DETERMINANTS OF ECONOMIC GROWTH IN ETHIOPIA:

ARDL APPROACH

BY

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DETERMINANTS OF ECONOMIC GROWTH IN ETHIOPIA:

A TIME SERIES ANALYSIS

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CERTIFICATE

*This is to certify that the Thesis entitles " Determinants of Economic growth in Ethiopia "
submitted to Jimma University for the award of the Degree of Masters of Science in
Economics and is a record of bona fide research work carried out by Mr. Wendimu Shenkoru
Merga, under our guidance and supervision. Therefore, we hereby declare that no part of this
thesis has been submitted to any other university or institutions for the award of any degree
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DECLARATION

I hereby declare that this thesis entitled "*Determinants of Economic growth in Ethiopia" has* been carried out by me under the guidance and supervision of Leta Sera (PHD candidate) and Mr. Miniyahil Alemu (Msc)   the thesis is original and has not been submitted for the award of any degree of diploma to any university or institutions.

Researcher's Name   Date   Signature

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ABSTRACT

The main objective of this study is to investigate the determinants of economic growth in Ethiopia during the period 1981-2016. The Autoregressive Distributed Lag (ARDL) Approach to Co-integration and Error Correction Model, respectively, are applied in order to investigate the long-run and short run relationship between the dependent variable real GDP and its determinants. The finding of the Bounds test shows that there is a stable long run relationship between real GDP, Gross Capital formation, Government Expenditure, population, export, foreign aid, and external debt and inflation variables. The estimation results reveal that Gross Capital formation, Government Expenditure, population, export and foreign aid are found to have positive impact on economic growth both in the short run and the long run, while debt has affects economic growth negatively and statically significantly in a long run and short run but inflation is affect Ethiopian economy negatively statically insignificant in short run significantly in long run . However, the study found out that, inflation and debt has statistically significant impact on economic growth in the long run. This study has important policy implication. The findings of this study imply that economic growth can be improved significantly when the Gross capital formation, export increases. Hence policy makers and /or the government should strive to increase capital formation (investment) which is believed as a back bone of growth and has allocate adequate finance for export intensive which will help to stabilizing the inflation and exchange rate . In addition to its effort, there should be a close monitoring and consistent debt management strategies, which is used to avoid misallocation and mismanagement of foreign aid and external debt problem.

Keywords: ARDL, ECM, Determinants, of Economic Growth, Ethiopia,

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Acronyms/ Abbreviations

ADF	Augmented Dickey Fuller
AFDB	African Development Bank
AIC	Akaike Information Criterion
ARDL	Autoregressive Distributed Lag
BGP	Balance Growth Path
CSA	Central Statistical Agency
ECM	Error Correction Model
ECT	Error Correction Term
EEA	Ethiopian Economic Association
EPRDF	Ethiopian People Revolutionary Democratic Front
GCF	Gross Capital Formation
GDP	Gross Domestic Product
GTP	Growth and Transformation Plan
HDI	Human Development Index
IMF	International Monetary Fund
KPSS	Kwiatkowski Phillips Schmidt Shin
MDGs	Millennium Development Goal
MoFEC	Ministry of Finance and Economic Cooperation
NBE	National Bank of Ethiopia
OLS	Ordinary Least Square
PASDEP	Plan for Accelerated and Sustained Development Plan to End Poverty
PMAC	Provision Military Administration Council
PP	Phillips Perron
SBC	Schwarz Bayesian Criterion
SDPRP	Sustainable Development and Poverty Reduction Program
UN	United Nations
UNDP	United Nation Development Program
VAR	Vector Autoregressive
WBI	World Bank Index

CHAPTER ONE

INTRODUCTION

1.1. Background of the study

Economic growth is one of the most important issues in international political economy and one the major goals of all countries. It is the increase of gross domestic product. Therefore, it shows only the quantity of goods and services produced in a country in given period of time. Human beings have always sought ways to improve their lives and living standards. To this end, development has become the primary goal of every nation. The aspiration for economic growth and development is the result of experiences seen in the form of sustained elevation in an entire society towards a better life. The basic function of all economic activities is to provide as many people as possible with means enough to meet basic needs and a level of material prosperity that guarantees worthiness and esteem. Moreover, economic growth increases the range of human choice i.e. freedom. The average level of satisfaction increases with a country's level of income, of course, this is true up to a certain level (*Todarro* 2009).

Economic growth reduces scarcity and gives us more satisfaction (more goods and services). Thus, all societies try to achieve economic growth and development. It is believed that economic growth explain much of the development aspect, countries spend much of their resources and time in an effort to ensure sustained economic growth. Economic growth is an issue of primary concern to policy makers in both developed and developing countries. As a consequence, growth theory has long occupied a central role in economics. It is a dynamic process, focusing on how and why output, capital, consumption and population change over time. The process of economic growth and the sources of differences in economic performance across nations are some of the most interesting, important and challenging areas in modern social science. The sources of economic growth is a question of great importance to many economists who are interested to know and search for factors enabling some countries to grow and develop while others are suffering from abject poverty. Growth is usually calculated in real terms: that is inflation-adjusted terms to eliminate the distorting effect of inflation on the price of goods produced.

Measurement of economic growth uses national income accounting. Economic growth or economic growth theory typically refers to growth of potential output. As an area of study, economic growth is generally distinguished from development economics. The former is primarily the study of how countries can advance their economies. The latter is the study of the economic aspects of the development process in low-income countries.

The trend of growth of real GDP can be considered as sustainable economic growth while the short-run fluctuations of growth over the trend can be thought of as business cycles. Economic development on the other hand includes economic growth, distribution of income; levels of literacy and education standards, levels of health care, quality and availability of housing, levels of environmental standards, unemployment and poverty (Seid, 2000). The Economic growth of Ethiopia has shown various changes in different political regimes. These changes in government structure created a problem of inconsistency in implementing the policies by previous regimes as well as natural disaster like famine, drought, political instability and war (Alemayehu and Befekadu, 2005) had a depressing effect on the history of Ethiopian economic growth.

According to Nafziger (2005), economic development refers to economic growth gone with an improvement in the material well-being of the poor; a decline in agriculture's share of national output; increase in the output share of industry and services; an increase in the education and skills of the labor force; and technical advances originating within the country. The economic achievements lead to the improvement of the standard of life, adequate conditions of medical care, improvement of the educational system and a better redistribution of incomes (Haller, 2012).

Ethiopia is one of the poorest countries in the world; its economy remains heavily dependent on agriculture, which accounts 43% (UNDP, 2014) of the GDP. Accordingly, 83% of the population gains its livelihood directly or indirectly from agricultural production. Despite the fact that the history of growth performance was poor in the past decades, the country has experienced strong economic growth in the current time. Real GDP growth averaged 11.2% per annum during 2003/04 and 2008/09 period, placing Ethiopia among the top performing economies in sub-Sahara Africa (NBE, 2013/14).

The Ethiopian economy has experienced impressive growth performance over the last decade with average GDP growth rate of 11 %, which is about double of the average growth for Sub Saharan Africa. 2012/13 was markedly successful in terms of maintaining macroeconomic stability and fiscal management as witnessed by inflation falling to a single digit, which had been a major challenge in the past two years. A number of parameters are employed to measure the economic progress of nations and evaluate the improvements in the living standards of citizens. One such measurement is real gross domestic product (GDP) or GDP per capita. Although there are difficulties in using real GDP per capita as a measure of the quality of life, it is reasonably correlated with other measures of well being such as health and literacy. Economic growth improves living standards through many channels. It creates more jobs, accelerates investment, boosts business confidence, and increases the revenue to the state in the form of taxes.

1.2. Statement of the Problem

Ethiopia is one of the poorest country in the world with a population of more than 88 Million (CSA, 2013) with subsistence agricultural sector. According to Alemayehu and Befekadu (2005), Ethiopia's history is full of conflict, drastic policy change and reversals. However, in the last 10 years Ethiopia is amongst the fastest growing non-oil economy as well as landlocked country in the world. Today the history of Ethiopia is changing from drought, famine, war and low economic growth to fast and sustainable economic growth. The Ethiopian economy shows an annual growth rate of 12.7% in the year 2004/05 and the annual average growth rate at a constant price was 11% for the period 2004/05 to 2012/13 (NBE , 2011/12). Two decades ago, Ethiopian policy makers pursued a structural adjustment program which shifted emphasis from public sector to private sector.

The goal was to encourage private domestic savings, private domestic investment and capital formation in order to enhance economic growth. In an attempt to achieve this goal, resources were diverted from current consumption and were invested in capital formation through privatization and commercialization of state enterprises. The economy of Ethiopia is growing fast with a double digit since 2004. In the year 2012 fiscal year Ethiopia's economy grew by 9.7% and the tenth year in a row of robust economic growth. However, the African annual growth rate was 4.9% and that of Sub-Saharan countries was 5.3% for the same period (AFDB, 2012). According to African

Economic Outlook report of 2012, Ethiopia was the 12th fastest growing economy in the world and the annual average real GDP growth rate for the last decade was 10.9%.

There are many studies such as, Seid (2000), Weeks *et al.,* (2004) and Tadesse (2011) done on factors affecting Ethiopian economic growth. Yet there is no comprehensive empirical study which determines factors affecting Ethiopian economic growth that includes export, aid, , external debt, gross capital formation , Government expenditure ,inflation and population . In this study, identifying the macroeconomic determinants of economic growth is a major step to know factors responsible for the fast growth. The above researchers have tried to identify the major factors affecting economic growth in Ethiopia. However, there are many macroeconomic variables including, Human Capital, exchange rate, Inflation which were not addressed in their studies. Therefore this study tries to fill this gab and empirically analyze the selected macroeconomic determinants of economic growth in Ethiopia during the specified period of time. Moreover, this study attempt would be made to fill another research gap of the above studies.

(*Tadesse, 2011*) used the Engle-Granger's two step procedure to test for the presence of Cointegration. However this methodology is criticized for its weakness when there is more than one co integrating. The Autoregressive distributed lag (ARDL*)* model is an alternative superior methodology, which has superior advantage than Engle-Granger and Johansen Cointegration. There is almost a universal consensus that macroeconomic stability, specifically defined as low inflation, is positively related to economic growth. Post reform (post 1992), the Ethiopian government has been introduced a free market economy whereby the private sector would drive force in the economic growth.

The huge public investment which focuses on infrastructure and pro-poor sector explained much of the economic performance from the expenditure side. Similarly the expenditure of socio-economic sector has been increasing form time to time, which expected to have a positive return to the economic growth in long run. Few studies have been conducted under this topic. Two of them are Seid (2000) and Tigabu (2005). These studies have contributed by including variable There is still a long way to go in order to identify the determinants of growth in Ethiopia. So there is no comprehensive empirical study which determines factors affecting Ethiopian economic growth that includes export, aid, external debt, gross capital formation, Government expenditure, inflation and

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population.   Therefore thesis tries to fill gab and empirically analyze the selected macroeconomic determinants of economic of Ethiopia growth in long run and short run during the specified period of time.

1.3. Objectives of the Study

The General objective of this research is to investigate the determinants of economic growth in Ethiopia (1981-2016).

1.3.1. Specific objectives

- ➤ Analyze the major determinants of economic growth in Ethiopia between the periods of 1981 – 2016 through applying the ARDL model.
- ➤ Analyze the long run and short run relationship among the variables.

1.4. Hypotheses of the Study

Based on the empirical literature, this study sets two hypotheses as follows:

$H_{01:}$ There is no long- run relationship between economic growth and its determinants in Ethiopia.

$H_{02:}$ There is no short-run relationship between economic growth and its determinants in   Ethiopia.

1.5. Significance of the Study

Most of the studies carried out so far in this area have dealt with the determinants of economic growth that includes macroeconomic variable like physical capital, affecting productivity (technology) and some other factors like rainfall. However, an ample of empirical studies done in both developed and developing countries indicates that exports of goods and services, Aid, population , Government expenditure ,external debt and inflation also affect economic growth in the long run and short run . Because one can be believe that a continuous and multi-disciplinary rigorous study is required to take the policy implications seriously as relevant to Ethiopia. Therefore this study tried to provide comprehensive evidence on the selected macroeconomic determinants of economic growth in Ethiopia during the period of 1981-2016. The issue of determinants of economic growth is still on debate, therefore, the significance of this study is to provoke and lead a path for further studies in the field. Therefore, this study will serve as an input for policy makers and as a future focus area for future researches.

1.6. Scope of the study

The study attempts to analyze macroeconomic determinants of economic Growth in Ethiopia for the time spanning from 1981/1982-2015/2016 G.C.

1.7. The Study area

The study area of a thesis focused on Ethiopia. Ethiopia is the oldest independent country in Africa. It is located in the north-eastern part of Africa and bordered by Sudan and South Sudan to the west, Eritrea to the North, Djibouti and Somalia to the east and Kenya to the south. Ethiopia has two major seasons encompassing dry and wet seasons. The dry season prevails from October through May and the wet season runs from June to September. Since 1995, Ethiopia is divided into nine ethnically-based regional states and two administration cities.

Figure 1. Ethiopia Regions
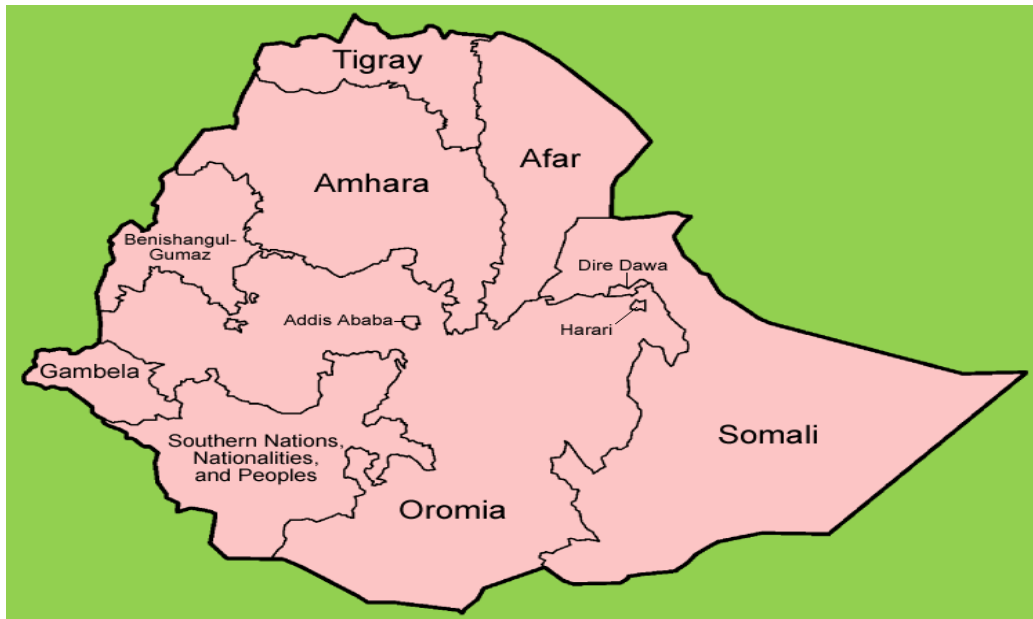
Source: from Google (internet)

1.8. Limitations of the study

The most challenge while doing this study came from inconsistency of data from different organizations. To overcome such a problem, majority sources with similar figures for various variables were used. The main aim of this study is to analyze the macroeconomic determinants of economic growth. However, there are also non-economic factors that affect growth like political stability, rules of economic regulation (monetary and fiscal policy), and rules of law (property right) are not addressed here and might be consider other limitations of this study.

1.9. Organization of this paper

The paper have are six chapters. The first chapter is dealing with introduction of the study, statements of problem and objective of the study. The second chapter presents the theoretical and empirical literature reviewed related to economic growth. Chapter three, a brief review about Ethiopia economy performance presented. Chapter four is contains the methodological aspect of the study which includes: model speciation, estimation producer and variable definition. In Chapter five contains the regression result and its interpretation. Finally, chapter six provides the conclusion and policy recommendation emanating from the study.

CHAPTER TWO
LITERATURE REVIEW

2.1. Theoretical Literature Review

2.1.1. Theories of economic growth

The process of economic growth and the sources of differences in economic performance across nations are some of the most interesting, important and challenging areas in modern social science. The analysis of the process of economic growth was a central feature of the work of the classical economists, as represented chiefly by Adam Smith, Thomas Malthus, David Ricardo, and Karl Marx were all concerned with the growth of the economy (I.e., the increase in the production of goods and services over time). The interest of these economists in problems of economic growth was rooted in the concrete conditions of their time. Specifically, they were confronted with the fact of economic growth and social changes taking place in contemporary English society as well as in previous historical periods. According to A. Smith (1776), the importance of 'invisible hand' (the force of supply/demand in a competitive market), specialization/division of labor, accumulation of physical capital (investment) and technological progress were the most determinants of economic growth in the long term and hence the prosperity of nations.

A wide range of studies have investigated the factors underlying economic growth. Using different conceptual and methodological viewpoints, these studies have placed emphasis on a different set of explanatory parameters and offered various insights to the sources of economic growth. The broad consensus highlighted in these studies is that a country's growth over a long period is basically determined by three factors, namely: (1) the efficient utilization of the existing stock of resources, (2) the accumulation of productive resources such as human capital, and (3) technological progress (Dewan and Hussein, 2001, Ndambiri et al., 2012). Moreover, research and development, economic policy and macroeconomic condition, openness to trade and institutional framework are among the most important determinants of economic growth. These broad categories can be further broken down into various determinants of economic growth.

 The influences considered here include, physical capital, exports, Aid, government policies, inflation, external debt, government expenditure, financial systems and technological progress.

A variety of studies have addressed the issue of economic growth, mostly using either cross-country or panel data approach (Barro, 1997, 2003). While most of these studies utilize the standard neo-classical growth Model, More recent studies focus on endogenous growth models. There have been two periods of powerful work on growth theory, the first was in the 1950s and 1960s, and the second (30 years later) in 1980s and 1990s. In the first period, the neoclassical theory of growth was best known contribution by Robert Solow (1956).

2.1.1.1. The Keynesian theory of growth

Unlike Smith's conception of saving (frugality) as an important prerequisite of growth, Keynesians approach gives emphasis to the demand aspect. According to the Keynesian theory of growth demand from consumer and state were the prerequisite for economic growth. This assumption means that changes in income, especially disposable income, is the prime influence on consumption expenditures. If the household sector has more income because of the economy is expanding, then they increase consumption expenditures. If the household sector has less income because of the economy is contracting and a large group of workers is unemployed, then they decrease consumption expenditures.

Following the publication of Keynes's *General Theory* in 1936, some economists sought to dynamize Keynes's static short-run theory in order to investigate the long-run dynamics of capitalist market economies. Roy Harrod (1939, 1948) and Evsey Domar (1946, 1947) were developing the growth model independently that relate an economy's rate of growth to its capital stock. However, the assumptions and results are, basically the same. While Keynes emphasized the impact of investment on aggregate demand, Harrod and Domar emphasized how investment spending also increased an economy's productive capacity (a supply-side effect).The Harrod-Domar (H-D) model considers a closed economy in which one homogenous good *Y* is produced, where Y is gross output. This good may be either used as an investment good, *I,* or as a consumption good, *C.* The model suggests that the economic rate of growth depends on the level of savings, and the productivity of investment (i.e. in order to grow, economies must save and invest a certain portion of their GDP).

The labor force is assumed to grow at a constant exogenous rate *n* and thus $\frac{\dot{L}}{L}$= n. Thus, an aggregate production function w it h fixed technological coefficient was given as:

$$Y_t = \min\left[\frac{k_t}{v} \frac{E_t}{U}\right]$$ -- [1]

Where, Y_t = total output (GDP) at a time t

K_t = physical capital stock at a time t

v = utilized capital-output ratio (constant, i.e.)

E_t = effective labor force at a time t

u = employed effective labor-output ratio (constant, i.e. . . .)

Assuming a two-sector economy (households and firms), can write the simple national income equation as:

$$Y_{t = C_t} + S_t$$ --- [2]

Where Y_t = GDP, C_t = consumption and S_t = saving.

the Harrod-Domar growth model, gross investment (I_t) is assumed to be equal to aggregate saving (S_t);

That Subtitling [2.3] into [2.2] yields [2.4] t is

$$I_t = S_t$$ --- [3]

Subtitling [2.3] into [2.2] yields [2.4]

$$Y = C_t + I_t$$ -- [4]

The evolution of the capital stock over time is given by:

$$Y_{t+1} Y_t = \left[\frac{s}{v} - \delta\right] Y_t$$ -- [5]

Where δ is the rate of depreciation of capital stock by assuming that total saving (S_t) is some proportion (s) of GDP (Y_T), $S_t = sY_t$ -- [6]

We know that $v = \frac{K}{Y}$, from this K = vY and $I_t = S_t = sY_t$, it follows that we can rewrite equation [2.5] as:

$$VY_{t+1}(1- \delta)vY_t + sY_t$$ --[7]

Dividing both sides by v, and subtracting Y_t from both sides of equation [2.7] yields equation (2.8):

$$Y_{t+1} - Y_t = \left[\frac{s}{v} - \delta\right]Y_t$$ --[8]

Dividing both sides equation [2.8] by Y_t yields that:

$$\Delta \frac{Y}{y} = (\frac{s}{v}) - \delta \rightarrow \mathbf{g_{y}} = (\frac{s}{v}) - \delta \quad \text{--} \quad [9]$$

This simply states that the growth rate (*gy*) of GDP is jointly determined by the savings ratio (*s*) divided by the capital–output ratio (*v*). The higher the savings ratio and the lower the capital–output ratio and depreciation rate, the faster will an economy grow (Brian Snowdon and Howard R. Vane, 2005).

2.1.1.2. The neo-classical theory of Growth

School of thoughts and theories on economic growth can be traced back to the classical economists of the eighteenth and nineteenth century, whose works are briefly reviewed alongside the transition to neo classical growth theory. The basic framework of neoclassical growth models was first developed by Robert Solow (1956) and Trevor Swan (1956). This neo-classical model states that, at any point in time, the total output of the economy depends on the quality and quantity of physical capital employed, the quantity of labor employed and the average level of skills of the labor force. However, once the economy reaches the full equilibrium level, additional growth in the stock of capital per worker will only take place if productivity increases, either through enhanced capital stock or through improvements in the quality of the labor force.

The basic assumptions of the Solow model include constant returns to scale, diminishing marginal productivity of capital, exogenously determined technical progress and substitutability between capital and labor. And his basic question was "what are the main determinants of economic growth in the long term". This model (Solow) was started by criticizing the Roy Harrod and Evsey Domar (Harrod, 1939 and Domar 1946) models for its weakness. Based on his growth model, high investment rate (saving rate), high level of technology, skilled human capital, low level of population growth rate and low rate of capital depreciation are the most determinants of economic growth in long run. According to this simple mathematical model, economic growth can be measured as follows:

$$\Delta \mathbf{Y_t} = \frac{\partial Y \Delta Kt}{\partial K} + \frac{\partial Y \Delta}{\partial L} + \frac{\partial Y \Delta At}{\partial A} \text{---} [10]$$

When we divide both sides of [2.10] by Yt, it becomes that:-

$$\frac{\Delta Y}{Yt} = \frac{\partial Y}{\partial K}\frac{\partial Y\Delta Kt}{Yt} \quad + \frac{\partial Y\Delta}{\partial LYt} + \frac{\Delta Y\Delta At}{\partial A\,Yt}$$ -- [11]

The above equation decomposes GDP growth into portions that can be attributed to growth in the capital stock, the labor force, and the technology level. Then

$$\frac{\Delta Y}{\partial k} * \frac{\Delta K}{Yt} = \frac{\partial Y}{\partial K} * \frac{Kt}{Yt} * \frac{\Delta K}{K}$$

$$\beta_k \frac{\Delta K}{K}$$

$$\beta_k$$

Using same methodology for labor and technology, reduced form of Equation [2.11] in growth form is as follows.

$$g_y = \beta_k g_{k\,+} \beta_L {}_+ \beta_A g_A$$ ---[12]

Since the Solow's growth model assumption was constant return to scale and perfect competitive market, the summation of the share of capital and labor is a unity. So if share of capital is βk, then the share of labor is 1-βk =βL and the above equation can be rewrite as

$$\beta_A g_A = g_y - \beta_k g_{k\,+} (1 - \beta_{k)}$$

Where gy= Growth rate of Real GDP

gk=Growth rate of physical capital

gA= Growth rate of technology and βk , βL, βA are the marginal elasticity of capital, labor force and technology respectively. So if we have observations on the growth rate of output, the labor force, and the capital stock, we can have an estimate on the growth rate of total factor productivity. Equation [2.13] defines as the "Solow residual" in its long run growth model.

According the neo classical theory of growth, the model makes three important forecasts. First, increasing capital relative to labor creates economic growth, since people can be more productive given more capital. Second, poor countries with less capital per person grow faster because each investment in capital produces a higher return than rich countries with sufficient capital. Third, because of diminishing returns to capital, economies eventually reach a point where any increase in capital no longer creates economic growth and which is called a steady state.

2.1.1.3. The Endogenous theory of Growth

In the mid-1980s it became increasingly clear that the standard neoclassical growth model was theoretically unsatisfactory as a tool to explore the determinants of long-run growth .The main limitation of the Solow model is that technological progress is assumed exogenous and common across countries (Elhanan Help man, 2004). The model without technological change predicts that the economy will eventually converge to a steady state with zero per capita growth. The fundamental reason is the diminishing returns to capital. The basic improvement of the new growth theory or endogenous growth theory over that model is that it explicitly tries to model technology rather assuming it to be exogenous. In essence, it looks for determinants of technology frontier upward continuously.

In this theory, the central motive of profit maximization of business firms are considered to determine technological progress as these firms involve in research and development (R&D) seeking new and better idea. 1980s several economists, most notably Roomer (1986) and Robert Lucas (1988), sought to construct alternative models of growth where the long-run growth of income per capita depends on investment decisions rather than unexplained technological progress.

Romer (1986) and Lucas (1988)) was developed an economic growth model that includes mathematical explanation of technological advancement, which incorporates a new concept of human capital (skill and knowledge) that make workers productive. Unlike physical capital, human capital has an increasing rate of return. Therefore, overall there are constant rate of return to capital and economies never reach a steady state. According to the Endogenous theory of growth, economic growth does not slow as capital accumulation, but the rate of growth depends on the type of capital a country invest in. As research indicates that increasing human capital (education) and technological change (innovation) fast economic growth in long run (Elhanan Helpman, *Hulya Ulka, 2004).*

The first version of endogenous growth theory was **AK** theory, which did not make an explicit distinction between capital accumulation and technological progress. In effect it lumped together the physical and human capital whose accumulation is studied by neoclassical theory with the intellectual capital that is accumulated when innovations occur. An early version of **AK** theory was produced by Frankel (1962), who argued that the aggregate production function can exhibit a

constant or even increasing marginal product of capital. In the special case where the marginal product of capital is exactly constant, aggregate output Y is proportional to the aggregate stock of capital K.

Thus   Y = AK: --- [13] where A is a positive constant.

According to **AK** theory, an economy's long-run growth rate depends on its saving rate. For example, if a fixed fraction **s** of output is saved and there is a fixed rate of depreciation, the rate of aggregate net investment is:

K = sY- ∂**K** -- [14]

Dividing both side of equation [2.15] by K and simplifying it yields:

$\frac{K}{K}$ = **s** $\frac{Y}{K}$ - δ →**g$_k$** = SA- δ --- [15]

A = $\frac{Y}{K}$ Hence an increase in the saving rate **s** will lead to a permanently higher growth rate. Romer (1986) produced a similar analysis with a more general production structure, under the assumption that saving is generated by inter-temporal utility maximization instead of the fixed saving rate of Frankel. Lucas (1988) also produced a similar analysis focusing on human capital rather than physical capital.

The Romer model tries to explain why and how advanced countries of the world exhibit sustained growth. According to his model, technological progress is driven by R&D sector in advanced world and endogenizes the technological progress by introducing an R&D sector, i.e. search of new ideas by researcher interested in profiting from their invention.

2.2. Empirical Literature Review

In connection with the above discussions (the theoretical literature review), numerous researchers have examined sources of growth for cross country differences, panel data approach and time series data in both developed and developing economies using a wide variety of explanatory variables. However, there are few widely agreed on results. There are many empirical studies conducted on determinants of economic growth (Ficher, 1993; Barro, 1991, 1997; Zafar Iqbal *et al.,* 1998; Edwin Dewan *et al.,* 2001; Ndambiri H.K *et al.,* 2012; Patrick Enu *et al.,* 2013; Biswas and Saha, 2014) and many more. Some of them are conducted to test the validity of the traditional growth models and others are extensions of the basic models. Those studies determine the major source of economic growth and mostly focus on cross-country basis rather than on a single country.

According to empirical studies of the above researchers', Country's economic growth is influenced by several macroeconomic variables like physical capital formation (formally gross investment) , population , export level, Aid, money supply, general price level (inflation), government expenditure, external debt etc. These relations are reviewed in this section as follows.

2.2.1. Physical Capital Accumulation versus Economic Growth

Gross Capital formation refers to the proportion of present income saved and invested in order to enhance future output and income. It usually results from acquiring of new factory, machinery, equipment and all productive capital goods. The rate of accumulation of physical capital is one of the main factors determining the level of real output (GDP). Basically capital acts as the most fundamental input in a production system. It provides the base of growth of an economy. There exists a non-linear positive relation between capital formation and growth in general depending on the degree of efficiency of the capital use within the economic system. So the level of capital used within the economy is not only important but also the way it is used is also an important determinant of economic growth.

Different several empirical studies (Zafar Iqbal *et al.,* 1998) and (Biswas and Saha, 2014) in Asia; Dewan and Hussein (2001) in 41 middle-income developing country including Africa; (Ndambiri H.K *et al.,* 2012; Patrick Enu et al., 2013 and Kanu *et al.,* 2014) in Africa; (Weeks *et al.,* 2004) and (Tadesse, 2011) in Ethiopia. The above studies have found critical linkage between physical capital formation and the rate of growth. It is claimed that even a little robust growth rate can be sustainable over a long period of time only when a country is capable of maintaining capital formation at a sizeable proportion of GDP. It has been observed that any proportion less that 27 per cent can't sustain economic growth (Biswas and Saha, 2014). It is 22 estimated that the ratio of gross capital formation to GDP in the Sub-Saharan African countries which has experienced poor growth in the 1990s was less than 17 per cent compared to 28 percent in advanced countries (M. E. Hern´andez-Cat´a, 2000).

A time series analysis conducted in India using the Johansen co-integration method with annual data ranged from 1980/81 to 2010/11 found that, gross domestic capital formation (proxy for physical capital accumulation) and economic growth have positive relationship and statistically significant (Biswas and Saha, 2014).

Accordingly physical capital is the main source of economic growth. In addition the result suggests that employment, export, foreign direct investment and money supply have positive effect on India's GDP growth where as inflation and fiscal deficit have negative effect. Similarly, a research done in Pakistan (Zafar Iqbal *et al.,* 1998) based on multiple regression frameworks over the period 1960 to 1997 indicates that, increasing the stock of physical capital would contribute to economic growth at large. The higher rate of physical capital accumulation leads to higher rate of economic growth (both per capita income and real GDP).

The other empirical work on growth is the one conducted by Dewan and Hussein (2001). This study was conducted in 41 middle-income developing countries including Africa based on panel data. The results suggest that apart from growth in the labor force, investment in both physical and human capital, as well as low inflation and open trade polices (less trade barriers), are necessary for economic growth.

Furthermore, the ability to adopt technological changes in order to increase efficiency is also an important. Since many developing countries have a large agricultural sector, adverse supply shocks in this sector was found to have a negative impact on growth. The growth rate in real GDP of one percent is due to the change of gross fixed investment of 0.17 percent. Though numerous determinants of economic growth, little has been done in Ethiopia. Some of those have done on the macroeconomic performance rather than on the determinants of economic growth. Recent works in economic growth in Ethiopia were the studies done by Seid (2000); Weeks *et al,*. (2004) and Tadesse (2011) were the best one.

According to Seid (2000) study done on the Ethiopian economic growth during the period 1960/61 and 1998/99 by applying methods of Johansen co-integration, fixed capital formation is statistically insignificant. Rather the main finding or determining factor is that economic growth in Ethiopia were rainfall, export level and labor force in log run. However the research conducted by Tadesse (2011) during 1981 and 2009 found that the economic growth in Ethiopia was driven by physical capital and human capital, which account 42 and 56 percent, respectively. On the other hand a research done in Ethiopia (Weeks *et al.,* 2004), indicates that the contribution of physical capital to growth is found to be statistically significant in short run despite the growth elasticity was less (0.30) comparing to *Tadess's result (I.e. 0.42).*

2.2.2. Export verses Economic Growth

Exports of goods and services represent one of the most important sources of foreign exchange income that affluence the pressure on the balance of payments and create an employment opportunities. An export led growth strategy aims to provide producers with incentives to export their goods through various economic and governmental policies. It is important to note that a large number of studies on the importance of exports in economic performance and the relationship between exports and aggregate economic activity (economic growth) have been conducted over the years, particularly in recent years. It is gratifying to observe that in recent times, there has been great and increasing interest in the study of exports and economic growth within the context of developing countries.

A theoretically consistent method to test validity of the export led growth (ELG) hypothesis for Libya. The current discussion is focused on whether a developing country would be better served by trade policies oriented toward import substitution or export promotion (Irwin, 2002, *Shafaeddin, Pizarro*, 2007, Jayanthakumaran, 1994, etc).The studies have been conducted to examine the link between exports and economic growth. These studies have been proved that there exists a strong relationship between exports and economic growth positively (Iqbal and Zahid, 1998; Faye, 2001; Khaled R.M. *et al.,* 2010; Ndambiri H.K. *et al.,* 2012; Ugochukwu and Chinyere, 2013; Biswas and Saha, 2014).

A research done in Pakistan during 1959/60 to 1996/97 Applying multiple regression technique (Iqbal and Zahid, 1998) showed that, export and economic growth have direct relationship during the specified period of study. Their result indicates that a one percentage increase in export-GDP ratio raises the growth rate of GDP per capita by 0.7 percentage points and real GDP by 0.77 percentage points per year. In addition the positive relationship between export and economic growth have also confirmed in Indian economy (Biswas and Saha, 2014). This research was conducted during 1980/81 to 2010/11 and applying Johansson Cointegration technique to test the long run relationship among the variables. As the result showed that one percent increase in export of goods and service will raises the GDP of Indian by 0.965 percent. When come to Ethiopia, the research result was inconsistent.

A research done by Faye (2001) indicates that there was a positive and significant impact between export and economic growth in the Ethiopian context. According to his result, the rate of real growth rate of real export has positive effect on the rate of economic growth. Not only this but also he found that, there was a strong positive relationship in the long run than in the short run. Similarly, a study done by Soressa (2013) Appling the Autoregressive distributed lag model (ARDL) and Grange causality for the period 1960 to 2011 found that, a one percent increase in export will lead to increase the economic growth by 0.57 percent in long run. Moreover, the research done by Hailegiorgis (2012) during 1974 to 2009 by using granger causality found that, there is an evidence of unidirectional causality between export and economic growth in Ethiopia (I.e. export growth causes economic growth).

However, the study of Gezahegn (2012), which was conducted during 1981 to 2011 that analyzed the long run effect of export volatility on economic growth, was inconsistence with the above studies. According to the study empirical finding, the long run effect of export volatility seems to have negatively statistical effect on output growth on Ethiopia. In addition the study found that export was insignificant to the Ethiopian economic growth even though there was a positive relationship between export and economic growth during the study period.

2.2.3 .Foreign Aid versus Economic growth

Foreign capital inflows are receiving due attention because of their potential to finance investment and perceived to promote economic growth in the recipient country. The growing divergence in saving and investment rates, export-import gap (foreign exchange constraints to import capital goods) and budget deficits in developing countries make them to depend highly on inflow of foreign capital. Poor countries like Ethiopia lack sufficient domestic resources to finance investment and the foreign exchange to import capital goods and technology. The existing situation in Ethiopia is a living example of the scenario which binds economic growth.

Different study on foreign aid and economic growth that generated mixed results (both negative and positive) in log run. A study done by Ndambiri H.K *et al.* (2012) on Sub-Sahara Africa countries using panel data indicates that there was negative relationship between foreign aid and economic growth. According to their result every unit increase in the foreign aid was likely to lead to a decline in GDP growth by 7.7 percent. Similarly, Malik (2008) argued that there was significant

and negative impact of foreign aid on economic growth in Sub-Saharan African (SSA) countries. The study conducted by E.M.Ekanayakeet *el al.* (2008) on 85 developing countries (Asian, African, Latin America and31 Caribbean) for the period of 1970 -2007 found that mixed results. Aid had negative impact on economic growth for Asia and Latin America countries. However, the study found that Aid was positively related with economic growth in Africa countries.

Similarly, the IMF working paper done by (Camelia *et al.,* 2009) in developing countries for the period 1960-2000, showed that foreign aid promotes economic growth in long run. In addition a study done in Ethiopia for the period 1970-2009, indicates that there is a positive and statistically significant relationship between foreign aid and economic growth in the long run but insignificant in short run (Tasew, 2011). According to his result the long run elasticity of growth with respect to aid is 0.45. This implies that every unit increase in the foreign aid was likely to grow GDP by 0.45 percent in long run.

2.2.4 .External Debt verses Economic growth

External debt magnitudes of larger proportion have been very common in Sub-Saharan Africa. Many countries in this region have been struggling with debt burdens that outweigh their export earnings, the growth rate and even level of their gross national products. The World Bank (World Debt Tables, 1987-88, p.xix) reveals that "the external indebtedness of African countries is an obstacle to the 'restoration' of the conditions needed for growth." The huge debt burden acts as a threat to the economic performance given the wide spread poverty and structural rigidities in these countries.

The international financial community has been providing help to Sub-Saharan Africa regarding external debt burden reduction, among other things. This assistance has been provided in the form of the provision of concessional financing from international financial institutions, debt relief from official creditors mainly in the context of Paris Club rescheduling, and, in some cases, through bilateral action by the creditors. Though, these measures have resulted in considerable success in alleviating the external debt burdens of many middle income countries, the countries in sub-Saharan Africa continue to suffer from unacceptable levels of poverty and heavy external debt burdens (IMF, 2001).The development efforts in most of the poor countries involve investments

that are greater than their domestic savings; foreign finance in the form of external debt becomes absolutely necessary. *Chenery and Strout (1966)* feel that this finance in the form of aid contributes to growth by relieving some of the potential bottlenecks of savings and foreign exchange However many resources from investment. Were (2001) shows a negative relationship between external debt accumulation growth and investment for Kenya. Osei (1995) suggests that external debt is a major constraint to the economic performance of Nigeria and Ghana. *Metwally (1994)* concludes that the effect of debt service ratio on economic growth is negative in some of the Asian economies. *Degefe* (1992), using a growth-debt model for Ethiopia, concludes that external capital had a differential impact on growth during the Derg and Imperial regimes and it adversely affected economic growth.

The study by *Geda and Zerfu (1998)* reveals that Ethiopia's foreign debt has been increasing in its magnitude and has become large relative to the size of its economy and level of exports Most developing countries, especially developing countries in Africa faced domestic financial constraints. Those constraints made external debt an essential complement to domestic resources for promoting sustainable economic growth among these developing countries. The theoretical literature suggests that foreign borrowing has a positive impact on investment and growth up to a certain threshold level; beyond this level, however, its impact is adverse. According to the empirical evidence of many developing countries including Africa and Latin America (IMF, 2002, 2003; Boboye *et al.,* 2012; Alfredo, 2005; S. Ayadi *et al.,* 2008; Teklu *et al.,* 2014) a reasonable external debt accelerates economic growth.

However, beyond certain threshold level, additional indebtedness may reduce growth. A study done on the Nigerian economy by Boboye *et al.* (2012) reported that external debt burden had an adverse effect on the nation income and per capita income. According this study, high level of external debt led to devaluation of the nation's currency, increase in retrenchment of workers, continued industrial strike and poor education system. In addition the IMF working paper (2002) from 1969-1998 based on panel data of 93 developing countries, a reasonable level of external debt help finance productive investment and expected to enhance growth but beyond certain threshold level, additional indebtedness may reduce growth. A country with average indebtedness and doubling the debt ratio to real GDP would reduce annual per capita growth by 0.5% -1%. The research done in Ethiopia for the last recent four decades by Teklu *et al.* (2014), reported that the ratio of public

external debt to GDP has negative and statistically significant relationship with real GDP in the long run and had no significant effect in short run.

A study by melese (2005) conducted in Ethiopia during 1970-2002 using a structural macroeconomic model found that; all the debt burden indicators have a negative relationship with economic growth. Similarly, Hailemariam (2011) examined the impact of external debt on Ethiopian economic growth and private investment in Ethiopian applying a vector autoregressive (VAR) model over the period of 1960/61 – 2008/09. The study found that in the long run both external debt stock as well as debt servicing ratio have a negative and significant impact on economic growth and private sector capital accumulation activity.

However, in the short run external debt and economic growth have positive relationship. He conclude that, the estimated short run models points out the current level of external debt flow has a positive while the past debt accumulation has a negative impact on economic growth and private investment of Ethiopia. The other recent study done in Ethiopia, which analyzed the effect of external debt on Ethiopian economic growth (Wessene, 2014) by applying ARDL model during the period of 1970/71-2010/11 was found that there is a negative and significant relationship between external debt and economic growth in long run. Generally despite the magnitude is different, all of the studies under this review came up with an influence that high level of external debt is liked with relatively low level of economic growth.

2.2.5. Government Expenditure Verse Economic Growth

Economic growth represents the expansion of a country's potential GDP or output. For instance, if the social rate of return on investment exceeds the private return, then tax policies that encourage can raise the growth rate and levels of utility. Growth models that incorporate public services, the optimal tax policy lingers on the characteristic of services. Wagner says, (1999:46) that there is a positive relationship between the per capital income of the citizens in a country with government spending such that the income elasticity of government expenditure is always greater than one. However, other researchers have discovered that the relationship is not always certain because there are periods when government expenditure in relations to the national income will decline when the elasticity of income to government expenditure is less than one (inelastic).

Rostow Musgrave model (1999:46) carried out a research on growth of public expenditure and concluded that, at the early stages of economic development, the rate of growth of public expenditure will be very high because government provides the basic infrastructural facilities (social overheads) and most of these projects are capital intensive, therefore, the spending of the government will increase steadily. The investment in education, health, roads, electricity, water supply are necessities that can launch the economy from the practitioner stage to the take off stage of economic development, making government to spend and increasing amount with time in order to develop an egalitarian society.

Iyoha (2002:217) in which he postulated five stages of expenditure growth; "traditional society, preconditions for take-off, the take off; the drive to maturity and the eye of high mass consumption."What determines the accepted expenditure growth depends critically on the assumption of the type of economy, i.e. whether it is a free market economy, a mixed economy or a command economy Samuelson (1995:514) contributed thus "it is a way of separating out contributions of the different trends during observed growth". In this, public expenditure will grow in sympathy to achieve growth in labour (L) and this will involve increase in education expenses; growth in capital (K) all these will come with through savings or borrowings and technological innovation (Tn), therefore $Q = F(K, L, Tn)$.

On the whole, the amount spent by the government did not bring economic growth Carvins(1993) cited by likita, adjusting terms of trade shock. Nigeria (2002, 2004) "it is supremely impossible that Nigeria did not take sufficient viable projects with returns higher than the rate of interest on foreign assets. From that perspective, investing domestic savings in domestic capital made foreign sense. But did the Nigerian authorities give themselves enough time to fund the right projects and to complement the investment in a reasonable efficient manner? There are strong grounds to suspects that the answer is no. The anxiety was how to dispose of the massive wealth that arose from oil without putting a conservative policy in place.

2.2.6. Inflation versus Economic Growth

Recently Inflation is global problem. A major finding from the empirical analysis is that the estimated effects of inflation on growth and investment are significantly negative when some plausible instruments are used in the statistical procedures. Thus, there is some reason to believe that the relations reflect causation from higher long-term inflation to reduced growth and investment *Robert J. Barro.* The empirical evidence shows that there is a negative relationship between inflation and Economic growth (Khan and Senhadji, 2000; Michael and William, 1996; Barro, 2013; Bawa and Abdullahi, 2010; Saliand and Gopakumar, 2008; Veiga *et al.,* 2014; Asmamaw, 2012). Although the magnitude of the inflation is different in different studies, high inflation rate slows down the growth rate. Barro (2013), classified the threshold of inflation in to three categories namely below 15% low inflation, 15 up to 40% medium rate and above 40% is high inflation rate and affected the growth rate negatively.

Similarly, Michael and William (1996), say that the threshold inflation rate is not exceeding 40% A study conducted in 140 countries (both developed and developing) during 1960-1998 (Khan and Senhadji, 2000) found out that the threshold inflation level for industrial countries and developing countries were 1-3 percent and 11-12 percent respectively, under the study period. Similarly, a study conducted in Nigeria Bawa and Abdullahi (2010) during 1981-2009 based on the quarterly data and by using the threshold regression model found out that the threshold inflation level was 13 percent. In addition their finding indicates that below the threshold level, inflation has a mild effect on economic activities, while above it, the magnitude of the negative effect of inflation on growth was high.

A research done by Barro (2013) in 100 countries of the world including Ethiopia from 1960 -1990, indicates that an increasing in average inflation by 10% are likely reduce the growth rate of real per capita GDP by 0.2 to 0.3 percentage and reduce the ratio of investment to real GDP by 0.4-0.6 percentage per year. Similarly the study done on 15 Sub-Sahara Africa by Veiga *et al.,* (2014) showed that a unit percentage rise in inflation will reduce the growth rate by 1.5% in the region. Not only this but also the study of Asmamaw (2012) in Ethiopia have similar result. According to his research result, which was based on time series data from 1974-2011 applying VAR methodology, a unit percentage rise in inflation will reduce the GDP growth by 0.178% in log run.

2.2.7. Population Verses Economic Growth

There is continued divergence of opinions regarding the consequences of population growth on economic growth the debate between positive impact and negative impact of population growth on the economy is thus still ongoing. On the positive side, population growth induces technological advancements and innovations. This is because population growth encourages competition in business activities and, as the country's population growths; the size of its potential market expands as well. The expansion of the market, in its turn, encourages entrepreneurs to set up new businesses (Simon 1992). A large population growth on the other side is not only associated with food problem but also imposes constraints on the development of savings, foreign exchange and human resources.

The increase in demand for food leads to a decrease in natural resources, which are needed for a nation to survive. Other negative effects of population growth include poverty caused by low income per capita, famine, and disease since rapid population growth complicates the task of providing and maintaining the infrastructure, education and health care needed in modern economies (Barro, 1991; Mankiw, Romer and Weil, 1992). The third school of thought is that population growth is a neutral factor in economic growth and I s determined outside standard growth models (Felmingham 2004). Malthus (1798) believed that the world's population tends to increase at a faster rate than its food supply. Whereas population grows at a geometric rate, the production capacity only grows arithmetically.

Therefore in The absence of consistent checks on population growth, Malthus made the prediction that in a short period of time, scarce resources will have to be shared among an increasing number of individuals. However, such checks that ease the pressure of population explosion do exist, and Malthus distinguished between two categories, the preventive check and the positive one. The preventive check consists of voluntary limitations of population growth. Individuals before getting married and building a family, make rational decisions based on the income they expect to earn and the quality of life they anticipate to maintain in the future for themselves and their families. The positive check to population is a direct consequence of the lack of a preventive check. When society does not limit population growth voluntarily, diseases, famines and wars reduce population size and establish the necessary balance with resources.

Bucci (2003) investigated whether there is a long run relationship between population n (size and growth) and per capita income focusing on human and physical capital as reproducible inputs. The study found out that population growth exerts a negative effect on economic growth. However, when individuals choose endogenously how much to save, population growth can also have a neutral influence on economic growth. The study also extended its analysis to the case where physical and human capital can interact with each other in the production of new human capital.

Other studies have sought to gauge the impact of population growth on economic growth. A well-known stylized fact of this literature is that the estimated effects of population growth measures on economic growth are not robust, varying between being positive, negative, and insignificantly different from zero. The present study analyzes 471 statistical regressions from 29 prominent economic growth studies using meta-regression analysis to identify the effect of alternative methodologies on key population growth results. The distinctive features of modern economic growth are the extremely high rates of increase-at least five times as high for population and at least ten times as high for per capita product as in the observable past. Both high rates of increase imply rapid shifts in the structure of production and patterns of life, suggested by the terms industrialization and urbanization.

Underlying these high aggregate rates and rapid structural shifts is the ex- tended application to problems of health and economic production of a vast and rapidly growing stock of tested knowledge and inventions. The knowledge, which relates not only to natural conditions of the universe in which we live but also to the characteristics of social groups, affects the values and beliefs of the societies that possess and apply it; and the inventions contribute to the advance not only of material technology but also of social institutions (Simon Kuznets 2001).

CHAPTER THREE

AN OVERVIEW OF ETHIOPIAN ECONOMY

3.1. Introduction

The Ethiopian economic growth is interchanging with in different territorial authority and various changes in different political regimes. These change in government structure created a problem of inconsistency in implementing the policies by previous regimes including external and internal wars as well as natural disaster like famine and drought had a depressing effect on the history of economic growth of the country. Modern Ethiopia, characterized by political centralization and a modern state apparatus, emerged in the mid-19th century. The Ethiopian economy relied primarily on agriculture, particularly coffee production.

In modern Ethiopian political economic history, we can distinguish three regimes that followed unique macroeconomic policies with its impact on macroeconomic growth performance of the country. These are the period of pre 1974(the monarchy regime), the period 1974-1991(the military regime) and 1992 to the present (the EPRDF regime). Ethiopia's economic policy history is characterized by several radical policy changes and blows. During the monarchy (pre 1974) economic policy was mainly known to be a market-oriented economic system. However, the period 1974–1991 characterized by centralized and command economic system. Since 1992 EPRDF officially denounced the socialist system and supported market-oriented economic system. The descriptive analysis of economic performance of the country by using secondary data in different regime as economic status and political amendment follows:

3.2. The Imperial Regime (1930-1974)

Emperor Haile Selassie I, (1930-1974). During this period an attempt to modernize the country is made (an expansion of modern schools and health facilities, the first constitution, infrastructural development, the beginning of medium term planning etc are cases in point). Under Haile Selassie's rule, during this time, agricultural production resembled a feudal system since land ownership was highly inequitable, and the vast majority of Ethiopian were obliged to till the fields of the wealthy landowners. Much of the marginal amount of industry that did exist was concentrated in the hands

of foreign ownership. The Imperial regime had also the positive record of modernizing the economy by developing infrastructure, establishing and encouraging the establishment of imports substituting industries, modern political system and in particular expansion of education. The Policy of Imperial regime pursued a market-oriented economic policy and economic growth during the period 1960-1974 was an average of 3.7 percent per annum (the per capita growth being 1.4 percent). Similarly, the sectorial growth performance for agriculture, Industry and service were 2.1, 6.9 and 7.6 percent, respectively for the same period (EEA, 2007/08). In addition the sectorial share of agriculture, Industry and service to real GDP was 62, 10 and 14 percent, respectively during the same period.

In the regime, land was the economic basis of the ruling class, which the emperor himself was at the top of the system. *According to Alemayehu and Befekadu (2005),* an economic growth of average of 4 percent per annum during 1960-1974 was achieved. However, it did not improve the lives of most Ethiopians. Majority of the Ethiopian population were subject to exploitation from feudal system. About 80 percent of the population was subsistence farmers who lived in abject poverty because they used most of their small production to pay taxes, rents, debt payments, and bribes to the feudal land lords and their affiliates.

By late 1960s new educated elite started to challenge the political system by articulating the misery under which the majority of the populations lived. Systemic exploitation by feudal and the monarchy outraged majority of the rural population (because of unjust distribution of land), who were basically in the state of serf-dom. There were a series of protests in 1974 against the feudal regime and the revolution toppled it the same year. The immediate causes for the revolution were associated with the famine in Northern Ethiopia (Wollo); the strike by taxi drivers following the 1974 OPEC-induced oil crisis; a revised curriculum of education which was strongly opposed by the educated elite and salary increase demand by the soldiers (military). As these problems were not addressed responsibly, the military regime DERG removed the emperor Hail sillasie from power in 1974.

3.3. The Socialist (Derg) Regime: (1974-1991)

The revolution in 1974 ultimately resulted in removal of the emperor from power. Immediately after Emperor *Haile Selassie* was overthrown; a Military Committee was established from several divisions of the Ethiopian Armed forces. As result the government installed a socialist (command) economic system where market system was deliberately repressed and socialization of the production and distribution process followed. The land reform policy of Derg was the major success history that earned credit to the socialist government and that was honored by the masses. The Derg did not give any opening for privatization to domestic and foreign investors.

After the revolution, the government's role in determining economic policies changed dramatically. In l975, the government nationalized or took partial control of most companies including extra housing, financial firms, manufacturing and so on. Moreover, the regime nationalized rural land and granted peasants "possessing rights" to parcels of land not to exceed ten hectares per grantee during; and issued Proclamation No. 76, which established a 500,000 birr ceiling on private investment and urged Ethiopians to invest in enterprises larger than cottage industries during this period (Alemayehu and Befekadu, 2005; Tadesse, 2011). However, this policy changed in mid-1989, when the government implemented three special declarations: Encourage the development of small-scale industries, the participation of non-governmental bodies in the hotel industry, and the establishments of joint ventures are the most one.

Under the Provisional Military Administrative Council (PMAC; also known as the Derg), Ethiopia's political system and economic structure changed dramatically, and the government embraced a Marxist-Leninist political philosophy. Planning became more ambitious and more pervasive, penetrating all regions and all sectors of the society, in contrast to the imperial period. By all measures they embraced a "hard control" during this regime. The average rate of growth of gross domestic product (GDP) and the per capita term was 1.6% and -0.7%, respectively (*Eshetu and Mekonnen*, 1992) during 1974-1990 and this growth rate was far below the estimated population growth of 2.5%. However, in 1984 and 1985, the GDP growth rate began to decelerate, amounting to -5.3%, which means that the per capita GDP was -10% in the same period. Similarly, Alemayehu and Befekadu (2005), reported that economic growth was decelerated to 2.3 percent (-0.4 percent in *per capita* terms) between 1974/75 and 1989/90. Reports *of EEA (2007/08)* indicates that, the

average annual growth of GDP and GDP per capita were 2% and 0.5%, respectively during the entire period of Derg (1974-1991). The sectorial growth rate of agriculture, industry and service sector were 1.3, 1.4 and 3 percent, respectively during the same period.

3.4 .The post -1991 EPRDF

The post-1991 period begun, with the coming to power of Ethiopian People Revolutionary Democratic Front (EPRDF) and the government removed the Derg regime that had ruled the country for seventeen years. In contrast to the previous policy regime of hard and command control, EPRDF initiated a wide range of reforms that covered the exchange rate, interest rates, liberalization of trade, domestic production and distribution, devaluation of currency, eliminating structural distortion, improving the country's human capital and infrastructure as well as poverty reduction.

In 1991 the regime adopted Structure Adjustment Program (SAP) as per recommendation of the World Bank (WB) and International Monetary Fund (IMF). The government promised to implement a series of policy reform measure in order to remove and change the command economic system with market based economy, to open the economy into the world economy and to encourage the wider participation of the private sectors in the development process of the national (*ADBG (2000))*. The promotion of small and micro finance enterprises is also critical to private sector development. The government has been providing support to such enterprises in several areas such as training, business skill, development, micro credit and information and marketing, (*AFDB/OECD (2008))*. Haile and *Assefa (2006)* described the specific measures taken to promote the export sector and participation of the private sector includes:

☐ Deregulation of domestic prices
  ➢ Devaluation of the national currency from 2,07 birr per dollar to 5 birr per dollar
  ➢ Liberalization of trade and the foreign exchange rate.
  ➢ Eliminating of export taxes except coffee
  ➢ Lowering of maximum import duties from 230% to 60%
  ➢ Simplification of export regulation and procedure
  ➢ Provision of adequate incentives, strengthening and enhancing institutional support for the export sector.

3.5. Macro Economic performance of Ethiopia

Ethiopia has a vision of becoming a middle income country in the coming one and half decades after implementing three successive five years transformation and development plan. The development policies and strategies pursued Sustainable Development and Poverty Reduction Program (SDPRP), the country's vision and achievements registered under SDPRP were the basis for PASDEP. The macroeconomic policy index developed from fiscal (budget deficit), monetary (inflation) and trade (Openness) policy. These macroeconomic policy environments determine the growth rate of the economy in general and effectiveness foreign aid in particular. Good macroeconomic policy creates a stable economic environment and initiate investors to invest and to generate a profit (see Schmidt-Hebbel, *et.al*, 1996). For instance, high inflationary environment distorted the value of financial assets and investors become uncertain about the economic policies, this uncertainty might leads the investors not invest. In similar ground, (Herandez-Cata, 2000) argued that inflation causes low levels of private investment as domestic and foreign investors foresee a low after-tax risk adjusted rate of return on capital.

3.5.1. Trend of Ethiopian GDP (1981-2016)

Real gross domestic product is the measure of country's final output at constant price at a given point in time. It measures the total income of the country in real terms. If we divide by the population of the country it measures the average income of the people in the country. Despite the fact that the history of the growth performance was poor in the past; the country has experienced strong economic growth in the current time (especially, since 2003/04).

The source of this overall economic growth between 2004 and 2012 is mainly attributed to the growth in agriculture and service sectors. During 2010/11, the country has registered 11.4% real GDP growth rate surpassing the GTP target of 11 percent. Particularly, the agriculture and industry sectors have registered growth rates above their targets set for the year. Manufacturing sector is a leading and significant sector for the country growth. This indicates that the openness of FDI for the sectors have a positive impact for the country's growth. These can be by increasing employment, standard of living and poverty reduction.

GTP emphasizes enhancing the growth of the manufacturing sector to make it play a significant (leading) role in the nation's overall development endeavors. According to Ministry of Finance and Economic development report , the GTP imagines among others improved use of best practices and investment in rural roads, increase in electricity generation capacity (for example: Grand Ethiopian Renaissance Dam), construction railway and telecommunication network.

Table 1. Sectorial Share of GDP

Year	Percentage share (%GDP) of sectors		
	Agriculture	Service	Industry
1992	59	29	13
1993	55	30	15
1994	52	31	16
1995	51	32	17
1996	53	31	15
1997	52	31	15
1998	49	33	17
1999	48	34	17
2000	47	35	17
2001	47	34	16
2002	46	35	17
2003	42	38	18
2004	43	36	18
2005	44	36	17
2006	45	41	14
2007	45	42	13
2008	48	40	12
2009	47	41	12
2010	44.7	45	10
2011	43	44	10
2012	47	41	10
2013	44	44	12
2014	41	43	15
2015	39	43	18
2016	38	42	20

Source: Own computation from NBE

Figure 2 .Trends of Real GDP (1981_2016)

RGDP
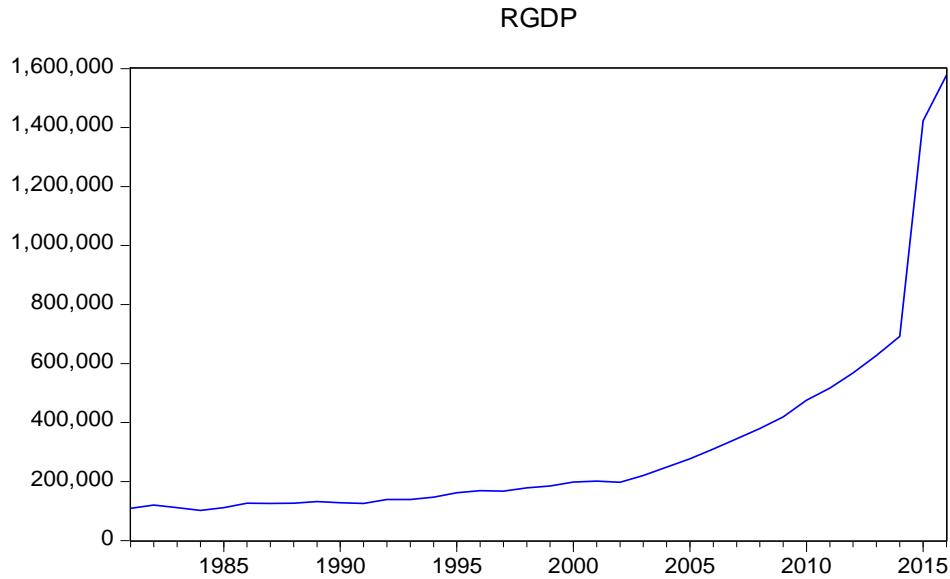
Source: NBE data Own computation

3.5.2. Saving and Investment Trends

Saving and investment are the two basic macroeconomic variables that measure the macroeconomic performance of the country. As per the growth theories from classical to endogenous, investment is the key variable in economic growth process. Investment is financed either by domestic resource or other. This section gives the description of saving and investment trend based on the data from 1981 to 2016. It is fact that, a countries economic growth is significantly affected by the rate of investment and rate of saving.

However, Low saving rate has been a dominant feature of the Ethiopian economy comparing to fast investment rate. The share of gross domestic savings from GDP was, on average, 12.9 percent for the last 15 years. On the other hand, gross capital formation as a share of GDP was 28.3 percent over the same years, which is higher than gross domestic saving (EEA, 2007/08). As a result, the resource gap was, on average, -15.4 percent over the last fifteen years, which was financed by external sources. According to the EEA report, the share of gross capital formation financed by the external sector was 73.6 percent during 1997/98 to 2007/08.

Similarly, MoFED (2013) also reported that, domestic saving was small (10.6%) while gross investment rate was 26.9 percent during 200/01 to 2011/12. Accordingly, the resource gap of the country registered 18.1 percent as ratio of GDP during the same period, and which was financed primarily from foreign source (specially, from external debt during 2000 to 2003 and 2007 to 2010 while during 2004 to 2005 was primarily from internal debt. According to the GTP, gross capital formation (formally gross investment) was expected to take 30 percent of GDP share while it reaches 40.3 percent during 2013/14 (NBE, 2013/14), which was achieved before the GTP period completed.

Despite, the gross domestic saving rate registered 22.5 percent of GDP share, which is above the GTP target (15%) and even achieved before the period is completed, still it very low as comparing to the investment rate needed. During 2009/10, domestic saving was only 5.2 percent of GDP. However, during the past 4 GTP periods domestic saving started to take off; as a result the share has jumped to 22.5 percent in 2014/15. For the amazing growth of domestic saving rate, the government introduced to stimulate domestic saving including wide range of awareness creation activities in urban and rural areas of the country; strengthening existing saving tools and introduction of new saving mobilization instruments such as selling of government Bonds, deepening of financial institutions, introducing private social security scheme, strengthening government workers social security scheme, strengthening saving for housing program, saving for investment equipment scheme, and sustaining the high level of government savings. Thus expansion of investment over the past years has been one of the key drivers of growth on the demand side.

Figure 3 . Trends of Gross Capital Formation (GCF) and share of real GDP) (1981-2016)
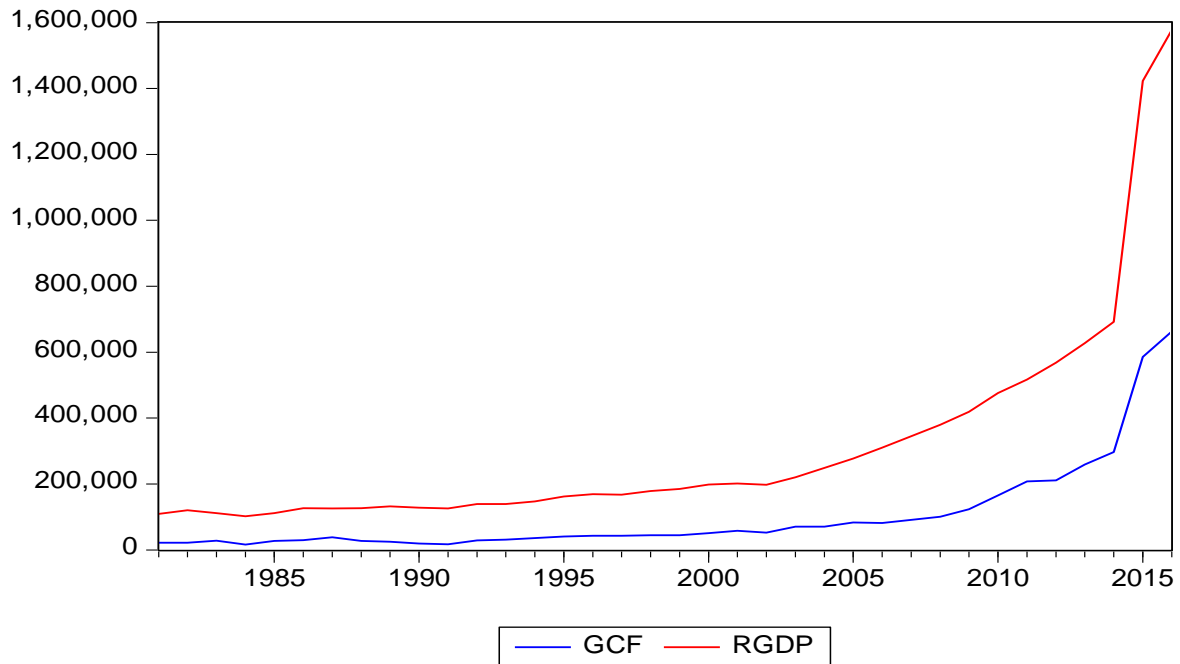
Source: MOFEC data Own Computation

3.5.3. Export and Ethiopian Economy (1981-2016)

The export sector has played an important role to bring about rapid economic growth in developing countries. However, most of them largely depend for their source of currency earning on a single product or a very narrow range of low value products, mostly agricultural commodities and minerals. Likewise, the Ethiopian commodity export sector is basically characterized by the dominant share of agricultural raw commodities in generating the greater proportion of the export earning of the country. These export commodities together have accounted more than 86 percent (NBE, 2012/13) of the total merchandise export earnings. The major export items, in order of their significance in the total commodity export value include coffee, gold, oil seeds, hides and skins, pulses, chat, flower, fruits and vegetables.

Figure 4 .**Trends of total export as percentage of real GDP (1981-2016)**
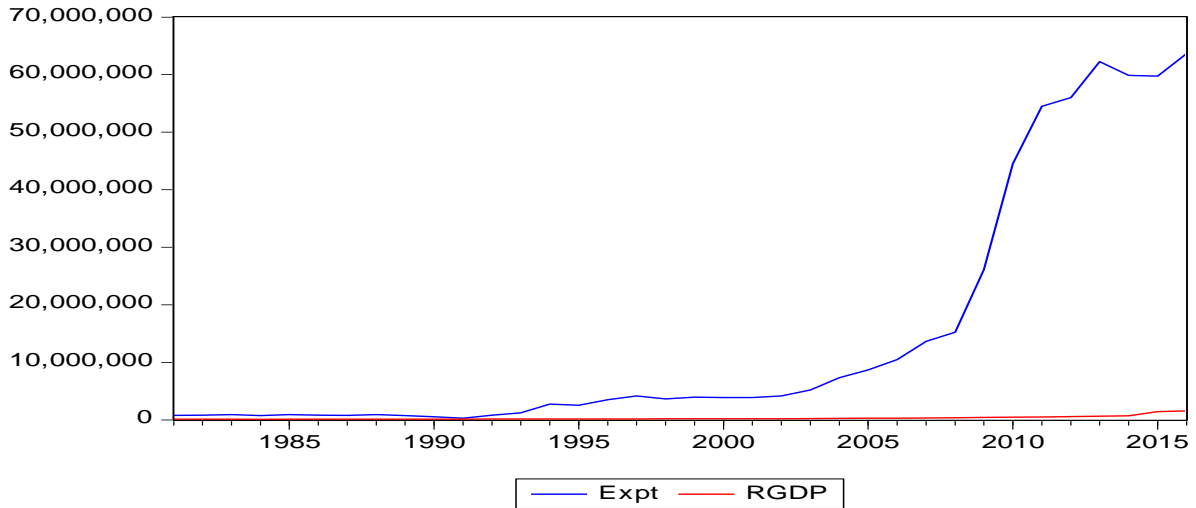
Ethiopia's export sector is characterized by over dependence on few agricultural products, with very limited exports of manufactured and semi-manufactured goods. This structure of concentrating on few agricultural commodities has not significantly changed over time.

Besides, Coffee has still remained to be the dominant export commodity, though its share in the value of total exports fluctuates from time to time. It accounted for, an average, 27 percent of export earnings between 2010/11 and 2012/13. Gold, Oil seeds, chat, flower, pulses, and live animal have share of 18, 13.7, 9.6, 6.2, 5.9 and 5.8 percent, respectively during the same period. The combined share of coffee along with the above six items were 86.2 percent. This indicates that the dominant shares of Ethiopian export sector are agricultural commodities and it confirms that the diversification of the export sector is limited to these agricultural raw commodities.

3.5.4. Aid and Ethiopian Economy

Ethiopia is one of the poorest countries in the world, which depend its export sector on agricultural primary commodities (68 percent) that suffers from low levels of domestic saving and insufficient amount of foreign exchange required to purchase capital goods. Not only this but also the country suffers from budget deficit, which required external assistance to enhance economic growth. Foreign aid, could fix this problem by supplementing domestic saving or foreign exchange reserves.

Figure 5. **Average Aid share of real GDP and Average real GDP growth rate (1981-2016)**
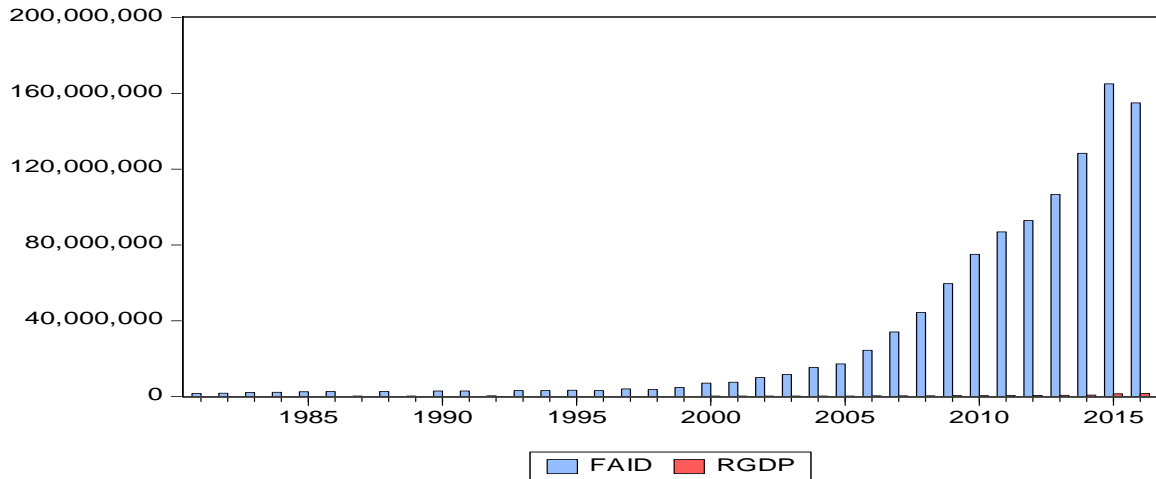
Source: own computation NBE data

observed from the above graph (Figure 5), even though the Aid ratio to real GDP continuously grew from 1.2 percent in 1981to 10.5 percent in 2003, the economic growth fluctuated, which registered the highest growth rate (12.1 percent) in 1986 and lowest growth rate (8.8 percent below zero point) in 1984, which was due to best rain seasons and catastrophic drought and famine, respectively. As a result the aid was served for consumption of the society rather than financing economic developments. However, Aid ratio to real GDP increases to 12.5 percent in 2010 (i.e. the highest value under the study period) from 10.5 percent in 2003, the economic growth also went in the same direction and registered an average growth rate of 10 percent for the period of 2003-2015

3.5.5. Trends of External Debt and Ethiopian Economy (1981-2016)

The Ethiopian external debt stock has shown significant change in its size over the years under consideration. Its external debt is steadily increasing specially, since 2007. According to the UNDP country report (2014), the Ethiopian external debt reached $11.1 billion or 24.3 percent of GDP during 2016 from $2.7 billion in 2006. While the real GDP growth registered 9.7 percent for the same period (GDP per capita reached 550 USD from 270 USD) in 2006.

Figure 6. Trends of external debt stock (total) in Millions of Birr.
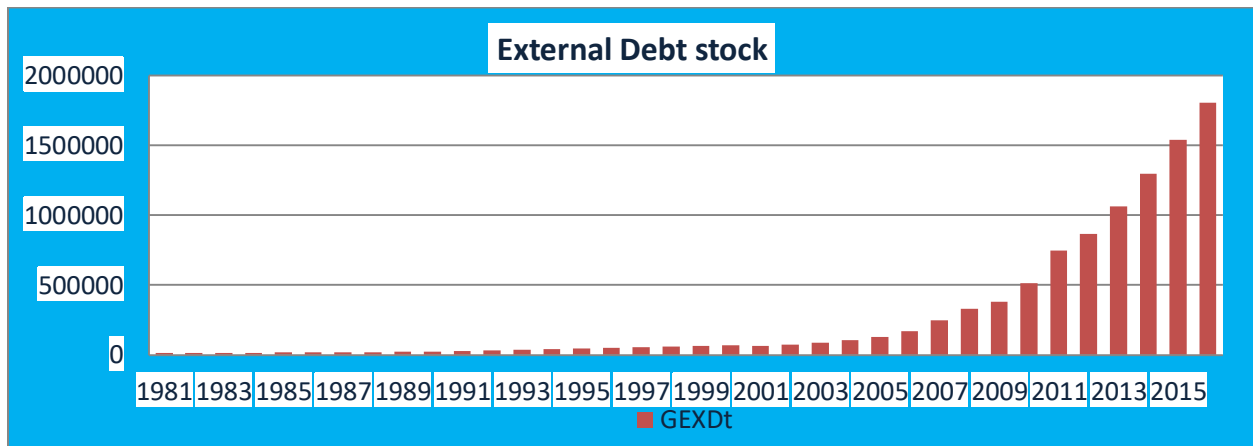
Source: Own Computation NBE data

However, during the military power the country had shown dependency on external assistance and reached a stage where it cannot function without external assistance (Befekade and Birhanu, 1999/00) as cited in Wessene (2014). But, the economic growth registered 2.3 percent while the per capita being -0.4 percent (Alemayehu and Befekadu, 2005). This very low economic growth may be associated with high external debt burden of which 40-50 percent financed for military expense during the same period (Tadesse, 2011). In the other hand, Hailemariam (2011) stated that, Ethiopia is one of the Highly Indebted Poor Countries HIPC) in the world. As we have seen in Figure 4.9 above, the external debt continually at increasing rate since 2007. The economy also grew at an average of double digit (11.4 percent) for the same period. Form this can observe that as the external debt increase the growth also raises, which indicates that the external debt were invested in the macroeconomic development rather for recurrent consumption despite they have inverse relationship between growth and external debt.

3.5.6. Trends of Government Expenditure and Ethiopian Economy (1981-2016)

Ethiopian Government performs two functions- protection (security) and provision of certain public goods. Protection function consists of the creation of rule of law and enforcement of property rights. This helps to minimize risks of criminality, protect life and property, and the nation from external aggression. Under the provision of public goods are defense, roads, education, health, and power, to mention few. the facts are argue that increase in government expenditure on socio-economic and physical infrastructures encourages economic growth.

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Ethiopian government expenditure spillover economic growth for example, government expenditure on health and education raises the productivity of labor and increase the growth of national output. Similarly, expenditure on infrastructure such as roads, communications, power, etc, reduces production costs, increases private sector investment and profitability of firms, thus fostering economic growth. Investigates of the relationship between government expenditure and economic growth in Ethiopia to test Wagner's Law which postulates that as real income increases there is a tendency for the share of public expenditure to increase relative to national income. Using the bounds test approach to Cointegration, evidence of a long-run relationship between government expenditure and GDP.

Figure 7 Government expenditure on real GDP
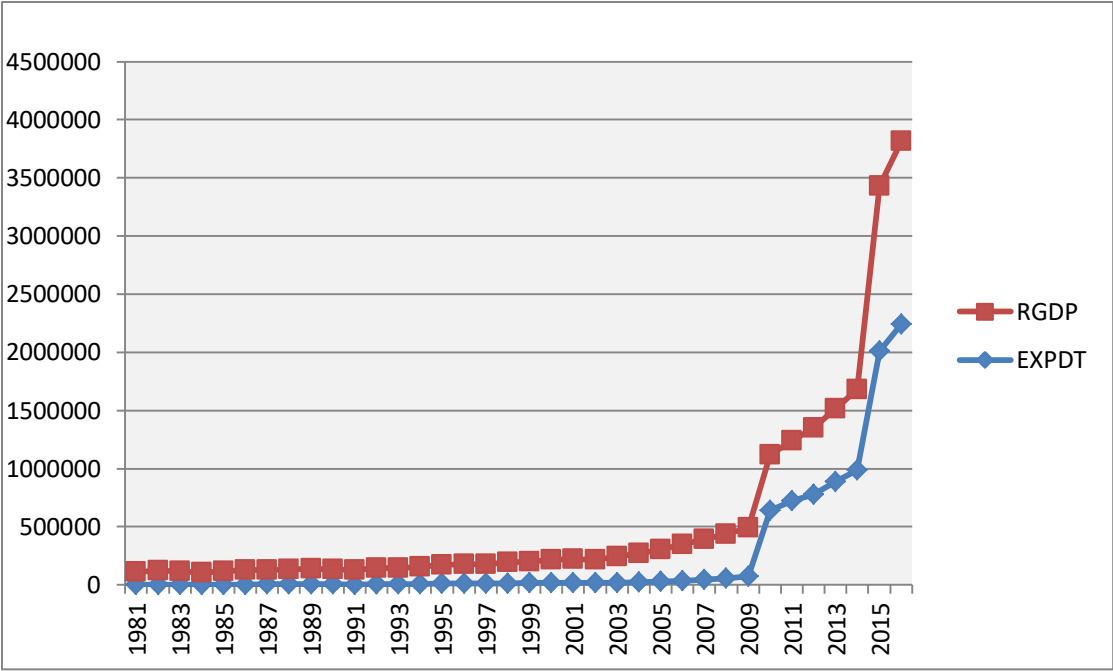
3.5.7 .Trends of Population and Ethiopia Economy (1981-2016)

The idea behind measuring aggregate output of the country in terms of GDP is to show the total economic activity of the country. GDP measures the market value of final goods and services produced by a country in a given year. It shows what the country paid for the final goods and services in a year and the more the country can afford higher cost the more benefits it gets.

It is commonly observed that countries with higher GDP are better-off than countries with lower GDP. Ethiopian population has grown along with economic expansion; increases in GDP do not necessarily result in an improvement in the standard of living. Economic growth in Ethiopia should be measured in terms of a sustained increase in GDP per capita over time. GDP per capita is used when economic growth focuses on standard of living of population. It shows the level of goods and services that, on average, individuals purchase or otherwise gain access to. This type of measuring economic growth at least takes into account the effects of population growth in the country. *Tsegaye Tegenu October 27, 2011.*

Ethiopian population is 88 millions that is growing at 2.5 % resulting in 2 million people added per year as *EIA forecasting*. Households which have higher consumption requirements and lower economic support ratio are growing by a constant average growth rate of 2.6% in rural areas requiring more land for production. also know that the absolute size of the national labor force is estimated more than 30 million, with an annual average increase of 1,3 per cent. Know that urbanization, as a result of rural-urban migration, is growing at higher speed (4,3%) affecting livelihood positions and infrastructure development.

Figure 8 **Ethiopian Population Trends (1981-2016)**
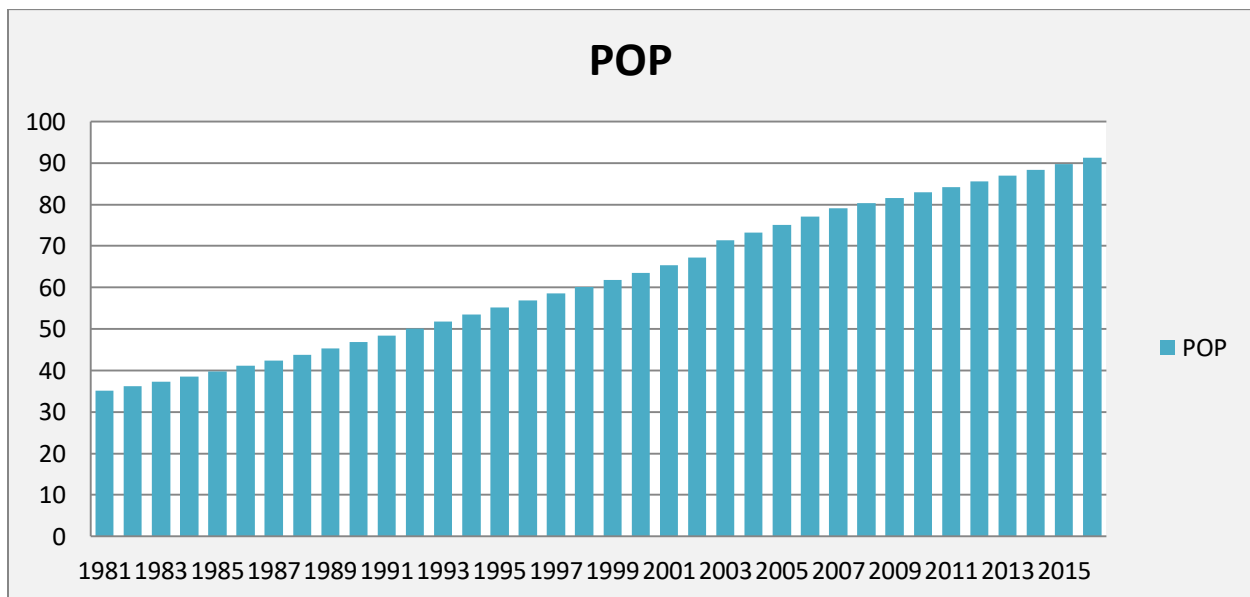
Source: CSA Data Own Computation.

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3.5.8. Trends of Inflation in Ethiopia (1981-2016)

Trends of inflation show the change in the inflation over the years. Looking at the trends of the Inflation would enable the reader to understand the change of inflation during the study periods. Ethiopia has recorded strong economic growth over the past 10 years mainly due to the Government-led development policies emphasizing public investment, commercialization of agriculture and non-farm private sector development. Inflation remained at a reasonable low level rate before 2000/03. However, post 2003/04 sow sharp increase despite rapid economic growth during the same period (Alemayehu and Kibrom, 2008). According to Alemayehu and Kibrom (2008), the sharp increasing of general inflation was caused primarily by food inflation, which is the effect of food demand triggered and international food price hike.

The official headline inflation during 2008 stood at about 33 percent with food inflation being about 49 percent. This was huge macroeconomic shock in the history of Ethiopia for the last five decades and until 2003, was below 5 percent per annum. This high rate of inflation continued until 2011/12. The 12 month moving average general inflation rate, which shows a longer inflation situation, was 18 percent for June 2010/11 and 33.7 percent in June 2011/12.

According to the MoFED report (2012/13) the high inflation rate, particularly in the year 2011/12 adversely affected the wellbeing of people and the effect to promote private investment. As a result, the Ethiopian government had taken policy measurements (prudent fiscal and monetary policy) and price stabilization intervention. Consequently, as of June 2012/13, the general inflation declined to 13.5 percent. As the National Bank of Ethiopia report indicates (2014/15), the general inflation declined from 13.5 percent in 2012/13 to 8.1 percent in 2013/14. Generally, we can say that, in the Ethiopian history inflation was at reasonable low level (i.e., does not harm the economy significantly) except for the period 2008-2012.

Figure 9 . **Trends of Inflation (1981-2016)**

INF
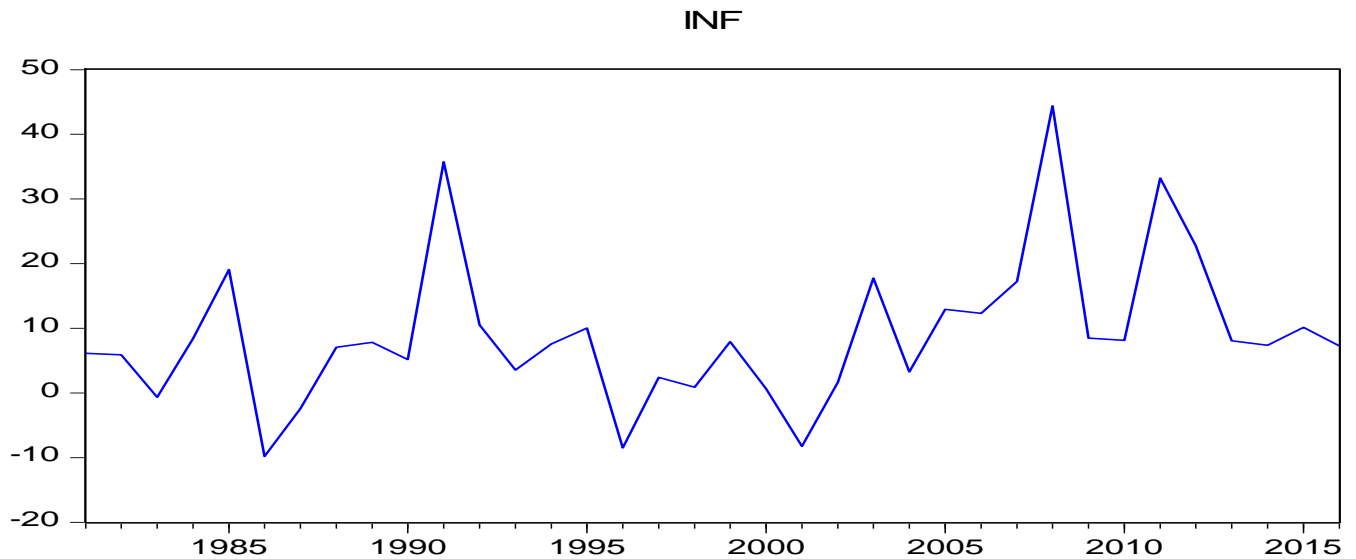
Source: NBE Data own computation

Historically, Ethiopia has not suffered from high inflation. For example "The annual average was only 5.2 percent between the years 1981–2003, and major inflationary episodes have occurred only during conflict and drought" (*kibrom, 2007*).   Annual average inflation reached a record of18 percent during 1984/85 because of drought, 21 percent in 1991/92 at the peak of war with Eritrea, and again 16 percent during the 2003 drought (Dick D. *et al,* 2010).

The study of causes of inflation has probably given rise to one of the most controversial debates in the field of economics. The debates differ in their hypotheses, mainly due to a range of conventional views about the appropriate measure to control inflation. For example, Neoclassical defined inflation as a rise in prices caused by excessive increase in the quantity of money. For Keynesians true inflation happens when money supply increases beyond full employment level (Jhingan, 1997). Though various economists define inflation in different ways a common general agreement is that inflation is a sustained increase in the general price level.

CHAPTER FOUR
METHODOLOGY

4.1. Type and Source of Data

4.2. Model specification

The growth model that attempts to capture some of the major macroeconomic factors affecting economic growth in Ethiopia. Macroeconomic theory has identified various factors that influence the growth of a country from the classical, neo classical and the new growth theories. These factors include natural resources, investment, human capital, innovation, technology, economic policies, foreign aid, trade openness, institutional framework, foreign direct investment, political factors, socio-cultural factors, geography, demography and many others. Understanding characteristics and determinants of economic growth requires an empirical framework that can be applied to a relatively long time frame. In order to examine the empirical evidence of the macroeconomic determinants of economic growth in Ethiopia, the study considers most of these factors. As we discussed in the theoretical literature review, origin of the econometric model is extended neoclassical growth model Thus:

$Y= f(Pk)$--[16]

Where Pk **presents** physical capital respectively.

Following broadly the approach of extended neo classical growth model, we specify the economic growth function for Ethiopia as follows: Real GDP is a function of physical capital, exports of goods and service, foreign aid, external debt and inflation, government expenditure, population ,. Studies like Patrick Enu *et al.* (2013); Biswas and Saha (2014) applied similar economic function to analyze macroeconomic determinants of economic growth in Ghana and India respectively. Moreover, the variables are preferred based on their relevance and data availabilities. Therefore the mathematically relationship between real GDP and its major macroeconomic determinant are expressed as follows:

$Y= f (GCF, EXT, GEXP, EXDT, POP, FAID, INF,)$ -- (17)

From the beginning the researcher transformed all the variables under study into Log data to avoid hetroscedasticity (Gujarati, 2004) and to show elasticity of the variables; the growth function of equation [24] becomes:

ln Y_t= β_0+ β_1+lnGCF+ $\beta_2$lnEXT+ $\beta_3$lnGEXP + ln β_4 EXDT+ ln β_5 lnPOP + $\beta_6$ln AID + β_7 lnINF β_8) --(18)

Where Y_t represents real GDP at a time t; GCF represent for physical capital (formally gross investment) at a time t;   EXT stands for total export; GEXP, Government expenditure POP ,population ,AID represents for foreign Aid; EXDT is for external debt and   is INF for general inflation;   .The error term (assumed to be normally and independently distributed with zero mean and constant variance, which captures all other explanatory variables which influences real gross domestic product in a country which are not captured in the model. are the partial elasticity's of real GDP with respect to macroeconomic variables listed above.

4.3. Estimation Procedure

To test the long run relationship between dependent variable (real GDP) and independent variable (physical capital, Export, Government expenditure, population, Aid, External debt and inflation the study applies Autoregressive Distributed Lag (ARDL) Model. The study first investigates the time series properties of data by using Augmented Dickey-Fuller (ADF) and Philip-Perron (PP) tests. The unit root tests will be used to check the stationary of the variables and to check none of the variables are not order two (I.e. I (1), which is precondition to apple ARDL model (Pesaran *et al.,* 2001).

4.4. The Autoregressive Distributed Lag Model (ARDL)

Cointegration becomes an overriding requirement for any economic model using nonstationary time series data. According to (Asteriou and Hall 2007), the concept of co-integration was first introduced by (Granger, 1981) and elaborated further (Engle, 1987), (Phillips, 1990), (Stock, 1988), (Phillips, 1986 and 1987), and (Johansen, 1988, 1991, and 1995). There is different procedure to test co-integration like Engle-Granger two step, Johansson maximum likelihood, and ARDL bound testing. Both the Engle Granger and Johansson require that the variables under consideration must be integrated of the same order.

To overcome this problem and below mentioned advantages   use ARDL bound testing. If the variables do not co-integrate, usually face the problems of spurious regression and econometric work becomes almost meaningless. If the variables are co-integrated the Error Correction Model

(ECM) can be formulated in terms of the first difference which eliminates trend from the variables and resolve the problem of spurious regression.

The past studies have used the Johansen Cointegration and Engle-Granger causality technique to determine the long-term relationships between variables of interest. In fact, this remains the technique of choice for many researchers who argue that this is the most accurate method to apply for I (1) variables. Recently, however, a series of studies by Pesaran *et al.* (1999, 2001); Narayan (2004); have introduced an alternative Cointegration technique known as the 'Autoregressive Distributed Lag (ARDL)' bound test.

There are numbers of advantages of using ARDL model also called 'Bound Testing Approach' instead of the conventional Engle-Granger two-step procedure (1987), Maximum likelihood methods of Cointegration (Johansen, 1988) and Johansen and Juselius (1990).ARDL model is the more statistically significant approach to determine the Cointegration relation in small samples as the case in this study (Pesaran *et al.,* 2001; Narayan,2004), while the Johansen co-integration techniques require large data samples for validity. A second advantage of the ARDL approach is that while other Cointegration techniques require all of the regresses to be integrated of the same order; the ARDL approach can be applied whether the regresses are purely order zero [I(0)], purely order one [I(1)], or mixture of both.

This means that the ARDL approach avoids the pre-testing problems associated with standard Cointegration, which requires that the variables be already classified into I(1) or I(0) or mixture of both (Pessaran *et al.,* 2001). Third, with the ARDL approach it is possible that different variables have different optimal numbers of lags, while in Johansen-type models this is not permitted. Forth, the other advantages of bound testing approach in the long run and short run parameters of the model in questions are determined simultaneously (Nasiru, 2012 as cited in Tsadkin, 2013). Finally, Appling the ARDL technique can obtain unbiased and efficient estimators of the model (Narayan, 2004), (Harris and Sollis, 2003; Pesaran, 1995) as cited in Tsadkin 2013.According to Pesaran *et al.* (2001), the ARDL modeling of unrestricted error correction model using .

$$\Delta Yt \ \ \beta 0 + \sum_{I=1}^{p} \beta \ \ \ \beta \ \Delta \text{Yt} - i + \sum_{I=a}^{p} \ \Delta xt - i + \ \ \ \partial 1 Yt - 1 \partial 2 \ - - - - - - - - - - [19]$$

Where Δ denotes for first difference operation, Y_t is for a vector of dependent variables, X_t is a vector of p determinants of Y_t regresses, U_t is the residual term which is assumed to be white noise.

Basically, the ARDL approach to Co integration (See Pesaran *et al.* 2001) involves estimating of the error correction model (ECM) version of ARDL model for the determinants of economic growth.

ΔRGDP= $\propto$+$\sum_{I=0}^{p}$ β_0 ΔlnRGDP$_{t-i}$ + $\sum_{I=0}^{p}$ β_1 ΔlnGCF$_{t-i}$ + $\sum_{I=0}^{p}$ $\beta2\Delta$ lnEXP$_{t-i}$ + $\sum_{I=0}^{p}$ β_3 ΔlnGEXP$_{t-i}$ + $\sum_{I=0}^{p}$ $\beta_4\Delta$ln EXDT$_{t-i}$ + $\sum_{I=0}^{p}$ $\beta_5\Delta$ln AID$_{t-i}$ +$\sum_{I=0}^{p}$ $\beta_6\Delta$ln POP $_{t-I}$ + $\sum_{I=0}^{p}$ $\beta5\Delta$ln INF $-i+$ θ_0 ΔlnR GDP$_{t-1}$ + θ_1 ΔlnGCF$_{t-1}$ + $\theta2\Delta$lnEXP$_{t-1}$ + θ_3 ΔlnGEXP$_{t-1}$ + $\theta_5\Delta ln$EXDT$_{t-1}$ + $\theta6\Delta ln$POPt $-1+$ θ_7 Δln AID$_{t-1}$ + $\theta8\Delta ln$INF -1 $_{Ut}$ ---[20]

Where RGDP is the real GDP in million Birr at a time t, GCF is capital formation (proxies by gross investment), , EXT is total export of goods and service, AID is foreign Aid, EXD is total external debt POP is total population, GEXP total government expend and INF is General Inflation , u is the residual term, which is assumed to be white noise, **p** is the optimal lag length and **ln** is natural logarithm. Except inflation and population all the variables entered in the model is measured in millions of Birr.

The bounds test is mainly based on the joint Wald test or F- test which its asymptotic distribution is non-standard under the null hypothesis of no Cointegration. The null hypothesis for no co-integration in the long-run among the variables in equation **[20]** is:-

H_0: $\theta_0 = \theta_1 = \theta_2 = \theta_3 = \theta_4 = \theta_5 = \theta_6 = \theta_7 = \theta_8 = 0$ meaning no long run relationship among the variables) against the alternative one:

H_1: $\theta_0 \neq \theta_1 = \theta_2 \neq \theta_3 \neq \theta_4 \neq \theta_5 \neq_= \theta_6 \neq \theta_7 =\neq \theta_8 \neq 0$ The **F**-test has no standard distribution which depends on (i) whether the variables include in the model are I(0), or I(1), (ii) the numbers of regressor, and (iii) whether the model contains an intercept and/or a trend (Narayan, 2004). In order to test the existence of long-term relationship among the variables, equation **[0]** had be estimated applying OLS.

To test the significance of lagged level of the variables under consideration, the appropriate statistic is **F** or Wald test as Pesaran *et al,.* (2001) proposed for bound test approach will be applied. According to Pesaran *et al.* (2001), there are two sets of critical value bounds for all classifications of regressor's namely upper critical bound value and lower critical bound value. The critical values for I (1) series are referred to as upper bound critical values; while the critical values for I (0) series

are referred to as lower bound critical values. If the calculated **F** statistic is greater than the upper bound critical values, we reject the null hypothesis of no long run relationship among the variables. If the calculated **F** statistic is less than the lower bound critical values, we can't reject the null hypothesis rather accept the null hypothesis of no Cointegration among the variables. However, if the calculated **F** statistic is between the upper and lower bound critical values, inference is inconclusive and we need to have knowledge on the order of integration of underling variables before we made conclusive inference (Pesaran *et al.,* 2001).If there is an evidence of long-run relationship (Cointegration) of the variables, the following long-run ARDL *(P1, P2, P3, P4, P5, P6, P7, P8)* mode will be estimated.

$$\Delta RGDP = \propto + \sum_{I=0}^{p} \beta_0 \ lnRGDP_{t-i} + \sum_{I=0}^{p} \beta_1 lnGCF_{t-i} + \sum_{I=0}^{p} \beta_2 \ lnEXP_{t-i} + \sum_{I=0}^{p} \beta_3 \Delta lnGEXP_{t-i} + \sum_{I=0}^{p} \beta_4 ln \ EXDT_{t-i} + \sum_{I=0}^{p} \beta_5 ln \ POP_{t-i} + \sum_{I=0}^{p} \beta_6 n \ AID_{t-i} \sum_{I=0}^{p} \beta_7 ln \ INF_{t-i} + \varepsilon_t$$ --- [20]

The orders of the lags in the ARDL Model is selected by either the Akaike Information criterion (AIC) or the Schwarz Bayesian criterion (SBC), before the selected model is estimated by ordinary least squares. Use the Akaike Information criterion (AIC) in lag selection because of its advantages for small sample size (Tsadkan, 2013) as it is the case in this study. Determination of the optimal lag length is so crucial in ARDL model, because of it helps us to address the issue of over parameterizations and to save the degree of freedom (Taban, 2010) as cited in Tsadkan (2013). For annual data, Pesaran and Shin (1999) recommend choosing a maximum of 2 lags. From this, the lag length that minimizes Akaike Information criterion (AIC) is selected.

$$RGDP = \propto + \sum_{I=0}^{p} \beta_0 \ lnRGDP_{t-i} + \sum_{I=0}^{p} \beta_1 lnGCF_{t-i} + \sum_{I=0}^{p} \beta_2 \ lnEXP_{t-i} + \sum_{I=0}^{p} \beta_3 \Delta lnGEXP_{t-i} + \sum_{I=0}^{p} \beta_4 ln \ EXDT_{t-i} + \sum_{I=0}^{p} \beta_5 lnPOP_{-i} + \sum_{I=0}^{p} \beta_7 n \ AID_{t-i} + \sum_{I=0}^{p} \beta_7 ln \ INF_{t-i} \quad \gamma_{ECTt-1}$$ -------------- ---[21]

Where ECTt is the error correction term, defined as:

ECT= $\ln RGDP_t - [\alpha_0 + \sum_{I=1}^{p} \quad \beta_0 \ln RGDP_{t-i} + \sum_{I=0}^{p} \beta_1 \ln GCF_{t-i} + \sum_{I=0}^{p} \beta_2 \Delta \ln GEXP_{t-I} + i =$

$op\beta_3 \ln EXPT_{t-i} + i = op\beta_4 \ln EXDT_{t-i} + i = op\beta_5 \ln POP_{t-i} + i = op\beta_6 \ln AID_{t-i} + i = op\beta_7 \ln INFt -$

i γ_{ECTt-1} -- [22]

To ascertain the goodness of fit of the ARDL models, diagnostic and stability tests were conducted. The diagnostic test examines the serial correlation, functional form, normality, and hetroscedasticity associated with the model. Based on this, the study used Breusch-Godfrey for serial correlation, The Breusch-Pagan-Godfrey Hetroscedasticity test were used. The Ramsey RESET test for functional form, conducted for the correct specification of the error-term. The Jarque-Berra statistic for normality (with the null the sample data normally distributed) was used to determine whether the sample data have the skewness and kurtosis matching a normal distribution. In Breusch-Godfrey Serial correlation of the residuals test the null hypothesis is that the residuals are not serially correlated. Rejecting this null leads to the residuals are serially correlated then our model is not good. Failing to reject the null makes our model acceptable. In Breusch-Pagan-Godfrey Hetroscedasticity test the null hypothesis is that the residual is homoscedastic and for model to be accepted we must fail to reject the null.

Parameter stability is important since unstable parameters can result in model misspecification (Narayan and Smith, 2004). The stability of parameters will be tested using the Cumulative sum (CUSUM) and cumulative sum square recursive (CUSUMSQ) tests. The CUSUM test is particularly important for detecting systematic changes in the regression coefficients, while the CUSUMSQ test is useful in situations where the departure from the constancy of the regression coefficients is arbitrary and sudden (Pesaran, 2009).The null in stability test is that the parameters are stable. If the blue line (CUSUM and CUSUMSQ) lies within the five degree of the red lines (bound) we fail to reject the null and conclude that the parameters are stable.

4.5. Unit Root Test

Before conducting ARDL co-integration test, first test for the stationary status of the given time series data to determine their order of integration. A unit root test is carried out using Phillips Perron (PP) and Augmented Dickey-Fuller (ADF) test for each variable in the model. To apply ARDL approach the variables used in the regression model should not be stationery at an integrated

of order two, because the computed F-statistics provided by (Pesaran, 2001) are valid only when the variables are I (0), I (1) or the combination of the two.

The testing procedure for the ADF unit root test is specified as follows:

$$\Delta Y_{t=}\ \alpha + \delta t + \gamma_{Yt\text{-}1} + \sum_{i=1}^{p}\ \Delta Y_{t-I}\ +\ \in t \text{---23}$$

Where Y_t is a time series variables under consideration in this model at time t, t is a time trend variable; Δ denotes the first difference operator; $\in t$ is the error term; p is the optimal lag length of each variable chosen such that first-differenced terms make a $\in t$ white noise. Thus, the ADF test the null hypothesis of no unit root (stationary).

That is: H0: γ =0; H1: γ =0

If the t value or t-statistic in absolute value is greater than the critical values, the null hypothesis (I.e. H0) cannot be rejected and the conclusion is that the series is stationary. Conversely, if the t-statistic is less negative than the critical values, the null hypothesis is accepted and the conclusion is that the series is non-stationary.

4.6. Data source and Variable description

4.6. 1. Data source

The data set will be collect mainly from Different organization that   data source   most reliable source of data and used by almost every researcher. sourced from Ethiopian Ministry of Finance and Economic Cooperation (MoFEC),National Bank of Ethiopia(NBE),   Central statically Agency (CSA),),World Bank(WB)and World economic Outlook data base . collect the data set from the time period of **1981/1982 to 2015/2016.** Except inflation is in percent and population in number all the variables are measured in millions of Birr.

4.6. 2 .Variable description

Real GDP (Y) is the market value of the goods and services produced by an economy over time. It is conventionally measured as the percent rate of increase in real Gross Domestic Product. Since most economists argue that economic growth can be measured as growth in real GDP, it includes in the model as main dependent variable in order to measure economic growth.

Gross Capital Formation (GCF) is defined as Gross capital formation the domestic investment in a country. In this study, gross investment was used of this variable and have been expected a positive impact on economic growth.

Exports of goods and service (EXT) are defined as the total exports of goods and service to the rest of the world. It is believed that export of a country's is one of the macroeconomic determinants of economic growth. For this reason and due to researcher's interest this variable is 44 entered as explanatory in order to analyze it effect on Ethiopian economic growth.The expected sign of this variable is expected to be positive.

. Government Expenditure (GEXPDT) is the capacity of Government to expend for all economic roles. So this variables implies that the capital stock capacity of Government to expend for services and goods. In order to analysis this variable the coefficient is positive impact on economic growth.

Foreign Aid (AID) is defined as aid inflows from external assistances. As we know Ethiopia is one of the poor countries in the world. As result Ethiopia is getting from external assistance in the form of aid. To see its effect on the economic growth this variable is chose as one explanatory variable and expected to have positive sign.

External Debt (EDT) is defined as net incurrence of government liabilities. Even though there is fast economic growth, Ethiopia is challenged in financial problem to finance its mega project. For this reason the Ethiopian external debt will increase from time to time. As a result, it is the researcher's interest to include in this study in order to analyze its effect on economic growth and would be expected a negative sign.

General Inflation (INF) Inflation is defined as an increase in the overall price level in a country and measured in percent. In Ethiopian history inflation was not a problem of economic growth. However, starting 2008 it is a serious problem. Therefore to analyze its effect on economic growth, it is the other interest of the researcher's, which is included in this study as independent variable. The coefficient of this variable would be expected a negative sign.

Population (Pop) is defined as the total population of Ethiopian People. It is believed that population of country's is one of the macroeconomic determinants of economic growth.

In Order to analyze it effect on Ethiopian economic growth. The expected sign of this variable is expected to be positive

4.7. Methods of data analysis

In this study both simple descriptive and econometrical methods of data analysis are employed. To analyze the macroeconomic performance of Ethiopia during the study period, we used tools of descriptive statistical such as tables, charts and trend graphs. On the other hand standard econometrical technique would apply to analyze the major determinants of economic growth under the study period. Finally, Enview 9 have been used as statistical software package for the entire analyze running this study

CHAPTER FIVE

RESULTS AND DISCUSSION

5.1 .The Unit Root Test Analysis

To determine the degree of integration, a unit root test is carried out using the standard Augmented Dickey-Fuller (ADF) and Phillips-Perron test statistic (PP) test. Moreover in applying ARDL model all the variables entered in the regression should not be integrated of order two. To check these conditions, unit root test is conducted before any sort of action taken. Even though the ARDL framework does not require per-testing variables to be done, the unit root test could convenience us whether or not the ARDL model should be used. The result in Table 1.1 and 1.2 shows that there is a mixture of I (0) and I (1) but not any order two.

Table 2. Unit root test (Augmented Dickey-Fuller test)

Variables	Intercept				Intercept and trend			
	Level	Difference	Cons	Order lag	Level	Difference	Cons	Order lag
RGDP	1.00	0.999	0.6009	(1)	1.00	0.000	0.193	(1)
EXPRT	0.966	0.000	0.117	(1)	0.8592	0.0002	0.0.925	(1)
EXPEND	1.000	0.6010	0.354	(1)	0.9963	0.0002	0.420	(1)
GCF	1.000	0.9885	0.452	(1)	1.000	0.003	0.0519	(1)
AID	0.0390	0.000	0.1179	(1)	0.2820	0.0001	0.012	(1)
POP	0.996	0.0032	0.00042	(1)	0.5213	0.000	0.5291	(1)
DEBT	0.9343	0.0080	0.0508	(1)	0.6556	0.000	0.551	(1)
INF	0.0006	0.000	0.8746	(0)	0.0017	0.000	0.675	(0)

Source: Eiview Result

Result of unit root (ADF) test form table2. , GDP, Gross capital formation (GCF), and Government Expenditure (EXPEND) are stationary with intercept and trend at first difference I(1).

When Export (EXPRT) external debt (DEBT) foreign aid (AID) and population (POP) integrated of order 0ne I (1) when inflation (INF) are stationary at I (0) . Meaning inflation is stationary in level where as GDP, Gross capital formation (GCF); Government expenditure (GEXPDT) is stationary with intercept and trend at first difference stationary. Export, external debt Aids, population, are stationary in first level Intercept**.**

Table 3. Unit root test (Phillips-Perron test statistic test)

Variables	Intercept				Intercept and trends			
	Level	Difference	Cons	Order lag	Level	Difference	Cons	Order lag
RGDP	1.00	0.0016	0.1429	(1)	1.00	0.000	0.2663	(1)
EXPRT	0.954	0.000	0.117	(1)	0.8592	0.0002	0.0.925	(1)
EXPEND	1.000	0.0012	0.146	(1)	1.000	0.0004	0.1375	(1)
GCF	1.000	0.000	0.452	(1)	1.000	0.000	0.1691	(1)
AID	1.000	0.0030	0.5312	(1)	0.999	0.0017	0.0691	(1)
POP	0.9836	0.002	0.8683	(1)	0.4446	0.000	0.5291	(1)
LDEBT	1.000	0.000	0.0508	(1)	1.000	0.000	0.3097	(1)
LINF	0.0006	0.000	0.9725	(0)	0.0017	0.000	0.9017	(1)

Source: Eview Result

Result of unit root PP test form table1.2 shows that mixture of integration order zero and order one. (GDP) , gross capital formation (GCF), and Government Expenditure (EXPEND), are Export (EXPRT) ,external debt (DEBT), foreign aid (AID) and External Debt (DEBT) are stationary with intercept at first difference but inflation (INF) are stationary with intercept at level . However, the variables are stationary after first difference with intercept and trend the variables are stationary after first difference with intercept. ARDL Cointegration technique proposed by Pesaran *et al.* (2001) is the most appropriate method for estimation or to check the long run relationship among the variables.

5.2. Diagnostic and model stability analysis

After checked the stationary of the time series variables in the study the basic ARDL equations were estimated for all variables. The standard ARDL estimated were used the Akaike Information Criteria (AIC) for lag length selection with maximum of four lags. (Pesaran, Shin, and Smith, 2001) provide lower and upper bounds for the asymptotic critical values depending on the number of regressor, their order of integration, and the deterministic model components. These alternatives are No intercept, no time trend, restricted intercept, no time trend, unrestricted intercept, no time trend. Unrestricted intercept, restricted time trend. Unrestricted intercept, unrestricted time trend. Estimating the standard ARDL with the level is the first step in ARDL method of Cointegration. The most important reason is that differencing the non-stationary time series destroy the potential valuable information about the long run relationship between these economic variables.

The theory of co-integration tries to estimate this long run relationship using non stationary time series themselves than their difference (Baltagi, 2008.To check whether the model is stable over the study period, the study employed the cumulative sum of recursive residual (CUSUM) and Cumulative sum square (CUSUMSQ), which was proposed by (Brown *et al*., 1975). If the plot of the CUSUM and CUSUMSQ stays within the 5 percent critical bound the null hypothesis that all coefficients are stable cannot be rejected. If however, either of the parallel lines are crossed then the null hypothesis (of parameter stability) is rejected at the 5 percent significance level. As indicated on graph below the CUSUM line lie between the 5% significance lines which indicates that the model is stable in the study period.

Figure 10 . Testing parameter stability using CUSUM and CUSUMSQ test
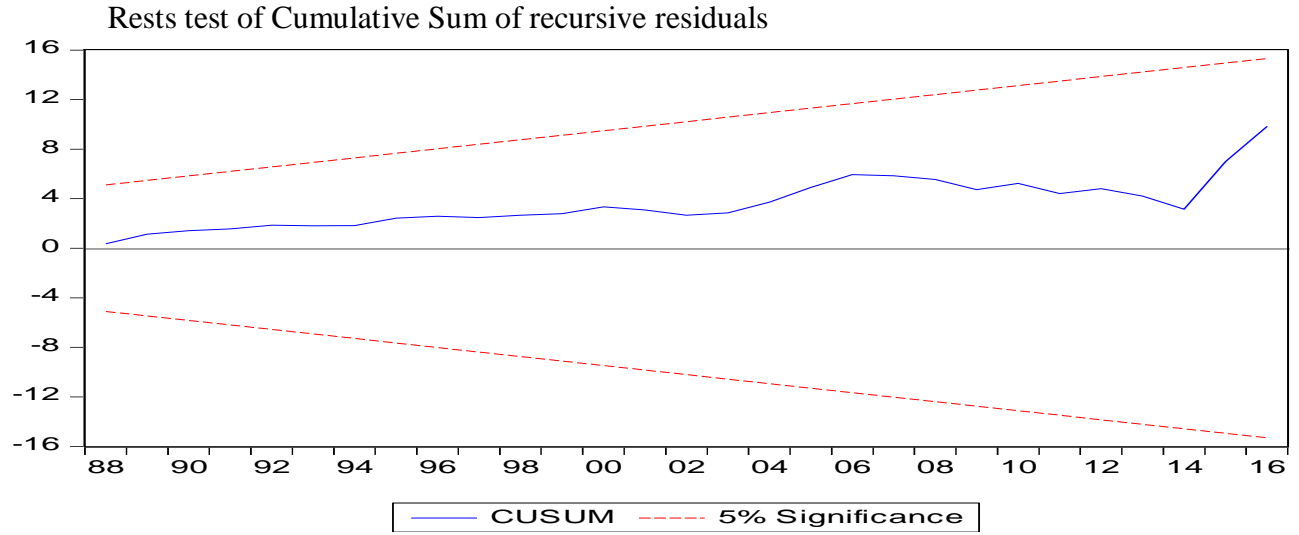
Rests test of Cumulative Sum of recursive residuals

The straight lines represent critical bounds at 5% significance level

Tests of Cumulative Sum of Squares of Recursive Residuals (CUSUMQ)
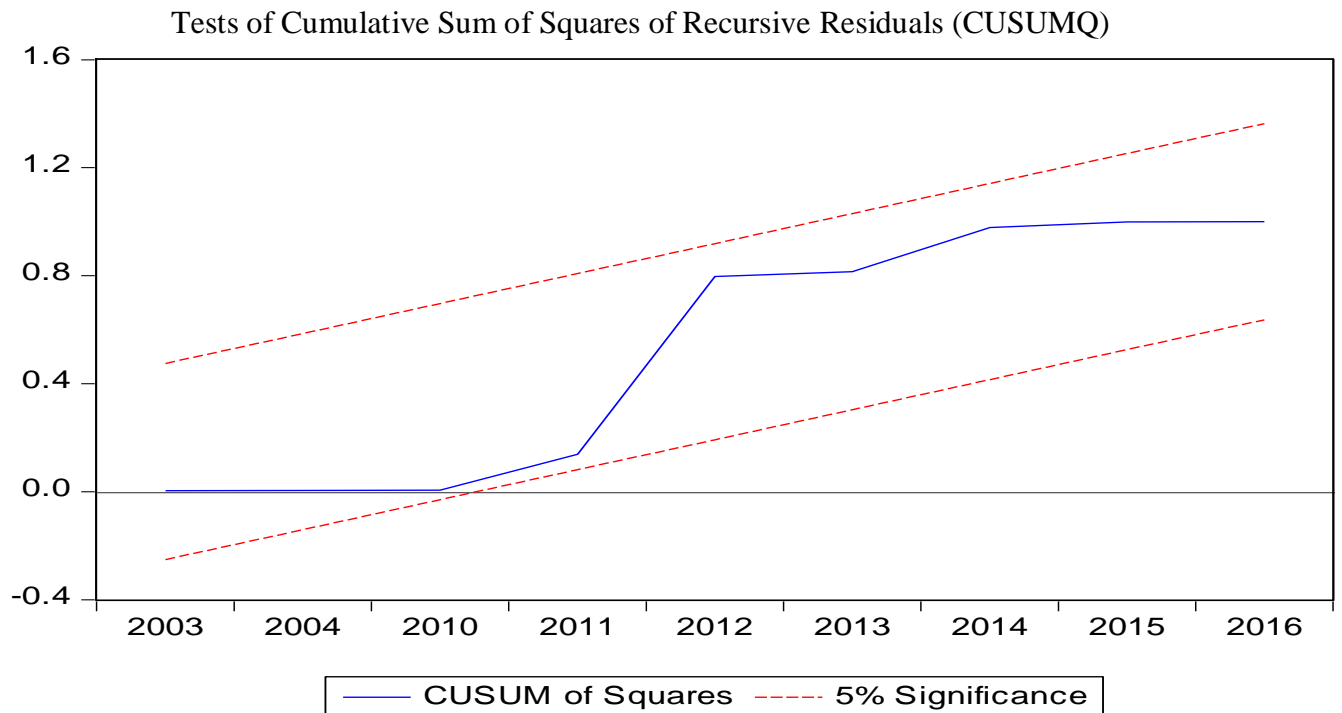
The straight lines represent critical bounds at 5% significance level

Source: eview stability test

As can be seen from the first figure, the plot of CUSUM test did not cross the critical limits. Similarly, the CUSUMSQ test shows that the graphs do not cross the lower and upper critical limits. So, we can conclude that long run estimates are stable and there is no any structural break. In addition the model has been explained by the regressor. Hence the results of the estimated model are reliable and efficient.

The basic diagnostic tests model like serial correlation of the error term (Breusch & Godfray LM test), hetroscedasticity (Breusch- Pagan-Godfrey), normality test (Jarque- Bera), and Ramsey's Regression Specification error test (RESET) were conducted. All these four residual diagnostic tests with the null hypothesis in favor of good results are failed to be rejected at five percent (F-statistics) are greater than five percent). These all indicates that the residual is normally distributed no serial correction among the residuals and the residual has constant variance. The residual diagnostic test tables are attached on the appendix. From the RESET test with inclusion of two fitted values found that there is no the problem of miss specification since the null hypothesis is failed to be rejected by F- statistics at five percent.

Table 4. Summary of Diagnostic tests model

Test	Null hypothesis	F-Stat DF	F-Statics prob.	Observed R-squared (Chi sq prob).	decision
Hetroscedasticity	Residual is homoscedastic	F(2,28)	(0.3908)	(0.3544)	Fail to reject
Serial correlation	No correlation among residuals	F(2,27)	(0.73460	(0.6731)	Fail to reject
Normality test	Residual are normality distributed	-	(0.2323)	Not applicable	Fail to reject
RESET TEST	No miss specification	F (1,28)	(0.000)	Not applicable	Fail to reject

Source: Eview 9.0 diagnostic test

The residual diagnostic tests like serial correlation (Breusch & Godfray LM test), normality (Jarque-Bera) and hetroscedasticity (Breusch- Pagan-Godfrey) were conducted. The results of all these four diagnostic tests indicates that the there is no the respective problems in the model from the

respective probability values (0.3544, 0.6731 0.2323) from the regression specification error (RESET) test fail to reject that the null hypothesis of no miss specification problem by probability F-test which is greater than five percent.

5.3. Long Run ARDL Bounds Tests for Co-integration

Determined the stationary nature of the variables, the next task in the bounds test approach of co-integration is estimating the ARDL model specified using the appropriate lag-length selection criterion. According to Pesaran and Shine (1999), as cited in Narayan (2004) for the annual data are recommended to choose a maximum of two lag lengths. From this, a lag length that minimize AIC is 2. In addition to this, we have also used AIC to determine the optimal lag because it is a better choice for smaller sample size data as this study.

Apart from this, AIC found to produce the least probability of under estimation among all criteria available (Liew *et al.,* 2004) as cited in *Tsadkan (2013).*As discussed in the third part of this study, the F-test through the Wald-test (bound test) is performed to check the joint significance of the coefficients specified . The Wald test is conducted by imposing restrictions on the estimated long-run coefficients of real GDP, gross capital formation, human capital, export, foreign aid, external debt and inflation. The computed F-statistic value is compared with the lower bound and upper bound critical values provided by Pesaran *et al.* (2001) and Narayan (2004)

Table 5. Results of Bound test for Cointegration Growth ARDL

Null Hypothesis: No long-run relationships exist

Test Statistic	Value	k
F-statistic	15.74409	7
Critical Value Bounds		
Significance	I(0) Bound	I(1) Bound
10%	2.03	3.13
5%	2.32	3.5
2.5%	2.6	3.84
1%	2.96	4.26

Source: Enview bound test

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The bound test of co-integration with the null hypothesis of no long run co-integration exist is rejected since the F-statics (15.74409) above the upper bound (4.26) at one percent.

5.4 .Long Run ARDL Model Estimation

After confirming the existence of long-run co-integration relationship among the variables, the next step is running the appropriate ARDL model to find out the long run coefficients, which is reported in below Table 2.4 Estimated of Cointegration and Long Run Coefficients using the ARDL Approach ARDL Selected Model: ARDL (1, 2, 1, 1, 2, 2, 2, 2) selected based on Akaike Information Criterion.

The critical values reported for Pesaran *et al.* (2001) are the case with unrestricted intercept and no trend. In this study we have been used Narayan (2004) which is developed based on 30 to 80 observations as discussed earlier in the third part of this study. As it is depicted in Table 2 and 2.1 above, with an intercept and trend, the calculated F statistics (15.74409) is higher than both the Pesaran *et al.* (2001) and Narayan (2004) upper bound critical values at 1% level of significance. This implies that the null hypothesis of no long-run relationship is rejected; rather accept the alternative hypothesis (there is long-run relationship) based on the Pesaran *et al.* (2001) and Narayan (2004) critical values at 1% level of significance. Therefore, there is cointegration relationship among the variables in long run.

Table 6 . Long run Estimation result Long Run Coefficients

Variable	Coefficient	Std. Error	t-statistics	Prob
POP	2018.458813	550.451086	3.666918	0.0028**
INF	- 1263.577528	460.029634	2.746731	0.0166***
GEXPDT	0.178679	0.088120	2.027678	0.00636*
EXDT	-0.467570	0.156230	-2.992836	0.0104***
GCF	3.123647	0.562232	5.555794	0.0001***
EXPT	0.001601	0.002837	-0.564361	0.005821**
FAID	0.001821	0.002030	-0.897279	0.003859**
C	-8901.903273	12993.53089	-0.685103	0.5053
R - Squared = 0.86 Durbin Watson = 2.779				

Note ***, **,* indicates the significance of the variables at 1%, 5% and 10%

Source: Eview 9.0 Long Run Coefficients

The coefficient of determination (R-squared) is high explaining that about 86 % of variation in the real GDP is attributed to variations in the explanatory variables in the model. The result of Table 6 indicates have discussed in the theoretical and empirical literature parts, Gross capital formation, exports of goods and service, foreign aid ,Government Expenditure , population have positive impact on Ethiopian economic growth while external debt and inflation have an inverse impact in Ethiopian economic growth with regard of significant.

The long run estimated result of the above table 6 showed, the gross capital formation has a positive impact on Ethiopian economic growth and statistically significant at 1 percent significance level at 3.123647 coefficient positively. The theory of economic growth which states that gross capital formation is the major determinates of economic growth (Keynesian theory of growth, Solow's theory of growth). Moreover, this study's result is consistence with study of Biswas and Saha (2014) in India; Iqbal and Zahid (1998) in Pakistan; Ndambiri H.K. *et al.* (2012) and Patrick Enu *et al.* (2013) in Africa; Weeks *et al.* (2004) and Tadesse (2011) in Ethiopia. Since have specified the growth model in a log-linear form, the coefficients can be interpreted as elasticity with respect to real GDP. The coefficient of gross capital formation (GCF) is 3.123647. This indicates that, in the long run, holding other things constant, a 1 percent change in gross capital formation change in real GDP during the study period.

The result of export in these study is total exports of goods and service on affects Ethiopian economic growth during the study period, is the result of positive relationship, at 5 present it is statistically significant and at 0.001601 coefficient positive relationship with Ethiopian economic growth in period of study. As indicated in table 6 above foreign aid has positive impact on Ethiopian economic growth. It is statistically significant at 5 present at 0.001821 coefficients this implies that foreign aid have positive relationship with Ethiopian economy in the period of study.

The debt is burden, which is measured by total external debt has a negative relationship with real GDP and statistically significant at 1 percent significance level at the -0.467570 coefficient. This result indicates that the existence of debt overhang problem in the country during the study periods and Ethiopia is one of the highly indebted poor countries in the world as Hailemariam (2011) stated. Moreover, this result was consistent with the finding of IMF (2002) working paper for 93 developing countries; Boboye *et al.* (2012) for Nigeria; Hailemariam (2011), Teklu *et al.* (2014) and Wessene (2014) for Ethiopia. As the result showed that a one percent increase in the external

debt will result in 1 percent decline in real GDP during the study periods. In addition this result is in line with Wessene's finding. In   view, the negative impact of external debt on economic growth might be liked with the low domestic saving rate in the country. As a result, to finance the government investment especially for the mega project, the Ethiopian government will borrow from different external financial institution and governments. This implies that the government with heavy debt burden may be forced to economic instability in order to pay the debt service.

The government expenditure is significant in the long run, relation of economic growth with 10 percent positive 0.178679 coefficients, which indicates the positive relationship between Government expenditure and Ethiopian economic growth. However,   government Expenditure is significant at 10 percent significance level with coefficient at 0.178679 positive relationships of Ethiopian economy and Government Expenditure in the period of the study. The above table (6), population is significantly affect Ethiopian economic growth during the study period, that statically result at 1 percent   their relationship is positive high coefficient 2018 in long run. From this   can understand that under the study period, whether in the long run or in the short run, general population rate, does have significant at 1 percent and positive relationship on the Ethiopian economic growth.

The general inflation rate, as showed in the above table 6 has negative impact on Ethiopian economic growth, even though statistically significantly at 1 percent with coefficient of - 1263.577.In the Ethiopian history, inflation remained at a reasonable low level rate until 2002/03. But after 2004, the inflation rate increased and reached 36.4 percent in 2009 (NBE, 2013/14), which was caused primarily by food inflation and affect the wellbeing of the society than harming the macroeconomic performance. The insignificant effects of inflation on Ethiopian economic growth might be associated with the reasonable low level (single digit) inflation rate until 2003 as discussed in chapter four of this study. Moreover, the result of this study also consistent with (Khan and Senhadji, 2000) and Bawa and Abdullah (2010) as an average inflation registered 9.7 percent during the study period. From the descriptive and econometric result can understand that, inflation does   harm the economic growth significantly for the study of period.

5.5. Short Run Error Correction Model

After the acceptance of long-run coefficients of the growth equation, the short-run ECM model is estimated. The error correction term (ECM), as discussed in chapter three, indicates the speed of adjustment to restore equilibrium in the dynamic model. It is a one lagged period residual obtained from the estimated dynamic long run model. The coefficient of the error correction term indicates how quickly variables converge to equilibrium. Moreover, it should have a negative sign and statistically significant at a standard significant level (i.e. p-value should less than 0.05).

Table 7 . Short run Error correction Model

Cointegration Form				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(POP)	10982.012808	3098.863670	-3.543884	0.0036**
D(POP(-1))	-6976.534667	3971.915878	-1.756466	0.1025
D(INF)	302.000844	187.047003	1.614572	0.1304
D(GEXPDT)	0.206063	0.034701	5.938309	0.0000***
D(GEXDT)	0.264761	0.166452	1.590617	0.0003***
D(GEXDT(-1))	0.838614	0.171321	4.894994	0.0003
D(GCF)	1.510549	0.200021	7.551952	0.0000***
D(GCF(-1))	-0.571870	0.312109	-1.832274	0.0899
D(FAID)	0.002303	0.000823	2.797274	0.0151**
D(FAID(-1))	0.001666	0.001303	1.279111	0.2232
D(EXPT)	-0.000236	0.001227	-0.192445	0.0044**
D(EXPT(-1))	-0.006978	0.002026	-3.444916	0.0044
CointEq(-1)	-0.783598	0.163002	-4.807286	0.0003

Cointeq = RGDP - (2018.4588*POP + 1263.5775*INF + 0.1787*GEXPDT

-0.4676*GEXDT + 3.1236*GCF -0.0018*FAID -0.0016*EXPT -8901.9033

The error correction coefficient, estimated at -0.783598 is highly significant, has the correct negative sign, and imply a very high speed of adjustment to equilibrium. According to Bannerjee *et al*. (2003) as cited in Kidanemarim (2014), the highly significant error correction term further confirms the existence of a stable long-run relationship.

Moreover, the coefficient of the error term (ECM-1) implies that the deviation from long run equilibrium level of real GDP in the current period is corrected by 78 % in the next period to bring back equilibrium when there is a shock to a steady state relationship. The coefficient of determination (R-squared) is high explaining that about 75 % of variation in the real GDP is attributed to variations in the explanatory variables in the model. In addition, the DW statistic does not suggest autocorrelation and the F-statistic is quite robust. As Chandran *et al.* (2010), which is quoted in Tsadkan (2013), the long run effect of the model can be captured by the error term (ECM). Thus, in the long run GCF, EXPT, GEXPDT, POP AID, EXD and INF granger cause RGDP (i.e. unidirectional causality). Not only this but also in applying autoregressive distributed lag (ARDL) model, does not require testing for granger causality since, it considers an endogeneity problem in the model (Wessene, 2014).

From the above table 7 similar to the long run result, gross capital formation (domestic investment) and have positive impact on Ethiopian economic growth and statistically significant at 1 percent significance level, respectively in the short term. As a result a one percent increases in capital formation will result in at one present level coefficient at 1.510549 increases in real GDP in the short run. On the other hand, total exports of goods and service is significant like the long run, with positive coefficient, which indicates the positive relationship between export and Ethiopian economic growth. However, export is significant at 1 percent significance level with positive 0.006978 coefficients.

The government expenditure is significant like the long run, with positive coefficient, which indicates the positive relationship between Government expenditure and Ethiopian economic growth. However, government Expenditure is significant at 1 percent significance level with positive at 0.206063 coefficients. Other the aid variable significantly affects economic growth at 1 percent significance level. Even though, the sign is positive at 0.002303 coefficients with positive relationship of Ethiopian economy. Similar to the long run effect, the external debt variable is found to have a negative relationship with real GDP. However, the one year lag result indicates that external debt is associated directly with economic growth. The result is significant at percent significance level. As a result a one percent increases in external debt will result in a decline in the real GDP by significantly in short run at -0.838614 coefficients so external debt affect negatively Ethiopian economy. The effect of external debt in Ethiopia under the study periods result is

significant at 1 percent at coefficient of -0.838614 in short run. This result is also consistent with Wessene (2014) for Ethiopia. According to her result, the reason behind the negative impact on economic growth in the short run might be the improper management of external debt, which might also the case in this study.

The above table 7 population is significantly affect Ethiopian economic growth during the study period, despite their relationship is positive in short run. From this can understand that under the study period, whether in the long run or in the short run, general population rate, does have significant at 1 percent and at positive coefficient of 10982 positive impact on the Ethiopian economic growth. As one can understand form the above table (7), inflation is insignificantly affect Ethiopian economic growth during the study period, despite their relationship is negative coefficient in short run. From this can understand that under the study period, whether in the long run or in the short run, general inflation rate, does insignificantly negative impact on the Ethiopian economic growth.

CHAPTER SIX

CONCLUSION AND POLICY RECOMMENDATION

6.1 .Conclusion

The main objective of this study is to analyze the determinants of economic growth in Ethiopia during the specified period. To determine the long run and short run relationship among the variables, Autoregressive Distributed Lag (ARDL) model was applied. Before applying the ARDL model, all the variables are tested for their time series properties (stationary properties) using the ADF and PP tests. Real GDP, Gross capital formation (GCF), and Government Expenditure (EXPEND) are stationary with intercept and trend at first difference I(1). When Export (EXPRT) external debt (DEBT) foreign aid (AID) and population (POP) integrated of intercept order 0ne I (1) but inflation is (INF) are stationary at I (0). Meaning   inflation is stationary in level where as GDP, Gross capital formation (GCF); Government expenditure (GEXPDT) is stationary with intercept and trend at first difference stationary. Export, external debt Aids,   population, are stationary in first level With Intercept**.**

Next to testing for time series property, the model stability was done by testing the diagonal testing techniques. The result revealed that no evidence of serial correlation, no functional form problem (the model is correctly specified), the residual is normally distributed and no evidence of hetroscedasticity problem. As discussed above, this study applied the methodological approach called ARDL model also known as bound test approach. As the result indicted the bound test (F-statistic) value is larger than the upper bound critical value both for Pesaran *et al.(*2001) and Narayan(2004), which indicates there is a long run relationship between real GDP and its determinants (Export ,Government expenditure , gross capital formation ,population , aid, external debt and inflation) in long run during the study period.

The empirical result showed   percent increase in Gross capital formation (gross   results in 1 and 1 percent increase in real GDP in long run and short run, respectively. Likewise, a one percent Export of goods and service is increase by percent of 1 anda1 in real GDP in long run and short run, respectively. The external debt also has negative impact in economic growth during the study period in both long run and short run. A one percent increase in external debt will result in 1 and 1

percent decline in real GDP in long run and short run, respectively. However, the study found out that foreign aid has statistically significant impact on economic growth with positive sign in the long run and short run at percent of 5 and 1. The other study is the significant impact of government Expenditure in Ethiopian economic growth during the study period. Despite its sign is conistant relation in long run and short run, it has significant at percent of 10 and 1 in long run and short run that have positive impact on Ethiopian economic growth. From this Government Expenditure is significantly positive impact on the Ethiopian economic growth during the study period.

The study result on population is the significant impact on Ethiopian economic growth during the study period. It have relation in long run and short run, it has significant in long run and in short run that have positive impact on Ethiopian economic growth The other finding of this study is the insignificant impact of inflation in Ethiopian economic growth during the study period. Despite its sign is inconsistent in long run and short run, it has insignificant in long run significant in short run that have negative impact on Ethiopian economic growth. From this one can understand that inflation is significantly and insignificantly harming the Ethiopian economic growth during the study period.

Moreover, this study is found out that economic growth during EPRDF (1992-2013) relatively strong in growth compared to the military regime (1974-1991). During the military period, the average growth rate of real GDP was 1.6 percent (real GDP per capita was -0.9%), while the average population growth was 2.5 percent, which indicates the growth rate in real GDP was far away from satisfactory points. However, during the EPRDF regime, growth is relatively and satisfactory. The average growth rate in real GDP registered 6.7 percent (real GDP per capita was 3.4%) during 1992 to 2013, while the average population growth was 2.6 percent. Moreover, since 2004, the growth rate in real GDP on average registered 10.9 percent (NBE, 2014/15) and by far more than the average growth rate for Sub-Sahara African Countries.

6. 2. Policy Recommendation

Depend on finding of this study; the following policy recommendations are forwarded.

➤ In order to enhance and sustain the economic development develop the contribution of the gross capital formation, the government of Ethiopia has to set policies to increase domestic saving which is believed as a back bone of growth and increase saving mobilization like selling of government Bonds, expanding financial institutions and by strengthening existing saving tools (strengthening both private and government workers social security scheme, strengthening saving for housing program, saving for investment equipment scheme), develop specialized structural bond of the Government for Further Development of Gross Capital formation.

➤ In order to enhance the contribution Government Expenditure, the government of Ethiopia has made systematical expending of Government finance for adequate social service, economic service and human capital. Thus educated and healthy societies will bring technology and innovation, which is believed as a spring board of economic growth.

➤ Population has significantly positive impact on Ethiopian economic growth. Therefore, the Federal Government of Ethiopia should have to Augmenting income per capita of nation by expanding employment opportunity, develop literacy rate of nation and competing the population density economic status of a country can survive.

➤ Exports of goods and service have significantly positive impact on Ethiopian economic growth. Therefore, the Federal Government of Ethiopia should strengthen the existing strategies in export development and promoting investment particularly in the manufacturing sector for export and import substitution.

➤ As debt affects the economic growth of Ethiopia negatively, allocating resources on selected productive investment areas, which used to return back the debt burden and together with basic infrastructure construction that facilities productive of other sector is decisive. In addition there should be close monitoring and consistent debt management strategies, which is used to avoid misallocation and mismanagement of external debt problem.

➢ Inflation is a problem in Ethiopian growth, the federal government should work to reduce the inflation rate if possible, otherwise, it should sustain the existing inflation rate (with single digit) by tight fiscal and monetary policies, financing of budget deficit from non-inflationary sources and implementation of price stabilization program by subsiding basic food items and stabilizing market by increase the supply of Good and services.

➢ Foreign aid is having positive impact on Ethiopian economic growth, the federal government should work to relatively regulate implementation of foreign aid depend on further economic Growth issues.

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8. Appendixes

Appendix A: Variable Addition Test

Dependent Variable: RGDP
Method: ARDL
Date: 05/11/18   Time: 13:34
Sample (adjusted): 1983 2016
Included observations: 34 after adjustments
Maximum dependent lags: 2 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (2 lags, automatic): POP INF GEXPDT GEXDT GCF
    EXPT FAID
Fixed regressors: C
Number of models evalualted: 4374
Selected Model: ARDL(1, 2, 1, 1, 2, 2, 2, 2)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
RGDP(-1)	0.216402	0.163002	1.327606	0.2072
POP	-10982.01	3098.864	-3.543884	0.0036
POP(-1)	5587.137	4200.822	1.330011	0.2064
POP(-2)	6976.535	3971.916	1.756466	0.1025
INF	302.0008	187.0470	1.614572	0.1304
INF(-1)	688.1354	184.9571	3.720514	0.0026
GEXPDT	0.206063	0.034701	5.938309	0.0000
GEXPDT(-1)	-0.066051	0.047438	-1.392366	0.1872
GEXDT	0.264761	0.166452	1.590617	0.1357
GEXDT(-1)	0.207466	0.147306	1.408400	0.1825
GEXDT(-2)	-0.838614	0.171321	-4.894994	0.0003
GCF	1.510549	0.200021	7.551952	0.0000
GCF(-1)	0.365263	0.354080	1.031586	0.3211
GCF(-2)	0.571870	0.312109	1.832274	0.0899
EXPT	-0.000236	0.001227	-0.192445	0.8504
EXPT(-1)	-0.007997	0.002804	-2.852190	0.0136
EXPT(-2)	0.006978	0.002026	3.444916	0.0044
FAID	0.002303	0.000823	2.797274	0.0151
FAID(-1)	-0.002064	0.001199	-1.722285	0.1087
FAID(-2)	-0.001666	0.001303	-1.279111	0.2232
C	-6975.509	9987.015	-0.698458	0.4972

R-squared	0.869884	Mean dependent var	325260.9
Adjusted R-squared	0.999704	S.D. dependent var	338827.2
S.E. of regression	5826.428	Akaike info criterion	20.45208
Sum squared resid	4.41E+08	Schwarz criterion	21.39483
Log likelihood	-326.6853	Hannan-Quinn criter.	20.77358
F-statistic	5579.369	Durbin-Watson stat	2.779342
Prob(F-statistic)	0.000000		

*Note: p-values and any subsequent tests do not account for model
    selection.

Appendix B: Diagnostic Tests

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.098843	Prob. F(7,28)	0.3908
Obs*R-squared	7.758300	Prob. Chi-Square(7)	0.3544
Scaled explained SS	5.978445	Prob. Chi-Square(7)	0.5423

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 05/09/18   Time: 00:00
Sample: 1981 2016
Included observations: 36

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.02E+08	4.49E+08	-0.226179	0.8227
POP	1061197.	11752234	0.090297	0.9287
INF	8684241.	6874843.	1.263191	0.2169
GEXPDT	-1124.688	1534.618	-0.732878	0.4697
GEXDT	368.5872	1400.949	0.263098	0.7944
GCF	4104.616	6653.103	0.616948	0.5423
FAID	-9.263812	14.72866	-0.628965	0.5345
EXPT	16.91511	25.98696	0.650908	0.5204

R-squared	0.215508	Mean dependent var	2.70E+08
Adjusted R-squared	0.019385	S.D. dependent var	4.22E+08
S.E. of regression	4.18E+08	Akaike info criterion	42.73232
Sum squared resid	4.89E+18	Schwarz criterion	43.08421
Log likelihood	-761.1817	Hannan-Quinn criter.	42.85514
F-statistic	1.098843	Durbin-Watson stat	2.213501
Prob(F-statistic)	0.390835		

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.091016	Prob. F(2,17)	0.9134
Obs*R-squared	0.360207	Prob. Chi-Square(2)	0.8352

Test Equation:
Dependent Variable: RESID
Method: ARDL
Date: 05/11/18   Time: 13:42
Sample: 1983 2016
Included observations: 34
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RGDP(-1)	0.009294	0.154113	0.060310	0.9526
RGDP(-2)	-0.020907	0.291216	-0.071793	0.9436
POP	473.9587	5105.365	0.092835	0.9271
POP(-1)	-494.2137	5351.514	-0.092350	0.9275
INF	0.438957	247.3776	0.001774	0.9986
INF(-1)	-27.46880	222.0080	-0.123729	0.9030
GEXPDT	-0.002828	0.045043	-0.062788	0.9507
GEXPDT(-1)	-0.004981	0.076872	-0.064790	0.9491
GEXDT	-0.009586	0.108884	-0.088034	0.9309
GCF	0.019526	0.248778	0.078487	0.9384
EXPT	-6.81E-05	0.001226	-0.055520	0.9564
EXPT(-1)	0.000249	0.002285	0.109054	0.9144
FAID	5.24E-06	0.001192	0.004393	0.9965
FAID(-1)	7.08E-05	0.001772	0.039980	0.9686
C	1144.905	16158.03	0.070857	0.9443
RESID(-1)	0.012609	0.328433	0.038391	0.9698
RESID(-2)	0.122609	0.287391	0.426628	0.6750

R-squared	0.010594	Mean dependent var	-9.76E-11
Adjusted R-squared	-0.920611	S.D. dependent var	7102.987
S.E. of regression	9843.753	Akaike info criterion	21.53391
Sum squared resid	1.65E+09	Schwarz criterion	22.29709
Log likelihood	-349.0765	Hannan-Quinn criter.	21.79418
F-statistic	0.011377	Durbin-Watson stat	1.902243
Prob(F-statistic)	1.000000		

Normality test
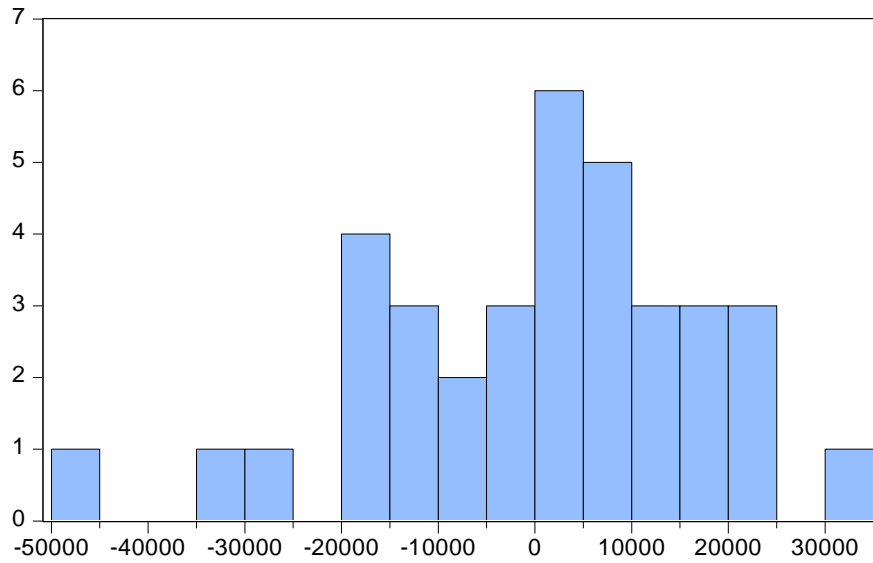
Series: Residuals	
Sample 1981 2016	
Observations 36	
Mean	403.4577
Median	1498.369
Maximum	30965.58
Minimum	-47174.83
Std. Dev.	16659.16
Skewness	-0.661843
Kurtosis	3.440461
Jarque-Bera	2.919227
Probability	0.232326

Ramsey RESET Test
Equation: UNTITLED
Specification: RGDP RGDP(-1) RGDP(-2) POP POP(-1) INF INF(-1)
    GEXPDT GEXPDT(-1) GEXDT GCF EXPT EXPT(-1) FAID FAID(-1) C
Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	5.527308	18	0.0000
F-statistic	30.55113	(1, 18)	0.0000

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	1.05E+09	1	1.05E+09
Restricted SSR	1.66E+09	19	87627884
Unrestricted SSR	6.17E+08	18	34292296

Unrestricted Test Equation:
Dependent Variable: RGDP
Method: ARDL
Date: 05/11/18   Time: 13:47
Sample: 1983 2016
Included observations: 34
Maximum dependent lags: 2 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressor (1 lag, automatic):
Fixed regressor: C

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
RGDP(-1)	0.313931	0.089649	3.501768	0.0025
RGDP(-2)	-0.166103	0.232260	-0.715157	0.4837
POP	422.4586	3705.034	0.114023	0.9105
POP(-1)	755.3283	3634.278	0.207835	0.8377
INF	279.7036	139.4466	2.005813	0.0601
INF(-1)	334.2685	182.8411	1.828191	0.0841
GEXPDT	-0.101895	0.047190	-2.159250	0.0446
GEXPDT(-1)	-0.205926	0.046293	-4.448294	0.0003
GEXDT	-0.063770	0.075828	-0.840984	0.4114
GCF	0.693599	0.313816	2.210210	0.0403
EXPT	0.000459	0.001027	0.446646	0.6605
EXPT(-1)	0.006465	0.001373	4.707356	0.0002
FAID	0.001230	0.000677	1.816927	0.0859
FAID(-1)	-0.001667	0.001086	-1.535445	0.1421
C	22865.39	11909.76	1.919887	0.0709
FITTED^2	4.33E-07	7.83E-08	5.527308	0.0000

R-squared	0.999837	Mean dependent var	325260.9
Adjusted R-squared	0.999701	S.D. dependent var	338827.2
S.E. of regression	5855.962	Akaike info criterion	20.49350
Sum squared resid	6.17E+08	Schwarz criterion	21.21178
Log likelihood	-332.3894	Hannan-Quinn criter.	20.73845
F-statistic	7363.968	Durbin-Watson stat	1.720047
Prob(F-statistic)	0.000000		

Appendix: C model *stability*
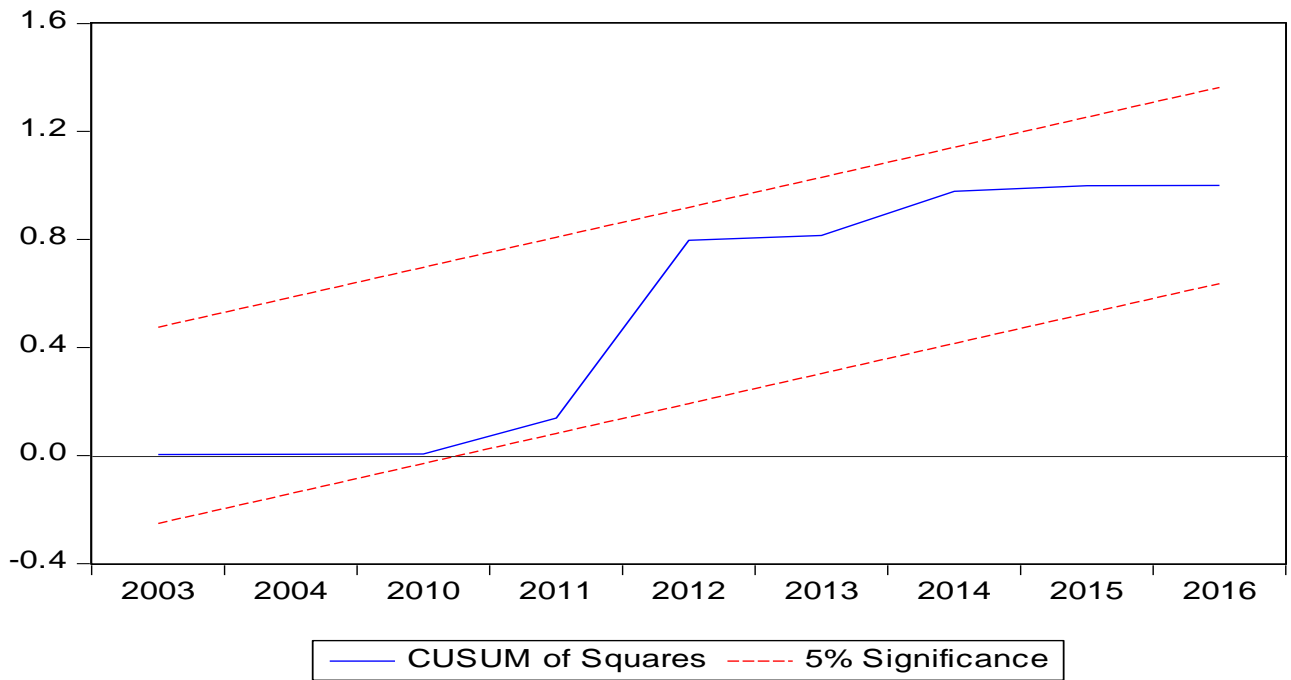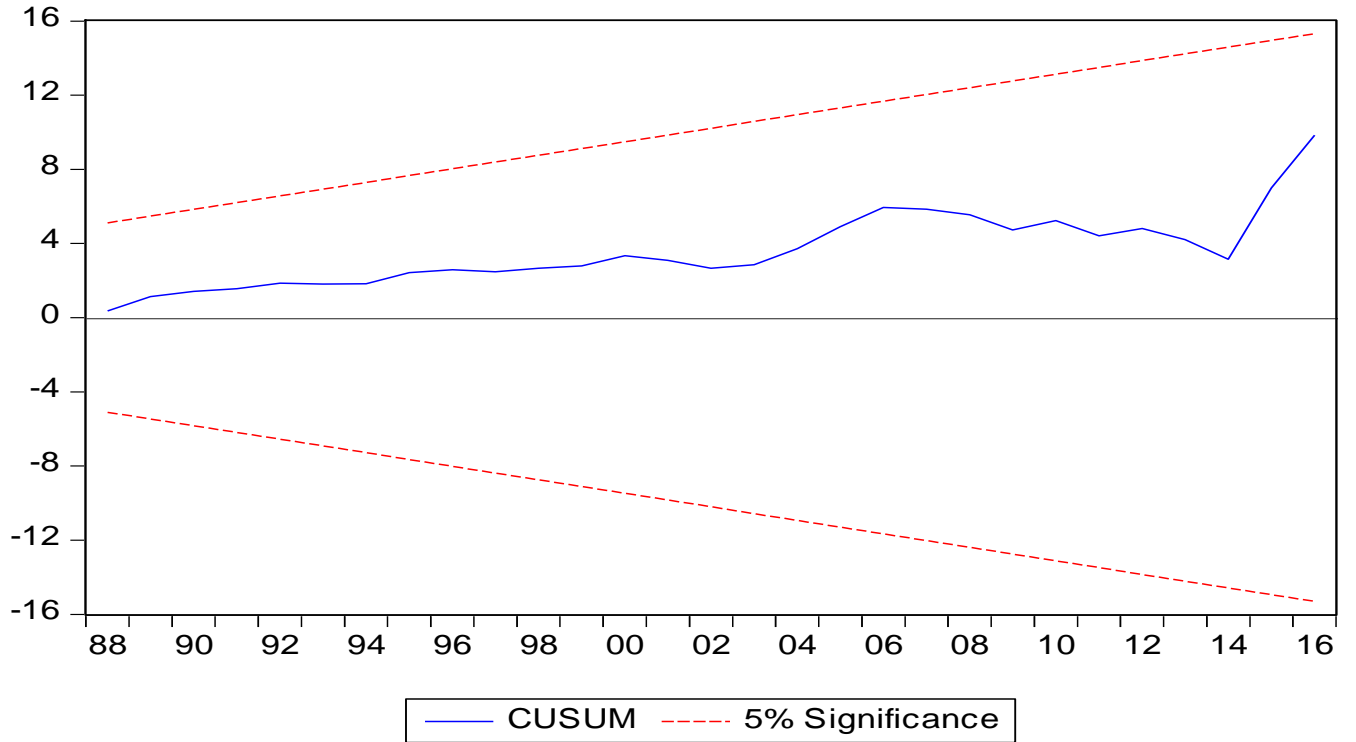
Appendix: D, Bound test

ARDL Bounds Test
Date: 05/11/18   Time: 14:00
Sample: 1983 2016
Included observations: 34
Null Hypothesis: No long-run relationships exist

Test Statistic	Value	k
F-statistic	15.74409	7

Critical Value Bounds

Significance	I0 Bound	I1 Bound
10%	2.03	3.13
5%	2.32	3.5
2.5%	2.6	3.84
1%	2.96	4.26

Appendix E: Long Run Cointegration

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
POP	2018.458813	550.451086	3.666918	0.0028
INF	-1263.577528	460.029634	2.746731	0.0166
GEXPDT	0.178679	0.088120	2.027678	0.00636
GEXDT	-0.467570	0.156230	-2.992836	0.0104
GCF	3.123647	0.562232	5.555794	0.0001
EXPT	0.001601	0.002837	-0.564361	0.005821
FAID	0.001821	0.002030	-0.897279	0.003859
C	-8901.903273	12993.530896	-0.685103	0.5053

Appendix, F: Short Run Cointegration

ARDL Cointegration And Long Run Form

Dependent Variable: RGDP

Selected Model: ARDL(1, 2, 1, 1, 2, 2, 2, 2)

Sample: 1981 2016

Included observations: 34

Cointegration Form				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(POP)	-10982.012808	3098.863670	-3.543884	0.0036
D(INF)	-302.000844	187.047003	1.614572	0.1304
D(GEXPDT)	0.206063	0.034701	5.938309	0.0000
D(EXDT)	-0.264761	0.166452	1.590617	0.0003
D(GCF)	1.510549	0.200021	7.551952	0.0000
D(EXPT(-1))	0.006978	0.002026	3.444916	0.0044
D(FAID)	0.002303	0.000823	2.797274	0.0151
CointEq(-1)	-0.783598	0.163002	-4.807286	0.0003

Date: 06/04/18   Time: 21:53
Sample: 1981 2016
Included observations: 34

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
. |** |	. |** |	1	0.301	0.301	3.3597	0.067
. |*. |	. |*. |	2	0.175	0.092	4.5253	0.104
. | . |	. | . |	3	0.071	-0.005	4.7259	0.193
. |*. |	. |*. |	4	0.102	0.075	5.1483	0.272
. | . |	. | . |	5	0.061	0.010	5.3037	0.380
. | . |	. | . |	6	-0.001	-0.044	5.3037	0.505
. | . |	. | . |	7	0.034	0.040	5.3562	0.617
.*| . |	.*| . |	8	-0.101	-0.134	5.8381	0.665
. | . |	. | . |	9	-0.044	0.006	5.9316	0.747
. |** |	. |** |	10	0.231	0.311	8.6535	0.565
. |*. |	.*| . |	11	0.074	-0.083	8.9471	0.627
. |*. |	. |*. |	12	0.176	0.148	10.664	0.558
. | . |	. | . |	13	0.040	-0.037	10.759	0.631
. |*. |	. | . |	14	0.081	-0.021	11.163	0.673
.*| . |	.*| . |	15	-0.067	-0.113	11.451	0.720
.*| . |	.*| . |	16	-0.101	-0.104	12.139	0.734

*Probabilities may not be valid for this equation specification.