St. Mary's University

School of Graduate Studies

The Impact of Inflation on Economic Growth in Ethiopia

By

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Addis Ababa, Ethiopia

July, 2017

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A thesis submitted to the School of Graduate Studies of St. Mary's University in Partial Fulfillment of the Requirements for the Degree of Masters of Science in Development Economics

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ACKNOWLEDGEMENTS

First of all I praise Almighty God for giving me the strength to carry out this research and for all his blessings in my life.

My deepest gratitude goes to my advisor Dr. Wondimagegn Chekol who supported me in undertaking this study. Next I would like to extend my heartfelt thanks to all who assisted me by contributing ideas to this thesis. Last but not least I thank all my friends and families for all their support and inspiration.

ACRONYMS

ADF	Augmented Dickey Fuller
AIC	Akakie Information Criterion
ARDL	Autoregressive Distributed Lag
ECM	Error Correction Model
GDP	Gross Domestic Product
MOFED	Ministry of Finance and Economic Development
NBE	National Bank of Ethiopia
OLS	Ordinary Least Square
PP	Phillips Perron
RGDP	Real Gross Domestic Product
VAR	Vector Autoregressive

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ABSTRACT

Almost all countries consider sustaining high level of economic growth with low level of inflation as their macroeconomic objective. But there has been a debate about the nature of relationship between these two important variables. Motivated by this argument, this study examined the long run and short run relationship between economic growth and inflation. The methodology employed is Autoregressive Distributed Lag Model (ARDL) of Bound test to cointegration for long run analysis and Error Correction Model (ECM) for short run analysis. The scope of the study spanned from 1981 to 2014. Agumented Dicky Fuller test (ADF) and Phillip-Perron test (PP) were used to carried out the stationarity test and the data is stationary at 1%, 5% and 10% level of significance. The bound test reveals the existence of stable long run relationship between inflation and economic growth. Further effort was made to check the causality by employing pairwise granger causality test at different lag length (lag 1 and lag 2). Uni-directional causality which runs from economic growth to inflation is obtained at both periods. A positive relationship was found in the long run and negative short run relationship between these two macroeconomic variables in Ethiopia during the study period. In the short run the coefficient of the error correction term is -0.622, its implication is that about 62.20% of the disequilibrium adjusts to the long run equilibrium after a shock annually. Hence Policy makers should emphasize on policies that enhance economic growth as well as inflation combating measures.

***Key Words**: Inflation, Economic growth, Autoregressive Distributed lag, cointegration, granger causality*

CHAPTER ONE

INTRODUCTION

1.1. Background of the Study

Economic growth is an issue of primary concern to policy makers in both developing and developed nations. In modern science, the process of economic growth and the reason of differences in economic performance among nations are some of the interesting and challenging areas. Growth is usually calculated in real terms that means in inflation-adjusted terms to eliminate the distorting effect of inflation on the price of goods and service produced.

Inflation is the most intricate and controversial issues of the contemporary world. One of the most fundamental macroeconomic policy objectives of both developing and developed nations is to sustain high economic growth together with low level of inflation. However, the relationship between inflation and economic growth has remained speculative till now. Specially, the question of whether or not inflation is harmful to economic growth has been a subject of intense debate among policy makers, central monetary authorities and macroeconomists. The debate originally evolves from the controversy of the structuralists and the monetarist. The Structuralists believe that inflation is essential for economic growth while Monetarists argue that inflation is detrimental to economic growth. The two basic aspects of the debate are related to the existence and the nature of relationship between inflation and growth and the direction of causality (Mallik and Chowdhury, 2001).

Since 1970 inflation was not taken as a threat to economic growth rather as a positive contributor to growth. In 1950's Keynesians quickly adopt and base their analysis on Phillips curve which empirically shows the positive reaction of inflation to economic growth and its negative relationship with unemployment. But after 1970's high inflation

started to slow down the economic growth of countries. Following this monetarist view of inflation come to table which replace the idea of positive effect of inflation on economic growth by the negative relationship of high level of inflation and economic growth (Friedman, 1976). This controversy on the relationship between inflation and economic growth is both theoretical and empirical. The difference in the relationship highly depends on the nature and structure of the economy and will vary from country to country.

From the causality aspect, there are two view points. There are studies that show inflation as advantageous for growth and studies that support growth could cause inflation. This means that, some empirical results reveal a unidirectional causality, moving from inflation to economic growth or vice-versa. Some evidence shows that, inflation-economic growth relationship is just a short-run phenomenon, while others show that inflation-economic growth relationship can only be explained well in the long-run.

Baro (2013) studied about inflation and economic growth and obtained an adverse influence of inflation on economic growth comes from the experience of high inflation. Another study by Ficsher (1993) also came up with the negative relationship between the two variables. One empirical result of the study conducted in Nigeria by Olu and Idih (2015) also support the inverse relationship of inflation and economic growth. Inflation slows down the pace of economic growth beyond the 9-12 threshold level in Iranian economy (Pahlavani and Ezzati,2011).Similarly Inflation affects economic growth negatively above the threshold inflation level in Ethiopia that ranges between 9 and10 (Rao and Abate, 2015). While in the long run most studies side with the positive relationship of inflation with economic growth. For instance one study in china brought the bi directional positive relation in the long run (Xiao, 2009) and again inflation caused by economic growth in the very long run in Malaysia according to Datta and Mukhopadhyay (2011).

Contrary to the studies which have shown either positive or negative relationship between inflation and economic growth, there are studies which have shown that there is no conclusive empirical evidence for either situation. Some countries have experienced inflation with and without economic growth and vice versa Friedman (1973). It is not inflation that determines economic growth but improvement of human capacities and technical and managerial knowledge therefore there is no persuasive evidence for the existence of relationship between inflation and economic growth according to Johanson (1967). Also, in a study in Nigeria, Chimobi (2010) examine the existence of a relationship between inflation and economic growth and finds no co-integrating relationship between the two variables. However, the study ascertains unidirectional causality running from inflation to economic growth. Likewise Mwakanemela and Kasidi (2013) support the non existence of relationship between the two macroeconomic variables on their study in Tanzania.

In Ethiopia, inflation was not generally an issue before the year 2002/03 due to tight monetary and fiscal policies of the government. After this period inflation becomes the issue for Ethiopian economy following the government less conservative monetary and fiscal policies. Inflation rose from 3.3 percent in 2004/05 to 44.39 percent in 2008/09 which was the highest in the country's history (NBE, 2010) and now in recent years it lowers to 10.4 percent in 2015. Likewise the economy of the country was known for its sluggish growth. However, the Ethiopian economy has achieved high growth rate in recent few years. Between the fiscal year 2004/05 and 2009/10 the real GDP grew by more than 11% on average (MOFED, 2010). This fast growth in economy of the country attained after government abandon neoliberal and follow developmental state approach. This study employed Autoregressive distributed lag model for long run and error correction model for short run and found the negative impact of inflation on economic growth.

1.2. Statement of the Problem

The monetary policies of most countries in the world focus on maintaining price stability with the aim of promoting sustainable growth and development. It also helps to strengthen the purchasing power of the domestic currency (Umaru and Abdurahman, 2012). Sustaining economic growth with low level of inflation is one of the macroeconomic objectives of many developing countries. It is a general consensus that developing countries are more susceptible to supply shocks causing unpredictability of inflation that could affect the production and consumption behavior as well as investment. Therefore, Prices don't give the right signals about policies and course of action in most developing countries. In addition, more government intervention in both financial and goods market cause economic instability and market failure.

Inflation is one of the vastly researched areas of economics discipline, but because of its complexity it is always a timely issue for research. Macroeconomists, central bankers and policy makers have often emphasized on the costs associated with high and variable inflation. Inflation poses negative externality on the economy when it interferes with an economy's efficiency (Gokal and Hanif, 2004). Moreover, inflation is said to hamper efficient resource allocation by making the signaling role of relative price changes to be ambiguous, which is the most important guide to efficient economic decision making (Fischer, 1993).

High and unpredictable inflation has a negative impact on investment and economic growth by creating uncertainty to investors. Inflation can lead to uncertainty about the future profitability of investment projects especially when it is coupled with increased price variability. This lead investors to follow conservative investment policy, ultimately leads to lower level of investment and hence economic growth. Inflation may also reduce the international competitiveness of a nation by making its exports relatively more expensive, thus affecting the balance of payment. Beyond this it has economic and social

costs and affects income distribution among society. The increase in price is detrimental to the low income groups and pensioners who live with fixed income.

Like other developing countries one of the fundamental macroeconomic objectives of Ethiopia is also to maintain high economic growth together with low inflation so as to uphold macroeconomic stability and boost up investment in the country. However there is no universally agreed consensus among macroeconomist about the relationship between inflation and economic growth. Some consider inflation as harmful and some others view inflation up to some threshold is good for economic growth of one country. Motivated by this controversy and the prevailing research gap of insufficient studies carried out on the relationship between inflation and economic growth in Ethiopia using different method of analysis this study is carried out. The examination of the relationship between inflation and economic growth in Ethiopia is imperative since inflation may create uncertainty to investors and decrease the international competitiveness of the country that is directly related to the economic growth of the country.

The problem regarding the relationship between these two macroeconomic concepts has received much attention from economists and policy makers. Therefore, this study thoroughly investigates this important relationship in Ethiopia. In this respect, the study also tried to answer questions such as whether inflation has useful information in predicting economic growth other than that provided by economic growth itself and vice versa. The study also tried to establish the effect of shocks to the variables on each other. It is not sufficient to base the policies on theories, but empirical investigations add more value by providing precise insights into the relationships among variables. Hence, this study seeks to provide some insights into the relationship between inflation and economic growth in the country using different method of analysis than the previous studies called Autoregressive Distributed Lag Model which is good for small sample size.

1.3. Objectives of the Study

1.3.1 General Objective

The general objective of the study is to examine the relationship between inflation and economic growth.

1.3.2 Specific Objectives

The study seek to achieve the following specific objectives

- To examine the short run relationship between inflation and economic growth in Ethiopia.
- To examine the long run relationship between inflation and growth in Ethiopia.

1.4. Significance of the Study

Over the years, the existence of the link between these two variables has been the subject of considerable interest and debate both at country specific and regional levels. Economic theories and empirical findings reach a variety of conclusions about the nature of the relationship between economic growth and inflation. They show that there might be no relationship, there might be a negative relationship or there might be a positive relationship between inflation and economic growth. Studies on inflation further fail to reach a consensus on the nature of direction of causality between inflation and economic growth.

Since the relationship between inflation and economic growth has been very debatable and this issue in Ethiopia has been studied only to some extent, this study sheds a light to the existing uncertainty. Hence, the study is significant in that it revealed some important inter-links between inflation and economic growth in Ethiopia. It attempts to provide an

explanation for the nature of inflation-economic growth relationship over the period under study using different method of analysis than the previous ones which is called autoregressive distributed lag model.

This study is also very vital to policy makers, macroeconomists, central bankers and development partners in understanding the relationship between these two major macroeconomic variables in Ethiopia. Therefore, policy makers come up with the appropriate policies so as to keep the reasonable rate of prices that encourage the existing economic growth of the country. Generally, it is very important in filling the prevailed knowledge gap of indecisive results and the above stated methodological gap.

1.5. Scope and Limitation of the Study

The scope of the study covers from the period 1980/81 to 2013/2014. Although both macroeconomic variables are influenced by many different variables, this study is concerned with only few determining variables. Therefore, the study analyzes the data on general inflation rate and economic growth that is proxied by real gross domestic product growth rate as well as real effective exchange rate, capital, human capital, population and export. This study will have its own shortcomings from which the availability and the accuracy of data take the priority.

1.6. Organization of the Thesis

The study is divided into five chapters. Beginning with the introductory chapter that focuses on the statement of the problem, highlights the objectives of the study and the significance as well as the scope of the study. The second chapter is dedicated to revision of relevant literatures. Then chapter three describes the methodology employed in the study. Chapter four presents the analysis of the results and discussion. At last, chapter five forwards the concluding remarks and recommendations.

CHAPTER TWO

REVIEW OF LITERATURE

This part of the study is dedicated to reviewing literature. First, it starts with relevant theoretical studies regarding inflation and economic growth. The second part presents the global empirical studies and their findings. The final part will focus on the studies carried out on the relationship between inflation and economic growth in Ethiopia.

2.1. Theoretical Review

Inflation is an increase in the overall level of prices in the economy. Another popular saying explains inflation as ‘‘too much money chasing too few goods’’. There are two causes of inflation namely the demand pull inflation caused by excessive demand over supply and cost push inflation caused by the rise in cost of production. When this increase in price is too sharp it is called Hyperinflation usually caused by an excessive growth of money supply (Mankiw, 2001). The opposite of inflation is deflation which is the general fall of price level. Stagflation is the situation where stagnation (fall in output) combines with inflation (rise in price).

The incident of inflation and its relationship with different economic variables has been discussed since the classical period and developed later on other modern economic theories. In this section the study will present different theories and empirical studies about inflation and economic growth as well as their relationship.

2.1.1 The Classical Theory

In 1776, when the book of Adam Smith called “Wealth of Nations” published the classical economic thinking start to flourish. He came up with supply side driven growth theory of growth model. In his model he acknowledged land, labor and capital as factors of production and put the function as follow:

$$Y=f(L, K, T)$$

Where L = labor, K = capital and T = land. So Output growth is related to growth in population, capital (Investment) and land. In order to achieve economic growth either the labor force or capital accumulation must rise. The diminishing return of growth caused by the increase in capital or labor is delayed by the rise in the level of technology (Snowdon and Vane, 2005). Smith argued that growth was self-reinforcing as it exhibited increasing returns to scale. Besides, he considered savings as a creator of investment and hence growth. He also conceived that profit declines not due to decrease in marginal productivity instead because of the competition of capitalists for workers that will bid the wage up.

In classical growth theories link between the change in price level (inflation) and its “tax” effect on profit and output were not specifically expressed. But the relationship between inflation and growth is implicitly recommended to be negative as indicated by the reduction in firms profit level through higher wage costs (Gokal and Hanif, 2004)

2.1.2 Keynesian Theory

After the works of John Maynard Keynes and his book ”The General Theory of Employment, Interest and Money” the theory of Keynesians became popular which in turn played a key role for the establishment of modern macroeconomics. This model used aggregate demand (AD) and aggregate supply (AS) to analyze the relationship between

inflation and economic growth. According to Keynesians, in the short run the AS curve is upward sloping rather than vertical. If the aggregate supply curve is vertical, changes on the demand side of the economy affects only prices. But if it is upward sloping then changes in AD affects both prices and output.

The short run Aggregate demand and aggregate supply also yields an adjustment path (Dornbusch, 1996). It exhibits positive relationship between inflation and output growth at the beginning and negative relationship at the latter part of the adjustment path. It is because producers of a certain product feel that only the prices of their products have increased while level of price remain the same for other producers even though that is not the case in reality. Thus producers go on producing more products until they realize the situation. Therefore, Keynesians generalize that there is a positive relationship between price and output at least in the short run (Snowdon, 2005). But in the long run the relationship becomes negative and phenomena of stagflation exist that is when output decrease or remain the same while prices rises (Gokal and Hanif, 2004).

This theory also defines the relationship between inflation and economic growth using potential output; it is the level of GDP where the economy is at its optimal level of production given some constraints. If GDP exceeds its potential, means unemployment is below its natural rate, the theory says that inflation will accelerate as suppliers increase their prices. If GDP falls below its potential, means unemployment is above its natural rate, inflation will decelerate when suppliers try to fill excess capacity. At last when GDP is equal to its potential and unemployment is equal to its natural rate, then the rate of inflation will remain unchanged unless there are no supply shocks. At given resource, attaining full production and full employment are rare to be achieved just resting upon market adjustment. According to Keynes expansionary economic policy interventions by the government will boost investment and promote demand to attain full production.

2.1.3 Monetarist Theory

The theory of Monetarism link inflation and economic growth by equating the total amount of spending to the total amount of money that circulates in the economy. In the short run money supply could be the most important but not exclusive determinant of output and price. And in the long run it is also not an exclusive determinant for the level of price.

When the supply of money in the economy is greater than the rate of growth, inflation will be there. However, the effect of money supply in the long run and short run is different. The influence of money supply in the short run is on real variables like employment and real GDP where as in the long run the influence of money supply is on nominal variables and price level.

Monetarists argue that inflation happen when the supply of money in the economy is greater than the rate of growth of the national economy. However, the effect of money supply in the long run and short run is different. The influence of money supply in the short run is on real variables like employment and real GDP where as in the long run the influence of money supply is on nominal variables and price level. For an economy at the natural rate of unemployment i.e. zero inflation and zero growth, if government want to reduce unemployment by increasing aggregate demand through an increase in money supply, and the workers consider the wage increase as real. Therefore, they will be motivated to increase their labor supply and hence productivity rises. However, this circumstance stays for short period only until the workers find out that the increase in wages are not in real terms. When they realize that their wage did not change in real terms, they decrease their labor supply.

Thus, for Monetarists there is a positive short-run relationship between inflation and economic growth, provided that the growth is accompanied by the decline of unemployment and rise in the cost of production leading to price inflation. This short-run

relationship exists if and only if the policy measure to raise the aggregate demand is not anticipated. In such cases, when workers adjust their expectations output adjusts to its natural rate at the vertical long-run leaving the price higher. As a result, an increase in money supply will increase the price level without having any effect on output and hence there will be no long-run trade-off between inflation and economic growth.

2.1.4 Neo-classical Theory

The neo – classical growth model was devised by Solow and Swan in 1956. They developed growth model that scientific innovation or technological change replaced investment (growth of capital) as the primary factor explaining long term growth and level of technological change is determined exogenously, that is independent of all other factors including inflation. The model exhibited diminishing returns to labor and capital separately and constant returns to both factors jointly (Todaro, 2000). For Neoclassical growth theory the determinants of output growth are technology, labor and capital (Gokal and Hanif, 2004). Unlike monetarist, monetary policy is used to control inflation but not to increase the aggregate demand. So to achieve higher economic growth supply side policies play a major role than the monetary policy.

Mundell (1963) is the first to point up that expected inflation has a real economic effect by depicting IS-LM curves. The money rate of interest rises by less than the rate of inflation and hence the real rate of interest falls during inflation. According to Mundell's model an increase in inflation or inflation expectations immediately reduces the people's wealth. This works on the premises that real investment depends on the real interest rate and real saving on real balances. Inflation decrease real money balance which create decline in wealth that in turn stimulates increased saving. Greater saving means high capital accumulation and hence quick economic growth. He also claims that expectation of fluctuations in the rate of inflation has real effects on economic activity. When prices are expected to increase, interest rate rises by less than the rate of inflation.

Tobin (1965) is another neoclassical economist who developed additional Mundell's model. He assumes that money as a store of value and inflation has a positive effect on economic growth. Tobin effect propose that inflation causes individuals to change money into other assets and obtain more capital than holding money because money and capital ratio depends negatively on the inflation rate, that leads to greater capital strength and promotes economic growth. Tobin supports that higher inflation rate raises the level of output. But, the positive effect of inflation on economic growth is only temporary. Initially inflation motivates capital accumulation so as to contribute to higher growth. But this trend works only until the return on capital falls.

Sidrauski (1967) introduced the 'super-neutrality' of money which holds when real variables are independent of the growth rate in the money supply in the long run. Sidrauski's approach to money, inflation and growth stress on portfolio substitution as the basic driving force in determining the relationship between inflation and growth. For instance an increase in the growth rate of money leads to an increase in expected rate of inflation thus reducing the demand for real goods and services. As a result an increase in the inflation rate doesn't affect the steady state capital stock so that neither output nor economic growth is affected and Sidrauski concluded that there is no conclusive relationship between inflation and economic growth.

Stockman (1981) came up with cash in advance transactions constraint model that consider money as complimentary to capital. This model assumes that firms put up some cash in financing their consumption and investment goods. An increase in the inflation rate results in a lower steady state level of output because inflation decrease the purchasing power of money that force individuals to reduce holding cash and purchase of capital as inflation rate raises. Likewise the steady state level of output falls in response to an increase in inflation rate.

Cooley and Hansen (1989) enlarge the mechanism to consider capital accumulation. According to them the key assumption is that the marginal product of capital is positively related to the quantity of labor. The return to labor falls when the inflation rate rises and people will respond by substituting away from consumption to leisure. With the decline in the quantity of labor, in response to the rise in inflation, the return to capital falls and the steady-state quantities of capital and output decline. Cooley and Hansen show that the level of output permanently falls as the inflation rate increases.

The review of theories regarding the neoclassical framework reveals that models under this framework can leads to indistinct results for the relationship between inflation and economic growth. Tobin observes a positive relationship between the two macroeconomic variables. On the contrary Stockman obtains a negative relationship and Sidrauski no possible relationship.

2.1.5 Neo Keynesian Theory

The origin of neo Keynesian theory is from Keynesians and develops the concept of potential output. This is the level of output where the economy is at optimal level of production where all factors of productions are fully utilized. This level of output also corresponds to the natural rate of unemployment. According to neo Keynesians concept of potential output, inflation depends on the level of actual output (GDP) and natural rate of unemployment.

If unemployment is below the natural rate of unemployment and GDP exceeds its potential, all else equal, inflation will go up as suppliers higher their prices and inflation worsens. This will cause stagflation where both inflation and unemployment are very. On the contrary if unemployment is above the natural rate of unemployment and GDP falls below its potential level, all else equal, inflation will go down as suppliers try to fill excess capacity, price reduces and undermining built in inflation that leads to disinflation. This brings the desired less inflation and less unemployment. Generally, for Neo

Keynesian high inflation has a negative impact on economic instability and hence growth.

From this review we can easily understand that there are inconsistent results between different theories about the relationship between inflation and economic growth. The next part is dedicated for review of some empirical literatures.

2.2. Empirical Literature Review

There are several studies carried out on the relationship between inflation and economic growth both at country and cross country level. However there is no consensus on the results of their findings. Thus, this section presents the general empirical findings concerning the link between the two macroeconomic variables.

The effect of inflation on growth was not important until 1970's. But when many countries especially Latin America countries experienced chronic inflation, numerous empirical researches were devoted to fund out the effect of inflation on high inflated countries. Fisher (1993) found the negative link between economic growth and inflation in pooled cross section, time series regression analysis for large number of countries. He argued that inflation obstruct the efficient allocation of resources by obscuring the indication role of price changes, the most significant indicator for efficient decision making.

Baro (1995) more precisely see the relationship between inflation and growth using the five year average data of 100 countries over the period of 1960-1990.He used instrumental variable (IV) method and to assess the effect of inflation on economic growth a system of regression equation were used in which other determinants of growth were kept constant. He obtained that an increase in average inflation by 10 % points per year would slow down the growth rate of the real per capita GDP by 0.2 % to 0.3 % points per year and a decrease on the ratio of investment to GDP by 0.4% to 0.6% points

per year. Following this result he concludes that even if the adverse effect of inflation on growth seems small, the long term effects on standard of living and investment can be large.

Andres and Hernando (1997) found a significant negative relationship between inflation and economic growth during long periods. Inflation reduces the level of investment and has a negative temporary impact on long term growth rates, which in turn generates permanent fall in per capita income. They conclude that the long run cost of inflation is huge and the effort to keep inflation down will pay off in terms of better economic growth. Another study by Bruno and Easterly (1995) also came up with the result that there is a negative relationship between inflation and growth, which is firmly established when looking at the temporal association of growth with discrete high inflation crises. According to the results obtained, causality remained problematic, but their results are consistent with the view that costs of inflation only become significant at relatively high rates of inflation. At lower rates of inflation, growth and inflation may simply be jointly affected by various demand and supply shocks and hence shows no consistent pattern.

Malla (1997) used small data sample for OECD and Asian countries to how inflation affects the rate of economic growth. The study employed a growth equation explained by capital accumulation and labor force. The result for the Asian countries divulges the existence of strong negative relationship between the two macroeconomic variables. However, on the contrary to the theories, the finding for 11 OECD countries reveals that there exists no relationship between inflation and economic growth. Another study in Brazil held by Faria and Carnerio (2001) for the period between 1980 and 1995 came up with the finding that in the long run the response of output to a permanent inflation shock in a high inflation country is not significantly different from zero. Their empirical results also support the super neutrality of money concept in the long run.

Using annual data of 21 countries covering from 1961 to 1987, Grimes (1991) found a short term positive relationship between inflation and economic growth and a long term

negative relationship between those two variables. Erbaykal and Okuyan (2008) studied the two variables relationship in Turkey from 1987 to 2006. The study employs Bound Test for long term relationship and found no statistical relationship. But with Autoregressive Distributed lagged (ARDL) model a negative and statistically significant short term relationship was found. Another study by Datta and Mukhopadhyay (2011) examined the relationship between inflation and economic growth in Malaysia with the data covering from 1971 to 2007. The result confirms short run causality between the variables and direction of causality is from inflation to economic growth and in the long run economic growth Granger cause inflation.

Gillman and Harris (2010) examine the effect of inflation on economic growth for countries under transition. The study is undertaken by using a panel data evidence for 13 transition countries over the period 1990 – 2003. The data is obtained from World Bank Development Indicator (WDI). The estimation process has three equation systems namely the growth, inflation and money demand equations. The maximum likelihood estimation technique using full information is applied. The results obtained from the study are similar to the findings for the OECD countries that there exists strong negative relationship between growth and inflation. This confirms that the growth in the region is similar to that of developed countries implying the convergence of growth. The authors thus suggest monetary policies to be inflation targeting and fiscal policies to keep budget deficits within acceptable range.

The study of Xiaojing (2008) examined the trade-off between inflation and economic growth in China using annual time series data from 1978 – 2007. He used the Phillips curve equation to see what the relationship would look like between the two variables. The finding of his study reveals that growth can be affected differently at different steady state levels. At the socially accepted steady state of inflation, 5%, GDP growth will be 9.39%. However a rising inflation above its steady state will have a negative effect on growth and tight monetary and fiscal policies are recommended in these cases.

Nevertheless, tight policies can harm the economic growth of the country if they are still adopted when the rate of inflation is below the steady state.

Gokal and Hanif (2004) have analyzed the relationship between inflation and economic growth in Fiji. Their study focuses mainly on whether there is any meaningful and causal relationship between the two variables in the country. To achieve their objectives they used annual observation of 34 years (1970 – 2003) for variables of Real GDP, annual average CPI, and year on year CPI inflation rate. To test the causal relationship Granger causality test is applied but before that the authors have examined the time series properties of the data using Augmented Dickey Fuller (ADF) and Phillips Perron (PP) tests and the variables are found to be integrated of order I(1). The findings of the analysis reveal that both inflation measures (annual average CPI and year on year CPI) have negative weak relationship with the GDP growth. The finding of the Granger causality test indicates that causality runs one way from economic growth to inflation. The authors conclude that inflation in Fiji is highly influenced by international factors and there is a weak and negative relationship between inflation and economic growth. They further recommend that Fiji's monetary policy must aim to reduce inflation and inflation expectations to promote economic growth.

The study of Hodge (2005) aims to check the findings of the numerous empirical findings that inflation has negative long-run impact on the economic growth in South Africa. The study also examines the level of growth sacrificed in the short-run to achieve lower inflation. To attain the results of the study annual time series data for the period of 1950 – 2002 is used. A growth equation is used with explanatory variables of CPI, labor productivity, investment, tax on income and wealth, and terms of trade to see the long-run relationship between the two variables. OLS regression results have shown the existence of a strong and statistically significant negative long-run relationship between inflation and economic growth in South Africa. To see the short run relationship between the two variables, an inflation equation explained by lagged inflation, lagged GDP growth rate, lagged change in labor cost and change in import prices is used. The finding

shows that there has to be accelerating inflation in order to achieve growth in the short run. Therefore, inflation targeting has to be ignored to achieve short-term growth. But in the long run the two variables have a negative relationship and thus an increase in inflation to achieve short-term growth will have higher cost in the long-run.

Baharumshah, Hamzah and Sarbi (2011) analyzed the effects of inflation and inflation uncertainty on the economy for five ASEAN (Association of South East Asian Nations) countries namely; Malaysia, Singapore, Thailand, Indonesia and Philippines. The L1-ARCH (Autoregressive conditional heteroscedastic) model is adapted to measure inflation uncertainty which is helpful to measure extreme observations. Based on the model employed the finding of the study shows that there exists a negative relationship between inflation uncertainty and economic growth. The authors indicated that measures that are undertaken to reduce inflation uncertainty have a positive impact on the overall growth of the economy. But the authors mentioned that their study is not a full analysis. It only focuses on inflation uncertainty and it ignores other growth determinants.

Dholakia and Sapre (2011) studied the trade-off between inflation and economic growth in India for the period 1950 – 2009. Specifically the study aims to estimate the short-run aggregate supply curve, analyze the inflation unemployment trade-off and address inflationary expectations. To estimate the short-run trade-off between inflation and growth, the regular Phillips Curve based on adaptive expectations is used. For the period under study, a trade-off between the two variables exists in India enabling them to capture the speed of the recovery. The finding of the analysis also reveals that there exists a positively sloped short-run aggregate supply curve responsive to market prices showing that the economy is being more exposed to the international market.

The study of Bittencourt (2010) has examined how higher inflation affected the growth of four Latin American countries (Bolivia, Peru, Argentina and Brazil). He used panel data for the period 1970 – 2007 obtained from the Bureaux of Census of the four countries,

World Bank's World Development Indicators (WDI) and Penn World Table (PWT). To execute the study Bittencourt used a growth equation with explanatory variables: inflation, government expenditure, openness, investment, money supply, political regime and interaction between education and urbanization. Among the explanatory variables only inflation is relevant for the study. Accordingly, inflation was found to have harmful effects on the growth of these countries. To him measures taken to lower inflation were effective. Some of the measures taken were introduction of the central bank independence, inflation targeting policies and fiscal responsibility laws.

Yap (1996) analyzed the inflation and growth experience in the Philippines. The study employed descriptive analysis of the data to see the development of the two macro-economic variables. In this analysis, Yap indicated that 10% to 15% inflation is tolerable. He also considered the measures taken during the period of the crisis as suitable but measures taken during the time of recovery (1985-95) as short sighted. He recommends the importance of macro-economic stability that can be gained by strong fiscal performance. He also indicated that inflation in Philippines is not only caused by lack of strong fiscal performance but also by the oligopolistic nature of the economy.

Lupu (2012) examined the interdependence between inflation and economic growth in Romania for the period 1990 – 2009. The two decades are analyzed separately using a quantitative and ideological approach. During the first period, i.e. 1990 – 2000, high and volatile inflation was a major source of macro-economic instability that led to the fall of GDP. However, starting from the year 2000 Romania has taken measures to control inflation that led to positive results. From the year 2001 – 2009 the country has witnessed lower level of inflation accompanied by higher economic growth. Thus, according to this study, there exists a negative relationship between inflation and economic growth.

Another study by Ahmed and Mortaza (2005), explored the relationship between inflation and economic growth in Bangladesh using annual data of real GDP and CPI for the period 1980 – 2005 obtained from Bangladesh Bureau of Statistics. In their study, long-run and short-run dynamic relationship of the two variables is assessed using the Engle-Granger co-integration test and error correction model. The model developed by Khan and Senhadji (2001) is employed to estimate the threshold level of inflation. The empirical finding of the study shows that there is a statistically significant long-run negative relationship between CPI and real GDP. The estimated threshold model of inflation also suggests 6% as a threshold point for the Bangladesh economy. Thus, macroeconomic policy makers of Bangladesh are advised to keep inflation below this threshold point.

Chimobi(2010) employed GDP and CPI time series data for the period 1970 – 2005 as proxy for growth and inflation, respectively to analyze the relationship between inflation and growth in Nigeria.. The Johansen and Juselius (1990) co-integration test and VAR based Granger Causality tests are used to see the co-integrating and causal relationships. The result obtained shows that there is a unidirectional causality that goes from inflation to economic growth. Though the study did not check whether there is a positive or negative relationship between the two variables, it assumed that inflation has a harmful impact on growth, as revealed from recent literature. Hence the one way causality that runs from inflation to growth shows the negative effect of inflation on economic growth, according to the author.

The findings of the global literature on the relationship between inflation and growth are conflicting as seen in the empirical literature review. Different studies have different findings in the relationship between inflation and growth. However, most of the economists agree that there is a non-linear relationship between the two macro-economic variables, i.e., lower inflation promotes growth while higher inflation discourages

growth. Some economists take this study further by questioning how low inflation should promote growth.

Jha and Dang (2011) studied the effect of inflation variability on the economic growth when inflation exceeds its threshold point. A panel data of 182 developing countries and 31 developed countries is used for the period 1961 – 2009. The threshold level is estimated first by using threshold regression developed by Khan and Senhadji (2001). Based on this result, when inflation exceeds its threshold level, the effect of inflation variability on growth will be assessed by using a bootstrap method as suggested by Hansen (1999). The result obtained is quite similar to that of Khan and Senhadji showing the similarity of methodology leading to similar results. The threshold level of inflation for developed countries is 1% and for developing countries is 11%. The overall threshold level of inflation for all countries is 10%. Having this result, inflation variability has no significant effect on the growth of the developed countries. But for the developing countries the case is different. For a level of inflation above the threshold point, inflation variability negatively affects economic growth of a country. Thus, it is necessary to keep inflation within the threshold level so that growth can be promoted.

Pollin and Zhu (2005) studied the relationship between inflation and growth by estimating the threshold level of inflation using panel data from 80 countries from 1961 – 2000. Pooled ordinary least square (OLS) estimation is used in order to achieve the objectives of the study. The findings indicate that for OECD countries there is no statistically significant relationship obtained between the two variables. For the middle income countries, inflation coefficients have positive values with turning band between 14- 16%. For developing nations however, the turning point of inflation on growth from positive to negative lies between 15-23%. The authors also recommend monetary policy measures in developing countries to keep inflation between 15-23%.

Mubarik (2005) has studied the threshold level of inflation for a single country, Pakistan, using annual time series data from 1973 to 2000. The study employs the method used by

Khan and Senhadji (2001). Among the variables used in the growth model are: CPI (based on 1990/1), real GDP at constant factor cost, population and total investment obtained from economic survey of Pakistan. Like Khan and Senhadji, Mubarik also transformed the variables used in the model to log version so as to get rid of asymmetry in inflation distribution. The finding of the study shows 9% threshold level for the economy of Pakistan. The causality test also shows that causality runs one way from inflation to economic growth. Mubarik also recommends macro-economic policy makers of Pakistan to keep inflation below 9%.

Frimpong and Oteng-Abayie (2010) have estimated the level of inflation that is harmful to economic growth in the case of Ghana. Time-series annual data for the period 1960 – 2008 obtained from the World Bank Report and Bank of Ghana quarterly digest of statistics is used to estimate the threshold level. As most of the papers do, this study also uses the model of Khan and Senhadji (2001). In the growth equation the explanatory variables include inflation as measured by CPI, threshold level of inflation that will be assigned in ascending order from 6-12, domestic investment, population growth, terms of trade and the growth in money supply. By estimating the regression for each value that minimizes the residual sum of square (RSS) and maximizes R^2 the optimal value of inflation that positively relates to growth is found. In the inflation threshold regression R^2 is maximized at 11%. The two stage least square estimation results also confirm that R^2 is maximized at 11%. Having this finding, the authors concluded that for the medium term 7% inflation target is below the threshold level inflation. They suggest the Bank of Ghana and the government to revisit its target of inflation.

In developing countries, the range of the threshold varies from 9 – 17% in different studies. However, there are exceptions such as Munir, Mansur and Furuoka (2009) and Hussain (2005) who found 3.89% and 5% as a threshold point for Malaysia and Pakistan, respectively. Studies such as Iqbal and Nawaz (2009) have found two threshold points for a developing country, Pakistan. The reason for large differences in the finding of the

threshold points in developing countries mainly seems to be the type of data used, structure of the economy and differences in the explanatory variables in the models. In general, one can conclude that developed countries have lower threshold points whereas developing countries have higher threshold points. Keeping this in mind, the next section discusses the literature on inflation and growth relationships in the Ethiopian context.

When we come to Ethiopia, during the past years literatures on the relationship between inflation and economic growth in the country were few due to low inflation experience of the country. Most of the papers focus on the impact of inflation in the country rather than the relationship.

The short run determinant of inflation in Ethiopia is money stock and the long run is supply factors (Getachew, 1996). His paper recommends that in the short run inflation is controlled by controlling money supply while in the long run he advice that removing the bottlenecks of the supply side of the economy. Another study by Yohannes (2000) also supports this idea that money supply is the determining factor of inflation in Ethiopia. He argues that controlling inflation is not the feasible policy instead the government should have to focus on solving the supply side problem of the economy.

The Ethiopian economy has been described by erratic nature of output growth as the economy has been highly dependent on fortune of nature and external shocks. Since agriculture accounted for above 50 percent of GDP of the country for most of the recent past, when weather conditions turned to be unfavorable, agricultural production 18 contracted and GDP followed and with this systematic relationship between GDP (output) and rainfall there followed by a systematic price trend. Prices followed the inverse of output growth trend. During years of good rainfall as output rises prices often dropped considerably. Even within any particular year prices have been lower during harvest periods. This co-movement appeared to have reversed in the post 2002 period. From 2003 onwards, output is on average reported to have grown by 11.8 percent per annum. Despite this reported

significant increase in output (especially in agriculture) prices continued to rise. Therefore, during the same period the general price level has recorded an average annual rise of 12 percent. The 2007 budget year alone witnessed prices jump by 18.4 percent, the food inflation being 49 percent in August 2008 (Geda and Tafere, 2008).

Teshome (2011) using statistical analysis tries to explain the relationship between inflation and economic growth in Ethiopia. Accordingly, he states that it is difficult to specify the exact relationship between inflation and growth. By comparing the rate of inflation and economic growth of Ethiopia to that of Sub Saharan Africa, he explains how inflation affects economic growth through time. Using statistical comparison of the rate of inflation and economic growth, he tries to figure out the relation between them from 2004 to 2010. As a result, inflation affects economic growth nonlinearly in the country. Between 2004-2006 inflation and economic growth has positive relationship while from 2006-2008 they have negative relationship. Regardless of the variation in the magnitude between 2008 and 2010, he states that inflation and economic growth has positive relationship.

Finally, Rao and Yesigat, 2015 declares the negative relationship between inflation and economic growth in Ethiopia both in the long run and short run. The paper specifically used VAR, ECM and threshold level analysis for annual data covering from 1974 to 2012. The threshold model estimation recommends 9-10 percent threshold inflation level, which is optimal for economic growth. Above this level inflation affects economic growth negatively. Therefore, controlling moderate inflation should be the main goal for policymakers in Ethiopia.

CHAPTER THREE

RESEARCH METHODOLOGY

In order to address the objective of the study Autoregressive Distributed lag model (ARDL) known as Bound test approach is employed. This model is used to see the long run relationship between inflation and economic growth. On the other hand, to find the short run elasticities the study uses Error Correction Model (ECM).

3.1 Research Design

The research design employed in this study is quantitative type of research design due to its convenience for secondary data and quantitative data. Quantitative methods are used to examine the relationship between variables through statistical analysis.

3.2. Data source

The data regarding Real GDP growth rate, General inflation rate and real effective exchange rate is collected from national bank of Ethiopia and the data for export as a share of GDP is obtained from World Bank While data for population growth rate National Bank of Ethiopia and the data for gross fixed capital formation as a share of GDP and human capital as a share of GDP is obtained from UNCTAD.

3.3. Methods of Data Analysis

To analyze the relationship between inflation and economic growth in Ethiopia during the study period, the study use econometrical method of analysis. Microfit 4.1 and Eviews 9.0 verions are used as statistical software package for the entire analysis of the study.

3.4. Model Specification

To address the objective of the study, an endogenous growth model which is extended from neoclassical growth model is employed. The production function is given by,

$$Y = F(K, L, H) \quad \text{.....3.1}$$

Where, *Y* denotes level of output and *K*, *L* & *H* are physical capital, labor force and human capital respectively and these variables are known as supply-driven inputs (Dornbusch and Fischer, 2001, Romer, 1996). It can be specified as

$$Y_t = A_t K_t^{x} (H_t)^{B} (L_t)^{1-x-B} \quad \text{.....3.2}$$

Economic growth depends on both supply driven inputs as well as demand side inputs. Thus, more specifically the economic growth model can be specified as follow including supply and demand variables. Real GDP growth rate is a function of inflation rate, real effective exchange rate, gross fixed capital formtion, human capital, population growth rate and export of goods and service.

$$RGDP = f(INF, REER, K, HK, POP, EXP) \quad \text{……3.3}$$

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. To avoid hetroscedasticity and to show elasticity of the variables the researcher transforms all variables under study into log data (Gujarati, 2004).

The mathematical function becomes;

$$\ln RGDPgr_t = \beta_o + \beta_1 INF_t + \beta_2 \ln REER_t + \beta_3 \ln K_t + \beta_4 \ln HK_t + \beta_5 \ln POP_t + \beta_6 \ln EXP_t + \varepsilon \quad \text{……3.4}$$

Where $RGDP_t$ = Real Gross Domestic Product growth rate at time t

INF_t = General Inflation rate at time t

$REER_t$ = Real effective exchange rate at time t

K_t = Gross fixed capital formation as a share of GDP at time t

HK_t = Human capital as a share of GDP at time t

POP_t = Population growth rate at time t

EXP_t = Export of goods and service as a share of GDP at time t

The error term (ε) captures all other explanatory variables that are not included in the model. It is assumed to be normally and independently distributed with zero mean and constant variance. And the β_i represent the partial elasticity of the dependent variable with respect to the independent variables.

To examine the long run relationship between the dependent variable (RGDPgr) and the independent variables (INF, REER, POP, K, HK, EXP) the study employ Autoregressive distributed lag (ARDL) model. When time series data is performed in econometric analysis the preliminary statistical step is to determine the order of integration of each time series data used. A time series Yt is stationary if its probability distribution does not change over time, that is, if the joint distribution of (Ys+1,Ys+2,…,Ys+T) does not depend on s; otherwise, Yt is said to be non stationary. If the series is not stationary, then inference procedures are invalid. If non stationary data is used, the results derived from the regression models would produce spurious results. Therefore, the first task is to check for the existence of stationarity property of the data by using Augmented Dickey-Fuller (ADF) and Phillips-Perron(PP) test. The unit root tests will be used to check the stationarity of the variables and to check the non existence of variables that are of order two (I.e. I (2)), which is precondition to apply ARDL model (Pesaran , 2001).

3.5. Variable Description

Real Gross Domestic Product growth rate (RGDPgr): RGDP is the market value of goods and service which are produced in the country's boundary on a given timeframe. As many economists conventionally agreed, economic growth can be measured by the growth in real GDP. Since economic growth is the variable of interest in this study it is treated as the dependent variable.

General inflation rate (INF): Inflation is defined as an increase in the overall price level in a country and measured in percent. Even though, inflation was not a problem of economic growth in Ethiopian history, it has become a serious problem since 2008. It is also a variable of interest.

Export of goods and service as a share of GDP (EXP): is defined as the total exports of goods and service to the rest of the world. It is believed that export of a country's plays one role for economic growth of a country. For this reason and due to researcher's interest this variable is entered as explanatory.

Human Capital as a share of GDP (HK): It is difficult to measure human capital in economics. As a result researchers use different proxy of human capital that is enrollment in the secondary education and enrollment in the secondary vocational education in both sexes. And it is indicate as major determinants of economic growth in long term.

Gross fixed Capital formation as a share of GDP (K): is defined as Gross capital formation (formerly gross investment) in a country. However, getting such a readymade time series data in Ethiopia is difficult. Therefore in this study, gross investment was used as proxy of this variable and have been expected a positive impact on economic growth.

Population growth rate (POP): is the total number of population of the country. In this study population growth rate is used. Since population has an effect on economic growth it is included as explanatory variable in the study.

Real Effective Exchange Rate (REER): is the weighted average of a countries currency relative to an index of other major currencies and adjusted for the effect of inflation. REER is trade weighted means it takes in to consideration any changes in price and shows what can be purchased in the country.

3.4. Autoregressive Distributed Lag (ARDL) Model

To study the long run relationship between different variables of interest, most of the past studies have used the Johansen cointegration and Engle-Granger causality technique. Many researchers preferred this method of analysis is because of its accuracy for application of I(1) variables. While (Pesaran *et al*., 2001) and Narayan (2004) have introduced an alternative cointegration technique called Autoregressive Distributed Lag (ARDL) or Bound test. It has a number of advantages over the conventional Engle-Granger two-step procedure, Maximum likelihood methods of cointegration (Johansen, 1988) and Johansen and Juselius (1990).

ARDL model is more statistically significant approach to determine cointegration in small samples (Pesaran *et al.,* 2001; Narayan *et al*., 2004), while the Johansen co-integration techniques require large data samples for validity. Another advantage of ARDL approach is that it avoids the pre-testing problems related with standard cointegration. It is because ARDL approach can be applied whether the independent variables are purely order zero I(0) , Purely I(1) or a mixture of both while other cointegration techniques oblige all independent variables to be integrated of the same order.

Bound testing approach makes possible determining long run and short run parameters simultaneously (Nasiru, 2012 as cited in Tsadkan, 2013). The other merit in this approach is that different variables can have different optimal number of lags but not allowed in Johansen cointegration approach. Generally, using Autoregressive Distributed Lag (ARDL) model yield unbiased and efficient estimator of the model (Narayan *et al.*, 2004).

In its basic form, an ARDL regression model looks like this:

$$Y_t = \beta_0 + \beta_1 y_t\text{-}1 + ...+ \beta_k y_{t-p} + \alpha_0 x_t + \alpha_1 x_{t-1} + \alpha_2 x_{t-2} + ... + \alpha_q x_{t-q} + \varepsilon_t$$

Where y_t is the vector dependent variable

x_t is the vector independent variables

ε_t is a random "disturbance" term.

The model is "autoregressive", in the sense that y_t is explained (in part) by lagged values of itself. It also has "distributed lag" component, in the form of the successive lags of the "x" explanatory variable. Sometimes, the current value of x_t itself is excluded from the distributed lag part of model's structure. The suitable statistic to test the significance of lagged level of variables for bound test approach is F test or Wald test (Pesaran *et al.*, 2001). Bound test largely relied on the joint Wald test or F- test which its asymptotic distribution is non-standard under the null hypothesis of no co integration. The null hypothesis for no co-integration in the long-run among the variables in equation is given as ;

H_o: $\theta_0 = \theta_1 = \theta_2 = \theta_3 = \theta_4 = \theta_5 = \theta_6 = 0$ (represent no long run relationship among variables)

H_A: $\theta_0 \neq \theta_1 \neq \theta_2 \neq \theta_3 \neq \theta_4 \neq \theta_4 \neq \theta_6 = 0$ (represent long run relationship among variables)

There are two set of asymptotic critical values that consider all the regressors are purely I(0) and purely I(1). The critical value for I(0) is called lower bound critical value where as the critical value for I(1) is called upper bound critical value. If the computed wald or

F-statistic falls inside the critical value bounds, the inference is inconclusive and knowing the order of integration of variables is vital in order to make conclusive inference (Pesaran *et al.*, 2001). While if the computed Wald or F-statistic falls outside the critical value bounds, conclusive inference can be drawn without knowing the order of integration of regressors. If the calculated F statistic is greater than the upper bound critical values, we can reject the null hypothesis of no long run cointegration between variables. If the calculated F statistic is less than the lower bound critical values, we accept the null hypothesis of no relationship among variables. In this study we will use the critical values developed by Narayan *et al*, (2004) that was developed based on small sample size between 30 and 80 observations.

To tackle the problem of parameterization and to save the degree of freedom, determining the maximum number of lag length is important in ARDL model (Taban, 2010). The study will use the Akaike Information criterion (AIC) in lag selection because of its advantages for small sample size (Tsadkan, 2013). And according to Pesaran and Shin (1999), it is recommended to use a maximum of two lags for annual data.

3.7. Short Run Analysis

For Short run analysis an Error Correction Model (ECM) is constructed and has the following form:

$$\Delta \ln RGDPgr_t = \alpha_0 + \sum_{i=1}^{p} \beta_o \, \Delta lnRGDPgr_{t-i} + \sum_{i=0}^{p} \beta_1 \, \Delta lnREER_{t-i} + \sum_{i=0}^{p} \beta_2 \Delta INF_{t-i} + \sum_{i=0}^{p} \beta_3 \, \Delta lnK_{t-i} + \sum_{i=o}^{p} \beta_4 \, \Delta lnHK_{t-i} + \sum_{i=0}^{p} \beta_5 \, \Delta lnPOP_{t-i} + \sum_{i=o}^{p} \beta_6 \, \Delta lnEXP_{t-i} + \theta_0 lnRGDPgr_{t-1} + \theta_1 lnREER_{t-1} + \theta_2 INF_{t-1} + \theta_3 lnK_{t-1} + \theta_4 lnHK_{t-1} + \theta_5 lnPOP_{t-1} + \theta_6 lnEXP_{t-1} + U_t$$

Where RGDP is the real Gross domestic product growth rate at a time t, REER is Real effective exchange rate, INF the general inflation rate, K is Capital formation (proxied by gross fixed capital formation and is as a share of GDP), HK is Human capital that is proxied by education enrollment and as a share of GDP, POP is Population growth rate and finally EXP is total export of goods and service as a share of GDP. The residual term is denoted by U_t which is assumed to be white noise, **p** is the optimal lag length and **ln** is natural logarithm.

3.8. Stationarity and Unit Roots

Stationarity in level form is very hard for time series data. Therefore, it is vital to test for statistical properties of variables i.e unit root. Variables that don't have tendency to return to a linear trend or non stationary will lead to the problem of spurious regression. Spurious regression is when the regression result shows significant relationship between variables but there exists no relationship in reality. When applying ARDL model, it is necessary to test for unit root test in order to check the variables in regression are not order two (I(2)) that is one condition for applying ARDL model. Non stationarity can be tested by using different testing mechanisms like the well known Augmented Dicky Fuller (ADF) test, Kwiatkowski- Phillips-Schmidt-Shin (KPSS) test and Phillips Perron

(PP) test. While to guarantee the result of stationarity test this study will employ both both Augmented Dickey-Fuller (ADF) test and Philip-Perron (PP) tests.

The standard classical methods of estimation are based on the assumption that all variables are stationary. However, most economic variables are not stationary. It is often said that most macro-economic variables follow a random walk model, i.e., exhibiting a unit root behavior. A random walk process can be identified as stationary when its mean and variance are found to be constant across time and the value of the co-variance between the two time periods is not dependent on the actual time of computing the covariance but on the lag between them.

A random walk model can be assured when,

$\text{Var}(Y_t) = E(Y_t - \mu)^2 = \delta^2$ ..... Variance

$E(Y_t) = \mu$ .....Mean

$A = E[(Yt - \mu)(Yt + A - \mu)]$ .....Covariance

Where, Y_t is a series of random walk, A is the auto covariance at lag A

If one or more of the above conditions fail, the random walk process Yt is said to be nonstationary showing a unit root problem (Studenmund , 2011).

The concern for stationarity of time series variables gives rise to analysis of unit root tests. Unit root tests are statistical procedures that are designed to make judgment as to whether a given sample of time series data implies a unit root or the time series is found to be stationary. In most cases a time series that exhibits stationarity is denoted as I(0) and a series that shows unit root is indicated as I(1) (Wooldridge, 2009).

Models containing non-stationary variables will often lead to a problem of spurious regression, where by the results obtained suggest that there are statistically significant relationships between the variables in the regression model when in fact all that is obtained is evidence of contemporaneous correlations rather than meaningful causal relations. Furthermore, inferences based on the standard statistical tests (i.e. t and F tests

will be invalid). Therefore before running to any regression analysis, it is necessary to test for stationarity of data. Frequently non-stationary variables become stationary after differencing and it is possible to estimate using difference of variables if the differences are stationary. But such a procedure gives only the short run dynamics.

CHAPTER FOUR

RESULT AND DISCUSSION

4.1. Unit Root Test Analysis

In order to perform ARDL model all the variables in the regression should not be integrated of order two (I(2)). To determine this condition, unit root test is applied using the well known Augmented Dickey Fuller (ADF) and Phillips –Perron (PP) testing mechanisms even though ARDL model doesn't require pre-testing variables. It shows us whether or not the ARDL model should be used. The following table shows the order of integration of variables.

From the below table 4.1 we can see that lnINF and lnPOP are integrated at level (I(0)) where as the other variables lnRGDPgr, lnREER, lnK, lnHK and lnEXP are integrated at first level difference (I(1)). On the other hand, for trend and intercept, except lnINF and lnPOP all variables are stationary at first difference (I (1)). lnINF and lnPOP are stationary at level I(0).

Table 4.1 unit root test (ADF test)

Variable	Augmented Dicky Fuller (ADF) test					
	With intercept			With trend and intercept		
	At level	1st difference	Order	At level	1st difference	Order
lnRGDPgr	-1.833	-6.478	I(1) at 1%	-2.826	-6.370	I(1) at 1%
lnINF	-5.109	-5.878	I(0) at 1%	-5.497	-5.754	I(0) at 1%
lnREER	-1.288	-5.283	I(1) at 1%	-1.752	-5.205	I(1) at 1%
lnHK	-0.237	-4.973	I(1) at 1%	-1.486	-4.983	I(1) at 1%
lnK	-0.330	-9.136	I(1) at 5%	-2.978	-9.162	I(1) at 1%
lnPOP	-3.117	-1.941	I(0) at 5%	-4.467	-1.061	I(0) at 1%
lnEXP	-1.254	-5.132	I(1) at 1%	-2.141	-5.038	I(1) at 1%
based on Mackinnon (1996) With constant and no trend Test Critical values 1% level -3.621 5% level -2.943 10% level -2.610				With constant and trend Test Critical values 1% level -4.227 5% level -3.537 10% level -3.200		

Source: Model result

Table 4.2 Phillips Pearson (PP)

Variable	Phillips Pearson(PP) test					
	With intercept			With trend and intercept		
	At level	1st difference	Order	At level	1st difference	Order
lnRGDPgr	-5.560	-4.30	I(0) at 1%	-7.223	-1.012	I(0) at 1%
lnINF	-5.120	-7.150	I(0) at 1%	-5.491	-26.29	I(0) at 1%
lnREER	-1.308	-5.297	I(1) at 1%	-1.752	-5.205	I(1) at 1%
lnHK	-0.313	-4.973	I(1) at 1%	-1.561	-4.983	I(1) at 1%
lnK	-2.053	-6.279	I(1) at 1%	-1.643	-14.073	I(1) at 1%
lnPOP	-3.544	-1.609	I(0) at 5%	4.448	-1.075	I(0) at 1%
lnEXP	-1.299	-5.184	I(1) at 1%	-2.265	-5.062	I(1) at 1%
Based on Mackinnon(1996) With constant and no trend Test Critical values 1% level -3.621 5% level -2.943 10% level -2.610				With constant and trend Test Critical values 1% level -4.227 5% level -3.537 10% level -3.200		

Source: Model result

Like ADF test, here in Phillips Pearson test lnRGDPgr, lnINF and lnPOP are integrated at level (I(0)) and lnREER, lnK, lnHK and lnEXP are integrated at first level difference

(I(1)). And for trend and intercept also, lnRGDPgr, lnINF and lnPOP are integrated at level (I(0)) and lnREER, lnK, lnHK and lnEXP are integrated at first level difference

From the above two tables we can conclude that none of the variables are integrated of order two (I(2)), which is a precondition for applying ARDL model. Therefore, for long run relationship analysis the study will apply ARDL model proposed by Pesaran et al (2001).

4.2. Model Stability and Diagnosis Test

Some diagnostic test is carried out to check the verifiability of the estimated long run model. The first test is Serial correlation test undertaken by Brush & Godfray LM test then test for correct specification of the model is carried out by Ramsey's RESET test. Finally test for normality based on Jaque-Bera test and the test for heteroskedasticity is applied. Accepting or rejecting the null hypothesis depends by P values. When the P Value is smaller than the standard significance level (0.05), reject the null hypothesis. Further, the stability of the long run estimates tested by the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of square of recursive residuals (CUSUMSQ) test.

Table 4.3 Diagnostic Tests

Test Statistics	LM Version	F Version
A:Serial Correlation	CHSQ(1)= 1 .1321[.287]	F(1, 16)= .586[.455]
B:Functional Form	CHSQ(1)= 1.2266[.268]	F(1, 18)= .169692[.501]
C:Normality	CHSQ(2)= .6903[.708]	Not applicable
D:Heteroscedasticity	CHSQ(1)= .9277[.976]	F(1, 30)= .869[.977]
R^2 = 0.895 Adj R^2 = 0.825 DW= 2.729		

Source: Microfit 4.0

A: Lagrange multiplier test of residual serial correlation

B: Ramsey's RESET test using the square of the fitted values

C: Based on a test of skewness and kurtosis of residuals

D: Based on the regression of squared residuals on squared fitted values

As it can be seen from the above diagnostic test, the P value linked with both versions failed to reject the null hypothesis for all tests. LM test is applied for testing serial correlation and the p-value associated with the test statistics is greater than the standard significance level (i.e 0.287>0.05), fail to reject the null hypothesis. The test result for functional form also shows the correct specification of the model since the p-value of the test greater than the standard level. Normality test about the error term indicate that the error term is normally distributed with zero mean and constant variance, as the p-value of the test 0.708 is higher than 0.05. The last diagnostic test for hetroscedacticity also pass the test, fail to reject the null hypothesis, as the p-value associated with the test exceeds the standard significance level (i.e 0.976>0.05).

In addition to the above diagnostic tests, the stability of long run estimates has been tested by applying the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ) test. Such tests are recommended by Pesaran and Shin (1999, 2001). From such graphical stability tests we can identify not only their significance but also the point of time when a possible instability (structural break) occurred. If the plot of CUSUM and CUSUMSQ statistic moves between the critical bounds (at 5% significance level), then the estimated coefficients are said to be stable (Appendix 4).

We can conclude that the estimates are stable since the plot of both CUSUM and CUSUMSQ tests do not cross the critical limits. Further 89.5% of the dependent variable i.e RGDPgr is explained by the independent variables.

4.3. Long Run ARDL Bounds Tests for Co-integration

Performing bound test approach of co-integration for estimating ARDL model needs selection of appropriate lag length. Based on Narayan(2004), for annual data it is advisable to choose a maximum of two lags. Furthermore it is better to use Akakie Information Criterion (AIC) to determine the optimal number of lag for small sample size. It also produces the least probability of under estimation from all other criterion (Liew, 2004) as cited in Tsadkan (2013).

The F-test through bound test (wald test) is carried out to check the joint significance of the coefficients. Bound test is applied by imposing restrictions on the estimated long-run coefficients of dependent (RGDPgr) and independent variables (REER, INF, K, HK, POP and EXP. The computed F-statistic value is compared with the lower bound and upper bound critical values provided by Pesaran (2001) and Narayan (2004).

4. 4 The Upper and Lower Critical Values

Table 4.4 The upper and lower critical values

Critical Values		**1%**	**5%**	**10%**
Pesaran et al. (2001)	**Lower bound**	3.15	2.45	2.12
	Upper bound	4.43	3.61	3.23
Narayan et al. (2004)	**Lower bound**	4.770	3.345	2.833
	Upper bound	6.333	4.523	3.730

Source: Pesaran et. al(2001) and Narayan (2004) critical values

The calculated F-Statistic is strongly significant at 1% significance level as depicted in the below table.

Table 4.5 the calculated F statistics

Description	Value
Lag length	2
Calculated F-statistics	16.123 [0.000]

Source: Model result

The critical values reported for Pesaran *et al.* (2001) are the case with unrestricted intercept and no trend (case III). The study used Narayan (2004) which is developed based on 30 to 80 observations as we discussed earlier in chapter three. As it is showed in Table 4.4 and 4.5 above, with an intercept and trend, the calculated F statistics (19.001) is higher than both the Pesaran *et al.* (2001) and Narayan (2004) upper bound critical values at 1% level of significance. This indicates that the null hypothesis of no long-run relationship is rejected and the alternative hypothesis (there is long-run relationship) is accepted based on the Pesaran *et al.* (2001) and Narayan (2004) critical values at 1% level of significance. It implies the existence of cointegration relationship among the variables in long run.

4.5 Granger Causality Test

Granger causality test is the most famous test to identify the direction of causality and correlation between inflation. The under table reveals the result that for both lag length one and lag length two, there is significant causality between Real gross domestic product growth rate and general inflation rate. The null hypothesis which says LnRGDPgr doesn't Granger Cause INF is rejected at 5% level of significance. It is a uni-directional (one way) causal relationship that goes from Real GDPgr to inflation rate.

Table 4.6 Pair wise granger causality test for LNRGDPgr and INF

	Lag length one		Lag length two	
Null Hypothesis	F- statistics	Prob.	F-statistics	Prob.
LnRGDPgr doesn't Granger Cause INF	3.7319	0.0108**	2.2802	0.0294**
INF doesn't Granger Cause LnRGDPgr	0.1422	0.7085	0.5758	0.5690

Note: ** denotes significant at 5% level of significance.

Source: Model result

4.6 Long Run ARDL Model Estimation

Subsequent to confirmation of the existence of longrun relationship, the next step is finding the long run coefficients using ARDL model and it is illustrated in the table 4.6 below.

Table 4.7 Estimated Long Run Coefficients using the ARDL Approach
ARDL(1,1,2,0,1,2,2) selected based on Akaike Information Criterion

Dependent variable is LNRGDP
32 observations used for estimation from 1983 to 2014

Regressor	Coefficient	Standard error	T-Ratio (Prob)
LNREER*	1.200	0.065	4.855(0.081)
INF**	0.373	0.024	- 2.524(0.004)
LNHK***	0.491	0.058	2.836(0.001)
LNK**	0.930	0.385	2.671(0.005)
LNEXPORT*	0.056	0.283	3.823(0.065)
LNPOPgr**	2.958	0.908	-3.080(0.007)
C***	3.267	0.724	4.149(0.000)

Note: *** denotes significant at 1% level of significance where * denotes significant at 10% level of significance.
Source : Model result

As it can be seen from the above table all of the variables are significant. And except inflation all other variables are positively related with economic growth which is proxied by real gross domestic product growth rate (RGDPgr). The Real effective exchange rate and export of goods and services as a share of GDP are significant at 10 % level of significance. Where as all other variables are significant at 1% level of significance.

The general inflation rate which is the concern of this study, shows a negative relationship with economic growth and also statistically significant. Inflation remained at low rate in the country until 2002/2003 but increased after 2004 and reached 36.4

percent in 2009 (NBE, 2013/2014) that was mainly caused by food inflation aggravated by the effect of high food demand and international food price hike (Geda and Tafere, 2008). Finally the long run estimated model can be written in the following functional form;

$$\underset{}{LNRGDP} = \underset{(4.149)}{3.267} + \underset{(4.855)}{1.20LNREER} + \underset{(-2.524)}{0.373INF} + \underset{(2.836)}{0.491LNHK} + \underset{(2.671)}{0.93LNK} + \underset{(3.823)}{0.056LNEXP} + \underset{(-3.08)}{2.958LNPOPgr}$$

4.7 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 signify the speed of adjustment to return to equilibrium in the dynamic model. The coefficient of the error correction term points out how quickly variables converge to equilibrium. It is a one period lagged residual found from the estimated long run model. It is expected to have negative sign and statistically significant.

The coefficient of determination (R-squared) is high explaining that about 88.98 % 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.

Table 4.8 Error correction representation for the selected ARDL Model
ARDL(1,1,2,0,1,2,2) selected based on Akaike Information Criterion

Dependent variable is LNRGDP
32 observations used for estimation from 1983 to 2014

Regressor	Coefficient	Standard error	T-Ratio (Prob)
dinf	-0.0070*	0.1769	0.395(0.069)
dLexp	3.9815**	1.7574	2.2656(0.034)
dLexp1	4.4764**	0.1476	2.0745(0.050)
dLpopgr	2.967***	0.7427	3.9946(0.001)
dLpopgr1	-1.1993*	0.1950	1.9520(0.068)
dLhk	0.6339***	1.5513	2.9871(0.007)
dLk	0.0122*	0.0703	2.6586(0.051)
dLreer	0.0702***	0.0912	0.5596(0.005)
dLreer1	0.9496***	1.1518	-3.2296(0.004)
dcons	3.7252**	1.0781	-2.4870(0.050)
ecm(-1)	-0.622***	0.1475	-8.1730(0.000)
R-squared	0.8951		R-bar Squared 0.80
F-statistic F(9,22)	16.123 (0.000)		D.W statistics 2.7280

*** denotes significance at 1%, ** significance at 5% and * significance at 10%

Source Model result

From the Error correction model estimation result, the coefficient of the error correction term has a negative sign which is compatible with the theoretical expectation that in the short run the rate of inflation converges to its equilibrium. It is estimated at about -0.622 that is highly significant. It implies a very high speed of adjustment to equilibrium after a shock. Around 62.20 % of the disequilibrium from the previous year's shock converges back to the long-run equilibrium in the current year. Such

highly significant Error correction term is another proof for the existence of a stable long run relationship among the variables.

The long run effect of the model can be captured by the error correction term. Therefore, in the long run the independent variables cause the dependent variable LNGDPgr. The estimated short run model reveals that all variables are significant like the long run estimation result. Except Population all variables has positive relationship with economic growth which is proxied by RGDPgr and significant at 1 percent and 5 percent level of significance. But population is significant at 10% level of significance at one period lag and negatively related with the dependent variable.

The concern of this study, inflation has a negative relation with economic growth but the effect it has is very minor. A one percent increase in the inflation rate results 0.0070 percent decrease in the real GDPgr. From this we can understand that under the study period inflation rate has a significant effect and a positive relationship with Ethiopian economic growth in the long run and a negative relationship in the short run even though its impact is very low.

CHAPTER FIVE
CONCLUSION AND RECOMMENDATION

5.1. Conclusion

The main objective of this study is to examine the relationship between inflation and economic growth in a given time frame for short run and long run. In doing so, Autoregressive Distributed (ARDL) model known as Bound test was applied to analyze the long run relationship between variables and Error correction model used for short run relationship analysis. The variables included in the study are Real growth domestic product growth rate as dependent variable and general inflation rate, real effective exchange rate, capital, human capital, population growth rate and export as a share of RGDP as independent variables.

Before applying the model the necessary tests like unit root test were applied using ADF and PP tests. And it is found that lnREER, lnK, lnHK and lnEXP are integrated at first level difference (I(1)) while lnRGDPgr, lnINF and lnPOP are integrated at level (I(0)) . On the other hand, for trend and intercept, except lnINF and lnPOP all variables are stationary at first difference (I(1)). lnINF and lnPOP are stationary at level I(0).

Following stationarity test, Model stability test was carried out in the study and the result shows the absence of serial correlation, functional form problem, hetroscedasticity problem and abnormal distribution of the residual. The value of bound test (F-statistics) is greater than the upper bound critical values for both Pesaran et al. (2001) and Narayan (2004). This result confirms the existence of long run relationship between the dependent variable (RGDPgr) and independent variables (REER, INF, K, HK, POP, EXP).

The finding of this study reveals the existence of positive long run relationship between inflation and economic growth. The long run positive relationship between inflation and economic growth is similar with the Keynesian theoretical framework of the macro economy. When Keynesian economics was popular, the economy of the world in general was under reconstruction after the incident of the Second World War. Likewise, the Ethiopian economy is now a day under construction and the positive relationship between inflation and economic growth should not be a surprise.

Since one of the objectives of the study is to find the short run relationship and short term dynamics, the result shows that in the short run, the relationship between inflation and economic growth is significant and negative. Concerning the dynamics the negative sign on the error correction term indicates the adjustment of any deviation in the independent variable in short run to its long run equilibrium. The coefficient of error correction term is -0.622 suggesting about 62.20 percent annual adjustment towards long run equilibrium. This is another proof for the existence of a stable long run relationship among the variables.

5.2. Policy Recommendation

Based on the finding of the study, the following recommendations are forwarded. One of the most essential objectives of macroeconomic policies of the country is to sustain high economic growth together with low level of inflation. Since high level of inflation retards growth by reducing investment and raising inefficiency, the level of inflation should be kept low.

According to the finding of this study, inflation has a positive relationship with economic growth in the long run and negative relationship in the short run. Therefore policy makers should focus on both policies that help to enhance economic growth as well as inflation combating measures. Coordination among different governmental

economic policy making institutions is essential. Though it is the choice of a policy on priority among inflation and growth, whatever the government chooses the coordination among fiscal policy, monetary policy, trade policy and investment policy is essential to achieve the desired goal.

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APPENDEX

Appendix 1: Diagnostic test

Autoregressive Distributed Lag Estimates

ARDL(1,1,2,2,2,0,1) selected based on Akaike Information Criterion

Diagnostic Tests

Test Statistics	LM Version	F Version
A:Serial Correlation	CHSQ(1)= 1.1321[.287]	F(1, 18)= 5.860[.455]
B:Functional Form	CHSQ(1)= 1.2266[.268]	F(1, 18)= .16969[.501]
C:Normality	CHSQ(2)= .6903[7.08]	Not applicable
D:Heteroscedasticity	CHSQ(1)= .9277[.976]	F(1, 30)= .8690[.977]

A:Lagrange multiplier test of residual serial correlation

B:Ramsey's RESET test using the square of the fitted values

C:Based on a test of skewness and kurtosis of residuals

D:Based on the regression of squared residuals on squared fitted values

R-Squared	.89649	R-Bar-Squared	.82562
S.E. of Regression	.09914	F-stat. F(14, 19)	74.7002 [.002]
Mean of Dependent Variable	17.6525	S.D. of Dependent Variable	.6204
Residual Sum of Squares	.016711	Equation Log-likelihood	35.0754
Akaike Info. Criterion	50.0116	Schwarz Bayesian Criterion	61.0927
DW-statistic	2.7289	Durbin's h-statistic	-.3924[.664]

Appendix 2: Estimated Long Run Coefficients

Estimated Long Run Coefficients using the ARDL Approach

ARDL(1,1,2,2,2,0,1) selected based on Akaike Information Criterion

Dependent variable is LNRGDPGR

32 observations used for estimation from 1983 to 2014

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
LNREER	1.200	.065940	4.8550[.081]
INF	.37346	.024128	-2.5241[.004]
LNK	.93044	.38512	2.6713[.005]
LNHK	.49109	.05844	2.8360[.001]
LNPOPgr	2.95845	.90817	-3.0801[.007]
LNEXPORT	.05632	.28301	3.8234[.065]
Cons	3.2671	.72431	4.1495[.000]

Appendix 3: Error Correction Representation

```
Error Correction Representation for the Selected ARDL Model
Error Correction Representation for the Selected ARDL Model
      ARDL(1,1,2,2,2,0,1) selected based on Akaike Information
Criterion
*******************************************************************************
********
 Dependent variable is dLNRGDPGR
 32 observations used for estimation from 1983 to 2014
*******************************************************************************
Regressor        Coefficient       Standard Error         T-Ratio[Prob]
 dINF              -.0070536          .017699            .39853[.069]
 dLNREER            .0702             .0912             .55966[.005]
 dLNREER1           .9496            2.1518            3.22960[.004]
 dLNEXP            3.9815            1.7574            2.26560[.034]
 dLNEXP1           4.4764             .1476            2.07451[.050]
 dLNPOPGR          2.9670            .74276            3.99464[.001]
 dLNPOPGR1        19.1993            9.9950            1.92091[.068]
 dLNK               .0122             .07036            2.65862[.051]
 dLNHK              .6339            1.5513           -2.98714[.007]
 ecm(-1)           -.6220              .147           -8.17305[.000]
*******************************************************************************
 List of additional temporary variables created:
 dLNRGDPGR = LNRGDPGR-LNRGDPGR(-1)
 dINF = INF-INF(-1)
 dLNREER = LNREER-LNREER(-1)
 dLNREER1 = LNREER(-1)-LNREER(-2)
 dLNEXP = LNEXP-LNEXP(-1)
 dLNEXP1 = LNEXP(-1)-LNEXP(-2)
 dLNPOPGR = LNPOPGR-LNPOPGR(-1)
 dLNPOPGR1 = LNPOPGR(-1)-LNPOPGR(-2)
 dLNK = LNK-LNK(-1)
 dLNHK = LNHK-LNHK(1)
*******************************************************************************
 R-Squared                      .89512   R-Bar-Squared                  .80023
 S.E. of Regression             .9914    F-stat.    F(  9,  22)   16.1230[.000]
 Mean of Dependent Variable   17.6525   S.D. of Dependent Variable      .62043
 Residual Sum of Squares      .016734   Equation Log-likelihood        35.0754
 Akaike Info. Criterion       50.0116   Schwarz Bayesian Criterion     61.0927
 DW-statistic                  2.728
*******************************************************************************
 R-Squared and R-Bar-Squared measures refer to the dependent variable
 dLNRGDPgr and in cases where the error correction model is highly
 restricted, these measures could become negative.
```

Appendix 4: Parameter test using CUSUM and CUSUMSQ test