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THE RELATIONSHIP BETWEEN INFLATION AND VALUE OF IMPORTS IN ETHIOPA: AN AUTOREGRESSIVE DISTRIBUTED LAG APPROACH

BY

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DECLARATION

This is to certify that the dissertation prepared by Henok Tsedeke entitled "THE RELATIONSHIP BETWEEN INFLATION AND VALUE OF IMPORTS IN ETHIOPIA: AN AUTOREGRESSIVE DISTRIBUTED LAG (ARDL) APPROACH" and submitted in partial fulfillment of the requirement for the degree of Master of Science in development economics for the graduate program complies with the regulations of the university and meets the accepted standards with respect of originality and equity.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURE

LIST OF ACRONYMS

AIC	Akaike Information Criterion
ADF	Augmented Dickey-Fuller
ARDL	Autoregressive distributive lag
CSA	Central Statistical Agency
ECM	Error correction model
EDtGDP (%)	External debt to GDP ratio (%)
EPRDF	Ethiopian People's Revolutionary Democratic Front
GRM2	Growth rate of broad money supply
GRRGDP	Growth rate of real gross domestic product
GINF	General Inflation
IMF	International Monetary Fund
IMtGDP (%)	Import value to GDP ratio (%)
LIR	Lending interest rate
MoF	Ministry of finance
NBE	National Bank of Ethiopia
OER	Official exchange rate
OLS	Ordinary Least Square
WB	World Bank
WDI	World development indicator

ABSTRACT

Stable price is one of the main goals of any country and it's considered by governments and policy makers and hence investigating the main cause of inflation is of great importance. Thus, this study aims to examine factors affecting inflation in Ethiopia with a focus on the role of import value of goods and services. An ARDL bound testing model was employed to investigate the relationship using a data covering the years 1981 to 2019. The results reveals that import value to GDP ratio and money growth increases inflation both in the short run and long run; lending interest has an increasing effect in short run but decreases inflation in the long run; official exchange rate, external debt to GDP ratio and growth rate of real GDP have a significant negative effect on general inflation in long run; Whereas external debt to GDP ratio has a negative and insignificant effect on general inflation in the short run. But, growth rate of real domestic product has a negative and significant effect on general inflation in short run. Finally, based on the estimation result, the researcher recommends the concerned body to reduce the severity of inflation in the country. The exchange rate policy should be implemented that will be favorable to reduce the cost of imported capital goods and the government should look inward for supplying of raw materials locally promotes investment in the area where the required raw materials are available locally.

CHAPTER ONE

INTRODUCTION

1.1. Background of the Study

A sustainable and continuous rise in the general price level and then leads to fall in purchasing power is called inflation. The definition of inflation concern, not increase in price of a particular product nor for a short period of time (Mishkin, 2007). Inflation is found in all kinds of economies, at every stage of economic development, under every variety of government and within all kinds of political, economic and social atmospheres. (Friedman, 1970) The cause of inflation is mainly either an increase in the money supply or a reduction in the quantity of goods being supplied.

Ethiopia has experienced rapid and continuous economic growth and development changes between 2005/06 and 2015/16 and international observers have appreciated Ethiopia's growth in the last decade and in particular in the second half of the decade by including the continental economic institutions such as the Economic Commission for Africa (ECA, 2007). Government expenditure have grown considerably, there has also been fast increase in money supply mainly as a result of growth in fiscal deficits. Studying the linkage between price developments and various macro-economic variables will, therefore enable us to understand the causes of the current inflation in Ethiopia (Alemayehu G., 2011).

The country has achieved eminent economic growth averaging 10.6 percent for almost half a decade since 2004 (World Bank, 2013) which is twice above the continental average (Mwanakatwe & Barrow, 2010). Based on the report, the expansion of agricultural growth and the service sector contributed most, while the contribution of the manufacturing sector was relatively modest.

According to National Bank of Ethiopia (2019) data shows that before 2004 the annual inflation rate of Ethiopia was 2.5 percent, but after 2004 it raised to 15.1 percent. By using political economic arguments, pointed out that traditionally, Ethiopia was not a country that experienced double digit inflation until 2004. Inflation rates trended upward after 2004 and this could be attributed to post-election 2005 development financing. The government was unable to secure

adequate foreign assistance because of prevailing political instability prevailed and it resorted to inflationary finance, financing by money creation (Assefa, 2015).

The Inflation dynamics and macroeconomic stability in Ethiopia by decomposition approach, for create a stable economic environment the government should work on managing the disequilibria, adjusting the welfare cost of inflation, supporting the supply side of the economy, efficiency in cooperation between the central statistics agency and the monetary authority is extremely important and also high quality institutions and independence of the central NBE significant role (Atnafu G., 2020).

Even though there is an extensive empirical literature on inflation in the case of developed and emerging countries, very few studies have looked at this issue from the perspective of developing countries. However, for developing economies like Ethiopia who import large amount goods and services from abroad, the investigation of inflation on import and consumer prices is an important issue. Therefore, the main purpose of this study is to examine the degree of import values of goods and services and inflation in the case of Ethiopia.

1.2 Statement of the Problem

To see the historical Ethiopian inflationary experience was moderate and not considered as series as the issue of economic growth which means it is not bad (Ayalew, 2007). However, recently the country has experienced high and persistent inflation growth which hinders the country economic growth. Several macro-economic stabilization measures and policies were implemented over the past and deemed to be completely failed. The booming economy has yet remained principally constrained by dual macroeconomic problems i.e. Price inflation and low international reserves (Barrow, 2010).

Even if no one disputes over the highly volatile inflationary experience in the country except with slight differences in the exact figures, there are enormous disagreements by elite group about the real causes of inflation and their magnitude of effects. There existed a number of potential sources as explained by several scholars and researchers. For instance, Government bodies, while expressing their solutions to the prevailing high level of inflation, put certain factors as the main sources of inflation. They have strong conviction that the sustained economic growth could generate upper price hike i.e. inflation due to high Aggregate demand. Similarly,

the World Bank report in (2013), declared that the main source of inflation in the country is the mounting aggregate demand due to the growth of Private consumption and public investment, out of which the latter has due importance in explaining the recent inflation.

Nevertheless, some writers have different views. From which, Loening (2009) as cited by Habtamu, a large fraction of the county's inflation is explained by foreign price and agricultural supply shocks and money growth. Hassan (2008) argued that the reasons behind the mounting inflation are neither the growing economy nor the Ethiopian peasantry getting richer than before. He rather pointed out a number of responsible factors, including money growth, lower interest rates, the soaring oil prices, war expenditures, declining foreign exchange reserves, budgets and current account deficits and so on. The African Report posted in August (2003), presented an argument explaining that Ethiopian inflation was mainly attributed to the service sector expansion mainly due to the injection of huge liquidity in the financial system. The writer stated that the country should continue to adopt tight monetary policy to effectively combat inflation. According to (Martin, 2009), the loosed fiscal stance and external price shocks have left Ethiopia to be more vulnerable to price spikes. According to the IMF and World Bank (2013), fiscal mismanagement and excess government expenditure were found to be the most detrimental factors behind the soaring price inflation in the country.

So far, there is no strong understanding by elite on the key sources of inflation in the country. Some argued that the main determinants of inflation in Ethiopia are imports and devaluation of local currency (Asayehgn, D. 2009); but, according to Kibrom T. (2008) the most important determinant of inflation in the long run are mainly domestic monetary development while cost push factors are the force behind short run inflation. He also stated that in the long run domestic food price influenced mostly by income growth, inflation expectation, money supply growth and increase in aggregate price. While he finds determinant of non-food inflation are found to be inflation expectation, money supply growth and interest rate. He also states in the short run, both demand and supply appear important in the current inflationary process, with supply factors having the edge over the demand factors.

There are many researchers made on the determinants of inflation both around the world and in Ethiopia. Moreover there are also researchers made on inflation of different components like food, non-food and agriculture and inflation and money supply relationships. While, there are no

much more studies on import component determinants of inflation in Ethiopia. However, import is one of the major determinants of inflation. Thus, the study mainly focuses on the effect of import value of goods and services on inflation in Ethiopia by using recent time serious data.

Additionally, this study contributes inflation in three dimensions. First, it captures the dynamics of inflation by using appropriate macro-econometric model. Second, the findings may help to diffuse the more general pessimism that can underestimate the non – monetary determinants of inflation. Third, many studies are done on inflation however; they did not address the real root causes of inflation in Ethiopia. So, this study identifies the secrets that cause inflation. More specifically this study investigate from the deamination of policy effective in which is that the government implementation problem or ignorance of the people in accepting the policy. Therefore, the study make empirical investigation on the causes of inflation in the Ethiopian economy by incorporating imported inflation in addition to money supply, real lending interest rate, external debt, exchange rate and real GDP.

1.3 Objectives of the Study

1.3.1 General Objectives

The main objective of the study was to examine the relationship between import values of goods and services and inflation in Ethiopia.

1.3.2 Specific Objectives

a) To assess the size, trend and composition of inflation in Ethiopia.
b) To estimate the relationship between inflation and imported value of goods and services.
c) To identifying the main causes of inflation.

1.4 Research Questions

The research objectives stated earlier necessitated the need for the research questions. So the research questions are as follows:

i. What are the size, trend and composition of inflation in Ethiopia?
ii. What is the relationship between imported value of goods and services and inflation in Ethiopia?

iii. What are the main causes of inflation?

1.5 Hypothesis of the Study

Based on the empirical literature on the relationship between import value of goods and services and inflation, the hypothesis will built around the specific objectives and assess the following relationships.

i. There is a negative and insignificant relationship between import value and inflation in Ethiopia;
ii. There is positive and significant relationship between import value and inflation in Ethiopia; and
iii. There exists a causal relationship between import value and inflation in Ethiopia.

1.6 Scope of the Study

The study is limited to the case of Ethiopia. In addition by considering the broadness of the concept of inflation, the study is delimited to investigate the relationship between inflation and imported value of goods and services in Ethiopia using time serious data that cover the year from 1981 up to 2019. The study period is selected purposely based on the data availability. On the other hand, due to the sensitivity nature of the indicators from the general macroeconomic point of view, the study may not carry out a thorough examination of each macro-economic indicator; perhaps principally focus on exploring the causal relationship.

1.7 Significance of the Study

Most importantly, the study expected to raise the interest of experts as input for world research to work on inflation since inflation has a wide range of impact on the socio-economic and political system of the country. It will also serve as a literature review for those working on inflation. The study also serves as a mirror in showing the policy direction of the government to mitigate inflation.

1.8 Organization of the Study

The rest of the paper organized as follows. Following this introductory chapter, chapter two presents the review of theoretical and empirical literatures. In chapter three methodologies and

model specification presented. In the fourth chapter descriptive analysis and analysis of results of econometric model made. Finally chapter five presents the conclusions and policy recommendations of the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Theoretical Literature

2.1.1 Definition of Inflation

Inflation is defined as a persistent increase in the aggregate price level, it use money as a units. The inflation rate is annualized percentage growth of some broad index of money prices (White L.H., 2008). According to Neoclassical definition inflation is a galloping general rise in prices caused by excessive increase in the quantity of money supply. For Keynesian it is increase of money supply beyond full employment level (Jhingan, 1997).

According to Dornbusch et al. (2001) there are different measures of inflation, among those the most common measure of inflation are the Consumer Price Index which is, it measures the cost of buying a fixed basket of goods and services representative of the purchase of consumers, another measure of inflation is GDP Deflator it is the ratio of nominal GDP to real GDP, it includes all the goods produced with in a country domestic territory but not included the import goods and also Producer Price Index (PPI) is a weighted index of prices measured at the wholesale, or producer level, as the Consumer Price Index measures the cost at the consumer or household level.

2.1.3 Types of Inflation

Economist's classified inflation in to various types mainly into three major categories, based on rate of inflation, causes of inflation and government reaction.

2.1.3.1 Based on the Rate of Inflation

Inflation can be moderate, running and hyperinflation. Moderate inflation is an average and normal form of inflation, which is not bad for the economy. However, when the movement of price accelerates rapidly, running inflation emerges. Running inflation may record more than one handed percent rise in prices over a decade. Thus, when price rise more than ten percent a year, running inflation occur, On the other hand, under the hyperinflation the prices raises every movement and there is no upper limit to the price rise. The classical examples of hyperinflation

are the great inflation of Germany after the world war first and the great inflation of china after the world war two (Mithani 2001).

2.1.3.2 Based on Government Reaction to the Inflation

Government and monetary authorities react to the inflation level based on the economic system they follow and accordingly, there is open and suppressed repressed type of inflation among this classification one is Open Inflation according to Milton Friedman in this type of inflation prices are allowed to rise without any government intervention, If the inflation is not checked by the government policies the creeping inflation changes to walking-running-galloping and finally to hyper-inflation. However, this type of inflation may prevail well without negatively affecting the economy in the market economy where the price mechanism works efficiently but price always fails for various reasons. Secondly Suppressed Inflation, which is refers to a situation in which the government intervenes directly to control the price system through various measures because no government can allow the price to rise beyond limits; especially during war periods we find that to avoid the harmful effects of rising prices, controls and rationing may be imposed which prevent households and firms from buying as many goods and services as they would like to buy at existing price and income levels. In general, if existing inflation is disguised by government price control or other interferences in the economy such as subsidies is called suppressed or repressed inflation (Dutta, 2015).

2.1.3.3 Based on Causes of Inflation

There are demand pull and cost push theories in related with the cause of inflation; Cost push inflation it occurs when businesses respond to rising production costs, by raising prices in order to maintain their profit margins. Higher costs shift a firm's supply curve upwards and leads to an increase in price. Ceteris paribus a fall in aggregate supply causes a contraction of real national income (Jhingan, 1997). And also the second is Demand pull inflation it refers to a rise in price due to aggregate demand in an economy is greater than the aggregate supply (Stanley, 1986). Demand-pull inflation often results at higher levels of employment or when employment is increasing in an economy. As more people have jobs, the aggregate demand in an economy increases. More people with money want more goods and services. Firms will try and hire more people to keep up with demand. As more people are hired and earn money, demand continues to

increase for even more goods, and the cycle continues. Each time aggregate demand (AD) increases, price rises and inflation results.

2.1.4 Theories of Inflation

A basic source of difference in the macro economic analysis of advanced and developed economies, according to Porter and Ranny (1982) is the dramatic difference between them in the structure and activities of their markets for financial assets. In the developed economy, market operations are smooth which is manifested through well-developed financial, goods and resource market. There are no much pronounced structural rigidities in these economies thus viewing the inflation case of developing economies separately is compulsory and the monetarist and structuralist explains the cause of inflation as follow.

2.1.4.1 The Monetarist Thinking (Quantity Theory of Money)

Monetarists suppose the most vital factor manipulating inflation or deflation is the management of money growth in an economy in the course of the easing or tightening of credit. They believe that fiscal policy is ineffective in controlling inflation. The monetarist model formally proposed by Friedman (1968, 1970, and 1971) and empirically tested by Schwartz (1973) simply stated that the major factor explaining the current rate of price inflation is the past conduct of money to output ratio. In Friedman's (1968) words, "Inflation is commonly and everywhere a monetary phenomenon".

Quantity theory supposes that real output is determined solely by real factors in the long run and prices are determined entirely by the money supply. Afterward Monetarists, by augmenting the expectations in their model, argue that though inflation could be effected by factors other than money in the short run yet there exist no long run connection between money and the real variables of the economy. In the developing countries the notable macro-economic factors that explain inflation is money supply (Saini, 1982). A huge government spending is the main source of excess money supply.

The monetarist proclaimed that excess money is the main factor for wider fluctuations in output and employment in the short run and price in the long run. In view of that, expansionary monetary policy aiming to push employment and output is assumed to cause inflation.

2.1.4.2 The Structuralist Theory of Inflation

The structuralist argues that by the very nature of their economies, the less developed countries are prone to inflation. The reason to this argument is that there exist structural rigidities or bottle necks namely; economic, institutional and socio-political factors in these countries, which in one way or the other impede expansion of output (Nill, 2004)

Generally, the underlying factors behind inflation in this theoretical framework includes low agricultural growth, administered industrial prices (due to input supply deficiency or excess demand due higher industrial employment), and inactive monetary stance (Cardoso, 1981). Furthermore, the presence of oligopolistic market and infant industries by virtue of inefficient and costly production and imperfect competition respectively overburdens inflation through the price control mechanism.

2.1.4.3 The Keynesian Theory of Inflation

Keynes (1940). Increase in general price levels or inflation is created by an increase in the aggregate demand which is greater than the increase in aggregate supply. The Keynesian inflation theory contends that in the presence of pressure from organized institutional forces of trade unions for increased wages, prices rise in excess of any rise in production in the absence of excess demand in the market. Another variant of Keynesian theory of inflation, which takes cognizance of level of unemployment as a determinant of inflation contends that price level in the short-run depends not only on the flow of money but also on the level of unemployment. The theoretical basis of this theory is that if the sum of private consumption (c), private investment (I), government expenditure (G) as well as foreign sector (N), that is, expenditure exceeds the full employment output, an inflationary gap results which causes price to rise. Thus inflation depends on excess demand relative to output.

2.1.4.4 Imported Inflation Theory

(Jombo, 2014), One of the very problematic channels which domestic price inflation in Ethiopia is affected by the exchange rate pass-through effect. Through this channel, currency devaluation is immediately affects the domestic price. The extent to which exchange rate pass-through affects the domestic price inflation mainly depends upon the cost and weight of imported goods. (Mishkin, 1995), under a floating exchange rate regime, a short run shock in the foreign sector

drifts into the domestic inflation and the fiscal imbalance. In summary, for the reason that supply is strongly rigid owing to the structural factors and inadequate purchasing power of exports (which prevents sufficient food imports), increasing demand for agricultural products induce higher prices.

2.2 Review of Empirical Literature

For macroeconomic imbalance economy like Ethiopian economy, assessing factors influencing macroeconomic balance is very important. In the past, several studies have attempted to assess the growth impact of inflation. So in this section, it is tried to survey the most prominent findings. The first part other country studies and the second part handles Ethiopian studies.

2.2.1 Other Counties Studies

Lim and Pap (1997) in this study of determinants of inflation in Turkey used the annual data from 1970-1975 within the framework of multi-sector macro-economic model. The major findings were that monetary variables (money supply and exchange rate), inflation inertia and public budget deficit plays a central role in the inflationary process of turkey.

Laryea and Sumalia (2001) in Tanzania examined the determinants of inflation using an error correction model and OLS technique for the period of 1992-1998 was used. The result of the econometrics analysis shows that inflation in Tanzania either in short or long term was influenced by monetary factors and to less extent by volatility in output and depreciation of exchange rate.

Kabundi (2012) has tried to identify the main factors underlying inflation in Uganda, both in the long - and short-run, using monthly data from January 1999 to October 2011, the study uses a single-equation Error Correction Model (ECM). The study result shows that internal and external factors affect the inflationary pressure in Uganda. In the long-run, money growth, world food prices, and local supply and demand effects in agricultural sector are main determinants of inflation in Uganda. Whereas money supply growth, world food prices, and energy prices, combined with local food prices have a short-run impact on inflation.

2.2.2 Empirical Studies in Ethiopia

Ahmed (2007) in his study of structural analysis of price drivers in Ethiopia used quarterly data from 1997-2006.The researcher used Micro-analysis, based on accounting equation, not on an econometric model and the analysis finding was that inflation is a function of money supply positively and real output negatively in the short run but in the long run money supply positively is the significant variable.

Research done by Ayalew (2007) examined the current sources of inflation in Ethiopia using the quarterly data from a year 1997-2006 employing the vector error correction model. The study tells us money supply, exchange rate and output affects inflation in the short run but in the long run monetary variables; money supply and exchange rate plays a significant role in the inflationary process of the nation's economy.

Loening (2008) analyzed short-run dynamics of inflation in Ethiopia, using a parsimonious error correction model fitted with monthly observations from 1997-2008. The finding shows that increased money supply and the nominal exchange rate significantly affect inflation in the short run. Agricultural output shocks, proxies by a cereal-weighted agricultural production index, are also important. The findings suggest that monetary policy in Ethiopia triggers price inertia, which has large and persistent effects and simulation suggests that monetary policy alone may be unfeasible to control inflation effectively.

Alemayehu and Kibrom (2008) studied the determinants of inflation in Ethiopia using data from 1994-2007. The study employed VAR model and the finding shows world commodity price, wage and exchange rate are sources of inflation positively in the short run. Food price, real output and money supply affects inflation positively in the long run.

Zewdu (2010) studied the investigation of inflation spiral employing the augmented monetarist and structural models and using the annual data from 1967-1994.The main sources of inflation in the short run according to the finding are nominal exchange rate and money supply while real output ,imported price and government expenditure affects significantly in the long run. Seifu (2011) investigated the multivariate time series analysis of inflation using the data from 2000-2010 and employed VAR model and granger causality test. The finding investigated that food price inflation affects significantly and positively.

Eden (2012) analyzed modeling inflation volatility and its impact on economic growth using the annual data from 1991-2011 and co-integrated VAR model and Granger causality test was employed. The major finding of the study was agricultural supply negatively and money supply positively in the short run and exchange rate and real output positively in the long run.

Girma (2012) studied the relationship between economic growth and inflation using the annual data of 1980-2011.The co-integrated VAR and vector of error correction (VECM) models were employed and the finding reveals that money supply positively and real output negatively affects the inflation process in the short run. In the long run exchange rate positively and real output inversely play a central role in the inflation of Ethiopia.

Haji & Gelaw (2012) examined the determinants of the recent soaring food inflation in Ethiopia using the data from 1997-2010.The model employed was VECM and Johansson co-integration test and the finding shows that money supply, exchange rate, food price and world commodity price affect inflation positively and oil price negatively in the short run. In the long run real output positively plays a considerable role in determining the inflationary process of Ethiopia.

Temesgen (2013) studied the determinants and impacts of inflation considering the data from 1998-2010 using Granger causality model approach. The finding shows as money supply, oil price and nominal exchange rate are the main sources of inflation in the short run and real output positively in the long run, and also Habtamu, G. (2015) Studied A Macro Econometric Approach Explaining that the Causes and Dynamics of Price Inflation in Ethiopia the model he employed was vector error correction model and the main finding reveals that money market, agricultural market and external market determines price inflation in the long run.

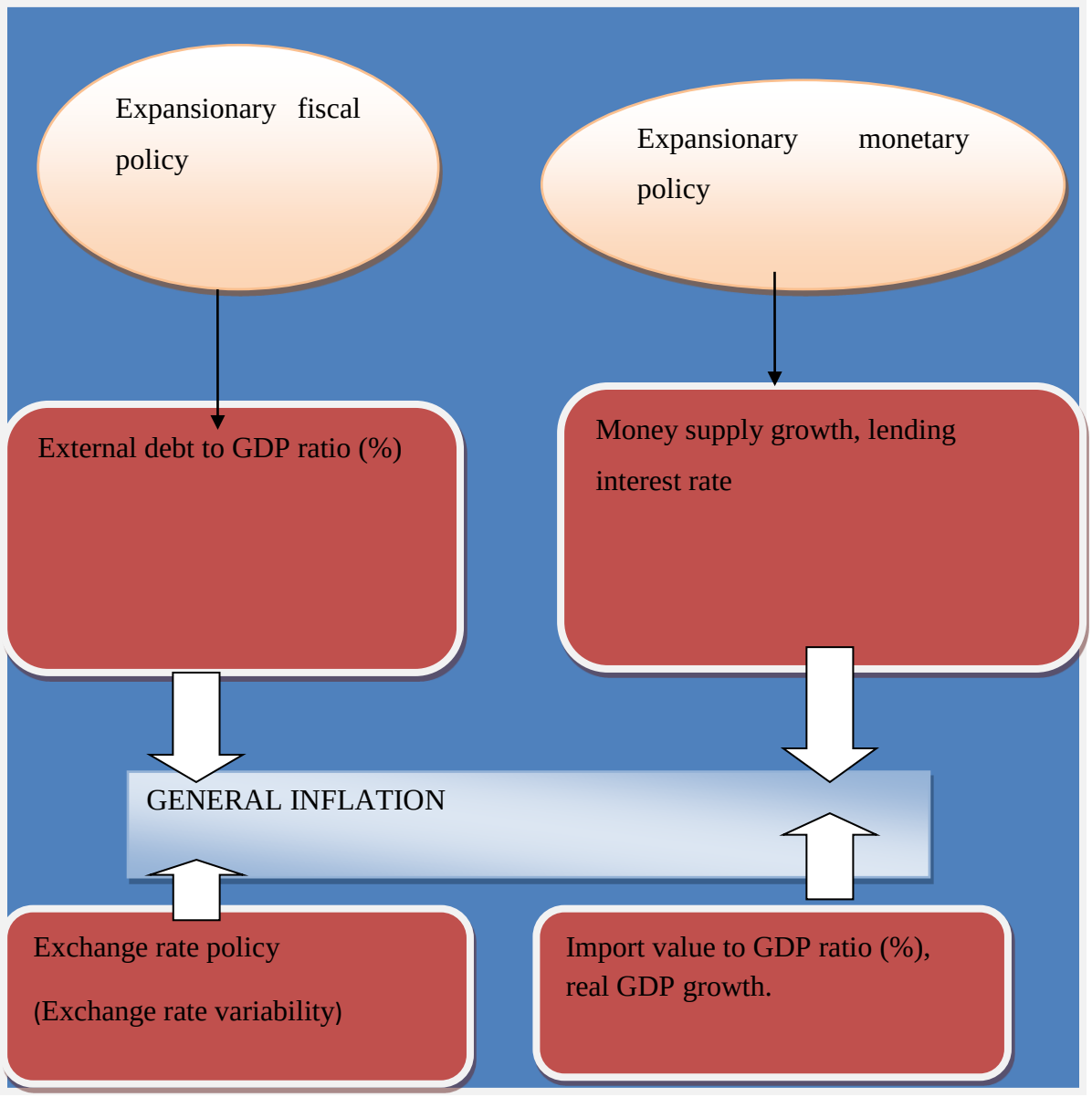
Jonse, B. (2018) on the other hand studied the Dynamics and Determinants of Inflation in Ethiopia by employing autoregressive distributive lag model, and the researcher finding shows that inflation is mainly caused by money supply.

Atnafu, G. (2020) studied the Inflation Dynamics and Macroeconomic Stability in Ethiopia by using a decomposition approach, the finding shows that the Construction materials and money growth rate are highly contributed to inflationary pressure.

2.3 Conceptual Framework of the Study

According to the literature survey, the conceptual framework for understanding the determinants of general inflation can be broadly classified into two. The first is cost push side determinant of inflation; it arises due to continuous decline in aggregate supply. This may be due to bad weather, increase in wage, or the prices of other inputs. And the second is inflation arises from demand side, for example broad money supply. In addition to this the study plans to investigate the exact relationship between import value of goods and services and inflation. Furthermore, the paper expected to give answer the question what are the tangible determinant of inflation in Ethiopia i.e. exchange rate, import to GDP ratio, external debt to GDP ratio, lending interest rate and growth rate of real GDP (Yen Chee Lim and Siok Kun Sek, 2015)

Figure 2.1: Conceptual framework



***Source**: own construction (by taking the theoretical and empirical review)*

CHAPTER THREE

DATA AND METHODOLOGY

In this chapter discuss the data used for the study and the methodology employed to meet the objective of the study. The chapter basically focuses on how the entire study done. Issues such as data sources, definitions of variables, model specification, and estimations procedures covered in this chapter.

3.1. Data Sources

To achieve the basic objective of the study, the study use secondary data sources and the necessary data required for the study obtained from different secondary data sources collected from mainly National Bank of Ethiopia, in reference such as Ministry of Finance and Economic Corporation (MoFEC), Ethiopian Economic Associations, world development indicator (WDI) and World Bank. The data analyzed via both descriptive and econometrics regression analysis. The descriptive method used to assess trends of inflation within specified time period 1981 to 2019, whereas, the time series econometric technique used to estimate the long run and short run relationship among determinant variables of inflation in Ethiopia.

3.2. Method of Data Analysis

The paper use both descriptive and econometric techniques. Time series econometric techniques are employed to estimate the impacts of the various explanatory variables on the measure of inflation.

3.3. Model Specification

The selection of variables and empirical analysis will be based on the theory and discussions. Model specification refers to a mathematical demonstration of the relation between variables. Hence inflation rate is specified as a function of money supply growth rate, real lending interest rate, external debt to GDP ratio, official exchange rate, and economic growth rate and import value to GDP ratio. Based on the theoretical grounds monetarist and structuralist school, the following model is specified to explain inflation in Ethiopia. The model is stated as follow:

GINFt=F (GRM2, OER, GRRGDP, EDtGDP, LIR and IMtGDP,)…….... (3.1)

Where GINF = general inflation rate

GRM2 = growth rate of broad money supply

OER: Official exchange rate

GRRGDP = growth rate of Real GDP

EDtGDP: External Debt to GDP ratio

LIR = lending interest rate

IMtGDP = Import to GDP ratio

3.3.1. Definition of Variables

1. **General Inflation Rate** (GINF): General inflation rate refers to the monthly or annual percentage changes in the price of a fixed basket of goods and services. The Ethiopian inflation rate is commonly measured by the percentage change of CPI, which is determined on the basis of precise representation of the weighted price index.

2. **Broad money supply** (M2): Broad money supply (M2) is defined as currency outside the bank, net demand deposit and quasi money. Growth rate of broad money supply is the percentage increase in the money stock and it is expected to have a positive relationship with the overall inflation.

3. **External debt to GDP (EDtGDP):** it is an accumulation of annual loans entered into the government and creditor nations and lending institutions, then divided it by GDP.

4. **Lending interest rate** (LIR): It is the interest adjusted for inflation paid by the borrowers for the use of money borrowed from Commercial Bank of Ethiopia. According to the Keynesian economic theory growth rate of interest rate is expected to have a positive relationship with the general inflation rate.

5. **Exchange rate** (ER): exchange rate is the price of one currency in terms of another currency or the rate at which one currency can be exchanged for another. Devaluation or depreciation of

exchange rate speed up inflation rate whereas revaluation or appreciation keeps inflation low, so it is expected to have a positive relationship.

6. **Real GDP Growth** (RGDPG): It is commonly called constant price GDP and the percentage change in real GDP is called economic growth or growth rate of real GDP .Economic theory tells us that increasing real GDP has a price depressing effect thus it is expected to have a negative sign Fisher (1993).

7. **Import to GDP (%)** (IMtGDP): Import to GDP is the percentage ratio of import value to GDP.

3.4. Econometric Analysis

In time series analysis, before estimating the empirical model given in section 3.3, one has to do a battery of tests to ensure that the regression is not spurious. A regression is said to be spurious when the test diagnostics show promising result while the regression analysis has no meaning (Gugarati, 2003). Therefore, before estimating the empirical model, we conduct stationary and co-integration tests.

3.4.1. Stationary Test (Unit ROOT TEST)

When we come to time series data, it is necessary to assess whether the series is stationary or not. This is because it shows the presence of unit roots has implications for model building, estimation strategy, and statistical inference. Regression of a non-stationary series on another non-stationary series leads to what is known as spurious regression. This occurs when the regression results reveal a high and significant relationship among variables that may appear to be significant when there is no meaningful relationship between the dependent variable and the explanatory variables. Time series data are noted of carrying past memories. This implies past events do influence current and future events.

The data series contains a unit root then the exogenous disturbances have permanent effects on the variable in question in the sense that the effects of the shocks do not disappear over time. That is, shocks to such a variable have permanent effects. On the other hand, if there is no unit root in the data series then exogenous disturbances only have transient effects in the sense that the effects of such disturbances die down over time and, in the long-run, the variable reverts back

to its long-run path. Thus, statistical tests of the parameters resulting from unit root regression may be biased and inconsistent. Thus, to eliminate the possibility of these spurious regressions and erroneous inferences, the study determined the order of integration of these series through unit root tests both in the levels and in the first differences.

Differencing is one way to remedy non-stationary, though this would lead to loss of long run information. A series that is differenced *d* times to achieve stationary is said to be integrated of order *d* that is I(d).A non-stationary series has a unit root or more, and is therefore differenced to make it stationary and hence it is integrated of order one, I(1) or higher. By contrast, a stationary series is time-independent, has short memory, constant mean, finite variance, transitory innovations and reverts to its mean or equilibrium value. A stationary series has no unit root and does not require differencing, hence it is integrated of order zero, that is I (0) and it does not have estimation problems. Several tests are employed to test for unit roots. The augmented Dickey-Fuller (ADF) and the Phillips-Peron are considered reliable and as such accepted by many in econometric analysis for the test for unit roots and are employed in the study.

The ADF tests the null hypothesis of the series y_t is integrated order one against it is integrated of order zero. The test is based on the estimation of a test regression which is stated below in a general form where an intercept and trend is included.

$$\Delta Y_t = \alpha_0 + \alpha_1 t + \Phi\, y_{t-1} + \beta \sum_{j=1}^{p} \Delta y_{t-1} + \varepsilon_t$$

Where: Y_t is the variable in the model to be tested for stationary, α_0, $\alpha_1$and β are parameters to be estimated, p refers to maximal lag length, Δ is the first difference operator and ε_t is the error term.

The null hypothesis is $\Phi=1$ against an alternative hypothesis of $\Phi<0$. A rejection of the null hypothesis means that the time series is stationary or it does not contain a unit root while accepting the null indicates that the time series is non-stationary. The computed value will be compared with critical values to determine whether the series are stationary or not.

An additional test employed in this study to examine the existence of unit-root in the variables is the Phillips-Perron Test, which is first suggested by Phillips and Perron (1988). The PP test differs from ADF test in that it does not take lagged difference terms into account for a potential

serial correlation in the error terms; instead it uses non-parametric statistical method. Both PP and ADF have the same asymptotic assumptions and a caveat of these tests is that the tests have low power in cases where first-order autocorrelation coefficient is close to one under alternative hypothesis.

3.4.2. Co Integration Test

Most econometric literature provides different methodological procedures to empirically examine the long-run relationship and dynamic interactions between two or more time-series variables. The most commonly used methods include the two-step residual based procedure for testing the null hypothesis of no co-integration which is attributed to Engle and Granger (1987) and Phillips and Ouliaris (1990) and the full information maximum likelihood-based approach of Johansen (1988) and Johansen and Juselius (1990).There are also other procedures such as the variable addition approach of Park (1990), the residual-based procedure for testing the null of co-integration by Shin (1994) and the stochastic common trend (system) approach of Stock and Watson (1988) (Pesaran *et al.*,1999).

All these methods require that the variables under investigation should be integrated of order one. This normally involves a step of stationarity pre-testing, by introducing a certain degree of uncertainty into the analysis. Furthermore, these tests suffer from low power and do not have good small sample properties (Cheung and Lai, 1993). From the above problems, we make use of a newly developed approach to co-integration that has become popular in recent years. The Bound Test approach to co integration developed by Pesaran and Shin (1999) and further explained by Pesaran et al. (2001) is adopted for this study. The procedure is adopted for the following reasons.

The first one of the reason is, the bounds test procedure is simple. As contrary to other multivariate co integration techniques such as Johansen and Juselius (1990), it allows the co integration relationship to be estimated by OLS once the lag order of the model is identified. Secondly, the bounds testing procedure does not require the pre-testing of the variables included in the model for unit roots unlike other techniques such as the Johansen approach. It is applicable irrespective of whether the regressors in the model are purely I(0), purely I(1) or mutually co integrated. Besides, endogeneity and serial correlation problems, that exists in many empirical

studies, and inability to test hypothesis on the estimated coefficients in this study in the long run associated with Engle and Granger (1987) method is avoided (Pesaran and Shin, 1999).

Apart from this, the long run and short run parameters of the model under consideration are determined simultaneously. Thirdly, the test is more efficient in small or finite sample data sizes relatively than others. Estimates derived from Johansen-Juselius method of co-integration are not robust when subjected to small sample sizes as compared to bounds test. Fourth as the name suggests, this approach allows both the dependent and independent variables to enter the model with lags, thereby allowing the past values of variables to determine its present values. This flexibility in terms of the structure of lags of the regressors is particularly plausible because reactions to a change in each variable may be different depending on various factors and in some cases they may respond to the changes in underlying factors with a lag; thus there is usually no reason to assume that all regressor should have the same lags as suggested by the co-integration VAR models, where different lags for different variables are not permitted (Pesaran*et al.*, 2001).

The main reason we are interested in co-integration is to examine if there is a long-run relationship between variables because making a variable stationary by differencing it only shows the short-run dynamics. Besides, conducting co-integration tests is crucial as one cannot estimate error correction model (ECM) when the variables do not have a long-run relationship.

The ARDL approach requires three steps. The first step is to check the existence of long run relationship among the variables of interest that is determined by F- test. The second step requires the estimation of long run relationship and to determine their values, thereafter the short run elasticity of the variables with error correction representation of the ARDL model. This application of error correction version of the ARDL model is mainly to determine the speed of adjustment to the equilibrium. Meaning that the ECM estimates the speed at which our dependent variable returns to the equilibrium given the change in the independent variable .The study proceeds to estimate the short run and long run relationship by following the Unrestricted Error Correction Model (UECM) which is unrestricted intercepts and no trends based on the assumption made by Pesaran et.al (2001).

The ARDL bounds test modeling involves estimating unrestricted error correction model (UECM) using OLS (Narayan.K.M and Smyth.R, 2004). And the model in this specific case can be stated as:

$$GINF=\beta0+\beta1\Sigma\Delta GINFt\text{-}i + \beta2\Sigma\Delta GRM2t\text{-}i + \beta3\Sigma\Delta OERt\text{-}i + \beta4\Sigma\Delta GRRGDPt\text{-}i + \beta5\Sigma\Delta EDtGDPt\text{-}i + \beta6\Sigma\Delta LIRt\text{-}i + \beta7\Sigma\Delta IMtGDPt\text{-}i + \alpha1GINF\ t\text{-}1 + \alpha2GRM2t\text{-}1 + \alpha3OER\ t\text{-}1 + \alpha4GRRGDPt\text{-}1 + \alpha5EDtGDPt\text{-}1 + \alpha6LIRt\text{-}1 + \alpha7IMtGDPt\text{-}1+\varepsilon t \quad \text{.....3.2}$$

Where β1, β2, β3, β4, β5, β6, and β7 are characterizing the coefficients of the short run dynamics of the model whereas, α1, α2, α3, α4, α5, α6, and α7 are coefficients show the long run relationship. To test the presence of long run relationship between the underlying variables, the above equations is estimated using OLS and to test the significance of lagged levels of the variables in this study, the appropriate test statistics is the familiar F or Wald test under the generalized Dickey-Fuller types of regressions in an unrestricted error correction regression. The null hypothesis for test of long run co-integration is stated as:

$$H0:\alpha1= \alpha2= \alpha3= \alpha4=\ldots\ldots = \alpha7 =0 \text{ against}$$

$$H1:\alpha1\neq\alpha2\neq \alpha3\neq \alpha4\neq\ldots\ldots\ldots\ldots\neq\alpha7\neq0$$

The co integration test is based on the F-statistics or Wald statistics. The F-test has a nonstandard distribution. Thus, Pesaran and Pesaran (1997) and Pesaran et al (2001) have provided two sets of critical values for the co integration test. The lower critical bound assumes that all the variables are I(0), this means that there is no co integration between the variables, while the upper bound assumes that all the variables are I(1). If the computed F-statistic is greater than the upper critical bound, then the null hypothesis in this case will be rejected, suggesting that there exists a co integrating relationship among the variables. If the F-statistic exist below the lower critical bounds value, it implies that there is no co integration relationship. However, when the F-statistic lies within the lower and upper bounds, in this case it means the test is inconclusive.

In this context, the unit root test is conducted to ascertain the order of integration of the variables. If all the variables in the research found to be I (1), then the decision is taken on the basis of the upper critical value. And, On the other hand, if all the variables are I (0), the decision is based on the lower critical bound value. The ARDL method estimates (P +1)k number of

regressions in order to obtain the optimal lags for each variable, where p is the maximum number of lags to be used and k is the number of variables in the equation (Shrestha and Chowdhury, 2005). The model is selected based on the Schwartz-Bayesian Criterion (SBC) or Akaike Information Criterion (AIC). The AIC chooses the maximum relevant lag length.

Once co integrating relationship is ascertained, the long run and error correction estimates of the ARDL model are obtained as given:

GINF= α1GINFt-1 +α2GRRM2t-1 + α3OERt-1 + α4GRRGDPt-1 + α5EDtGDPt-1 + α6LIRt-1+α7IMtGDPt-1+εt …….3.3

After the long run model is estimated, the next duty is to model the short run dynamics of the model by estimating an Error Correction Model associated with the long run estimates. The error correction representation of the series can be given as follows:

GINF = β0+β1ΣΔGINFt-i + β2ΣΔGRM2t-i + β3ΣΔOERt-i + β4ΣΔGRRGDPt-i + β5ΣΔEDtGDPt-i + β6ΣΔLIRt-i + β7ΣΔIMtGDPt-i+□ECMt-1+ϵ_t …….3.4

($\sqrt{ECM}_{t-1}$) Where the speed of adjustment of the parameter and is the residual obtained from equations (i.e. the error correction term). The coefficient of the lagged error correction term is expected to be negative and statistically significant to further confirm the existence of a co integrating relationship. Before directly getting on estimating the long run relationship of the model using ARDL bounds testing procedure, it is must to first test the order of integration of each variable included in the model. It is mainly to ensure that the variables are not co-integrated of order two (I (2)). This is because as stated earlier, ARDL approach is based on the assumption that the underlying series is either I(1), I(0) or mutually co-integrated. If the variable are found to be I (2), the computed F or Wald statistic are not going to be valid which may lead to erroneous conclusion. The diagnostic test statistics of the selected ARDL model can be examined from the short run estimates at this stage of the estimation procedure. Similarly, the test for parameter stability of the model can be performed by Cumulative Sum of Square of Recursive Residuals (CUSUMSQ) statistics. If the plots of CUSUMSQ statistics stay within the critical bounds of five percent level of significance, the null hypothesis of all coefficients in the given regression are stable cannot be rejected.

3.4.3 Other Diagnostic Tests

After estimating our econometric model, we need to make sure that the model passes through a battery of diagnostic tests before drawing conclusions from the results and using them to inform policy making. Some of the most relevant post-estimation tests are given below.

Ramsey RESET TEST

Ramsey RESET test for functional form examines whether the models are well constructed. The null hypothesis of the test is that there are no omitted variables or the model doesn't suffer from an omitted variable bias and the model is well constructed.

Normality test

One of the assumptions in the OLS regression is that the error terms are normally distributed, and it is necessary to verify whether this assumption is matching using the data. Using information obtained from kurtosis and skewness, Jarque-Bera normality, which is a joint asymptotic test, investigates whether the error terms from the regression are normally distributed or not. The null hypothesis is that the error terms are normally distributed.

Autocorrelation test

In regression we assume that there is no serial correlation among the error terms meaning that the error terms from period are not correlated with the error terms from adjustment time periods. Lagrange Multiplier test is used to test the serial correlation between the error terms. The null hypothesis is that the residuals are not serially correlated.

Hetroskedesity test

The hetroskedesity test enables us to check whether the variance of the error term is constant. We use White's test to investigate whether the assumption of homescedestity of the error terms is satisfied. The null hypothesis of White's test is that the error terms are homoscedastic and there is no model specification.

Stability test

We perform the test for parameter stability of the model using the Cumulative Sum of Square of Recursive Residuals (CUSUMSQ) statistics. If the plots of CUSUMSQ statistics stay within the critical bounds of five percent level of significance, the null hypothesis of all coefficients in the given regression are stable cannot be rejected (UECM) using OLS (Narayan.K.M and Smyth.R, 2004).

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Descriptive Analysis

4.1.1 Summary statistics

Before estimating the data, it's important to describe the properties and the behavior of the study variables. It is useful to take some corrective measures so that the variables are certainly applicable for the estimation process. The result shows that the standard deviation of each variable is less than the mean value and shows that all variables are normally distributed. The result given in the table below describes some behavior of the variables.

Table 4.1: Summery of descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
General inflation	39	9.035	9.9	-10.57	36.4
Import to GDP (%)	39	22.6	9.4	5.6	39.55
External debt to GDP (%)	39	44.6	21.9	11.2	90.8
Lending interest rate	39	10.9	2.5	6.8	15.5
Growth of real GDP	39	5.9	5.7	-8.8	13.13
Exchange rate	39	9.1	7.4	2.07	28.05
Money growth(M2)	39	17.7	8.5	4.3	39.2

From the above table general inflation in Ethiopia for the period under study had a mean of 9.035 and a standard deviation of 9.9 with a minimum and maximum of negative 10.5 and 36.4 respectively. Import to GDP ratio had a mean of 22.6 and a standard deviation of 9.4 with a minimum value of 5.6 and a maximum value of 39.55 for the period under study. The external debt to GDP ratio had a mean of 44.6 and a standard deviation of 21.9 with a minimum of 11.2 and a maximum of 90.8. Lending interest rate had a mean of 10.9 and a standard deviation of 2.5 with a minimum and maximum value of 6.8 and 15.5 respectively while growth rate of real GDP had a mean of 5.9 and a standard deviation of 5.7 with a minimum and maximum value of -8.8 and 13.13 respectively. Official exchange rates on the other hand had a mean of 9.1 and a standard deviation of 7.4 with a minimum and maximum value of 2.07 and 28.05 respectively.

Growth of broad money supply had a mean of 17.7 and a standard deviation of 8.5 with a minimum and maximum value of 4.3 and 39.2 respectively. The standard deviation indicates how much dispersion exists from the average value. A low standard deviation from the mean shows that the data point tends to be very close to the mean. As shown in the summary statistics, all have low standard deviation and shows stability in the long run relationship between general inflation and its determinant factors.

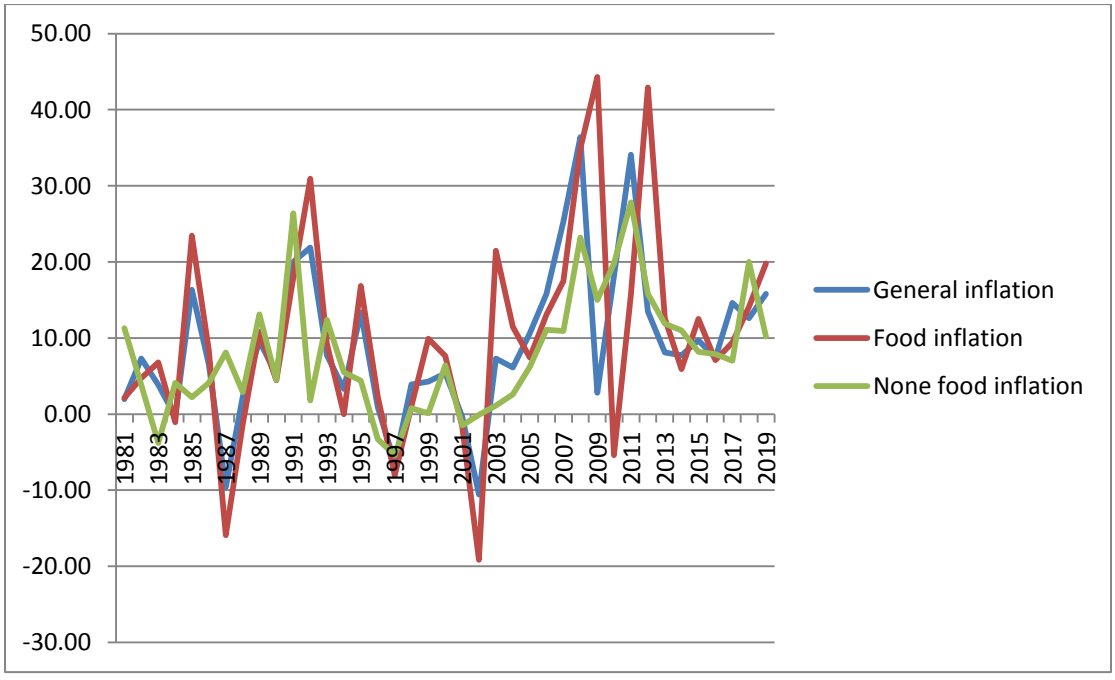
4.1.2 Trends of Inflation

Inflation in Ethiopia is measured by using the change in consumer price index and it is divided in to two which is food and non-food items with different weights. Us you know food side of CPI establish the major share of the total household expense (52.5%), it is found to be the most influential sub index in the overall inflation.

$$\pi = \frac{Pt - Pt-1}{PT-1} * 100$$

Where π–inflation (in percentage) p_t – present price level

Figure 4.1: Trends of general inflation, food inflation, and non-food inflation



Source: Own computation using the data from NBE

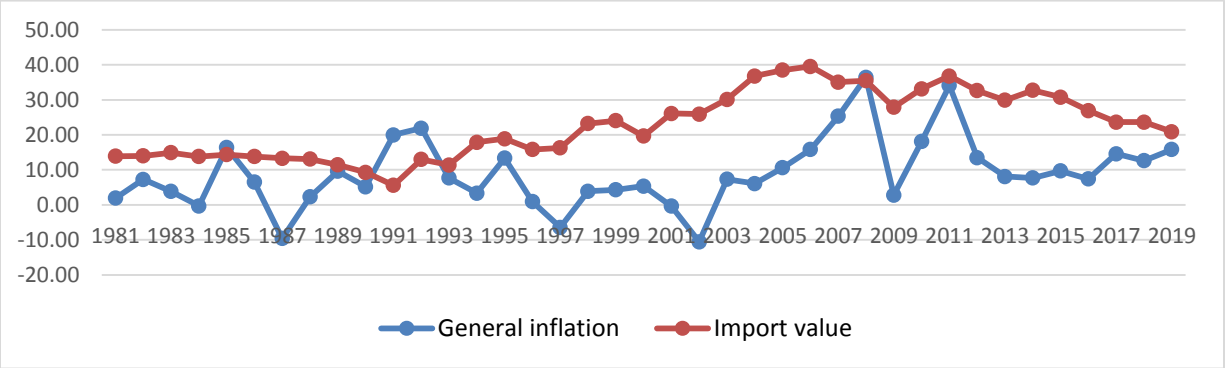
In the Ethiopian history, the presence of highly volatile inflation has been dated not longer than 30 years. Evidences reveal that the average annual inflation rate during 1980 to 2003 was 5.5 percent. The major inflationary episodes were occurred at the time of war and drought (IMF, 2008; Loening, 2007; Eden, 2011). The rate of inflation during 1984/85 in radical manner rises up to 16.4%. As that time, inflation was primarily increases by the reduction of agricultural production due to severe weather conditions. The high level of inflation 21% was recorded at the time of the war between Ethiopia and Eritrea (1991 and 1992). After that, it was declined in a dramatic manner.

In sum, the Non-food Inflation is comparably a low trend and rose at a slower rate than Food inflation. Food price was deflated to -5.4% in 2010 by a good government policy interventions and lower international food prices and then began to soar faster than non-food prices in 2011. In 2012, food inflation remains highly volatile and grown up to double digits mainly due to shortage of rainfall, which factor out drought expectation and then price rise. At all the equal trend of inflation (food and general inflation) rises to the higher share of food sides of the consumer price index. The present increase of non-food inflation comes from rise in the prices of petroleum and other internationally traded commodities may have contributed to the comparable trends of consumer price index general and non-food inflation.

4.1.3 Trends of Inflation and Import Value to GDP Ratio

According to the data collected from national bank of Ethiopia an import of goods and services was found to have a positive effect on inflation in Ethiopia. To confirm this result we can see the figure given below.

Figure 4.2: Trends of inflation and import value of goods and services.



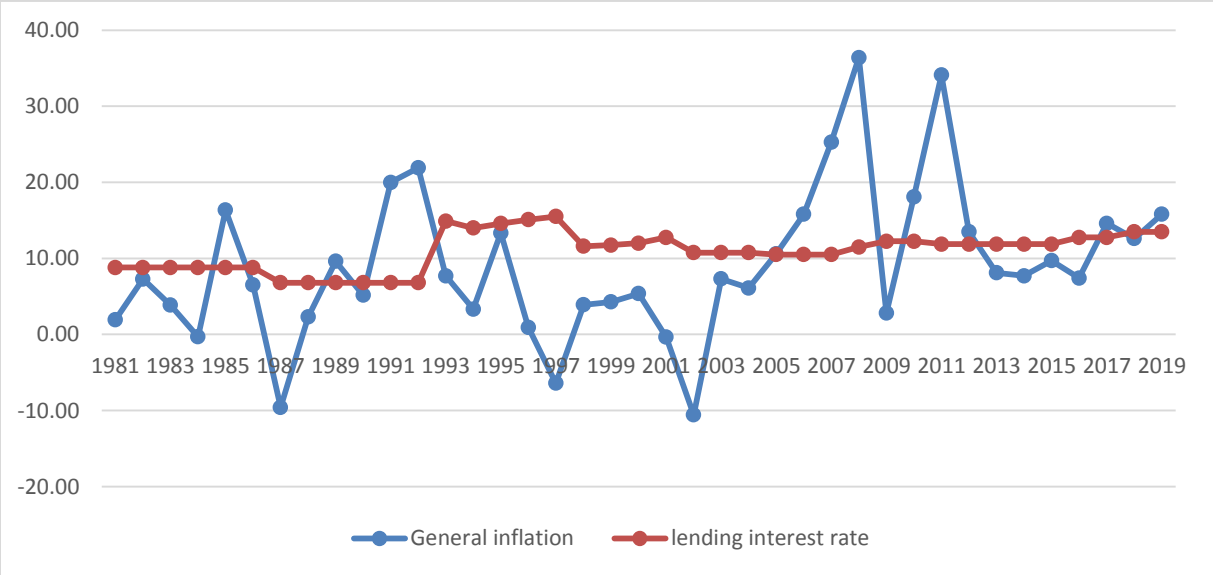
Source: Own computation using the data from NBE.

Based on the above figure, from the beginning import value was more or less stable than inflation. After that both inflation and import value of goods and services go with similar trend. It is similar to author's expectation. (I.e. import value of goods and services are the most tangible determinant of Ethiopian inflation).

4.1.4 Inflation and Lending Interest Rate

According to Keynesian economics interest rate has indirect impact on inflation through investment. This is because lower interest rates induce investment which in turn increases output and hence reduce inflation. Higher interest rate hampers investment; lowers output and hence increase inflation (sisay, 2008).Looking at the trend of average lending rate and inflation; it's similar to the economic theory such that less stable lending interest rate is associated with unstable inflation rate.

Figure 4.3: Trends of general inflation and average lending rate



Source: Own computation using the data from NBE.

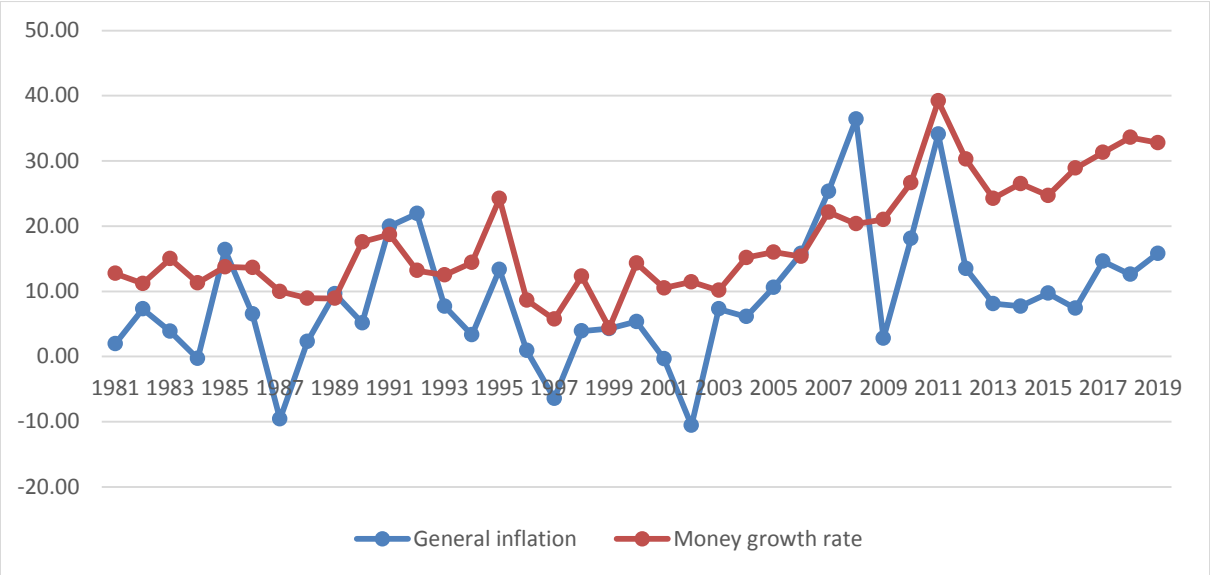
As it is shown in the above graph, average lending rate has been stable in most of the years. This stable trend of lending rate has decreased the impact of average lending rate trend on the trend of inflation according to the economic theory.

4.1.5 Inflation and Growth Rate of Broad Money Supply (M2)

The Monetarist school mainly Milton Friedman states that the sources of all inflation is a high growth rate of money supply and argue that increase in money supply has positive and direct impact on inflation. The trend of money supply growth and inflation rate more or less shows that variables were moving in the same direction in most of the years and basically in the high inflation period.

M_2 = M_{1+} small saving accounts, money market funds and small time deposits.

Figure 4.4: Trends of general inflation and broad money supply (M2) growth rate



Source: Own computation using the data from NBE.

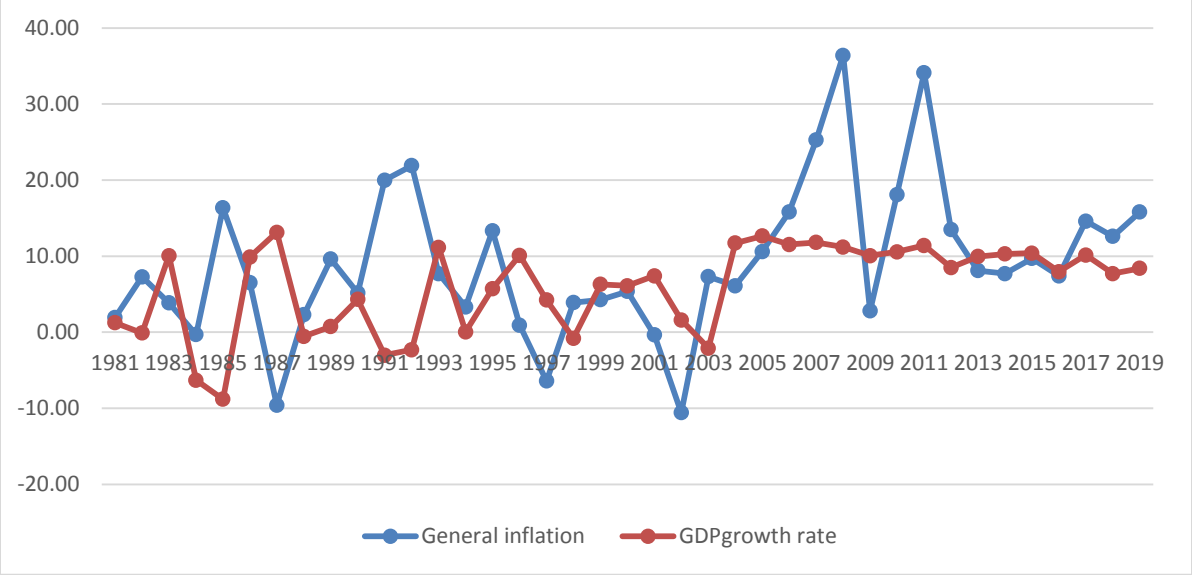
Although both variables were moving in the same direction, M2 growth rate was greater than inflation and real GDP growth in most of the years under investigation. According to the monetarist theory, the higher growth of money supply than real GDP tell us the strong impact of M2 on inflation in Ethiopia. As the above figure reveals the minimum broad money supply growth registered was 4.37% and 5.3% and inflation rate was 4.3% and -6.5% in 1996/97 and 1998/99 respectively and the maximum growth rate of money supply achieved was 39.2% and inflation rate during this time was 34.10% in 2011. Money supply was continuously increasing after 2001/02 (take into account the inflation trend) but before that there was minimum growth

commonly less than 15% with some ups and downs in the growth of money supply. This implies the presence of expansionary monetary policy in the country which could aggravate the inflation pressure

4.1.6 Inflation and Real GDP Growth

Fisher (1993) showed that inflation and output growth go in opposite direction.

Figure 4.5: Trends of general inflation and growth rate of real GDP or economic growth.



Source: Own computation using the data from NBE.

Trends of GDP growth look the same trends in opposite direction of general inflation rate in most cases. The growth of real GDP of the economy declines significantly four times from 1981 to 2019 because of the combined effects of internal conflict, war and drought. The first was during the disastrous drought in the country in which real GDP growth declined by 6 percent and 8.8 percent consecutively for two years (1984 &1985) but during this time general inflation raised from -0.32% (deflation) to 16.4% which was sky rocketed. After that production started to increase probably due to the good fortune of weather and reached its apex in 1987 (13.31%).On the other hand, inflation starts to decline and reached its minimum inflation rate of -9.6% (deflation) when real GDP growth was at climax level (14%) as revealed by the above figure.

The second contraction of the economy was due to political instability in the country in 1991-92. The country was in political transition from military junta to the transitional government currently called EPRDF and since the country did not have appropriately running government, production of the economy suffered greatly. The growth declined by more than 3% and inflation rate escalated more than 20%. From 1993 up to 1997 economic growth revives and inflation rate declines due to better conditions of rainfall, government status, internal conflicts and wars.

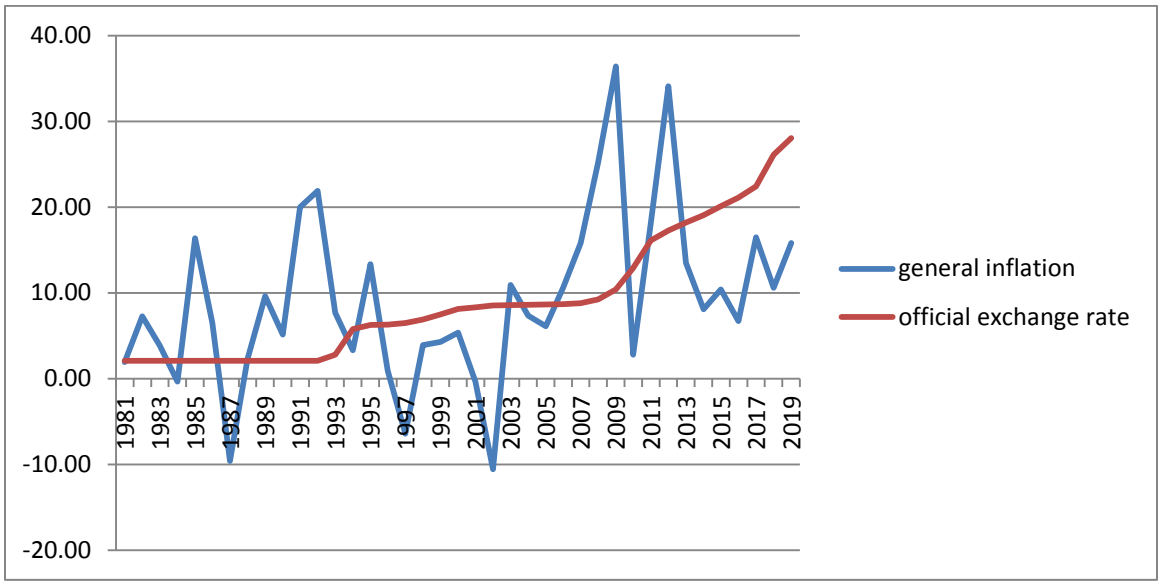
The third contraction of the GDP was observed during the Ethio- Eritrean war of 1997/98. It is obvious that during war some resources of the economy are diverted to sustain the war. This greatly harms economy of one country especially poor countries like Ethiopia. During this time, economic growth declined by 0.8% and inflation rose from deflation rate of 6.4% to inflation rate of 4 %.The fourth contraction of the economy occurred in 2003 when drought has occurred due to shortage of rainfall all over the country and economic growth declined by 2.09% and inflation increased from deflation rate of 10% to inflation rate of 7.3%.

Since agriculture employs majority of labor force, it has the highest share in GDP of the country. The country depends greatly on the good outcomes of agriculture. However, from 2004-2012 inflation rate and economic growth has shown similar trends and directions. Fascinating and sustained economic growth (double digit growth rate) has been achieved and simultaneously the inflation rate rose continuously at an alarming rate and reached 36.4% in 2008 which is a sign of unhealthy economy. But, in the last six years (2014 up to 2019) on average the rate changed from running and galloping inflation to moderate inflation with average double digit economic growth. In general, rate of economic growth and rate of inflation moves with the same trend and in opposite direction up to 2003 but since 2003 moved in the same direction at excessive rate of inflation which is more than the highest economic growth achieved.

4.1.7 Inflation and Exchange Rates

According to economic theory exchange rate influences general inflation rate positively.

Figure 4.6: Trends of general inflation rate and exchange rate



Source: Own computation using the data from NBE

From the above graph, it is observed that the growth rate of nominal exchange rate shows a simple stable and gradual straight upward trend. This stable trend of exchange rate has resulted in a lower impact of inflation. During 1980/81-1991/92 the military government was following fixed exchange rate system, so exchange rate was constant at the rate of 2.07 birr per dollar. Since 1992, the current government applied managed floating exchange rate thus increasing slowly and reached its maximum of 20 birr per dollar in 2014/15. The gradual upward movement of nominal exchange rate reflects steady depreciation over time. More recently, the pace of depreciation revealed an upward spiral over time. Changes in the rate of nominal depreciation can be a decisive factor through the cost transmission channel.

As it can be seen from the above trend analysis, the trend of inflation was in line with the trend of CPI food, which may be due to the gross share (52%) of food in CPI. The present increase in the price of petroleum and other internationally traded goods like cement has contributed to the similar trend of CPI general and non-food. Inflation was showing ups and downs reaching a maximum of 36.4 and a minimum of -10.57. Similar to that of CPI, inflation was having similar trend with that of food inflation while non-food inflation was having similar trends with inflation after 2005/06. As it is expected theoretically inflation and real GDP growth were having opposite

trends, which may be attributable to the close association of output growth and food production in Ethiopia. Broad Money supply was having similar trend with that of inflation.

4.2 Empirical Analysis

4.2.1 Results of Unit Root Test

A unit root test is a common practice and a first step that are to be undertaken in macro-level data analysis to address the non-stationary problem of variables. Hence, before the estimation of the econometric model, unit root test for stationary of each time series variable is necessary to show mean, variance, and covariance of the process is time-invariant. Most often macroeconomic variables are non-stationary; hence, before doing any econometric analysis testing stationary of variables is common and mandatory. Otherwise, estimating non-stationary dependent variable upon a non-stationary independent variable lead to the spurious regression in which the estimators and test statistics are misleading.

Table 4.2: Unit root test

Variable	ADF Test				Order of integration
	Level		1st difference		
	Intercept	Intercept & trend	Intercept	Intercept & trend	
General inflation	-4.05***	-4.36***	-8.38***	-8.25***	I(0)
Growth of money supply	-1.71	-3.21	-6.27***	-6.36	I(1)
Import to GDP ratio.	-1.35	-1.11	-6.49***	-6.54***	I(1)
External debt to GDP ratio	-2.13	-2.44	-4.94	-4.86	I(1)
Lending interest rate	-1.95	-2.40	-6.63***	-6.53***	I(1)
GDP growth rate	-1.73	-5.73***	-10.11***	-9.95***	I(0)
Official exchange rate	1.87	-0.35	-2.90*	-3.8*	I(1)

As shown in the table above, in both augmented Dickey-Fuller and Phillip and Perron tests general inflation (GINF) and growth rate of real GDP (GRRGDP) are stationary at level,

integrated of order zero (I(0)), whereas Broad money supply (GRM2), import to GDP ratio (IMtGDP, external debt to GDP ratio, lending interest rate (LIR),and official exchange rate (OER) are not stationary at level but stationary at the first difference, integrated of order one (I (1)). This implies the series are of mixed order of I (1) and I (0) and therefore, for the given time series, the ARDL methodology is quite appropriate to be adopted. This gives the stepping stone for the next co-integration analysis and error correction estimation that may proceed to the existence of co-integration.

4.2.2 Result of Bound Test for Co-Integration

Co-integration is the formal statistical justification of the existence of this relationship among the variables for the long-run equilibrium. Hence, after determining the stationary nature of the variables, the next task in the bounds test approach of co-integration is estimating the specified ARDL model using the appropriate lag-length selection criterion. According to Pesaran and Shine (1999), as cited in Narayan (2004) for the annual data, they recommended choosing a maximum of two lag lengths but for small data, it is advisable to use 1 lag because when the lag length increases, the observation fail to show the appropriate long run relationship among variables. Accordingly, under the study period, co-integration (a long run relationship) is witnessed between general inflation and the given set of determinants considered and shown as follows:

Table 4.3: Bound test for co-integration

Table: Bounds Co-integration Testing Result		
Null Hypothesis: No long run relationship exist (No level relationship)		
Test Statistic	Value	K
F-statistic	5.83	7
Critical Value Bounds	Lower bound	Upper bound
Significance	I0 Bound	I1 Bound
10%	2.03	3.13
5%	2.32	3.5
2.5%	2.6	3.84
1%	2.96	4.26
Source: own computation by eviews9		

From the above table, the F-statistics (5.83) is higher than both the Pesaran et al. (2001) and Narayan (2004) upper bound critical values at a 1% level of significance. That means the alternative hypothesis of a long run relationship is accepted; rather reject the null hypothesis (there is no a long-run relationship) based on critical values at a 1% level of significance. Therefore, there is co-integration or long-run relationship among the variables. Thus, the bound test shows there is co-integration among the variables. In other words, there is a systematic relationship that functionalizes the variables to form a linear stationary process that adjusts to the long-run after any shocks or deviation of the short-run.

4.2.3 Diagnostics Testing Result

Prior to doing any statistical regression analysis of the model, different diagnostic tests should be undertaken to check the fulfillment of different assumptions. In other words, a diagnostic test is required to check the standard property of the model. In this study, the researcher is carried out a number of diagnostic check, which includes a Serial correlation test (Brush & God fray LM test), Functional form (Ramsey's RESET) test, Normality (Jaque-Bera test), and Heteroscedasticity test. In order to reject or accept the null hypothesis, a decision is made by looking at the p-values associated with the test statistics. That is the alternative hypothesis is accepted when the p-value is smaller relative to the standard significance level five percent.

Table 4.4: Diagnosing testing results

Table: Diagnostic Testing Results for selected ARDL (1, 1, 1, 1, 0, 1, 1, 1) model				
H0: hypothesis	H1:hypothesis	Test type	F-statistics (F-version) ($P \geq 0.05$)	Decision
No serial correlation	Serial correlation	Breusch-Godfrey Serial Correlation LM Test	0.045(0.83)	Accept the null hypothesis
Homoskedastic	Heteroskedastic	Breusch Pagan	1.32(0.23)	Accept the null hypothesis
No omitted variable	Omitted variable	Ramsey RESET test	1.75(0.19)	Accept the null hypothesis
Normally Distributed	Not the normally distributed	Jarque-Berra test For the distribution Of the disturbance	1.15(0.56)	Accept the null hypothesis
Source: own Computation by eviews9; 2021				

The above table shows that the ARDL model estimated in this study generally passes all the diagnostic tests.

Serial correlation test: the post estimation test of serial correlation in the null hypothesis of there is no serial correlation over the alternative hypothesis of there is serial correlation has the expected result. As shown in the first row of the table above, a p-value is 0.83. This is much higher than 0.05 or even the weak significance level of 0.1. Therefore, we can't reject the null hypothesis of there is no serial correlation. Thus, there is no evidence of serial correlation in the model as the Brush Godfray LM test failed to reject the null hypothesis.

Heteroscedasticity: heteroscedasticity test shows that the error term/ or residual have a constant variance or not. By assumption, the variance of the errors is constant, $\sigma 2$ this is known as the homoscedasticity. The study uses Breusch-Pagan-Godfrey test for Heteroscedasticity. Thus, in the table above, the Breusch-Pagan heteroscedasticity test statistics show the absence of heteroscedasticity as p-value of the test statistics is 0.23 which is greater than 5 percent. Hence, the model exhibits constant variance as hetrokedatisticity test failed reject the null hypothesis.

Functional form: the model specification test for omitted variables problem of the analysis shows whether the model suffers from omitted variable bias or not. In this study, the researcher uses Ramsey's Reset test of H0: no omitted variable in the model specification against H1. Taking the p-value 0.19 greater than 5%, we can't reject the null hypothesis of there is no omitted variable in the model. Hence, the model is correctly specified.

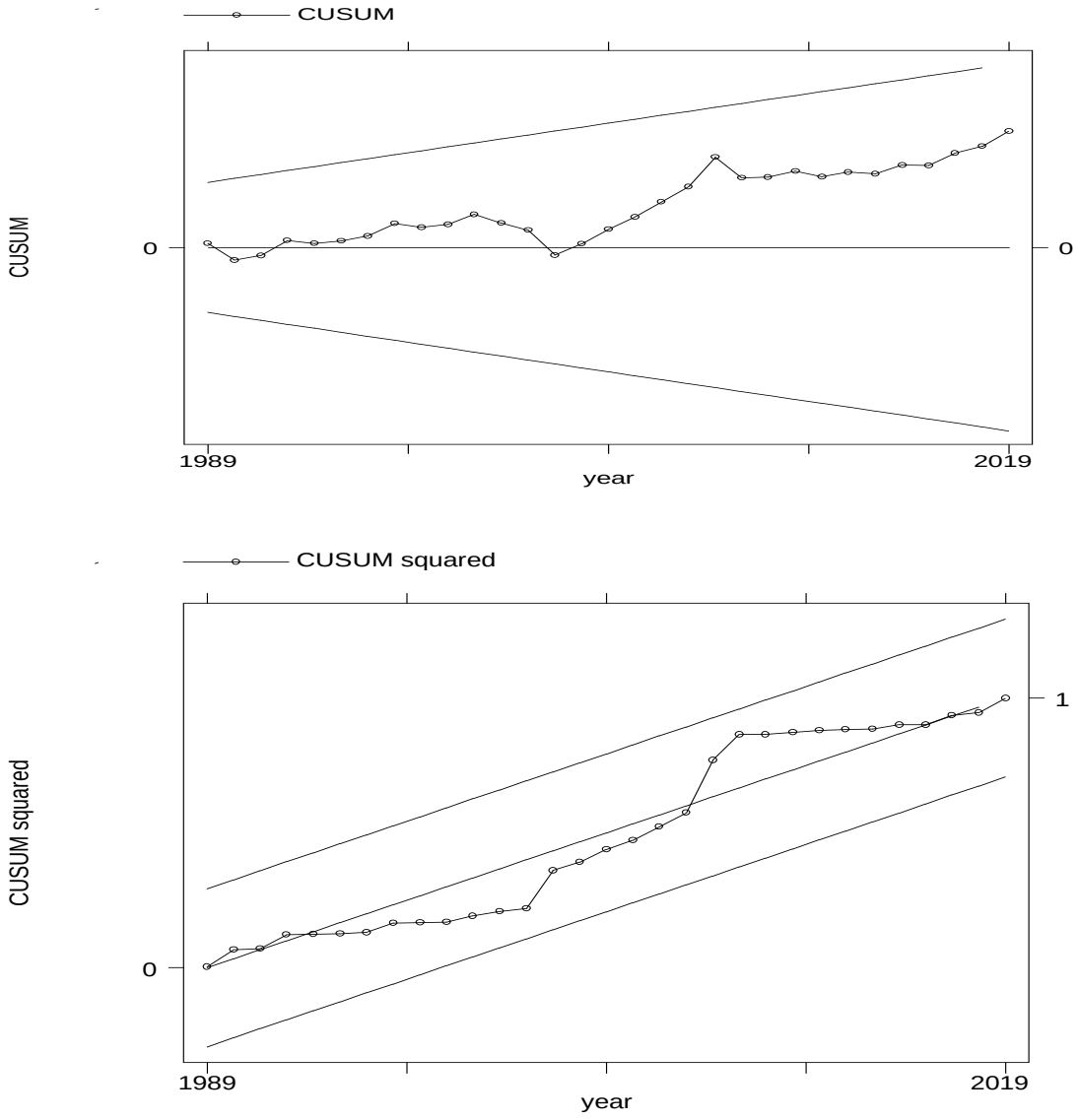
Normality: the normality Jarque-Berra test of the disturbance term found good results. In the same fashion, p-value 0.56 is greater than 5 percent and we can't reject the null hypothesis in favor of the normality of the disturbance term. Hence, the residual is normally distributed since Jaque-Berra normality test is larger than the standard significance level.

4.2.4 Model Stability Testing Result

After the entire short-run and long-run estimation, model/ parameters stability is tested. Commonly, the stability of the model for long run and short run relationship is detected by using the cumulative sum of recursive residuals (CUSUM) and cumulative sum of squares of recursive residuals (CUSUMSQ). Cumulative sum of recursive residuals (CUSUM) helps as to show if

coefficients of the parameters are changing systematically and the cumulative sum of squares of recursive residuals (CUSUMSQ) tests is useful to indicate if the coefficient of regression are changing suddenly. Accordingly, we accept the null hypothesis of the parameter instability if the blue line cross redline which is critical line and never returns back between two critical line and we reject the null and accept the alternative there is parameter stability in the short run and long run if the cumulative sum goes inside the area (can returns back) between the two critical lines.

Figure 4.7: Model stability testing result.



In the above two graph obtained in STATA14, the test of the stability of the parameters by cumulative sum of recursive residuals shows the model is stable. The plot of CUSUM test did

not cross the critical limits and the CUSUMSQ test also shows that the graphs do not cross the lower and upper critical limits. So, we can conclude that long-run estimates are stable and there is no any structural break. In addition to the confirming model stability, we can look at goodness of fit statistics of the model containing the explanatory variables that actually explain variations in the dependent variable because it is important to have some measure of how well the regression model actually fits the data. According to the result, R^2 is 0.69 and adjusted R^2 is 0.57. Thus, 69 percent of the variation in the dependent variable is explained by the explanatory variables. Hence, the results of the estimated model are consistent and efficient.

4.2.5 Long Run Results

Table 4.5: Long Run Coefficients Co Integrating Equation

Long Run Coefficients		
Variable	Coefficients	Std. Error
Broad money supply	0.80***	0.26
Import/GDP	0.48**	0.19
External debt/GDP	-0.24**	0.09
Growth of real GDP	-1.007**	0.43
Lending interest rate	0.21	0.69
Official exchange rate	-0.66*	0.32
C	4.35	8.58
Note: ***, **, and * denote significance at 1%, 5%, & 10% respectively; C stands for constant		
Cointeg = GINF – (0.79***GRM2) + 0.48*IMTGDP – 0.24*EDTGDP – 1.007 *GRRGDP + 0.21*LIR -0.66*OER + 4.35		

From the above table, the root cause of inflation is that higher money supply by the government. Because as money supply increases in a given economy aggregate supply becomes lower than aggregate demand and leads to a rise in price to bring demand and supply to equilibrium. In which inflation rises since inflation is an increase average price level in a given economy. Hence, the long run estimate result shows broad money supply is a significant factor affecting inflation. An increase in broad money supply by one percent leads to an increase inflation by eighty percent on average in the long-run. The result is based on macroeconomic situation of classical

economists given in quantity theory of money as rise in money supply results to higher price levels. Due to more money supply in the economy, more funds will be available to run in the economy, investment will be found, full employment, aggregate demand will be rise, and eventually there will be increase in general inflation in the country. Other studies also confirmed a similar result (Jonse, B. (2018), Atnafu, G. (2020). An import of goods and services to GDP ratio is found to have a significant impact on inflation in Ethiopia. A rise by one percent of the imports, holding other variables constant, results in a 48 percent increase in inflation and this relationship is found to be relevant.

External debt to GDP ratio has a negative effect on inflation in the long run. Based on the above result a percentage increase in external debt to GDP ratio leads to a fall in inflation by 24 percent. This is not similar to its expected sign. This result conforms that most less developed countries debt burden is financed by international companies this in turn results low transportation cost and other inputs. Thus the impact of these projects for reducing transportation and communication and other production costs might have reduced the cost push side of general inflation. In addition to this the output of the estimated project in the long period of time may intense the demand pull inflation. This result is also in contradicted with researcher Reinhart (2010) who found out a significant and positive impact of external debt on inflation. This difference could due to the fact that his study includes war time debt, which is unproductive in the long period of time. Other researchers Kannan and Singh (2007) found that government budget deficit and external debt have a negative impact on general inflation the period of 1971 up to 2006 in India.

Growth rate of real GDP (GRRGDP) causes in inflation in Ethiopia falls in the long run. This might be due to the decline in demand pull inflation by the rise in output. Based on above table, a unitary increase in RGDP results to a 1.007 reduced in general inflation in the long period of time. My finding is similar to other researchers Khan and Qasim (1996).The other variable; real interest rate is positively related to general inflation although it is statistically insignificant in the long run. In the end, in contradict to my expectation, official exchange rate is found to have insignificant impact on inflation in Ethiopia in the study period. (Romer, 1993), he concludes the option of the exchange rate regime not a tangible determinant of inflation. Another researcher Loungani (2001) in countries with fixed exchange rate inflation cannot be caused by exchange

rate changes. Since the collapse of military government until now Ethiopia follows managed floating exchange rate regime, it is possible to absorb negative impact of exchange rate on general inflation in the long period of time.

Thus, the weak relation between the general inflation and official exchange rate might be due to Ethiopian governments pegged the domestic currency to U.S dollar. Particularly, fixed exchange rate regime during the military government was fixed at 2.07 dollar.

4.2.6 Short Run Results

When we come to the short run empirical analysis, An error correction model belongs to a category of multiple time series models most commonly used for data where the underlying variables have a long-run stochastic trend, is called co-integration. The term error-correction relates to the fact that last-periods deviation from long run equilibrium, the error, influences its short-run dynamics. Thus ECMs directly estimate the speed at which a dependent variable (general inflation rate) returns to equilibrium after a change in other variables. The short run model is estimated by the ECM and the result is summarized in the table below.

Table 4.6: Short run estimation result

Co-integrating Form		
Variable	Coefficient	Std. Error
D(GRM2)	0.79***	0.27
D(IMTGDP)	0.97**	0.35
D(EDTGDP)	-0.11	0.12
D(GRRGDP)	-0.58**	0.27
D(LIR)	2.03**	0.94
D(OER)	-0.65*	0.34
CointEq(-1)	-0.98***	0.16
R-square:0.69 Durbin Watson: 1.87 Adjusted R-square: 0.57 F-statistics: 5.497 (0.000)		
Note: ***, **, & * denotes significance at 1%; 5% and 10% respectively; Dependent variable is D (GRPUI) and D represents deference.		
Cointeg = GINF – (0.79***GRM2) + 0.48*IMTGDP – 0.24*EDTGDP – 1.007 *GRRGDP + 0.21*LIR -0.66*OER + 4.35		
Source: Author's own computation by eviews9: 2021		

From the above table, R2 and adjusted R2 for the short-run model are 69% and 57% respectively showing that 69.9% and after adjustment 57% of the variation in general inflation is explained by the variation in the explanatory variables in the short-run. Further, the result of the short-run model revealed that broad money supply, import to GDP ratio and lending interest rate are positive significant variables in explaining the variation of inflation in the short-run whereas growth rate of real GDP and official exchange rate are a negative significant variable in explaining the variation of general inflation in the short period. While, external debt to GDP ratio is negative but not statically significant.

The statistical significance of lagged value of the residual E q (-1) conveys a very important information. The value of 98% of the short run model shows that 98% of the disequilibrium in one year will be corrected in the subsequent year. This implies it takes almost one year to fully adjust the shock. The negative coefficient of the error correction term shows that the inflation rate was above the normal condition, so it should be falling in the subsequent year to arrive on the long run equilibrium level.

CHAPTER FIVE

CONCLUSION AND RECOMMENDDATIONS

5.1 Conclusions

The primary objectives of this study was to investigate the relationship between imported value of goods and services and general inflation in Ethiopia using a time series data from 1981-2019. To fulfill the objective, the author has reviewed both theoretical explanations and empirical literature regarding to the determinants of general inflation in the context of developing countries. The study used secondary data sourced from NBE, CSA, MOFEC, and WDI in examining the trending behavior of general inflation, broad money growth, lending interest rate, official exchange rate, import to GDP ratio, and external debt to GDP ratio in Ethiopia. In this study, the author tried to see the trends of general inflation in Ethiopia. Under the study period, the trend of general inflation also shows that inflation fluctuates in each year, especially; food inflation highly fluctuates than non-food inflation. This is not only because of cost push inflation factors but also demand pull factors. In addition, the author tried to see the trends of general inflation and broad money supply and as it seen from the graph as money supply rises inflation also rises and it means there is a strong positive association between inflation and broad money supply.

To figure out the long-run and short-run relation among the variables, an Autoregressive Distributed Lag (ARDL) bounds test approach to co-integration was employed to help in addressing the objectives. Prior to applying the auto regressive distributive lag approach (ARDL) model, all the variables are tested for their time series properties (stationarity properties) by using the ADF test. As a result, general inflation and growth of real GDP are stationary at level, I (0). While growth rate of money supply, official exchange rate, import value to GDP ratio, lending interest rate and external debt to GDP ratio are stationary at first difference. I.e. there is no macro -economic variable of the variables used in this study are I (2). After the stationary test, the bound test for co-integration showed that general inflation and its determinants considered are co-integrated. Hence, an error correction model (ECM) was then estimated. The model passed all the required diagnostic tests. The results revealed that no evidence of serial

correlation, no functional form problem (the model is correctly specified), the residual is normally distributed and no evidence of hetrosKedasticity problem.

Besides, the error correction coefficient estimated at negative 0.98 is highly significant which further confirmed the existence of a stable long-run relationship among the data series. According to the estimation, the major findings of the empirical models revealed that broad money supply and import to GDP ratio have a positive and significant effect on general inflation in both short run and long run whereas the growth real gross domestic product and official exchange rate has a negative and significant effect on general inflation both in the short-run and long run. Whereas external debt to GDP ratio has a negative and significant effect in short run but insignificant in long run. While lending interest rate has a positive and significant effects in the long run but in short run, it has insignificant effect.

In sum, the estimation result shows that, in the short run, inflation is determined by money supply, import to GDP ratio and lending interest rate positively, whereas real GDP and official exchange rate have a negative effect. On the other side inflation is positively determined by broad money supply and import to GDP ratio in long run. While real GDP, external debt to GDP ratio and official exchange rate has a negative effect.

5.2 Recommendation

The trends and determinants of general inflation were examined using both descriptive and econometrics analysis. From this analysis of the determinants of general inflation in Ethiopia, the researcher recommends the following policy implication. That is, to reduce and minimize the severity of inflation in the country.

A. The exchange rate policy should be implemented that will be favorable to reduce the cost of imported capital goods.
    - Hence, the government should look inward for the supplying of raw materials locally promotes investment in the area where the required raw materials are available locally.

B. On the determining power of broad money supply (M2) on inflation, the policy of selective credit control should be pursued.
    - Greater effort should be made to make available short, medium and long term loans to productive investments like small scale industries as they constitute an integral part of the growth and transformation process of an agro-based economy. So that money stock grows in line with real GDP.

C. The government should implement strict rule to punish voracious trader.

D. Policymakers should push for massive investment in agricultural sector, especially in rural areas. This policy will assist to mitigate effects of adverse climatic conditions and increase employment creation in rural parts of the country where unemployment is rampant.

E. In addition, the country should adopt policies which advocate for massive production in agriculture to avoid scarcity in periods of adverse weather conditions. So that the effect of real GDP and food prices on inflation would be minimal.

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APPENDIXES

Annex 1: Correlation Analysis

Matrix of correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) GINF	1.000						
(2) IMtGDP	0.363	1.000					
(3) EDtGDP	-0.482	-0.344	1.000				
(4) LIR	-0.007	0.368	0.137	1.000			
(5) GRRGDP	0.153	0.558	-0.380	0.396	1.000		
(6) OER	0.268	0.560	-0.387	0.535	0.448	1.000	
(7) GRM2	0.578	0.449	-0.591	0.305	0.412	0.802	1.000

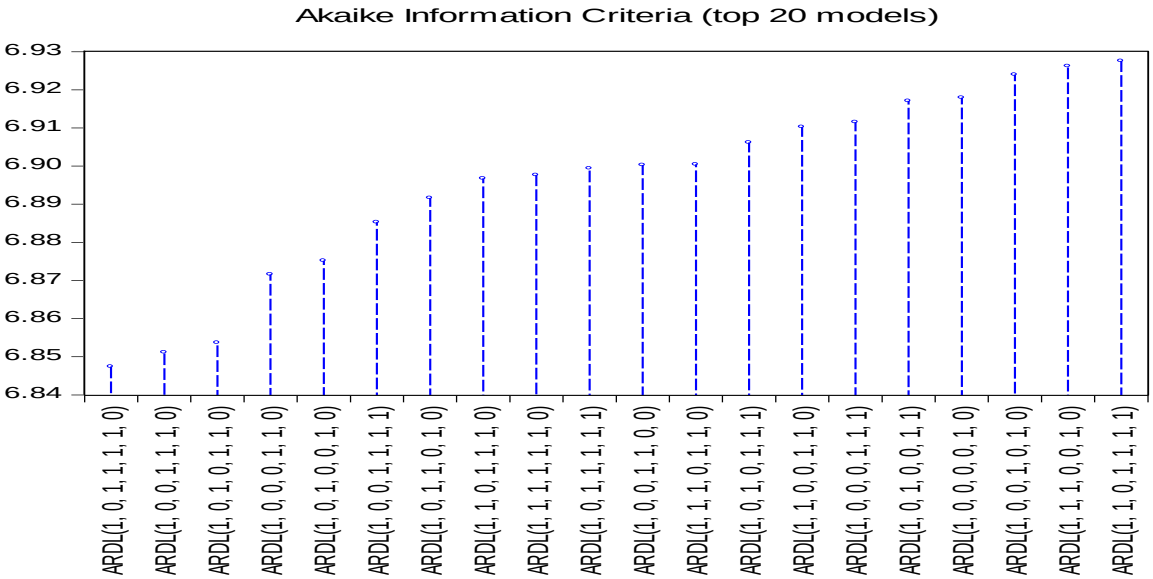
Annex 2: Descriptive Summery

Variable	Obs	Mean	Std. Dev.	Min	Max
GINF	39	9.035	9.936	-10.57	36.4
IMtGDP	39	22.657	9.428	5.6	39.55
EDtGDP	39	44.633	21.953	11.2	90.8
LIR	39	10.959	2.516	6.8	15.5
GRRGDP	39	5.96	5.794	-8.8	13.13
OER	39	9.133	7.401	2.07	28.054
GRM2	39	17.735	8.536	4.37	39.2

Annex 3: Unit Root Test

Variable	ADF Test				Order of integration
	Level		1st difference		
	Intercept	Intercept & trend	Intercept	Intercept & trend	
GINF	-4.050657*	-4.366653*	-8.3815848*	-8.2539088*	I(0)
GRM2	-1.712251	-3.214602	-6.277689*	-6.368795	I(1)
IMtGDP	-1.359735	-1.117276	-6.494739*	-6.540117*	I(1)
EDtGDP	-2.130066	-2.443650	-4.943770	-4.865774	I(1)
LIR	-1.956175	-2.409191	-6.633285*	-6.538272*	I(1)
GRRGDP	-1.733086	-5.736546*	-10.11291*	-9.955938*	I(0)
OER	1.874070	-0.353418	-2.906425***	-3.837324***	I(1)

Annex 4: Optimal Lag Length Selection Criteria



Annex 5: Diagnostic Test

A. Autocorrelation Test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.045990	Prob. F(1,25)	0.8319
Obs*R-squared	0.069776	Prob. Chi-Square(1)	0.7917

B. Hetroscedasticity Test

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.399520	Prob. F(11,26)	0.2314
Obs*R-squared	14.13222	Prob. Chi-Square(11)	0.2258
Scaled explained SS	6.152679	Prob. Chi-Square(11)	0.8630

C. Functional Form

Ramsey RESET Test

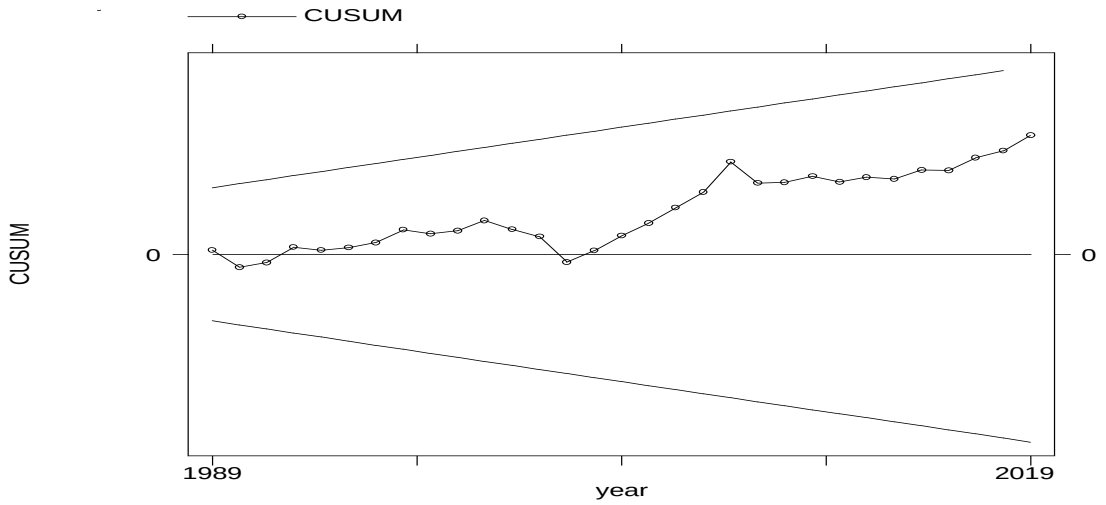
Equation: UNTITLED

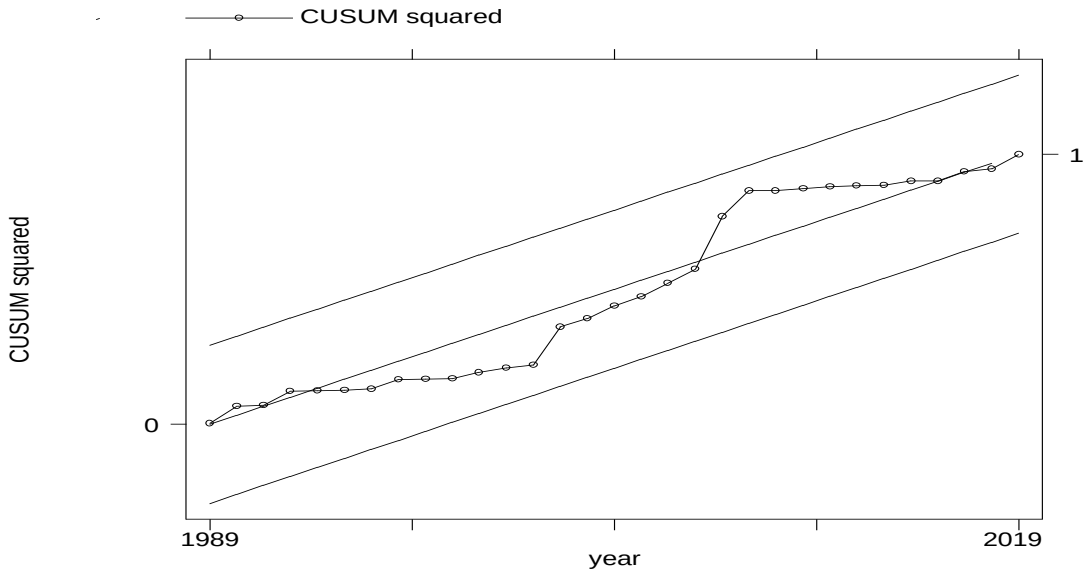
Specification: GINF GINF(-1) GRM2 IMTGDP IMTGDP(-1) EDTGDP EDTGDP(-1) GRRGDP GRRGDP(-1) LIR LIR(-1) OER C

Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	1.326322	25	0.1967
F-statistic	1.759130	(1, 25)	0.1967

Annex 6: Model Stability Test





Appendix 7: Estimation Result

A. Short Run Result

ARDL Cointegrating And Long Run Form
Dependent Variable: GINF
Selected Model: ARDL(1, 0, 1, 1, 1, 1, 0)
Date: 06/01/21 Time: 17:38
Sample: 1981 2019
Included observations: 38

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GRM2)	0.797485	0.273717	2.913541	0.0073
D(IMTGDP)	0.979454	0.356159	2.750047	0.0107
D(EDTGDP)	-0.110589	0.122140	-0.905425	0.3736
D(GRRGDP)	-0.589421	0.272335	-2.164321	0.0398
D(LIR)	2.030214	0.949002	2.139314	0.0420
D(OER)	0.659651	0.340493	-1.937339	0.0636
CointEq(-1)	-0.989155	0.160942	-6.146026	0.0000

Cointeq = GINF - (0.8062*GRM2 + 0.4888*IMTGDP -0.2479*EDTGDP
-1.0076*GRRGDP + 0.2184*LIR -0.6669*OER + 4.3530)

B. Long Run Result

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GRM2	0.806228	0.265815	3.033044	0.0054
IMTGDP	0.488802	0.190878	2.560810	0.0166
EDTGDP	-0.247911	0.094276	-2.629624	0.0142
GRRGDP	-1.007608	0.434375	-2.319672	0.0285
LIR	0.218369	0.691484	0.315798	0.7547
OER	-0.666883	0.325229	-2.050504	0.0505
C	4.352976	8.589249	0.506793	0.6166

Appendix 8: Equation Results

A. Estimation Equation:

==========

GINF = C(1)*GINF(-1) + C(2)*GRM2 + C(3)*IMTGDP + C(4)*IMTGDP(-1) + C(5)*EDTGDP + C(6)*EDTGDP(-1) + C(7)*GRRGDP + C(8)*GRRGDP(-1) + C(9)*LIR + C(10)*LIR(-1) + C(11)*OER + C(12)

B. Substituted Coefficients:

==========

GINF = 0.0108445283134*GINF(-1) + 0.797484942877*GRM2 + 0.979453973667*IMTGDP - 0.495952722925*IMTGDP(-1) - 0.110588962118*EDTGDP - 0.134633230775*EDTGDP(-1) - 0.589421167128*GRRGDP - 0.40726026045*GRRGDP(-1) + 2.03021355156*LIR - 1.8142128188*LIR(-1) - 0.659650650748*OER + 4.30576959955

C. Cointegrating Equation:

D(GINF) = 0.797484942877*D(GRM2) + 0.979453973667*D(IMTGDP) -0.110588962118*D(EDTGDP) - 0.589421167128*D(GRRGDP) + 2.030213551563*D(LIR) -0.659650650748*D(OER) -0.989155471687*(GINF - (0.80622811*GRM2(-1) + 0.48880208*IMTGDP(-1) -0.24791067*EDTGDP(-1) -1.00760847*GRRGDP(-1) + 0.21836884*LIR(-1) -0.66688268*OER(-1) + 4.35297557))