Addis Ababa University

School of Graduate Studies

The relationship between inflation and economic growth: evidence of Ethiopia from the period 1991/92-2018/19

By: Segni Tesema Olika

June, 2020

Addis Ababa, Ethiopia

The relationship between inflation and economic growth:

Evidence of Ethiopia from the period 1991/92-2018/19

Segni Tesema Olika

A thesis submitted to the Department of Economics in Partial fulfillment of the requirements for the Degree of Master Science in Economics (Economic Policy Analysis).

Addis Ababa University

Addis Ababa, Ethiopia

June, 2020

Addis Ababa University

School of Graduate Studies

This is to certify that the thesis prepared by **Segni Tesema Olika**, entitled: T**he relationship between inflation and economic growth: Evidence of Ethiopia from the period 1991/92-2018/19** and submitted in partial fulfillment of the requirements for the Degree of Master of Science in Economics (Economic Policy Analysis) complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

Signed by the Examining Committee:

Alemayehu Geda (Prof)	**_____**
Advisor	***Signature***
Zerihayehu Sime (PhD)	**_____**
Examiner	***Signature***
Andualem Goshu(PhD)	**_____**
Examiner	***Signature***

Acknowledgement

I would like to express the deepest of my gratitude and thankfulness to my advisor **Professor Alemayehu Geda** for his endurance and constructive advice throughout the course of the thesis. Not only did he help me with vital advice, I have also learned a lot from him. The brotherly handling he accorded me has served as a motivation for the achievement of this study.

The special thanks are devoted to **Debela Gelana (Msc)** for his enormous role to my knowledge of econometric methods as well his support with the data and providing useful information.

I also owe a great deal of gratitude to my uncle **Kebede Desta**, my aunt **Ababech Olika** and all family members as well my friends **Nagasa Olani, Lemi Taye(Msc), Kumadebis Tamiru(Msc), *Bayeta Gadisa*, *Belay Temesgen and Gemechu Desale*** for their moral support.

Acronyms

- ADF-Augmented Dickey Fuller
- AIC- Akaike Information Criteria
- ARDL-Auto Autoregressive Distributed Lag
- ARCH – Autoregressive Conditional Heteroscedasticity
- BG-Breusch–Godfrey
- CIA - Cash in-advance
- CLRM- Classical Linear Regression Model
- CSA-Central statistics Authority
- CSO-Central statistics office
- CUSUM- Cumulative sum of squares of recursive
- ECM- Error Correction Estimates
- ECT- Error correction term
- GDP-Growth domestic product
- GTP I-Growth and transformation plan one
- GTP II –Growth and transformation plan two
- I(0)- Integrated of Order Zero
- I(1)- Integrated of Order One
- IMF-International monetary fund
- MoF-Ministry of Finance
- NAIRU- Non-accelerating inflation rate of unemployment
- NBE-National bank of Ethiopia
- OLS-Ordinary least square
- QTM- Quantity theory of money
- RGDP- Real Gross domestic product
- SC-Schwartz Criterion
- SIC- Schwarz Information Criteria
- VAR –Vector Autoregressive

Abstract

The relationship between economic growth and inflation has attracted the attention of many researchers, Economists and policy makers all over the world. The main target of macroeconomic policies is to achieve a high economic growth rate with a low inflation rate; it is also believed that a high inflation has an adverse effect on economic growth. On the other hand, previous studies on the relationship between inflation and economic growth have revealed the complexity of this subject. Those studies come with different conclusions and policy recommendation there might be no relationship, a positive relationship or a negative relationship between inflation and economic growth. Other studies further show that these macro-economic variables might be related either in the short-run or the long-run or both, with no consensus on the direction of causality. Therefore, the ambiguity of the relationship between inflation and economic growth as represented in both theory and empirical studies warrants an investigation into this matter in the context of Ethiopia. The main aim of this study is to decide the cointegration between inflation and economic growth in Ethiopia. In doing so, the study seeks to unravel the short-run and long-run dynamics between inflation and economic growth as well as establishing the nature of causality between these economic variables. The study employs both descriptive and econometric analysis between economic growth and inflation relationship using annual data from 1991/92-2018/19 of different economic variables by applying Autoregressive distributive lag (ARDL) model as all variables are the combination of I(0) and I(1). The result of the study reveals that, the coefficient parameter of inflation is statistically insignificant since its p- value is greater than 5%. Moreover, the study concludes that there is no significant relationship between inflation and economic growth in the long run. In the short run the result suggests that, for the selected autoregressive distributive lag model, there is no relationship between inflation and economic growth. Generally both in long run and short run the study finds no co integration between inflation and economic growth. The paper discusses the important policy implications of the results. One important policy implication of the study is that, by knowing the past values of Economic growth, it is difficult to predict what inflation rate will be in the future.

Keywords: *Inflation, Economic Growth, Ethiopia, Cointegration, Granger Causality, Autoregressive distributive lag (ARDL)*

Table of content

List of figures and tables

Chapter-One

1. Introduction

1.1. Background of the study

The most fundamental objectives of macroeconomic policies in Ethiopia are to sustain high economic growth and macroeconomic stability where inflation is one among many macro-economic variables. The relationship between inflation and economic growth is one of the great interests in macroeconomics and monetary policy.

Many researchers have concentrated on different countries and country groups and have employed diverse proxy variables and methodologies to show the relationship between inflation and economic growth. Empirical results and policy recommendations are widely different and sometimes in conflict. Different researchers examined inflation-economic growth nexus and came up with dissimilar findings. Some of them said inflation is essential for economic growth or it is hurtful to create a significant debate both empirically and theoretically.

Some consensus exists, suggesting that the macroeconomic stability, particular defined as low inflation, is positively related to high economic growth. The difference relationship between these two economic variables is highly dependent on the economic condition of the world.

After the Great Depression, during the rise of Keynesian economics countries have been effective in applying Keynesian policies. The increment of aggregate demand increased not only production but it has also increased the aggregate price level which enhance the inflation rate in the country. Besides to that, the 1970's inflation was not seen as a danger to the economy, but rather it was considered to boost economic growth. (Snowdon and Vane 2005).

The economy of Ethiopian has gone through many stages of Economic growth and inflation relationship. In Besides to that, before 2003, Ethiopian was well-known country when compared with small economic growth by recording low inflation country. During this period the average growth rate was 2.6% while the inflation was 7.5%. Accordingly, inflation was not an issue rather than economic growth during this period. This was mainly explained by practical government budgets surplus and a restrictive monetary policy (Alemayehu and Kibrom, 2011).

Beyond 2004, except in 2009 and 2013, when inflation was at a single digit level, inflation was beyond the comfort zone; researchers, policy makers and economists of the country had been hovering around double digit inflation. During the same period, however, Ethiopia's economic growth, which is mainly determined by public investment in main infrastructure projects, averaged 10.7% (World Bank, 2014). This stage of growth is the fastest that the country has ever experienced and it also exceeds what was achieved by low-income and Sub-Saharan African countries in that period (World Bank, 2015).

According to Ministry of Finance (2015/16), the world economy grew at the lower than expected rates of 3.2 percent in 2015 and 3.1 percent in 2016. The initial growing prediction was 3.8 percent for 2015 and 3.7 percent in 2016. The Ethiopian economy has reached uprightly with a growth rate of 3.1 percent in 2015/16. The inflation rate was significantly down to 0.9 percent– one of the neither most in several decades. The good concert of Ethiopian economy was also caused in the unemployment rate going down to 7.4 percent for the quarter ending June 2016, from 7.8 percent for the same period in 2015. The country practiced a higher Gross Domestic Product growth rate of 3.4% in fiscal year 2015-2016 as compared to 3.0% in fiscal year 2014-2015. Inflation rate was very low at 0.9% as at June 2016, which is the lowest rate in greater than 25 years.

According to National Bank of Ethiopia Annual Report (2016-17) a severe drought and the weak global environment have seriously affected during the past year 2015/16. Due to that in 2015/16 the output growth slowed fails down to 6.5 percent, which was improved by effective and timely strategy responses to the drought and buoyant industrial and services sectors.

According to IMF's (2016/17) report, the broad money-supply growth was 37.5 percent at the end of March 2017, which had previously projected a growth of 24 percent. Such a main inflationary period could reverse the significant enhancement in poverty decline in rural areas and might worsen Ethiopia's chronic food insecurity. The rate of inflation is expected to keep on single digits in the medium term as the reserve money stays in line with nominal gross domestic product (NGDP) and government borrowing remains steady with monetary policy goals. The National Bank of Ethiopia is working on creating a secondary market for government securities to efficiently pursue indirect policy tools in its monetary policy actions. To further support its monetary policy context, a forecasting team has been set up under the Economic

Modeling and Statistical Analysis Directorate to progress liquidity monitoring and forecasting. (IMF, 2016).

There are diverse empirical studies on the possible sources of inflationary situation in Ethiopia. The key sources of inflation deliberated in the literature are: the rise in money supply unwarranted by the level of output growth, the nature of investment in the country, the spreading the national deficit and ways of financing this deficit, the inefficiency within government controlled organizations, soaring of oil prices and others. According to them contrast, the government disputes that the inflation is due to rapid economic expansion that has come to pass in the country. It also specified that oil prices and increase in world food prices as the likely causes of the inflation (Geda and Tafere, 2008).

1.2. Statement of Problem

The problem surveyed by the present study is the relationship between economic growth and inflation in the Ethiopian economy. There is a rising body of literature on the inflation-growth nexus regarding Ethiopian economy as well as other African countries. Though there are plentiful studies regarding to the relationship between inflation and economic growth is not well defined.

There is a vast dissimilarity on the relationship between inflation and Economic growth both on theoretical and empirical basis. The present-day empirical disagreement of the relation between inflation and economic growth is due to the sign and significance of the linear relationship. Regardless of this divergence, recent research findings agree on the non-linear relationship that positive, negative and stable inflation is positively related to growth while high and unstable inflation has a depressing effect on the growth of the economy. The two macroeconomic concepts, inflation and economic growth have received the care of economists and policy makers around the world and there were reaching different conclusions: some argued that there is a negative; some argue that there is a positive and some argues that there is no relationship between inflation and economic growth.

Globally, there is a debate both theoretically and empirically about the relationship between inflation and economic growth. Some like Xiao (2009), say it is positive, while others, like Hossin (2015), claim it is negative. Diverse theories also confirm the controversy. Monetarists

say that higher inflation retard economic growth; whereas structuralisms advocate that inflation is necessary for economic growth (Raj, Mukherjee, Mukherjee, Ghose, & Nag, 2007).

During the periods of 1991 and 1992 growth rate of GDP was negative 7.2 and 9 percent respectively, whereas inflation displayed more than one digit rate, i.e., 20.9 % and 21 % respectively. During these fiscal years, the Ethiopian economy was exposed to mixed performance of both positive and negative real GDP growth rate. (IMF, 2015). This specifies that in the first periods of the transitional government, the country had comparatively high inflation rate without a good economic performance. Later, from 1993 to 1997 the growth rate of Gross Domestic Product was positive, ranging from 3.5 % which is somewhat low because of drought to 13.4 %. But this could not be maintained in 1998 because of the Ethio- Eritrean war, which accounts for negative 4 % growth rate. However, the rate of inflation during the period of 1993-1998 was relatively good, with a maximum of 13.4 % in 1995 and a minimum of negative 6.4 % in 1997, related to 1991 and 1992. Near the end of neo-liberalization period and at the start of application of millennium development goals in the years of 1999- 2001,economic growth and inflation rate, respectively, were 6.4 % and 1 % per annum on average (IMF, 2015).

Some of the studies conducted on the relationship between inflation and economic growth have already investigated the existence of a relationship between inflation and economic growth. (NBE, 2013/14).

As it was stated by Alemayehu and Kibrom (2008) before the year 2002/2003 there is a positive relationship between inflation and economic growth. However, starting from the period 2003/2004 the co-movement of inflation and economic growth are no longer continued rather reversed.

As indicted in Rutaysire (2013), it is now commonly believed by different policy makers, macro-economists and central banks, that the core target of macro-economic policy is to realize high economic growth with low inflation rate and believed that high level of inflation rate negatively affects the economic growth of a country, by failing the people's confidence on economy, decreasing productive investment in the way that search for higher interest rate by lenders to keep themselves. Inflation rate, outside its threshold level, will highly affect welfare negatively, raise the current account deficit, lessen investment by minimizing saving and consumer

consume more since real value of saving erodes over time which is the result of ineffective allocation of factors of production, which in turn lessen economic growth of a country (Raj et al., 2007).

Nonetheless, this research tries to fill the gap by eliminating the data mixing problem among different regimes in the study area, Ethiopia. Other studies faces the problem of mixing data of one regime to the other, pure communist regime where there was no private investment in the economy with the current market oriented economy when there is private investment. The outcome of such mix of data may lead to wrong conclusions and hence wrong policy implication. This problem is over come in this study by just focusing on the period after the post socialist regime. Second, the contradictory views on the relationship between inflation and growth not only in overall literature but also in Ethiopia is interested this paper and contributing to the awareness in this area. Third, is the presence and omission of variables in both growth and inflation models given the characteristic of the Ethiopian economy.

1.3 Objective of the Study

The main objective of this study is to express the relationship between inflation and economic growth in Ethiopia. To realize the general objective, the researcher assesses the following specific objectives:

- To test the short-run and long run relationship between inflation and economic growth in Ethiopia.
- To determine whether inflation targeting contributes to lower economic growth in Ethiopia
- To identify policy implications of inflation-economic growth relationship for the Ethiopian economy.

1.4 Research Questions

This study investigates the relationship between inflation and economic growth, and evaluates the causal relationship between inflation and economic growth in Ethiopia. Therefore, at the end, this study would answer the following questions:

- Is there a significant relationship between economic growth and inflation in Ethiopia? If there, is the relationship between these economic variables positive or negative?

- Is the causality relationship between economic growth and inflation bidirectional, unidirectional (either from economic growth to inflation or from inflation to economic growth) or no causality relation?
- What policies can be laid in place to support economic growth without causing an exploding inflationary reaction?

1.5. Significance of the study

In recent times, economists, policy makers and researchers seem to agree that high rates of inflation cause problems, not for some individuals, but for aggregate economic performance. High inflation and low economic growth are maybe the two most central challenges that face the Ethiopian economy and policy formulators in Ethiopian economy today. There is a very common problem in Ethiopian economy, which is high level inflation and low level economic growth. This study tries to find the relationship between inflation and economic growth in the context of the Ethiopian economy.

The significance of the study is to provide policy assistance for the monetary policy makers and researchers with regards to the relationship between inflation and economic growth in Ethiopia.

1.6 Hypothesis

The following hypothesis would be tested;

H_0: Inflation rate has no significant relation with economic growth of Ethiopia.

H_1: Inflation rate has a significant relation with economic growth of Ethiopia.

1.7 Methods and Data

To achieve the objectives of the study, the researcher used the long run and short-run co integration relations between inflation and economic growth for the Ethiopian economy by using the model of autoregressive distributive lag (ARDL) which is applied on empirical annual data from 1991/92 to 2018/19 fiscal years.

To identify the relationship between inflation and economic growth the researcher used time series analysis in econometrics. Co-integration modeling is mostly used for long-term forecasting and long-run relationships (Lin and Tsay 1996).

The data for the relevant variables are obtained from National Bank of Ethiopia, World Economic Outlook (2019) of the IMF in comparison with publications from the Central Statistical Office (CSO) and World Bank. The annual data are analyzed from the year 1991/92 to 2018/19 which includes 28 year observations. All these methodological issues and disaggregation methods will be discussed in third chapter.

Chapter Two

2. Literature Review

The literature review part has three main sections. The first section discusses the appropriate theoretical studies concerning to inflation and economic growth. The second section discusses the global empirical studies and their conclusions related to the study area. The last section concentrated on the studies carried to cognize the relationship between inflation and economic growth in the study area; Ethiopia.

2.1 Theoretical Literature Review

The area of economic growth and inflation are not a new topic in economic theories. In this section, there is evaluation of different economic theories, which focus on the relationship between inflation and economic growth.

2.1.1 The Classical Economists View

The Classicalists undertake that there is continuously a full employment of factors of production and thus income and capital are constant, so that an increase in money supply will not have any effect on economic growth but directly raises price which is the general price level which invites the inflation to the economy.(Cottrell 1997).

According to classicalist's quantity theory, a rise in money supply leads to a rise for quantity money at hand among the customers and manufacturers having no consequence on the level of output. The increment in the level of money at the hand of agents raises the demand for goods and services produced at full employment. This increment in demand for goods and service produced at full employment leads to a rise in inflation (Dimand 2005).

2.1.2. The Keynesian Economists View

The Keynesians Economists impression of potential output as a level of gross domestic product where the economy is at its optimum level of production given institutional and natural restrictions. This level of output tells to the non-accelerating inflation rate of unemployment. (Dornbusch, 1996).

Keynes claimed that if gross domestic product surpasses its potential, that is unemployment is under the non-accelerating inflation rate of unemployment (NAIRU), inflation will accelerate as suppliers raise their prices and built-in inflation deteriorates and if gross domestic product (GDP) decreases below its potential level, that is unemployment is above the NAIRU, inflation will slow as suppliers attempt to fill excess capacity, by cutting prices and undermining built-in inflation (Ghosh and Phillips,1998).

In summary, Keynes argued, if Gross domestic product is equal to its potential and the unemployment rate is equal to non-accelerating inflation rate of unemployment, then the rate of inflation would remain constant, which means there are no supply shocks in long run. That is rate of unemployment is given and equal to the natural rate of unemployment, while there are a large number of possible inflation rates that can prevail at that unemployment rate (Gokal and Hanif, 2004).

2.1.3 The Monetarist Economists View

Milton Friedman proposed Monetarist's view which basically highlighted several main long-run properties of the economy, (Leeson, 1994). Milton recommended that inflation was an outcome of a rise in money supply or velocity of money at a rate higher than the rate of economic growth. The Quantity Theory of Money correlated to inflation and economic growth by only relating the aggregate amount of spending in the economy to the aggregate amount of money in existence (Leeson,1994).

According to Monetarists' opinion, there is a direct long-run relationship between inflation and economic growth, in case that the economic growth is go together with by the decline of unemployment and fall in the cost of production prominent to price inflation (Ramalho 2011).

However as Ramalho (2011) renowned the short-run relationship happens if and only if the policy measure to raise the total demand is not anticipated. In this case, when employers adjust their expectations the total output of the economy corrects to its natural rate at the vertical long-run Phillips Curve sendoff the high price. As a result, a rise in money supply will also rise the price level without affecting the total output and then will the long-run trade-off between inflation and economic growth (Friedman 1976).

In summary, Monetarism put forward that in the long-run, prices are essentially affected by growth rate of money, whereas the money supply have no real effect on economic growth. However, inflation occurs if the growth of money supply of one country is higher than the economic growth rate of that country.

2.1.4 The New Classical Economists View

The neo-classical models was proposed by Solow (1956) and Swan (1956) which showed the diminishing returns to labour and capital one by one and constant returns to both labour and capital. According to neo-classical model technological change substituted the investment which is the growth of capital as the main factors of production which explain the long-term economic growth and which was expected by Solow and other growth economic theorists to be control exogenously, that is, autonomously of all other factors, as well as inflation rate (Todaro,2000).

According to the Tobin (1965) presented money to the Solow-Swan model as an asset rather than capital accumulation. He stressed that inflation rises in the economy gives the opportunity cost of holding high amount money supply which, increase the capital accumulation and in consequence supports the economic growth of country.

The other New Keynesian economist Stockman (1981) investigated that the neoclassical growth model with inelastic labour supply and clarify that the rate of money growth has not only transitional effects on economic growth of per-capita income, if money is held to satisfy a cash in-advance constraint for consumption. The estimation when inflation rate increase it erodes the purchasing power of money. This forces firms to fails to purchases of both cash goods and capital, resulting in a decline in the steady state level of output. Consequently, Stockman (1981), money is excellent unbiased in the long run if only consumption is subject to the cash in-advance. Contrary to Stockman's (1981) conclusion, Zeria (1991) found that even cash in-advance constraint hold for consumption. According to Zeria's Cash in-advance model, high rate of inflation raise the amount of inflation tax firms pay as firms hold money because of overdue deposit. This in turn reduces profitability and slows down capital accumulation and growth.

In summary, many New Keynesian economists propose that inflation will support the long run economic growth by increasing the capital accumulation which assesses the positive relationship between inflation and economic growth. However rise in inflation or the expectation inflation immediately fails down the wealth of people by decreasing the rate of return on individual's real money balance which encourage, people to save more by switching to assets, increasing their price, thus driving down the real interest rate. When people save more, more capital accumulation would be accelerated which gives economic growth of one country (Khan, Senhadji 2001)

2.1.5 The New Keynesians Economists View

The New Keynesian economics is a school of modern-day macroeconomics that tries to deliver microeconomic foundations for Keynesian economics. According to the new Keynesian school of view the aggregate demand increases as the real money balances decreases with the price level. The main concern of neo-Keynesian theory is productivity, because, declining productivity signals diminishing returns to scale which consequently, fails the inflationary pressures, resulting mainly from over-heating of the economic growth and widening the gap of output (Aminu and Anono, 2012)

According to New Keynesians high inflation has a negative impact on economic growth and economic instability. To attain the rapid economic growth and to have fair distribution of income stable and low level of inflation rate should be exist. For them declining money supply to decline inflation leads the recession due to price rigidities. According to the new Keynesians economists view, in order to set monetary policy there has to be previous full and accurate information about future values of inflation and economic growth. In inflation targeting monetary policies, credibility of the policy is very important and hence the central bank's deliverance plays a crucial role in this case. Inflation can generates costs in the economy which includes the costs of anticipated inflation and costs of unanticipated inflation (Ambler 2008).

2.1.6 Endogenous Growth Theory

According to Endogenous growth theories many economic variables; among one is inflation which decreases the rate of return, by increasing the capital accumulation and falls down the economic growth rate (Gillman, Harris and Matyas, 2002).

The endogenous growth theory economists noticed that when money is introduced in the budget constraint in a model of human capital accumulation, a rise in the rate of inflation negatively affects both consumption and supply of labour. De Gregorio (1993) argued that inflation might have critical effects also on the accumulation of physical capital. In addition to that he argued there exists a negative relationship between inflation and economic growth (Gomme,1993).

The designated forms of endogenous growth economies discover that the inflation rate effects on growth are small. The efficient allocation of scarce resource is to satisfy the condition that the edge value of the last unit of current consumption equals the change in the cost of the last unit of work. The increment in inflation rate reduces the marginal value of today's last unit of consumption which encouraging workers to work less. With less labor force, the marginal product of capital accumulation is permanently reduced, resulting in a slower rate of capital accumulation. In this economy, eliminating a moderate inflation rate (for example, single digit percent) results in only a very small (less than 0.01 percentage point) gain in the growth of output (Gomme,1993).

In conclusion, according to endogenous growth theories there is negative relationship between inflation and economic growth.

2.2 Empirical literature review

Many global papers were done to assess the relationship between inflation and economic growth around the world both in developing and developed countries. Some countries of them are on a cross-country basis and others have studied it on a specific country basis**.**

2.2.1 Cross country Empirical Literature Review

Diverse studies have found across-country evidence supporting the view that long-term economic growth is adversely affected by inflation. The cross country empirical review tries to show the relation between inflation and economic growth in different countries mostly in African countries and East African countries in particular.

According to Dotsey and Sarte (2000) the effects of inflation is inconsistency on economic growth. They used the neo-classical growth model with money included as an explanatory variable. The study of the authors reveals that at the steady state of economic growth is highly affected by higher average inflation negatively. This is because of the fact that the higher cost of transaction that inflation causes to the money market in the economy. Additionally the authors argue that there is positive cointegration between inflation and economic growth in the short-run through protective savings. Throughout precautionary savings, increasing inflation volatility is positively correlated to Economic growth, but negatively correlated to the welfare of the economy. In the whole studies, the negative effect of inflation outweighs the positive impact of inflation; by supporting the outlook that rise in the level inflation has a negative effect on economic growth.

The other famous economist, Fischer (1993), studies the effect of macroeconomic factors in economic growth and its role to economic growth by including inflation. By doing that the researcher found that economic growth is negatively correlated to inflation and absolutely associated with good fiscal performance and exact foreign exchange markets. Growth may be associated to uncertainty and macroeconomic instability where temporary uncertainty about the macro economy potential investors to wait for its resolution, thereby reducing the investment rate (Pindyck and Solimano 1993). This study suggested by both cross-country evidence and comparison over time for countries where the rate of growth has increase in relation to an boosted the rate of inflation. Fischer recommends that, since there are no good arguments for very from top to bottom rates of inflation, which was produced by the government should controlled by the government again. The inflation rate is an indicator of macroeconomic stability which includes economic growth of one country and the total capability of the government to manage the economy of that country.

Nathan (2015) investigated the relationship between inflation and economic growth by using panel data. The study found that there is directional Granger causality between the two economic variables inflation and economic growth. In this study inflation is negatively correlated with economic growth as well with capital formulation by giving policy bring and maintain the optimal economic growth with together of capital accumulation.

Wiza (2014) finds that the relationship between economic growth and inflation in the South African economy. The study shows that there is a debate about the relationship between economic growth and inflation is significant for the conduction of monetary policy. Depending on the relevance of the study, an important number of models and theories in the macroeconomics literature analyze. The study concludes that there is positive correlation between inflation and economic growth in South African economy.

Bruno and Easterly (1996) analyzed the belongings of inflation on long-term economic growth. The study use panel data of 26 countries over a period of thirty-one years from 1961 – 1992 was used. They recognized countries that showed more than 40% inflation rate and the growth performance of these countries is assessed before, during and after the occurrence of the high inflation crisis. The study of their analysis shows that a higher level of inflation harms economic growth and lower inflation has less cost on the economy. They also conclude that the high inflation in the 70's and 80's had affected tentatively the economic growth of the countries under study.

Miftahu and Rosni (2017) studied the relationship between inflation and economic growth. The study show the relation between inflation and economic growth using different variables including GDP growth in order to deliver better understanding on how inflation rates affects the preferred level of economic growth. The study identifies the possible relationship between inflation and economic growth that may accelerate the process of realizing the possible policy options to be assumed towards achieving sound macroeconomic growth. The study concludes that the current inflationary trend is negatively affecting the realization of sustainable development and growth. This implies that one of the necessary requirements for attaining the desired growth level to control the excessive increase in inflation rate.

Nyongesa, Eunice and Odhiambo (2017) studied the relationship between inflation and growth in East African Community Countries using a panel data for selected east African countries to show the relationship between inflation and economic growth in the community for the period the period 1990-2014. According to this study the economic growth model is developed to clarify the fixed exchange rate, rate of inflation and intermediate exchange rate , investment, civil unrest and hyperinflation ,as exchange rate, civil unrest where hyperinflation;was measured as a dummy variable. The study advises that correlation analysis showed that inflation had a weak relationship between economic growth and inflation by using co integration analysis. The study found that there exist a long run relationship between economic growth and inflation whereas causality analysis found that economic growth causes inflation however the effect was effective after 2 years for all countries in the sample, which means that economic growth can be used to predict inflation for all East African Community Countries, which policy recommendation as an increase in the general price level (inflation) has been detrimental to sustainable economic growth in East African Countries. The of the study is very important for the policy implications as well for the governments and policy makers of East African Countries to concentrate on options that keep inflation rate which moderate and stable the minimum fluctuations and uncertainties in financial sector of these economies. This study efforts would eventually boost capital formation activities hence improve economic growth.

Ferdinand and Isidore (2014) indicate that the long-run and short-run economic growth and inflation. The study studies the relationship between economic growth and inflation using quarterly data from 1986Q1 to 2012Q4. The study hires the error correction model and co-integration which reveals that government expenditure, capital labour force and money supply have a positive impact on GDP. Furthermore, inflation and interest rate has a decreasing impact on economic growth. The study recommends to the policy makers and government targeting that inflation as monetary policy and government to increase expenditure in the area of infrastructure development and human capital to increase output.

Martin and Veerachamy (2017) studied the impact of inflation on economic growth, which objective was to review the theoretical as well the empirical impact of inflation on economic growth. Accordingly, the theoretical literature point out that the relation between inflation and economic growth can be neutral, positive or negative. Also the empirical conclusions are varied depending on the methodology employed by the researchers the economic variables conditions as well as data used, nature of the study whether cross section, panel data or country specific and time period of the study as well as the economic growth. The study proved that the relationship between inflation and economic growth are influenced by factors such as model and statistical analysis employed, data used, nature of the study whether panel data, cross section or country specific studies and time period of the study.

2.2.2. Empirical Studies in Ethiopian

There are many studies about economic growth and inflation in Ethiopia. In this section, the researcher attempt to briefly review different studies related to this study in Ethiopia

Alemayehu and Kibrom (2008) conceded an empirical study to classify the forces behind the recent inflationary pressure in Ethiopia. The Quarterly data for the period 1994/5 – 2007/8 is used. They used vector autoregressive based error correction estimate model after the cointegration vectors are identified for the models of food and non-food inflation, a single error correction model is estimated for both models. In this study, it is found out that one of the sources of food inflation is the rise of money supply. The reason given for this is the low level of income among households. Given the low level of income, an increase in income leads to higher food inflation because households spend their additional income on food items. These authors recommend that policy makers cool down economic growth through fiscal and monetary conservatism. Hence, it can be concluded that there is a negative relationship between inflation and economic growth in Ethiopia.

Loening and Takada (2008) examined the dynamics of inflation in the short run using error correction model fitted with monthly observations. The result shows that the nominal exchange rate and increased money supply significantly affect inflation in the short run and that monetary policy in Ethiopia triggers price inertia, which has large and determined effects. A simulation suggests that monetary policy alone may be unrealistic to control inflation effectively. To circumvent an extreme tightening with discouraging impacts on growth, additional measures are needed. These should improve the transparency and credibility of monetary policy and reduce structural barriers that affect price formation and market efficiency.

Michael (2008) examined the basic factors that affect the rate of inflation and assessed the short-run and long-run relationships between economic growth and inflation in Ethiopia using the annual data of relevant variables for the period 1971 – 2006. To see the short-run and long-run relationships between inflation and growth, he employed error correction and co-integration model. The findings of the study show that money supply is the main factor for the rising inflation and that an increase in gross domestic product has a price reducing effect. From the study, it appears that there is a negative relationship between economic growth and inflation.

Ayalew (2000) find out that if there is a trade-off between unemployment and inflation, long-run determinants of inflation in the country and whether the Ethiopian economy affords stabilization, by using quarterly data over the period of 1973(Q2) – 1999(Q4). To show the trade-off between unemployment and inflation, he has measured unemployment by estimating the potential output and taking the difference from the actual output. To estimate the trade-off between inflation and unemployment, inflation is explained as a function of unemployment. The estimation result disclosed that there is no trade-off between the inflation and unemployment under study. To see the long-term factors that affect the inflation in the country; the explanatory variables that are used are money supply, world price index, inflation inertia, unemployment, drought and war. The estimated result shows that structural variables such as unemployment of resources explain inflationary pressures quite well in Ethiopia. Generally, the main finding of this study implies that as unemployment level decrease inflation also decrease, which shows there is positive relationship between inflation and unemployment according to this study in the Ethiopian context assuming that the lower rate of unemployment is accompanied by higher economic growth.

Birru, Durevall and Loening (2010) develops error correction terms that measure deviations from equilibrium in the money market, external sector and agricultural market to evaluate the impact on inflation of excess changes in food, money supply and non-food world prices and domestic agricultural supply shocks in Ethiopia. Their main purpose is to express the determinants of the current widespread of inflation in the country. Since Ethiopia is a one of developing country with large agriculture sector dominance; it is very important to give due emphasis to food inflation. The result shows that general inflation in Ethiopia is relatively associated with food in the economy and agriculture, and that the international food crisis had a strong impact on domestic food prices in the long run.

The Empirical finding by Teshome (2011) explains the relationship between inflation and economic growth in Ethiopia using statistical analysis, even though the researcher states that it is challenging to specify the exact relationship between economic growth and inflation However, one must revise the structure of government spending and the nature of economic growth. By comparing the rate of economic growth inflation of Ethiopia to that of Sub Saharan Africa, he explains how economic growth is affected by inflation through time. Using statistical comparison of the rate of economic growth and inflation, he tries to figure out the relation between them from 2004 to 2010. Accordingly, economic growth was affected nonlinearly in the country by inflation. Between 2004-2006 economic growth and inflation has positive relationship while from 2006-2008 they have negative correlation. Despite the variation in the magnitude between 2008 and 2010, he states that economic growth and inflation has positive relationship.

Fekadu (2012) investigated that the relationship between economic growth and inflation in Ethiopia. The study examines the relationship between these two economic variables in Ethiopia using yearly data gained from the world economic outlook database of International monetary fund for the period 1980 to 2011. A vector auto regression model was estimated by differencing the variables once to avoid problems related to using non stationary data. The findings were interpreted carefully as it depends on the nature of the economy being studied and the underlying sources of economic growth and inflation the Ethiopia. According to this study the economic growth reduces inflation if the underlying sources of economic growth are noninflationary which includes increase in production and productivity. But if economic growth comes from sources

which raise the money supply above the level of output production, it creates problems of too much money chasing too few goods which in turn results in price increment. The assessed model appears robust to standard misspecification tests. The study shows that there exist a long run relationship between inflation and economic growth in Ethiopia. Vector error correction estimates specify that economic growth significantly decline the inflation in short run. In long run, if inflation had before been larger than normal share, then economic growth causes inflation to be lower. The error correction terms are statistically significant to show that if both economic growth and inflation are out of equilibrium, inflation will adjust to reduce the equilibrium error in the long run.

Abis (2013) studies the relationship between economic growth and inflation by using quarterly data from 1992Q1 to 2010Q4. In doing so, the researcher arise the policy by raising the question, what is the threshold level of inflation rate for the Ethiopian economy? He used Engle-Granger and Johansen co-integration tests to found out that the relationship between these economic variables, as such a way that he found positive long-run relationship between inflation and economic growth. The main objective of the study are to observe the relationship between economic growth and inflation in the long run and short run by considering inflation at that time as long run determinant. The study also search for optimum level of inflation that economy hold without the growth being affected negatively. The result of the study shows that inflation expectation is the independent variable in model of inflation that largely explains the rate of inflation. The study also recommends that the Ethiopian government not only aim to combating inflation but also should have to consider the economic position of the country.

Finally, Ashagire (2015) study found that achieving low and stable inflation level with high economic growth is the macroeconomic policy objective of Ethiopia specifically and many countries of the world. The researcher examines whether there is a threshold effect between economic growth and inflation in Ethiopia for the period 1971 to 2013 using annual data and hansen's threshold autoregressive model. The empirical result didn't support the existence of threshold effect between inflation and economic growth in the period of study. The likely reason for the non-existence of non-linearity might be linked to the non-appearance of the absence market led economic system and the low financial sector development of the study period mainly in first 25 years. The informational friction that delays with the efficiency of the financial system

which finally inhibits long-run economic growth might be absent in the study period. Due to the fact that when there is small number of observations, the outcome should be interpreted with caution which this study faces.

In general there are conflicting theories and empirical findings regarding the relationship between economic growth and inflation. The relationship between these two macro-economic variables is extensively studied both in cross country by using panel data and single country using time series data. However, in case of Ethiopia due to stable macro-economic history of the country, the subject of relationship between inflation and economic growth is not exhaustively studied with formal modeling and appropriate econometric procedure. The area of this study started to be discussed mainly after 2004/5 when the economy began achieving rapid growth associated with higher inflation.

Chapter Three

3. Data source and methodology of the study

3.1 Introduction

Having a suitable data and managing the variables included in the model is necessary for not only empirical analysis but also for validity of the research hypothesis. The methodology and variables included in this study are selected taking into consideration their comparative importance on the empirical and theoretical basis. The data covers the period from 1991/92-2018/19.

The selected variables are taken on annual basis from the National Bank of Ethiopia, World Economic Outlook (2019) of the IMF, the Central Statistical Office (CSO) and World Bank. This period was assumed due to the obtainability of correct annual data and the methodology used in the analysis by having the following variables

Real Gross domestic product ($RGDP_t$): is the dependent variable for the model considered in this study, which is an aggregate measure of the size of an economy adjusted for price changes over a time. The empirical and theoretical literatures stress that there is no as such a clear and vivid relationship between these two macroeconomic variables. Gross domestic product is the value of all final goods and services produced in the country for a given period of time which is measured in local currency birr for this study case. The market value of gross domestic product depends on the actual quantity of goods and service produced in a given period of time and their relative price. Real gross domestic product was used to capture the overall economic performance based on constant national currency of the country, which is from 1991/92-2018/19.

Inflation rate is calculated as annual percent change of average consumer price index. Data for inflation are averages for the year of from 1991/92-2018/19. Basically to disclose the type of relationship between the level inflation and economic growth, it seems natural to take inflation rate as a variable to be explained and in fact many international researches stick to this approach

Broad Money Supply (M2t): is a measure of the domestic money supply that includes M1 plus Quasi-money which includes savings and time deposits, personal balances in money market accounts and overnight repurchase agreements. M2 is the money which is quickly converted to M1. The national bank of Ethiopia takes the broader definition for money or M2 as money supply and in this study; this definition of money is used as money supply and measured in local currency which is in birr for this study.

Investment: - is any asset or property right held for the primary purpose of preserving the wealth or earning an income. Sustainable economic growth is highly determined by the rate of investment, which in turn is mainly determined by the national savings level. An investment involves a long relationship and reflecting a lasting interest of and control by an entity resident in one economy in an enterprise resident in an economy other than that of foreign direct investor. The gross capital formation which consists of outlays on additions to the fixed assets of the economy plus net changes in the level of inventories (UNCTAD, 1997).

Average lending rate: -is the rate of bank that usually meets the short- term and medium-term financing needs for the private sector which enforce the economic growth of one country. The rate of bank is typically differentiated according to objectives of financing and creditworthiness of borrowers. The conditions and terms attached to these rates may differ by economic level of the country. The loaning interest rate in Ethiopia is the interest rate on praises from banks to leading borrowers, which is the lowest risk borrower in the private sector.

3.2. Model Specification

This study paper used autoregressive distributive lag (ARDL) model bounds testing technique of cointegration which was developed by Pesaran (1997), Pesaran and Shin (1999) and Pesaran et al. (2001). The researcher choice ARDL cointegration method due to many advantages. Among the advantages, the ARDL procedure can be applied whether the repressors are I (1) and/or I (0). Second, whereas other techniques require large data samples for validity, the ARDL model is statistically a more strong approach to determine the cointegration relationship between variables in small samples. Third, the ARDL procedure allows than the other models that the variables may have different optimal lags. Finally, the ARDL procedure is applicable for only a single reduced form equation to evaluate the long-run relationships within a context of system equations (Pesaran, 2001).

Accordingly the following model is specified to examine the relationship between economic growth and inflation in this study.

$$\Delta Ln\ \text{RGDP} = \beta 0 + \lambda_1 Ln\text{RGDP}_{t-1} + \lambda_2 Ln\text{inf}_{t-1} + \lambda_3 \text{LnBMS}_{t-1} + \lambda_4 \text{ALR}_{t-1} + \lambda_5 \text{Inv}_{t-1} + \beta_1 \sum_{i=0}^{n} \Delta\, Ln\ \text{RGDP}_{t-1} + \beta_2 \sum_{i=0}^{n} \Delta\, Ln\text{Inf}_{t-1} + \beta_3 \sum_{i=0}^{n} \Delta\ \ \text{LnBMSt} - 1 + \beta_4 \sum_{i=0}^{n} \Delta\, \text{LnALRt} - 1 + \beta_5 \sum_{i=0}^{n} \Delta\, \text{LnInvt} - 1_{t-1} + \varepsilon_t \ldots\ldots(3.1)$$

Where

LnRGDPt =Natural logarithm of real gross domestic product at time t

LnInft= Natural logarithm of inflation rate at time t

LnBMS_t = Natural logarithm of Broad Money supply at time t

LnALRt=Natural logarithm of Average lending rate at time t

Lninvt = Natural logarithm of investment growth at time t

β's = coefficients that measure short run relationship

$\lambda's =$ Coefficients that measure long run relationships.

ε_t= error term and $\Delta - implies\ the\ first\ difference\ operator$

t= time trend of the model.

To test whether there is a long run relationship between inflation and economic growth; bounds test for co-integration is applied out as proposed by Pesaran and Shin (1999) and Pesaran, Shin, and Smith (2001). The following are hypotheses:

Ho: $\lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = \lambda_5$=0, when there is no long run relationship among the variables.

H1: $\lambda_1 \neq \lambda_2 \neq \lambda_3 \neq \lambda_4 \neq \lambda_5 \neq$0, when there is a long run relationship among the variables.

In this study, the calculated F-statistics is compared with both critical values delivered by Pesaran, Shin, and Smith (2001) and Narayan (2005) also estimated his own critical values by assuming that using such critical values for small sample size might leads to misleading results. Accordingly, if the result of computed F-statistics is higher than the appropriate upper bound of the critical value, the null hypothesis of no co-integration will be rejected and vice versa.

Hence the presence long-run relationship between the selected variables is confirmed the following stable long-run model is estimated:

Ln RGDP=$\beta_0 + \beta_1 \sum_{i=0}^{n} Ln$ RGDPt − i +$\beta_2 \sum_{i=0}^{n} Ln$Inft − i +$\beta_3 \sum_{i=0}^{n}$ LnBMSt − i

+$\beta_4 \sum_{i=0}^{n}$ LnALRt − i +$\beta_5 \sum_{i=0}^{n}$ LnInvt − i +β_6t + vt … … … … … … … … … … . … … … … … … .3.2

Subsequently the model is established next task is to estimate the vector error correction model that shows the short run dynamic parameters by adjusting parameters that measure the speed of correction to long-run equilibrium after a short-run disturbance. The standard error correction model is assessed as follows:

ΔLn RGDP = β0 + $\beta_1 \sum_{i=0}^{a} \Delta\, Ln$ RGDP_{t-1} +$\beta_2 \sum_{i=0}^{b} \Delta\, Ln\text{Inf}_{t-1}$+$\beta_3 \sum_{i=0}^{c} \Delta$ LnBMSt −

1+$\beta_4 \sum_{i=0}^{d} \Delta$ LnALRt − 1 +$\beta_5 \sum_{i=0}^{e} \Delta$ LnInv − 1+β_6t + δECTt − 1 +

v_t……...……3.3

Where

β's = coefficients that represent the short run dynamic of the model

δECTt − 1 = Error correction term lagged by one period.

v_t=vector of white noise error terms and (a-e) denotes the optimal lag length of each variable in the auto regressive process.

δ =Error correction parameter that measure the speed of adjustment towards the long run equilibrium.

The error correction term (ECT) is resulting from the reliable long run model whose coefficients are obtained by normalizing the equation. In order to evaluate the models specified in equation (1), (2) and (3) above and to perform the post estimation and pre estimation diagnostic test Eviews *10* statistical packages are used.

3.3 Time Series Issues and Unit Root Tests

The stationary test that has become usually common in time series econometric analysis is the unit root test. In this study the researcher use Augmented Dickey Fuller test to analysis the unit root test. Unit root tests are statistical techniques that are deliberated to make decision whether a given sample of time series data shows 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).

3.3.1 The Augmented Dickey-Fuller (ADF) Test

Many researchers have developed numerous procedures for the test of order integration Augmented Dickey Fuller test owing to Dickey and Fuller (1979, 1981). The Augmented Dickey Fuller test depends on the rejecting null hypothesis of unit root when the series are non-stationary in favour of the alternative hypotheses of stationarity test of the model.

To permit these opportunities the Dickey-Fuller test is estimated in three different forms

$y_t = \beta + \gamma y_{t-1} + e_t$ by subtract yt-1 from both sides we get

$y_t - y_{t-1} = \beta + \gamma y_{t-1} - y_{t-1} + \varepsilon_t$ which is yields

$\Delta y_t = \beta + (\gamma - 1) y_{t-1} + \varepsilon_t$

Let us assume that $\gamma - 1 = \tau$

$\Delta y_t = \beta + \tau y_{t-1} + \varepsilon_t$

Y_t is a random walk: $\Delta Yt = \gamma Yt\text{-}1 + \varepsilon t$……..3.4

Yt is a random walk with drift: $\Delta Yt = \beta 1 + \gamma Yt\text{-}1 + \varepsilon t$…….……...3.5

Yt is a random walk with drift around a stochastic trend: $\Delta Yt = \beta 1 + \beta 2t + \gamma Yt\text{-}1 + \varepsilon t$…….....3.6

Where, t is the time trend variable. In each case the null hypothesis H0: $\boldsymbol{\gamma} = 0$ and $\beta = 0$, i.e., no deterministic trend where the time series is non-stationary and there exists unit root. The alternative hypothesis H1:$\gamma < 0$ and the time series are stationary.

Thus, if the null hypothesis that H0: $\gamma = 0$ is rejected Y_t is stationary with zero mean, non-zero mean and around deterministic trend for equations **(3.3)**, **(3.4)** and **(3.5)**, respectively (Gujarati 2003).

The random walk model with drift around the stochastic trend, i.e., equation **(3.5)**, as appropriately stated by augmenting the lagged values of the clarified variables ΔYt, the ADF test can be estimated using the equation **(3.6).**

$\Delta Y_t = \beta_0 + \beta_1 t + \gamma Yt\text{-}1 + \Psi 1 \Delta Yt\text{-}1 + \Psi 2 \Delta Yt\text{-}2 + \ldots + \varepsilon t$

$\Delta Y_t = \beta_0 + \beta_1 t + \gamma Yt\text{-}1 + \Sigma_{i=0}^{k} \Psi i \Delta yt + \varepsilon t$ ……..3.7

Where, εt = white noise error term,

$\Delta Y_{t-1} = (Y_{t-1} - Y_{t-2})$, $\Delta Y_{t-2} = (Y_{t-2} - Y_{t-3})$

The most significant concern of the Augmented Dickey Fuller test is to evaluate$e\ \gamma$, similar to the Dickey-Fuller test (Ng and Perron 2001)

3.4 Diagnostic test (Post Estimation Test)

To realize the appropriate result obtained in the long run there should be the reliability of checking the post estimation tests. The most relevant post- estimation test for dynamic models includes Autocorrelation, normality test, stability of the model, heteroscedasticity test and so on

3.4.1 Autocorrelation problem

Is mostly the problem of time series in which the serial relationship among successive errors are arise over the period of time.

Hypothesis; H_0: there is no autocorrelation problem

H_1: There is autocorrelation problem

Decision rule: If the probability of Chi-Square (2) is less than 5%, significance level, reject the null hypothesis of no autocorrelation and otherwise accept the null hypothesis of no autocorrelation.

3.4.2 Heteroscedasticity Test

Heteroscedasticity is the scenario by which the distribution of error term (ε_i) around the mean is not constant (no constant variance). Heteroscedasticity does not affect the unbiasedness of the parameter but the consistency properties of OLS estimators are no longer minimum variance or efficient.

Hypothesis test: H_0 the error variances are all equal.

H_1: The error variances are multiplicative function of one or more variables.

Decision rule: If the computed Chi –square (x^2) exceeds the critical x^2 value at the chosen level of significance, one can reject the hypothesis of homoscedasticity. Otherwise, the alternative hypothesis would be accepted.

3.4.3 Normality Test

Normality is another criterion of good econometrics analysis, which determines whether the result follows symmetric distribution of data. The model is normal if the probability of Jarque-Bera is greater than 5% and vice versa.

3.4.4 Stability of the model

The stability of the model is measured by the Cumulative sum of squares of recursive (CUSUM) as denoted on the figure. In this case, CUSUM test, which is based on the residuals from the recursive estimates, provides such a test.

Hypothesis: H_0: the CUSUM distribution is a symmetric distribution centered at 0.

H_1: The CUSUM distribution is not symmetric distributed and no normal distribution

Decision rule: The null hypothesis of normal distribution is accepted when the graph of CUSUM statistics lays between the bounds of the critical region for a test at 5% level of significance and vice versa.

3.5 Engle Granger causality test

The term granger causality refers to the existence of Granger-causality from inflation to economic growth, investment, rate of interest, money supply and vice versa and from all these variables to inflation itself.

Hypothesis test: $\boldsymbol{H_0}$: Inflation does not granger cause economic growth of Ethiopia

H_1: Inflation granger causes economic growth of Ethiopia

Decision rule: if the probability of the significance level is less than 5 percent we can reject the null hypothesis of no granger causality and if not we accept the null hypothesis. If there is granger causality from inflation to economic growth and from economic growth to inflation we call it bidirectional causality.

3.6 Autoregressive Distributed Lag (ARDL) Co integration Analysis

Auto-Regressive Distributed Lag (ARDL) of Pesaran et al. (2001) is recent single cointegration which becomes the most widely used approach by many researchers and scholars, due to the low power and other problems associated with other test methods.

This study employed ARDL bounds testing approach of cointegration which was developed by Pesaran and Shin (1999),Pesaran (1997) and Pesaran (2001).

The autogressive distributed lag approach to cointegration includes two phases for estimating long run relationship (Pesara, 2001). The first phase is to observe the presence of long run relationship among all variables in the equation under estimation. The autogressive distributed lag model for the standard log-linear functional specification of long-run relationship between Economic growth and inflation rate may follows as:

$$D\text{RGDPt}=\beta 0+\sum_i^n \beta_1\, D\text{RGDP}_{t-1}+\sum_i^n \beta 2\, D\text{inft}-1+\ \delta_1\ \text{RGDP}_{t-1}+\ \delta_2\text{Inf}_{t+}\,\varepsilon_{1t} \quad \ldots\ldots..3.22$$

$$D\text{Inft}=\beta 0+\sum_i^n \beta_1\, D\text{RGDP}_{t-1}+\sum_i^n \beta 2\, D\text{inft}-1+\ \delta_1\ \text{RGDPF}_{t-1}+\ \delta_2\text{InfF}_{t+}\,\varepsilon_{1t} \quad \ldots\ldots\ldots\ldots\ldots\ldots 3.23$$

Where:

D=first difference operator

$\beta 0$ = drift component

ε_{1t} = usual white noise Residual

Co-integration relationship is conducted by testing:

Null hypothesis HN: $\delta 1 = \delta 2 = 0$ *against*

Alternative hypothesis HA: $\delta 1 \neq \delta 1 \neq 0$.

3.7 Co-integration and Error Correction Mechanisms

The concept of co-integration was first announced by Granger (1981) and established by Engle and Granger (1987) giving it a foundation for representation, estimation, testing and modeling of co integrated non-stationary time series variables. This approach of co-integration analysis non-stationary time series data sets are allowed to be used and spurious regression can also be avoided.

In the previous section, discussed, if individual time series variables are not stationary in levels there is a possibility that their first difference becomes stationary. If the variables utilized in the study are found stationary at the same order, say in their first difference I (1), it is possible to continue the regression. After the regression takes place if the error terms are found stationary at levels, then the linear combination of the individually non-stationary I(1) variables is said to be stationary I(0). This is simply the two-step procedure of the Engle and Granger (1987) that will be discussed in detail in the coming subsection.

The co-integration test in this study will be carried out using the Engle and Granger (1987) approach and the Johansen (1988) approach. The economic interpretation of co-integrated variables shows the long-term relationship between inflation and economic growth under study (Engle and Yoo 1987).

Chapter- Four

4. Data analysis and Econometric result

4.1 Descriptive analysis

4.1.1 Relationship between inflation and economic growth

The economic growth of one country is the outcome of fiscal, monetary and other economic policies undertaken by its policy makers. A number of elements, among the many one is inflation, affects economic growth at the world wide level generally and case of Ethiopia particularly. To show the relationship between inflation level and economic growth is not easy task. The difficulty of relationship between inflation and economic growth has been explored in the course of many studies in Ethiopia specifically and the internationally generally.

Different studies (Mamo, 2012) showed that the relationship between inflation and economic growth might be negative, positive and neutral. Chibwe (2014) showed that there is no relationship between economic growth and inflation. Sidrauski (1967) recommended that there is no relationship between economic growth and inflation. A study conducted by Fisher (1993) shows that the relationship between economic growth and inflation is negative for advanced countries. Mallik and Chowdhury (2001) also showed that there is a positive relationship between economic growth and inflation. Nowadays the question is not only is there any relationship between inflation and economic growth but (Mamo, 2012) which level of inflation can disturb economic growth negatively or positively by plans the significance of predicting inflation for economic growth.

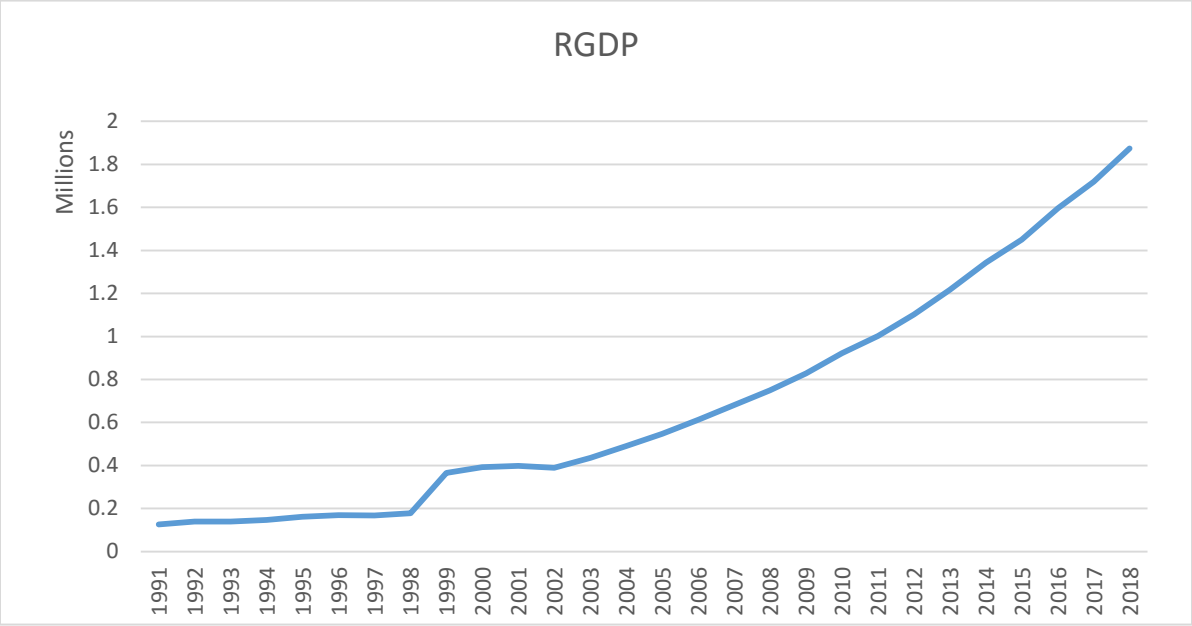
4.1.2 The trend of Economic growth

The rapid economic growth of Ethiopia is one of the great stories of the 21st Century, but there are symbols that the country's prosperous may not be sustainable. The Recent reports put forward government spending in Ethiopia, not enhance the productivity which has been boosting economy of the country. In 2000, Ethiopia, the second-greatest populous country in Africa, was the third-poorest country in the world. Its annual gross domestic product per capita was only about $620 (in 2011 dollars). More than half of the population lived under the global poverty line, the maximum poverty rate in the world. According to World Bank estimations, from 2000 to 2018, Ethiopia faces rapid economic growth; third-fastest growing country of 10 million or

more people at international level, as measured by gross domestic product per capita. (World Bank 2019)

As stated above the economic grow of Ethiopia has witnessed raid economic growth with real gross domestic product in the fiscal year of the study. The trend of economic grow show slow increasing from 1991-1998. Ethiopia began to see faster economic progress from 1998 to 2019 there was high economic growth. For this study there is rapid economic growth in Ethiopia from time to time as we see from figure 4.1.

Figure 4.1 the trend of Economic growth



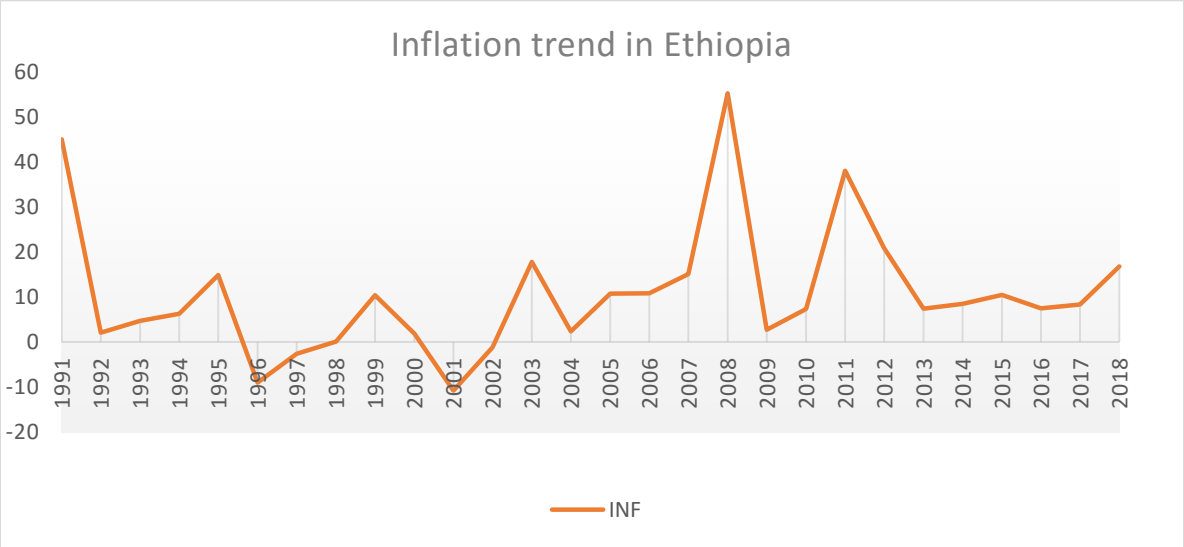
Source: National Bank of Ethiopia (2020) and own computation.

4.1.3 Trends of Inflation in Ethiopia

Trends of inflation in Ethiopia shows that the change in the inflation rate over Ethiopia in years. Inflation continued at a reasonable low-level rate before 2000/03. However, post 2003/04 sow high-pitched increase notwithstanding rapid economic growth during the same period (Alemayehu and Kibrom, 2008). According to them, the sharp increasing of general inflation was caused due to primarily by food inflation, which is the consequence of international food price increase and food demand triggered monetary expansion.

There is strong fluctuation of inflation in Ethiopian economy during the area of the study. According to the data National Bank of Ethiopia there was high inflation rate in 1991 and 2008 in Ethiopia. After 2012 to 2018 there is moderate inflation in Ethiopia. In 2018, inflation rate for Ethiopia was 13.8 %. Though Ethiopia inflation rate fluctuated substantially in recent years, it tended to increase through 1991 - 2018 period ending at 13.8 % in 2018.

Figure 4.2 the trend of inflation

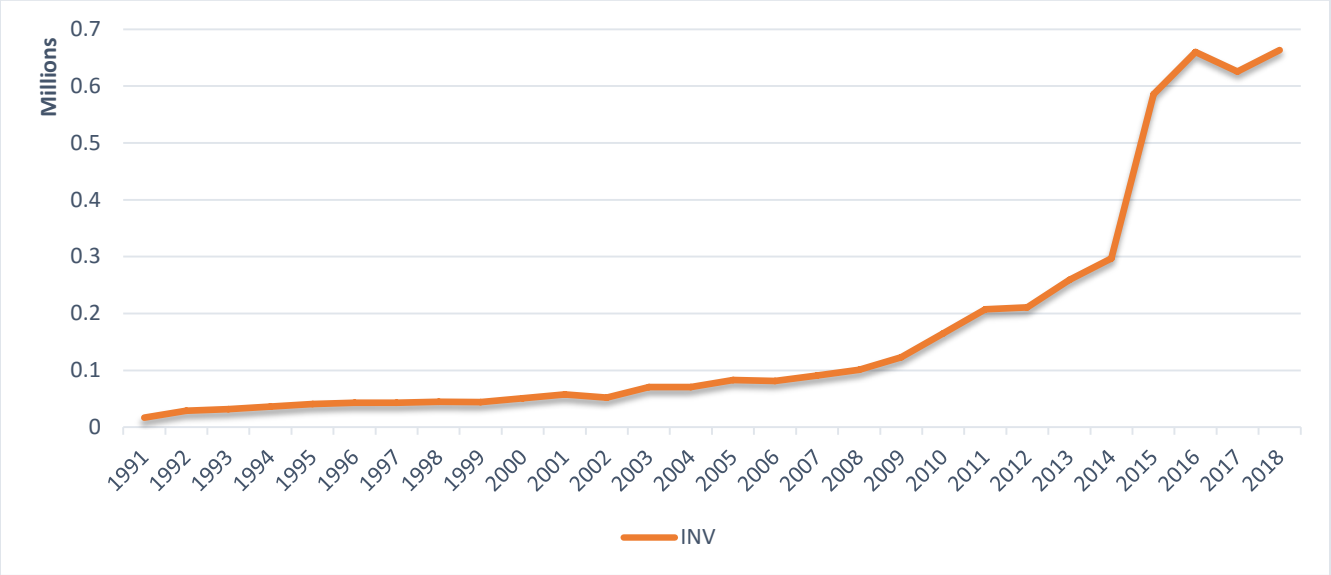


Source: National Bank of Ethiopia (2020) and own computation.

4.1.4 The trend of investment

The Ethiopian investment increased from time to time as the economic growth of the country increase. As can be read from the fig 4.3 the investment of Ethiopia had slowly increasing from 1991 to 1999/2000, however due to government attract the private investors locally and internationally the investment of the country highly increased from 2000 to 2015. Nevertheless, during the year of 2017 due to increment of tax the investment of country decreased from the previous year and increased from starting 2017/18 to 2018/19.

Figure 4.3 The trend of Investment

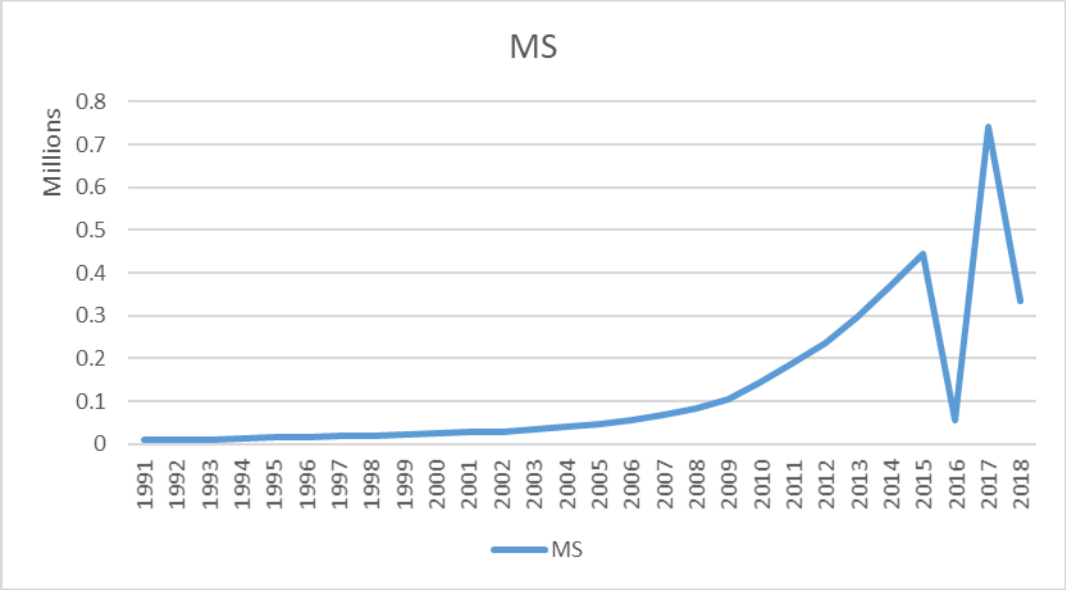


Source: National Bank of Ethiopia (2020) and own computation.

4.1.5 The trend of Money Supply

During the fiscal year under review there was increment of money supply. Starting from 1991/92-2003/4 there was slow increment of money supply and as we can see from the figure 4.4 after 2004/5 to 2014/15 there is rapid increment of money supply in Ethiopian Economy. During the fiscal year of this study the lowest money supply faces in 2016 and the highest was during 2017. Generally the study indicates that money supply is positively affect the economic growth if the country money supply is one variable which is significant variable in long run as well in short run in econometrics analysis too.

Figure 4.4 The trend of Money supply

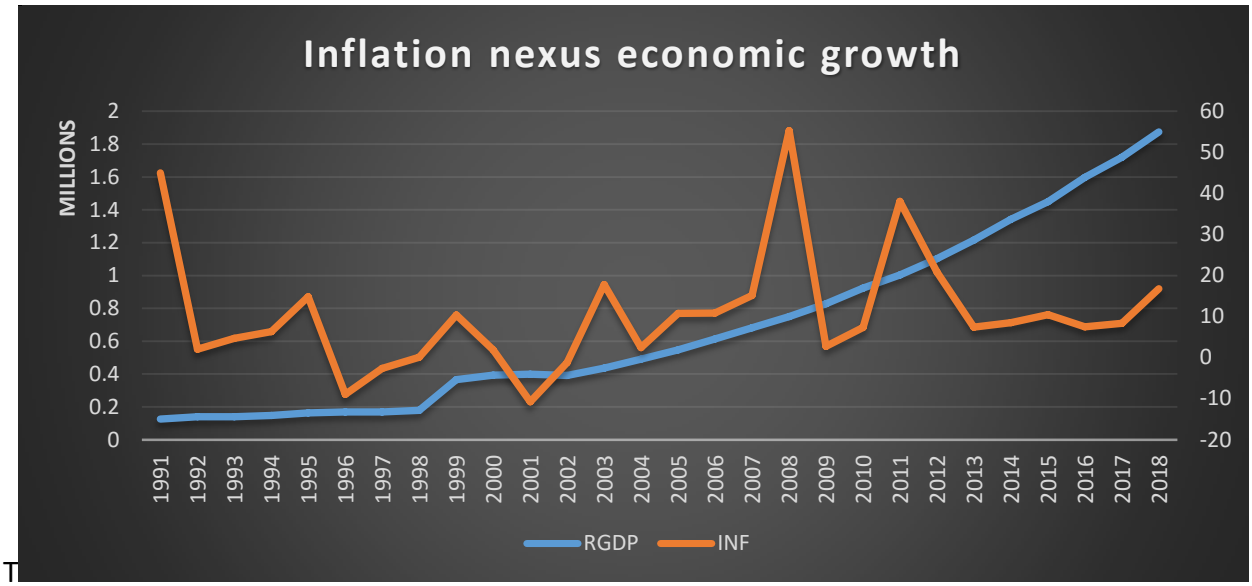


Source: National Bank of Ethiopia (2020) and own computation.

4.1.6 The trend of Inflation and Economic growth

During the fiscal year under review the following figure 4.5 indicates that the trend of inflation and economic growth, which is the main objective of this study; to show the relationship between inflation and economic growth in Ethiopia.

Figure 4.5 The trend of inflation nexus Economic Growth



Source: National Bank of Ethiopia (2020) and own computation.

4.2 Econometric result and interpretation

4.2.1 Unit root test

Before using any raw time series data testing the stationarity of the series data is very important. Accordingly, in this study employed Augmented Dickey (ADF) has been employed as follows.

4.2.2 Augmented Dickey Fuller (ADF) Test

Augmented Dickey Fuller test is one of the crucial indicators of the stationarity of the series of data. Use any data of estimation technique without checking whether the series of data is stationary or not fails under the problem of spurious result. Hereunder is the tabular result of the stationarity of each series both regressand and regressors included in the data discussion in table 4.1 below.

Table 4.1 ADF stationarity test

Variables at level and 1st difference	t-statistics	t- critical at (5%)	Probability
LNRGDP	2.40729414	2.981038	0.149
ΔLNRGDP	-5.2447668**	-2.9862250	0.0003**
LNINF	-7.273218**	-2.986225	2.61044
LNINV	0.736668	-2.893956	0.9924
ΔLNINV	-3.913331**	-2.981038	0.0062**
LNMS	1.89999	2.99187	0.32667
ΔLN MS	3.953396**	2.981038	0.0063**
LNIR	5.58496**	2.981038	0.0001**

Source: National bank of Ethiopia (2020) and Authors' computation

*** indicates each series are stationary at 5% level.*

In the above result, some of the series are stationary at level while some series are stationary after first difference. This implies these variables are the combination of I (0) and I (1) and hence Autoregressive distributive lag (ARDL) model is applicable for this analysis.

4.3 Long run ARDL Bounds Tests for Co-integration

The first task to be taken in the bound test approach of co-integration is estimating the ARDL model specified in equation 3.3 using the appropriate lag length criteria. In this paper, Akaike information criterion (AIC) was taken as a guide and a maximum lag order of 2 was chosen for the condition ARDL model.

Then F-test through the Wald-test (bound test) is performed to check the joint significance of the coefficients specified in equation 3.2. The Wald test is conducted by imposing restrictions on the estimated long run coefficients of real GDP, inflation, investment, money supply and rate of interest tradeoff. Accordingly, the computed F-statistic value is compared with the lower bound and upper bound critical values tabulated in table 4.2 of Pesaran, Shin, and Smith (2001) and Narayan (2005).

Table 4.2-Bound test for co-integration analysis

Bounds Test	Null Hypothesis: No cointegrating relationships exist			
Test Statistic	Value	Significance level.	I(0)	I(1)
F-statistic	5.64	10%	2.2	3.09
K	4	5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37

Source: National bank of Ethiopia (2020) and Authors' computation

The above table shows the calculated F-static 5.64 is higher than the Pesaran, Shin, and (2001) and Narayan (2005) upper bound critical value even at 1%. This result depicts that the null hypothesis of $\beta_1 = 0, \beta_2 = 0, \beta_3 = 0, \beta_4 = 0$ (no long run co-integration) against to the alternative hypothesis $\beta_1 \neq 0, \beta_2 \neq 0, \beta_3 \neq 0, \beta_4 \neq 0$ (there is long run relation among these variables) is rejected based on Pesaran, Shin, and Smith (2001) and Narayan (2005) at 1% critical value.

4.4. Long-run Model Estimation

Under the bound test of long run co-integration, it is confirmed that all variables (real GDP, inflation, investment, money supply and interest rate) are co integrated in the long run. After the long run relationship is checked, the estimated long run coefficients after normalizing on real GDP are reported in 4.3 as follows.

Table 4.3 long run estimation of the model) Approach: ARDL (1, 0, 1, 1, 1)

Long Run Coefficients				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
DLNINF	**-100.538**	**526.05**	**-0.191**	**0.85**
DLNINV	**0.678**	**0.209**	**3.243**	**0.0047****
DLNMS	**0.694**	**0.208**	**3.327**	**0.0039****
DIR	**-15687.0**	**8150.390**	**-1.9247**	**0.071**
C	**40401.6**	**11921.04**	**3.389**	**0.0034****

Source: National bank of Ethiopia (2020) and Authors' computation

*** implies the statistically significant coefficients*

The above result implies, two variables significantly affect the economic growth of Ethiopia in the long run, as their probability is less than 5%. Money supply has a great contribution in the economic determination of the country and investment is the next major contributor of growth as both variables affect positively. However, the study intended to investigate the relationship between economic growth and inflation, the coefficient parameter of inflation is statistically insignificant hence, its p- value is greater than 5%. Interest rate also has no significant effect on the economic growth of the country for the same p- value reason.

From the specification of the growth model, it is specified in logarithmic form and the coefficient of each variables measure the elasticity responses of economic growth as a result of explanatory variable. More specifically, holding other things remain the same, 1% increases in money supply leads to 0.694% increases in economic growth on average term in the long run. Similarly, investment also positively affects 1% increases in capital formation results to 0.678% increases in economic growth of the country in the long run, given other things are remain constant. It is clear that there is no significant relation between inflation and economic growth even in the long run.

4.5 Short run Error Correction Estimates

Once, the long run coefficients of the economic growth equation are accepted, the short-coefficients and ECM would be estimated. As the result reveals, the coefficient of error correction term is -0.88 and highly significant with correct sign. The term implies, the system adjusts itself to the equilibrium by 88% per annum in the long run when there is a shock in the short run. In other words, the disequilibrium in the previous year is converged to its equilibrium by 88% in the long run per annum. The estimated coefficient of short run equation reveals that money supply is the main determinant of economic growth while all other variables are insignificant including inflation.

The coefficient of money supply is statistically significant and shows, other things are remain constant, increasing the stock of money by 1% unit results to enhancing economic growth of the nation by **0.26%.** The contribution of each explanatory variable on economic growth has been shown by the following figure with their respective probability regardless of the insignificance of other variables.

Table 4.4 Error correction representation for selected ARDL (1, 0, 1, 1, 1)

ECM Regression				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(DLNINF)	-0.003	0.098	-0.036	0.9716
D(DLNINV)	-345.7	45.9812	-0.056	0.71645
D(DLNMS)	0.260	0.060	4.32	0.0005**
D(DLNIR)	-3211.80	2767.209	-1.160	0.2618
CointEq(-1)*	-0.883	0.169	-5.21	0.0001**

Source: National bank of Ethiopia (2020) and Authors' computation

4.6 Diagnostic test

To realize the appropriate result obtained in the long run there should be the reliability of checking the post estimation tests. These are stability of the model, normality issue, serial correlation among the successive errors, heteroscedasticity of the errors, and so on.

4.6.1 Autocorrelation problem

Is mostly the problem of time series in which the serial relationship among successive errors are arise over the period of time.

Hypothesis; H_0: there is no autocorrelation problem

H_1: There is autocorrelation problem

Decision rule: If the probability of Chi-Square (2) is less than 5%, significance level, reject the null hypothesis of no autocorrelation and otherwise accept the null hypothesis of no autocorrelation.

Table 4.5 Breusch-Godfrey Serial Correlation LM test

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.33465	Prob. F(2,10)	0.7232
Obs*R-squared	1.5055	Prob. Chi-Square(2)	0.4710

Source: National bank of Ethiopia (2020) and Authors' computation

This result implies there is no autocorrelation problem since the probability of Chi-Square (2) 47.1% which is greater than 5% and the null hypothesis is accepted.

4.6.2 Heteroscedasticity test

Heteroscedasticity is the scenario by which the distribution of error term (ε_i) around the mean is not constant (no constant variance). Heteroscedasticity does not affect the unbiasedness of the parameter but the consistency properties of OLS estimators are no longer minimum variance or efficient.

Hypothesis test: H_0 the error variances are all equal.

H_1: The error variances are multiplicative function of one or more variables.

Decision rule: If the computed Chi –square (x^2) exceeds the critical x^2 value at the chosen level of significance, one can reject the hypothesis of homoscedasticity. Otherwise, the alternative hypothesis would be accepted. The probability of Chi-Square (2) is shown as follows by table 4.6.

Table 4.6 Heteroscedasticity: Breusch-pagan Godfrey

Heteroscedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	0.5201191	Prob. F(8,17)	0.825282
Obs*R-squared	5.1124723	Prob. Chi-Square(8)	0.745490
Scaled explained SS	4.9244137	Prob. Chi-Square(8)	0.765623

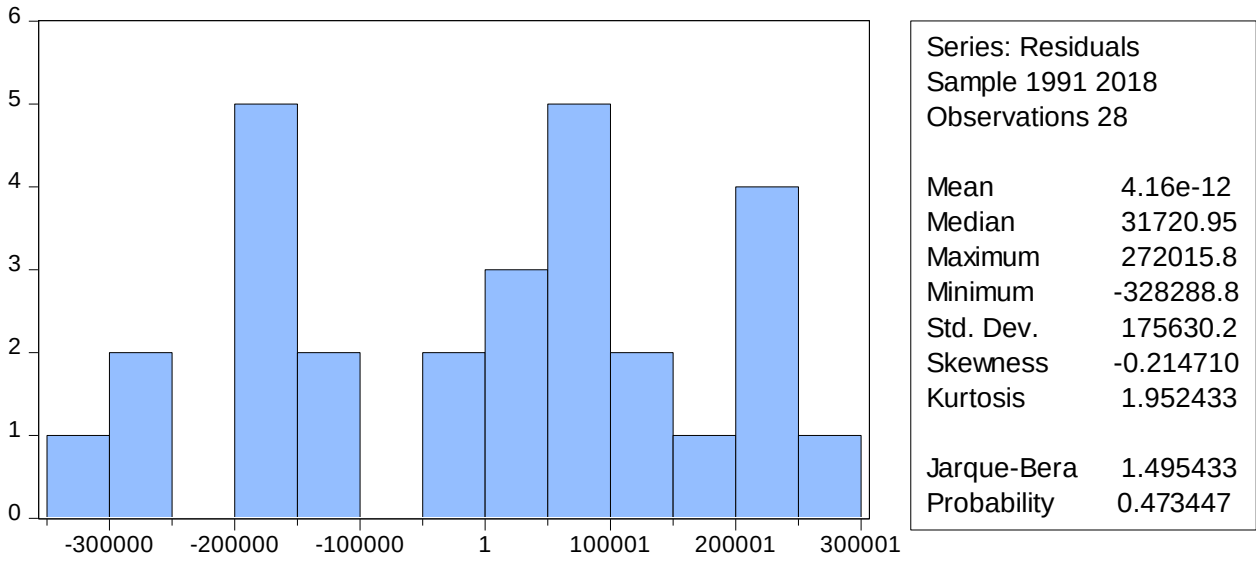
Source: National Bank of Ethiopia (2020) and Authors' computation

Based on the result hence *the probability value of Chi-Square (2) is statistically insignificant and* The decision is accepting the null hypothesis of homoscedasticity. This is because p – value of Chi-Square (2) is 74.5, which is greater than 5 % level of significance.

4.6.3 Normality test

Normality is another criterion of good econometrics analysis, which determines whether the result follows symmetric distribution of data. The model is normal if the probability of Jarque-Bera is greater than 5% and vice versa.

Figure 4.7 Jarque-Bera CUSUM normality test



Source: National bank of Ethiopia (2020) and Authors' computation

Based on the output, the result shows that the model is normal, as the p- value of Jarque-Bera is 47.3% as denoted on the figure above.

4.6.4 Stability of the model

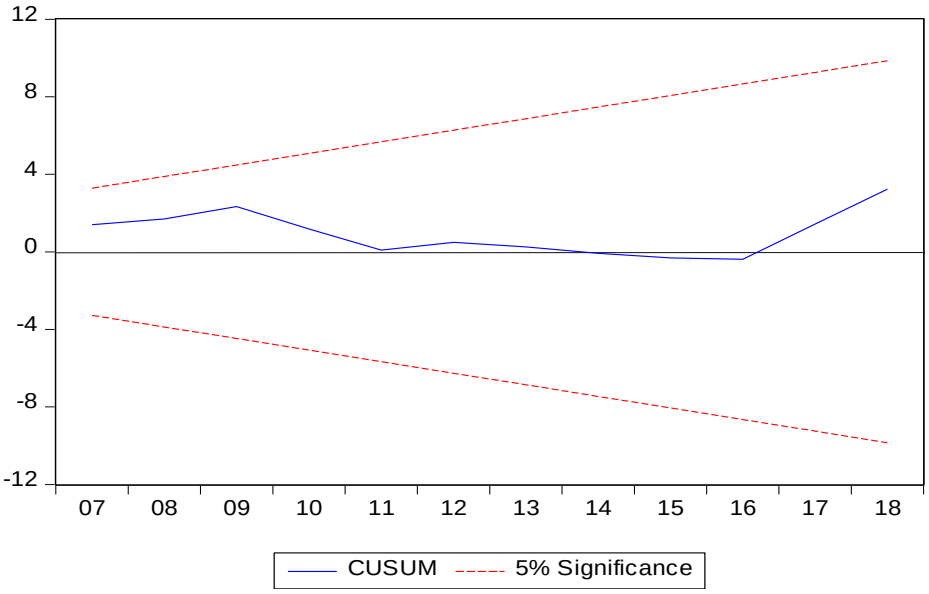
The stability of the model is measured by the Cumulative sum of squares of recursive (CUSUM) as denoted on the figure. In this case, CUSUM test, which is based on the residuals from the recursive estimates, provides such a test.

Hypothesis:H_0: the CUSUM distribution is a symmetric distribution centered at 0.

H_1: The CUSUM distribution is not symmetric distributed and no normal distribution

Decision rule: The null hypothesis of normal distribution is accepted when the graph of CUSUM statistics lays between the bounds of the critical region for a test at 5% level of significance and vice versa. Based on the result of the study the graph of CUSUM statistics lays between the bounds of the critical region as follows.

Figure 4.8 CUSUM stability test



Source: National bank of Ethiopia (2020) and Authors' computation

It is clear that the growth model is stable because the cumulative sum (CUSUM) graph lays between the critical bounds at 5% level of significance.

4.7 Engle Granger causality test

The term granger causality refers to the existence of Granger-causality from inflation to economic growth, investment, rate of interest, money supply and vice versa and from all these variables to inflation itself.

Hypothesis test: $\boldsymbol{H_0}$: Inflation does not granger cause economic growth of Ethiopia

H_1: Inflation granger causes economic growth of Ethiopia

Decision rule: if the probability of the significance level is less than 5 percent we can reject the null hypothesis of no granger causality and if not we accept the null hypothesis. If there is granger causality from inflation to economic growth and from economic growth to inflation we call it bidirectional causality.

Table 4.7 Granger causality test

Dependent variable: D(DLNRGD)

Excluded	Chi-sq	Df	Prob.
D(DLNINF)	19.60696	2	0.0001**
D(DLNINV)	10.18906	2	0.0061
D(DLNIR)	4.935693	2	0.0848
D(DLNMS)	13.47218	2	0.0012
All	37.83264	8	0.0000

Source: National Bank of Ethiopia (2020) and own computation.

Based on the result, inflation, investment and money supply granger cause real GDP of the country, as their probability is statistically significant while interest rate is statistically insignificant.

Chapter Five

5-Conclusion and policy implications

5.1. Introduction

This chapter provides a summary of the key findings of the study. The researcher also highlighted policy implications of the study. The chapter finishes with the presentation of selected limitations to the study.

5.2. Main Findings of the Study, Conclusion and Policy Implications

The main objective of this study is to show the relationship between inflation and economic growth in Ethiopia. The study used the Autoregressive Distributed Lag (ARDL) bound test of long run co-integration procedure to identify the long run equilibrium relationship between inflation and economic growth. The descriptive analysis indicates the trend of economic growth and inflation. Accordingly the descriptive analysis specifies that there is no correlation between these two macroeconomic variables. Hence undertaking only a descriptive analysis cannot help to fully address the objectives of the study, the study uses time series econometric investigation to accompaniment the descriptive one.

Accordingly, the ARDL bound test of long run co-integration result investigate the relationship between economic growth and inflation, the coefficient parameter of inflation is statistically insignificant hence, its p- value is greater than 5% which shows that there was is no cointegrating relationship between inflation and economic growth for Ethiopian in fiscal years of the study data

The results of the error correction model are negative and statistically insignificant which is greater than five percent; (97) percent) level of insignificance, meaning that there is no short run relationship between these two macroeconomic variables according to the data from National Bank of Ethiopia during the fiscal year of study (1991/92-2018/19)

The finding of no cointegration relationship implies that there is no stable long-run equilibrium relationship between inflation and economic growth.

Granger causality test indicates that there is a unidirectional causality running from inflation to economic growth. These results are in conformity with several studies reviewed in literature which reveal that inflation is and has been detrimental to economic growth.

Hence, the study through the empirical findings maintains the fact that the causality that runs from inflation to economic growth is an indication of a relationship showing that inflation indeed has an impact on economic growth.

The most outstanding result of my findings is that, economic growth does not help to forecast future inflation rate, having taken into account the information provided by economic growth itself. By knowing the past values of growth in real gross domestic product, we cannot predict what inflation rate will be in future. On the contrary, it is inflation which helps predict the future rate of real GDP growth. Therefore, the study shows that, given the current situation in Ethiopia, government should give concentration on inflation reduction as a primary focus.

5.3. Limitations of the Study and Recommendations for Future Research

This study has been successful at investigating the relationship between inflation and economic growth in Ethiopia. However, this has not been done without its own limitations. Firstly, the data used in the study is somehow sensitive to different modeling.

The other limitation is the short span of data used in this study considering the methodology employed. However, the statistical package used in this thesis has the flexibility of reporting small sample statistics. Future research should consider employing non-linear models and probably include more countries within the region to repeat the estimation process and check the robustness of the results.

Biblography/References

- Aaron, H., 1967, Structuralism versus Monetarism: A note on evidence', *T and F online*, viewed 2 April 2012.
- Abbott, A. & De Vita,G., 2011,'Revisiting the Relationship between Inflation and Growth: A Note on the Role of Exchange Rate Regimes', Economic Issues 16(1), 37 –52.
- Abis Getachew, 2008, *''The Relationship between Inflation and Economic growth in Ethiopia''* Master of commerce in Economics, University of South Africa. .
- Ahmed, S. and Mortaza, M. G., 2005, 'Inflation and growth in Bangladesh: 1981-2005' *Policy Analysis Unit Working Paper*, Series WP0604, 1 – 22.
- Ambler, S., 2008, 'The Cost of Inflation in New Keynesian Models', Bank of Canada, winter 2007 2008, 5 – 14.
- Ashagrie Demile, 2015, "Inflation - Growth Nexus in Ethiopia:Evidence from Threshold Auto Regressive Model" Ethiopian Economic Association (EEA.)
- Asteriou, D. and Hall, S.G., 2007, *Applied Econometrics: A Modern Approach*, Pagrave Macmillan, New York.
- Ayalew, Y., 2000, The Trade-off between Inflation and Unemployment in Ethiopia. *Proceedings of the 10th Annual Conference on the Ethiopian Economy:* Adama, Ethiopia, Ethiopian Economics Association.Nov. 3-5, 2000
- Barro and Sala-i-Martin (1995 Determinants of economic growth: a cross-country empirical study". National Bureau of Economic Research, Working paper 5698.
- Barro, R.J., 1995, 'Inflation and Economic Growth', Bank of England Quarterly Bulletin, 166 –176.
- Baumol, W.J., 1999, 'Retrospectives Say's Law', Journal of Economic Perspectives 13(1), 195 204.
- Bruno, M. & Easterly, W., 1996, 'Inflation and Growth: In Search of a Stable Relationship' Federal Reserve Bank of St. Louis, May/June 1996, 139 – 145.
- Bullard, J. and Keating, J. W. The Long-Run Relationship between Inflation and Output in Postwar Economies. Journal of Monetary Economies, 36, pp.477-496, 1995.
- Central Statistics Agency (CSA), 2008, Annual Report 2006/07, DDCSA, Addis Ababa.
- Central Statistics Agency (CSA), 2011, Annual Report 2009/10, DDCSA, Addis Ababa

- Cooley F. and HansenD. (1989): The Inflation Tax in a Real Business Cycle Model, The American Economic Review, Vol. 79 No. 4, 733-748
- Cottrell, A., 1997, 'Keynes, Richardo, Malthus and Say's Law', History of Economic Societies meetings, Charleston, SC, June 1997, 1 – 20.Culver S. and Papell D. (1997): is there a unit root in the inflation rate? Evidence from sequential break and Panel data models, Journal of Applied Economics, Vol. 12, 435-444
- De Gregorio, J., 1996. "Inflation, Growth and Central Banks: Theory and Evidence." Ministry of Finance Paper, Santiago Chile.
- Dickey DA, Fuller WA. (1981). Likelihood ration statistics for autoregressive time series with a unit root. Econometrica; 49:1057e72.

- Dickey DA, Fuller WA (1997). Distribution of the estimators for autoregressive time series with a unit root. J AM Stat Assoc; 74:427 e31.
- Dimand, R.W., 2005, 'David Hume and Irving Fisher on the Quantity Theory of Money', Brock University, St. Catharines, Ontario L2S 3A1, Canada,1 – 9.
- Dotsey, M. &Sarte,P.D. G., 2000, 'Inflation Uncertainty and Growth in a Cash-In-Advance Economy'.
- Engle, R.F. & Granger, C.W.J., 1987, 'Co-Integration and Error Correction: Representation, Estimation and Testing', Econometrica 55(2), 251 – 276.
- Friedman, B.M., 1976, 'Inflation and Unemployment', Nobel Memorial Lecture, 267-286.
- *Ferdinand* and *Isidore* (2014) 'Short-Run and Long-Run Inflation and Economic Growth Nexus in Ghana' *Department of Economics, University of Cape Coast, Cape Coast, Ghana*
- *DOI: http://dx.doi.org/10.4314/gjds.v11i2.3*Ghosh, A. and S. Phillips. 1998. "Warning: Inflation May Be Harmful to Your Growth." IMF Staff Papers., 45(4), 23-45.
- Gillman, M. & Harris, M.N., 2010, 'The Effect of Inflation and Growth: Evidence from a Panel of Transition Countries', Economics of Transition 18(4), 697 – 714.
- Gokal, V. &Hanif, S., 2004, 'Relationship between inflation and economic growth'.
- Gomme, P., 1993. "Money and Growth Revisited: Measuring the Costs of Inflation in an Endogenous Growth Model." Journal of Monetary Economics. 32, 51-77.
- Gregorio, J. D., (1993).The Effects of Inflation on Economic Growth Lessons from Latin America, European Economic Review 36 (1992) pp. 417-425. North-Holland
- Goodo J. E., (1994), *Does Inflation Uncertainty Increase with Inflation?, Federal Reserve Bank of Kansas City, Economic Review,* Q III , p. 27-38
- Hamilton D. (1994): Time Series Analysis, Princeton: Princeton University press
- Haslag H. (1995): "Inflation and Intermediation in a Model with Endogenous Growth", Federal Reserve Bank of Dallas working paper, Vol. 95 No. 02
- Howitt, P., 2007. "Innovation, Competition and Growth: A Schumpeterian Perspective on Canada's Economy." available from www.cdhowe.org.

- Hossain, M., 2005, 'Inflation and Growth: Estimation of Threshold point for Pakistan', *Economic Policy Department: State Bank of Pakistan*, 2 – 10.
- IMF (2012): Statement by an IMF Staff Mission on the 2012 Article IV Consultation with Ethiopia, IMF Press Release No. 12/224
- IMF (2016): Statement by an IMF Staff Mission on the 2016 Article IV Consultation with Ethiopia, IMF Press Release No. 16/124
- Jarque, C. M., and Bera, A. K., 1980, 'Efficient Tests for Normality, Homoscedasticity and Serial Independence of Regression Residuals', *Economics Letters*, 6, 255-259.
- Jarque, C. M.,and Bera, A. K., 1987, 'A Test for Normality of Observations and Regression Residuals', *International Statistical Review*, 55(2), 163-172.*International Statistical Review*, 55(2), 163-172.
- Johansen S. (1988) Statistical Analysis of Cointegrating Vectors. J econ DYn control; 12:231e54.
- Johansen S, Juselius K. (1990). Maximum likelihood estimation and influence on cointegration with application to the demand for money. Oxf.Bull.Econ Stat:52:169 e210.
- Johansen, S., 1991, 'Estimation and Hypothesis Testing of Co-integration Vectors in Gaussian Vector Autoregressive Models', Econometrica,59, 1551 – 1580.
- Johansen S. (1991): Likelihood-Based Inference in Cointegrated Vector AutoregressiveModels, Oxford: Oxford University Press.
- Johansen S. (1995): Likelihood-Based Inference in Cointegrated Vector Autoregressive Models, Oxford: Oxford University Press
- Keynes, J. M., 1936. The General Theory of Employment, Interest, and Money. Macmillan Publication: London.
- Khan, M.S., &Senhadji, A.S., 2001, 'Threshold Effects in the Relationship between Inflation and Economic Growth' IMF Staff Papers 48(1), 1-21.
- Leeson, R., 1997, 'The Phillips Controversy: A Further Reply to Chapple', History of Economics Review 29(7), 97 – 106.
- Levine, R. and Zervos, S. (1 993): "What have we learned about policy and growth from cross-country regressions?, American Economic Review. 83, 426430.
- Lin J.L. and Tsay R.S., 1996, 'Co-integration constraint and Forecasting: An empirical examination', Journal of Applied Econometrics, 11(5), 519 – 538.

- Martin and P.Veerachamy (2017), Impact of inflation on economic growth: a survey of literature review, International Multidisciplinary Research Journal, golden research thoughts, Vol 5 Issue 10 April 2016
- Michael, Y., 2008, *'The Relationship between Inflation and Unemployment in Ethiopia'*. M.A.dissertation, Department of Economics. Addis Ababa University.
- Mallik, G., & Chowdhury, A., 2001, 'Inflation and Economic Growth: Evidence from Four South Asian Countries', *Asia-Pacific Development Journal 8(1)*, 123 – 135.
- Mallick, H., 2008, 'Inflation and Growth Dynamics: the Indian Experience', Journal of Economic Policy Reform 11(3), 163 – 172.
- Miftahu and Rosni 2017 "The Relationship between Inflation and Economic Growth in Nigeria: A Conceptual Approach",*School of Business Innovation and Technopreneurship, University Malaysia Perlis, Malaysia.*
- Ministry of Finance (MoF), 2000, Annual Report 1999/2000, Addis Ababa, Ethiopia.
- Ministry of Finance and Economic Development (MoF), 2010, Growth and Transformation Plan 2011 – 2015, Addis Ababa, Ethiopia.
- Ministry of Finance and Economic Development (MoF), 2011, Annual Report 2010/11, Addis Ababa, Ethiopia.
- Ministry of Finance and Economic Development (MoF), 2015, Annual Report 2010/11, Addis Ababa, Ethiopia.
- Mudell R. (1963): Inflation and Interest rate, Journal of Political Economy, Vol. 71 No. 3, 280-283
- Nathan Seth 2015, "assess the relationship between inflation and economic growth of Tanzania", Mzumbe University.
- Nyongesa, Eunice and Odhiambo (2017), "The Relationship between Inflation and Economic Growth in East African Community Countries", Department of Economics, Maseno University
- National Bank of Ethiopia (NBE), 2016, Annual Report 2016/17, Addis Ababa, Ethiopia.
- Pesaran H., Shin Y. and Smith R. (2001),"Bounds testing approaches to the analysis of levelsrelationships", *Journal of Applied Econometrics*, 16(3), 289-326.
- Phillips, P. C. B. and Perron, P., 1988, 'Testing for a Unit Root in Time Series Regression', Biometrika, 75(2), 335–346

- Phillips, P. C. B., 1958, 'Time Series Regression with a Unit Root', *Econometrica,* 55(2), 277 –301.
- Pindyck, R. and Solimano, A. (1993): "Economic instability and aggregate investment", NBER working paper 4380
- Pesaran, H. and Y. Shin (1997).An Autoregressive Distributed Lag Modeling Approach to Co-integration Analysis, Cambridge, England.
- Pesaran, H. and Y. Shin (1999).An Autoregressive Distributed Lag Modeling Approach to Co-integration Analysis, Cambridge, England.
- Pesaran, H., Shin,Y.,and R. Smith (2001). Bounds Testing Approaches to the Analysis of Level Relationships. *Journal of Applied Econometrics, 16(3)*:1924-1996
- Ramalho da Silva, D.F., 2011, 'Friedman, Phelps, Lucas and the Natural Rate of Unemployment', Paper prepared for the 12th annual Summer Institutefor the Preservation of the History of Economic Thought at the University of Richmond,1 – 44.
- Sidrauski M. (1967): Inflation and Economic Growth, Journal of Political Economy, Vol. 75No. 6, 796-810
- Seid , N. (2000). The Determinants of Economic Growth in Ethiopia, Msc. Unpublished Thesis, School of Graduate Studies, A.A.U, Ethiopia.
- Snowdon, B. & Vane, H.R., 2005, Modern Macroeconomics: Its Origins, Development andCurrent state, Edward Elgar, Cheltenham, U.K.
- Solow, R.M., 1956, 'A Contribution to the Theory of Economic Growth', Quarterly Journal of Economics 70 (1),65 – 94.
- Stock, J. H. and W. W. J. Mark. 2001. "Vector Auto regressions." March 2001
- Stockman, A. C. (1981). Anticipated Inflation and the Capital Stock
- Swan, Trevor W (1956). Economic Growth and Capital Accumulation. Economic Record 32.63: 334-361.
- Teshome, A. 2011, 'Sources of Inflation and Economic Growth in Ethiopia: Descriptive Analysis', *aiga forum web*, viewed 3 April 2012, from http://www.aigaforum.com/articles/Inflation_and_Growth_Ethiopia_Part1.pdf.
- Tobin J. (1965): Money and Economic Growth, Econometrica, Vol. 33 No. 4, 671-684.
- Todaro, M.P. (2000). Economic Development. Addison Wesley Longman, Inc., New York.

- Wiza Munyeka 2014, *"*The Relationship Between Economic Growth and Inflation in the South African Economy" *University of Limpopo (Turf loop Campus),*
- World Bank (2012): "Economic Overview of Ethiopia", available at http://www.worldbank.org/en/country/ethiopia/overview
- World Bank (2014): "Economic Overview of Ethiopia", available at http://www.worldbank.org/en/country/ethiopia/overview
- World Bank (2015): "Economic Overview of Ethiopia", available at http://www.worldbank.org/en/country/ethiopia/overview
- World Bank (2019): "Economic Overview of Ethiopia", available at http://www.worldbank.org/en/country/ethiopia/overview
- World economic outlook (October, 2018). International Monetary Fund. Washington D.C.
- Wooldridge J.M., 2002, *Introductory Econometrics a Modern Approach*, South-Western College, Cincinnati, OH.
- Wooldridge J.M. 2009. *Econometrics*, Cengage Learning, New Delhi.
- Xiao jing, Z., 2008, 'How Should China Handle Trade-offs between Growth and Inflation?, *China Economist*, May 2008, 76 – 85.

Appendix

Appendix: 1-Stationarity test

Null Hypothesis: LNRGDP has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on SIC, maxlag=2)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.40729412253481	0.14953289456436 66
Test critical values:	1% level	-3.71145682 9603194	
	5% level	-2.98103847 5104111	
	10% level	-2.62990625 2128804	

Null Hypothesis: D(LNRGDP) has a unit root

Exogenous: Constant

Lag Length: 2 (Automatic - based on SIC, maxlag=2)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.24476682 3516184	0.000324 16706978 54034
Test critical values:	1% level	-	

		3.752946349739781
	5% level	-2.998064246748113
	10% level	-2.638752385639290

Null Hypothesis: INF has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.223947964489927	0.000232617262096028
Test critical values:	1% level	-3.699871270134496	
	5% level	-2.976263487683370	
	10% level	-2.627419752877427	

Null Hypothesis: INV has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on SIC, maxlag=2)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		1.33668097 3420758	0.998146 3951736 744
Test critical values:	1% level	-3.69987127 0134496	
	5% level	-2.97626348 768337	
	10% level	-2.62741975 2877427	

Null Hypothesis: D(INV) has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on SIC, maxlag=2)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.913331487833393	0.006229465885932574
Test critical values:	1% level	-3.711456829603194	
	5% level	-2.981038475104111	
	10% level	-2.629906252128804	

Null Hypothesis: LNMS has a unit root

Exogenous: Constant

Lag Length: 2 (Automatic - based on SIC, maxlag=2)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.899991463838	0.326678 90812944 19
Test critical values:	1% level	-3.737853154385 66	
	5% level	-2.991878404846562	
	10% level	-2.635541896759123	

Null Hypothesis: D(LNMS) has a unit root

Exogenous: Constant

Lag Length: 2 (Automatic - based on SIC, maxlag=2)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.95339639090818	0.006373568889126681
Test critical values:	1% level	-3.75294634739781	
	5% level	-2.99806424674811 3	
	10% level	-2.63875238563929	

Null Hypothesis: LNIR has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on SIC, maxlag=2)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.584969339837725	0.0001
Test critical values:	1% level	-3.711456829603194	
	5% level	-2.981038475104111	
	10% level	-2.629906252128804	

Appendix 2: Bound test

Bounds Test	Null Hypothesis: No cointegrating relationships exist			
Test Statistic	Value	Signif.	I(0)	I(1)
	5.6446941			
F-statistic	566	10%	2.2	3.09
K	4	5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37

Appendix 3: long run equation of the model

Cointegrating Form				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	35691.18	12391.69	2.880252	0.0104
DLNRGDP(-1)	-0.883410	0.218250	-4.047688	0.0008
DLNINF*	-88.81643	467.7746	-0.189870	0.8517
DLNINV(-1)	0.599733	0.238250	2.517237	0.0222
DLNMS(-1)	0.613866	0.238806	2.570562	0.0199
DIR(-1)	-13858.13	6526.822	-2.123259	0.0487
D(DLNINV)	-0.003577	0.152822	-0.023407	0.9816
D(DLNMS)	0.260789	0.113676	2.294150	0.0348
D(DIR)	-3211.801	4304.206	-0.746201	0.4657

Appendix 4: Short run and Vector error correction term

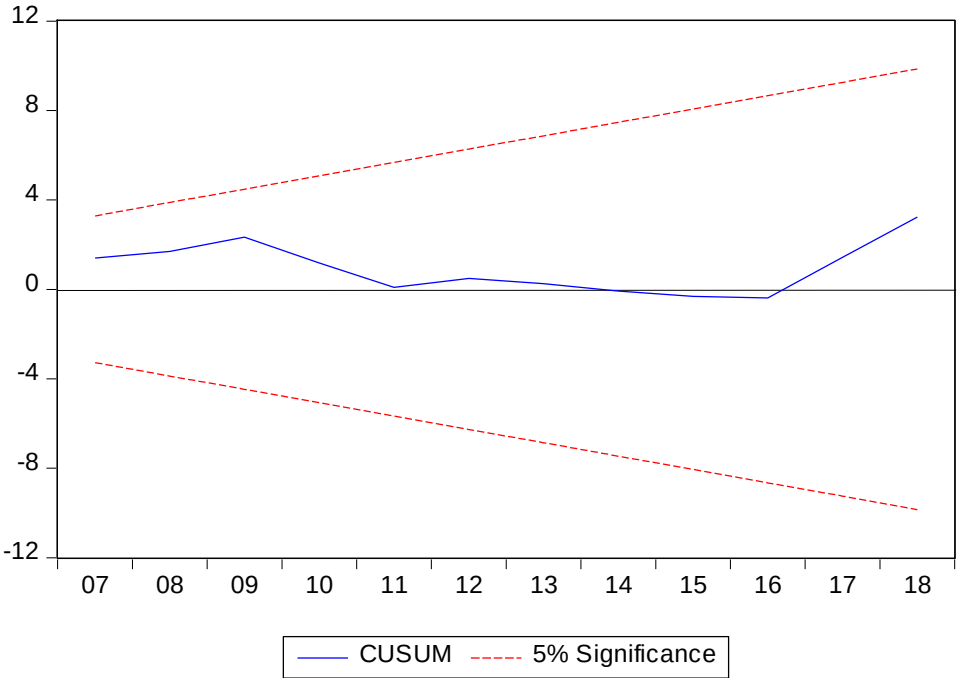
ARDL Error Correction Regression				
Dependent Variable: D(DLNRGD)				
Selected Model: ARDL(1, 0, 1, 1, 1)				
Date: 05/16/20 Time: 07:32				
Sample: 1991 2018				
Included observations: 26				
ECM Regression				
Case 2: Restricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(DLNINF)	-0.003	0.098	-0.036	0.9716
D(DLNINV)	-345.7	45.9812	-0.056	0.7164
D(DLNMS)	0.26078	0.060332	4.322594	0.0005
D(DLNIR)	-3211.80	2767.209	-1.160664	0.2618
CointEq(-1)*	-0.88341	0.169535	-5.210782	0.0001
R-squared	0.583699	Mean dependent var		5430.490
Adjusted R-squared	0.526931	S.D. dependent var		50911.63
S.E. of regression	35017.04	Akaike info criterion		23.90570
Sum squared resid	2.70E+10	Schwarz criterion		24.0992
Log likelihood	-306.774	Hannan-Quinn criter.		23.961
Durbin-Watson stat	2.142545			

Appendix 5: Autocorrelation

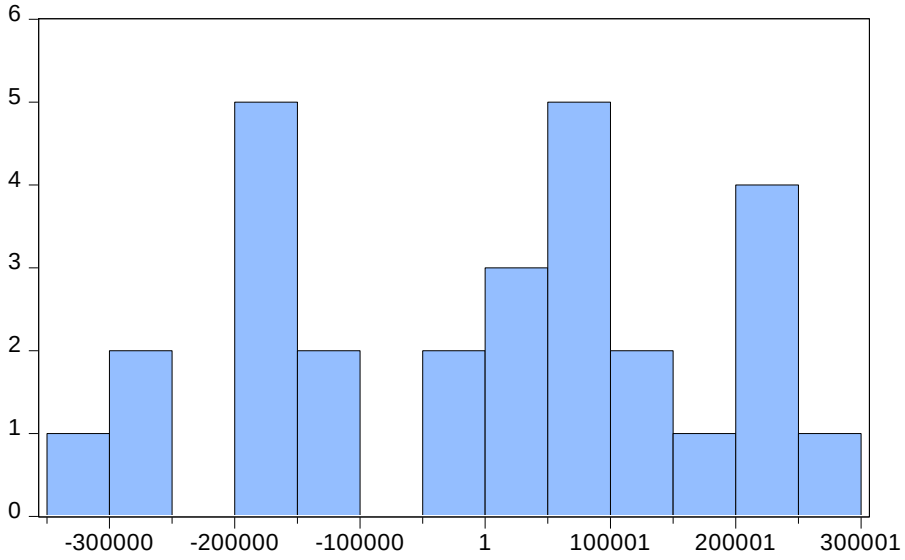
Breusch-Godfrey Serial Correlation LM Test:

			0.723298
	0.3346564		75985432
F-statistic	990477177	Prob. F(2,10)	88
			0.471050
	1.5055807		31705404
Obs*R-squared	20816601	Prob. Chi-Square(2)	51

Appendix 6: stability test



Appendix 7: Normality test



Series: Residuals	
Sample 1991 2018	
Observations 28	
Mean	4.16e-12
Median	31720.95
Maximum	272015.8
Minimum	-328288.8
Std. Dev.	175630.2
Skewness	-0.214710
Kurtosis	1.952433
Jarque-Bera	1.495433
Probability	0.473447