UNIVERSITY OF GHANA
COLLEGE OF HUMANITIES

TURNING POINT:
WHEN CAN PUBLIC DEBT GO FROM GOOD TO BAD IN AFRICA

BY

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DECLARATION

I affirm that, this thesis is the author’s work produced from research undertaken under supervision. The thesis does not incorporate without acknowledgement any material previously submitted within a degree program at this or any other institution. And to the best of my knowledge, it does not contain any information previously published where due reference is not made in the text.

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DEDICATION

This dissertation is dedicated first of all to God Almighty and secondly to my family.
ACKNOWLEDGEMENTS

First, I give thanks to God for His grace and wisdom that has enabled me through this Program. My appreciation further goes to my family; Gifty, Anna, Kojo, Josiane and Joan for their great support and encouragement.

My profound gratitude likewise goes to my supervisors; Dr. William Bekoe and Dr. Patrick Asuming for accepting to supervise me and guiding me through the thesis.

I pray that the good LORD will continue to bless us all.
ABSTRACT

Debt remains one of the most important means of financing growth across the world. There are however varied opinions about it effects and threshold. There has been a growing research interest in recent times to understand the exact relationship between public debt and economic growth and likewise the threshold limit of debt. The literature on Africa in this area is, however, limited. Given that, 33 out of the 39 HIPC countries are from Africa, understanding the effect and the threshold of public debt is imperative for fiscal policy directions in the region. Accordingly, the goal of this study is to first examines if there is a non-linear relationship between public debt and economic growth and secondly, to investigate the public debt threshold in Africa using a panel of 50 African countries between 1980-2016.

To establish evidence of non-linearity, the study specified a quadratic model of debt and used both Fixed Effect (FE) and Generalized Method of Moment (GMM) estimation techniques for the analysis. The study found a strong evidence of a non-linear relationship between public debt and economic growth for the 50 African countries for the period between 1980 and 2016. The study investigated the existence of public debt threshold using the Arellano & Bover (1995) dynamic estimation technique in stata and the non-dynamic threshold estimation technique in eviews. The empirical analysis found a positive and highly statistically significant effect of public debt on GDP growth rate. After the debt ratio of 80.06%, the influence of public debt on economic growth diminishes with each additional increase in debt to GDP ratio. Thus, the study identified a threshold value of 80.06% as the limit above which public debt can go from good to bad for the panel of 50 African countries from 1980-2016. The result is robust across varied specifications. The result suggests that, the optimal benefit of public debt for the panel of 50 African countries is achieved at a debt to
GDP ratio of 80.06%. The result could be an important guide to policy makers within the study area in their public financing decisions to realize the optimal advantage of public debt.
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CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

The two main economic policies that shape the behavior of an economy are; fiscal and monetary policies. Whereas monetary policies are developed and implemented by the central bank to achieve price stability, full employment, and stable economic growth, fiscal policies are determined by the central government to guide its revenue (tax) and spending directions. The short-term fiscal objectives of the central government are expressed in a form of annual budget which provide information on government revenue and spending in a fiscal year.

Fiscal deficit arises when government spending exceeds its revenue from tax and grant sources in a given period. Most African countries have historically maintained some amounts of deficits. But the levels in some of these countries have seen a significant increase in recent times.

Figure 1.1 Pattern of Deficit in Africa
Source: Authors Construct, 2016, using data from Africa Development Bank.
For example, from Figure 1 above, Ghana maintained an average deficit of 9.6% from 2010 and 2016. The deficit for Africa as a whole has been deteriorating over the period increasing from 2.5% in 2010 to 6.5% in 2016 with an average of 4.2% between 2010 and 2016. Among the five regional blocs in Africa, North Africa recorded the highest deficit between 2010 and 2016. The bloc’s deficit position increased from approximately 3% in 2010 to 11% in 2014 and 8% in 2016 respectively. From 2010-2016, the bloc maintained an average deficit of 7% which was higher than the regional average of 4.2%.

As evidenced in Figure 1 above, the Central Africa bloc after recording a budget surplus of 1.5% and 2.3% in 2010 and 2011 respectively, experienced a worsening fiscal position with deficit increasing from 0.4% in 2012 to 4% in 2016. With an average deficit of 1.2% between 2010 and 2016, the Central Africa bloc remained the bloc with the lowest deficit position within the period (2010-2016).

The West Africa bloc has maintained a relatively low deficit at an average of 1.9% from 2010 to 2016. The negative fiscal position of the West Africa bloc increased from 2.5% in 2010 to 3.6% in 2016 and remained lower than the regional average of 4.2%. The deterioration in the deficit position in the West Africa bloc in recent period is mainly due to effect of low oil prices on Nigeria’s economy that has worsened the country’s deficit position rising to 1.6% in 2015 from 0.9 % in 2014.

Domestic and external borrowing remains critical means of financing deficit in Africa; this has caused an upsurge in the public debt of some Africa countries and the continent in general in recent times.
The average debt of the continent stood at 21.7% from 2010 - 2016. As evidenced in Figure 2, among the five regional blocs in Africa, the Southern Africa bloc recorded the highest average debt to GDP ratio from 2010 and 2016 at a rate of 37.1%.

The East Africa bloc recorded the second highest average debt to GDP ratio of 34.3% between 2010 and 2016. The North Africa bloc followed the East Africa bloc as the one with the third highest average debt to GDP ratio of 17.1% within the same period, they were followed by the Central and West Africa blocs that recorded an average debt to GDP ratio of 16.9% and 10.2% respectively within the referenced years.

Ghana’s public debt to GDP ratio stood at 71.4% at end of 2015 fiscal year according to Bank of Ghana records. The increasing levels of public debt in Africa in recent times have not been accompanied by growth. Economic growth in Africa has been unstable experiencing a nose-dive, real GDP per Capita declined from 3.4% in 2002 to 2.4% in 2016 at an average growth rate of 2.49%. Though the West Africa Regional bloc has maintained a positive growth performance since 2000, growing at an average rate of 3.6%, growth performance declined to 1.6% in 2016 below its long-term growth potential. Ghana recorded its highest growth in recent times in 2011...
growing at 11.2%, growth however declined to 1.6% in 2015. The high public debt and declining growth in the Africa economies have left many to question the long-term macroeconomic stability and fiscal sustainability of the region, and their broader impact on growth.

![Real GDP Per Capita Growth Pattern in Africa (2010-2016)](image)

**Figure 3: Real GDP Per Capita Growth Pattern in Africa (2010-2016)**

*Source: Authors Construct, 2016, using data from Africa Development Bank.*

Theoretically, there are two main schools of thought on the influence of public debt on economic growth. The conventional view suggests that public debt has positive effects on growth. The progressive effect of public debt on growth draws on two main arguments: the first is the general argument that postulates that, public debt can inspire cumulative demand and have a productive growth outcome in the short run (Kumar & Woo, 2010). The second argument is the developing country argument that suggests that, during the primary phases of development; developing economies have limited amount of capital but are possible to have investment prospects that offer higher levels of returns relative to developed economies. Pattillo et al. (2004) therefore argue that rational amounts of borrowing by a developing economy at early stages of development could enhance economic growth and allow for timely repayment of debt given that the borrowed funds are applied for productive
investment under stable macroeconomic environment, minimal shocks and sound policies that provide economic incentives.

The Keynesians, however, argue that public debt has unfavorable outcome on growth (Kumar & Woo, 2010; Cecchetti et al., 2010; Krugman, 2013; Elmeskov & Sutherland, 2012). Panizza & Presbitero (2013), contend that, though the argument for favorable outcome of debt on economic growth in short run may hold, expansionary fiscal policies that increases the scale of public indebtedness can weaken long-run growth, and hence partially (or completely) deny the positive influence of the fiscal incentive. There are growing number of empirical literature that support the negative connection amongst economic growth and public debt. The empirical outcomes from Reinhart & Rogoff, 2010a, 2010b; Checherita & Rother, 2010; Kumar & Woo, 2010; Cecchetti et al. 2012 identify that the negative influence of public debt on economic growth in advanced and emerging economies becomes particularly strong when debt to GDP ratio approaches 100%.

Theoretical works recognizes various channels by which debt adversely affect economic growth. These include the crowd out effects on investments (Elmendorf and Mankiw, 1999), long term interest rate (Modigliani, 1961; Baldacci & Kumar, 2010), high fiscal deficit (Saint–Paul, 1992; Adam & Bevan, 2005), distortionary taxation or high inflation (Aghion & Kharroubi, 2007; Kumar and Woo, 2010) and banking or currency crises (Burnside et al., 2001; Hemming et al., 2003).

Debt unarguably remains an essential tool for driving economic growth, nonetheless, the high levels of public debt in Africa economies have gained enormous attention in the media, academia and policy cycles in recent times. Despite the concerns, there is limited empirical evidence on the non-linear effect of public debt on economic growth
and the threshold of public debt in Africa. Therefore, the objective of this thesis is to first examine the non-linear relationship between public debt and economic growth in the Africa and secondly, to examine the threshold behaviour (the turning point) of debt by means of a panel of 50 Africa countries from 1980 - 2016.

1.2 Problem Statement

A number of Africa economies witnessed severe indebtedness in the late 70’s and early 80’s forcing some of these countries to sign on to the Economic Recovery Program (ERP) of the International Monetary Fund (IMF) in 1983. One positive outcome of the program was the decline in debt to GDP ratio to a generally sustainable level. The appetite for borrowing among some member countries premised on the need for accelerated growth through infrastructure expansion revived soon as the program ended.

The revived interest in borrowing has caused an upsurge in the levels of public indebtedness in most of these countries to unsustainable levels in the late 90’s. Thirty-Three African countries were categorized as Heavily-Indebted Poor Country (HIPC) in early 2000 and thus signed on to the HIPC program introduced by IMF and World Bank in the late 1990’s. The initiative offered debt relief to the beneficiaries resulting in a sharp decline in public debt levels among the Africa countries and the continent in general. Most Africa economies recovered and witnessed deepening macroeconomic stability and rising GDP growth from the early 2000. Boosted by the rising commodity prices and oil find and production in some Africa economies, the continent grew by 4.1% in 2012. The overall macroeconomic performance of the Africa continent has however been declining with rising fiscal deficits and debts. The rising public debt in recent periods has revived the debate on the influence of public
The effects of high public debt are well documented in literature and include high interest rate leading to high cost of living; crowd out effects on investment leading to decline in growth; transfer of debt burden to future generation leading to generational inequality and high interest payment leading to fiscal pressures. The earlier studies on the effects of public debt on economic growth focused on understanding the linear correlation between public debt and economic growth. Empirical studies on the subject focused on Africa mainly relied on the debt overhang hypothesis to establish the influence of external debt on economic growth.

Recent research interest on the subject seeks to explore the non-linear effect of public debt on economic growth. Most existing literature on the subject is focused on OECD countries and emerging economies and reported divergent outcomes on threshold behavior. Whereas Reinhart & Regoff (2010), Woo & Kumar (2010) and Rother & Checherita (2010) identified a non-linear relationship amongst public debt and economic growth at a threshold of 90%, Chechetti et al. (2011) found a nonlinear threshold of 85% and Chang & Chiang (2011) found positive relationship at all three-debt thresholds (30%, 60% and 90%) proposed by Reinhart & Regoff (2010).

There is limited literature on the non-linear impact of public debt on economic growth with focus on Africa. A number of existing empirical works did not include dynamic effect on the estimated thresholds and coefficients with the exception of Checherita et al. (2012) to the best of my information. Against this background, this work intends to investigate the nonlinear relationship between public debt and economic growth in Africa using a dynamic panel estimation method following the work of Caner & Hansen (2004) and Checherita et al. (2012).
1.3 Research Questions

Arising from the justification of the research problem, the study attempts to answer the following research questions;

1. What is the effect of public debt on economic growth in Africa?
2. What is the public debt threshold in Africa?

1.4 Objectives of the Study

The objective of this study is to examine the non-linear relationship amongst public debt and economic growth in Africa.

Specifically, the study intends to achieve the following objectives;

1. To determine if there exist a non-linear relationship between public debt and economic growth in Africa and
2. To determine public debt threshold in Africa.

1.5 Hypothesis of the Study

In line with the stated objectives, the following hypothesis will be tested:

$H_0$: Public debt has no significant non-linear influence on economic growth in Africa.

$H_a$: Public debt has significant non-linear influence on economic growth in Africa.

1.6 The Relevance of the Study

Outcomes from empirical studies on the non-linear relationship between public debt and economic growth are inconclusive. Most studies (Rogoff & Reinhart, 2010; Woo & Kumar, 2010 and Rother & Checherita, 2010) suggest that public debt adversely impact growth once debt as a percentage of GDP is above 90%. Chang and Chiang
(2011) nonetheless argue that, the influence of debt on growth remains positive at different debt regimes; 32.5% and 66.25% of debt to GDP ratio.

Though the rising public debt in most Africa economies has received great attention in recent times, there is limited evidence on the non-linear relationship between public debt and economic growth in Africa. This study therefore seeks to investigate the non-linear relationship between public debt and economic growth and the turning point where public debt can go from good to bad in Africa. The study contributes to literature on the subject with specific focus on Africa. The results of the research can aid policy makers to provide specific policy inference related to Africa. Additionally, the results provide the basis that consolidate the current debate on debt sustainability and inform the future debt threshold criteria for Africa.

1.7 Organization of the Study

The study is planned under five (5) chapters. Chapter one covers the introduction that entails; background to the study, problem statement, objectives and relevance of the study. Chapter two discusses the relevant literature on the effect of public debt on economic growth. The chapter provides a review of both theoretical and empirical studies associated with this study. Chapter three outline the methodology employed to achieve the objectives of the study. In particular, it discusses the theoretical framework on the analytical model employed for the study, and the sources and type of data used for the study. Chapter four cover the presentation and discussion of empirical result. The summary, conclusions and recommendation from the study is captured in chapter five.
CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

The chapter details the theoretical and empirical appraisal of relevant literature pertaining to this study.

2.2 Theoretical Review

2.2.1 Theories of Economic Growth

The upsurge in the productive capacity of a country measured by the increases in real gross domestic product (real GDP) or per capita income is referred to as economic growth. Per Capita GDP measure rate of increase in output per individual and defines the degree in the rise of a country's standard of living.

Theoretical literature suggests that, the rise in the standards of living in the long run is mostly influenced to a large extent by the scale of productivity and growth of a country.

Rise in productivity and growth are driven by four main factors namely human capital: covering supply of labour, schooling, motivation and discipline: Natural resources such as mineral deposits, land, oil & gas deposits and quality of the environment: Physical Capital encompassing infrastructure, machineries, plants as well as scientific and engineering technology.

Economists and policy makers differ on the relative importance of these factors in driving productivity and growth. One group places much importance on the need to increase capital investment, others argue in favor of research, development and technological advances whereas a third grouping also underscores the relevant function of well-educated labor force. The history of growth theory is important to
understanding the differences among economists and policy makers on the main factors that drives productivity and growth.

The classical economist led by Adam Smith, and Reverend Thomas Malthus in the eighteenth and nineteenth centuries placed emphasis on the role of land and population as drivers of productivity and growth. The authors suggest all economies have a steady state GDP and any aberration from the steady state is transitory and will ultimately reverse. They argue that, a rise in GDP is associated with an upsurge in population and the upsurge in population can have adverse consequences on GDP resulting from a rise in demand on inadequate economic resources from expansion in population. Hence, eventually GDP will decline to the steady state level. Similarly, where GDP depart beneath the steady state, population will decline and consequently lower demand on the economic resources. In the end, the GDP will reverse to its steady state.

Adam Smith in his book “the Wealth of Nations” in 1776 offered a guide for fiscal growth and development. Adams Smith assumed idyllic age (golden age) where land was freely available to all and there was no cost to capital (land). From this golden age proposition, Adams Smith advanced that, productivity and growth could be achieved by simply spreading out and cultivating more acres of land as population increased. On the basis of the golden age proposition, Adam Smith maintained that national output increased in direct proportion to increases in population. However, as the population continue to grow, available land will be engaged and equilibrium growth of land, labour and output becomes impossible. The growing population to land ratio imply that, at a certain level, the marginal benefit of any extra unit of the
population (labour) will start to decrease (diminishing marginal returns will set in) leading to decline in productivity and growth.

The work of Reverend Thomas Malthus corroborates the effect of diminishing marginal returns on productivity and growth. He advanced that population forces could push the economy to a state where labour force will be at a least level of sustenance. Malthus argued that each and every time wage remained above the sustenance level, population will rise however below sustenance, wages will cause a rise in mortality and population will wanes. Consequently, Malthus claimed that solely at the state of sustenance earnings could there be a steady balance of population.

Contrary to Adams Smith's golden age which linked proportional growth in population to proportional increases in productivity and growth and failed to consider land as possible constraint on productivity and growth, Malthus associated population growth with declining productivity and growth and argued that, as more people crowded on a limited land, diminishing returns drive down output per person.

The argument by Malthus however failed to appreciate the role scientific revolution and investment can play to overcome the law of diminishing returns. Consequently, land could not be a preventive factor in production as the industrial uprising witnessed the influence of heavy duty machinery that advanced productivity and growth.

Sir Harrod (1939) and Domar (1946) recognized the role of capital formation in enhancing productivity and growth. The H-D theory was proposed separately by Harrod and Domar to explain how the rate of growth can be influenced jointly by the ability of the economy to save (saving ratio) and the capital output ratio.
Harrod’s novel influence flings the short-run equilibrium state by the Keynesian in a long-run condition and investigated if any means existed to permit one to assume a full employment stable growth path was probable. Harrod’s main concern was that, if changes in income induce investment, how much should income grow to ensure parity between savings and investment in a manner that drives growth?

Domar claimed that, investment play a duality role of both raising productive capacity and driving demand and assumed that, the optimal utility of the productive capacity is achieved only where there is equivalent demand for the goods produced. Hence, Domar conceived that, for a state of equilibrium in the economy to occur, it is required that total supply (or productive capacity) equals total demand (or income). Domar’s growth theory addresses itself to the question as to what should be the rate of growth of investment for a proportional rise in income to be at parity with proportional rise in productive capacity. Domar advanced his theory from both demand as well as source segment of the economy by stressing on the dual character of investment and provided the condition for steady growth.

The H-D theory is thus premised on investment as the driving force for economic growth. The theory hypothesizes that a rise in the rate of saving in an economy will provide capital required by companies to invest. Consequently, investment could push up the physical capital stock of a country and improve economic performance via the rise in improved production levels of goods and services. The efficiency of investment that arises is measured by the capital output ratio. A fall in capital output ratio is associated with a higher productive economy, implying more outputs will be produced from less inputs spurring economic growth. The H-D theory emphasizes on the likelihood of steady growth through adjustment of supply of demand for capital.
The H-D model is explained mathematically by the model below:

\[
\text{Ratio of growth (Y)} = \frac{\text{Savings (s)}}{\text{capital output ratio (k)}}
\]

The main weakness of the H-D theory is its assumption that the key determinants of growth (propensity to save and capital output ratio) remain constant. In reality, the factors could vary over the long run. The changes in these ratios are the essential requirement in maintaining steady growth.

The theory further assumes, the technology for production is fixed hence drivers of production cannot be substituted for each other which are not possible for the steady growth of the economy. To a greater extent, technological and organizational changes bring about the shifts in production function. The neoclassical theory of economic growth addresses this drawback by assuming substitution between capital and labour and a neutral technical progress in the sense that technical progress is neither saving nor absorbing of labour or capital.

The neoclassical theory of economic growth which identifies three factors that drive economic growth, namely: labour, capital and technological progress was advanced by two economists, T.W. Swan and Robert Solow. This theory is premised on the Cumulative Production Function (CPF) that associates technical progress and factors such as capital and labor, to over-all possible GDP. According to the neoclassical economists, the fundamental principles of growth are capital deepening and efficiency. Capital deepening relates to the means of improving the level of the volume of capital per labor force whereas efficiency relates to the process of improving output per worker.
The theory hypothesizes that productivity by each unit of labor force rises as per capita output rises, however, this occurs at a declining rate known as the diminishing marginal returns. Accordingly, a threshold would exist where labor and capital can be defined to achieve a balanced condition. Given that nations could notionally regulate the capacity of labour and capital necessary to remain at that steady condition, the key drive of economic growth then becomes technical advances. According to the theory, economic growth is achieved only when there is technological progress. Thus, labor and capital adjust at the instance of technological progress. It further maintains that, nations with access to common technology, would have equal standard of living.

Robert Solow (1956) criticized the fundamental assumption of the H-D model which presumes the production function is fixed, and that factors of production cannot be substituted for each other. By considering all the assumptions underlying the Harrods’s model, Solow asserted the cumulative production function exhibits constant returns to scale in labor and capital. The production function takes the form

$$ Y = F(K, L) \quad Eqn (2.1) $$

Where $Y$ output or income, $K$ is the stock of capital and $L$ is the labor force.

The model assumes a closed economy with total output $Y$ produced by labour, $L$, and capital, $K$, resources.

There are two main assumptions underlying the aggregate production function namely Diminishing Returns to Input and Constant Returns to Scale (CRS). Under constant return to scale, the production function is defined by:

$$ Y = F(K, L) = L. F(K, L) = L. \frac{K}{L} \quad Eqn (2.2) $$

Alternatively, the intensive form per worker production can be written as:

$$ y = f(k) \quad Eqn (2.3) $$
Explained as: \( y = \frac{Y}{L} \) (output per worker) and \( k = \frac{K}{L} \) (capital stock per worker/Capital intensity)

The implication of the equation 2.3 is that, a rise in labour productivity (output per worker) is conditioned on capital deepening (i.e. rise in capital intensity).

A critical principle underlying the neoclassical model is that, when there is decreasing returns on capital, productivity per unit of labor does not rise open-endedly. A fall in the capital stock per labor unit resulting from population growth and depreciation is relational to the capital stock. However, an increase in capital per labor by savings is inhibited through declining returns on capital in production. Given a drop in the marginal product of capital per labor unit to a very low rate, gross investment would be reasonable enough to preserve the prevailing stock of capital. At a steady-state equilibrium, both the output produced and the capital will continue to rise proportionately to the rate of population growth.

Solow (1957) applied the above theoretical context to establish that an effort to explain decades of economic growth in the US revealed an alarming residual of almost 85%. Most of the residuals was credited to technical progress by Solow.

The Solow’s model is criticized for its limitation to account for the causes of the technical progress. Even though the model demonstrates that technical progress drives economic growth, its lacks clarity on why the technical progress occur. The rate of technical progress is set exogenously lacking any theoretical relations with other variables in the model. The primary reasons usually offered to justify this is that, technical progress comes from knowledge generated through educational which is presumed to be external to the domain of the economic system the model highlights (Solow, 1957; Shell & Stiglitz, 1967).
Nevertheless, to a greater extent, it is believed that technological progress itself is contingent on fiscal choices, much the same as investment. One way by which industrialists maximize their profit potentials is by producing new knowledge and innovation. Because economic incentives exist for producing new ideas and to innovate it becomes necessary to incorporate knowledge conception and innovation in economic growth model such that it is endogenized.

Additional limitation of the Solow growth model is its premise of cost and return to scale. Evidence suggesting increasing returns in long-term economic growth was reported by Kendrick (1976). Romer (1986), highlighted that cumulative production functions exhibits increasing returns.

Methodological constrains in capturing increasing return in a dynamic general equilibrium context accounts for the inability of neoclassical models to incorporate technological progress in such a way to account for its causes. Romer’s two seminal papers in 1986 and 1990 made an effort to endogenize technical progress on the premise that technology is a public good but then the private investment in capital intensify the level of technology accessible to every enterprise. Romer argue that, the externality related to investment upsets the hypothesis of diminishing marginal returns to investment in his model. Hence, economic policies that alter the investment rate could influence economic growth.

With respect to endogenous technical progress, Grossman and Helpman (1989) have built an elegant two-country model that emphasizes the role of scientific inquiries as well as development as drivers for growth. In this setting, scientific inquiries as well as development are necessary to obtain this variety so firms have strong incentives to
devote skilled labour to this activity. Since the outlays on R&D that generate these inputs are recouped by firms that operate in monopolistically competitive markets, governments policies that affect the motivations to devote resources into R&D will have long-run growth effects. Thus, these models show that the overall policy regime of a country could adjust the decisions for savings and investment in manner that vary long-term growth.

Though the above models provide the framework for considering endogenous growth in a general equilibrium setting, the broad nature of their results makes isolating the effect of specific policies on growth difficult. A number of models have therefore been developed to deal with specific policies and empirical issues. For the reason that many macroeconomic indicators are simultaneously identified to be associated with growth, the Solow type model has been extended to incorporate macroeconomic variables (Chenery, 1986). According to Rivelt (1991), in equilibrium framework there can be no justification for adding macroeconomic variables to the basic neoclassical model. However, if disequilibrium effects are allowed then structural macroeconomic variables (such as inflation and exchange rate) which in addition to capital and labour determine growth rate, may be added to the basic model in developing countries. This may be vital for policy makers to shape their understanding of the relevance of the factors that drive long-term growth.

2.3 Economic Growth and Public Debt

Public debt encompasses total debt of the central government made up of both domestic and external debts. Debt remains one of the important means of financing central government expenditure. However, policy makers, economists and researchers have varied opinions about the influences of public debt on the behavior of the
The aspect of public debt that has received great attention in research is its relationship with economic growth.

Theoretical literature suggests that in the short term, public debt stimulates aggregate demand and drive economic growth. Piana (2001) suggests that crowding in effect is a prime channel that public debt influences economic growth favorably. The author defined crowding in effect as an attempt by Government to increase private sector investment through undertaking of capital projects such as roads infrastructure, energy, education or health care facilities which ultimately results in economies for scale for the private sector. The author argues that, the huge Government investment in capital goods crowd in private sector participation and drives growth positively.

Similarly, Pattillo et al. (2004) suggest that, during the primary phases of development, developing economies have limited amounts of capital with prospective investment incentives than developed economies. Consequently, rational degree of borrowed resources would enhance growth potentials and allow for timely debt repayment on the condition that, the borrowed funds are applied for productive investment under stable macroeconomic environment, minimal shocks and sound policies that provide economic incentives.

On the contrary, the Keynesians assert that public debt has negative outcome on economic growth (Kumar & Woo, 2010; Krugman, 1988 & 2013; Elmeskov & Sutherland, 2012). The scholars contend that, even though in the short-run, there is favorable impact of public debt on economic growth, public liability crowds out private investment and worsen long run economic incentives (Elmendorf & Mankiw, 1999; Panizza & Presbitero, 2013).
The inverse relationship between economic growth and public debt has also been explained by the debt overhang hypothesis. According to Krugman (1988), debt overhang is a state in which a country’s debt burden and obligation exceeds its capacity to meet those obligations. He argues that, such conditions create uncertainty among investors on the programs and policies adopted by the central government to meet its obligations; hence, investors adopt a wait and see attitude which eventually affects private investments and therefore economic growth.

There are growing numbers of empirical literature that confirms evidence of long run negative effects of total central government liability on economic growth in advanced and emerging economies and thus maintain that the relationship becomes particularly strong when debt to GDP ratio approaches 100 percent (Reinhart & Rogoff, 2010a, 2010b; Woo & Kumar, 2010; Checherita & Rother, 2010; Chechetti et al. 2011).

In theoretical works, several other channels through which public debt negatively impact economic growth have been identified. Modigliani (1961) argues that, excessive central government debt could influence unfavorable long term growth through its effects on capital accumulation and long term interest rate. This position is supported by authors like Gale & Orszag (2003) and Baldacci & Kumar (2010). It is further argued that, high public debt can impact growth negatively via high fiscal deficit (Saint –Paul, 1992; Adam & Bevan, 2005); distortionary taxation or higher inflation (Aghion and Kharroubi, 2007; Kumar and Woo, 2010) and banking or financial crises (Burnside et al., 2001; Hemming et. al 2003)

2.4 **Empirical Review on Economic Growth and Public Debt**
Empirical literature on the relationship between public debt and economic growth is inconclusive. The earlier work on the subject focused on understanding the linear association amongst economic growth and public debt.

By means of a cross sectional data for 99 developing countries and fixed effects panel estimation, Elbadawi et al. (1996) observed the link between external debt, investments and growth. The result showed evidence of debt overhang and crowding out effects and conclude that external debt is a burden on growth and investments in developing countries; hence supporting the theory that, current debt inflows spur GDP growth whilst past (lagged) accumulated debt was detrimental to growth.

With a sizable panel dataset of 93 developing economies from 1969-1998, Pattillo et al. (2004) identified that, the influence of external debt on GDP per-capita growth is negative for net present value of debt levels above 35-40% of GDP. Clements et al. (2003) observed similar relationship for a panel of 55 low-income countries over the period 1970-1999. The study concluded that the turning point in the net present value of external debt is at around 20-25% of GDP.

Malik & Siddiqui (2001) investigated the effect of public debt on economic growth in South Asia. The study reported that foreign borrowing increased resource availability and contributed to economic growth in South Asia. On the other hand, extreme dependence on national debt and inappropriate national debt management and strategies can increase macroeconomic risks and hamper economic growth.

In the work of Schclarek (2004), the author identified a linear negative impact of external debt on per-capita growth in a panel of 59 developing countries over the

Similarly, Oteng–Abayie & Frimpong (2006) empirically analyzed the effect of external debt on economic growth in Ghana to determine the existence of debt overhang and/or “crowding out” effect using data from the period 1970 to 1999. The authors concluded that, external debt inflow has favorable outcomes on growth but debt servicing had an unfavorable outcome on growth establishing the presence of “crowding out effect”.

In Abula & Adoufu (2009), the authors investigated the effects of rising domestic debt on the Nigerian economy, using time series data from 1986-2005. The analysis showed that domestic debt adversely impacted economic growth. Fosu (1996) investigated the relationship between economic growth and external debt using a sample of sub-Saharan African countries over 1970-1986 by employing OLS.

Lee and Ng (2015) investigated the impact of public debt on economic growth by means of time series analysis using data from 1991 to 2013. The study reported a negative relationship between economic growth and public debt. The empirical outcome is consistent with studies such as Chong et al. (2010) and Mohd Daud et al. (2013) who also reported a negative correlation between public debt and economic growth.

Hassan & Abu Bakar (2008) found a positive relationship between public debt and economic growth. The empirical result was contrary to Lee and Ng (2015), and Daud and Podivinsky (2015). Panizza and Presbitero (2014) undertook a study to examine the effect of public debt on economic growth and found that, a negative correlation
existed between public debt and economic growth. Studies such as Sen et al. (2007) and Malik and Atique (2012) also reported that public debt have negative influence on economic growth.


Čeh Časni et al. (2014) studied the correlation amongst public debt and economic growth in some selected Eastern and South-Eastern European countries. The study employed panel data with a reference period from 2000 to 2011. The study evaluated both the long-run and short-run relationship and established a negative relationship between public debt and economic growth in both the short-run and long-run respectively.
Kourtellos et al. (2013) investigated the impact of public debt on economic growth in multiple regimes by applying structural regression and concluded that public debt had a positive correlation with economic growth.

Christensen & Abbas (2010) used a panel of low-income countries and emerging economies via GMM to establish that, moderate levels of domestic debt are associated with positive GDP per capita growth. The authors argued that the presence of developed financial markets, increased private savings, better institutions, political accountability and improved monetary policies mainly accounted for the outcome. The authors however concluded that in the long-run, when the level of domestic debt becomes excessive beyond 35% of total bank deposits, the contribution of debt to economic growth becomes negative as a result of inflationary pressure and crowding out of private investment.

In recent times, a number of studies on the relationship between public debt and economic growth tend to focus on examining the existence of nonlinearity and threshold levels.

Reinhart and Rogoff (2010a; 2010b) ignited the interest in this area of research. In their famous paper, “growth in a time of debt”, the authors identified that high levels of public debt is associated with negative economic growth. Reinhart and Rogoff (2010a) used a yearly data on debt and output for 20 advanced countries from 1946-2009 and applied descriptive analysis to establish a negative nonlinear relationship between public debt and economic growth at a threshold of 90% of debt to GDP ratio. The authors recognized that, the relationship between public debt and long run
economic growth is weak for debt to GDP ratio below a threshold of 90%, above 90%, median growths falls by 1%.

Woo & Kumar (2010) examined the impact of high public debt on subsequent growth of real per capita GDP for a panel of 38 advanced and emerging market economies in the period 1970–2007. The authors reported a negative relationship between initial level of debt and subsequent growth after controlling for other explanatory variables. The authors confirmed a non-linear relationship at a threshold of 90% debt to GDP.

Checherita & Rother (2010) investigated the impact of public debt on GDP per capita growth for twelve euro countries over 40 years from 1970-2009. The authors found a non-linear relationship between public debt and economic growth and a threshold of 90%. Caner et al. (2010) established a turning point of 77% of debt to GDP ratio for a panel of 77 countries.

Cecchetti et al. (2010) observed the relationship between public debt and growth and reported a threshold of 86% of debt to GDP for a panel of 18 OECD countries from 1980-2010 by dynamic threshold panel methodology. By means of data for OECD countries, Fincke and Greiner (2011) identified that that the optimal level of public debt ranges between 43% and 63% of GDP.

Elmeskov & Sutherland (2012) attained a threshold of 66% for 12 OECD countries. Checherita-Westphal et al. (2012) and Ghosh et al. (2013) suggest, the consequence of public debt on growth may, in fact, be nonlinear and concludes that optimal level of public debt may exist. Checherita and Rother (2010) determined the average impact of government debt on per capita GDP growth for twelve-euro area countries over a period of about 40 years from 1970-2009. The authors confirmed a non-linear
negative impact of government debt on economic growth.

On the contrary, Chang & Chiang (2009) consequently established a favorable short-run effect of debt on growth in three different debt regimes (below 32.2%, above 32.2% but below 66.25% and above 66.25%) using a panel of 15 OECD countries with data from 1990-2014.

2.5 Review of Methodology

Several studies have employed the dynamic approach for their estimations. Hiebert et al. (2002) noted that numerous researches when dealing with issues of simultaneity bias in their growth regressions resort to the application of instrumental variable approach. Abbas and Christensen (2010) used the generalized method of moment (GMM) to investigate the link between economic growth and domestic debt. The GMM estimator has the advantage of correcting heteroscedasticity and autocorrelation that may exist in the error structure by use of consistent estimator.

Čeh Časlno et al. (2014) employed panel analysis to explore the relationship public debt and growth in Eastern and South-Eastern Europe. Pattillo et al. (2004) also used the data estimation approach to assess the kind of relationship that exists amongst GDP per capita growth and external debt. Seo and Shin (2014) used the non-linear panel GMM approach to examine the relationship amongst public debt and economic growth. The authors employed a large dataset of 129 countries for the period 1980-20091. The empirical result revealed a robust and statistically significant non-linear link amongst public debt and economic growth. Westerlund and Prohl (2010) employed the non-stationary panel data analysis method to research on fiscal condition of 8 OECD countries. The result of the researchers could not reject the
sustainability hypothesis. Rault & Afonso (2010) used a panel technique to analyse the fiscal sustainability of selected EU countries. Afonso and Jalles (2013) employed panel data of developed and emerging countries over 39 years, and found a lower economic growth in the presence of increased fiscal policy volatility. Kim and Lane (2013) used panel data from 17 OECD economies from 1973 and 2000 to investigate the relationship between public health expenditure and national health.

Yasin (2000) used the panel data analysis (random and fixed estimation techniques) to examine the effect of government spending on economic growth in Sub-Saharan Africa. The result revealed that central government spending has a positive and statistically significant effect on growth. Alexiou (2009) also used two different panel data methodologies to seven transition economies in South Eastern Europe. The empirical result showed that economic growth is impacted positively by government spending. Fölster and Henrekson (2001) conducted a study with a panel approach over a period of 26 years to determine the associations that exist amongst public expenditure and economic development. His findings revealed that the relationship between variables is negative. The studies such as (Pevcin, 2003; Brady et al. 2007; Pham, 2009; and Maku, 2009) corroborate the results of Fölster and Henrekson (2001).

2.6 Regional Economic Communities in Sub-Saharan Africa

2.6.1 Formation of Regional Economic Communities (RECs) in SSA

Following the end of colonial era, Africa countries have endeavored to grow their economies through industrialization and trade. The Organization of Africa Unity (OAU) was formed in 1963 by the heads of states and governments of Africa to stimulate the integration of African economies into the global economic system. By a
general agreement, the Lagos Plan of Action was signed in 1980 at the Summit of Heads of States and Governments to fashion out strategies for regional integration and development. Sako (2006) posit that in order to confirm the continent’s vow in attaining regional integration and cooperation, the Abuja Treaty was signed in 1991 to set up African Economic Community (AEC) with a main order to “promote economic, social and cultural development and integration of African economies in order to upsurge economic self-reliance and promote an endogenous and self-sustained development”. Regional Economic Communities (RECs) were thus established to involve all regions of the continent to serve as building blocks for regional economic cooperation and integration.

At present, the RECs in Africa are the Arab Maghreb Union (AMU), the Community of Sahel –Saharan States (CEN-SAD), the Common Market for Eastern and Southern Africa (COMESA), the East African Community (EAC), the Economic Community of Central African States (ECCAS), the Economic Community of West African States (ECOWAS), the Inter-Governmental Authority on Development (IGAD), and the Southern African Development Corporation (SADC). However, given the scope of this study, focus would be on five of the RECs in SSA, namely, EAC, ECCAS, ECOWAS, IGAD and SADC.

2.7 Overview of Regional Economic Communities in Sub-Saharan Africa

2.7.1 East Africa Community (EAC)

The East African Community (EAC) is consisted of five (5) East Africa Countries namely Burundi, Kenya, Rwanda, Tanzania and Uganda. The Community which was at first founded in 1967, disintegrated in 1977 and was re-established through the signing of the East African Community Treaty in 1999 which came into force on 7
July 2000. The EAC reached an agreement after consultations with the Southern African Development Corporation (SADC) and the Common Market for Eastern and Southern Africa (COMESA) agreed to the free movement of labor, capital, goods and services within the Community on the whole because of the overlapping memberships of Burundi, Kenya and Rwanda in COMESA. With a population of over 149 million people as at 2013 covering a land area of about 1.82 million square kilometers and with a combined Gross Domestic Product (GDP) in nominal terms of about US$100 billion, the EAC regional economic bloc represents a small market comparative to the global market. Preceding results have also established a rise in intra-regional trade nonetheless with a high level of trade diversion over trade creation within the Community. Trade within the REC logged some level of upgrading according to the 2009 EAC Report. Trade among member countries within the bloc was US$2,715.4 million representing a 37.6 percentage increment with Kenya accounting for about 44.8 percent of this increment (EAC, 2012).

2.7.2 Economic Community of Central Africa States (ECCAAS)

The Economic Community of Central African States (ECCAS), formerly the Customs and Economic Union of Central Africa (CEUCA- UDEAC) was first established in 1964 but became effective in 1966 by a Brazzaville Treaty. It was however re-established through a consensus by the then five member states, namely Cameroon, Central Africa Republic, Chad, Gabon and Republic of the Congo to form a wider community of 10 members. It was later renamed as ECCAS in 1983 but became inactive for years due to failure of member states to pay membership dues and also due to the war in Angola, DR. Congo and Rwanda. The community however became active again in 1998 through a summit by Heads of States and Government. The community is made up of ten (10) Central Africa States namely Angola, Burundi,
Cameroon, Central African Republic, Chad, Democratic Republic of the Congo, Equatorial Guinea, Gabon, Republic of the Congo; and São Tomé en Príncipe. In 2004, ECCAS set up an FTA and this was expected to result in the formation of a Custom's Union by the end of 2012 (WTO, 2013). This was to see to the abolishment of quantitative trade barriers and restrictions. However, the regional group has been performing poorly. Intra-ECCAS trade was about 1.2% of total intra-African trade in 2009; a figure which increased from 1.1% in 2001 ("Regional Integration Strategy Paper", 2012). The reasons for this poor performance in intra-trade within the group is as a result of non-tariff trade barriers such as poor state of roads, random immigration checkpoints along member countries' corridors as well as the multiple membership of member countries in other regional groupings.

In 2009, intra-ECCAS trade recorded a value of US$ 0.2 billion which represented about 0.3 percent of its trade with the rest of the world (Mbekeani, 2013). The 2013 UNCTAD report indicated that intra-ECCAS trade formed about 1.7 percent of total African trade implying a GDP of US$32,383 million between the period, 1996-2000. However, trade dropped to 1.5 percent between 2001 and 2006 and then increased to 1.9 percent representing US$170,929 million between 2007 and 2011.

2.7.3 Economic Community of West Africa States (ECOWAS)

With its current headquarters in Abuja, Nigeria, the Economic Community of West Africa States (ECOWAS) has a membership of fifteen (15) West African countries. They are Burkina Faso, Benin, Cape Verde, Ivory Coast, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone and Togo. ECOWAS was founded in 1975 through the signing of the Lagos Treaty. With a population of over 340 billion covering an area of about 1.97 million square
kilometers and a GDP about US$402 billion, ECOWAS seen as one of the pillars of the African Economic Community (AEC) was formed with the objective of achieving a collective independence for its member states by creating a single large trading bloc by means of an economic and trade union.

Trade within the bloc experienced some fluctuations between 2001 and 2010. For instance, between 2001 and 2002, intra-ECOWAS trade improved with an increase in trade values from US$2,255.4 million to US$3144.3 million representing an increase of 39 percent of intra-bloc exports. This figure also represents a rise of 2.5 percentage points of the share of intra-bloc exports in the bloc’s total exports to the rest of the world. However, 2010 witnessed a decline of 1.6 percentage points of the share of intra-bloc trade in total exports to the rest of the world (Seid, 2013).

2.7.4 Intergovernmental Authority on Development (IGAD)

The Intergovernmental Authority on Development (IGAD) created in 1996, was renamed to replace the Intergovernmental Authority on Drought and Development (IGADD) which was established in 1986. IGAD’s membership is made up of eight (8) countries from the Horn of Africa, Nile Valley and the African Great Lakes namely Eritrea, Djibouti, Ethiopia, Kenya, Somalia, Sudan, South Sudan and Uganda. With a population of over 180 million covering an area of about 5.2 million square kilometers with a nominal GDP of US$197.2 billion, the community aims at improving the trade, investment and banking environment of its member states. Intra-IGAD trade witnessed some improvements between 2001 and 2010. However, the share of intra-bloc exports in total export to rest of the world declined sharply over this period. For instance, between 2001 and 2004, intra-bloc exports increased from US$827.8 million to US$1094.3 million representing 32.2 percent increase. However,
the share of intra-bloc exports in total exports to the rest of the world declined significantly by 7.4 percentage points (Seid, 2013).

2.7.5 Southern African Development Corporation (SADC)

The Southern Africa Development Corporation (SADC) was formerly known as the Southern African Development Coordination Conference (SADCC). SADCC was established in 1980 with a membership of nine (9) Southern African countries. It was later re-established as SADC in 1992. The Community has a population of about 277 million people covering an area of about 9.88 million square kilometers with a GDP of about US$575.5 billion. The SADC Free Trade Area (FTA) which was initiated in 2000 and launched in 2008 had a membership of 12 countries. The countries in SADC include Angola, Botswana, the Democratic Republic of Congo, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, United Republic of Tanzania, Zambia and Zimbabwe.

Intra-SADC trade has been encouraging with records showing a trade value of US$16 billion as of 2009 representing 12.2 percent in the share of the community’s world exports (Mbekeani, 2013). Intra-SADC volume of trade as a share of total intra-African trade between the periods, 1996-2000 was 32.3 percent representing US$189,416 million of GDP of the continent. This share however experienced a fall with a share of 13.8 percent between 2001 and 2006 and 12.9 percent between 2007 and 2011 representing US$269,324 million and US$510,538 million respectively. Despite the increase in the GDP figures over time, the share of total intra-SADC trade in total intra-African trade decreased (UNCTAD, 2013).

2.8 Summary of Chapter
The foregoing discussion on literature review reveals very interesting dimensions to the linkage amongst public debt and economic growth. It can be inferred from the literature review that in the short run public debt impact positively on economic growth whereas in the long term adverse effect occurs. Similarly, empirical literature shows conflicting conclusions on the effect of public debt on economic growth. Recent research interest on the subject tends to focus on nonlinear relationship and threshold effects and in this, there are limited literature on Africa and divergent threshold behaviors. This study seeks to address this gap and provide basis to support policy maker on the threshold behavior within the Africa context.
3.1 Introduction

This chapter presents empirical account of how the relationship between public debt and economic growth occur in section 3.1. The generalized model specification for the study in section 3.2, the empirical model specification in section 3.3, measurement and justification of variables in sections 3.3.1 and 3.3.2, equation for determining the trend of public debt in section 3.4 and the stationarity and unit root test in section 3.5. The chapter again presents the type and source of data for the study in section 3.6.

3.2 Theoretical Framework

The study relies on the augmented Solow (1956) neoclassical model of economic growth premised on the general Cobb Douglas production function and expressed as:

\[ Y = AL^{\delta_1}K^{\delta_2} \quad Eqn (3.1) \]

Defined as:

Y = Output, K = Capital, L = Labour force and A = Total factor productivity (TFP), \( \delta_1 \) and \( \delta_2 \) are output elasticities of labour and capital respectively.

From equation (3.1), we can conclude that:

\[ Y = f(A, K, L) \quad Eqn (3.2) \]
As per the endogenous growth theory total productivity (A) is determined endogenously by economic factors. The aggregate production function supposes that, in addition to “conventional inputs” of labour and capital used in the neoclassical production function, “unconventional inputs” like public debt may be included in the model to capture their contribution to economic growth.

Assuming constant technology, a rise in the quantity of capital and/or labour will increase the level of output in the economic. In this regard, Total Factor Productivity (A) captures growth and output not accounted for by the changes in labour and capital.

3.3 Econometric Approaches

3.3.1 Panel Techniques

As an alternative to the use of cross-section methods to analyze the influence of public debt on economic growth, the current study utilized the panel data approach to examine the dynamics on GDP per capita.

According to Greene (2003), panel data are commonly used because it has the advantage of giving more information as it consists of both the cross-sectional information, which captures individual variability, and the time series information, which captures dynamic adjustment. Thus, panel modelling helps to identify a common group of characteristics while, at the same time, taking into account the heterogeneity that is present among individual units. Moreover, in panel data modelling, several data points are used which improves the degrees of freedom. The collinearity among the explanatory variables is also reduced thus the efficiency of economic estimates is improved.
Bourke (1989) and Park (2009) considered several functional forms and concluded that the linear model produces results as good as any other functional forms. It is therefore common to see that several literatures on bank profitability have adopted the linear functional form as an appropriate form of analysis. A linear form is therefore adopted in this study to analyze the panel data.

The panel model can be estimated with either the fixed effect model, random effect model or the constant coefficient effects model. But with regards to this work, the fixed and the random effect were used in order to check the robustness of the results. The fixed group effect model examines group differences in intercepts, assuming the same slopes and constant variance across entities or subjects. The more likely and interesting case occurs where the unobserved individual effects are correlated with the regressors. The random effect model assumes that a common mean value for the intercepts exists and the cross-sectional differences in the intercept values of each bank are reflected in an error term. The constant coefficient effect model is appropriately utilized under the assumption that there are no significant variations in both intercepts (cross-sectional units) and slopes in a model. In that regards, the data can be pooled and ran as an Ordinary Least Squares (OLS) regression.

3.3.2 Empirical Estimation

3.3.2.1 The Growth Regression

Accounting for the continuation of the growth rate requires a threshold model that allows for endogeneity. This study follows the work of Checherita et al. (2012) by developing a panel framework premised on the threshold methodology advanced by Caner & Hansen (2004).
Caner & Hansen (2004) proposed an estimator and a theory of extrapolation for linear models with endogenous variables and an exogenous threshold variable. The estimator is founded on estimation of a reduced form regression for the endogenous variables as a function of the exogenous instruments. This requires the development of a reduced form model. Grounded on the reduced form, predicted values for the endogenous variables are formed and placed into the structural equation of interest. Least-squares (LS) minimization yields the estimate of the threshold. Estimation of the slope parameters of this equation occurs in the third step, where the sample is split based on the estimated threshold and then conventional two-stage least squares (2SLS) or generalized method of moments (GMM) estimation is performed on the subsamples.

3.3.2.2 The Reduced Form Estimation

Before estimating the dynamic threshold model, the study initially ran a reduced form regression of the endogenous variable on a set of instruments. The reduced form model is a conditional expectation of the exogenous variable which gives a set of exogenous instruments.

The baseline model for the reduced form regression is a balanced panel of the form

\[ y_{it} = \mu_i + \chi y_{i,t-1} + \alpha X_{it} + u_{it} \]  \hspace{1cm} (eqn 3.3)

Where

- \( y_{it} \) represents the endogenous (dependent) variable of country \( i \) at time \( t \)
- \( y_{i,t-1} \) represents the lagged endogenous variable
- \( \mu_i \) represents country specific fixed effects
- \( X \) represents a set of explanatory variables
$u_{it}$ represents the error term which is assumed to be independent and identically distributed with mean zero and finite variance.

The linear model is estimated following the Arellano and Bond (1991) dynamic panel approach.

### 3.3.2.3 The Threshold Estimation

In estimating the dynamic panel threshold model, the study first runs a reduced form regression. The endogenous variables (GDP growth) are regressed on its own lags and use the predicted values in the structural equation.

The structural equation of interest is:

$$y_{it} = \mu_i + \chi y_{it-1} + \alpha' x_{it} + \beta_1 d_{it} I(z_{it} \leq z^*) + \beta_{12} d_{it} I(z_{it} > z^*) + u_{it}$$

_Eqn (3.4)_

Where

- $x$: represents regime independent control variables
- $d$: represents regime dependent variables allowed to switch between regimes
- $I$: represents an indicator function taking on the value 1 if the value of the threshold series $z$ is below a specific threshold value $z^*$.

In most works (Reinhart & Rogoff, 2010; Kumar & Woo, 2010; and Checherita-Westphal & Rother, 2010), the choice of the range of debt regimes and the value of the thresholds are made subjectively and there is limited evidence to validate if any of the non-linear models provides a better fit for the underlying data than alternative linear and non-linear specifications (Égert, 2015);

This study follows Hansen (1999) to determine specific threshold value. The analytical procedure involves the following steps as summarized in Checherita et al. (2011);
1. The procedure first estimates the dynamic model with 2SLS for each value of the threshold series \( z \) and keeps the associated LS estimates of the parameter and the sum squared of residuals.

2. Secondly, the threshold value \( z^* \) is selected on the bases of the one with minimum sum of squared residuals.

3. Lastly a test of statistical significance of the chosen \( z^* \) by means of an F-statistic that is approximated by bootstrap procedure is carried out.

### 3.3.2.4 The Slope Estimation

Following Checherita (2012), after establishing the significance of the threshold value of \( z^* \), the slope coefficient of the baseline equation was estimated using GMM.

### 3.3.2.5 Stationarity

The study conducted a stationarity test to identify any non-stationary series in order to avoid spurious regression (Abdulai and Rieder, 1995).

In explaining stationarity, let \( Y_{it} \) be a stochastic panel data with the following properties;

- **Mean:** \( E(Y_{it}) = \mu \)
- **Variance:** \( \text{Var}(Y_{it}) = E(Y_{it} - \mu)^2 = \sigma^2 \)
- **Covariance:** \( Y_{ik} = E(Y_{it} - \mu)(Y_{it+k} - \mu) \)

Where \( Y_{ik} \) is the covariance between the values of \( Y_{it} \) and \( Y_{it+k} \), that is between two \( Y \) values \( k \) periods apart. If \( k = 0 \), we obtain \( \text{Var} \), which is simply the variance of \( Y = (\sigma^2) \); if \( k = 1 \), \( Y_1 \) is the variance between two adjacent values of \( Y \).

Assuming \( Y \) is shifted from \( Y_{it} \) to \( Y_{it+m} \) (say from 1960 to 2016), if \( Y_{it} \) is to be stationary, the mean, variance and autocovariance of \( Y_{it+m} \) must be the same as that
of $Y_{it}$. Thus, given that a panel data is stationary, its mean variance, and autocovariance at various lags remain the same no matter at what point in time we measure them; implying that, they are time invariant. If a panel data is not stationary in the sense just explained, it is a non-stationary panel data. Stationarity of panel is important because otherwise, its behavior can only be analyzed for a particular time period and becomes impossible to generalize it outcome to other time periods.

Non-stationary data can be made stationary by the method of differencing. It helps to determine the order of integration of the series. If the first difference of a non-stationary panel data renders the data stationary, then we say the series is integrated of order one, denoted as $I(1)$. Similarly, if a panel data has to be differenced twice in order to make it stationary, then it is integrated of order two, $I(2)$. Generally, if a nonstationary panel data has been differenced $D$ times to make it stationary, such a series is said to be integrated of order $D$, $Y_{it} \sim I(D)$. However, the decision to difference or not depends on whether the data has a unit root or not.

### 3.3.2.6 Testing for Unit Root

A common test of stationarity that has gained popularity among researcher is the unit root test. It assumes a random walk mechanism of a series specified as

$$Y_{it} = \rho Y_{it-1} + v_{it}, \quad -1 \leq \rho \leq 1,$$

Where $v$ is the white noise error term. If $\rho = 1$, then unit root problem exists, meaning the series is non-stationary. If $|\rho| < 1$ (that is, if the absolute value of $\rho$ is less than one) then the panel data is stationary in the sense defined above. The first difference of the series is then tested with the Philip-Perron and Augmented Duckey-Fuller Tests under the null hypothesis that $\rho = 1$. 

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3.4 Type and Source of Data for the study

The study is completed using a panel of 51-member states in Africa and from 1980-2016. Data for the study is obtained from the World Development Index (WDI) of the World Bank and Open Data portal of the African Development Bank.

The study relies on principal set of growth determinants in order to ensure robustness in the results achieved (Sala-i-Martin, et al. 2004; Kumar & Woo, 2010; Checherita & Rother, 2010; Clements et al., 2003 and Bosworth & Collins 2003). Against this background, the endogenous variable is the real GDP growth rate, the threshold variable is the debt-to-GDP ratio (only regime-dependent variable) and some selected control variables such as gross fixed capital formation, trade openness and others that are supported by existing literature.
CHAPTER FOUR
RESULTS AND DISCUSSIONS

4.1 Introduction

This section presents the results of the study. It provides the stationarity and unit root test, the estimated results of nonlinear relationship between economic growth and public debt in Africa and the public debt threshold in Africa.

4.2 Presentation of the Results

This section presents the results from the analysis done to achieve each specific objective.

4.2.1 Stationarity Test

The Im, Pesaran and Shin W-stat unit root testing approach was employed to ascertain whether the variables employed in the model were free of unit root.

Table 4.1 Stationarity Test Result

<table>
<thead>
<tr>
<th>Variable</th>
<th>Individual Effect</th>
<th>Individual effects, individual linear trends</th>
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<tr>
<td></td>
<td>Statistic</td>
<td>Prob.**</td>
</tr>
<tr>
<td>DEBT</td>
<td>-20.3435***</td>
<td>0.0000</td>
</tr>
<tr>
<td>ENROLMENT</td>
<td>-17.7057***</td>
<td>0.0000</td>
</tr>
<tr>
<td>EXCHANGE</td>
<td>-6.51343***</td>
<td>0.0000</td>
</tr>
<tr>
<td>GCF</td>
<td>4.86321***</td>
<td>0.0000</td>
</tr>
<tr>
<td>GROWTH</td>
<td>-15.6438***</td>
<td>0.0000</td>
</tr>
<tr>
<td>INTEREST</td>
<td>-7.12501***</td>
<td>0.0000</td>
</tr>
<tr>
<td>POPULATION</td>
<td>-8.20988***</td>
<td>0.0000</td>
</tr>
<tr>
<td>OPENNESS</td>
<td>-6.35271***</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Source: Author’s Analysis (2017)

The Im, Pesaran and Shin W-stat unit root test was employed to test for the presence of unit root among the dependent and independent variables. There was the need to undertake the stationarity analysis, this was to help evade the trouble of nonsensical (to establish a false relationship among the variables) regressions that are associated
with non-stationary time series models (Im et al., 2003). Table 1 presents the result of the stationarity tests for the variables. From the analysis of the unit roots, if the series were observed to be integrated of order one – I (1), it will mean that they must be modeled in first difference to make them stationary. A time series is stationary if it does not vary overtime, which implies that its values have constant variability. All the variables were stationary so differencing was not necessary.

4.2.2 Non-linear Relationship between Public Debt and Growth

This study explores the relationship between public debt and economic growth in a sample of 50 African countries (as reported in Table 2). The first objective investigates the nonlinear relationship between public debt and economic growth. The empirical analysis follows the augmented Solow growth model based on the general Cobb Douglas production function which defines GDP per capita growth rate as a function of human capital, labor and physical capital. Human capital is proxied by secondary school enrolments assessed as the ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to secondary level education, labor was proxied by population growth rate and physical capital by investment/Gross Capital Formation as a percentage of GDP (GCF). Further control variables were used namely trade openness, exchange rate and interest rate.

Data for the empirical analysis originates from the World Development Index (WDI) of the World Bank and Open Data portal of the African Development Bank covering the period 1980-2016. Two models were employed for the estimation; fixed effect (FE) and generalized method of moment (GMM). The Hausman test was used to choose between the random effects (RE) and FE. The result of the test favored the use
of the FE model. The GMM was used to correct for possible problem of heteroskedasticity and autocorrelation that may be present in the error structure.

4.2.2.1 Linear Relationship between Public Debt and Economic Growth

The study first explores the linear relationship between public debt and economic growth. The results from both models showed a negative relationship with very high level of statistical significance.

Assuming a time lag effect on the productivity of debt, the study subsequently examined the relationship between lagged debt and GDP per capita growth. The analysis found a positive relationship from both models at 5% level of statistical significance respectively. The results suggest that there is a time lag between debt and when the incentive for debt becomes evidenced.

4.2.2.2 Accounting for Nonlinearity

To investigate the first objective, the study specified a quadratic form of public debt and analyzed it relationship with GDP per capita growth rate using both FE and GMM and Table 1 summarizes the results obtained from both models.

Table 4.2 Nonlinear Relationship between Debt and Growth

<table>
<thead>
<tr>
<th>Models</th>
<th>FE</th>
<th>GMM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debt</td>
<td>0.0046**</td>
<td>0.0021</td>
</tr>
<tr>
<td>Squared Debt</td>
<td>-0.00004****</td>
<td>0.0000</td>
</tr>
<tr>
<td>GCF</td>
<td>0.0772***</td>
<td>0.0105</td>
</tr>
<tr>
<td>Enroll</td>
<td>-0.0030</td>
<td>0.0049</td>
</tr>
<tr>
<td>Population</td>
<td>0.1324*</td>
<td>0.0744</td>
</tr>
<tr>
<td>Openness</td>
<td>0.003***</td>
<td>0.0036</td>
</tr>
<tr>
<td>Exchange rate</td>
<td>-0.0030*</td>
<td>0.0042</td>
</tr>
<tr>
<td>Interest rate</td>
<td>0.0047</td>
<td>0.0142</td>
</tr>
</tbody>
</table>
### Diagnostics

<table>
<thead>
<tr>
<th></th>
<th>Prob &gt; F</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.0000</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

*** Significance at 1%/ **Significant at 5%/ *Significant at 10%

The results across the two models show negative nonlinear and highly statistically significant relationship between public debt and economic growth for the 50 Africa countries from 1980-2016. This empirical outcome agrees with the expectation of the study and is further supported by theoretical literature and earlier empirical findings. According to Panizza & Presbitero (2013), though debt may impact positively on economic growth in short run, expansionary fiscal policies that increases the level of debt may reduce long-run growth, and thus partly (or fully) negate the positive effects of the fiscal stimulus supporting the basis for nonlinearity. There are growing numbers of empirical literature that support the non-linear impact of public debt on economic growth (Kumar & Woo, 2010; Checherita & Rother, 2010; Reinhart & Rogoff, 2010a, b; Cecchetti et al. 2011).

#### 4.2.2.3 Accounting for other Control Variables

The Solow growth model identifies the three main factors of economic growth as technical progress, investment and labor (population). The study examines the effect of these factors on the GDP per capita growth.

Table 2 shows that Investment/ GCF has a positive and highly statistically significant relationship with GDP per capita growth for the 50 African countries from 1980-2016 for both FE and GMM models. Accordingly, a 1 percent increase in investment will result in an approximately 0.08 percent increase in per-capita GDP growth rate at 1 percent level of statistical significance holding all other variables constant using FE model. Similarly, for the GMM model, a 1 percent increase in investment will result in an approximately 0.09 percent increase in per-capita GDP growth rate at 1 percent
level of statistical significance holding all other variables constant. The positive effect of gross capital formation/investment is consistent with the study's expectation supported by both existing theoretical and empirical literature. Neoclassical economists suggest that investments increase the share of capital per worker, improves capital deepening and the productive capacity of the economy leading to economic growth. Earlier findings by Barro & Lee (1993) and Li & Liu (2005) support the empirical results.

From Table 2, the study reported a positive relationship between population growth rate and GDP per capita growth for the 50 Africa countries across the two models. The statistical significance of the effect of population on GDP per capita growth however varied across the models. Whereas the FE model reported a 10% statistical significance, the effect was however statistically non-significant for the GMM model.

The reported positive relationship was inconsistent with the expectation of the study. The neoclassical economists argue that in the long run, economic growth is only driven by capital accumulation and that countries with higher savings rates will have higher income in the long run. In this context, it is assumed that more rapid population growth will have inverse relationship with GDP per capita growth since the share capital per worker will fall with a larger population.

The outcome of the results is however consistent with some theoretical literature which have devoted attention to understanding the relationship between economic growth and population. These literatures argue that population growth may generate economies of scale, induce favourable technological change and positive productivity
effects resulting from younger labour force from the growing population (Boserup, 1981; Simon and Jacquez, 1992; & Kremer, 1993).

According to reports by the United Nations and World Bank, the ten (10) youngest populations are all in Africa and the continent has the largest young population in the world. Some economists suggest that, Africa’s youthful population is a major advantage for the continent and argue that the increasing working-age population is a major opportunity for economic growth in Africa. The World Bank estimates that this demographic dividend could generate 11-15% GDP growth between 2011 and 2030. The empirical results from the study validate these claims and earlier empirical findings by Kuznets (1960), Kelley & Schmidt (1994), Kling and Pritchett (1995) and Hamza (2008), who reported a positive relationship between population and per-capita GDP growth rate.

Technical Progress proxied by secondary school enrolment had a negative statistically non-significant relationship with GDP per capita growth across the two models for the 50 Africa countries between 1980 to 2016. The outcome did not agree with the expectation of the study. It is widely believed that education can contribute to economic growth and existing literature confirm that secondary and post-secondary education rather than primary drives economic growth (Krueger & Lindahl, 2000; Nelson & Phelps, 1966 and Romer, 1990).

The proponent of the human capita theory; (Schultz, 1961; Becker,1964) argue that education increases a person’s skills level and consequently his human capital which enhance productive capacity. The augmented Solow growth model recognizes human capital and suggests that an average increase in years of schooling (a proxy to average
skills level) in the labor force increases the human capital stock and thus national output. Nelson and Phelps (1966) assume that the human capital stock facilitates technical progress and diffusion and determines the ability to adopt new technologies. The scholars maintain that, the level of human capital is imperative for the growth rate of output. By assuming a time lag between the investment in human capital and the time when human capital becomes suitable for production, this study examined the relationship between lagged enrolment and GDP per capita growth. The analysis reported a positive relationship for FE and GMM models at 10% and 5% level of statistical significance respectively. The empirical outcome of this study corroborates the works of Nelson & Phelps (1996), Lucas (1988) and Romer (1990). The scholars argued that human capital produces innovation and sustains economic growth.

Despite the strong theoretical support for a positive role of human capital in growth, Sala-i-Martin (2002), Easterly (2001) and Pritchett (2001) argue that the empirical relationship between education and growth is weak. Petrakis and Stamatakis (2002) examined the relationship between education levels and growth using a cross-country regression with three groups of countries: advanced, developed and less developed. The empirical findings suggest that the relationship between education and growth varies with respect to a country’s level of development. The authors reported that primary education is more significant in less developed countries, while higher education appeared foremost in advanced countries. Similarly, Gemmell (1996) separates primary, secondary and tertiary schooling for these three groups of countries and identified that the effects of human capital on growth are most important at the primary and secondary levels in developing countries, but at the tertiary level for OECD countries. Benhabib (2003) empirically examined the influence of primary and
post primary education on growth. In a cross-country regression, the authors identified that primary education contributes mainly to the production of final output, whereas post-primary education contributes to the adoption and innovation of technology. When the data is divided into subsamples, the results are less encouraging. Nevertheless, the implied deduction is that, for the poorest countries human capital acts mainly as input into final production and, to a lesser extent, as a facilitator for innovation. The relative contribution of human capital to innovation seems to increase with country prosperity.

Despite evidence of general improvement in school enrolment and educational services in the last decade globally, according to a 2011 UNESCO report, the Africa Progress Report 2011 identifies that results for Africa are not encouraging. Accordingly, many SSA countries trailed behind in the Universal Primary Education. The report identifies that, 50% all children do not complete primary education in one-third of SSA countries and secondary as well as tertiary intake rates in SSA are very low. It is possible that these may account for the negative non-significant relationship between secondary enrolment and per capita growth.

As captured in Table 2, trade openness has a positive significant relationship with GDP per capita growth rate for the 50 countries for the period 1980-2016 across the two models (FE and GMM). The degree of impact and levels of significance however varied across the models. For the FE model, a 1 percent increase in trade openness will result in an approximately 0.009 percent increase in per-capita GDP growth rate at 1 percent level of statistical significance holding all other variables constant. Likewise, for the GMM model, a 1 percent rise in trade openness will drive an
approximately 0.007 percent increase in per-capita GDP growth rate at 10% level of significance holding all variables constant.

The positive significant relationship between trade openness and GDP per capita growth produced by the empirical analysis is consistent with the expectations of the study. The expectation of this study is premised on the theoretical proposition that in the long-run, trade openness can potentially enhance economic growth via access to goods and services, efficiency in the allocation of resources and improving total factor productivity through technology diffusion and knowledge dissemination (Barro & Sala-i-Martin, 2003; Rivera-Batiz & Romer, 1991).

In this context, countries with more trade openness are generally expected to perform better economically than those with less openness. This assumption had been the force behind liberalization policies for developing countries by institutions like the IMF and the World Bank in the hope that by opening and integrating them into the global market, developing countries would have much to gain. Studies such as Chang, Kaltani, & Loayza, 2009; Dollar & Kraay, 2004; Frankel & Romer, 1999; Freund & Bolaky, 2008 report a positive relationship between trade openness and GDP per capita growth and are confirmed by the empirical outcome of the study.

From Table 2, the study reported a negative non-significant relationship between exchange rate and GDP per capita growth rate for the 50 countries for the period 1980-2016 for both FE and GMM models.

Generally, most Africa economies maintain weak exchange rate hence the study expected that relationship between the real effective exchange rate and GDP per
capita growth will be positive. The expectation of the study was informed by theoretical literature that suggest that weak real exchange rate act as a support for the production of tradable goods which eventually lead economic growth (Aizenman & Lee, 2010; Benigno et al., 2015 and McLeod & Mileva, 2011). Rodrik (2008) maintain that a weak real exchange rate compensates for institutional weaknesses and market failures (e.g. knowledge spillovers, credit market imperfections, etc.). Di Nino et al. (2011) suggest that nominal depreciation has persistent real effect on output growth. Glüzmann et al. (2012) further identify that a weak exchange rate leads to higher saving and investment through lower labour costs and income re-distribution by shifting resources from consumers to financially-constrained firms.

However, based on a measure of undervaluation, Rodrik (2008) finds that, at least for developing countries, an undervalued (strong) real exchange rate predicts stronger growth. By implication, when weak real exchange rate is unable to compensate for institutional weaknesses and market failure, it can lead to underinvestment in the traded goods sector in developing countries and negatively impact on growth. Hence the alternative will be true. The outcome of the study is can be situated in the above context.

The results from Table 2 shows that, interest rate has a positive non-significant relationship with GDP per capita growth rate for the 50 Africa countries for the period 1980-2016 across the two models (FE and GMM) employed for the analysis.

The positive relationship is at odd with the study’s expectation and the conventional view of a negative relationship between interest rates and growth. The study’s outcome is, however, consistent with some existing literature that argue that high
interest rates are associated with periods of rapid growth because of improved resource allocation and increased productivity. These authors maintain that high real interest rates may be a reflection of growing investment opportunities and increasing returns because of externalities and therefore are consistent with rapid growth. Africa countries have maintained a positive growth outlook in the past decade and the above claims are consistent with current development in Africa and the outcome of the study.

4.2.3 Threshold Estimation

The first objective provides evidence of existence of nonlinear relationship between public debt and economic growth without providing details at the point at which this nonlinearity occurs. The second part of the empirical analysis investigates the threshold at which the nonlinear relationship between public debt and economic growth (turning point) occurs. Following the results from the first objective where lagged debt was found to impact positively on growth, the second part of the empirical analysis specifically examine the threshold effect of one year lagged debt-to-GDP ratios on annual real GDP growth rates.

The empirical analysis follows Caner & Hansen (2004) and specifies the baseline model for the 50 African countries for the period between 1980 to 2016 as follows:

\[ y_{it} = \mu_i + \chi y_{it-1} + \alpha' x_{it} + \beta_1 d_{it} I(z_{it} \leq z^*) + \beta_{12} d_{it} I(z_{it} > z^*) + u_{it} \]

Where;

\( x \): represents regime independent control variables: gross capital formation,
population growth rate, secondary school enrolment, trade openness, exchange rate, interest rate and bloc membership

\[ \mathbf{d}: \text{represents regime dependent variables allowed to switch between regimes:} \text{debt} \]

\[ \mathbf{I}: \text{represents an indicator function taking on the value 1 if the value of the threshold series z is below a specific threshold value } z^* \]

In choosing the regime and the value of threshold, the study followed Hansen (1999). Hansen (1999) provides a testing procedure that ensures that the nonlinear model provides a better fit for the underlying data than alternative linear and nonlinear specifications. The procedure is based on estimation of a reduced form regression for the GDP growth rate as a function of lagged GDP growth rate.

Based on the reduced form, predicted values for the GDP growth rate are formed and substituted into the baseline equation to determine the threshold value through grid search. The second stage in Hansen’s procedure is to test the endogenous models against one another using bootstrapping method. The model’s selection is based on the one which is significant and provides the minimum Sum Squared Residual (SSR). The estimation of the slope parameters is the third and final stage of the process, the sample is split based on the estimated threshold and then conventional two-stage least squares (2SLS) or generalized method of moments (GMM) estimation is performed on the subsamples.

Following the above procedure, the study imposed the three debt threshold values (30%, 60% and 90%) proposed in Reinarhart & Regoff (2010) and this produces four debt regimes; debt below 30%, debt between 30% and 60%, debt between 60% and 90% and debt above 90%. The four models were ran separately using the baseline
model. A sequential testing of the models was further done to choose the threshold variable that minimises the sum squared residuals of the estimated regime models.

The analysis identified that the threshold variable of 60 to 90% debt regime was the most statistically significant and the model with the minimum SSR among the four. The result provided evidence of where the threshold value lies, hence a grid search with steps of 1% starting from 55% was undertaken to establish the value of the threshold.

The search identified that the highest positive and statistically significant impact of public debt on economic growth occurs at debt to GDP ratio of 80.06% for the 50 Africa countries from 1980-2016. The coefficient of debt increases and reaches its optimum at debt to GDP ratio of 80.06%. Beyond debt to GDP ratio of 80.06%, an additional increase in the debt reduces its impact on growth.

Having established the threshold value, the study finally estimates the slope parameters using a non-dynamic panel threshold technique in EViews and a dynamic panel with the Generalized Method of Moments (GMM) estimation in Stata. The results are presented in Table 3 below.

**Table 4.3 Baseline Estimate Results**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Dynamic Panel</th>
<th>Non-Dynamic Panel</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>Standard Dev.</td>
</tr>
<tr>
<td>y(t-1)</td>
<td>0.0616***</td>
<td>0.0224</td>
</tr>
<tr>
<td>GCF</td>
<td>0.0210**</td>
<td>0.0105</td>
</tr>
<tr>
<td>Enrol(t-1)</td>
<td>0.0094**</td>
<td>0.0048</td>
</tr>
<tr>
<td>Population</td>
<td>0.1829***</td>
<td>0.0646</td>
</tr>
<tr>
<td>d(t-2) if d≤80.06</td>
<td>0.0124***</td>
<td>0.0043</td>
</tr>
<tr>
<td>d(t-2) if d &gt;80.06</td>
<td>-0.0022</td>
<td>0.0017</td>
</tr>
</tbody>
</table>

Source: Author’s Analysis (2017)
The relationship between past GDP growth rates and the current GDP growth rate was analyzed in the dynamic model and only the results for the one year lagged GDP growth was found to be positive and significant. As captured in Table 3, the empirical results show that, holding all other variable’s constant, a rise in the past year GDP growth rate by 1 percent will result in 0.062 percent increase in the current year GDP growth rate at 1 percent level of statistical significance. The outcome is consistent with the expectations of the study and consistent with other empirical work such as Baum et al. (2012).

Gross Capital Formation (a proxy for investment) has positive and statistical significance effect on GDP growth rate from both the dynamic and non-dynamic panel estimation. The degree of impact and level of statistical significance however varied across the models. For the non-dynamic panel, holding all variables constant, a 1 percent rise in investment will result in an approximately 0.032 percent increase in GDP growth rate at 1 percent level of statistical significance. Similarly, for the dynamic model, holding all other variables constant, 1 percent rise in investment result in an approximately 0.021 percentage increase in GDP growth rate at 5 percent level of statistical significance.

The positive significant effect of gross capital formation on GDP growth rate is consistent with the expectation of the study and supported by both existing theoretical and empirical literature. The neoclassical economists argue that, investments increase the share of capital per worker, improves capital deepening and the productive capacity of an economy making it the primary source of long term economic growth (Barro & Lee, 1993: Li & Liu, 2005: Baum et al., 2012).
Both the dynamic and non-dynamic models reported a positive relationship between one year lagged secondary school enrolment (a proxy for technical progress) and GDP growth rate with varied levels of statistical significance across the models. The dynamic model when estimated with the first four variables (lagged GDP growth rate, Population growth rate, Investment and Enrolment) showed that, given a 1% rise in secondary school enrolment, GDP growth rate rises by 0.009 at 5% level of statistical significance. However, when additional variables are added to the model, though the sign remains positive, the impact reduces to 0.007 and becomes non-significant.

The non-dynamic model showed a highly statistical significance effect of lagged school enrolment on GDP growth rate. The model reported that, given a 1% increase in secondary school enrolment, GDP growth rate rises by approximately 0.036. The empirical outcome from the non-dynamic model is consistent with the expectation of the study. The proponent of the human capital theory; (Schultz, 1961; Becker (1964) argue that, education increases a person’s skills level and consequently the human capital thereby enhancing productive capacity. The augmented Solow growth model uphold that an average increase in years of schooling (a proxy to average skills level) in the labor force increases the human capital stock and thus national output. Nelson and Phelps (1966) assume that the human capital stock facilitates technical progress and diffusion as well as determining the ability to adopt new technologies and thus maintain that, the level of human capital is imperative for the growth rate of output. Their position is supported by Lucas (1988) and Romer (1990) who argue that human capital stock produces innovation and sustain economic growth.
The two models produced completely opposite results for population. The dynamic model found a positive and a highly statically significant relationship between population growth rate and GDP growth rate. When population is however lagged by one year, the dynamic model reports a negative and non-significant relationship between population and GDP growth rate.

The non-dynamic model found negative and a highly statistically significant relationship between population growth rate and GDP growth rate for both lagged population and non-lagged population series. The outcome of the non-dynamic model is consistent with the expectation of the study. Theoretical growth literature suggests that, the fundamental factor for long run economic growth is capital accumulation and those countries with higher per income rates will enjoy faster growth. On this basis, the study assumed that more rapid population growth will reduce share of capital per worker and worsen relationship with GDP growth rate.

Nevertheless, there are theoretical argumentations that support the positive significant relationship between economic growth and population as reported by the dynamic model. These literatures argue that, population growth may generate economies of scale, induce favourable technological change and positive productivity effects resulting from younger labour force from the growing population (Boserup, 1981, Simon and Jacquez, 1992, Kremer, 1993).

As argued in page 47 above, the African continent has the advantage of its youthful population. From the Table 3, the dynamic panel model finds that, holding all variables constant, a 1 percent rise in population growth rate will result in an approximately 0.183 percent increase in GDP growth rate at 1 percent level of statistical significance. Contrary for the non-dynamic model, holding all other
variables constant, a 1 percent rise in population growth rate will result in an approximately 0.180 percentage decrease in GDP growth rate at 1 percent level of statistical significance.

The threshold analysis found a debt to GDP threshold value of 80.06% for the 50 Africa countries from 1980-2016 across both dynamic and non-dynamic models. This implies that, the optimal effect of debt on growth occurs when debt to GDP ratio is at 80.06%. A debt threshold of 80.06 splits the observation of the non-dynamic panel into 1264 observations in the lower (debts below 80.06%) and 549 observations in the upper regime (debts above 80.06).

The Table 3 shows that, for the dynamic panel model, when debt to GDP ratio is at the threshold value of 80.06%, impact of debt on growth is 0.0124 at 1% level of statistical significance. When debt to GDP ratio is below the threshold value of 80.06%, its impact on growth is positive and highly statistically significant but the value of impact is below the impact of the threshold level.

For instance, the empirical analysis found that, debt to GDP ratio of 79.06% was associated with a coefficient impact of 0.0120 below the threshold impact. Likewise, when debt to GDP ratio rises above the threshold value of 80.06%, the impact of debt on growth reduces to 0.010. In the same vein, when debt to GDP ratio of reaches 83.06%, the impact of debt on growth becomes negative and statistically non-significant. Also for the non-dynamic model, at the threshold value of 80.06%, the impact of debt on growth is 0.0114 at 10% level of statistical significance. Below the threshold value of 80.06%, the impact of debt on growth remains positive and statistically significant. For example, debt to GDP ratio of 79.06% was found to be
associated with a coefficient impact of 0.010. Similarly, when debt to GDP ratio surges above the threshold value of 80.06%, the impact reduces to 0.009 and statistically non-significant.

4.3 Robustness Checking
To establish the structural validity of the model specification, the study carries out further tests by including additional explanatory variables, an analysis of influential series/countries. The results from the robustness tests largely validated the results of the baseline specification.
Table 4. 4 Threshold Panel Model Robustness Results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Dynamic Model</th>
<th>Non-Dynamic Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>y (t-1)</td>
<td>0.0616*** (0.0224)</td>
<td>0.0652*** (0.0225)</td>
</tr>
<tr>
<td>GCF</td>
<td>0.0210** (0.0105)</td>
<td>0.0208** (0.0105)</td>
</tr>
<tr>
<td>Enrol(t-1)</td>
<td>0.0094 (0.0050)</td>
<td>0.0075 (0.0050)</td>
</tr>
<tr>
<td>Population</td>
<td>0.1829*** (0.0646)</td>
<td>0.1816*** (0.0645)</td>
</tr>
<tr>
<td>Openness</td>
<td>-0.0009 (0.0043)</td>
<td>.</td>
</tr>
<tr>
<td>Exchange Rate</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>Interest Rate</td>
<td>-0.002 (0.01)</td>
<td>-0.002 (0.01)</td>
</tr>
<tr>
<td>Bloc Membership</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>North</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>Central</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>East</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>West</td>
<td>.</td>
<td>.</td>
</tr>
</tbody>
</table>

| d(t-2) if d≤80.06   | 0.0124*** (0.0043) | 0.0122*** (0.0043) | 0.0122*** (0.0043) | 0.0122*** (0.0043) | 0.0112*** (0.0043) | 0.0016 (0.0024) | 0.0010 (0.0024) | 0.0005 (0.0024) | 0.0007 (0.0024) |
| d(t-2) if d>80.06   | -0.0022 (0.0017) | -0.0024 (0.0017) | -0.0023 (0.0017) | -0.0023 (0.0018) | -0.0023 (0.0018) | -0.0022 (0.0017) | -0.0022 (0.0017) | -0.0022 (0.0017) | -0.0022 (0.0017) |

Source: Author’s Own Analysis (2017)
4.3.1 Including Additional Regressors

The study sequentially included further explanatory variables to lagged GDP growth rate, enrolment, gross capital formation and population growth rate to examine how the threshold coefficient behave with the inclusion of these variables. The variables included were lagged trade openness, real effective exchange rate and real interest rate. The result for the robustness analysis are reported in Table 4.

For the dynamic panel, the coefficient of the threshold value did not see any significant changes in all the specifications. Moreover, for all the specifications, the threshold value of 80.06% was associated with the smallest sum of squares and the threshold value of 80.06 remained statistically significant at 1% level.

Similarly, for the non-dynamic model, the additional variable inclusion saw the coefficient of the threshold value drop from 0.009 to 0.008 and non-significant with the inclusion of the last two variables.

4.3.2 Influence of High and Low Debt Countries

The study further analysed the effect of influential series on the threshold behaviour. Here, the study first excludes countries with average debt to GDP ratio above 125% and subsequently excludes the countries with average debt to GDP ratio below 25%. Three countries were excluded from each category. For the data set that excludes countries with average debt to GDP ratio above 125%, the empirical analysis showed that, the threshold value associated with the smallest SSR was 87.6%. At this debt to GDP ratio of 87.6%, the impact of debt on growth was positive but non-significant. The results suggest that lower debt regimes may be associated with higher threshold.
The analysis of the series that exclude the average debt to GDP ratio below 25% identified the threshold value to be 80.06%. The coefficient at the threshold value was same as positive and highly statistically significant.
CHAPTER FIVE
SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Introduction
This chapter presents the summary, main conclusions and policy recommendations based on the findings of the study.

5.2 Summary and Conclusion of the Study
Domestic and external borrowing remains critical means of financing deficit in Africa. This has led to a rise in the public debt of some Africa countries and the continent in general in recent times. The descriptive analysis of the data for this study suggests that the average debt of the continent stood at 21.7% between 2010 and 2016. The review of growth data further shows that, the increasing levels of public debt in Africa in recent times have not been accompanied by growth. Economic growth in Africa has been unstable experiencing a nose-dive since 2002 from real GDP per Capita growth of 3.4% to 2.4% in 2016 at an average growth rate of 2.49%. The high public debt and declining growth in the Africa economies have left many to question the long-term macroeconomic stability and fiscal sustainability of the region, and their broader impact on growth.

There are divergent opinions on the effect and behaviour of public debt on economic growth. Earlier literature on the subject paid attention to understanding the linear effect of debt on growth. Those studies related to Africa focused more on understanding the linear relationship between external debt and growth. In recent times, following the financial crises in 2007/8 and the subsequent famous paper by Reinhart and Rogoff, “Growth in Times of Debt”, there has been growing interest in understanding the nonlinear relationship between public debt and economic growth.
Literature focused on Africa in this area is however limited. Given that, 33 out of the 39 HIPC countries are from Africa, understanding the effect and the threshold behaviour of public debt is relevant to serve as a guide in fiscal policy decisions and choices. Consequently, this study sought to examine the nonlinear effect of public debt on economic growth; and further establish the threshold at which the nonlinearity occurs using a panel of 50 Africa countries from 1980-2016. The study found a strong evidence of a non-linear relationship between public debt and economic growth for the 50 Africa countries for the period from 1980 to 2016.

The empirical results showed a positive and highly statistically significant impact of public debt on economic growth. The impact of public debt on GDP growth rate however reduces proportionately to increases in the debt to GDP ratio beyond 80.06%. Thus, the study identified a threshold value of 80.06% as the turning point beyond which public debt goes from good to bad. The result is robust across varied specifications.

5.3 **Recommendation**

Following the empirical outcome of this study, it is recommended that policy makers within the study area be guided by the threshold level in their public financing decisions in order to realize the optimal benefit of public debt on economic growth. By implication, the result suggests that, beyond the threshold value of 80.06%, public debt becomes a bane to economic growth with broader socio-economic consequences.

To give full meaning to the above recommendation, the study suggest a legislative public debt limit for member countries based on the threshold value of 80.06%. This would ensure economic stability and enhance the capacity of countries to be able to
meet their debt obligation as they fall due. The legislative action will further force the central governments of these countries to prioritize their expenditure and put in place effective policies that will enhance their fiscal outlooks on the basis of the constraints that will be placed on borrowing.

The study found a positive and statistically significant relationship between investment and GDP growth rate. The result is consistent with the neoclassical growth theory. However, according to the World Bank Africa pulse report, Vol. 15, Sub-Saharan Africa experienced a slowdown in investment growth from nearly 8% in 2014 to 0.6% in 2015 and the sluggish investment coincided with a sharp deceleration in economic growth in Africa. The report further suggests that, the growth effects of narrowing Sub-Saharan Africa’s infrastructure quantity and quality gap are potentially large. Accordingly, the report identifies that, growth of GDP per capita for the region would increase by an estimated 1.7 percentage points per year if it were to close the gap with the median of the rest of the developing world. By closing the infrastructure quantity and quality gap relative to the best performers in the world, Africa could increase growth of GDP per capita by 2.6% per year. Punam Chuhan-Pole of the World Bank yet suggest that, Public capital spending levels are too low to address the region’s infrastructure needs.

The study therefore recommends that, Africa countries prioritize their borrowings to target infrastructure development to scale up the continents growth potential.

The study recommends for further research a comprehensive analysis of the main factors that drive public debt in Africa. This will help measure the efficiency and effectiveness of borrowed funds and the potential capacity to repay.
Lastly, the study recommends for further research, a comparative analysis of the threshold value for the regional blocs to assess if there are differences in threshold value across the regional blocs.
REFERENCES


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APPENDIX

Correlation-coefficient matrix

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<th>POP</th>
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