ST. MARY'S UNIVERSITY

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THE RELATIONSHIP BETWEEN FOREIGN EXCHANGE RESERVE AND INFLATION IN ETHIOPIA

BY

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A THESISSUBMITTED TO ST. MARY'S UNIVERISTY SCHOOL OF GRADUATE STUDIES IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE MASTERS ARTS IN DEVELOPMENT ECONOMICS

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Declaration

I, the undersigned, declare that this thesis is my original work, prepared under the guidance of Maru Shete (PhD). All sources of materials used for the thesis have been duly acknowledged, the researcher further confirm that the thesis has not been submitted either in part or in full to any other higher learning institution for the purpose of earning any degree.

Elleni Kassahun _____

St. Mary's University, Addis AbabaDecember, 2019

ENDORSEMENT

This thesis has been submitted to St. Mary's university, school of Graduate Studies for examination with my approval as a university advisor.

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Advisor Signature

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ACRONYMS

ARDL	Autoregressive Distributed lag model
CPI	Consumer Price Index
FER	Foreign exchange reserve

ABSTRACT

There is higher inflation rate in Ethiopia that increase from time to time. Different studies identified different causes of inflation. Among these causes is foreign exchange reserve increase. But findings on relationship between inflation and foreign exchange are not conclusive. Therefore, this study was conducted with an objective of identifying the relationship between foreign exchange reserve and inflation in Ethiopia during the period of 1991 to 2018. The study data was collected from secondary sources. After checking stationarity of the data, the study has employed Autoregressive Distributed lag model (ARDL) model that the foreign exchange reserve (FER)is integrate at I(0) and Consumer Price Index (CPI) I(1). The study reveals that the relationship between change in foreign exchange reserves and inflation rate is positive in Ethiopia during the period of 1991 to 2018. The effect of foreign exchange reserve in short run estimation is insignificant. But in long run estimation, foreign exchange reserve and inflation are positively associated during the study period. The long run estimation is similar with the earlier studies and consistent with hypothesis of the study. From this, the study concludes that the increase of foreign exchange reserves results on sustained growth of general price level. The study recommends to improve sterilization policy of the country.

Key words: foreign exchange reserve, inflation, ARDL model

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Reza, Ostry and Sheehy (2011) stated that foreign exchange reserves are those external assets that are readily available to and controlled by monetary authorities for meeting balance of payments financing needs, intervention in exchange markets to affect foreign exchange rates and other purposes. Foreign Exchange Reserves (FER) include official reserves positions of Central Banks held in different Reserves currencies such as US Dollar, British Pound Sterling and Euro. They also include gold, silver, bonds held by the Central Bank of a nation, Special Drawing Rights (SDRs) issued by the International Monetary Fund (IMF). Countries maintain reserves so to manage exchange rate and reduce volatility or excess fluctuations.

It is one of the major development in global financial system for the past two decades that rapid growth of Foreign Exchange Reserves have been seen. According to Elhiraika and Ndikumana(2007) an accumulation of foreign exchange reserves increases with international trade. The upsurge in accumulation of reserves in developing and emerging economies has been interpreted as a form of self-insurance against the high level of world economic and financial instability. This accumulation has been widely perceived as precautionary savings to prevent financial crises.

Aizenman and Lee (2005) states countries accumulate reserves as a tool for maintaining low exchange rates so as to promote international trade and competitiveness.The management of Foreign Exchange Reserves has been directed towards the wealth maximization of the nation, other than maintaining trade balances and others, irrespective of costs involved in it. It is then necessary for the emerging economy to hold large Foreign Exchange Reserves against disruptive effect of abrupt capital outflows. Some countries have also maintained high reserves accumulation to boost investors' confidence and enhance economic growth and stability. Inflation is one of the macroeconomic problems that take the attention of macroeconomists, policy makers and central or national bankers of countries. It is the major concern of macroeconomic and principal

focus of policy decision makers and the public issue.According to the quantity theory of money, the accumulation of reserves might result in inflationary pressures if the resulting monetary expansion is not fully sterilized and exceeds the growth of money demand.

Different empirical studies were conducted in different countries to identify the relationship between Foreign exchange reserve and inflation. According to Krušković and Maričić (2015)Exchange accumulation of foreign exchange reserves is not inflationary in Brazil, China and Russia. Steiner (2010) indicated that global reserves accumulation drives global inflation and inflation within each country. Meiselman (2015) showed that external reserve positively affect the world wide inflation. According to Zhou (2014)exchange reserves growth was promoting consumer price index increasein china. Lin and Wang (2009) indicated increase of foreign exchange reserves was rising inflation rate in East Asian economies. According to Chowdhury et al (2014) relationship between external reserve and inflation in Bangladesh was negative.Usman and Waheed (2010) and Umeora (2013)changes in reserves show no significant relationship between accumulation of reserves and inflation in Nigeria. Aizenman and Glick, (2009) shows positive association between foreign exchange reserves and inflation rate in Kenya. Irefin and Yaaba (2012) indicated that foreign reserve aggregation and inflation rate are not associated in Tanzania.

In Ethiopia, in last few decades, local currency was frequently devaluatedbased on the foreign exchange reserves accumulation of the country. On the other hand, inflation of the country is increasing from year to year. Therefore, this study is endeavored to investigate the nature and intensity of relationship between foreign exchange reserves and inflation rate in Ethiopia during the period of 1991 to 2018.

1.2 Statement of the Problem

Foreign exchange reserves play important role in economic stability, self-insecure against possible sudden stops in capital inflows especially in case of small open economy countries. Most developing countries of Africa and East Asia, have engaged in massive accumulation of Foreign Exchange Reserves. It has been argued that excessive reserve accumulation may create costs for reserve hoarding countries, in terms of sterilization (or

opportunity) costs of holding reserves. Variations in foreign exchange reserves also have an effect on the prices of goods and services that play a significant role for inflation variations. The accumulation has been done regardless of the economic implication on the macro economy. Foreign exchange policy makers have become more anxious of the uncertainties in the international financial system that the accumulations are made as insurance against shocks in exchange rateregardless of the effects.

According to Steiner (2017) an increase in foreign exchange reserves enhance increase in national money supply that has an impact on national inflation rate channels via supply changes. But in developing countries who are importers of less elastic goods and services, imports are based on approximately inelastic items (oil products, pesticides, fertilizers, medicine, machinery, and food products etc.).Reduction in foreign exchange reserves results on decline on imports of agricultural raw materials and oil products in the form of supply shock and higher level of food and core inflation.Irrespective of volatility in accumulations, the Foreign Exchange Reserves have might have impact on its inflation of a nation. Krušković and Maričić (2015) states that accumulation of foreign exchange reserves does not lead to inflation if the rate of accumulation of foreign exchange reserves does not exceed the rate of economic growth. Foreign exchange reserve is not inflationary when the exchange rate depreciation that occurs as a result of the accumulation of foreign exchange reserves is a one-time, non-persistent shock, unlike the sudden depreciation of the exchange rate.

Different studies were conducted about the relationship between foreign exchange reserve and inflation. But the findings of the studies vary from country to country. Steiner (2010), Meiselman (2015), Zhou (2014), Lin and Wang (2009), Aizenman and Glick, (2009) indicated that foreign exchange reserves accumulation drives inflation in a country.In contrary to these studies, Chowdhury et al (2014) stated that relationship between external reserve and inflation is negative. On the other hand, findings of Krušković and Maričić (2015), Usman and Waheed (2010) and Umeora (2013) andIrefin and Yaaba (2012)show that changes in reserves show no significant relationship between accumulation of reserves and inflation. Difference in the finds implies that it needs further study about relationship between foreign exchange reserve and inflation. In

addition, these studies are conducted about other countries. In Ethiopia, most studies deal with exchange rates and management of reserves that shows studies that identified effect of foreign exchange reserves accumulation on inflation are scanty.

Based on gaps in the area of relationship between foreign exchange reserves accumulation and inflation in Ethiopia, this study intended to investigate the relationship between foreign exchange reserves and Inflation in Ethiopia during the period of year from 1991 to 2018.

1.3 Objectives of the Study

1.3.1 The general objectives

The general objective of this study is to examine relationship between foreign exchange reserve and inflation rate in Ethiopia from 1991 to 2018.

The specific objectives

- To analyze the foreign exchange reserve and inflation in Ethiopia during the period of 1991 to 2018.
- To examine the long run association between foreign exchange reserves and inflation rate in Ethiopia from 1991 to 2018.
- Toidentify the short run association between foreign exchange reserves and inflation rate in Ethiopia from 1991 to 2018; and

1.3 Hypothesis of the Study

Ho: Foreign exchange reserve does not cause inflation in Ethiopia during the period of 1991 to 2018.

H1: Foreign exchange reserve has positive effect on inflation in Ethiopia during the period of 1991 to 2018.

1.4 Significance of the Study

This studyhas attemptedexamine the relationship between foreign exchange reserve and inflation over the period under study. Hence, the study will be important for different users that it reveals inter-links between foreign exchange reserve and inflation in Ethiopia. Specifically, this study will help policy makers in regarding to inflation

controlling in subject to managing foreign exchange reserve. In addition, the study will be important for further studies that intends to identify any association between foreign exchange reserve and inflation.

1.5 Scope and Limitation of the Study

A vital component of any move towards economic growth and development is an integrated effort towards macroeconomic stability. The aim of this study is investigating the nexuses between the foreign exchange reserve and inflation in Ethiopia using annual data from 1991 to 2018. This study was conducted with an objective identifying effect of foreign exchange reserve on inflation in Ethiopia during the period of 1991 to 2018.

1.6 Organization of the Study

The study isorganized under five chapters. Fist chapter provides introduction about the study that presents about background of the study, statement of the problem, objective of the study, hypothesis of the study, scope of the study, significance and limitation of the study. The second chapter deals with review of both theoretical and empirical literatures related to the study and conceptual framework of the study. The third chapterdeals with research methodology which is about approaches of the study, design of the research, source of data, variable specification, and model specifications. The fourth chapter presents the results and discussions which summarize the results/findings of the study, and interpret and/or discuss the findings. The final chapter isabout summary of major findings, conclusions and recommendations.

CHAPTER TWO

REVIEW OF LITERATURE

2.1 Introduction

This study was conducted with an objective of identifying the relationship between foreign exchange reserve and inflation rate in Ethiopia during the period of 1991 to 2018. In relation to objective of the study. In thischapter,present different theories and empirical studies about inflation and foreign exchange reserve as well as their relationship. The first section explores the theoretical framework of the study, the second section presents the global empirical studies and their findings. The final part will focus on the studies carried and draws conclusions from both the theoretical and empirical literature.

2.2 Theoretical Review

2.2.1 Concepts and Definition

2.2.1.1 Foreign Exchange Reserves

Another term given for Foreign Exchange Reserves is External Reserves and Foreign reserves. Foreign exchange reserves include gold, silver, bonds held by the Central Bank of a nation, Special Drawing Rights (SDRs) issued by the International Monetary Fund (IMF). External Reserves also include official reserves positions of Central Banks held in different Reserves currencies such as US Dollar, British Pound Sterling and Euro. Reza, Ostry and Sheehy (2011) stated that foreign exchange reserves are those external assets that are readily available to and controlled by monetary authorities for meeting balance of payments financing needs, intervention in exchange markets to affect foreign exchange rates and other purposes.

The benefits of foreign reserves as a shock absorber of crisis associated with external economic transactions cannot be overemphasized. Fischer (2001), emphasizes this position by positing that there is a restriction to the level of foreign exchange reserves required to prevent thefinancial crisis, given the fact that accumulation of large foreign reserves implies higher costs. If foreignexchange reserves' holding is spurred by

preventable desires, it should terminate at thelevel where the country has reached its optimal level in addressing the issue of what constitute an adequate foreign reserves.

Frenkeland Jovanovic (1981) argued that some of the conditions for the demand for foreignexchange reserves of an economy centre on variables, like total trade (import and export), external debt, possible trade shocksseverity and considerations of monetary policy. Shcherbakov (2002) argued that, there are some common parameters used to assess the adequacy of foreignreserves for an economy. Some of these measures show the level of foreign weakness of an economy and the ability of foreign exchange reserves to guide against this vulnerability. These parameters are sufficiency of imports, adequacy of debts and monetarysufficiency.

Notwithstanding, recently, an active strategy for foreign exchange reserves administration appears to centre on the creation of future wealth for a country. This happens when exchange rate, debt management and monetary policy issues to central banks are of marginal interest. On the other hand, when weaknesses in thefinancial and corporate sectors are low; when government seriously drives a flexibleexchange rate policy; and when the government has an efficient fiscal policy and sound management framework as well ashighly developed domestic financial markets, in this case, the foreign exchange reserves portfolio is organized into active and non-active parts. The inactive portfolio centre on macroeconomic objectives concentrating on mainly finance while the active portfolio is used for maximizing profit, taking into consideration the objective of liability management (Carlos et al 2004). Peter and Machiel(2004) arguing in tandem with the motive of profit maximization to foreign exchange reserves administration, posit that, "over a decade now, foreign currency reserves administration has changed its aim from sustaining liquidity and economic protection objectives to that of maximizing total profit.

2.2.1.2 Inflation

Inflation is an increase in the overall level of prices in the economy. Another popular saying explains inflation as ''too much money chasing too few goods''. There are twocauses of inflation namely the demand pull inflation caused by excessive demand

oversupply and cost push inflation caused by the rise in cost of production. When this increase in price is too sharp it is called Hyperinflation usually caused by an excessive growth of money supply (Mankiw, 2001). The opposite of inflation is deflation which isthe general fall of price level. Stagflation is the situation where stagnation (fall in output)combines with inflation (rise in price).The incident of inflation and its relationship with different economic variables has beendiscussed since the classical period and developed later on other modern economictheories.

2.2.2 Theories of Foreign Exchange Reserve

The theoretical frame work of foreign exchange reserves relates to theoretical formulations of balance of payments (Nzotta, 2004). Dwivedi (2008) defines Balance of Payments (BOP) as "A systematic record of all economic transactions between the residents of a country and residents of foreign countries during the period". Sloman (2004) briefly stated "Balance of Payment (BOP) accounts are on accounting record of all monetary transactions between a country and the rest of the world". Balance of Payments often results in disequilibrium giving rise to surplus or deficit and also necessitating the maintenance of external reserves. The disequilibrium is always associated with Current Account. If there is a surplus, it is taken in to increase reserves but if there is deficit, it is taken from reserves. According Dwivedi (2008) if there is a deficit in current Account it is offset from surplus in capital account, it may be borrowing from abroad or running down of foreign exchange reserves. If there is surplus in current Account, it is previous external borrowing. It is thus regard that the with Capital Account and External Reserves economists say that balance of payments must always balance.

Three theoretical approaches have also been put up as foundation for foreign exchange reserves. The approaches are: the elasticity approach, income absorption approach and the monetary approach (Nzotta, 2004). The elasticity approach examines the effect of an appreciation or depreciation of the exchange rate on the resource flows of a country. The approach posits that with down ward adjustment of exchange rates, a country with balance of payments disequilibrium would have to export more, import less and thus accumulate more foreign reserves. According to I.M.F (2015), the position is based on the rigidassumption of mass unemployment, perfectly elastic supplied, an initial balanced

growth and the assumption that the elasticities of domestic and foreign demand for imports should exceed unity. International integration should cause capital to flow from high income countries characterized by high capital labor ratios to low-income countries with lower capital-labor ratios (Prasad and Rajan, 2008). According to this approach, the process would improve the levels of investment through the access to foreign capital. It would also boost growth in poor countries and support higher returns to foreign investors who will be induced to make capital flows abroad. The process of capital flows will be facilitated foreign exchange liberalization.

The income absorption approach views that under extreme conditions, direct control measures could be used to reduce foreign exchange expenditures and thus increase the stock of reserves. Obaseki (1991) recommends that the principal measures of financing temporary deficits through reserves should be for cases where there are large controls as well as domestic credit restrictions. This approach recommends appreciation or depreciation of the exchange rate on resource flows of a country (Nzotta, 2004). The approach states that if there is downward adjustment of exchange rates, a nation experiencing and balance of payment disequilibrium has to raise exports and reduce imports and thus accumulate more external reserves. Devaluations are necessary where deficit are persistent.

The monetary approach is related to quantity theory of money. The Quantity Theory of Money (QTM) is one of the popular classical macroeconomic models that explain the relationship between the quantity of money in an economy and the level of prices of goods and services.The monetarists say that accumulation of reserves is as a result of the excess demand for the domestic currency and the growth of world trade. For the Keynesians accumulation of foreign reserves is to improve the current account and thereby positively impact on the aggregate input. This impact is in the short run and will affect nominal exchange rates. In Keynesian theory, the upward sloping curve shows that the increase in demand due to government intervention not only increases inflation but also output. Hence, there is positive relationship between inflation and economic growth in Keynesian theory. The monetary approach takes note of the rate of money supply in exercising influence over other macroeconomic aggregates which affect the movement of

external resource flows and then foreign reserves. The approach believes that the inflow and outflow of foreign exchange associated with surpluses and deficits in the balance of payments are not immediately sterilized and thus affect the money supply (M2). This approach does not concentrate on trade balance in explaining the factors that exert influence on the external sector. The approach assumes that when the exchange rate is fixed, the monetary authorities con control foreign exchange reserves through monetary policies since monetary policies exert pressure on domestic credit and money supply. In this situation of assumed fixed exchange rates, foreign reserves have to be adequate to protect foreign exchange rates.

2.2.3 Theories of Inflation

The classical theory of inflation attaches sustained price inflation to excessive growth in the quantity of money in circulation. For this reason, the classical theory is sometimes called the quantity theory of money. More specifically, the classical theory of inflation explains how the aggregate price level gets determined through the interaction between money supply and money demand. As a matter of fact, because it traces the behavior of an important economy-wide variable – inflation – back to the most basic forces of supply and demand, the classical theory must qualify as one of the oldest models in all of macroeconomics (Ireland, 2014).The literature on inflation has been widely discussed by theorists. Three main types of inflation have been prevalent namely demand-pull inflation, cost-push inflation, and structural inflation (Dwivedi, 2009, Vaish 2011).

The demand-pull inflation occurs when the aggregate demand increases much more rapidly than the aggregate supply. The increase in aggregate demand may be caused by monetary factors (i.e. increase in money supply), and real factors (increase in demand for real output). That is, increase in money supply in excess of output is one of the most important factors causing demand-pull inflation. In addition, the real factors that cause inflation include taxes and government (public) expenditure (Dwivedi, 2009, Vaish, 2011).

The cost-push inflation is generally caused by monopolistic groups of society, like labour unions and firms in monopolistic and oligopolistic market setting. Strong labour unions often succeed in forcing money wages to go up causing increase in prices. This kind of

rise in price level is called wage-push inflation. Also firms enjoying monopoly power have also been found using their monopoly power to raise prices which in turn causing a rise in the general price level. This kind of inflation is called profit-push inflation. Another kind of cost-push inflation is said to be caused by supply shocks (decrease in the aggregate supply). This is called supply shock inflation which in particular attributed to, for example, food prices shoot up due to crop failure, and increase in prices of some key industrial inputs. That is, this rise in prices may be caused by supply bottlenecks in the domestic economy or international events (generally wars) causing bottlenecks in the movement of traded goods and causing shortage of supply (Dwivedi, 2009, Vaish,2011).

The structuralist theories of inflation were the work of structuralists and mainly attributed to the works of Myrdal, Streeten, and several Latin American economists who gave birth to structural inflation (Dwivedi, 2009).According to the structuralist view, inflation in LDCs is an unavoidable result of their ambitious development programmes and is caused mainly by structural imbalances in such economies. The structural imbalances in LDCs' economies are (Dwivedi, 2009): (i) food scarcity: the imbalance between the demand for and supply of food. (ii) Input imbalance: shortage of capital and surplus labour, shortage of fuel and oil, (iii) foreign exchange bottlenecks: imbalance between exports and imports and balance of payment deficits, (iv) infrastructural bottlenecks: inadequate supply of electricity, transport and communication, and telecommunication and (v) social and political constraints.

2.2.4 Problem of Foreign Exchange Reserves Accumulation

Amarchy (2009) stressed this problem of wide fluctuations when she opined that countries "which held reserves in US Dollars are now significant losses of wealth due to the weakness of the Dollar especially as a result of the international financial crisis. According to Lor (Amarcy) "this creates a vicious cycle in which countries will have to accumulate as much as they can in terms of foreign exchange reserves to counteract these losses in wealth".

There is also the problem of sterilization costs association exchange reserves. Amarchy (2009) states that the role of sterilization is to offset the impact of increase of money supply on inflation. This offsetting is made through the issuance of domestic debts so that

if the interest rate for domestic borrowing exceeds the interest rate on reserves, there are direct fiscal costs implied which can be significant if the level of foreign reserves if high (Green & Torgerson, 2007; Elhlraika, 2007).

There is also the problem of balance sheet risks. If there is appreciation of domestic currency, the values of foreign reserves will fall and means less for the Central Bank Balance Sheet unless it increases the foreign reserves stock. It has also been known that these reserves invested mainly US Dollar Treasury Bills and Bond wholes earning a low yielding. If invested in other safe investments would have earned more and this means substantial investment losses especially to developing countries. Akyuz (2010) estimates that developing countries lose some $130 billion annually in this way. This figure is larger than development assistance from developed to developing nations. He concludes that these are essentially subsidies foisted on developed countries.

Another problem is the social cost- Reserves are accumulated and held in foreign currencies but have opportunity costs lost in terms of alternative investments. There are also crying needs for development capital such as infrastructure but these funds are tied down as reserves (almost as idle funds) while the under development persists. Rodrik (2006) opines that keeping these reserves, it should be noted, has lots of imputed costs that are ignored by the reserves accumulations. He argues that" developing nations are paying a very high price to play by the rules of financial globalization".

2.3 Empirical Literature Review

This study is conducted to address the relationship between foreign exchange reserves and rate of inflation. To meet this objective, the study has reviewed empirical studies related to the study. The study has tried to address the recent literatures.

Bastourre et al. (2004) used Dynamic Panel Data approach to study why countries accumulate reserves. They observed that nations were moved by the fact that with a few exceptions, emerging economies as well as developing countries are leaders in the quest for the accumulation. Their study identified East Asia countries are the greatest seekers of foreign reserves while European and North American countries are least in the quest for accumulation. In view of the magnitude of the accumulated their study among others

posed some of these questions: why do so many countries accumulate international reserves? Is there a common reason behind accumulation? What are the roles of reserves in an era of capital liberalization and exchange rate flexibility? Are the theoretical models and empirical estimations adequate to explain rationality of accumulation? Bastourre et al. (2004) stated that answers for their questions are to be answered by international macroeconomics literature. On their part based on their dynamic panel approach their study emphasized the traditional views which gave these three determinants: (i) The benefit of building up reserves is calculated by the reciprocal of the marginal propensity to import. The aim is to reduce national income and hence reduce imports. (ii) The opportunity lost of hoarding reserves which is the spread between interest rate earned byreserves and the alternative social use of the resources tied down as reserves. (iii) The volatility of the balance of payments, to take into consideration the degree of synchrony between external flows. Banstorne et.al study dwelt extensively on the works of Clark and Kelly (1970), Hamada and Ueda (1977), Frenkel and Jovanovich (1981). Like these researcher they came to the same conclusion: "optimal reserves increase with volatility and decrease with propensity to import and the opportunity cost" (Grimes, 1993).

Lane and Barke (2001) in their own study dealt with the work of Lardell-mills (1989) and Borodo and Eichengreen (1998) and their result concluded that "trade openness is easily the most important factor in explaining cross-country variation in accumulation". They also observed that "there is some evidence that financial development and at lest among industrial countries, country size and external volatility are association with an increase in the reserves/GDP ratio". Their study found for low income and developing countries that there is a negative partial correlation between external debt and reserves.

Romero (2011) made a comparative study of factors that affect foreign reserves in China and India. The time of the study was not specified but it is believed to be recent. She mentioned the factors so far stated by other researchers. However she added that the type of exchange rate system has influence on the demand for reserves (Beaufort & Kapteyn, 2001). The exchange rate is depreciated when the rate goes up. More of the domestic currency is required to buy a unit of foreign currency. In other offset this devaluation, the central currency in the have to buy some of its own currency in the open market.

Reserves will then be used to buy the domestic currency thus depleting reserves. As China and India have tremendous quantity of reserves, Romero hypothesized that China's reserves will be negatively correlated to the level of the exchange rate. On the part of India, she hypothesized that India's, reserves will be positively correlated to its exchange rate.

On developing countries output per capital, exchange rate regime, oil dummy (for oil producing countries such as Nigeria) and trade openness are important determinants. Amarcy (2009) made a comparative study of Mozambigne and Nigeria about the negative real and monetary implications of excessive accumulation of reserves. She did not use any statistical analytical tools but quoted the work of Green and Torgerson (2007). They gave what can be regarded as the parameters of evaluating adequate reserves level. The parameters are:(i) Reserves are to equal short term debt- This is called Greespan – Gniditti Rules which states that countries with vulnerability to capital account crisis may hold reserves high enough to cover all debts of short maturity of about one year. The aim is to prevent countries from going into currency crisis. (ii) Reserves to equal 5-20% of Money Supply (M2). This is used by countries that need to fortify the confidence in the value of the home currency to reduce the risk of diversion of capital. (ii) Reserves to equal 3 or months of imports: This is appropriate to low income and countries where the exposure to current account shocks is high. Nigeria is very susceptible to this being and import inelastic nation. In low income countries such as Mozambigne foreign exchange is very scale and much of it comes by way of foreign aids.

Usman and Ibrahim (2010) made a study of external reserves holding with implications for investment, inflation and exchange rate. Using Vector Error Correction (VEC) model they concluded that demand for external reserves in Nigeria "has been driven mainly by current account variability, real exchange rate and opportunity cost of holding reserves (measured by the difference between the real return on reserves and the real return on domestic investments)". They opined that their finding corroborate those of Adam and Leonce (2007) who stated that "demand for international resources in Africa is determined by Export, GDP growth and opportunity cost of holding reserves".

Aizenman and Glick, (2009) analyzed the effect of foreign exchange reserve on inflation in Kenya by using the data from 1989-2008. The study has identified both short run and long run association between foreign exchange reserve and inflation rate. The result of the study revealed that foreign exchange reserve and inflation are positively associated during the study period.According to the study, the most well-known channel through which reserve accumulation can lead to higher domestic inflation is imperfect sterilization, as a large array of studies suggests. An unsterilized increase in foreign reserve holdings (on the asset side of central bank's balance sheet) is matched by an increase in base money (on the liability side of the central bank's balance sheet). Coupled with the money multiplier, this initial increase leads to an expansion in the total quantity of money. Aizenman and Glick (2009) analyzed sterilization patterns associated with reserves accumulation and find similar evidence of inflationary effects of reserve inflows.The study is supported by the quantitative theory of money that states monetary base causes prices to rise.

Meiselman (2015) examined the connection between international reserves and inflation in Morocco. The study used 15 years data from 2000 to 2014. The data was analyzed by using ARDL model. The study found the direct association between changes in international reserves and inflation. It shows that change in international reserves positively affect the world wide inflation through change in monetary base and money supply. The study concludes that the increase in national money supplies prompted by the international reserves enlargement ultimately have positive impact on national inflation. The study suggested consistence of finding with the quantity theory of money approach extended to the international economy.

Lin and Wang (2009) analyzed the relation between foreign exchange reserves and inflation rate by using data for five East Asian economies. The study argued that when the foreign exchange reserves increases (or the domestic currency depreciates), the inflation rate will be rising while the trade effect is strong. On the other hand, the inflation rate will be reduced when the monetary surprise effect is more powerful and the weight placed on output stability is not large.

Steiner (2010) studied Central Bank's Dilemma on Reserves Accumulation and Inflation. He opines that the transmission of global liquidity to domestic asset prices works through the accumulation of reserves. He adds that inflationary consequences of reserves accumulation may depend on exchange rate arrangement – whether fixed or floating exchange rates. Under fixed exchange rate, worldwide inflation is determined by changes in global money supply which in turn depends on the Money Multiplier and the Monetary Base. Under floating exchange rate, inflation is a national phenomenon and international reserves lose their significance for inflation in the world economy. Steiner (2010) adds that the effect of an accumulation of informational reserves on inflation will also depend on the degree of sterilization applied by monetary authorities. Sterilization refers to action or policies undertaken by the monetary authorities to isolate or dampen the effects of reserves accumulation on inflation. His work concluded that global reserves accumulation drives global inflation and is inflation within each country.

Usman and Waheed (2010) conducted study about the relationship between international reserve and inflation rate in Nigeria. The study has used 20 years' time series data and analyzed the result by Error Correcting Model. The study opined that changes in reserves show no significant relationship between accumulation of reserves and inflation. They add that external reserves holding in Nigeria has no impact on inflation but the domestic money supply which should be a control measure for domestic inflation.

Irefin and Yaaba (2012) analyzed the association between foreign reserve and inflation in Tanzania during the period of 1991 to 2010. The study used the ARDLmethod to investigate restructured econometrics of Buffer Stock Model of Frenkel and Jovanovic (1981) with emphasis on level of income, interest rate, imports and exchange rate. Their findings altered the presence of buffer stock model forforeign exchange reserves aggregation and provided vital indicators in support level of income as the key variable influencing reservesaggregation. The finding of the study indicated that foreign reserve aggregation and inflation rate are not associated.

Bacchetta, Benhima and Kalantzis (2013) found that in a steady state it is optimal for the central bank to replicate the open economy, i.e. to issue debt financed by the

accumulation of reserves so that the domestic interest rate equals the foreign rate. They also found that capital controls can still help reach the first best when the planner has more fiscal instruments.

Umeora (2013) investigated the relationship between Foreign Exchange Reserves Accumulation, Exchange Rate, Inflation and Gross Domestic Product (GDP) in Nigeria. The study has used data with Time series figures for the period 1986-2011 by employing multiple regression analysis based ARDL approach. The results of the study identified that Exchange Rate and GDP have positive and significant relationship with FER accumulation while the relationship between foreign exchange reserve and inflation is insignificant relationship. The study opines that Nigeria is accumulating foreign exchange rate because of over dependence on imports but should be aware of the social costs implication.

Chowdhury et al (2014) recently conducted an empirical analysis of the factors influencing foreign exchange reserves in Bangladesh, applying the Augmented Dicky Fuller (ADF) test, toanalyze unit roots properties of the variables and Engle Granger residual based co-integration test to examine the long run relationship among the variables, and some diagnostic tests for better modeling. The study therefore suggested an efficient exchange rate administration, strong remittance related policies, quality products for exports trade and sustainable national income level as possible measures that can enhance healthy amount of foreign exchange reserves for a developing country like Bangladesh. The results of the studyidentified the negative relationship between foreign exchange reserve and inflation rate in Bangladesh and the finding revealed the presence of strong relationship among foreign exchange reserves and inflation.

Zhou (2014) examined the relationship between Foreign exchange reserves and inflation covering monthly data from Jan. 2008 to Dec. 2011 for People Republic of China. The study has identified that China's foreign exchange reserves growth will promote consumer price index increase, foreign exchange reserves will influence the monetary policy by increasing money supply. So that, the excessive foreign exchange reserves is the reason to CPI increase. Further, the study examined that the contribution degree of

foreign exchange reserves to CPI is more that 20% that means the influence of foreign exchange reserves is obvious.

Krušković and Maričić (2015) analyzed the effect of the accumulation of foreign exchange reserves to economic growth in emerging countries. The study utilized balanced panel data methodology for Brazil, China and Russia, for the period from 1993 to 2012. The empirical results in the study suggest that the increase in foreign exchange reserves causes the growth of GDP, while in the opposite direction causality has not been proven. Exchange rate depreciation that occurs as a result of the accumulation of foreign exchange reserves is not inflationary because it is a one-time, non-persistent shock, unlike the sudden depreciation of the exchange rate that occurs as a result of maintaining an overvalued exchange rate in the long term and leads to currency crisis. Moreover, the accumulation of foreign exchange reserves does not lead to inflation if the rate of accumulation of foreign exchange reserves does not exceed the rate of economic growth.

Steiner (2017) assessed the consequences for monetary policy on theoretical and empirical grounds. The estimation results of the study showed that the degree of sterilization has varied considerably over time. The empirical analysis of monetary and non-monetary determinants of inflation provides evidence that the accumulation of reserves raises the inflation rate, both on the global and the individual-country level.

2.4 Conceptual Framework

Based on the reviewed literature above, the study has developed following conceptual framework. Foreign exchange reserve is treated as independent variable and consumer price index (CPI) which is proxy to inflation is treated as dependent variable.

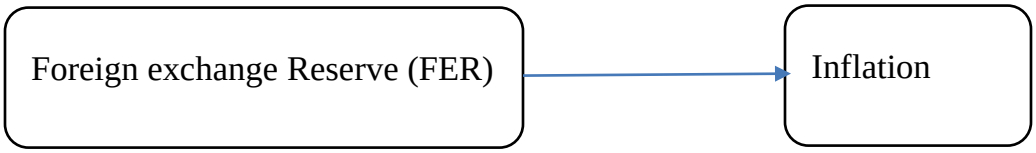


Figure 2. 1 Conceptual Framework (Source: Own Design, 2019)

CHAPTER THREE

RESEARCH METHODOLOGY

This chapter presents about the methodology followed to meet the research objective. It deals with the research design, data source, and model specification.

3.1 Research Design

This study was conducted with main objective of identifying the relationship between foreign exchange reserve and inflation in Ethiopia during the period of 1991 to 2018. It has followed descriptive and explanatory research designs. The descriptive design was intended to assess the trend of foreign exchange reserve and inflation that is analyzed by using mean, standard deviations and time series graphs.The explanatory design was used to examine the association between foreign exchange reserve and inflation by using econometric and statistical procedures. To this end, this study has used ARDL model and its procedures. Further, this study designs to use quantitative data from secondary sources.

3.2 Data Type and Source

This study has used dataset of 28 years (1991-2018) that includes regime of Ethiopia People Revolutionary Democratic Front (EPRDF)). This study is conducted by using two variables; foreign exchange reserve and annual inflation rate. These variables were used for the descriptive and regression purposes. In both cases, the study hasused secondary data. Data of foreign exchange reserve and inflation ratewas collected from World Bank database about World Bank Development Indicators (WDI) and United Nations Conference for Agreement on Trade and Development (UNCATD). Except CPI in 2018 all study data was collected form WB data base. CPI in 2018 was collected from UNCATD stats.

3.3 The Model Specification

This section of the study shows the econometric equation used estimate the relationship between the study variables. The study intends to identify both short run and long run

effect of foreign exchange reserve on inflation rate in Ethiopia. Since the study covers the period 1991 to 2018 that the variables constitute time-series information, the appropriate modeling strategy is one involving time-series analysis. In order to address the objective of the study Autoregressive Distributed lag model(ARDL) suggested by Pesaran (2001), for co-integration investigation and error correction (short run) analysis.ARDL model identifies both the short run and long run relationship.

The model is specified based on the model employed by Chaudhry et al. (2011) and presented as follow in equation (1).

$$INF_{t=} f(FER)_t \quad (1)$$

$$LOGCPI_t = \alpha_0 + \alpha_1 LOGFER_t + \varepsilon_t \quad (2)$$

Where INF is annual inflation rate of the country, FER is Foreign Exchange Reserves, LOG is logarithmic form of Consumer price index, LOGFER is logarithmic form of total foreign exchange reserve at a certain period of time t; α_0 and is the constant; α_1 is coefficient of LOGFER and εt is the error term.

The study has used Eviews 10, statistical software package for the entire analysis of the study.

3.4 Variable specification and Hypothesis

This study has reviewed different studies that include theoretical and empirical findings. Empirical studies reviewed by this study have used different variables in estimating the relationship between foreign exchange reserve and inflation. Drama (2016) has used GDP deflator proxy to inflation and then transformed both foreign exchange reserve and GDP deflator by using logarithm for easier interpretation. Zhou (2014) identified the effect of foreign exchange reserve on inflation in china by using foreign exchange reserve as independent variable and CPI which is proxy to inflation as dependent variable. Thisstudy has also specified the variables in logarithmic form. Poongothai (2017) used wholesaler price index proxy to inflation.

This study has used CPI proxy to inflation. In this study similar to previous studies, both FER and CPI were used in the logarithmic form. In this study inflation is measured in consumer price index, in order to transform the data in logarithm form to better interpretation of the result as elasticity, which is impossible while using inflation rate as it might be negative.

Table3.1 Variable Specification

Variable	Description of variable	Type of variable	Expected sign
LOGCPI	Log of CPI	Dependent	Not Applicable
LOGFER	Log of FER	Independent	Positive

Source: own construction based on Zhou (2014), 2019

3.5 Econometric estimation

3.5.1 Unit Root Test

Before conducting the ARDL strategy, the time series properties of the variables need to be examined. Non-stationary time series data has often been regarded as a problem in empirical analysis. Working with non-stationary variables leads to spurious regression results from which further inference is meaningless when these variables are estimated in their levels. In order to overcome this problem there is a need for testing the stationarity of these economic variables. The unit root and co-integration test on relevant economic variables are performed in order to determine time series characteristics. In general, economic variables which are stationary are called I(0) series and those which are to be differenced once in order to achieve a stationary value are called I(1) series. In testing for stationarity, the standard Augmented Dickey and Fuller (1979), and Phillips and Perron (1988) are performed to test the existence of unit root in order to establish the properties of individual series.

3.5.2 ARDL (Bounds Test) Approach to Co-integration

The Autoregressive Distributed Lag (ARDL) or Bound Test approach to co-integration developed by Pesaran and Shin (1999) and further extended by Pesaran et al. (2001) is adopted for this study. The procedure is adopted for the following reasons. Firstly, the

bounds test procedure is simple. As opposed 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 pretesting 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. Thirdly, the test is relatively more efficient in small or finite sample data sizes. Estimates derived from Johansen-Juselius method of co-integration are not robust when subjected to small sample sizes as compared to bounds test. With these reasons specified, the researcher adopts the ARDL model for this study.

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), meaning that there is no co-integration among 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 will be rejected suggesting that there exists a cointegrating relationship among the variables. If the F-statistic falls 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, then 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 are found to be I(1), then the decision is taken on the basis of the upper critical value. On the other hand, if all the variables are I (0), then the decision is based on the lower critical bound value.

The ARDL model specified in equation tested using the appropriate lag-length selection criterion. According to (Pesaran & Shin, 1999), as cited in (Narayan, 2004) for the annual data a maximum of two lag lengths are recommended. From this, a lag length that minimize AIC is chosen. In addition to this, we have also used AIC to determine the optimal lag because it is a better choice for smaller sample size data as this study. Apart

from this, AIC found to produce the least probability of under estimation among all criteria available. (Liew & Khimsen , 2004).

3.5.3 Model Assumption Tests

An important consideration to be made in relation to estimating the model is to do with the existence of spurious regression. The model that was used for the study was tested for conformance of classical model assumptions.

After the models is estimated, the study has conducted the diagnostic tests which are important in order to make sure that the results obtained from ARDL estimation can be used for forecasting or policy purposes. These post estimation tests are mostly performed on the residual of the model and they include: the LM test for residual autocorrelation, Jarque-Bera test for residual, test for stability and test for the presence of heteroskedasticity residuals.

The Jarque-Bera normality test is used to determine whether the regression errors are normally distributed. It is a joint asymptotic test whose statistic is calculated from the skewness and kurtosis of the residuals. This study will use Jarque-Bera method to test normal distribution of residuals.

Testing for autocorrelation helps to identify any relationships that may exist between the current values of the regression residuals and any of its lagged values (Brooks, 2002). The null hypothesis of the LM test for autocorrelation is that the residuals are not serially correlated, while the alternative is that the residuals are serially correlated. This study will check the serial correlation by using LM Method.

The test for stability checks whether the roots of the characteristic polynomial lies inside the unit circle. If all roots lie inside the unit circle then the VAR is considered as stable and can be used for policy analysis. This study can also make use of variance decomposition and impulse response functions in the analysis if the model is stable.

The test for heteroskedasticity investigates whether the variance of the errors in the model are constant or not. Breusch-Pagan-Godfrey test is used to check whether the residuals are homoscedastic. It tests the null hypothesis that the residuals are both homoscedastic and that there is no problem of misspecification. The test regression is run by regressing each cross product of the residuals on the cross products of the repressors and testing the joint significance of the regression.

To check the verifiability of the estimated long run model, some diagnostic test is undertaken prior in doing any analysis. In this study we carried a number of model stability and diagnostic checking, which includes serial correlation test (Brush & Godfray LM test), Hetroskedasticity test (ARCH) and Normality test (Jaque-Bera test). In addition to the above diagnostic tests, the stability of long run estimates has been tested by applying the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ) test. Such tests are recommended by (Pesaran et al.2001). In order to reject or accept the null hypothesis, we can decide by looking the p-values associated with the test statistics. That is the null hypothesis is rejected when the p-value are smaller than the standard significance level (i.e. 5%).

CHAPTER FOUR

RESULT AND DISCUSSION

4.1 Descriptive Analysis

This section presents the result of descriptive analysis and provides discussion on the result. The researcher has used statistics such as mean, standard deviation, minimum and maximum and the result is presented in table 4.1 below. The value of the mean reports the arithmetical average of the variables which are included in the study. The minimum and maximum values indicate the lower and the highest value of the variable. The standard deviation exhibits how much variation or dispersion exists from the mean. A low standard deviation indicates that the data points are inclined to be extremely close to the mean; while high values of standard deviation indicates that the data set is broaden out over a large range of values.

Table 4.1 Descriptive Analysis

	CPI	**FER(‘000,000)**
Mean	91.30030	1,504.844
Maximum	283.5030	3,977.210
Minimum	27.00380	106.4365
Std. Dev.	79.31139	1,169.281
Observations	28	28

Source: Own computation, 2019

As depicted in the table 4.1 above, the annual average of CPI during the period of 1991 to 2018 was 91.30. During the study period, highest inflation was 283.5 that was observed in 2018. The lowest inflation was indicated by value of 27.0 CPI in 1991. During the

period of 1991 to 2018, an average foreign exchange reserve was 1,504.85 million USD ranging from 106.44 million USD in 1991 to 3.98 billion USD in 2018.

As indicated in figure 4.1 below, both CPI and foreign exchange reserve are increasing together during the study period. This shows long run association between inflation and foreign exchange reserve.

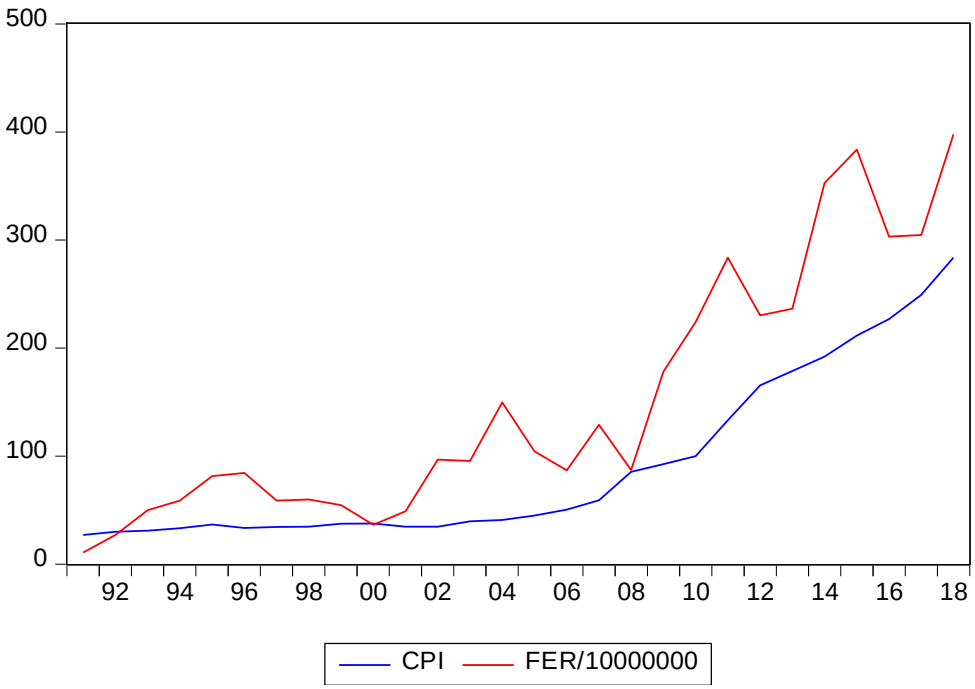


Figure 4. 1 Trend of CPI and FER (Source: Own computation, 2019)

4.2Unit Root Test

According to Gujarati (2004) the standard classical methods of estimation are based on a set of assumptions that all variables are stationary. However, most economic variables are not stationary. Stationary data has zero mean for its error term, constant variance and the covariance between any two time periods depends only on the distance or lag between the two periods and not on the actual time which it is computed. On the other hand a time series variable is stationary if its mean, variance and auto covariance (at various lags) remain the same on matter at what point they are measured i.e. they are time invariant.

Harris, (1995) states that the most common and popular method of testing unit root is the Dickey-Fuller (DF) test that it is simple and more general method. However, the DF test has a series limitation in that it suffers from residual autocorrelation. Therefore to overcome this problem, the study will use Augmented Dickey-Fuller model (ADF) that the DF model is augmented with additional lagged first differences of the dependent variable. If the variables are not stationary at level, they are differenced to make them stationary.

Unit Roots tests were conducted by utilizing the Augmented Dickey- Fuller (ADF) tests. The time series variables are in log form; LOGCPI and LOGFER. ARDL co-integration approach is based on the assumption that no variable is integrated at I(2) level. Therefore, to avoid spurious results it is necessary to check that all variables are integrated at I(0) and I(1). The underlying models include a constant and time trend. The essence of the Augmented Dickey-Fuller (ADF) tests is to verify the null hypothesis of non-stationary, the rejection of which requires a negative and significant test statistic. The optimal lag length of the lagged differences of the tested variable is determined by minimizing the Akaike Information Criterion (AIC).

Table 4. 2 Unit Root Test

Variable	Level		First Difference		Order of Integration
	Intercept	Trend and intercept	Intercept	Trend and intercept	
LOGCPI	1.609619 (-2.976263)	-1.073470 (-3.587527)	-3.384314** (-2.981038)	-3.940710** (-3.595026)	I(1)
LOGFER	-2.455091 (-2.976263)	-4.013787** (-3.587527)	-5.350950*** (-2.981038)	-5.163458*** (-3.595026)	I(0)

*, **, and *** denotes 10%, 5% and 1% significance level respectively; ( ) denotes critical values

Source: Own Estimation, 2019

The computed absolute value of the test statistics (Dickely-Fuller statistics) was checked against the maximum values of these criteria with the 95 percent absolute critical value for the Augmented Dickey-Fuller statistic. If the computed absolute test statistic value was greater than the absolute critical value, then we rejected the null of unit root, which

means stationary in the time series. Variable LOGFER is stationary at level that the absolute value of ADF statistics is greater than critical value at 5% significance level at trend and intercept. Therefore, null hypothesis of unit root is rejected.

The null hypothesis of unit root could not be rejected for variable LOGCPI because absolute value computed statistics is less than absolute value of critical values at 5% significance level. Therefore, the unit root is tested at first difference. At first difference, absolute values of computed statistics are greater than critical values at 5% significance level. Therefore, the researcher can reject the null hypothesis that there is unit root.

4.3 Co-integration test (ARDL approach)

The study will employ co-integration test to select appropriate model for the study. Co-integration among the non-stationary variables reflects the presence of long run relationship (Gujarati, 2004). There are two approaches used in testing for co-integration; Engle-Granger (two step algorism) and Johansen Approach. The Engle-Granger (E-G) method requires that co-integration exists when all variables are integrated of the same order. Hence, once the variables are found to have the same order of integration, the next step is testing for level of integration. This needs to generate the residual from the estimated static equation and test its stationarity.Although, the Engle-Granger (EG) procedure is easily implemented, it is subject to several limitations.

On the other hand, the Johansen (1988) procedure enables estimating and testing for the presence of multiple co-integration relationships, in a single step procedure. Moreover, it permits to estimate the model without priory restricting the variables as endogenous and exogenous. Under this procedure, the variables of the model are represented by a vector of potentially endogenous variables. Therefore, this study will use the Johansen maximum Likelihood Procedure since it addresses the weakness of the E-G method.

In the ARDL approach to co-integration, the first step is to test the presence of co-integration or long run relationship among the variables. This test for the long run relationship is done using the ARDL Bounds test F-statistic and the optimal lag was selected by Akaike Information criterion (AIC) method.

The co-integration test is based on the F-statistics or Wald statistics. But these tests have problem of a nonstandard distribution. Thus, 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), meaning that there is no co-integration among 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 will be rejected suggesting that there exists a co-integrating relationship among the variables. If the F-statistic falls 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, then the inference is inconclusive and knowledge of the order of the integration of the underlying variables is required before conclusive inferences can be made. In this context, the unit root test is conducted to ascertain the order of integration of the variables. If all the variables are found to be I(1), then the decision is taken on the basis of the upper critical value. The result of bound test is presented in table 4.3 below.

Table 4 3 Bound Test

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	3.815513	10%	3.02	3.51
K	1	5%	3.62	4.16
		2.5%	4.18	4.79
		1%	4.94	5.58

Source: Author's Computation using eviews 10, 2019

As shown in the table 4.3 above, in co-integration test of ARDL bounds test, since the calculated F statistics (3.815513) is greater than the upper critical bound(3.51) at 10% significance level, the null hypothesis is rejected suggesting that there exists a co-integrating relationship between inflation and foreign exchange reserve during the period of 1991 to 2018.

4.4 Lag Order selection

The model was estimated by ARDL and the optimal lag was selected by Akaike Information criterion (AIC) method. In this study automatic selection (using the Akaike

Information Criterion) was used with a maximum of 2 lags of both the dependent variable and the repressors. The procedure has selected an ARDL (1,0) model (1 lags dependent variable, LOGCPI, and no lag of independent variable, LOGFER). Figure 4.2 below presents model selection criteria by using AIC.

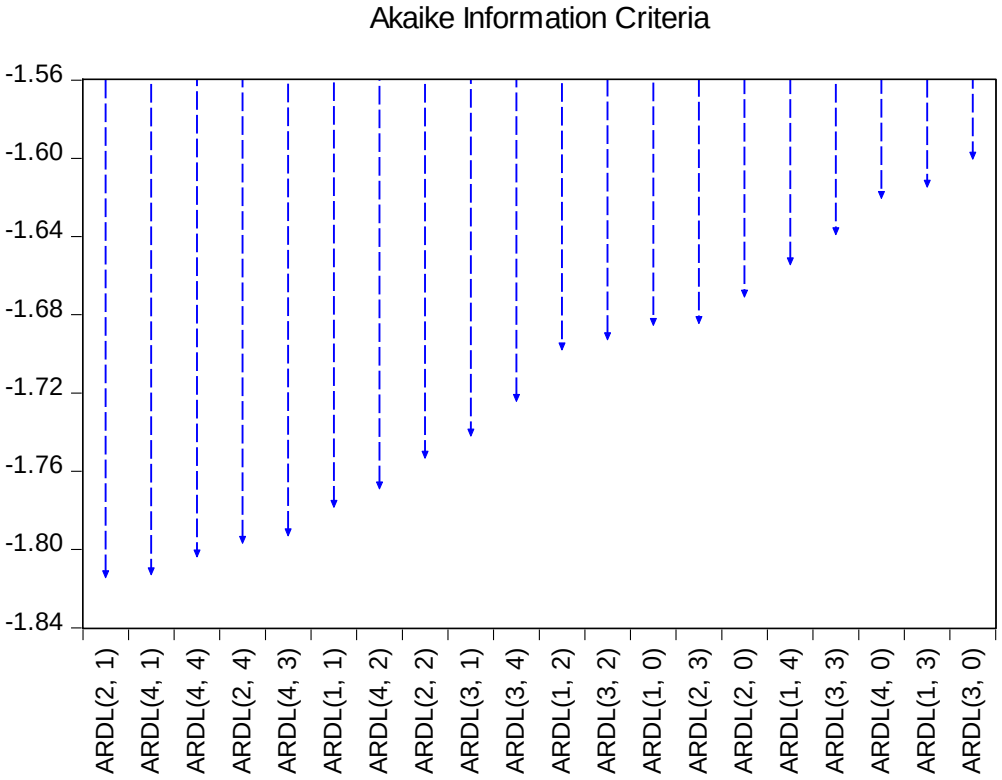


Figure 4. 2 Model Selection Criteria (Source: Own computation, 2019)

4.5 Diagnostic tests

To ascertain the goodness of fit of the estimated model, the diagnostic tests were conducted about residual diagnosis and model stability. The residual diagnostic test were conducted to identify the existence of problem of serial correlation, heteroskedasticity and non-normality. The stability diagnosis is intended to identify the stability in long-run equation during study period and it is analyzed by using cumulative sum of recursive residuals (CUSUM) and the cumulative sum squares of recursive residuals (CUSUMSQ).

4.5.1 Residual Diagnosis

4.5.1.1 Normality Test

By using the Jarque-Bera normality test, the study checked whether the residuals are normally distributed or not. If the residuals are normally distributed, the histogram should be bell-shaped and the Bera-Jarque statistic would not be significant. Since P-value of Jarque-Bera is greater than 0.05, the study could not reject suggesting that the error terms of the specified model are normally distribute.

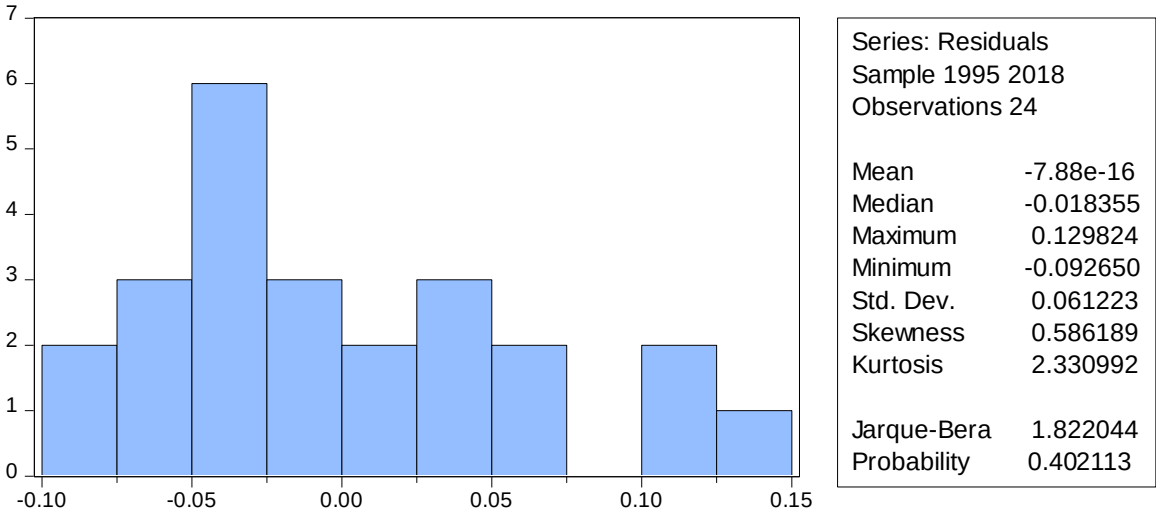


Figure 4. 3 Normality Test (Source: Own computation, 2019)

4.5.1.2 Serial correlation test

The residuals associated with one observation are not correlated with the residuals of any other observation. In this study the BreuschGodfrey Serial Correlation LM Test is applied. The p-values of F-statistic and Obs*R-squared exceeds the 5% critical value suggesting that there is no serial correlation.

Table 4. 4 Serial Correlation Test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.741460	Prob. F(2,19)	0.4897
Obs*R-squared	1.882345	Prob. Chi-Square(2)	0.3902

Source: Own computation, 2019

4.5.1.3 Heteroskedasticity

The presence of heteroskedasticity has been checked for the efficiency model to ensure that the standard errors are not wrong and any inferences made could not be misleading. If the variance of the residuals is non-constant then the error variance is said to be heteroscedastic. The null hypothesis of the test is that the errors are homoscedastic and independent of the repressors and that there is no problem of misspecification. This study carries out both Breusch-Pagan test and ARCH test for heteroskedasticity. The decision rule states that, if the p-value of the test is lower than any of the chosen significance levels, i.e., 1%, 5% and 10% it indicates possible problem of heteroskedasticity; whereas if the p-value of the test is greater than any of the chosen significance levels, i.e., 1%, 5% and 10% indicate no possible problem of heteroskedasticity

The Breusch-Pagan-Godfrey Test shows that the F- statistic and chi-square p-value are more than 5% percent. Therefore, the study could not reject the null-hypothesis that the residuals. This suggests that the residuals of the model have no problem of heteroskedasticity.

Table 4. 5Heteroskedasticity Test: Breusch-Pagan-Godfrey

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.802057	Prob. F(4,21)	0.5375
Obs*R-squared	3.445684	Prob. Chi-Square(4)	0.4862
Scaled explained SS	4.567867	Prob. Chi-Square(4)	0.3346

Source: Own computation, 2019

In addition, the ARCH heteroscedastic shows that the p-value of both the F-statistic and chi-square are more than 5 percent, meaning the null hypothesis could not be rejected suggesting that there is no ARCH effect.

Table 4. 6Heteroskedasticity Test: ARCH

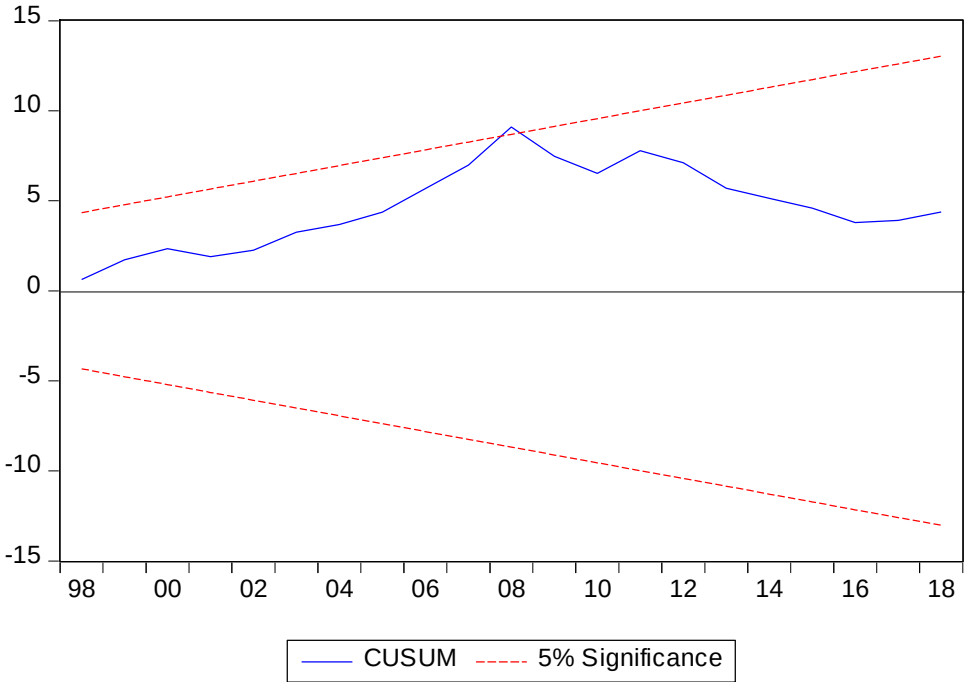
Heteroskedasticity Test: ARCH

F-statistic	0.564690	Prob. F(2,21)	0.5769
Obs*R-squared	1.224848	Prob. Chi-Square(2)	0.5420

4.5.1.4 Stability Test

The stability test of the regression parameters is undertaken using the Brown, Durbin and Evans (1975) stability testing technique, also known as cumulative sum of recursive residuals (CUSUM) and the cumulative sum squares of recursive residuals (CUSUMSQ) that Pesaran et al (2001) recommended that the stability of long run estimates to be tested by applying CUSUM and CUSUMSQ. According to these tests parameter instability is exists when cumulative sum goes outside the area between the two critical lines within the 5% significance lines. In this study, the line is well within the confidence bands that suggests the null hypothesis of stability is cannot be rejected. Therefore, this indicates that stability in the equation during the sample period.

Figure 4. 4 Model Stability CUSUM Test



Source: Own computation, 2019

In addition, the CUSUMQ test finds parameter stability if the cumulative sum of squares is generally within the 5% significance lines, suggesting that the residual variance is stable. Since the line is well within the confidence bands, the null hypothesis of stability is not rejected that suggests the residual variance is stable in the equation during the sample period.

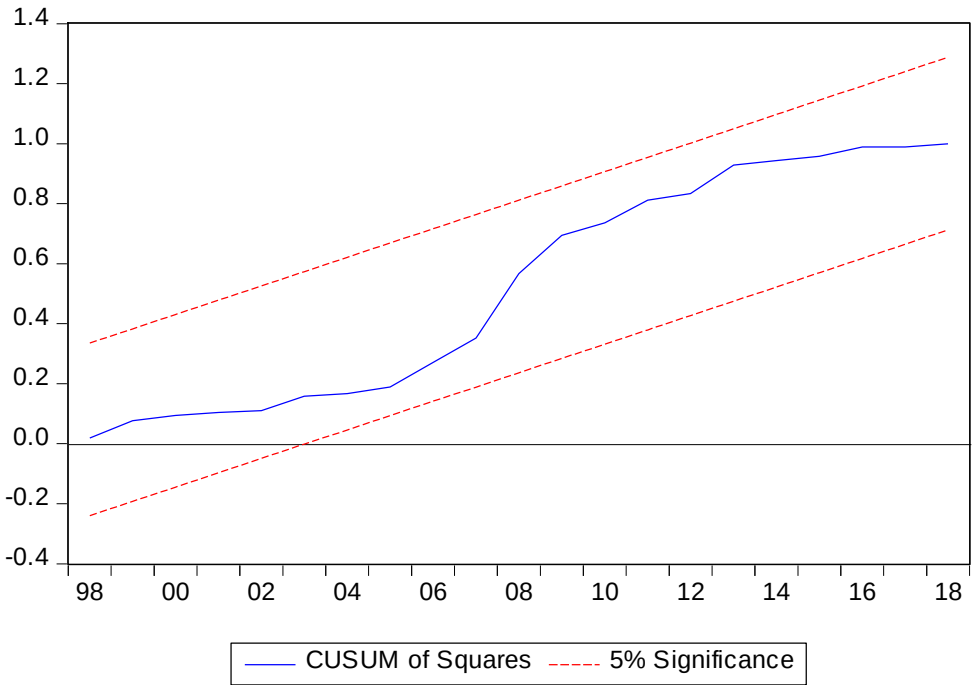


Figure 4. 5 Model Stability: CUSUMQ Test (Source: Own computation, 2019)

4.6 Long Run and Short Run Dynamics Behaviors

This study was conducted with an objective of identifying effect of foreign exchange reserve on inflation in Ethiopia. The study intends to examine both short-run and long-run association between these variables. After ensuring that the study variables are stationary at first difference, the ARDL (Autoregressive Distributive Lag Model) method was employed to investigate the existence of co-integration both in long and short run.

If two variables that are non-stationary in levels have a stationary linear combination then the two variables are co-integrated. Co-integration means the presence of error correcting representation.That is, any deviation from the equilibrium point will revert back to its long run path. Therefore, an ECM depicts both the short run and long run behavior of a system.The VECM has co-integration relation built into the specification so that it restricts the long run behavior of the endogenous variable to converge to their co-integrating relationships while allowing for short run adjustment dynamics. The co-integrating term is known as the error correction term since the deviation from long run

equilibrium is corrected gradually through a series of partial short run adjustments. Thus co-integration implies the presence of error correcting representation and any deviation from equilibrium will revert back to its long run path.

4.6.1 Short Run Dynamics

Short run behavior of economic variables is captured through dynamic modeling. If there is long run relationship among the variables, an error correction model can be formulated that portray both the dynamic and long run interaction between the variables. VECM enables to capture the short run dynamics of the model and formulated based on the identified long run relationships.

To capture the speed of adjustment, the following dynamic error correction model is estimated as depicted by the equation bellow:

$$\Delta LOG(CPI)_t = \propto_0 + \sum_{i=1}^{n} \beta_i \Delta LOG(CPI)_{t-1} + \sum_{i=1}^{n} \beta_i \Delta LOG(FER)_{t-1} + ECT_{t-1}$$

Table 4. 7Error Correction Regression

ARDL Error Correction Regression
Dependent Variable: DLOG(CPI)
Selected Model: ARDL(2, 1)
Sample: 1991 2018
Included observations: 26

ECM Regression
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLOG(CPI(-1))	0.326625	0.168816	1.934801	0.0666
DLOG(FER)	-0.005544	0.052196	-0.106216	0.9164
CointEq(-1)*	-0.085650	0.024190	-3.540718	0.0019

Source: Own Computation, 2019

The error-correction term (ECT) coefficient term is estimated of back adjustment speed to the long-run equilibrium relationship. The (ECT) should have a negative sign and significantly different from zero. The negative sign of (ECT) means that the deviation event between actual and long-run equilibrium level would be adjusted back to the long-run relationship in the current periods to clear this discrepancy. Since all the variables in

the above model follow I(1) process, statistical inference base on standard (t) and F-test is valid.

The short run association between foreign exchange reserve and inflation is not significant at the conventional level 1%, 5% and 10%. This suggests that foreign exchange reserve has no effect on inflation in short-run. Therefore, the study cannot reject null hypothesis that foreign exchange reserve has no short-run effect on inflation in Ethiopia during the period of 1991 to 2018.

The equilibrium correction coefficients estimated value is -0.08565, which is statistically significant and has negative sign. This implies an 8.57 % per annum speed of correction if economy suffered with unexpected inflation due to uneven variations in foreign exchange reserves. In other words, 8.57 % disequilibrium (in inflation) from the previous year shock (in foreign exchange reserves) converges back to the long run equilibrium in the current year.

4.6.2 Long run estimation

The other objective this study is to examine the long run relationship between inflation and foreign exchange reserve in Ethiopia during the period of 1991 to 2018. In addition to analyzing the short-run dynamics, this study has used VECM, to identify the existence of the long-run association between foreign exchange reserves. The result of long run estimation is presented in table 4.8 below.

Table 4. 8 Long Run Dynamics

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(FER)	1.407922	0.474136	2.969448	0.0073
C	-24.48003	9.384546	-2.608548	0.0164
EC = LOG(CPI) - (1.4079*LOG(FER) -24.4800)				
R-squared	0.331547	Mean dependent var		0.086583
Adjusted R-squared	0.273421	S.D. dependent var		0.097043
S.E. of regression	0.082719	Akaike info criterion		-2.038564
Sum squared resid	0.157377	Schwarz criterion		-1.893399
Log likelihood	29.50134	Hannan-Quinn criter.		-1.996762
Durbin-Watson stat	1.810972			

Source: Own computation, 2019

As presents in table 4.8 above, long run association between foreign exchange reserve and inflation that the coefficient is positive. The coefficient of 1.4 suggests that 1% increase in foreign exchange reserve result on 1.4% increase in inflation in terms of consumer price index during the period of 1991 to 2018. This association is statistically significant at significance level of 1% that indicates very strong association between foreign exchange reserve and inflation in long run. Therefore, this study can reject the null hypothesis that foreign exchange reserve and inflation have no relationship during the period of 1991 to 2018 in long run and accepts the alternative hypothesis that foreign exchange reserve positively affects inflation.

Fischer (2001) suggests restriction on the level of foreign exchange reserves to prevent thefinancial crisis that the accumulation of large foreign reserves results on higher costs. If holding of foreign exchange reserves is spurred by preventable desires, it should terminate at thelevel where the country has reached its optimal level in addressing the issue of what constitute an adequate foreign reserves.Based on the finding, this study suggests that higher inflation in Ethiopia was caused from annual foreign exchange reserve rise. This study further imply thatmoney supply effect sterilization in Ethiopia during the period of 1991 to 2018 was imperfect that foreign exchange reserve is resulting on high money supply. This rise in money supply is causing inflation. Finding of this study is similar to findings of Aizenman and Glick, (2009), Meiselman (2015) and Meiselman (2015). Based on quantitative theory of money, Aizenman and Glick, (2009) indicated that reserve accumulation lead to higher domestic inflation through imperfect sterilization in Kenya. Similarly, Meiselman (2015) indicated that national money supplies prompted by the international reserves enlargement ultimately resulted on national inflation in Morocco. Zhou (2014) examined foreign exchange reserve results on inflation in China due to increase in money supply.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

This study was conducted with an objective of identifying the relationship between foreign exchange reserve and inflation in Ethiopia during the period of 1991 to 2018. Finding of this study shows that the relationship between change in foreign exchange reserves and inflation rate is positive in Ethiopia during the period of 1991 to 2018. The effect of foreign exchange reserve in short run estimation is insignificant at the 1%, 5% and 10% critical level. But in long run estimation, foreign exchange reserve and inflation are positively associated during the study period. The long run estimation is similar with the earlier studies and consistent with hypothesis of the study. From this, the study concludes that the increase of foreign exchange reserves results on sustained growth of general price level. Foreign exchange reserve will push prices continually to rise since it is much more difficult to control the inflation after once it occurs.

5.2 Recommendation

Based on the conclusion reached recommendation for Ethiopian government. As suggestion, government of Ethiopia should pay more attention to foreign exchange system management by increasing the open market operations. Further, the government is suggested to reinforce to promote the international payments balance through coordination of monetary and fiscal policy, and adopt comprehensive measures.

Moreover, the government is recommended to use sterilization to reduce foreign exchange reserves to stabilize domestic economy. The NBE is suggested to expand channels of the base money supply and develop effective sterilization strategies.

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ANNEX

2.5 Annex A: Unit Root Test

Null Hypothesis: LOG(CPI) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		1.609619	0.9992
Test critical values:	1% level	-3.699871	
	5% level	-2.976263	
	10% level	-2.627420	

Null Hypothesis: LOG(CPI) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.073470	0.9152
Test critical values:	1% level	-4.339330	
	5% level	-3.587527	
	10% level	-3.229230	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LOG(CPI)) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.384314	0.0210
Test critical values:	1% level	-3.711457	
	5% level	-2.981038	
	10% level	-2.629906	

Null Hypothesis: D(LOG(CPI)) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.940710	0.0246
Test critical values:	1% level	-4.356068	
	5% level	-3.595026	
	10% level	-3.233456	

Null Hypothesis: LOG(FER) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.455091	0.1371
Test critical values:	1% level	-3.699871	
	5% level	-2.976263	
	10% level	-2.627420	

Null Hypothesis: LOG(FER) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.013787	0.0205
Test critical values:	1% level	-4.339330	
	5% level	-3.587527	
	10% level	-3.229230	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LOG(FER)) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.350950	0.0002
Test critical values:	1% level	-3.711457	
	5% level	-2.981038	
	10% level	-2.629906	

Null Hypothesis: D(LOG(FER)) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.163458	0.0016
Test critical values:	1% level	-4.356068	
	5% level	-3.595026	
	10% level	-3.233456	

2.6 Annex B: Study Data

Year	FER	CPI
1991	106,436,547.41	27.0038
1992	270,054,785.99	29.84661
1993	499,938,564.08	30.90409
1994	587,541,811.04	33.25091
1995	815,019,143.29	36.58337
1996	843,310,623.93	33.47955
1997	588,431,597.75	34.28145
1998	598,411,583.85	34.58821
1999	546,583,407.07	37.33501
2000	362,554,284.79	37.58234
2001	489,895,048.94	34.48636
2002	965,896,507.02	34.71918
2003	955,608,364.11	39.46669
2004	1,496,784,398.44	40.7799
2005	1,042,595,212.19	44.84564
2006	867,438,326.79	50.36142
2007	1,289,865,533.39	59.04393
2008	870,502,457.02	85.23386
2009	1,780,874,201.12	92.4648
2010	2,241,164,058.22	100
2011	2,837,311,396.11	133.25
2012	2,301,655,559.19	165.3957
2013	2,363,513,694.45	178.7592
2014	3,525,245,485.21	191.9913
2015	3,835,287,532.59	211.403
2016	3,030,943,883.00	226.7588
2017	3,045,571,314.80	249.0905
2018	3,977,210,469.90	283.503

Source: WDI (2019)