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DEBT SUSTAINABILITY AND ECONOMIC GROWTH: EVIDENCE FROM LOW INCOME SUB SAHARAN AFRICA COUNTRIES

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This is to certify that the thesis prepared by Nitsuh Mengist, entitled with: *Debt Sustainability and Economic Growth: Evidence from Low Income Sub Saharan Africa countries* and submitted in partial fulfillment of the requirements for the Degree of Master of Science in Economic Policy Analysis complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

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Table of Contents

List of Tables

List of Figures

List of Acronyms

AFRODAD	African Forum and Network on Debt and Development
ARDL	Autoregressive Distributed Lag model
DSA	Debt Sustainability Analysis
DSF	Debt Sustainability Framework
FDI	Foreign Direct Investment
FE	Fixed Effect
GNI	Gross National Income
HIPC	Highly Indebted Poor Countries
IBC	Intertemporal Budget Condition
IMF	International Monetary Fund
MDRI	Multilateral Debt Relief Initiatives
MSD	Maximum Sustainable Debt
PD	Probability of Default
PNG	Private Non-Guaranteed debt
PPG	Public and Publicly Guaranteed debt
PV	Present Value
RE	Random Effect
SSA	Sub-Saharan Africa
UNCTD	United Nations Conference on Trade and Development
UNECA	United Nations Economic Commission for Africa

VIF	Variable Inflation Factor
WB	World Bank
WDI	World Development Indicator

List of Appendices

Abstract

There exist mixed evidential outcomes on the effect of external debt on economic growth. With high saving gaps in low-income SSA countries, it seems plausible that external borrowing can affect growth positively if well utilized or negatively as the debt becomes a burden. As a result, the purpose of this study is to examine the effect of external public debt on economic growth and to assess the debt sustainability of twenty-four SSA countries over the period 2000-2017 using descriptive trend analysis and panel data analysis. The trend and descriptive analysis assessed the behavior of external public debt and economic growth while the empirical analyses employed panel data regression in which a fixed effect model is estimated. The study found that external public debt, external public debt service, and trade openness have a negative and significant effect on the economic growth of low income SSA countries. However, investment and domestic debt have a positive and significant impact on the economic growth of the countries that the study covers. Additionally, the inflation rate and population growth have no significant effect on economic growth. For the purpose of examining the debt sustainability of chosen countries, various tests were undertaken. The study concludes that the external debt of low income SSA nations is unsustainable. In light of these findings, selected SSA countries should adopt a balance between external and domestic debt to ensure sustainable economic growth. They should also implement measures to promote export and expand domestic investment.

Keywords: *Sub-Saharan Africa, Panel data regression, Fixed Effect Model, Debt Sustainability, Hausman test.*

CHAPTER ONE

INTRODUCTION

1.1. Background of the Study

Many African countries have a problem to finance all of their development spending with the revenues they collect. That is, governments have domestic revenue sources (tax and non-tax sources) to provide activities such as infrastructural development, defense, and provision of social services, the resources are not enough. As a result, governments consider borrowing as a substantial source of financing to realize sustainable economic growth[1].Governments' debt financing can help in this regard by channeling resources to projects where the rates of returns are at least sufficient to service the debt incurred.

Governments borrow either from domestic or external sources or both. Domestic debt holds funds raised through financial assets such as Treasury bills and bonds and money borrowed from other locally-owned financial institutions. Similarly, external debt generated from bilateral and multilateral sources. Bilateral external debt sources include government to government while multilateral sources include government to a union of countries or agencies. Multilateral debt could be sourced from financial institutions such as the World Bank, International Monetary Fund, European Commission, European Investment Bank, and African Development Bank, among other institutions.

Similarly, external debt classified as public and publicly guaranteed debt, private non-guaranteed debt, central bank deposits, and loans due to the IMF and WB. Public external debt refers to all foreign loans contracted between external creditors and the borrower country's Ministry of Finance, while publicly guaranteed external debt is contracted between credit suppliers and borrower countries public enterprises and guaranteed by the Ministry of Finance as well as the

[1]Sustainable economic growth is economic development that attempts to satisfy the needs of humans but in a manner that sustains natural resources and the environment for future generations. Sustainable economic growth is a sole and most important factor to change the living standard of peoples (Buscemi and Alem, 2012).

state-owned bank. Additionally, private non-guaranteed debt defined as loans contracted by public enterprises, mainly without government or government-owned bank guarantee (Irwin, 2015).

Debt has both negative and positive effects on economic growth. Halima (2013) stated that the first tenet of Keynesian economics agrees on the advantage of debt because, investments at all levels of government (building roads, municipal utility system, factories and educating the population), corporation and individuals requires spending. Due to this, the government is forced to borrow money. Thus spending with debt stimulates the economy and in this condition increasing debt is desirable for future growth. On the contrary, the debt overhang hypothesis is the most commonly used argument to establish the adverse effect of external debt. The hypothesis states that when countries accumulate external debt, investors expect a higher future tax to service foreign debt. This reduces investment and, hence, adversely affects economic growth.

In the 1980s, the world experienced a debt crisis in which, highly indebted Latin American and other developing regions were unable to repay their debt. The study of Harl (1990) presented that, the problem exploded in August 1982 as Mexico reported the failure to service its international debt, and a similar problem immediately expanded to the rest of the world. To solve this, macroeconomic tightening and structural adjustment were conducted, via the conditionality of the IMF and the WB. This crisis involved long-term commercial bank debt which was accumulated in the public sector. The governments of developing countries were unable to repay their debt, so financial liberalizing operations became necessary.

Similarly, debt-related problems are not new to SSA countries. In the 1980s and 1990s, their debt burden increased to higher levels, and they become unable to pay back their debt. Most of them have been granted relief and reduction schemes following the massive debt-forgiveness campaigns of the 1990s. The subsequent fall in debt levels reduced worries about debt-related problems in these countries (Kelbesa, 2014).

Following the 1980s debt crisis, debt relief was one of the issues on the policy agenda of governments and international institutions. Donors and the international community agreed to

further debt cancellation to the Highly Indebted Poor Countries (HIPC). According to Moss and Chiang (2003) accumulated debt has an effect on SSA countries macroeconomic performance, political, and institutional aspects. High debts could threaten the effectiveness of structural reforms aimed at enhancing growth and poverty reduction. The permanent fiscal crisis and huge administrative burdens due to the number of rescheduling and different creditors and to a large number of currencies in which debt is denominated could undermine the development of sound institutions, capable of making strategic choices.

Therefore, SSA countries' situations towards debt servicing and debt accumulation raise the issue of debt sustainability. Debt sustainability is the ability of a country to meet its debt obligations without requiring debt relief or accumulating arrears. One of the methodologies used to assess debt sustainability situation of a country is The Debt Sustainability Framework (DSF), developed in 2005. The Framework is designed to guide the borrowing decisions of low-income countries in a way that matches their financing needs with their current and prospective ability to repay debt. It also allows creditors to adjust their financing terms in anticipation of future risks. A fundamental part of the DSF is Debt Sustainability Analysis (DSA) and is a tool developed by the World Bank and International Monetary Fund to help and guide countries and donors in mobilizing critical financing for low-income countries while reducing the chances of an excessive build-up of debt. It includes a scenario where the Millennium Development Goals and other national development plans are fully funded. Therefore the essential aim of assessing debt sustainability should be to reconcile financing needs for development with sustainable debt levels (Development Finance International, 2018).

1.2. Statement of the Problem

A decade after the global financial crisis, global debt levels continue to reach new high record. The Institute of International Finance estimates that by the end of March 2018, global debt stocks had reached $247.2 trillion, up from $168 trillion at the onset of the financial crisis of 2007–2008 and by nearly $25 trillion from a year earlier. UNCTAD estimates that the ratio of global debt-to-world gross domestic product (GDP) is nearly one third higher than in 2008, with global debt stocks amounting to more than three times global GDP. The high dependence of a modest global

recovery on debt reflects systemic fragilities in global growth dynamics that have persisted, despite the profound shock of the financial crisis (UNCTAD, 2018).

Based on the study of UNCTAD (2018), the fragile financial and economic environment poses serious challenges for developing country debt sustainability. While the bulk of global debt is still held in developed countries, emerging and developing countries debt rose from 40 per cent of global GDP in 2008 to 93.2 percent in 2017. For developing countries as a whole, total external debt stocks had reached $7.64 trillion in 2017, having grown at an average yearly rate of 8.5 percent between 2008 and 2017, or more than 80 per cent over the period. Over the same period, total external debt stocks increased from $155 billion to $293.4 billion in the least developed countries, representing an average annual growth rate of 7.4 percent. Emerging economies registered a slightly higher average growth rate at 9.5 per cent of their external debt stocks. As a result, high debt levels can be problematic as the countries may require debt restructuring and forgiveness which is disruptive and costly and the burden of a debt overhang may undermine urgent progress on policy reform

External debt-servicing difficulties have historically afflicted SSA countries, as it is hampering the continent's economic growth as servicing external debt diverts scarce fiscal resources from crucial areas of spending for development and growth. As (AFRODAD, 2016) report shows, in 1999 it were estimated that “the Highly-Indebted Poor Countries (HIPCs) spent one third of their tax revenues in servicing their debts.

As a result, many researchers are interested in identifying the effect of external debt on growth and reached different conclusions. Some of the researchers decided that external debt has a negative impact on economic growth. For instance, Greene (1989), Elbadawi et al. (1996), UNECA (1998), Iyoha (1999), Mwaba (2001), Reinhart et al. (2012), and Panizza and Presbitero (2014) conclude that accumulated external debt works against growth. Their findings imply that external debt accumulation discourages investment and retard growth. Their results support theories of both debt overhang and crowding-out effects from excessive external debt burdens on growth and investment in developing countries.

On the other hand, a study by Tunde (2012), Matiti (2013), Zeaud (2014), Spilioti and Vamvoukas, (2015), Cassimon et al. (2015), and Njangang (2018) revealed a positive relationship between external debt and growth. The estimation results of these studies revealed that external debt helps a capital deficient nation to develop its productive activities and infrastructures. These dissimilarities of results suggest an ensuing controversy in the literature about the relationship between external debt and economic growth. Therefore, there is a need for further empirical investigation into the subject matter. Furthermore, although these studies have provided an explanation on the relationship between external debt and economic growth in SSA, there are problems in estimating the effect of external debt on economic growth. It is important to realize that different types of foreign debt do exist. As a result, foreign debt classified as public and publicly guaranteed debt, private non-guaranteed debt, central bank deposits, and loans due to the IMF and WB; this helps to clearly show the effect of foreign debt on economic growth. This study, therefore, seeks to investigate the effects of external public debt on economic growth.

There are three features distinguishing this study from much of the substantial empirical literature on the effect of debt. Firstly, there are some studies conducted mainly on the relationship between external debt and economic growth in SSA. But to the best of knowledge of the author, the existing studies which present the impact of foreign debt on economic growth in the countries did not distinguish between public and private external debt. But this is crucial given that the transmission channels are substantially different. Hence, this paper gives an analysis of the impact of external public debt (public and publicly guaranteed) on the economic growth of selected SSA countries.

The second feature is that the study examines the debt sustainability situation of low-income SSA countries[2]. That is because in low-income countries policies has been at the heart of international investors' concerns, but whose external public debt sustainability has remained mostly unexplored and exposed to external shocks and budget deficits than other economies. The existing empirical literature focuses on the debt crises of SSA countries where middle-income countries of the region are also included. But the concept of debt sustainability in low-income

[2] Low income SSA countries are Benin, Burkina Faso, Burundi, Central African Republic, Chad, Comoros, Congo Democratic Republic, Eritrea, Ethiopia, Gambia, Guinea, Guinea-Bissau, Liberia, Madagascar, Malawi, Mali, Mozambique, Niger, Rwanda, Senegal, Sierra Leone, Somalia, South Sudan, Tanzania, Togo, Uganda, Zimbabwe.

countries is different from that in middle-income countries. Low-income countries are a group of poor countries with weak policy records to relatively middle-income countries that have some access to private capital inflows.

Finally, the study incorporates the issues of both the effect of external public debt on economic growth and external debt sustainability of low-income SSA together. As a result, this paper tries to fill this gap.

1.3.Research Questions

This study aims to addresses the following questions.

- What is the effect of external public debt on economic growth whether this effect is positive or negative (debt overhang [3]and debt crowding out[4])?
- Are low-income SSA countries in a position to pay back their debt obligations without requiring debt relief?
- What policy measures should be used in order to have a sustainable debt in low-income SSA countries?

1.4.The Objective of the Study

The general objective of this study is to test debt sustainability and to examine the relationships between external public debt and economic growth of low-income SSA countries. The study has the following specific objectives:

1. To investigate the effect of external public debt on the economic growth of low-income SSA countries;
2. To analyze the trend of external public debt and economic growth;
3. To examine the effects of other macroeconomic variables on economic growth;

[3] Debt overhang refers to a situation in which the debt of a nation exceeds its future capacity to repay it. This can occur from an output gap or economic underemployment, repeatedly plugged by the creation of additional credit (www.investopedia.com).

[4] Debt crowding out is a situation when increased interest rates lead to a reduction in private investment spending such that it dampens the initial increase of total investment spending. A high magnitude of the crowding out effect may even lead to lesser income in the economy (economictimes.indiatimes.com).

4. To analyze the ability of low-income SSA countries to meet their debt obligations without requiring debt relief or accumulating arrears;

1.5. Significance of the Study

The governments of SSA countries emphasize on external public debt as a way forward to achieve economic growth. Due to these, countries of the region have increasingly accumulated external public debt over time. Continuous debt accumulation harms economic growth. As a result, it is essential to establish a positive relationship between external public debt and economic growth so as to develop the capacity to repay external borrowings. Therefore, the finding from this study contributes to the countries by identifying the relationship between external public debt and economic growth in accordance with the debt servicing capacity of the nations. This paper also contributes to other researchers to give insight for further studies as a source of the document. Moreover, it would be useful to explore the above-mentioned issues by updating data and come up with results that expected to have insightful implications for policy.

1.6. Research Methodology and Data Sources

The study used panel data for 24 SSA countries that are classified as low income based on a measure of national income per person, or GNI per capita. The data covers the period between 2000 and 2017 for all variables included in the study. This paper employed data from the World Bank's World Development Indicator (WDI) database, Global Development Finance database (World Bank), and supplemented with data from the World Economic Outlook database (IMF).
The study employed seven explanatory variables so as to evaluate debt sustainability and the effect of external public debt on economic growth. The variables are external public debt, external public debt service, investment, population, inflation, trade openness, and domestic debt. In this study, both descriptive statistics and econometric methods of data analysis are employed.

1.6.1. Data Limitations

There is problem related to data availability. The problem is that the World Development Indicators database, Global Development Finance database, and World Economic Outlook database provide no data on domestic debt and external public debt for South Sudan, Somalia, and Zimbabwe. The unavailability of such data contributes to the exclusion of these countries from the sample.

1.7.Organization

This paper is organized into five chapters. Chapter one is an introductory part. The second chapter presents a critical review of the literature on external debt-growth nexus and debt sustainability (both theoretical and empirical). The specification of econometric models and the method of analysis are explained in the third chapter. Chapter four presents data and the descriptive analysis of the data as well as the estimation results. The fifth chapter summarizes the main findings and concludes the paper.

CHAPTER TWO

LITERATURE REVIEW

2.1. Theoretical Literature Review

2.1.1. Theories on the Economic Effect of Public Debt

External debt positively affects growth through different channels. But the positive channel works only in the presence of good macroeconomic policies and sound state institutions. In the presence of good economic policies, foreign debt encourages the development process that will definitely improve the investment climate and generate more tax revenues in the long run. It is also argued that foreign debt can also help to improve the governance quality by removing the constraints regarding the low tax revenues and makes possible for the government to invest on those activities that improve the quality of bureaucracy, reduce corruption, and enforce rule of law (Qayyum and Haider, 2012).

Foreign debt may affect economic growth negatively through capital-accumulation and total factor productivity growth channels. Pattillo, Poirson and Ricci (2004) stated that the capital-accumulation channel is supported by the debt-overhang concept and implies that when external debt grows large, investors lower their expectations of returns in anticipation of higher taxes needed to repay debt, so that new domestic and foreign investment is discouraged, which, in turn, slows capital-stock accumulation. Other considerations imply that high debt levels may also constrain growth by lowering total factor productivity growth. For example, governments may be less willing to undertake difficult and costly policy reforms if it is perceived that the future benefit in terms of higher output will accrue partly to foreign creditors. The poorer policy environment, in turn, is likely to affect the efficiency of investment and productivity.

In addition, high levels of uncertainties and instabilities related to the debt overhang are likely to hinder incentives to improve technology or to use resources efficiently. Theories on different periods have shown that public debt can entail both positive and negative effects on growth. In this part, the review of main theories (the classical, the Keynesian, and the monetarist theory) on the economic effect of public indebtedness is presented.

The Classical Views on Public Debt

The principle of "Laissez-Faire" attributes that the state only has the role of ensuring the smooth ongoing of the economy and public authorities allowed to intervene to maintain law and order, and defending from external aggression. The classical economists consider public expenditure as unproductive. This is because in the public sector resources are consumed and managed in an extravagant way compared to the private sector. The classical economists blamed state indebtedness considering that it distorts private capital from its productive function to non-productive uses, thus affecting the accumulation of capital and the growth and development of the economy, so public debt is predominantly unfavorable (Bilan, 2016). In the discussion of public debt the researcher concentrate on four major classical economists (Smith, Ricardo, J.S. Mill, and Malthus).

Smith argues that governments should not run budget deficits because the accumulation of debt is considered as harmful for the nation even if all of it is owed to domestic investors. According to Smith debt will lead to increased taxation, causing the flight of domestic capital and the devaluation of the currency with negative effects on the remaining domestic producers. He concluded that debt severely retards the natural progress of a nation towards wealth and prosperity since resources that could be used productively from the private sector of the economy are diverted by the state in order to finance its unproductive activities. Consequently, Smith proposed balanced budgets, where all government expenditures are financed by taxation. Budget deficits can be justified only in emergencies, like those that arise during wars or natural disasters. In such circumstances, Smith argues that the method of financing public expenditures (i.e., via taxation or issue of public bonds) is crucial for capital accumulation. He describes that taxation does not have the same effects as those of public borrowing which encroaches mainly on savings. The amount of money raised by the government through borrowing crowds out an equal amount of private investment. The two methods of financing government expenditures are not equivalent, and taxation is preferred to borrowing since the latter diminishes savings, that is, the investible product and hence the accumulation capacity of the nation (Tsoulfidis, 2007).

The classical economist David Ricardo explained the effect of public debt by his Ricardian Equivalence Theory. This theory states that the effect of government external debt on the economy is zero or government external debt is not important. When the government reduces tax now and finances its expenditure via borrowed money economic agents know that tax would be increased in the future. Thus, citizens would not consume more rather they would save more in order to pay the future tax and the budget deficit will coincide with an increase in private saving. He concludes that debt did not affect the economic agent's ability to pay tax because no great economic advantage could be achieved by taking debt (Bilan 2016).

Ricardian Equivalence theory is criticized because the theory works only when agents are planning horizon. When the government is dealing with the debt today people know that tax will be higher in the future. However, this theory does not specify the time in the future. But Baro (1974) adopts intergenerational altruism to extend and support Ricardian Equivalence theory of planning Horizon. According to Baro (1974), parents are not eager to increase their consumption today even if they know that tax today is reduced and leave their large part of saving to their children to help to pay higher tax in the future (Bilan, 2016). The other critic of Ricardian Equivalence theory is due to the argument that government debt does not matter to the aggregate economy. Poterba and Summers (1987) claimed that government debt can be repaid by the same generation when the government reduces taxes, issues bonds and after a certain period increases taxes for the interest payment. Ricardian Equivalence theory fails to prove this argument. Furthermore, the Ricardian theory does not provide the effect of myopia[5], people usually are not foresight and do not think about the tax rates in the future.

Unlike some economists in the classical school, Thomas Malthus argues that an adequate level of external debt reduces the gap between the supply and demand of goods and services. The borrowed resource regulates the market by creating more demand or consumption for goods which is overproduced in the market. Similarly, John Stuart Mill identifies the situation where public debt affects growth positively. According to Mill, government debt is important for accumulating productive capital and mobilizing saving to support production companies.

[5]Myopia is the behavior of people, agent and economy in general inability of foresight in the future. "people are shortsighted and often put off decisions, which may be partly due to inertia, the complexity of decision making (choice overload) and present bias" (Johnson et al., 2012).

However, debt causes a problem when public authorities depend on debt to finance its expenditure (Bilan 2016).

In general, the classical economist's argument that public borrowing is always unproductive is criticized by Keynesian economists. Future generations not only inherit liabilities of the payment of interest and principals from the present generation but also inherit the asset.

The Keynesian View on Public Debt

The Keynesian economists oppose the assumptions of "states to be liberal". They argue that government intervention is necessary to supplement the market and correct when imperfections happen (Pressman, 2007). Keynesians and classical economists have an opposite conclusion regarding the effect of public debt. Keynesians prove the positive effect of debt that smooth the functioning of the economy by employing the following arguments. The first argument states that public expenditure negatively affects the national wealth and the prosperity of the nation as a whole. But states involvement in debt contract helps for deficit financing and contributed to economic growth and development and this leads to the increment of employment and output.

The second argument explains that, since the state has the power to distribute resources for economic and social activities, then public borrowing corrects imbalances and ensures an upward evolution of the economy (Neck and Sturm, 2008). The Keynesians view to support the advantage of public debt with strict limits. Debt is necessary only when countries are in a situation of economic recession or stagnation. But after the stagnation or declining economy recovers, the public budget should return to equilibrium.

The View of Monetarist on Public Debt

The monetarists reject the positive effect of debt on economic growth. Their main argument justifies that; increasing money supply via debt only provides a temporary boost to economic growth. Over the long run, it increases the country's sovereign debt. Similarly, when public authorities depend on borrowing to finance budget deficit then the demand for loanable funds

increases while the offer remains unchanged, this contributes to the increment of interest rate and has an unfavorable effect on private investment (Halima, 2013).

To sum up, it is clearly shown from the above section that there is no consensus on debt-growth nexus. The analyses of the three (Smith, Ricardo, and Mill) classical economists and monetarists are complementary to each other and conclude that financing of public expenditures via borrowing is harmful in the economy and to its wealth-generating. In the case where expenditures are necessary, the preferred way of financing them is through taxation. Contrary to this, the Keynesians advocate a positive and significant effect of public debt on economic growth because of its role in financing deficit and government expenditure.

2.2.External Debt Sustainability

The analysis of Cohen (1999) regarding debt sustainability mainly explains whether the current debt burden is sustainable and will the African countries meet their future accumulated debt servicing ability. Cohen develops two conditions for external debt to be sustainable. The first condition is that during the project period balance of payment equilibrium has to be achieved without resorting to "exceptional financing"[6]. And the second condition states that the level of indebtedness at the end of the projection period must be low enough, to avoid future debt service problems.

The external debt sustainability issue is widely debatable in the theoretical and empirical literature. As a result, there are different approaches to debt sustainability, depending on the economic targets and the considerations of lenders' and borrowers' behavior. The approaches are financial sustainability perspective based approach, economic sustainability perspective based approach, and a comprehensive approach to debt sustainability.

[6] Exceptional financing denotes any other arrangements made by the authorities of an economy to finance balance of payment needs (IMF credit and loans, and liabilities consulting foreign authorities' reserves to deal with payment imbalance) (Cohen 1995).

2.2.1. Financial sustainability perspective based approach

Financial sustainability perspective based approach targets mainly the impact of debt on the borrowing country economy and the financial position of debtor country regarding its debt service. There are two types of financial sustainability perspective based approaches; borrower based and the lender based approaches are explained in the following section.

A. The Borrower Based Approach

International Monetary Fund and the World Bank define the external debt sustainability of a country as its ability to meet the current and future external debt service obligations in full, without recourse to debt rescheduling or accumulation of arrears. This concept of sustainability focuses on the behavior of the borrower (the borrower's willingness and ability to repay its debt) rather than on the behavior of the lender. This approach analyzes internal and external problems which borrower country faces and these problems determine the debt capacity of a country. The literature on this viewpoint can be split into three types of models; threshold models, debt optimizing, and non-optimizing models (Sheikh and Abbasi, 2018). According to the threshold model foreign debt plays a positive role in the investment and growth up to a certain point, and it is sustainable; beyond the thresholds, external borrowing hampers economic activity; and it is unsustainable. This model takes the thresholds of debt as exogenous or endogenous.

The debt optimizing model emphasizes how much a country should borrow and the benefit from borrowing after the nation pays its debt back. The debt optimizing model determines the optimal level of debt wherever the marginal cost equal to the marginal benefit of external borrowing.

Marginal Cost of External Borrowing = Marginal Benefit of External Borrowing

If the marginal cost of external borrowing is higher than its marginal benefit, it is beneficial for a borrower country not to borrow as borrowing in such a situation leads to a net loss after all. If the marginal cost of borrowing is less than its marginal benefit, it means that the borrower country is in the situation of net gain and should borrow.

The third model in the financial sustainability perspective based approach is the non-optimizing debt model. This model includes the growth-cum-debt model and debt dynamics model. In the growth-cum-debt model, external borrowing uses to fill the gap between domestic saving and investment. Besides, this role debt will hamper economic growth; and the economy will face the problem of unsustainable external debt level. In this case, the country should decide to borrow when the rate of growth of the economy is higher than the rate of interest. The shortcoming of this model is the lack of attention to foreign currency issues. Similarly, the debt dynamics model links the country's repayment capacity directly to the country's export earnings. In the debt dynamics model, the condition for external debt sustainability is where the cost of borrowing (interest rate) must be less than the growth rate of exports.

B. Lender Based Approach

According to the Intertemporal Budget Constraint-based concept of debt sustainability, the external debt of a country is considered to be sustainable if the country satisfies the condition of the No Ponzi Game (NPG) which requires the equivalence between actual external debt and present discounted value of the country's future trade surpluses.

The NPG condition sometimes also referred to as the present value constraint and testifies that "a country's external debt is sustainable if the Intertemporal Budget Condition (IBC) or transversality condition is fulfilled in the infinite horizon". The necessary condition for the sustainability of a country's external debt is that the current external debt stock should be equal to the present discounted value of future trade surpluses. In terms of growth rates, the criteria restrict that "the growth rate of trade surplus should exceed the interest rate on debt which confirms that the debtor nation is accumulating the sufficient exports' earning that the country can fully retire its current foreign debt obligations" (Sheikh and Abbasi, 2018:25).

2.2.2. Economic sustainability perspective based approach

Economic sustainability perspective identifies the channel through which debt burden retard economic growth of debtor country. This approach takes into account the amount of money needed by debtor countries to reach specific targets of growth and poverty reduction. Economic sustainability approach analyzes the linkages between fiscal deficit, inflation rate, exchange rate, investment, interest rate, imports and exports (balance of payments), economic growth, external debt stock and external debt servicing (Cohen, 1995).

Based on the economic sustainability perspective Arnone et al. (2005) identify two channels (cash flow effect and disincentive effect) through which debt burden affects economic growth. The Cash flow effect states that a debt service burden has a negative impact on investment and capital imports. The main reason is that the greater percentage of reserves (foreign currency) goes to meet debt service and there will be a reduction in external capital because of a decrease in credit worthiness. Similarly, the disincentive effect explains that very high level of debt retards economic growth. This means that a large debt stock discourages investments because potential investors assume that there would be taxes on future income in order to make debt repayments. As a result accumulated debt stock reduces economic growth.

2.2.3. A comprehensive approach to debt sustainability

This approach requires a fully-fledged government budget constraint which includes external debt, domestic debt, and exchange rate. Economic growth is influenced by external debt, domestic debt, and other macroeconomic variables. A more appropriate approach should be based on the government budget constraint that links fiscal deficit, public debt, output growth, inflation, and balance of payments. In fact, a high level of internal indebtedness soaks up resources and diverge money from development and growth programs and it should be considered together with external debt (Cohen, 1995).

2.3. The Debt Crisis of Africa

African countries have not been able to generate a sufficient increase in output, and in particular export earnings, to be able to meet their debt obligations. The countries have undertaken public projects with heavy use of foreign financing to expand industries. Unfortunately, many of the aid-funded projects were unproductive, because of lack of effective macroeconomic policy, protracted civil wars, and excessive population growth. In addition, loans were given to corrupt African leaders who misappropriated the money for their personal enrichment. All of these factors played a great role in the African debt crisis. But the crisis has been severely exacerbated by several other reasons as well, including rise in foreign interest rates, decline in net capital inflows, the oil price shock, and over borrowing (many African countries domestic saving fails to fully provide as a source of capital and this leads countries to become a net foreign borrower) (Greene and Khan 1990).

The oil price shock contributed as a cause for the African debt crisis. In the early 1970s, following the first round of oil-price increases in 1973, “prices for a number of commodities rose sharply. The increment in price raised revenue and this influenced the countries to increase their public expenditure. Revenues from commodity taxation, though higher, did not rise as fast, and governments used foreign borrowing to meet the remaining costs of particular spending projects” (Greene and Khan, 1990: 9). The international banking system appropriated substantial loans to Africa and other developing nations, often without appropriately evaluating the loan requests or monitoring how the borrowed monies were utilized. When commodity prices subsequently fell, expenditures were not reduced commensurately, and governments resorted to additional borrowing to maintain expenditure levels (Ezenwe, 1993).

In addition to the above-listed reasons, Mistry (1991) stated a prolonged and devastating drought between 1981-84 which severely impaired the continent's agricultural and cash crop production and resulted in extensive damage to output and to the financial structure of Africa's fragile economies. Similarly, the emergence of high real interest rates throughout the 1980s compounded Africa's debt servicing and debt accumulation burdens. And protectionism in the world's markets for agricultural products and low technology manufactures makes difficult for

African countries to diversify and increase exports to hard currency markets. Thus, it is difficult for them to earn their way out of the debt trap; as a cause for the African debt crisis.

The debt crisis had a severe impact on African economies. As a result "during 1986-1987 export earnings were about 36 percent below the level of 1980, steadily rising debt-service obligations have sharply constrained Africa's import capacity. By 1987, real imports and real GDP per capita of African countries were 29 and 8 percent respectively below the level of 1980" (Greene and Khan, 1990:12).During the crisis; the decline in the capital- goods and intermediate imports had a serious problem for the productive capacity of African countries. Generally, debt accumulation causes a decline in living standards, imposed constraints on economic policy, impaired the credit worthiness of countries and reduces foreign direct investment (Danso, 1990)

SSA countries responded to the temporary non-oil commodity price booms in the 1980s by adapting adjustment programs aimed to encourage export earning, limiting domestic absorption, reducing inflation, adjusting exchange rate, and increase domestic savings for capital projects. In addition to this, the World Bank employed a mechanism to address the debt problem of low-income countries in 1987. World Bank has secured commitments from major donors "to provide substantial co-financing for its special program of assistance for debt-distressed low-income sub-Saharan countries. And in 1988 the group of seven countries agreed on measures to reduce the bilateral debt service obligations of very low-income countries" (Greene, 1989: 865). The empirical evidence shows that besides the measures listed above, there were other mechanisms assisted countries in meeting their debt service obligations. The mechanisms were lent borrower countries another debt, relaxed the rule of bilateral lenders and established large-scale debt forgiveness programs which gave indebted countries more time to meet their debt service obligations (Greene, 1989).

2.4. SSA Countries Debt Situation

The composition of external debt in SSA has not experienced any significant changes since 1970. Akanbi (2016) indicates that external debt has only declined from an average of about 80 percent in the 1970s to about 68 percent in the 2000s. During the same period, private nonguaranteed debt rose from 3 percent to about 11 percent while the use of the IMF credit and short-term debt remained fairly stable (20 percent) since the 1980s after rising from about 17 percent in the 1970s. Since 1970, debt burdens defined as a ratio of debt to gross domestic product (GDP) or exports have increased rapidly. During 1970 to 1979, an average present value (PV) of external debt as a ratio of GDP was about 22 percent. The ratio rose to about 52 percent (more than double) in the 1980s, "largely due to external shocks and rapid borrowing to finance development" (Akanbi, 2016:857). This trend continued into the 1990s with a rise to about 100 percent. Debt ratios eventually fell to 57 percent of GDP from 2000 to 2012 as a result of debt relief. The debt-to-exports ratio displayed a similar trend, starting at about 103 percent in the 1970s and rising to about 335 percent and 535 percent in the 1980s and 1990s, respectively. Debt relief helped to reduce the debt-to-exports ratio to about 267 percent between 2000 and 2012. In the period covering 2000 to 2012, debt accumulation increased substantially in the region to about 27 percent of GDP and 49 percent of exports despite the rising growths in GDP and exports during this period.

The composition of public external debt in SSA has changed dramatically over recent years. First, the shares of multilateral and concessional external debt were declined steadily in SSA since its peak in 2005. As of 2016, multilateral debt accounted for less than 40% of external public debt on average, down from 53% in 2005. Second, the share of non-Paris club sovereign creditors among bilateral creditors has risen. The share of non-Paris Club creditors in total public and publicly guaranteed external debt doubled, from 15% in 2007 to 30% in 2016. At the same time, the share of the Paris Club[7] bilateral debt decreased from 25% to 7%. While lending from China, which is not a Paris Club member, finances much-needed infrastructure development in the region, these loans to SSA have grown rapidly since the early 2010s and often fund large-

[7]The Paris Club is an informal group of 22 sovereign lenders, hosted at the French Treasury, which aims to coordinate solutions to the payment difficulties experienced by debtor countries (Mustapha and Prizzon, 2018).

scale infrastructure that could pose repayment challenges if projects do not generate sufficient returns, especially in foreign exchange (Mustapha and Prizzon, 2018).

2.5.Empirical Literature Review

Several studies have been conducted to assess the impact of external debt on economic growth. In this section, the available empirical papers are discussed. For this purpose, the empirical studies are grouped into two. The first group contains empirical studies on the area of debt sustainability while the second group includes papers on the nexus between external debt and economic growth

2.5.1. Review on Debt Sustainability

External debt is not sustainable in SSA because of excess accumulation of debt burden. Researchers considered three types of actions to reduce debt accumulation; those are proposals to assist countries in meeting debt service obligations to multilateral organizations, measures for bilateral debt forgiveness, and more general debt forgiveness measures aimed at eliminating both bilateral and multilateral debt and providing all future assistance in the form of grants. Akcay et al. (2002) finding implies an unsustainable fiscal outlook of Turkey and points to the necessity of a policy change towards fiscal austerity if insolvency is to be avoided in the medium to long term.

Similarly, Greene (1989) reviews trends in the debt levels and economic growth of SSA countries and concludes that SSA countries face a severe and growing external debt problem. External debt as a ratio to GDP or exports of goods and services for SSA countries has risen more than threefold since 1980 and exceeds the comparable ratios identified in the Baker initiative. In addition to this, Aguiar and Gopinath (2004) develop a quantitative model of debt and default in a small open economy and present a model of endogenous default that emphasizes the role of switches in growth regimes in matching important business cycle features of emerging markets and in generating default levels that are closer to the frequency observed in the data. They found unsustainable debt in case of a small open economy.

Collard et al. (2015) investigate Sovereign Debt Sustainability in Advanced Economies. Investors willingness to lend a country's government depends on the country's suspected primary surplus, the level, and volatility of its rate of growth, and the amount of debt government expects to be able to propose in the future for the purpose of servicing the debt it seeks to raise today. They provide a simple formula computes a country's maximum sustainable debt (MSD) as a function of four parameters; compute a country's theoretical probability of default (PD) as a function of its debt-to-GDP ratio and calibrate measures for 23 OECD countries and test the relation between sovereign yield spreads and the researchers theoretical probability of default (PD) at prevailing debt levels. The researchers conclude that countries whose actual debt increases beyond MSD generally encounter the difficulty of servicing their debt. A somewhat unexpected yet important result is a country's probability of default increases slowly below MSD and very rapidly above MSD.

2.5.2. The Nexus between Public Debt and Economic Growth

Using different data and methodologies, various researchers have found negative external debt-economic growth nexus. Some of these are Greene, 1989; Iyoha, 1999; Presbitero, 2006;Reinhart et al., 2012; Halima, 2013; Ramzan and Ahmad, 2013; Kourtellos et al., 2013; Ndikumana and Boyce, 2013; Bal and Rath, 2014; Panizza and Presbitero, 2014; Chudik et al., 2015; Eberhardt and Presbitero, 2015; Kim et al., 2017; Siddique and Padda, 2017; and Vita et al., 2018. For instance, Iyoha (1999) investigate the impact of external debt on economic growth in SSA countries between the years 1970 and 1990. The result indicates the significance of debt-overhang variables in the investment equation, suggesting that mounting external debt depresses investment through both a "disincentive" effect and a "crowding out" effect and debt stock reduction would have significantly increased investment and growth performance. Similarly, Presbitero (2005) investigated the nexuses between debt and economic growth in poor countries. He underlines the presence of a negative and linear relationship between past values of the NPV external debt and current economic growth over the period 1977-2002. The adverse effect is due to the "extended debt overhang" according to which a large indebtedness leads to misallocation of capital and discourage long-term investment and structural reforms. However, his study failed to show the effect of current debt on current economic growth.

Even if a debt has an adverse effect on growth, the effect can be reduced or even reversed in the presence of sound macroeconomic policy. The policy measures include reducing the budget deficit, lowering inflation rate, and achieving trade openness. Presbitero (2005) emphasizes the critical role of economic policies and institutions with the necessity of focusing on LICs. As a result, debt relief initiatives should focus on creating fertile ground for macroeconomic stability. Moreover, Ramzan and Ahmad (2013) found a negative external debt effect on Pakistan's economic growth. The researchers allowed external debt to interact with the macroeconomic policy index as an additional factor in the growth regression. They recommended policies that increase the inflow of Foreign Direct Investment are favorable for Pakistan economy. However, the study excludes relevant variables like; domestic debt, export, and trade openness.

Halima (2013) evaluated the effect of external public debt on economic growth in four East African countries from 1981 to 2014 and established that external debt has a negative effect on economic growth. She recommended the countries to adopt an optimal balance between external and domestic debt to ensure sustainable economic growth. But she employed small sample countries relative to other studies. Additionally, Bal and Rath (2014) trace a long-run equilibrium relationship between public debt and economic growth between 1980 and 2011 in India and the results presented that central government debt, total factor productivity (TFP) growth, and debt-services were affected economic growth in the short-run.

On the contrary, other researchers (Matiti, 2013; Zeaud, 2014; Spilioti and Vamvoukas, 2014; Cassimon et al., 2015; and Saifuddin, 2016) find that public debt positively affects economic growth in the steady area. For instance, Spilioti and Vamvoukas (2014) empirical results suggested a positive and statistically significant impact of debt on GDP growth from 1970 to 2010 in Greek. In the study, other variables like fiscal policy indicators affect economic growth. The study included trade openness and other control variables related to the demographic characteristics of the economy.

External debt helps a capital deficient nation to develop its productive activities and infrastructures. Government investments are financed by an additional resource from external debt and this contributes to economic growth. Saifuddin (2016) examines how public debt in

Bangladesh may influence its economic growth. The empirical finding of the study indicates that public debt has made a significant contribution to economic growth not only directly but also indirectly via its effect on investment. From the study, it appears that the resources generated through public debt are basically used for productive investment in Bangladesh. Additionally, Zeaud (2014) examines the impact of public debt on the performance of the Jordanian economy. The study suggests that public debt, population growth, and inflation rate all have a significant relationship with economic growth. Also, it shows that the population growth has a strong, negative and significant relationship with economic growth, while public debt and inflation rate have a positive and significant relationship with economic growth in Jordan.

As far as my knowledge is concerned, studies that showed the positive impact of public external debt on economic growth are investigated in a single country case (employ time series data). Analyzing studies via panel data gives an advantage of more accurate inference of model parameters because panel data usually contain more degrees of freedom and sample variability than time series data. In addition to this panel data allows the researcher to control for variables that cannot be observed and helps to generate accurate predictions for individual outcomes.

Unlike the result of the above-listed studies, there are various researchers found a nonlinear relationship between public external debt and economic growth. For instance, Ludvigson (1996), Egert (2014), Kelbesa (2014), Dogan and Bilgili (2014), Baaziz and Guesmi (2015), Chen et al. (2016), Siddique et al. (2016), and Shahor (2018) empirically verify the non linear effect of public debt on economic growth.

Debt has a positive contribution to the economic growth of low-income countries, albeit up to a point, beyond the threshold it may start to drag economic growth. In this case, the government should finance its expenditure through other mechanisms than debt. Kelbesa (2014) addresses the question of non-linearity in the long-term relationship between public debt and economic growth in SSA. The results present evidence of a bell-shaped relationship between economic growth and total public debt. Higher and lower debt values are associated with lower and higher growth rates, respectively. Similarly, Dogan and Bilgili (2014) examine the non-linear impact of high and growing government external debt on the economic growth of Turkey for the period

from 1974 to 2009. The Paper yields that, the main growth variables such as investment and human capital have a positive impact on growth as expected; eventually, the conclusion reveals that the economic development and borrowing variables do not follow a linear path.

A country borrowing exceeds a certain endogenous threshold level of debt results in efficiency losses. That is due partly to the magnitude of the debt burden and the inability of the country to invest part of its income because of servicing the debt. In such cases, debt forgiveness at a minimal cost of creditors is recommended. Moreover, Shahor (2018) evaluated the impact of public debt on the long run economic growth of Israel. The hypothesis of his study suggested that at low levels of debt to GDP, an increase in debt can increase the long-run growth rate. But beyond a particular debt to GDP ratio, further improvements in the ratio will hurt growth. That means the regression curve has an inverted "U" shape.

Furthermore, Chen et al. (2016) established a nonlinear theoretical model and uses panel smoothing transitional regression to study the optimal levels of government investment and public debt in a growth model using a panel dataset of 65 developed and developing economies over the period 1991–2014. The estimated results show that the positive effects of government investment on economic growth decreases as the level of government investment rises, especially when the government investment/GDP ratio is higher than 20.04%, after which the positive effect would turn to be negative. Similarly, the impact of public debt on economic growth decreases if the size of public debt rises, especially when the public debt/GDP ratio is higher than 59.72%, after which the positive impact would turn into a negative effect. The empirical results support that there should be an optimal level for government investment and public debt as far as economic growth is concerned.

Studies can be reviewed based on the model and the data type they employed. To analyze empirical results researchers used a growth model, and the others employed the autoregressive distributed lag (ARDL) model and a macro-econometric simulation model. So, the researcher briefly reviews those papers which are done by growth model, ARDL, and macro-econometric simulation model below. For instance, Jarju et al. (2016), and Presbitero(2005) analyzed trends and investigated the relationship between external debt and economic growth using descriptive

trend analysis and panel data analysis. The Panel data analysis adopted a reduced-form growth mode using fixed effect and random effect estimators. Similarly, Chudik et al. (2015) specify a heterogeneous dynamic panel-threshold output growth model and provide a formal statistical analysis of debt-threshold effects on output growth. Egert (2015) puts a variant of the Reinhart–Rogoff data set to formal econometric testing to see whether the public debt has a negative nonlinear effect on growth if public debt exceeds 90% of GDP using nonlinear threshold output growth models.

Some researchers employed a simulation approach to investigate the impact of external debt on economic growth. The basic macro-econometric simulation model consists of two stochastic equations and one identity. The two stochastic equations relate to the production function (output equation) and an investment demand equation incorporating a debt overhang variable in addition to a variable to capture the "crowding out" effect of debt service payments. The third equation is the debt accumulation identity. The simultaneous equation model is estimated using the two-stage least squares technique. For instance, Iyoha (1999) uses a simulation approach In particular; it undertakes policy simulations (using alternative debt stock reduction scenarios) to analyze the effect of debt on investment and output in SSA countries between 1987 and 1994. Ramzan and Ahmad (2013) employ the standard growth model. Debt variables namely external debt to GDP ratio and debt service to export ratio, are included in the standard growth model. The empirical analysis for the impact of external debt on growth employed the ARDL approach to co-integration. Ludvigson (1996) examines how government liabilities affect macroeconomic aggregates in a standard general equilibrium growth model. Bhandari et al. (1990) construct and analyzed an optimizing growth model for a highly indebted small open economy. An important innovation in the model is the incorporation of sovereign risk through the specification of an upward-sloping foreign debt supply function.

Studies that employed vector auto-regressions are the following; Lof and Malinen (2014) estimate panel vector auto-regressions to analyze the highly disputed relationship between sovereign debt and economic growth. In an attempt to decompose cause and effect, the researchers estimate panel vector auto-regressions (PVAR) that describe the dynamic relationship between sovereign debt and economic growth, using data on debt and GDP for a

panel of 20 developed countries ranging from the beginning of the 20th century. Accordingly, Bal and Rath (2014) implement the autoregressive distributed lag (ARDL) model, or bound testing approach to check the existence of the short and long-run relationship between per capita economic growth, domestic debt, external debt, debt services ratio, TFP growth, and exports in India. They employ the ARDL model for two reasons. First, there are combinations of I (0) and I (1) order among the variables that are involved in the model. Second, this approach is more suitable for the small and finite sample data period.

Siddiqueet al. *(*2016) examine the influence of a change in external debt on economic growth in the HIPC countries over the period 1970 to 2007 using recent developments in time series and cross-sectional analysis. To model the relationship between external debt and the economic performance of the HIPCs, the researchers use the stationarity and co-integration test. The results suggest that a dynamic model such as an Auto Regressive Distributed Lag (ARDL) model would be most suitable for the analysis as some of the variables are I(0), and others are I(1).

To sum up, as far as the author knowledge concerned this study is expected to fill the gap of the existing literatures by analyzing the external debt growth nexus and debt sustainability together. Similarly, it is necessary to classify African countries based on their income group. This is because their situation is different on external public debt and this study focus on low income SSA countries with recent data set (2000-2017).

CHAPTER THREE

METHODOLOGY OF THE STUDY

This chapter presents the empirical models and various tests that were conducted to ascertain the validity of the data and the effectiveness of the model in order to analyze debt sustainability and debt-growth nexus in the selected Sub-Saharan African Countries.

3.1.Theoretical Framework for Debt Sustainability

Econometric tests of debt sustainability consist of investigating whether export, import, and other debt sustainability indicators are co-integrated. The theoretical framework of this study is based on the Husted (1992) framework. Husted (1992) provides a simple small-economy framework in which a representative household is able to borrow and lend freely in international financial markets at a given world rate of interest. The representative agent's budget constraint derived as follows:

$$Y_0 = C_0 + I_0 + NX_0 \qquad \text{where: } NX_0 = X_0 - M_0 \tag{1}$$

Husted (1992) considers the above equation as a small open economy that produces and exports a single composite of good and has no government.

The agent is able to borrow and lend in international markets using one-period financial instruments, faces a given world rate of interest, and is assumed to maximize lifetime utility subject to budget constraints. The current period budget constraint of this agent is given in equation (2)

$$C_0 = Y_0 + B_0 - I_0 - (1 + r_0) B_{-1} \qquad \text{where: } NX_0 = (1 + r_0) B_{-1} - B_0 \tag{2}$$

Where C_O is current consumption; Y_O is output; I_o is an investment; r_o is the one-period world interest rate; B_0 is international borrowing; and $(1 + r_O) B_{-1}$ is the initial debt of the representative agents, corresponding to the country's external debt.

Husted (1992) suggested that equation (2) hold for every time period. Iterating equation (2) forward provides the economy's inter-temporal budget constraint.

$$B_0 = \sum_{t=1}^{\infty} \delta t\, NXt + \lim_{n\to\infty} \delta n Bn \quad (3)$$

Where NXt is the trade balance in period t which equals $NXt = Xt - Mt = Yt - Ct - It$, Xt equals export and Mtis import, andδtis the discount factor or$\delta t = 1/(1+r)t$.

A necessary and sufficient condition for external debt sustainability is that as $n\to\infty$, the discounted value of the external debt converges asymptotically to zero. This transversality condition can be expressed as:

$$\mathrm{Lim}_{n\to\infty}\, \delta n Bn = 0 \quad (4)$$

Equation (4) implies that a country cannot borrow (lend) indefinitely in global capital markets to finance its trade account deficit (surplus). If this transversality condition holds, then the amount of country borrows (lends) in international financial markets equals the present value of the future trade surplus (deficits). Thus, a test for the sustainability of the external debt can check for the co-integration of Mt and Xt. If they are I (1) this co-integration regression takes the following form:

$$X_t = a + \delta M_t + U_t \quad (5)$$

Formally, if M_t and X_t are I (1), the null hypothesis is that M_t and X_t are co-integrated and $\delta = 1$. If the null hypothesis is not rejected, then the external debt is said to be sustainable.

3.2.Theoretical Framework and Model Specification for External Public Debt-Economic Growth Nexus

The study uses panel data analysis with annual datasets from 2000 to 2017 and aims to show the impact of external public debt on the economic growth of low-income SSA countries. The theoretical foundation is the augmented Solow model and endogenous growth model with a modification that extends the basic production function framework to permit human capital as an additional input into the production function following Romer (1996) and debt burden following

Cunningham (1993). As implied by the Solow's formulation, economic growth is a function of capital accumulation, labor force, and exogenous technological progress which makes physical capital and labor more productive. According to the endogenous growth model, human capital influences economic growth as:

$$Y=f(K, HK, LF, A) \quad (6)$$

Where Y is a proxy for economic growth; K is capital stock; HK represents Human capital; LF denotes labor force and A is technology. Although the endogenous growth model explains variables which affect economic growth, the model does not consider the impact of debt burden on economic growth. But Cunningham (1993) revealed debt burden is a vital determinant of economic growth especially, for those who are developing and highly indebted economies. Then after including debt burden as a new variable, the growth model can be expressed as:

$$Y=f(K, HK, LF, DB, A) \quad (7)$$

Where Y is a proxy for economic growth; K is capital stock; HK represents Human capital; LF denotes labor force; A is technology and DB is debt burden. To assess the impact of external debt on growth, in this study variables namely external public debt to GDP ratio and debt service to export ratio, are included in the standard growth model. In many of the studies, the ratio of the gross fixed domestic investment to GDP is employed as a proxy variable for capital stock. In this study, the researcher employs domestic investment including FDI as a proxy variable for K. In this study, I incorporate both human capital and labor force as labor and employs population growth as a proxy for rates of growth in labor as a factor input for the production process.

GDP is affected by other important variables, which must be included in the GDP equation in order to avoid specification bias in the debt–growth relationship. These control variables in this study include inflation rate, trade openness, and domestic debt. Openness measured by the total trade (sum of import and export of goods and services) as a ratio to GDP and reflects what extent an economic activity of a country is linked to the rest of the world.

Based on economic theories and using equation (7), this study modeled GDP growth as a function of external public debt (EPD), external public debt service (EPDS), investment (INV),

population growth (POP), trade openness (TOP), Domestic debt(DOM) ,and inflation rate (INF). This relationship is expressed as:

$$GDP = \beta_0 + \beta_1 lnEPD_{it} + \beta_2 lnEPDS_{it} + \beta_3 lnINV_{it} + \beta_4 POP_{it} + \beta_5 lnTOP_{it} + \beta_6 lnDOM_{it} + \beta_7 lnINF_{it} + U_{it} \quad (8)$$

3.3.Description of Variables

This paper used the Gross Domestic Product as a proxy for economic growth. GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products (World Bank, 2014). The World Bank has calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. The study employed external Public debt to GDP ratio as a proxy for capturing external debt burden. It is the amount of debt owed to nonresidents by the borrower country government and repayable in currency, goods, or services. External public borrowing related to economic growth positively via financing public investment and bridges the resources gap of the borrower country. On the other way, it discourages investment when it is not used for productive purpose. Therefore, the stock of external public debt in this study is expected to have either a positive or negative impact on the economy.

Similarly, external public debt servicing to export ratio issued as a proxy for total debt service. Karagol (2002) and Celement et al. (2003) argued that external debt service burden has a negative impact on investment and capital accumulation. The main reason is that the greater percentage of capital and foreign currency reserves goes to meet debt service and there will be a reduction in domestic resource and will lead to poor trade performance. Additionally, when the debtor countries are unable to meet their debt services promptly, they face bad credit standing and will have difficulties in borrowing and pay too much to get new credit. As a result, Public external debt servicing is assumed to have a negative effect on economic growth in this study.

Investment refers to the purchase of goods that are not consumed today but are used in the future to create wealth. An investment is an asset acquired with the goal of generating income. Jorgenson (2003) states that investment in tangible assets is the most important source of economic growth and can encourage growth through the use of sound investment at the business

level. Investment increases production and this leads to a rise in nations gross domestic product and this allows the economy to grow. Due to this investment in this study is expected to have a positive effect on economic growth. Additionally, Population growth represents population growth rate in percent. Population growth benefits growth in different ways. First, an increase in population means an increase in the number of the working population who can function as an active participant in the process of economic growth. Secondly, a growing population means a growing market for most goods and services. Therefore, the expected sign of population growth is positive.

Inflation is a quantitative measure of the generally rising prices of goods and services within a particular economy. A high rate of inflation is a sign of internal economic instability and tends to cause uncertainty and leading to less investment. It also leads to lower international competitiveness, to fewer exports with higher demand for imports and deterioration in the current account balance of payment (Ayyoubet al., 2011). Due to this fact, the inflation rate in this study is expected to have a negative impact on economic growth. Furthermore, Trade openness can potentially enhance economic growth by providing access to goods and services, achieving efficiency in the allocation of resources and improving total factor productivity through technology diffusion and knowledge dissemination (Rajan and Zingales, 2003). The expected sign is positive in this study.

Finally, domestic debt is expected to have a positive and significant effect on economic growth. According to Babu et al. (2015) domestic debt is debt owed to holders of Government securities such as Treasury Bills and Treasury Bonds. Governments usually borrow by issuing securities, government bonds and bills. Governments borrow for two reasons: when the projected revenue targets fall short of the projected expenditure and to pay off maturing loans. Therefore, the expected sign of domestic debt is positive.

3.4. Estimation Procedure

This paper employs panel data econometric analysis to identify the effect of external public debt on the economic growth of selected SSA countries using the above model. The estimation procedure involves the following tests. A panel unit root test uses to determine the stationarity status of all the variables under consideration or to determine the order of integration. The direct

application of ordinary least square (OLS) or generalized least squares (GLS) to non-stationary data produces spurious results with inflated test statistics, such as high R^2s and t-statistics. It is therefore relevant to begin panel data analysis with unit root tests (Engle and Granger, 1987). This paper thus, employed a panel unit root tests which are based on Levin et al. (2002) test which supposes a common unit root under the null hypothesis and ImPesaran and Shin (2003) test carried out on a single series.

Secondly, both the fixed effect (FE) and the random effect (RE) model are estimated. The FE model allows exploring the relationship between external public debt and economic growth within each selected SSA countries. Fixed effect model is employed due to the reason that each country has a unique macroeconomic environment with variables that may or may not affect GDP growth. The model assumes that unobserved country-specific factors may impact economic growth, hence the need to control for them. The unobserved country-specific factors are correlated with one or more of the explanatory variables. Another important assumption of the FE model is that those time-invariant characteristics are unique to the country and should not be correlated with other country characteristics. Each country is different therefore the country's error term and the constant should not be correlated with the others. While Random Effect model assumes that differences across entities are random and uncorrelated with the independent variables. It is also based on the assumption that the error terms of individual entities are not correlated with the independent variables.

As a result, the Hausman test is conducted to select either the FE or the RE model as appropriate. The test is based on the null hypothesis that the preferred model is a random effect and the alternative hypothesis represents a fixed effect model. Finally, other panel diagnostic tests (heteroskedasticity, multicollinearity and, cross sectional dependency) are performed. The condition of the classical linear regression model implies that the error term of the regression model should be homoscedasticity. This means that the variance of the error term should be constant and same otherwise; the condition for homoscedasticity would be violated (the model become heteroskedasticity).

Similarly, Multicollinearity is a case of multiple regression in which the predictor variables are themselves highly correlated or indicates a linear relationship between explanatory variables which may cause the regression model biased. When independent variables are multicollinear

then the individual “P” values can be misleading (a P value can be high, even though the variable is important). Multicollinearity also causes a problem that the confidence intervals on the regression coefficients will be very wide. In this case, the researcher cannot be confident in the effect of explanatory variables (Paul, 2014). Furthermore, the debt sustainability condition of selected SSA is assessed based on three econometrics tests. The techniques are univariate unit root tests, panel unit root tests, and panel co-integration tests.

CHAPTER FOUR

EMPIRICAL RESULTS AND DISCUSSION

In this chapter, data obtained from different sources are analyzed using trend graphs, descriptive and econometric analysis. In the first part of the chapter trend graphs for variables over time are conducted. The trend graphs provide us a picture of how our variables of interest behave over time. In the second part, descriptive statistics for all variables are presented to identify the characteristics of variables. Finally, multivariate econometric analysis is made to assess the external public debt- growth nexus, and the debt sustainability situations of selected SSA.

4.1.Trend Analysis of Variables

4.1.1. Trends of SSA Economic Growth

From the end of the 19th century, SSA countries suffered around 60 years of colonial embezzlement and have a decade of independence in the 1960s. As a result of the colonial era, SSA countries experienced serious challenges for economic growth, and the nations were dependent mainly on imports. In addition to this colonialism restricted the continent participation in only limited long-distance trade and the countries became cash crop producer and exporter of minerals to the rest of the world. Figure1 below presents the trend of SSA countries economic growth from 1970 to 2017.

As indicated by the figure1 below, the GDP growth of SSA countries increased in the year from 1971 to 1975. The rate increased to 31 percent in 1975 from 2 percent in 1971. In late 1975 there was an improvement in economic growth but not as rapid as the growth from 1970 to 1975. UNCTD (2001) illustrated that in 1970, SSA recorded accelerated growth with a boom in commodity prices and foreign aid. Investment in many countries in the region exceeded 25 percent of GDP, and the saving gap remained relatively moderate.

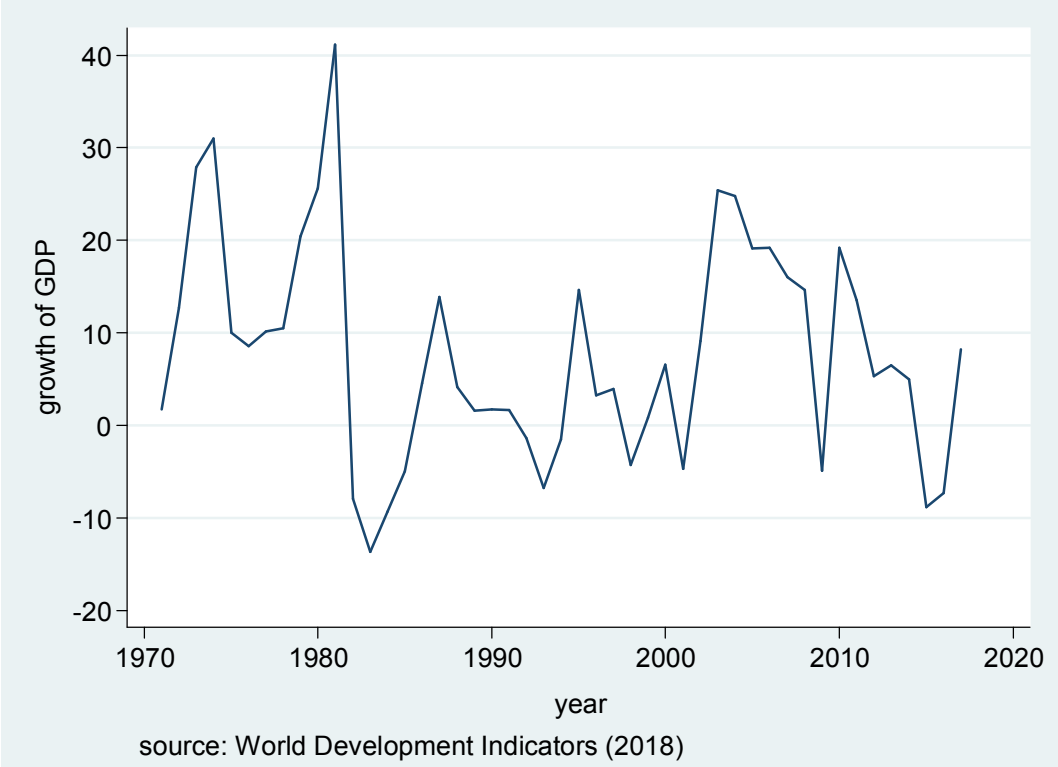

Figure 1: Trends of SSA countries economic growth

The above figure shows that the GDP growth rate fluctuates between the years 1981 and 1990. It was 41 percent in 1981 and 2 percent in 1990. The shocks of the 1980s exposed the vulnerable nature of African economies, with their low per capita incomes, generally small economic size, and a high dependence on the export of primary commodities. Addison et al. (2017) stated that the 1980s have been characterized as a disastrous experience in terms of development for Africa and saw severe crisis across much of SSA, as terms-of-trade shocks hit economies. The 1979 oil-price crisis substantially increased the import bills of oil-importing countries, many of which also saw a fall in the prices of their commodity exports (mainly unprocessed agricultural products) as the global economy slowed in response to the oil-price shock. The resulting foreign exchange shortages undermined the emerging industrial sector, which was highly dependent upon imports of intermediate inputs and capital equipment. The industrial strategy was largely import-substituting in nature and reliant on mostly small domestic markets.

The figure also illustrates that SSA GDP was US$ 342 billion in the year 1991 and US$ 392 billion in 2000. GDP growth increased between the years 2001 and 2005; it was negative 5

percent and 19 percent respectively. GDP was US$ 906 billion in the year 2006 and US$ 1366 billion in 2010, and the rate was 19 percent. Fosu (2010) recognizes that total factor productivity and terms of trade improvement as sources for the growth recovery in the late 1990s. Many of SSA member countries were benefited from Structural Adjustment Programs (SAPs); leading to the improvement of their corresponding macroeconomic environments for growth. Finally, the above figure explains that the GDP growth rate was 14 percent in 2011 and a negative 9 percent in 2015. And the rate increased and became positive (8 percent) in 2017 and World Bank forecasts that SSA Africa GDP growth will increase in 2019.

4.1.2. The trend of External Public Debt in Low-Income SSA

Despite the increment of GDP growth in the region, the public debt, however, remains one of the main economic policy challenges facing governments and could lead the countries into an economic crisis. African countries borrowed heavily in the 1970s with some using commodities as collateral for the borrowed funds (Manzano et al., 2001). Increased oil prices in the 1970s, resulted in an increased need for credit to pay for imported oil. The resultant effect was a rose in debt levels in developing countries including SSA (Chiminyaet al., 2018).

Figure2 below indicates that the amount of external public debt fluctuates from year to year in low income SSA. In the early 1990s, there was a smooth growth of external public debt in the region. From the year 1995 to 2000 the rate of external public debt was 3 and negative 3 percent in low-income SSA[8]. In the mid-1990s debt forgiveness under the Highly Indebted Poor Countries, Initiative (HIPC) reduced the debt burden in most African countries.

[8] Low-income economies are defined as those with a GNI per capita, calculated using the World Bank Atlas method, of $995 or less in 2017;

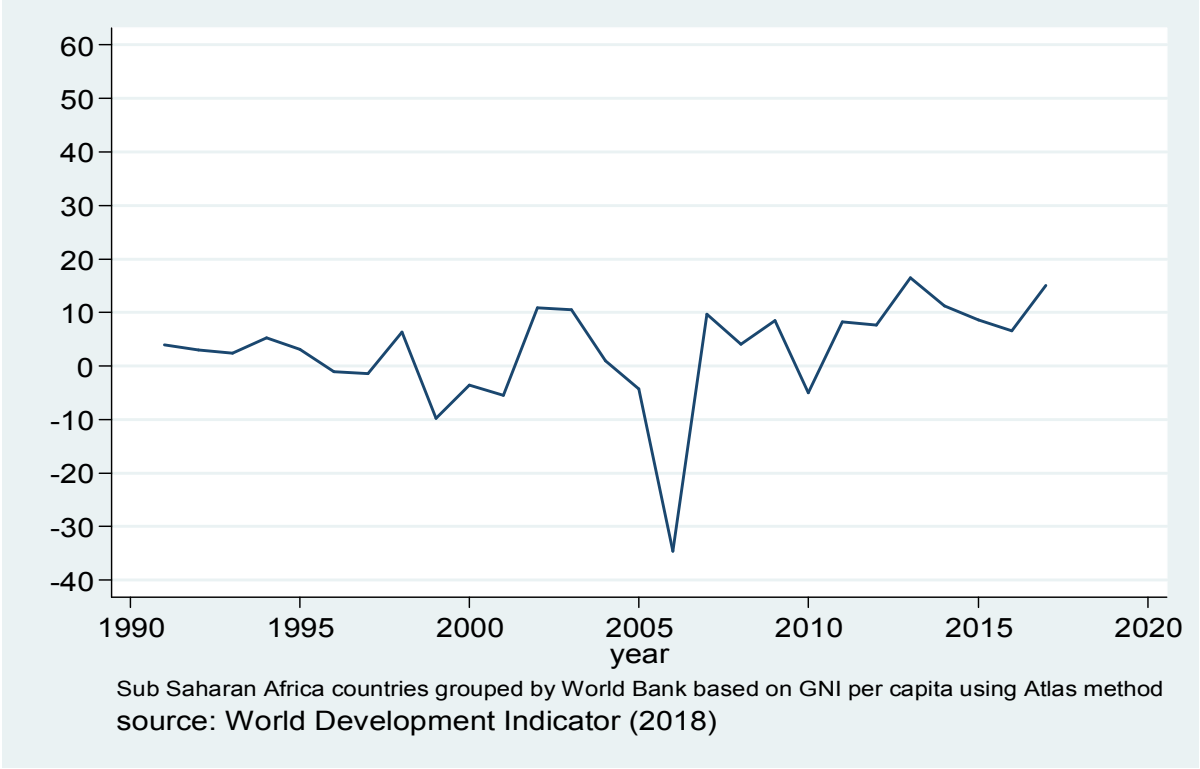

Figure 2: Trend of external public debt in low-income SSA from the year 1990-2017

Figure 2 also shows that in the early 2000s, external public debt burden increased with a small amount; while this burden decreased in 2005 mainly because of debt forgiveness under Multi-lateral Debt Relief Initiatives (MDRI). MDRI was approved on 2005 by Group of 8 major industrial countries proposed that the IMF, the World Bank, and the African development fund aimed to cancel 100 percent of their debt claims on countries that had reached, or would eventually reach, the "completion point"[9]. Since 2010 SSA's debt levels have increased and reached US$ 100 billion for low income countries of SSA in 2017. Generally, external public debt is very high in lower-income SSA countries.

[9] In order to receive full and irrevocable reduction in debt relief a country must met the following criteria's; first, establish a further track record of good performance under programs supported by loans from the IMF and the World Bank; second, Implement satisfactorily key reforms ; and third, Adopt and implement its Poverty Reduction Strategy Paper for at least one year. Once a country has met these criteria, it can reach its completion point (IMF factsheet, 2019).

4.1.3. Low-Income SSA Countries Economic Growth and Debt

Figure 3 below demonstrates that the GDP rate for SSA associated with relatively less fluctuating rate of public external debt between 1970 and 2000. In the years between 2001 and 2010 low-income, SSA countries economic growth and rate of external public debt increased and decreased, respectively. The rate of external public debt shows improvement from the year 2013 to 2017. Bernardin et al. (2018) explained that even though many countries in the developing regions have managed to restore growth fortunes after the global economic distress of the 1980s, stagnation persisted in SSA into the first half of the 1990s due to the burden of external debt. The drastic decline in external debt rate starting from 2001 was on account of many SSA countries subscribing to debt relief under the highly indebted poor countries (HIPC) initiative. The improved growth performance witnessed following the declining debt burden could be indicating the increment of additional resources through reduced external debt service obligations to push growth.

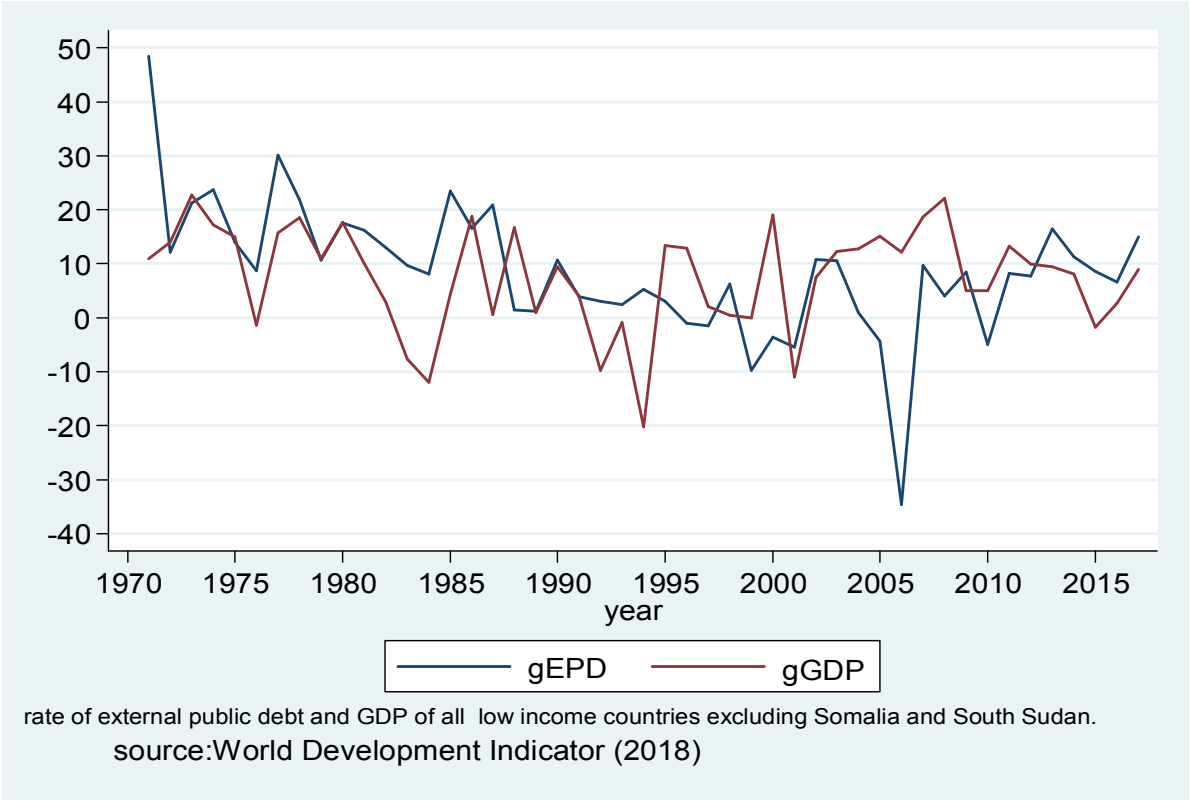

Figure 3: Relationship between external public debt and economic growth of low-income SSA from 1970 to 2017.

4.1.4. Low Income SSA External Public Debt and Debt Service

The challenge facing SSA and the international community in the 1990s was how to service the external debt while resuming growth. Similarly, the balance between growth resumption and external debt service financing has become the most intractable problem facing low-income SSA nations. In figure 4 below the rate of external public debt service exceeds the growth of external public debt in the early 1970s. However, from the year 1980 to 1995, the rate of external public debt was higher than the rate of external public debt service. Low-income SSA countries external public debt service was US$ 1.3 billion and external public debt was US$ 17.6 billion in 1980. In the year 1995, external public debt service and external public debt were US$ 2 and 64.6 billion, respectively. In recent years external public debt payment of low-income SSA countries shows small improvement due to the recorded improvement of economic growth. External public debt service was US$ 3.5, 3, 3.7 and 4.1 billion in the years 2014 to 2017, respectively.

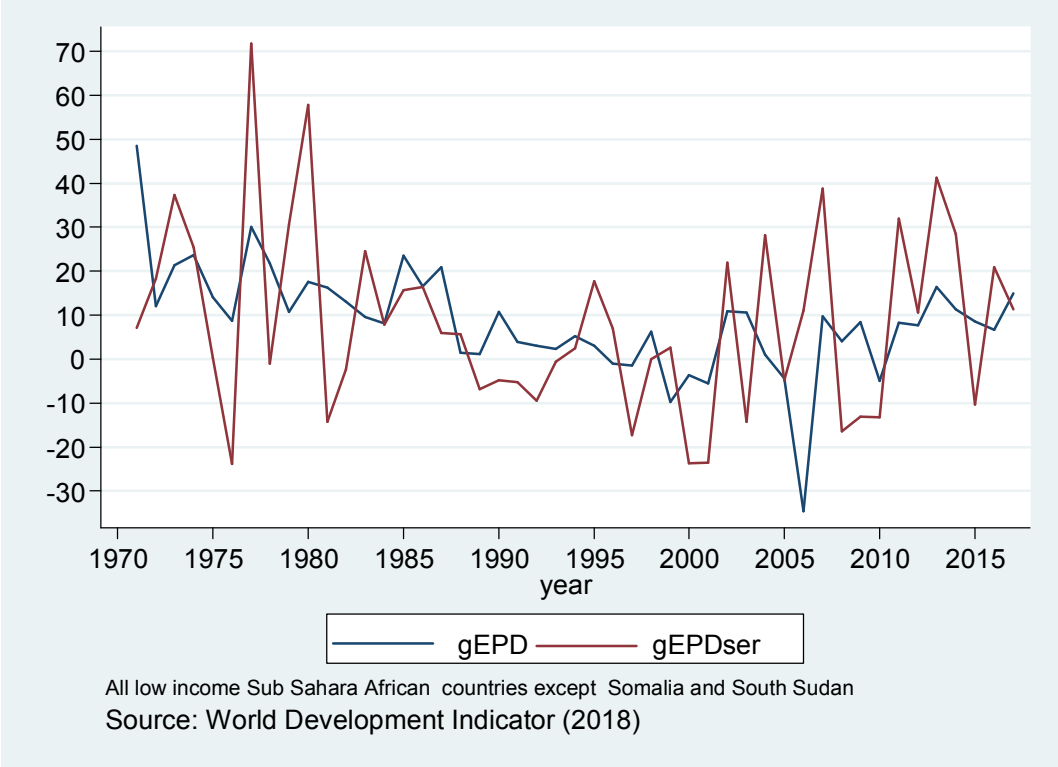

Figure 4: Relationship between external public debt and external public debt service of low-income SSA from 1970 to 2017.

4.1.5. Total External Debt Compositions in SSA

The composition of total external debt is an influential factor in debt analysis since it has a direct effect on the processes of debt repayment, rescheduling, and relief. External debt consists of three major divisions of debt; long term debt, short term debt, and IMF credit. Hence, long term debt consists of public and publicly guaranteed debt and private non-guaranteed debt. Due to the inconsistency of data for IMF credit, the researcher incorporates only long and short term debt in the chart below.

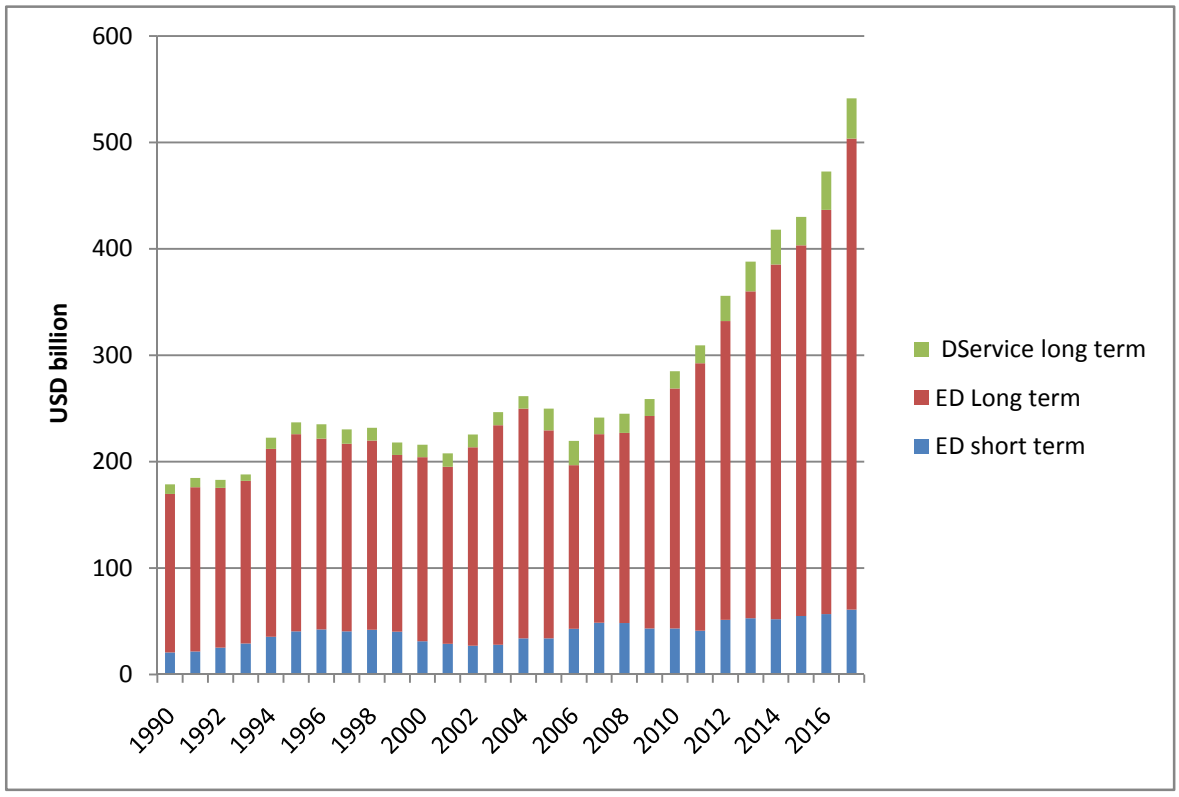

Figure 5: Composition of SSA total external debt and debt payment between years 1990 and 2017. Data for Seychelles, Somalia, and South Sudan not available

The above figure explains that long term debt remained the largest component of external debt. In 1990 short term external debt, long term external debt, and long term debt service were US$ 20.6 billion, US$ 149 billion, and US$ 9 billion, respectively. Starting from the year 2010 to 2017 a large increment in long term external debt was recorded. Short term external debt, the long term external debt, and long term debt service become US$ 61 billion, US$ 443 billion and

US$ 38 billion, respectively in 2017. From the graph above, it is concluded that short term and long term external debts had been increasing over time. But the growth rate of short term external debt was slow compared to long term external debt. The pattern of long term debt service indicates that SSA accumulated a substantial amount of arrears.

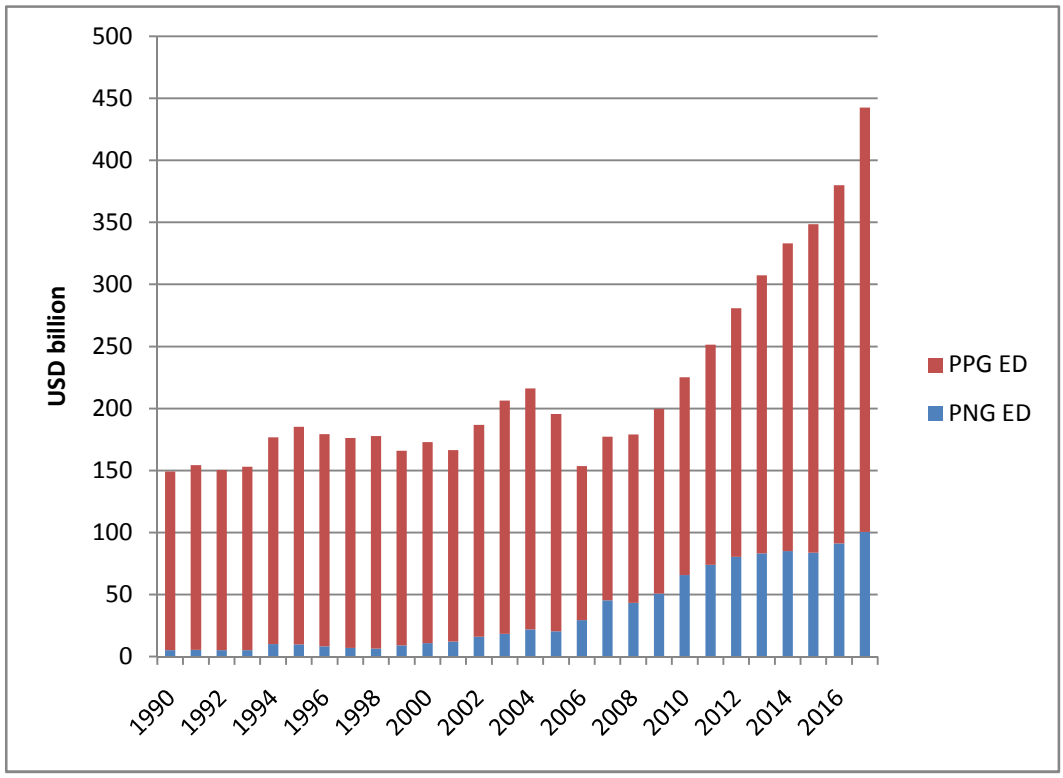

Figure 6: Composition of SSA long term external debt from 1990 to 2017. Data for Seychelles, Somalia, and South Sudan not available

The distribution of long term external debt into public and publicly guaranteed, and privately not guaranteed is necessary due to its bearing on the issues of financial access, debt repayment and relief (Fosu, 1996). It is clearly shown from figure 6 above that the largest share of external public debt is in the form of public and publicly guaranteed. In the year 1990 PPG and PNG were US$ 144 billion and US$ 5 billion, respectively. Debt forgiveness under the Highly Indebted Poor Countries Initiative (HIPC) in 1996 and debt forgiveness under Multi-lateral Debt Relief Initiatives (MDRI) in 2006 reduce the external debt burden. From the figure above, both PPG and PNG reach a higher point in 2017 and become US$ 342 billion and US$ 100 billion,

respectively. The maximum and minimum value of PPG was recorded in Central Africa republic in 2008 and Comoros in 2015, respectively.

4.2. Descriptive Statistics

The descriptive statistic shows the characteristics of variables with 432 observations between 2000 and 2017 over 24 SSA countries. Based on table 1 on average, each country's gross domestic product varies by US$ 10.8 billion from the mean of US$ 7.9 billion. The maximum GDP is US$ 80.6 billion for Ethiopia in 2017 whereas the minimum GDP is US$ 1.82 for Burkina Faso in 2000. This higher variation of GDP implies that low-income SSA countries have heterogeneous economic growth during the study period.

Table 1 presents the external public debt-to-GDP ratio has a higher variation of 0.52 from the mean of 0.17 for the overall observation. External public debt to GDP ratio has the maximum value of 2.8 for the Central Africa Republic in 2008 and a minimum of 0.07 for Liberia in 2013. This variation in the external public debt-to-GDP ratio resulted from the investment and other related policies they adapted as a way to reduce external borrowing and to promote economic growth.

From table 1 below it is possible to understand that the external public debt service-to-export ratio has a small variation of 0.28 from the mean of 0.097 of the observation. There is a minimum amount of debt service and export earnings in those countries as a result; external public debt is highly accumulated. Countries with high debt burden and currency not tradable in the international market require enough inflow of foreign exchange to service the debt. A situation where a country has low exports and capital inflows as well as inadequate reserves, debt servicing becomes a problem to economic growth.

Similarly, Investment has a higher standard deviation of 4.11 billion with a mean of 1.94 billion for all observations. Investment has a maximum value of US$ 43.3 billion for Ethiopia in 2004 and a minimum value of US$ negative 1.78 billion and this value were recorded for Liberia in the year 2012. This variation is due to the policies formulated and the attractive environment created in the countries to promote foreign and domestic investment.

Table 1: Summary of descriptive statistics

Var	Obs	Mean	Std. Dev	Min	Max
GDP	432	7.93*	10.8*	1.8	80.6*
EPD	432	0.16 *	0.52*	0.07	2.8*
EPDS	432	0.09	0.28	0.00004	4.3
INV	432	1.9*	4.11*	-1.7*	43.3*
POP	432	2.8	0.61	0.2	5.5
INF	432	9.2	30.6	-8.9	513.9
TOP	432	0.028*	0.161*	0.029	1.3*
DOM	432	0.77*	4.72*	-0.56	52.4*

Source: Authors computation from WDI (2018). * indicates values in US$ billion.

The sixth row of the above table presents the summary of population growth. It has the highest value of 5.5 percent for Rwanda in 2000 and a minimum value of 0.2 percent for the Central Africa Republic in 2013. Population growth has a small variation of 0.61 percent from the mean of 2.83 percent for all low-income SSA countries. Population growth is very high in those countries and it is difficult to provide employment and this reduces the productivity of labor force and this adversely affects capital formation and economic growth.

Generally, the above table explained that the mean and standard deviation of Gross Domestic Product and external public debt service as a rate of export has relatively higher and lower value respectively. A low standard deviation indicates that the data points tend to be close to the mean of the data set, while a high standard deviation indicates that the data points are spread out over a wider range of values from the mean. Investment and the gross domestic product have extremely minimum and maximum value for low-income SSA countries between 2000 and 2017.

4.3.Econometric Result

4.3.1. Results of Panel Unit Root Test

The first step in the econometric analysis is to carry out a unit root test on the variables of interest. The test examines whether the variables are stationary or not. Non-stationary data has often been regarded as a problem in the empirical analysis. Working with non-stationary variables may lead to spurious regression results, from which further inference is meaningless. Panel unit root test is conducted based on Levin-Lin-Chu and ImPesaran-Shin test. The results from the tests are presented in table 2 below and all the variables except external public debt and external public debt services are stationary in level. External public debt and external public debt services are stationary at first difference. Hence, all the variables are integrated of order zero and one the basic conditions for the applications of other test are met and can move to the next step of the analysis.

Table 2: Unit Root test result

Var	**Levin-Lin-Chu**		**Im-Pesaran-Shin**	
	t-statistic	**P-value**	**t-statistic**	**P-value**
lnGDP	-6.1094	0.0000*	-5.1539	0.0000*
lnEPD	-1.5728	0.0579	-1.3276	0.0922
lnEPDS	0.4910	0.6883	-0.1473	0.4415
lnINV	-3.0759	0.0010*	-2.3998	0.0001*
POP	-8.2349	0.0000 *	-2.3212	0.0101*
lnINF	-5.9949	0.0000*	-3.2777	0.0000*
lnTOP	-5.6768	0.0000 *	-6.0009	0.0000*
lnDOM	-2.8025	0.0025*	2.4748	0.0005*
	t-statistic	**P-value**	**t-statistic**	**P-value**
lnEPD	-4.7403	0.0000**	-8.5440	0.0000**
lnEPDS	-9.5041	0.0000**	-9.8945	0.0000**

Source: Authors computation from the WDI (2018). The null hypothesis is non-stationarity and the alternative hypothesis is stationarity.* and ** indicates statistical significance at I (0) (level) and I (1) (first difference), respectively.

4.3.2. Test for Heteroscedasticity

The presence of heteroskedasticity in this study is tested using the Modified Wald test for GroupWise heteroskedasticity and the result is presented in the Annex**.** The result of the heteroscedasticity test in fixed effect regression model indicates the presence of heteroscedasticity as the null hypothesis of 'homoscedasticity' was rejected at the 5 percent level of significance. Thus, the problem of heteroscedasticity is corrected by re-estimating the fixed effect model with robust standard errors.

4.3.3. Multicollinearity Test

Multicollinearity test is conducted by calculating the VIF for each variable, and the results are presented in Table 3. Multicollinearity is not a problem of this study since the VIFs for all explanatory variables are less than 10.

Table 3: Multicollinearity test result

Var	**VIF**	**1/VIF**
lnEPD	1.87	0.536148
lnEPDS	1.06	0.943281
lnINV	1.34	0.748842
POP	1.26	0.794921
lnINF	1.06	0.942150
lnTOP	5.16	0.193661
lnDOM	4.44	0.225092
Mean VIF	2.31	

Source: Authors computation from WDI (2018)

4.3.4. Test for Cross-Sectional Dependence

Pesaran CD (cross-sectional dependence) test is used to test whether the residuals are correlated across entities with the null hypothesis of not correlated residuals. The test result is presented in the Annex. According to Pesaran's test, the researcher rejected the null hypothesis (it is significant at 5% that says residuals are correlated). Thus, it is mandatory to cluster the data by countries, which handle arbitrary forms of spatial dependence in conjunction with heteroskedasticity and autocorrelation. Therefore performing fixed effect regression with clustering errors makes standard errors robust to very general forms of cross-sectional.

4.3.5. Tests for Debt Sustainability

There are three types of tests applied on debt sustainability indicators (external public debt to GDP ratio and external public debt service to export ratio), export and import to check the status of countries regarding their external debt sustainability. Those are univariate unit root tests, panel unit root tests, and panel co-integration tests.

A. Univariate unit root test

Two univariate unit root tests are applied in this study to assess the external debt Sustainability of each low-income SSA countries. The test results of ADF and PP in level form have been generated and presented in the annex part. The univariate unit-root test statistics for all series fail to reject the unit-root null at the level at the 5% significance level while; all series are stationary at first difference. As a result, the researcher turns to test panel unit root, and panel co-integration between the selected variables.

B. Panel unit root test

In this part two panel unit root tests that are the Levin, Lin, and Chu, and the Im-Pesaran-Shin test is applied on the external debt sustainability indicators, export, and import. As it is shown in table 4 below all test statistics at first difference are found to reject the null hypothesis. Thus, the

reported results confirmed that external debt is unsustainable and similar to the test result of the univariate unit root test; and leads to the third step of panel co-integration test.

Table 4: Panel Unit Root test result of debt sustainability indicators

		Levin-Lin-Chu		Im-Pesaran-Shin	
	Specification	t-statistic	P-value	t-statistic	P-value
lnEPD	1st difference	-4.7403	0.0000	-8.5440	0.0000
lnEPDS	1st difference	-9.5041	0.0000	-9.8945	0.0000
lnEXP	1st difference	-5.6579	0.0000	-8.5516	0.0000
lnIMP	1st difference	-10.5485	0.0000	-6.1226	0.0000

Source: Authors computation from WDI (2018). All the variables are stationary at first difference.

C. Panel co-integration test

The third step in analyzing public debt sustainability is a panel co-integration test. The test is employed to investigate whether the debt sustainability indicators, export, and import are cointegrated; cointegration implies that the *I* (1) series are in a long-run equilibrium; they move together, although the group of them can wander arbitrarily. Cointegration between these variables is a necessary condition for debt sustainability.

Panel cointegration tests can be carried out using tests proposed by Pedroni (1999, 2004) or by Kao Residual Cointegration test. Pedroni (1999) derives seven-panel cointegration test statistics. Of the seven statistics, four are based on within-dimension, and the three are based on between-dimension with a null hypothesis of no cointegration, Table 5 below presented the result of Pedroni test.

Table 5: Pedroni Residual test result

	Within-Dimension			
	Statistic	**Prob.**	**Weighted stat.**	**Prob.**
Panel v-statistics	1.108247	0.1339	0.466468	0.3204
Panel rho-Statistic	-0.025379	0.4899	0.226572	0.5896
Panel PP-Statistic	-3.870339	0.0001***	-3.804654	0.0001***
panel ADF- statistic	1.544687	0.9388	-0.350664	0.3629
	Between-Dimension			
	Statistic	**Prob.**		
Group rho-Statistic	1.762812	0.9610		
Group PP-Statistic	-5.418933	0.0000***		
Group ADF-Statistic	0.775672	0.7810		

Source: Authors computation using WDI data (2018) and *** represents the rejection of the null hypothesis at 1 percent significance level.

As shown in table 5, except for the Group PP-Statistic and Group ADF-Statistic test, all other tests accept the null hypothesis of no cointegration between external public debt to GDP ratio, external public debt service to export ratio, export, and import at the 5% significance level. This test implies that in a panel perspective, external public debt is not sustainable in the long run for low-income SSA from 2000 to 2017. In addition to the panel cointegration test, time series cointegration test is applied and finds that there was no long-run relationship observed between those variables for each of low-income SSA countries.

Similarly, Kao (1999) describes two tests under the null hypothesis of no cointegration for panel data. One is a Dickey-Fuller type test and another is an Augmented Dickey-Fuller type test, and from table 6, it is concluded that all the panel tests accept the null hypothesis of no cointegration between variables.

Table 6: Kao Residual cointegration test result

	Statistic	Prob.
DF	-1.359955	0.0869
Residual variance	0.107172	
HAC variance	0.120998	

Source: Authors computation from WDI (2018)

To sum up, the first two tests of univariate unit root and panel unit root test result shows all countries debt was unsustainable. The third necessary test of panel cointegration depicts that external public debt was unsustainable in the study area. Since exports and imports had no long-run relationship the countries faced a trade deficit. The countries must borrow from other countries and institution to pay for extra imports. Countries external debt is accumulated as a result of the foreign currency shortage. In a similar manner, there were no long-run relationships between the debt sustainability indicators. Thus, external public debt was unsustainable in low-income SSA countries from 2000 to 2017. Greene (1989), Akcay et al. (2002), Siddique et al.*(*2016) and Mustapha and Prizzon (2018) found a similar result with this study, that SSA debt is unsustainable and this compels governments to spend more on debt servicing and less on education, health, and infrastructure. Unsustainable debt also creates uncertainty, deterring investment and innovation, and has a negative impact on economic growth.

4.3.6. Estimation Result of Fixed Effect and Random Effect Model

In this part, the main objective is to estimate the effect of external public debt and other independent variables on the economic growth of low-income SSA countries. In order to identify the way to treat the individual effect as a fixed or random the researcher developed two types of model namely fixed effect and random effect model. The result obtained from the fixed effect model using Stata is presented in Table 7 below.

Table 7: Estimation result of Fixed Effect model

Var	Fixed Effect Model		
	Coefficient	Std. Err.	P-value
lnEPD	-.3492947	.0279621	0.000***
lnEPDS	-.1743913	.0892649	0.052*
lnINV	.2596801	.0259908	0.000***
POP	-.1534773	.0719024	0.034**
lnINF	.0015258	.0169436	0.928
lnTOP	-.4740249	.0499799	0.000***
lnDOM	.2080128	.0251467	0.000***
CONS	16.10268	.566514	0.000***

Source: Authors computation from the WDI (2018). ***, **and * indicates significance level at 1, 5, and 10 percent, respectively.

In order to decide between fixed effect and random effect model, it is mandatory to run a Hausman test where the null hypothesis is that the preferred model is random effects and the alternative is the fixed effects. Table 8 below shows the result of the Hausman test and indicates that the null hypothesis is rejected (the P value is less than 5). This implies that the fixed effect model is the appropriate model for estimating the relationship between external debt and economic growth in the selected countries.

Table 8: Hausman test result

	Coefficients			
	(b) fe	(B) re	(b-B) difference	Sqrt (diag(V_b-V_B)) S.E
lnEPD	-.3492947	-.1221099	-.2271849	.021433
lnEPDS	-.1743913	-.5537162	.3793249	-
lnINV	.2596801	.4405002	-.1808201	-
POP	-.1534773	-.11047	-.0430073	-
lnINF	.0015258	-.0276158	.0291417	-
lnTOP	-.4740249	-.9368452	.4628203	.0297382
lnDOM	.2080128	.1494465	.0585662	-
b = consistent under Ho and Ha; obtained from xtreg B = inconsistent under Ha, efficient under Ho; obtained from xtreg				
Test: Ho: difference in coefficients not systematic				
Chi2(7) = (b-B)' [(V_b-V_B)^(-1)] (b-B) = 296.4 Prob>chi2 = 0.0000				

Source: Authors computation from the WDI (2018).

4.3.7. Interpretations of Variables

In this part, the fixed effect estimation result with Heteroskedasticity-robust standard errors is presented.

Table 9: Fixed Effect model estimation test result

lnGDP	Coefficient	Robust Std.Err.	t-value	P-value
lnPED	-.3492947	.0544624	-6.41	0.000***
lnPEDS	-.1743913	.0552937	-3.15	0.004***
lnINV	.2596801	.0978064	2.66	0.014**
POP	-.1534773	.0757545	-2.03	0.055*
lnINF	.0015258	.0205354	0.07	0.941
lnTOP	-.4740249	.1282074	-3.70	0.001***
lnDOM	.2080128	.0609789	3.41	0.002***
CONS	16.10268	2.009333	8.01	0.000

Source: Authors computation using WDI data (2018). ***, ** and * represents significant variables at 1%, 5% and 10% significant level, respectively.

From the above-fixed effect robust standard errors estimation result, we have seen that out of seven explanatory variables five of them are significantly affected the economic growth of low-income SSA countries from 2000 to 2017. Table 9 shows that both external public debt to GDP ratio and external public debt service to export ratio have a negative and significant effect i.e. similar to the expected sign. Thus, on average, 1 percent increases in external public debt to GDP ratio and external public debt service to export ratio of the countries results in 34.9 and 17.4 percent reduction in economic growth, respectively. This result is consistent with the classical and monetarist theory of public debt. It also agrees with the findings of Greene, 1989; Iyoha, 1999; Presbitero, 2006; Reinhart et al., 2012, and Siddique and Padda, 2017, that external debt depresses investment through both a disincentive effect and a crowding out effect and debt stock reduction would have significantly increased investment and growth performance. The result of negative and significant effect of external public debt service to export ratio is supported by the findings of Elbadawi et al. (1997), Adesola (2009) and Ali and Mustafa (2012).

Similarly, the coefficient of population growth is negative but insignificant. Unlike the expected sign, trade openness has a negative and significant effect on economic growth, similar with Rodriguez and Rodrik (1999), Vlastou (2010), and Jawaid (2014) findings that trade restrictions in the form of tariffs, as well as trade-related taxes, are positively associated with economic growth. Relying on a large sample of both developing and developed countries the relationship between trade openness and growth is negative even if it depends on the level of development and the size of the economy.

However, gross investment (similar with the findings of Firebaugh (1992), Borensztein et al. (1998) and Asiedu (2002)) and domestic debt have a positive and significant effect on economic growth. Abbas and Christensen (2007), Owino and Mutai (2008) and Babu et al. (2015) found that domestic debt has a positive role in economic growth because the funds generated through domestic borrowing have been used partially to finance those expenditures of governments that contribute to the growth of GDP and long-term development purposes.

According to Christensen (2004), governments may still look towards domestic borrowing because of the following reasons. Government with large recurrent budget deficit may be forced to tap into domestic savings including through the issuance of domestic debt, to close their budget gap. In addition to this domestic debt can also be used to achieve monetary policy target. This is particularly the case in countries with a large balance of payment surpluses, created by large aid inflow and this increases liquidity which could undermine macroeconomic stability and central banks often decides to intervene by selling government or central bank bills to stem inflationary pressure from excess liquidity. Finally, the inflation rate has a positive but insignificant effect in this study.

CHAPTER FIVE

CONCLUSIONS AND POLICY IMPLICATIONS

5.1. Summary of Findings and Conclusion

This study examines the debt sustainability and Economic Growth of low-income SSA countries from 2000 to 2017. In order to assess the effect of external public debt on economic growth, the fixed-effect model is employed. The result of this model indicates that a significant and negative effect of external public debt to GDP and external public debt service to the export ratio on economic growth. This indicates that a higher debt burden leads to a significant portion of government revenue being devoted to debt servicing instead of being channeled to productive investment and this is a constraint to improve economic growth. As a result, GDP growth declines. A significant increase in external public debt also discourages investments by increasing uncertainty concerning government policies. An increasing external public debt stock often creates expectations that the government is likely to increase tax to meet its debt obligations. Due to this, the private sector investors are likely to postpone their investments, which in turn reduce economic growth.

The finding of this study implied that the coefficients of population growth and inflation rates are not statistically significant in the selected countries. Similarly, gross investment has a positive and significant effect on the economic growth of low-income SSA countries from 2000 to 2017. An increase in investment involves increased spending of a countries savings on capital goods that are necessary for production and is likely to increase labor productivity. The resulting increase in aggregate output leads to an improvement in GDP growth and standards of living.

Furthermore, domestic debt in this study has a positive and significant effect on economic growth in the selected countries. Domestic debt is better for low income countries of SSA for two reasons. First, the payment is made by domestic currencies and this reduces the problem of foreign currencies shortage; second, the domestic debt interest rate is low compared with external debt. Unlike the expected positive coefficient, trade openness has a negative and significant effect. Trade liberalization reduces the productivity of the infant industry. For a newly created industry to survive, the government needs to protect it from foreign competition until its production process becomes more efficient and cost-effective.

In this study, the researcher applied econometric techniques useful to assess the sustainability of external debt. Various univariates and panel unit root test have been applied to 24 Sub Saharan low-income countries with 18 years of data. Three different techniques were applied. The first was the univariate unit root tests (ADF and PP) to know the external debt sustainability of individual countries and the result depicted nonstationary series of external public debt stock to GDP, external public debt service to exports ratios, export, and import. Thus, all the countries are facing the unsustainable level of external public debts. panel unit root tests (LL and IPS) was the second type of test and applied on low-income SSA countries as a whole to assess their external debt status. The test found that the external debt of the selected countries' economies as a whole was unsustainable.

The third type of tests includes time series and panel cointegration based approaches and found that there was no long-run relationship observed between external public debt, external public debt service, export and import for each of the selected countries (unsustainable external public debt) and panel cointegration approach declared their external debt was unsustainable as a whole. Based on the results, it can be said that the increased external debt is leading the low-income SSA countries' economies toward the low level of growth and retarding development in the economies.

5.2.Policy Implication

The objective of this study is to analyze the effect of external public debt on economic growth and to assess debt sustainability of low-income SSA. Based on the empirical results the following measures are recommended. First, there is a need to implement an appropriate policy measure in order to achieve the positive impact of external debt on economic growth through minimizing budgetary deficit, implementing import substitution policy and by adopting a balance between external and domestic debt so as maintain steady economic growth. Moreover, for countries with a narrow export base, there is a need for export diversification in order to widen the revenue base and reduce external borrowing for the countries to move out of debt distress.

Second, the study recommends that in order to avoid unsustainable levels of external debt all low-income SSA countries should reduce their current expenditures instead of directly going for external borrowing and reallocate their resources in the development heads. They can utilize

their externally borrowed resources in production and development purposes so that the profits and better repayment capacity can make the debt sustainable. The countries may create the economic environment attracting foreign direct investment which supplements not only the countries capital stock by filling the saving-investment gap but also removes fiscal and current account deficits. The countries should export more and try hard to stable general price level, adopt measures to increase the domestic saving and investment rates, borrow from the sources having the less volatile and low-interest rate.

Finally, low-income SSA nations should examine their economic policies to see what sorts of adjustment can be made to allow them to resume debt payment. So, appropriate debt management mechanisms should be adopted and implemented to keep debt levels within sustainable limits. Specifically, the Government should invest the borrowed money on productive investments, reduces unnecessary expenditures, and try to reduce corruption.

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APPENDICES

Appendix 1: Panel Unit Root test result

```
. xtunitroot llc lngdp

Levin-Lin-Chu unit-root test for lngdp
--------------------------------------

Ho: Panels contain unit roots               Number of panels  =     24
Ha: Panels are stationary                   Number of periods =     18

AR parameter: Common                        Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Not included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 8.00 lags average (chosen by LLC)
------------------------------------------------------------------------------
                     Statistic      p-value
------------------------------------------------------------------------------
 Unadjusted t         -8.0350
 Adjusted t*          -6.1094        0.0000
------------------------------------------------------------------------------
```

```
. xtunitroot ips lnped

Im-Pesaran-Shin unit-root test for lnped
----------------------------------------

Ho: All panels contain unit roots           Number of panels  =     24
Ha: Some panels are stationary              Number of periods =     18

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                   sequentially
Time trend:   Not included

ADF regressions: No lags included
------------------------------------------------------------------------------
                                              Fixed-N exact critical values
                     Statistic      p-value        1%      5%      10%
------------------------------------------------------------------------------
 t-bar                -1.4095                   -1.950  -1.820  -1.750
 t-tilde-bar          -1.3080
 Z-t-tilde-bar         0.4408        0.6703
------------------------------------------------------------------------------
```

```
Im-Pesaran-Shin unit-root test for lnpeds
-----------------------------------------

Ho: All panels contain unit roots          Number of panels  =     24
Ha: Some panels are stationary             Number of periods =     18

AR parameter: Panel-specific               Asymptotics: T,N -> Infinity
Panel means:  Included                                  sequentially
Time trend:   Included                     Cross-sectional means removed

ADF regressions: 2 lags
------------------------------------------------------------------------------
                 Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar          -0.1473        0.4415
------------------------------------------------------------------------------



. xtunitroot llc lnpeds, noconstant

Levin-Lin-Chu unit-root test for lnpeds
---------------------------------------

Ho: Panels contain unit roots              Number of panels  =     24
Ha: Panels are stationary                  Number of periods =     18

AR parameter: Common                       Asymptotics: root(N)/T -> 0
Panel means:  Not included
Time trend:   Not included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 8.00 lags average (chosen by LLC)
------------------------------------------------------------------------------
                   Statistic      p-value
------------------------------------------------------------------------------
 Unadjusted t         0.5239        0.6998
 Adjusted t*          0.4910        0.6883
------------------------------------------------------------------------------
```

```
. xtunitroot llc d.lnpeds

Levin-Lin-Chu unit-root test for D.lnpeds
-----------------------------------------

Ho: Panels contain unit roots              Number of panels  =     24
Ha: Panels are stationary                  Number of periods =     17

AR parameter: Common                       Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Not included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 8.00 lags average (chosen by LLC)
```

	Statistic	p-value
Unadjusted t	-16.6022	
Adjusted t*	-9.5041	0.0000

```
. xtunitroot ips d.lnpeds

Im-Pesaran-Shin unit-root test for D.lnpeds
-------------------------------------------

Ho: All panels contain unit roots          Number of panels  =     24
Ha: Some panels are stationary             Number of periods =     17

AR parameter: Panel-specific               Asymptotics: T,N -> Infinity
Panel means:  Included                                  sequentially
Time trend:   Not included

ADF regressions: No lags included
```

			Fixed-N exact critical values		
	Statistic	p-value	1%	5%	10%
t-bar	-4.4921		-1.950	-1.820	-1.750
t-tilde-bar	-2.9000				
Z-t-tilde-bar	-9.8945	0.0000			

```
. xtunitroot llc lnped

Levin-Lin-Chu unit-root test for lnped
--------------------------------------

Ho: Panels contain unit roots              Number of panels  =     24
Ha: Panels are stationary                  Number of periods =     18

AR parameter: Common                       Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Not included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 8.00 lags average (chosen by LLC)
------------------------------------------------------------------------------
                 Statistic      p-value
------------------------------------------------------------------------------
 Unadjusted t       -6.3368
 Adjusted t*        -1.5728       0.0579
------------------------------------------------------------------------------


. xtunitroot ips lninv, trend

Im-Pesaran-Shin unit-root test for lninv
----------------------------------------

Ho: All panels contain unit roots          Number of panels       =      24
Ha: Some panels are stationary             Avg. number of periods =   17.21

AR parameter: Panel-specific               Asymptotics: T,N -> Infinity
Panel means:  Included                                  sequentially
Time trend:   Included

ADF regressions: No lags included
------------------------------------------------------------------------------
                                                 Fixed-N exact critical values
                     Statistic      p-value          1%       5%       10%
------------------------------------------------------------------------------
 t-bar                -2.3998                          (Not available)
 t-tilde-bar          -1.9395
 Z-t-tilde-bar        -3.6915        0.0001
------------------------------------------------------------------------------
```

```
. xtunitroot llc pop

Levin-Lin-Chu unit-root test for pop
------------------------------------

Ho: Panels contain unit roots                Number of panels  =     24
Ha: Panels are stationary                    Number of periods =     18

AR parameter: Common                         Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Not included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 8.00 lags average (chosen by LLC)
------------------------------------------------------------------------------
                     Statistic      p-value
------------------------------------------------------------------------------
 Unadjusted t       -11.7154
 Adjusted t*         -8.2349        0.0000
------------------------------------------------------------------------------


. xtunitroot ips  lninf, trend

Im-Pesaran-Shin unit-root test for lninf
----------------------------------------

Ho: All panels contain unit roots          Number of panels       =     24
Ha: Some panels are stationary             Avg. number of periods =  16.29

AR parameter: Panel-specific               Asymptotics: T,N -> Infinity
Panel means:  Included                                  sequentially
Time trend:   Included

ADF regressions: No lags included
------------------------------------------------------------------------------
                                                Fixed-N exact critical values
                     Statistic      p-value         1%      5%      10%
------------------------------------------------------------------------------
 t-bar               -3.2777                          (Not available)
 t-tilde-bar         -2.3837
 Z-t-tilde-bar       -6.6496        0.0000
------------------------------------------------------------------------------
```

```
. xtunitroot llc lntop, trend

Levin-Lin-Chu unit-root test for lntop
```

Ho: Panels contain unit roots — Number of panels = 24
Ha: Panels are stationary — Number of periods = 18

AR parameter: Common — Asymptotics: N/T -> 0
Panel means: Included
Time trend: Included

ADF regressions: 1 lag
LR variance: Bartlett kernel, 8.00 lags average (chosen by LLC)

	Statistic	p-value
Unadjusted t	-13.8518	
Adjusted t*	-5.6768	0.0000

```
. xtunitroot ips  lndom, trend

Im-Pesaran-Shin unit-root test for lndom
```

Ho: All panels contain unit roots — Number of panels = 24
Ha: Some panels are stationary — Avg. number of periods = 17.96

AR parameter: Panel-specific — Asymptotics: T,N -> Infinity sequentially
Panel means: Included
Time trend: Included

ADF regressions: No lags included

			Fixed-N exact critical values		
	Statistic	p-value	1%	5%	10%
t-bar	-2.4748		(Not available)		
t-tilde-bar	-1.8845				
Z-t-tilde-bar	-3.2671	0.0005			

Appendix 2: Model Specification tests

```
. xtreg  lngdp lnped pedsexp lninv pop lninf lntop lndom, fe

Fixed-effects (within) regression               Number of obs      =       371
Group variable: n                               Number of groups   =        24

R-sq:  within  = 0.7186                         Obs per group: min =        11
       between = 0.5979                                        avg =      15.5
       overall = 0.5470                                        max =        18

                                                F(7,340)           =    124.06
corr(u_i, Xb)  = -0.1794                        Prob > F           =    0.0000
```

lngdp	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnped	-.3492949	.0279621	-12.49	0.000	-.4042952	-.2942945
pedsexp	-.1743914	.0892648	-1.95	0.052	-.3499722	.0011895
lninv	.2596798	.0259907	9.99	0.000	.208557	.3108027
pop	-.1534763	.0719024	-2.13	0.034	-.2949058	-.0120467
lninf	.0015259	.0169436	0.09	0.928	-.0318015	.0348533
lntop	-.4740241	.0499798	-9.48	0.000	-.5723328	-.3757155
lndom	.2080126	.0251467	8.27	0.000	.15855	.2574753
_cons	16.10268	.5665141	28.42	0.000	14.98837	17.217
sigma_u	2.7367599					
sigma_e	.27775062					
rho	.98980502	(fraction of variance due to u_i)				

```
F test that all u_i=0:     F(23, 340) =     58.17                 Prob > F = 0.0000

. estimate store fixed
```

```
. xtreg  lngdp lnped pedsexp lninv pop lninf lntop lndom, re

Random-effects GLS regression                   Number of obs      =       371
Group variable: n                               Number of groups   =        24

R-sq:  within  = 0.5970                         Obs per group: min =        11
       between = 0.9492                                        avg =      15.5
       overall = 0.9306                                        max =        18

                                                Wald chi2(7)       =   1554.58
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000
```

lngdp	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lnped	-.12211	.0179581	-6.80	0.000	-.1573072	-.0869128
pedsexp	-.5537165	.1094616	-5.06	0.000	-.7682572	-.3391757
lninv	.4405	.0290707	15.15	0.000	.3835226	.4974775
pop	-.110469	.0920349	-1.20	0.230	-.2908541	.069916
lninf	-.0276158	.0215373	-1.28	0.200	-.0698282	.0145966
lntop	-.9368449	.04017	-23.32	0.000	-1.015577	-.8581132
lndom	.1494464	.0284706	5.25	0.000	.0936451	.2052478
_cons	12.40712	.6307868	19.67	0.000	11.1708	13.64344
sigma_u	.45345554					
sigma_e	.27775062					
rho	.72717709	(fraction of variance due to u_i)				

```
. estimate store random
```

```
. hausman fixed random
```

	Coefficients (b) fixed	(B) random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
lnped	-.3492949	-.12211	-.2271849	.0214332
pedsexp	-.1743914	-.5537165	.3793251	.
lninv	.2596798	.4405	-.1808202	.
pop	-.1534763	-.110469	-.0430072	.
lninf	.0015259	-.0276158	.0291417	.
lntop	-.4740241	-.9368449	.4628207	.0297382
lndom	.2080126	.1494464	.0585662	.

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(7) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 296.40
Prob>chi2 = 0.0000

Appendix 3: Univariate Unit Root tests

Intermediate ADF test results LNPED

Cross section	Prob.	Lag	Max Lag	Obs
Benin	0.4251	0	0	17
Burkinafa	0.0264	0	0	17
Burundi	0.8702	0	0	17
Centeral	0.1625	0	0	17
Chad	0.1282	0	0	17
Comoros	0.8056	0	0	17
Congo	0.9176	0	0	17
Eritrea	0.6745	0	0	17
Ethiopia	0.5528	0	0	17
Gambia	0.9285	0	0	17
Guinea	0.9401	0	0	17
Guinea bissau	0.8339	0	0	17
Liberia	0.7365	0	0	17
Madagas	0.3754	0	0	17
Malawi	0.3675	0	0	17
Mali	0.2080	0	0	17
Mozambi	0.5521	0	0	17
Niger	0.4056	0	0	17
Rwanda	0.5320	0	0	17
Senegal	0.5095	0	0	17
Sierra Leo	0.3545	0	0	17
Tanzania	0.4079	0	0	17
Togo	0.6731	0	0	17
Uganda	0.5350	0	0	17

Intermediate Phillips-Perron test results LNPED

Cross section	Prob.	Bandwidth	Obs
Benin	0.4210	1.0	17
Burkinafa	0.0220	2.0	17
Burundi	0.8702	0.0	17
Centeral	0.1751	2.0	17
Chad	0.1682	1.0	17
Comoros	0.8056	0.0	17
Congo	0.9076	1.0	17
Eritrea	0.6865	2.0	17
Ethiopia	0.4645	2.0	17
Gambia	0.9652	2.0	17
Guinea	0.9529	2.0	17
Guinea bissau	0.8652	3.0	17
Liberia	0.6935	2.0	17
Madagas	0.3754	0.0	17
Malawi	0.3675	0.0	17
Mali	0.2080	0.0	17
Mozambi	0.4386	2.0	17
Niger	0.3801	2.0	17
Rwanda	0.5169	1.0	17
Senegal	0.4496	2.0	17
Sierra Leo	0.3597	1.0	17
Tanzania	0.4001	1.0	17
Togo	0.6530	1.0	17
Uganda	0.5217	1.0	17

Intermediate ADF test results LNPEDS

Cross section	Prob.	Lag	Max Lag	Obs
Benin	0.0226	0	0	17
Burkinafa	0.2872	0	0	17
Burundi	0.6129	0	0	17
Centeral	0.0557	0	0	17
Chad	0.1600	0	0	17
Comoros	0.3301	0	0	17
Congo	0.3317	0	0	17
Eritrea	0.1225	0	0	17
Ethiopia	0.8989	0	0	17
Gambia	0.4140	0	0	17
Guinea	0.9237	0	0	17
Guinea bissau	0.1080	0	0	17
Liberia	0.0044	0	0	17
Madagas	0.1976	0	0	17
Malawi	0.3540	0	0	17
Mali	0.1030	0	0	17
Mozambi	0.3132	0	0	17
Niger	0.6548	0	0	17
Rwanda	0.2807	0	0	17
Senegal	0.2169	0	0	17
Sierra Leo	0.3860	0	0	17
Tanzania	0.3482	0	0	17
Togo	0.0777	0	0	17
Uganda	0.5741	0	0	17

Intermediate Phillips-Perron test results LNPEDS

Cross section	Prob.	Bandwidth	Obs
Benin	0.8697	2.0	17
Burkinafa	0.9341	2.0	17
Burundi	0.4533	1.0	17
Centeral	0.3762	1.0	17
Chad	0.6282	1.0	17
Comoros	0.8663	14.0	17
Congo	0.7406	16.0	17
Eritrea	0.1271	1.0	17
Ethiopia	0.2105	1.0	17
Gambia	0.1265	16.0	17
Guinea	0.9986	4.0	17
Guinea bissau	0.7445	2.0	17
Liberia	0.0370	6.0	17
Madagas	0.7823	6.0	17
Malawi	0.8289	2.0	17
Mali	0.8522	1.0	17
Mozambi	0.6810	0.0	17
Niger	0.4399	1.0	17
Rwanda	0.8018	2.0	17
Senegal	0.6935	2.0	17
Sierra Leo	0.7649	1.0	17
Tanzania	0.6339	1.0	17
Togo	0.5158	1.0	17
Uganda	0.7220	0.0	17

Appendix 4: Panel Cointegration tests

Kao Residual Cointegration Test

	rho	Prob.	t-Statistic	Prob.
DF	-1.558809	0.0595	-1.359955	0.0869
DF*	-2.263893	0.0118	-1.722593	0.0425
Residual variance			0.107172	
HAC variance			0.120998	

Pedroni Residual Cointegration Test
Series: LNPEDLNPEDS EXPORT IMPORT
Sample: 2000 2017
Included observations: 432
Cross-sections included: 24
Null Hypothesis: No cointegration
Trend assumption: No deterministic trend
User-specified lag length: 1
Newey-West automatic bandwidth selection and Bartlett kernel

Alternative hypothesis: common AR coefs. (within-dimension)

	Statistic	Prob.	Weighted Statistic	Prob.
Panel v-Statistic	1.108247	0.1339	0.466468	0.3204
Panel rho-Statistic	-0.025379	0.4899	0.226572	0.5896
Panel PP-Statistic	-3.870339	0.0001	-3.804654	0.0001
Panel ADF-Statistic	1.544687	0.9388	-0.350664	0.3629

Alternative hypothesis: individual AR coefs. (between-dimension)

	Statistic	Prob.
Group rho-Statistic	1.762812	0.9610
Group PP-Statistic	-5.418933	0.0000
Group ADF-Statistic	0.775672	0.7810

Appendix 5: Multicollinearity tests

```
. vif

    Variable |       VIF       1/VIF
-------------+----------------------
       lntop |      5.21    0.192069
       lndom |      4.49    0.222897
       lnped |      1.87    0.535601
       lninv |      1.32    0.756988
         pop |      1.25    0.800968
       lninf |      1.06    0.939799
        peds |      1.06    0.943705
-------------+----------------------
    Mean VIF |      2.32
```

Appendix 6: Heteroscedasticity Test

```
. xttest3

Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

H0: sigma(i)^2 = sigma^2 for all i

chi2 (24)  =     292.04
Prob>chi2 =      0.0000
```

Appendix 7: Test for Cross-Sectional Dependency

```
. xtserial loggdp logpedgdp logpedsexp loginv logpopgr loginf logtop logpedgdp2

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
   F(  1,     24) =    106.788
         Prob > F =     0.0000
```

Appendix 8: Fixed Effect model tests

```
. xtreg  lngdp lnped peds lninv pop lninf lntop lndom, fe cluster(n) robust

Fixed-effects (within) regression               Number of obs      =       371
Group variable: n                               Number of groups   =        24

R-sq:  within  = 0.7186                         Obs per group: min =        11
       between = 0.5979                                        avg =      15.5
       overall = 0.5470                                        max =        18

                                                F(7,23)            =     32.32
corr(u_i, Xb)  = -0.1794                        Prob > F           =    0.0000

                                    (Std. Err. adjusted for 24 clusters in n)
```

lngdp	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnped	-.3492947	.0544624	-6.41	0.000	-.4619587	-.2366308
peds	-.1743913	.0552937	-3.15	0.004	-.2887751	-.0600075
lninv	.2596801	.0978064	2.66	0.014	.0573521	.4620082
pop	-.1534773	.0757545	-2.03	0.055	-.3101874	.0032327
lninf	.0015258	.0205354	0.07	0.941	-.0409549	.0440065
lntop	-.4740249	.1282074	-3.70	0.001	-.7392421	-.2088077
lndom	.2080128	.0609789	3.41	0.002	.0818684	.3341571
_cons	16.10268	2.009333	8.01	0.000	11.94606	20.2593
sigma_u	2.7367581					
sigma_e	.27775086					
rho	.98980499	(fraction of variance due to u_i)				

DECLARATION

The thesis is my original work, has not been presented for a degree in any other university and that all sources of material used for the thesis have been duly acknowledged.

Declared by:

Name: Nitsuh Mengist

Signature: _____

Date: June, 2019

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Date: June, 2019