt and economic growth. According to Warner (1992), the debt crisis

does not depress investment. These results, however, are contrary to Greene & Villanueva (1991), Serven & Solimano (1993), Elbadawi *et al.* (1997), Deshpande (1997) and Chowdhury (2001), who find evidence in support of the debt overhang hypothesis. Warner (1992) findings are also contrary to Fosu (1999) study for 35 sub-Saharan African countries, who finds support for the debt overhang hypothesis. According to Warner (1992), a decline in export prices, high international interest rate and sluggish economic growth in the developed world are the major reasons that adversely affect the growth rate of investment in most indebted countries. The main criticism of Warner (1992) results is that structural changes like domestic policies and world economic conditions that happened in 1982 were expected to be the cause for the debt crisis that has occurred in most indebted countries in the same period (Rockerbie, 1994). Also, Warner (1992) analysis failed to incorporate debt variables in the investment equation as these variables are expected to be endogenous in the model (Rockerbie, 1994). In fact, Rockerbie (1994) analysis for the 13 countries over the 1965 –1990 period, while including variables that represent domestic monetary and fiscal policies, debt stock, and flows, and world economic condition, suggests that the debt crisis of 1982 affects the investment condition of the countries under study.

Notably, conclusions from the majority of previous studies show that external debt has an adverse effect on growth indirectly by reducing investments through high-interest rates and high debt repayment costs. For example, Senadza *et al.* (2017) study on the effect of external debt in Sub Saharan African for the 1990-2013 period concludes that there is a negative effect of external debt on growth. The study also shows that control variables such as labour force (population growth rate), investment as a percentage of GDP, the growth rate of exports have a positive effect on growth. Likewise, Zouhaier & Fatma, (2014) study for 19 developing countries reveals that external public debt as a percentage of GDP and GNI have a negative and statistically significant effect on economic growth. In a very similar study, Babu *et al.* (2014), employ a panel fixed effect model to estimate the effect of external debt on economic growth in the East African community for the 1970 -2010 period. Results show that external debt has a negative effect on GDP per capita growth rate. The study also includes some control variables such as investment, government expenditure, terms of trade, openness (sum of import and export). Like, Babu *et al.* (2014), Ibrahim (2015) examines the effect of external debt on economic growth in East African countries using fixed effects (FE) and the random effects (RE) while covering the 1981-2014 period. External debt and growth apart, the study includes a number of regressors namely domestic, capital stock, exchange rate, inflation, interest rate, and labour force. The overall conclusion is that external debt has a negative effect on economic growth in East African Countries, whereas domestic debt and other macroeconomic factors do not have a significant effect on economic growth. Moreover, Geiger (1990) while applying a lag distributional model for 9 South American countries over the 1974-1986 period, reveals a significantly negative relationship between external debt and economic growth.

Even time series studies for single countries reveal contradictory results. For example, Elwasila (2018) for Sudan, over the 1969-2015 period, finds a positive effect of external debt on economic growth while Akram (2011) for Pakistan, over the 1972-2009 period,

reveals an inverse relationship between external debt and economic growth due to crowding-out effect.

Ndubuisi (2017) for Nigeria, over the period spanning from 1985-2015, while applying Johansen cointegration and error correction tests, shows that debt service payment has no effect on economic growth whereas external debt stock has a positive and significant effect on growth. Other factors such as external reserve and exchange rate also have a positive and significant effect on economic growth in Nigeria. The main implication of these results is that the government should apply external loans to infrastructural development and improve the business environment. In Tanzania the study by Kasidi & Makame (2013), over the 1990-2010 period, finds that there is no long-run relationship between external debt and GDP in Tanzania.

Furthermore, Sami & Mbah (2018) for Oman, over the 1990-2015 period, show that external debt has a negative effect on economic growth. The study also includes a number of control variables namely, population growth, gross fixed capital formation ration of trade to GDP, Inflation, and human capital proxied by primary school enrollments.

2.3. Summary

Empirical investigations have different findings in their attempt to examine the effect of external debt and economic growth. Most of these studies differ in their methodology, geographical area, and time period covered. Although many of these empirical studies have provided some explanation as well as shedding light on the relationship between external debt and economic growth, they are unable to provide any explanation on external debt and growth in a large group of countries. Most of them concentrated on a single country or on a small sample of sub-Saharan African countries. This paper bridges this gap by analyzing the effect of external debt in African countries, taking into account 45 African countries over the 1990-2017 period. The paper also captures a number of control variables namely, inflation, exchange rate, exports, population growth rate, and gross fixed capital formation. In, examining the effect of external debt and external debt services on public investment, the paper includes an institutional variable, namely corruption.

3. Research methodology

3.1. Measurements of variables and sources of data

Empirical studies on the relationship between external debt and economic growth tend to employ real gross domestic product or per capita GDP growth as the regress and (Adamu & Rasiah, 2016; Akram, 2011; Dao & Oanh, 2017; Ehikioya, *et al*., 2020; Ejigayehu, 2013; Elwasila, 2018; Gohar *et al*., 2012 and Guei, 2019). Apart from external debt and debt service, which are used as the main regressors, other regressors or control variables tend to differ from one study to another, although some variables seem to be common across studies. These variables include gross public investment, inflation rate, labour force or population growth, and export and imports of goods and services. Other variables include the exchange rate and foreign direct investments. Table 1 presents definitions and expected signs of these key variables. Apart from the fact that these control variables have been used

in many of the theoretical and empirical literature as discussed in theoretical and literature review, it is undoubtedly, these variables play a great role in economic growth. For example, inflation is known to affect the value of currencies in countries and the purchasing power of people, which in turn affect growth. Moreover, population growth has been regarded as a proxy of labour inputs in many studies on growth because without labour force there is either no or less productivity. Similarly, the employment of public investment is a virtual instrument in enhancing economic growth. Intuitively, population growth and gross investment are proxies for the rates of growth of factor inputs, i.e. labour and capital in the production process. Furthermore, exports are marked to speedily cause economic growth through improving domestic industries and production as well as appreciating local currencies. In addition, the exchange rate has a main role to play in growth because the poor exchange rate system is likely to cause low growth and vice-versa. To distinguish between debt overhang and the crowding-out effect discussed earlier, both debt service and stock of external debt are included in the regression analysis (Clements *et al.,* 2003). Overall, it is hypothesized that a relatively high external debt has a negative effect on economic growth in Africa.

Table 1. *Definition of variables and sources of data*

Sn	Variable	Abbr.	Definition	Expected sign
1	GDP Growth	Y	Annual percent growth rate of GDP per capita	
2	External debt	ED	Gross external debt (percent of GDP).	Positive
3	External debt squared	$(ED)^2$	Gross external debt (percent of GDP) squared (Laffer curve effect)	Negative
4	Debt service	DS	Debt service, percent of exports	Negative
5	Inflation	INF	General increase in consumer prices, annual percent	Negative
6	Exchange rate	EXR	Local currency/USD	Negative
7	Exports & Imports	EXP	Export of goods and services, percent of GDP	Positive
8	FDI	FDI	Inflows from foreign investment, percentage of GDP)	Positive
9	Population growth	PGR	Population, annual percent increase	Positive
10	Public investment	PI	Gross public investment, percent of GDP	Positive

Source: Authors' construction from literature review, 2019.

As has been mentioned, the empirical analysis of this paper uses data for 45 African countries. The data cover the 1990-2017 period. External debt and gross public investment data were obtained from the World Bank's *Global Development Network Growth* database while data on external debt as a share of GDP and debt service payments as a share of exports were drawn from the World Bank's *World Development Indicators (WDI)* database. All other data including population growth rate, inflation rate, exports-to-GDP ratio, and exchange rate were taken from the WDI.

3.2. Model specification

The choice of an appropriate estimation method is paramount for realizing robust estimates. As has been explained, to examine the effect of external debt on economic growth in Africa, this paper employs panel data estimation techniques. The panel data estimation techniques are considered as efficient analytical methods, since they allow combining different cross-sections and time periods, and provide more reliable, valid, and robust inferences. Specifically, panel data can take an explicit account of individual-specific heterogeneity. Also, by combining data in two dimensions, panel data give more data variation, less collinearity, and more degrees of freedom. Panel data is better suited than cross-sectional data for studying the dynamics of change, unlike pooled ordinary least squares regression

model, where we pool all observations and run the regression while neglecting cross-section and time-series nature of the variables. Pooled ordinary least squares regression may result in heterogeneity bias because we deny the heterogeneity or individuality that may exist across countries. Hence, this paper employs fixed effects (FE) and random effects (RE) models. Both FE and RE regressions are reported for comparison purposes.

3.2.1. Fixed-effects and random effects models

Fixed effects (FE) model assumes that each group, countries in this case, has a non-stochastic group-specific component to the dependent variable, economic growth. In other words, FE assumes that the individual specific effect is correlated with the independent variable while random effect assumes the individual specific effects are uncorrelated with the independent variables. The FE model can be specified as follows:

$$Y_{it} = \alpha_i + \beta.X_{it} + u_{it} \tag{16}$$

where α_i is the country fixed effect, these are individual intercepts (fixed for given N). No overall intercept is included in the model. u_{it} is the usual random disturbance term. Under FE, consistency does not require, that the individual intercepts (whose coefficients are the $\alpha_i's$) and u_{it} are uncorrelated. Only $E(X_{it}u_{it})$ must hold. The variables are defined as follows

Y_{it} = The value of dependent variable, economic growth, for the i^{th} country for t^{th} time period.

X_{it} = The value of independent variables, external debt (*ED*), debt Laffer curve effect $(ED)^2$, external debt service (*EDS*), inflation ((π), exchange rate (*ER*), degree of openness (*Trade)*, *FDI*, population growth (*Labour*), gross public investment *(PubInv.*) for the i^{th} country for t^{th} time period.

$t = 1990, 1992, 6, 2017$

$i.e. T = 28$

$i = 1, 2, 6, 45$

$i.e. N = 45$

Including dummy variables in the FE is a way of controlling for unobservable effects on the dependent variable, economic growth. But these unobservable effects may be stochastic (i.e. random). The random effects (RE) model attempts to deal with this problem. The random effect specification is expressed as

$$Y_{it} = \alpha + \beta.X_{it} + v_i + u_{it} \tag{17}$$

where

$$v_i \sim iid\left(0, \sigma_\alpha^2\right)$$

$$u_{it} \sim iid\left(0, \sigma_\alpha^2\right)$$

where v_i is the random effect or the unobserved country-specific effects. $v_i s$ are random variables with the same variance. The value v_i is specific for individual country. The v of different individual countries are independent, have a mean of zero, and their distribution is assumed to be not too far away from normality. The overall mean is captured in α. v_i is time invariant and homoscedastic across individual countries. *t-test* is used to test the significance of the coefficient of each variable included in the model, while the *F-test* is applied to test whether the coefficients are jointly or simultaneously equal to or different from zero. Estimation of the random effects model cannot be performed by OLS. The model can be estimated by feasible or generalized least squares (GLS). GLS is more efficient than OLS.

3.2.2. Hausman test

Judge *et al.* (1985) suggest that if number of time series data (T) is large and the number of cross section units (N) is small, there is likely to be little difference in the values of parameters estimated, thus FE may be preferable. Likewise, when N is large and T is small, the estimates obtained by two methods can differ significantly, in this case RE is appropriate. However, the Hausman test, developed by Hausman (1978) can be performed to determine whether the data fit well the random effects or fixed effects models. Hausman tests for the statistical significance of the difference between the coefficient estimates obtained by FE and by RE, under then null hypothesis that the RE estimates are efficient and consistent, and FE estimates are inefficient. The test has a Wald test form, and is usually reported in χ^2 form with *k-1* degrees of freedom. Where k is the number of regressors. Specifically, the null hypothesis and alternative hypothesis of the Hausman test are presented as follows:

H_0:	All unobserved factors (the deterministic component and random component) that vary across units but are constant over time, are not correlated with the independent variables.	Random effects model is appropriate
H_1:	Unobserved factors (the deterministic component and random component) that vary across units but are constant over time, are correlated with the independent variables.	Fixed effects model is appropriate
If probability value is greater than 0.05, that is, if W < critical value then random effects is the preferred estimator.		We apply a RE model
If probability value is less than or equal to 0.05		We apply a FE model

4. Empirical results

4.1. External debt and economic growth

Results of the fixed effects (FE) and random effects (RE) regressions are reported in Table 2 and Table 3 respectively. Both estimates yield broadly similar results. In all cases, the F-tests reject the null hypothesis of a common intercept term across countries. Despite the similarities of results obtained from FE and RE models, the choice of appropriate model between the two models is of paramount importance. The results of the Hausman test are presented in Table 4. Since the probability value is less than 0.05, that is, W > critical value, this rejects the null hypothesis that random effects is appropriate model, and suggests that fixed effects is the preferred estimator. This also suggests that interpretations of the results should base on fixed effects model. The advantage of a fixed effects model is that it provides consistent estimates in the presence of country-specific effects that are correlated with the explanatory variables in the model.

The empirical estimates provide some support for the debt overhang hypothesis. The measure of debt Laffer curve effect, $Log(ED)^2$ is negative and statistically significant at one percent, which suggests that beyond a certain threshold, higher external debt is associated with lower rates of growth of GDP per capita. FE estimates imply that when external is relatively high, for each 1 percentage point increase in external debt, annual per capita growth declines by 2.5 percentage point. Notwithstanding, both regressions show that the coefficient of external debt is positive and statistically significant at a one percent level suggesting that a relatively low external debt has a positive impact on economic growth in Africa. Intuitively, countries that are relatively less dependent on external debts are likely to grow rapidly. FE regression suggests that when external debt is relatively low, for each 1 percentage point increase in external debt, annual GDP per capita rises by 5.9 percentage point. Thus, external debt is still important for African economies.

Similarly, as expected, both FE and RE models reveal positive and statistically significant coefficients on trade, gross public investment, and rate of population growth. In fact, in the FE regression, the coefficients on both trade and population growth are statistically significant at one percent level while the coefficient on public investment is statistically significant at 5 percent level. Results suggest that one unit increase in the ratio of gross public investment to GDP will lead to a 0.05 percent increase in the growth rate of GDP per capita. Unsurprisingly, population growth, which is normally regarded as a proxy for labour growth in many economies, its growth, is obviously likely to bring about a higher economic growth rate. Furthermore, both models show that the exchange rate has a negative effect on economic growth in Africa. The coefficient on the exchange rate is significant at one percent in the FE regression.

However, this is not a surprise since most of the African countries' currencies are weak compared to the most widely used currency in exchange that is the US dollar. Thus, an increase in a dollar will undoubtedly cause local currency depressions, which in turn adversely affect economic growth.

Inflation rate and foreign direct investment were statistically insignificant, and consequently were dropped from empirical regressions. Similarly, debt service seemed to

have no direct effect on real per capita GDP growth may be due to the reason that its effect is realized through its impact on investment, which is included as an explanatory variable in the public investment model but it was not included in the final regression analysis of the growth model.

Table 2. *Fixed effects regression: Impact of external debt on per capita GDP growth*

Fixed-effects (within) regression					Number of obs	=	1,080
Group variable: code					Number of groups	=	45
R-sq: within	=	0.129			Obs per group: min	=	7
between	=	0.156			avg	=	24.0
Overall	=	0.097			max	=	28
					F(6,1029)	=	25.39
Corr(u_i, xb)	=	-0.4684			Prob > F	=	0.0000
Growth (*Y*)	Coef.	Std. Err.	*z*	$p>\|z\|$	[95% Conf. Interval]		
Log(ED)	5.948	2.460	2.42	0.013	0.121		10.774
Log(ED)^2	-2.523	0.718	-3.51	0.000	-3.932		-1.114
Export	0.078	0.020	3.90	0.000	0.039		0.117
Log(EXR)	-0.776	0.310	-2.50	0.012	-1.383		-0.168
Public Inv.	0.050	0.022	2.21	0.027	0.056		0.094
Population	1.710	0.196	8.71	0.000	1.324		2.095
Constant	4.565	2.428	1.88	0.060	9.330		0.199
Sigma_u	2.0776						
Sigma_e	4.6534						
rho	0.1602	(fraction of variance due to u_i)					
F test that all u_i = 0:		F(44,1029) = 2.47		Prob > F= 0.0000			

Table 3. *Random effects regression: Impact of external debt on per capita GDP growth*

Random-effects GLS regression				Number of obs	=	1,080
Group variable: code				Number of groups	=	45
R-sq: within	=	0.122		Obs per group: min	=	7
between	=	0.322		avg	=	24.0
Overall	=	0.128		max	=	28
Random effects u_i ~ Gaussian				Wald chi2(5)	=	155.37
Corr(u_i, x)	=	0 (assumed)		Prob > chi2	=	0.0000
gdp	Coef.	Std. Err.	*z*	$p>\|z\|$	[95% Conf. Interval]	
Log(ED)	5.354	2.189	2.450	0.014	1.063	9.646
Log(ED)^2	-2.327	0.640	-3.640	0.000	-3.582	-1.073
Trade	0.023	0.012	1.960	0.050	0.000	0.046
Log(EXR)	-0.451	0.189	-2.380	0.017	-0.822	-0.080
Public Inv.	0.062	0.019	3.220	0.001	0.024	0.100
Population	1.545	0.170	9.100	0.000	1.213	1.878
Constant	2.956	2.066	1.430	0.152	7.005	1.093
Sigma_u	1.060					
Sigma_e	4.653					
rho	0.049	(fraction of variance due to u_i)				
F test that all u_i = 0:		Wald chi2(5) = 155.37		Prob > chi2 = 0.0000		

Source: Authors' estimates.

Table 4. *The Hausman test: Fixed effects vs. random effects regressions*

	Coefficients			
	(b)	(B)	(b-B)	Sqrt (diag(V_b-V_B)
	FE	RE	Difference	S.E
Log(ED)	5.948	5.354	0.593	1.121
$Log(ED)^2$	-2.523	-2.327	-0.196	0.325
Export	0.078	0.023	0.055	0.016
Log(EXR)	-0.776	-0.451	-0.325	0.245
PubInv.	0.050	0.062	-0.013	0.011
Population	1.710	1.545	0.164	0.099
	Test: Ho: difference in coefficient not systematic			
	b = consistent under Ho and Ha; obtained from xtreg			
	B = inconsistent under Ha, efficient under Ho; obtained from xtreg			
	Chi2(6) = (b-B)' [V_b-V_B)^(-1)](b-B)			
	= 18.06			
	Prob > chi2 = 0.0061			

Source: Authors' estimates.

4.2. External debt and public investment

There has been relatively little research undertaken on the determinants of public investment in African countries. Tanzi &Davoodi (1997) recognize corruption as one of the politico-institutional factors of public investment, in addition to the economic factors identified namely, real per capita income and government revenue to GDP ratio. Ntavou (2018), Makouezi (2010), Ngouhouo (2008), and Dupuch & Milan (2002) model public investment using a number of explanatory variables such as interest rate, exchange rate, trade openness, public consumption, population, official development assistance, tax revenue and various indicators of governance including corruption control. Likewise, Sturm (2001) models public investment using three sets of explanatory variables namely, structural variables, such as urbanization and population growth; economic variables, such as real GDP growth, government debt, budget deficits, and foreign aid; and politico-institutional variables, such as political stability and political business cycles. In a similarly study, Clements *et al.* (2003) model public investment in low income countries while including foreign aid in percent of gross national income, the urbanization ratio, total debt service in percent of GDP, trade openness and external debt.

Clements *et al.* (2003) empirical analysis of public investment, however, excludes institutional variables because they seem to be less significant in explaining public investment in developing countries. Lack of data also was the main reason for excluding these variables.

Based on previous models of public investment, we estimate the following public investment equation:

$$PubInv._{it} = \gamma_i + \gamma_1 ED_{it} + \gamma_2 (ED)^2_{it} + \gamma_3 DS_{it} + \gamma_4 Y_{it} + \gamma_5 Trade_{it} + \\ + \gamma_6 R_{it} + \gamma_7 CPI_{it} + v_{it}. \quad (18)$$

where
$PubInv.$ = Public investment, percent of GDP.
ED = External debt, percent of GDP.
$(ED)^2$ = Measure of debt Laffer curve effect of external debt on public investment.
DS = External debt service, percent of exports.
Y = Annual percent growth rate of GDP per capita.

$Trade$ = Degree of openness, export plus import, percent of GDP.
R = Interest rate.
CPI = Corruption perception index.
v_{it}= The standard error term.

As before, the subscript (it) for the explanatory variables refer to country and time period, respectively. The real GDP per capita variable is used as a proxy for the level of economic development (Clements *et al.*, 2003; Tanzi&Davoodi (1997). Hence, it is expected to have a positive effect on the ratio of public investment to GDP. Similarly, since economies that are more open often compete for foreign direct investment by investing more in infrastructure, the degree of openness is likely to have a positive on public investment (Clements *et al.*, 2003).

Corruption is one of the institutional variables that affect the economic activities and hence, there is increasing interest in the impact of corruption on public investment. In literature, however, there are different conclusions about the effects of corruption on public investment. These contradicting conclusions may be due to differences in time, sample, and used variables. Tanzi & Davoodi (1997) and Haque & Kneller (2008) assert that corruption increases public investment but it decreases productivity. According to Haque & Kneller (2008), corruption promotes the level of public investment but reduces the returns to this investment. A large portion of the effects of corruption on economic growth takes place through investment (Mauro, 1996). Indeed, Mauro (1995) finds that there is a negative and significant relationship between corruption and the investment rate. If a country could reduce its corruption level, it would have been able to raise its investment (Wei, 1999). Lastly, The Keynesian analysis shows that investment is a negative function of the interest rate. Now, we estimate model (18) using both fixed and random effects. Results are reported in Table 5 and Table 6 respectively.

Table 7 presents the Hausman test associated with these fixed effects and random effects regressions.

Table 5. *Fixed Effects Regression: Impact of External Debt on Public Investment*

Fixed-effects (within) regression				Number of obs	=	458
Group variable: code				Number of groups	=	33
R-sq: within	=	0.126		Obs per group: min	=	6
Between	=	0.159		avg	=	13.6
Overall	=	0.111		max	=	18
				F(7, 418)	=	8.59
Corr(u_i, xb)	=	-0.0580		Prob > F	=	0.0000
PubInv.	Coef.	Std. Err.	z	$p>\|z\|$	[95% Conf. Interval]	
Log(ED)	7.317	3.896	1.880	0.061	-0.329	14.962
$Log(ED)^2$	-2.275	1.138	-2.000	0.046	-4.507	-0.042
Log(DS)	-0.033	0.020	-1.710	0.088	-0.072	0.005
Trade	0.066	0.038	1.760	0.080	-0.008	0.141
Y	0.195	0.035	5.560	0.000	0.126	0.263
R	-0.084	0.032	-2.630	0.009	-0.148	-0.212
CPI	0.198	0.054	3.640	0.000	0.091	0.305
Constant	7.894	4.524	1.740	0.082	-0.999	16.788
Sigma_u	7.603					
Sigma_e	4.910					
rho	0.706	(fraction of variance due to u_i)				
F test that all u_i = 0:		F(32,418) = 26.62		Prob > F= 0.0000		

Table 6. *Random Effects Regression: Impact of External Debt on Public Investment*

Random-effects GLS regression					Number of obs		=	458
Group variable: code					Number of groups		=	33
R-sq: within	=	0.1249			Obs per group: min		=	6
between	=	0.1822			avg		=	13.9
Overall	=	0.1243			max		=	18
Random effects u_i ~ Gaussian					Wald chi2(5)		=	66.55
Corr(u_i, x)	=	0 (assumed)			Prob > chi2		=	0.0000
PubInv.		Coef.	Std. Err.	z	$p>\|z\|$	[95% Conf. Interval]		
Log(ED)		5.745	3.812	1.510	0.132	-1.727		13.216
$Log(ED)^2$		-1.912	1.117	-1.710	0.087	-4.102		0.277
Log(DS)		-0.030	0.195	-1.580	0.115	-0.069		0.007
Trade		0.079	0.036	2.230	0.026	0.010		0.150
Y		0.190	0.034	5.540	0.000	0.123		0.258
R		-0.080	0.031	-2.550	0.011	-0.141		-0.019
CPI		0.213	0.051	4.200	0.000	0.113		0.312
Constant		8.096	4.531	1.790	0.074	-0.785		16.977
Sigma_u		7.372						
Sigma_e		4.910						
rho		0.693	(fraction of variance due to u_i)					
F test that all u_i = 0:			Wald chi2(5) = 66.55 Prob > chi2 = 0.0000					

Source: Authors' estimates.

Table 7. *The Hausman test: Fixed effects vs. random effects regressions*

	Coefficients			
	(b)	(B)	(b-B)	Sqrt (diag(V_b-V_B)
	FE	RE	Difference	S.E
Log(ED)	7.317	5.745	1.572	0.808
$Log(ED)^2$	-2.275	-1.912	-0.362	0.217
Log(DS)	-0.033	-0.030	-0.004	0.002
Trade	0.066	0.079	-0.013	0.013
Y	0.195	0.190	0.004	0.007
R	-0.084	-0.080	-0.005	0.007
CPI	0.198	0.213	-0.014	0.020
	Test: Ho: difference in coefficient not systematic			
	b = consistent under Ho and Ha; obtained from xtreg			
	B = inconsistent under Ha, efficient under Ho; obtained from xtreg			
	Chi2(7) = (b-B)' [V_b-V_B)^(-1)](b-B)			
	= 7.83			
	Prob > chi2 = 0.3478			

Source: Authors' estimates.

Both fixed effects and random effects regressions yield almost identical results, and their associated F-statistics confirm that both models are generally statistically significant. However, based on the Hausman test, random effects is the preferred estimator because the probability value is greater than 0.05 or 5 percent. Empirical results show that the coefficient on external debt is positive, while the coefficient on the measure of debt Laffer curve effect is negative. Both coefficients, nonetheless, are statistically significant at 10 percent level.

These results suggest that, if the ratio of debt-to-GDP is relatively low, keeping other factors constant, RE regressions reveal that a 1 percent increase in the ratio of external debt-to-GDP will likely increase the public investment-to-GDP ratio in Africa by about 5.7 percent. However, if the ratio of debt-to-GDP is considerably high, a 1 percent increase in

the external debt-to-GDP ratio will reduce the public investment-to-GDP ratio in Africa by about 1.9 percent. Similarly, the coefficient on debt service-to-export ratio is negative and statistically significant at 10 percent implying that debt service tends to reduce public investment in Africa.

Consistent with Chowdhury (2001); Cohen (1995) and Elbandawi *et al.* (1997), these results confirm the debt crowding out effect on growth as income from exports is used to pay the accumulated debt, reducing amounts available for infrastructure development and social expenditure programmes such as health and education.

Consistent with Clements *et al.*, (2003) results, but contrary to Tanzi & Davoodi (1997) findings, the coefficient on real GDP per capita is positiveand statistically significant at 1 percent, suggesting that countries with higher real GDP per capita can generate greater tax revenues and can afford higher levels of public investment. Similarly, results show that the degree of openness has a positive and significant effect on public investment in Africa. Holding other factors constant, a percent increase in the ratio of export and import-to-GDP will lead to about a 0.08 percent increase in the ratio of public investment-to-GDP. Unsurprisingly, and consistent with the IS market for goods and services analysis, the coefficient on interest rate is negative and statistically significant implying that there is an inverse relationship between the interest rate and ratio of public investment-to-GDP.

The coefficient on corruption perception index (CPI) is positive and statistically significant at 1 percent level, suggesting that public investment tends to increase with low levels of public sector corruption. It is worth noting that CPI uses a scale of 0 to 100, where 0 is highly corrupt and 100 is very clean. In fact, more than two-thirds of African countries score, on average, below 50 with an average score of 32. Botswana, Cabo Verde, and Mauritius are considerably the cleanest countries in Africa, with an average score of 60, 55, and 50 respectively while Angola with an average score of 19, Chad with an average score of 20, Burundi and Guinea-Bissau with an average score of 21, and Nigeria with an average score of 22 are among the highly corrupt countries in Africa. Corruption tends to hamper public investment.

5. Conclusions

Low levels of external debt tend to increase economic growth and public investment in African countries. However, high levels of external debt can depress both economic growth and public investment in Africa. This seems to be plausible because the level of domestic saving in Africa is generally inadequate for generating the level of investment required for growth and development therefore the amount of borrowed funds is needed to finance such investments. As a result, external debt could have a positive impact on investment and economic growth. Intuitively, African countries use external debt to bridge their deficits and carry out economic projects that are able to increase to promote growth but if a country borrows, too much beyond a certain endogenous threshold level of debt, then it may result in a negative impact. The implication is that African countries should borrow only when they have made enough research and satisfy that the borrowed funds will lead to improved

economy, as the growth-cum-debt model suggests. Even at lower levels of external debt, to reap the positive effects of external debt on investment and growth, African countries will need to realize the importance of trade and institutional factors such as corruption while executing a sustained growth-inducing external debt plan or policy. Higher degree of openness is likely to increase both public investment and growth while a reduction in public sector corruption increases public investment, which in turn, raises growth. Moreover, African countries need to expedite effectiveand efficient external debt management strategies that will favour timely repayment to avoid debt overhang and debt-crowding effects.

More importantly, the fact that trade has a positive impact on both investment and growth, economic growth activities in African countries should be financed through increased export earnings spearheaded by export-led-growth strategy as these would be the best alternative to external debt in the long-run. Pursuing policies that strengthen exports, sound exchange rate, and effective use of labour force will lead to an improvement in economic growth.

Since the use of external debt have observed to take the main part of the public debt structure in African countries, and indeed, external debt serving is becoming a great burden in African economies, there is a need for other upcoming research to stress on this matter. Further research could analyse channels through which external debt affects growth while including domestic factors such as political stability, government effectiveness, government revenue, and foreign aid or official development assistance.

Note

(1) Including interest

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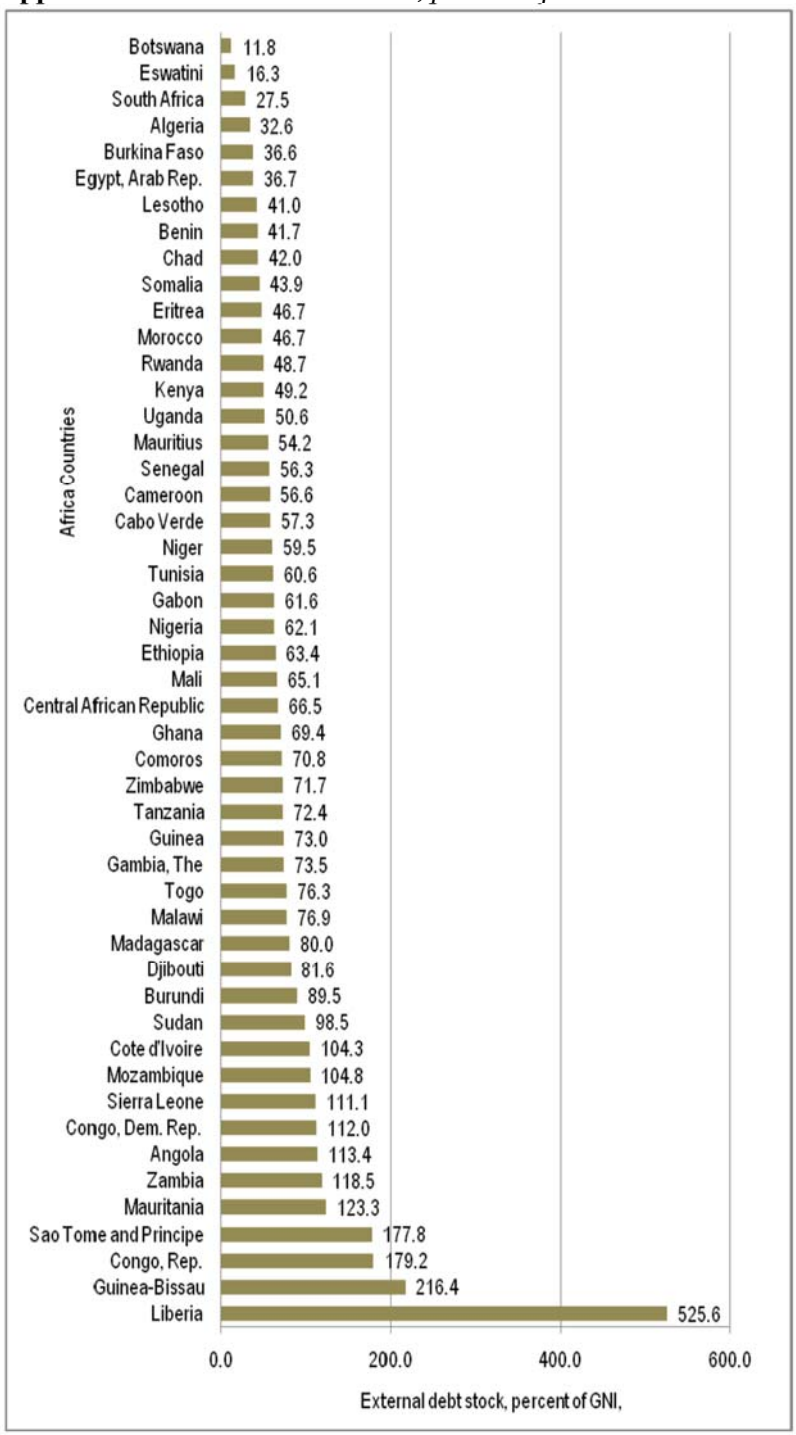
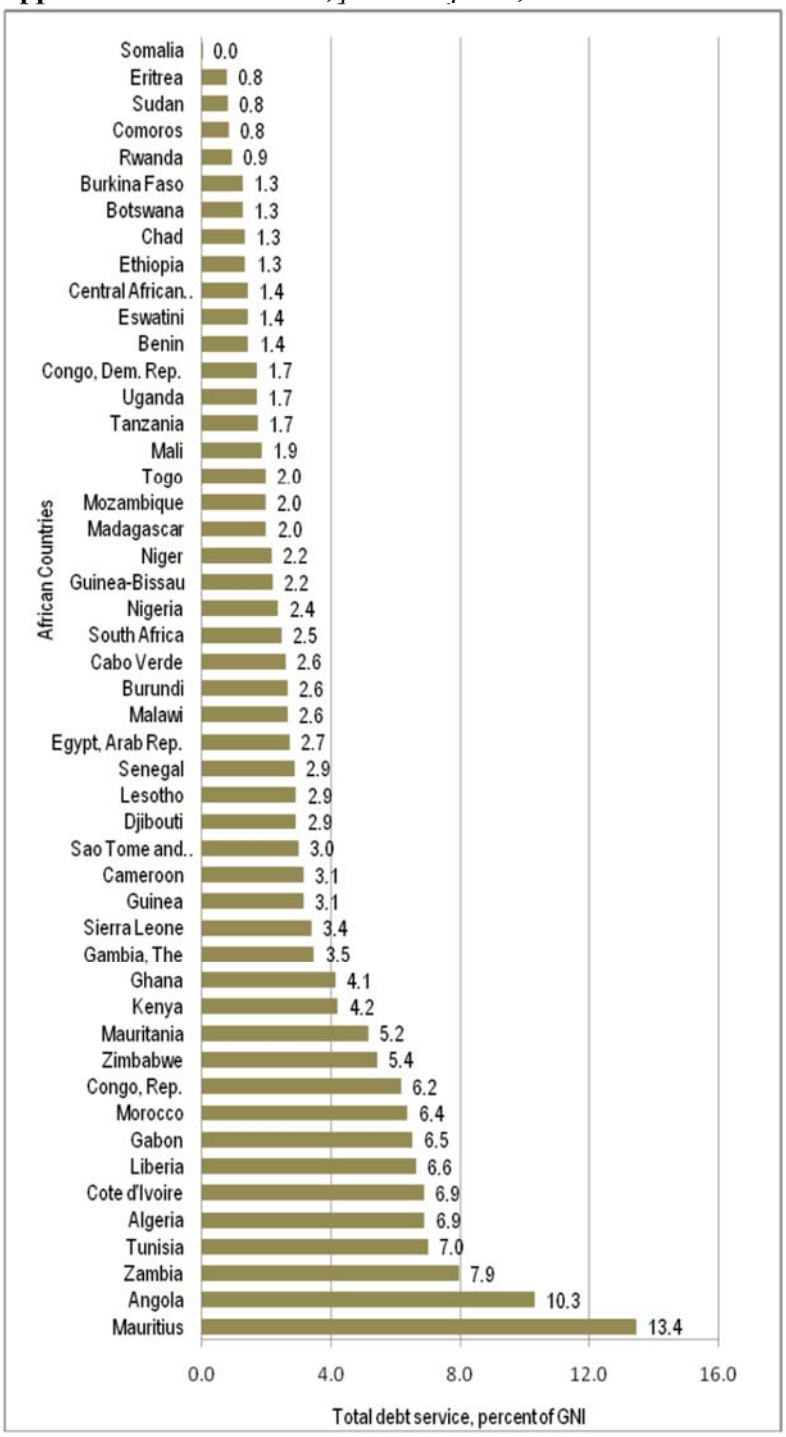
Appendix 1A. *External debt stocks, percent of Gross National Income*



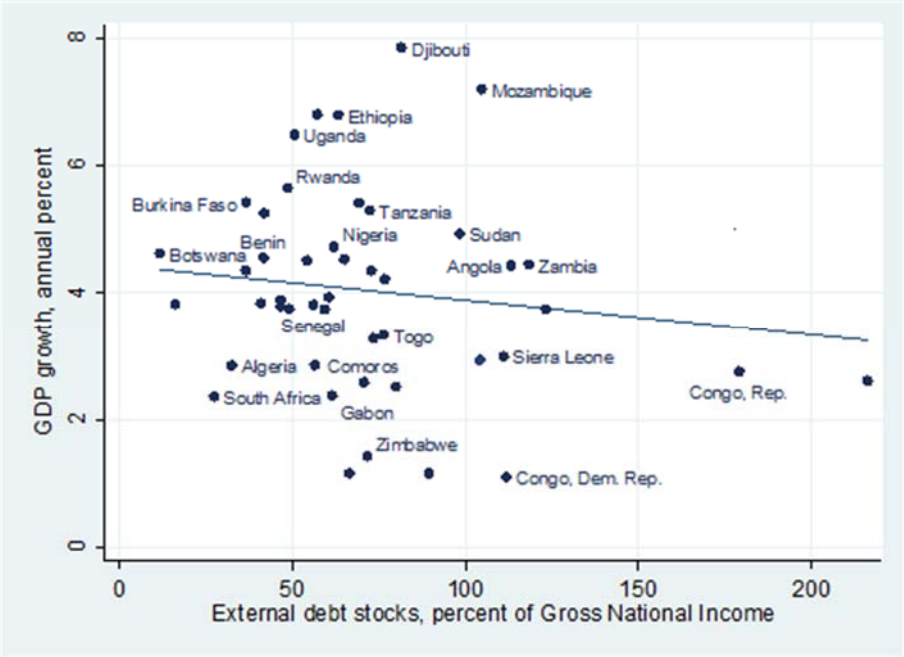
Source: World Bank Development Indicators (WDI) (2018).

Appendix 2A. *Debt service, percent of GNI, 1990-2017*



Source: World Bank Development Indicators (WDI) (2018).

Appendix 3A. *Scatter Plot, GDP Growth vs. External Debt, 1990-2017*



Source: Authors, estimates using data from World Bank Development Indicators (WDI) (2018).

Table 1A. *List of countries included in the empirical analysis*

1	Algeria	16	Ethiopia	31	Mozambique
2	Angola	17	Gabon	32	Namibia
3	Benin	18	Gambia	33	Niger
4	Botswana	19	Ghana	34	Nigeria
5	Burkina faso	20	Guinea-Bissau	35	Rwanda
6	Burundi	21	Kenya	36	Senegal
7	Cabo Verde	22	Lesotho	37	Seychelles
8	Cameroon	23	Liberia	38	Sierra Leone
9	Central Africa Rep.	24	Libya	39	South Africa
10	Chad	25	Madagascar	40	Tanzania
11	Comoros	26	Malawi	41	Togo
12	Congo. Rep	27	Mali	42	Tunisia
13	Cote d'Ivoire	28	Mauritania	43	Uganda
14	Egypt, Arab Rep.	29	Mauritius	44	Zambia
15	Eswatini	30	Morocco	45	Zimbabwe