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BAHIR DAR UNIVERSITY
COLLEGE OF BUSINESS AND ECONOMICS
DEPARTMENT OF ECONOMICS
MSc IN DEVELOPMENT ECONOMICS

**THE NEXUS BETWEEN DEVALUATION, EXTERNAL DEBT, AND ECONOMIC
GROWTH IN ETHIOPIA**

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June, 2019

Bahir Dar, Ethiopia

The Nexus between Devaluation, External Debt and Economic Growth in Ethiopia

BY:

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A thesis submitted to the department of Economics in partial fulfillment for the award of the degree of Master of Science in Economics

(Development Economics)

Bahir Dar University

Bahir Dar, Ethiopia

June, 2019

Declaration

I declare that the thesis is my original work and has not been presented for a degree in any other university, and all sources of materials used for the thesis have been dully acknowledged.

Declared by: Name _____

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Abstract

In developing countries, currency devaluation and external debt are important options to promote economic growth described by International Monetary Fund. However, these policy packages were not effective in many developing countries. Thus, cognizant of this fact, this study examined the nexus between devaluation, external debt and economic growth. In this study, Vector autoregressive (VAR) and Vector Error Correction Model (VECM) were employed. The VAR was analyzed through impulse response function and forecast error variance decomposition. The impulse response function and variance decomposition are used and estimated based on annual data from NBE, MOFED, and EEA during 1991-2018. The study found that in the long run, devaluation had expansionary effect on output but output increases at decreasing rate. In addition, devaluation increased external debt at decreasing rate in the long run. Moreover, in the long run, the variation of external debt resulted from variation of exchange rate and variation of real GDP; and the variation of real GDP is resulted from variation of exchange rate in the long run by using forecast error variance estimation. In general, the study showed that there is long run relationship between devaluation, external debt and output in Ethiopia. Lastly, the study recommended that devaluation is the last option to promote economic growth of Ethiopia so that the government should give attention to import substitution strategy, good business environment, access to infrastructure; political stability and focus on the efficiency of exports are alternative policies to devaluation. Besides, the government should give attention to spending on education and private investment relative to devaluation and external debt policies.

Acronyms

ADF	Augmented Dickey Fuller
AIC	Akaike Information Criterion
ARDL	Auto Regressive Distributed Lag
CMI	Chr.Michelsen Institute
CPI	Consumer Price Index
CSA	Central Statistical Agency
CUSUM	Cumulative Sum
E	Exchange Rate
ED	External Debt
EEA	Ethiopian Economic Association
Eexp	Expenditure on Education
ETB	Ethiopian Birr
FPE	Final Prediction Error
GDP	Gross Domestic Product
HQ	Hannan- Quinn Criterion
IMF	International Monetary Fund
LDC	Least Developed Country
LR	Likely Hood Ratio Test
MLC	Marshall Lerner Condition
MOFED	Ministry of Finance and Economic Development
MS	Money Supply

MSPE	Mean Squared Prediction Error
NBE	National Bank of Ethiopia
OECD	Organization of Economic Cooperation and Development
OLS	Ordinary Least Square
PI	Private Investment
PP	Philips Peron Test
PPP	Purchasing Power Parity
RGDP	Real Gross Domestic Product
SAP	Structural Adjustment Program
SIC	Schwarz Information Criterion
SSA	Sub Saharan African Countries
UNCTAD	United Nation Conference of Trade and Development
USD	United States Dollar
VAR	Vector Auto-regression
VECM	Vector Error Correction Model
WB	World Bank

CHAPTER ONE

1. Introduction

1.1 Background

Now a day's, devaluation has become a critical growth issue in developing countries (Tirsit, 2011). As of International Monetary Fund stated devaluation is the most important tool in determining the macro economic performance of the developing countries. Devaluation is a multifaced concept but for the purpose of this paper devaluation can be defined as a decline in the value of a currency in terms of another currency. On the other hand, devaluation is the weakening of domestic currency in terms of foreign currency in a fixed exchange rate system by the Federal bank. It shows that the rise in the domestic currency price of foreign exchange (Rode, 2012). Or devaluation is a deliberate downward adjustment in the official exchange rate (Financial Glossary, 2011).

As per World Bank (1990) report, in Africa, countries are adopting Structural adjustment program to overcome periods of economic deterioration. Later on in 1991, the government of Ethiopia accept partially or fully to implement SAP and other preconditions of the World Bank and IMF (NBE, 2009). Thus, before 1991 the country was used a fixed exchange rate with a rate of 2.07 Birr per US dollar. That is, Birr was overvalued which leads to a trade and public budget deficit (Kidane, 1994). This fixed exchange rate negatively affects the national economy like loss of international competitiveness, external imbalances. Later on Ethiopian government adopt devaluation policy in 1992 and there is a special feature in its declining currency every year like in order to increase its competitiveness in the international market, to fill the foreign exchange gap and to increase demand for domestic products so that, exchange rate is a proxy for devaluation.

Yaqub,(2010) stated as governments of different countries devalue their currency only when they have no alternatives to correct the economic problem. However, it can be seen as an attractive option that has also a negative consequence by making imports more expensive which protects domestic industries.

Most exchange rates are determined by foreign market. Exchange rate is one of the most important macroeconomic elements. It has two components the domestic currency and foreign currency. Exchange rate is the price of one currency in relation to another currency (Azid et al., 2005). That is exchange rate is the price of foreign currency in terms of domestic currency. Exchange rate can either appreciate or depreciate. Appreciation in the exchange rate occurs if less unit of domestic currency exchanges for a unit of foreign currency while depreciation in exchange rate occurs if more unit of country's currency exchanges for a unit of foreign currency. Accordingly, the official exchange rate of Ethiopian currency with US dollar was created, with the official exchange rate of 2.48 birr per United State dollar, on July 23, 1945 (Dresse, 2001).

Alejandro et al., (1963) investigates that devaluation resulted in an improvement of the trade balance which was accompanied a decline in the level of total output. According to (Taye, 1999), examines devaluation would help improve the current account balance, while output and employment are decreasing, because of expenditure reducing effect of devaluation than expenditure switching and expansion of output.

Contractionary devaluation could happen in the developed countries as well as in the developing countries in any exchange rate regime (Lian et al., 2014). (Ahmed et al., 2002) reports that contractionary devaluation in the developed countries is as strong as in the developing countries.

Currency devaluation is expansionary in Hungary and Switzerland but, contractionary in Finland, Germany and Turkey in short run. While, currency devaluation is contractionary in Hungary and Switzerland; And expansionary in Finland, Germany and Turkey in long run (Kalyoncu et al., 2008).

As per (Razmi et al., (2012)) portrays that the nearly super natural development of some Asian countries is the result of an export-led growth strategy supported by "smart" and deliberate manipulation of exchange rate levels. (Allen, 2006) also points out the effect of exchange rate movements in developing country significantly rests on the nature of the country's principal export type (i.e. Manufactures, non-oil commodities, or oil). Because the Marshall-Lerner Condition governs whether nominal exchange rate depreciation (appreciation) will improve (deteriorate) trade balance respectively.

Krugman and Taylor (1978) contends that a decline in real output is brought about by contractionary influences on aggregate demand. Because when devaluation takes place, which exist trade deficit, price increases of traded goods immediately reduce real income at home and increase it abroad.

Devaluation can exert a contractionary effect on aggregate supply in third world nation through imported goods (input), devaluation raises relative prices of imported inputs relative to final goods, real wages are indexed to consumer price index which accounts for both foreign and domestic goods, in such case an increase in competitiveness implies that foreign goods become more expensive than domestic goods. If real wages are indexed to a consumption asset that includes foreign goods this implies that real product wages rise and that the improvement in competitiveness occurs at the expense of domestic production (Van Wijnbergen ,1986).

Devaluation and external debt on economic growth have controversial impact especially in developing countries so that the importance of this paper is to contribute economic literature. Though there are many studies to investigate the relationship between the impacts of devaluation on economic growth and to examine the impact of external debt on economic growth, their findings are inconclusive.

Even though Ethiopia devalues its currency so many times and one of the top borrowers in Africa, Ethiopia is still encircled with in external imbalances leads to affect economic growth and this is the intension behind the paper. Hence, this paper will add value on literature, to provide a new insight for other developing countries, and to give policy recommendation.

Currency devaluation and debt crisis could be positively related because of negative shocks on aggregate demand might lead to a break down in real economic activity and imposes market pressure on the local currency to devalue and based on the view that sovereign debt crisis cause lose in trade output, and employment and it affects exchange rate indirectly.

1.2 Statement of the problem

Exchange rate is one of the macro- economic indicators of the nation to determine the growth performance of the nation. Exchange rate is one policy instrument and central issue in developing countries and one of controversial policy instrument for their vulnerability to external shocks. That is exchange rate fluctuation and their direct and indirect effects have impact on economic growth, economic policies, and related macroeconomic variables.

Currency changes have an expansionary, contractionary and no impact on economic growth and devaluation will have a decline in aggregate output in the short run, and it will have also an expansionary effect on output after a one year (Khan and Knight,1981). Therefore, the model suggests that devaluation will have no effect on output in the long run.

In Ethiopia there has been a sharp decrease in the export of coffee, oilseed, and other exported commodities during the last five years owing to the highly fluctuating commodity prices in the international market due to the improved strength of US dollar over Ethiopian currency. In this case, the World Bank advises the Ethiopian government to devalue its currency at least by 10%. In accordance with the advice of World Bank,(2017), the NBE has devalued the birr by 15% (NBE,2017). During this time, the response of devaluation accelerates current inflation. According to CSA, (2018) it has increased by 3.4% point from 12.2% to 15.6% in Feb, 2018. This shows that one important factor in the persistence of high inflation is a frequent devaluation of birr. As Priewe (2016) explores that the main problem of the strategy followed by the Ethiopian government is the persistent appreciation of real effective exchange rate and unclear consequence of the past commodity price boom.

Currency devaluation, and external debt have controversial impact on economic growth in the third world nation and policy makers face a dilemma in achieving high economic growth with a positive effect of devaluation and foreign debt. In order to address these conflicting ideas the paper fills the gap in the literature by developing a quantitative macroeconomic model that captures the link between devaluation, external debt and output in Ethiopia. The study is different from others because of the study period, variation in the source of data and different in methodology and models use. Previous studies, however, have attempted to consider the impact of devaluation on output, the impact of foreign debt but their finding is inconclusive. In addition,

there is no more well and sufficient researches about the nexus between devaluation, external debt and output which may alter the long run impact of devaluation, and external debt on output in Ethiopia. As per (Tirsit,2011) examined as devaluation has a negative effect on the GDP per capita on one side and it has also a positive effect in the lag year on the other side in the Ethiopian economy using OLS method from the period 1980-2010. Moreover, (Medina, 2015) examined there is positive relationship between devaluation and export in the short run nevertheless, devaluation does not decrease Ethiopian imports using OLS and co integration method from the period 1978-2013. But in this paper I used VAR and VECM because of it is easy to use models for the analysis of multivariate time series, it is important to overcome the limitation of classical approach and to get precise result relative to OLS and others. It also describes the dynamic inter relationship of the variables and policy analysis and VECM takes into account the co -integration relationship among variables relative to OLS method.

1.3 Objective of the study

The primary objective of the study is to analyze the nexus between currency devaluation, external debt and output in Ethiopia. The specific objectives are:

- ✓ To examine the effects of devaluation on economic growth in Ethiopia for the period 1991 to 2018.
- ✓ To assess the effects of devaluation on external debt in Ethiopia for the period 1991 to 2018.
- ✓ To see the long run and short run series between devaluation, external debt and economic growth in Ethiopia.

1.4 Hypothesis of the study

To address the specified objectives the study develops the following hypothesis:

- ✓ Devaluation has positive effect on external debt by increasing the amount payable to foreigners.
- ✓ Devaluation has contractionary effect on economic growth of Ethiopia through price of imported inputs.

1.5 Research Question

- Do currency devaluation, external debt, and output have both short run and long run relation?
- What is the connection between currency devaluation, external debt, and output in Ethiopia?

1.6 Scope of the study

To address the objectives, the study extensively examined both theoretical and empirical studies by using time series data from the period 1991-2018 for devaluation, external debt, and output in Ethiopia. The period is chosen because Ethiopia starts devaluation during the period of transitional government came to power and depending on the availability of data to achieve the objectives. Devaluation is a deliberate down ward adjustment of the official exchange rate. Since devaluation is one policy package to correct economic distortion and open up the economy to foreign trade in 1960's so that Ethiopia devalue its currency in 1990's in order to avoid external imbalances, to increase international competitiveness. Hence, exchange rate is a proxy for devaluation.

1.7 Significance of the study

Since in 1991/92's, Ethiopia devalues its currency in order to boost export, to shrink trade deficit and to reduce sovereign debt burden, and also Ethiopia borrows external debt in order to accelerate economic growth. However, these measures cannot solve the objectives effectively. Hence, the study would have an important implication on devaluation, foreign debt, and output in Ethiopia. To identify devaluation is good policy for Ethiopia or not and to give a policy implication for the government, to analysis the impact of devaluation on external debt, and to examine the impact of external debt on economic growth. Moreover, to add value on economic literature, to analyze the link between devaluation, foreign debt and output in Ethiopia. Finally, to give policy recommendation on nexus between currency devaluation, foreign debt and output in Ethiopia, and it is probably used as an input for further research.

1.8 Limitation of the study

Even though the study has significance to link between currency devaluation, external debt and economic growth, it has the following limitations: Sufficient data are not available for all variables in the required period; hence the data for the analysis are collected from different sources. Generally, restricting data from 1991 up to 2018 to achieve the objective is one limitation. And lastly, inconsistency of data from the same source is also a concern.

1.9 Theoretical frame of the study

There are different ways of specifying the relationship between devaluation, external debt and output based on theories. There are many factors which affect economic growth and different theories are stated by scholars. In my case the endogenous growth theory will be emphasized which consists private investment and human capital because these are important elements for determining economic growth. In the new growth theory model, private investment is important for economic growth and the long economic growth can be created if and only if there is human development and endogenous technological progress. The theory of endogenous growth emphasis that the source of growth both physical investment and investment in human resources like expenditure on education.

Mendel-Fleming model theory argued that devaluation is expansionary in terms of real gross domestic product Because of export increases more than import by considering the price elasticity of demand for tradable goods.

Devaluation has no single impact on output. Some argued that devaluation promotes economic growth (Narayan & Narayan, 2007), while (Agenor, 1991) suggests that expected devaluation has contractionary effect and unexpected devaluation has an expansionary effect. Hence, devaluation has an effect on output.

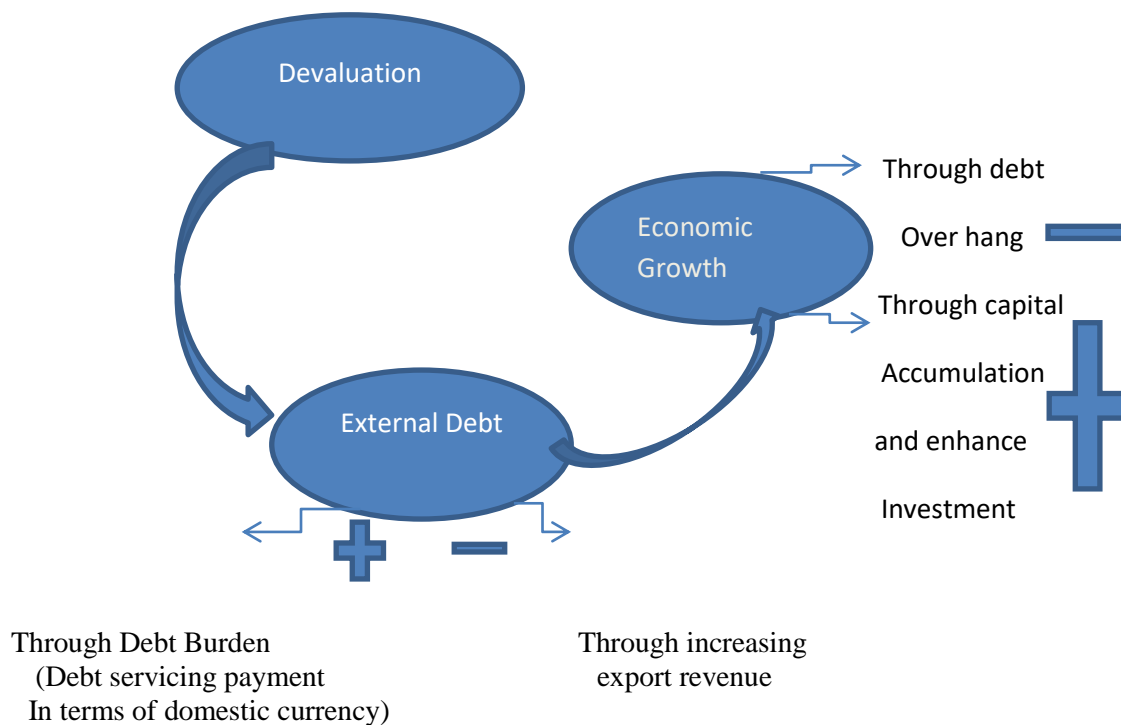
Exchange rate devaluation has a contractionary effect on output through on imported inputs effect (Lizando & Montiel,1989). Depreciation of currency does not stimulate private domestic investment in Nigeria (Oniore et al., 2016). Ajayi & Khan, (2000) portrays that the most important consideration in contracting external debt is signing up for debt from abroad only

when investments can generate higher returns than the cost of funds. In the dual-gap theory, borrowing nations would be enhancing their productivity and national output through investments facilitated by borrowed funds. A country has large foreign currency liability and has a sharp depreciation of exchange rate leads to reduce total asset in terms of domestic currency and thus reduces economic growth by lowering investment (Céspedes et al., (2004) ; Shin (2015) and Caruana (2016)).

By assuming credit constraints on firms' borrowing capacity and nominal price rigidities, a sharp change in the value of the domestic currency leads to an increase in the real costs of foreign currency-denominated debt. Therefore, firms' profits as well as their borrowing capacity decrease, provoking a drop in future investment and output (Saibene & Sicouri, 2012).

Devaluation affects aggregate demand, capital accumulation and external debt through change in income distribution and thus affect economic growth (Köhler,2017).

Figure1 1 The connected series of devaluation, external debt and economic growth



In the series indicates that devaluation affects external debt and external debt affects economic growth through debt burden, export revenue, through capital accumulation, productivity of labor

and enhance productivity ,through increasing level of investment, reasonable level of borrowing, and through debt over hang effect shows that nexus of the variable.

In the endogenous growth theory, education affects economic growth positively through increasing the productivity capacity of the economy, knowledge of new technology, products and process (Hanushek and Wossesmann,2008). Thus, countries have a greater stock of human capital investing more on education.

In the endogenous growth model, the role of human capital is the main source of increasing returns and divergence in growth rates of first world nation and third world nation (Lucas,1988; Romer,1986). Endogenous growth model validates that education has important to promote economic growth and investing on education has a positive impact on individual man power and economic growth. Moreover, private investment has also important for economic growth in the endogenous model. Private investment has a positive impact on economic growth of OECD economies by employing VAR model from the period 1960-2014(Afonso & Aubyn, 2019).

Otani and Villanueva (1993) argued that countries will achieve high level of economic growth when they invest more on education. Expenditure on education was a highly significant determinants of economic growth in Kenya (Mudaki,2012). Similarly, Government spending on human capital has a positive and significant impact on economic growth of Ethiopia (Mulugeta, 2012; Teshome, 2006).

Khan & Reinhart (1990) examined as private investment contributes more for economic growth than public investment in LDC's. As the paper by Suhendra & Anwar, (2017) examined that private investment has a positive and significant impact on economic growth in Indonesia. And domestic private investment and foreign direct investment have positive impact on economic growth of Tanzania the series starts from 1970-2014 (Epaphra & Massawe, 2016).

According to Otani & Villanueva (1989) examined that the development of human capital is essential when external debt is excessive an improvement of the quality of labor would enhance the profit opportunities of the sector and increasing domestic saving and exports. This leads to the salutary effect of reducing the foreign borrowing requirement.

The relationship between economic growth and external debt is negative through debt overhang theory: large amount of debt stock will be financed by inflation tax leads to decline investment and then economic growth. The original cause of debt crisis was excessive borrowing by the public sector to service their existing debt (Agenor & Montiel,1996).

When money supply increase which lowers interests leads to reduces borrowing costs, and encourages investment which might promote domestic output. Furthermore, a higher money supply will reduce the value of currency. This relation shows that money supply affects investment and output. In addition, the change of money supply will have an impact on the fluctuation of output in the short run (Tobin, 1969).

In the long run, exchange rate and real GDP have significant positive contribution to private investment in Ethiopia and exchange rate has also positive contribution in the short run by supplementing VAR and VECM starting from 1971-2014 (Abate,2016).

Chhibber & Shafik (1992) argued that devaluation affects investment negatively because of the increase real price of imported inputs which affects output, wage and the profitability of the firm, real income leads to affect the demand for domestic produced goods and nominal and real interest rate which affects investment in developing countries. Appreciation of the real exchange rate has negative impact on the level of investment while depreciation has positive impact on the investment of Bangladesh manufacturing (Rahman et al., 2003).

Currency devaluation will have an impact on reducing external debt in the developing economies through increasing exports and thus improve the current account balance (Assibey-Yeboah et al., 2016).

External debt has negative impact on economic growth in Pakistan especially bilateral external debt by employing ARDL model from the period1970-2009 (Ramzan and Ahmad, 2014). As of Fosu, (1999) examined that external debt has negative impact on economic growth of Sub Saharan African nations over the long term through reduction in marginal productivity of capital and employing debt measure techniques from the period 1970-1986.

As of (Egungwu, 2018) examined that both external debt stock and external debt servicing had significant negative effect on human capital development in Nigeria. (Were, 2001) examined also external debt accumulation growth and investment in Kenya has negative relation. The debt and growth relationship in Ethiopia is negative and nonlinear relationship (Ramakrishna, 2003).

Pattillo, (2004) and lots of others argued that excessive debt stages may constrain boom by lowering overall component productivity boom. One cause is if the government perceives that the advantage of better output will partly accrue to foreign creditor, their promoting to reform and improve their productivity may be lower. At the same time, the debt-overhang brings uncertainties and instabilities, letting investments be misallocated to brief time period tasks in preference to long time ones, accordingly resulting in excessive hazard of irreversible investment which can be conducive to productivity growth.

1.9 Organization of the paper

The study focuses the nexus between devaluation, external debt and economic growth in Ethiopia. The paper consists of six chapters including this chapter. The remaining chapter organized in the following manner. The second chapter presents review of literature composed of theoretical and empirical reviews. The third chapter methodology of the study consists of data type and source, model specification, econometric tests, and method of data analysis. The fourth section presents overview about the Ethiopian economy. The fifth chapter articulates estimation result and interpretation. The final chapter presents conclusion and policy recommendation.

CHAPTER TWO

2. Literature review

There are different kinds of theoretical and empirical studies that have examined between devaluation, external debt on output although there is still debatable on the impact of devaluation and external debt on output. The primary objective of theoretical and empirical model of the nexus between devaluation, foreign debt and output to be a clear understanding of economic condition that governing the actual behavior of exchange rate (devaluation), external debt, and output and its relationship.

2.1 Theoretical Literature

2.1.1 Definition and concepts

2.1.1.1 Devaluation

Exchange rate is the price of one currency in terms of another currency (Azied et al., 2005). Exchange rate is one of the most important factor that determine economic performance of the nation (Ghura and Grennes,1993).Chronic misalignment in the real exchange rate has been a major source of slow growth in Africa and America including Ethiopia and exchange rate policy has one factor that determine the economy and the current government follows devaluation in 1992 (NBE,2009).

Currency devaluation is a deliberate downward movement of the value of domestic currency in terms of foreign currency in a fixed exchange rate system (Yilkal, 2014). The currency devaluation of the Ethiopian birr is related to shocks arise from the falling price of exported commodities and declining the world demand of Ethiopian exported commodities and the strength of United states of dollar.

Different countries use different exchange rate regime such as: fixed and flexible exchange rate because it can be used as in different literature. Fixed exchange rate system is a system in which officially fixed in terms of other currencies by the government at some desired level. It does not change with in a change in demand and supply of foreign currency and it is important to

facilitate trade and investment (Frenkel, 2003). Under this regime, there is devaluation and over valuation. Devaluation is a decline in the value of currency under fixed exchange rate system. In other words, an increase the number of units of foreign currency that can be purchased for a dollar (Copper, 1971).

Flexible exchange rate system is a system the authority does not intervene to buy and sell their currency in the foreign exchange market. It changes according to the change in demand and supply in foreign currency. Under this regime there is depreciation and appreciation.

There are different factors that determine exchange rate such as: difference in interest rate, purchasing power parity and difference in productivity growth rate. The Balassa-Samuelson, (2010) model stated as the relative price of non-tradable goods in terms of tradable goods is increasing in the productivity differential between the traded and non-traded. Those deviations from Purchasing Power Parity (PPP) and variations in the real exchange rate are also due to differences in relative productivity growth rates across countries. Therefore, productivity differential among nations is a key determinant for real exchange rate.

Purchasing power parity states that the exchange rate between two countries' currencies is determined by the equality of the relative change in price level in the two countries that is it would keep competitiveness constant over time (Jhingan ,2011). It is theory refers to identical products are sold in different markets will be sold at the same price when expressed in terms of common currency called as the law of one price.

Devaluation can have an expansionary or contractionary effect on economic growth. In the traditional views argument in macroeconomics such as Keynesians approach emphasize the expansionary effects of devaluation to output and growth. In the traditional approach, output is determined by aggregate Demand and devaluation will have expansionary impact by stimulating aggregate demand and output.

Monetarist view argued that currency devaluation affects real magnitudes through real Balance effect in the short run, while leaves all real variables unchanged in the long-run. This is based on the purchasing power parity (PPP) assumption. It predicts that an increase in the exchange rate leads to increase in output and improves the balance of payments in the short run , but the

monetary consequence of the devaluation ensure that the increase in output and improvement in the balance of payment is neutralized by the rise in prices in the long-run.

Devaluation has different effects on a country's output. It has an expansionary effect through "expenditure switching and reducing effect". It is important to shift the demand from foreign goods to domestically produced goods (Taye, 1999). Moreover, in the devaluing country the price of imported goods will increase whereas the price of domestic goods will decrease which in turn will increase the export of goods. And if the Marshall- Lerner condition is satisfied devaluation of currency can improve the trade balance as well as GDP in the long run.

In developing countries the authorities usually exhibit devaluation pessimism. The main reason for devaluation pessimism is that political and economic consequence of the exchange rate shock and low price elasticity.

Orthodox view argued that devaluation will have an expansionary effect on economic growth, because of it results an expenditure switching, and increased production of tradable, higher exports, provided by the Marshal Lerner Condition is met. Devaluation switches demand from imports to domestic produced goods by increasing the relative price of imports and making export industries more competitive in the international market (Imimole & Enoma, 2011).

Currency devaluation has a strategy for boosting economic growth in the world especially in third world nation in addition to the financial aid and loans to their member countries for the development of domestic countries (IMF, 2014). Others investigates that devaluation will have an adverse effect on output (Cooper,1971a, 1971b;Krugman&Taylor,1978).

According to modern approach devaluation can be contractionary and generate a decline in real activity through demand side. Because of devaluation will result higher price level and generate negative real balance effect it will in turn in decline aggregate demand and output. As Lizando and Montiel (1989) stated devaluation boost prices initially by raising the domestic currency value of traded goods.

In international economics theory there are three approaches to analysis devaluation because of the effect of devaluation in the developed and developing is different based on monetary approach, elasticity approach, and absorption approach of theory of balance of payment. In the **monetary approach**, exchange rate devaluation is an expenditure switching device working mainly through the real balance effect. For a country an initial deficit, the right devaluation will achieve just the right reduction in the real value of the money supply, and the deficit will cease. To restore lost reserves the country must devalue by more than that amount, in order to achieve a surplus.

Elasticity approach- It is based on the assumption of demand condition and assumes the supply elasticity for domestic export and foreign imports are perfectly elastic. Pilbim,(2006) argued that the change in relative price is due to the variation in nominal exchange rate.it focuses on the current account under the variation of exchange rate. Devaluation would improve the current account if $PEdNX > 1$. If $PEdNX < 1$, devaluation does not improve the current account,if $PEdNX = 1$, the change in exchange rate is not affect the current account. Technically speaking, on the assumption the elasticity of demand for export is zero; export in domestic currencies are identical as before devaluation. If the sum of elasticity is greater than one, the elasticity of demand for import is greater than one, so that the value of import falls but the value of export does not fall, then current account improves. The J-curve effect of trade balance associated with the depreciation of the currency of a country is one of the highly debatable issues in international trade. It is based on the ground of the Marshall-Lerner conditions which explains why a reduction in value of a nation's currency (depreciation) need not immediately improve its balance of trade. The theory explained that for a currency devaluation to have a positive impact on trade balance, the sum of price elasticity of exports and imports (in absolute value) must be greater than one. Hence, currency devaluation increases export and reduce import (Dwivedi, 2001). This depends on price elasticity and if this condition is violated, then currency depreciation will not bring forth any improvement in trade balance. In case of **absorption approach** states that how devaluation affects income and absorption to the balance of payment and in turn affects output. The fundamental equation of absorption approach is $CA = Y - A$, if devaluation increases income relative to absorption, current account will be improved and if devaluation increases absorption relative to income ,current account will be worsened.

2.2 External debt

Most third world nations have become victims of foreign debts which have rendered their individual economics frail and prone to dictatorship of foreign donors. As of United nation conference on trade and development (UNCTAD,2013) reports that in 2011 and 2012 the total external debt of developing countries is estimated to have \$4.8 trillion and \$5.4trillion respectively and in 2017 projection approximately reached about \$7 trillion. Specifically total debt stock in SSA reached about \$313.2 billion in 2012. In addition, in 2016/17, the external debt stock of Ethiopia has reached 23.5 billion \$ from NBE annual report. This shows that one of the top borrowers in Africa to multilateral and bilateral creditors. Though debt has no single definition, it has technical definition. Debt is the disbursement of funds made available to a needy entity by a wealthy entity for development and consumption purpose in certain terms of repayment.

As per IMF the proportion of country's debt that was borrowed from foreign lenders including commercial bank, government or international financial institution, these loans including interest must usually be paid in the currency the loans was made. In order to earn the needed currency the borrowing country may seal and export goods to lender country.

Chenery and Strout (1966) argued that the main reason why countries borrow is to supplement the lack of savings and investment in that country. In the dual-gap analysis explanation the need for external borrowing as an attempt in trying to bridge the savings-investment gap in a nation.

2.2.1 External debt and economic growth

External debt is the composition of long term debt (public and publicly guaranteed debt plus private nonguaranteed debt), short term commercial debt and International Monetary Fund loan.

According to (Central Bank of Turkey ,2015b) describes external debt is the remainder of current and unconditional liabilities used at any time by the resident of an economy owed to nonresident and which requires payments of principal and interest on due date. In another way, external debt is a part of country's total debt that was borrowed from foreign lenders and the debtor nations to pay principal and interest at some point in the future.

The relationship between foreign debt and economic growth is not a very simple one as we expect. As a result of the reduction in economic growth via investment, namely debt overhang, external debt has attracted to the interest of developing countries. Scholars argued that debt overhang is a major and significant factor responsible for slowing down investment. As the Debt overhang hypothesis explained that if debt will exceed the countries repayment ability with some probability in the future, expected debt service is likely to be a positive function of the country's output level. Therefore, some of the returns from investing in the domestic economy are effectively taxed away by existing foreign servicing, including interest payments and repayments, may also be a real linkage from an indebted country. It takes large advantage from the domestic economy to transfer to the foreign economy. Therefore, the country foregoes some spectacular multiplier-accelerator effects. The debt overhang scope is much wider in that the effects of debt do not only affect investment in physical capital but any activity that involves incurring costs upfront for the sake of increased output in the future. Like, activities include investment in human capital and in technology acquisition whose effects on growth may be even stronger over time. Private investment is discouraged through debt overhang depends on how the government is expected to raise the resources needed to finance external debt service and whether private and public investment are complementary. For instance, private investment is likely to be discouraged when the government charges a higher tax on private investors.

International debt crisis has started in the early 1980's. Different scholars argued that why some debtor nations are poor relative to other debtor nations. Some argued that some debtor nations in the early 1980's were less external shocks than others, While others argued that some countries may borrowed over which raise interest loan and they use for nonproductive investment.

Debtor nation have been accused of severe economic mismanagement like corrupt practice among government officials. The real reason for debt crisis is exogenous shocks like decline terms of trade (Yap ,1988).

Debt overhang hypothesis states that when countries accumulate external debt investors anticipate a higher future tax to finance external debt servicing payment. This reduces investment and affects economic growth negatively because it act as a tax on future output (Geiger, 1990;

Were,2001). On the other hand, (Savvides,1992) argued that when the debtor country is not capable to pay its debt, debt payment will affect economic growth.

According to economists believed that the macroeconomic mismanagement is not only the cause of growth but also the heavily indebted poor countries. As a result, the roots of debt crisis can be traced to poor policy making and economic mismanagement the macroeconomic policies of highly indebted poor countries are the main causes of their high indebtedness (Easterly,2002).

Liquidity constraint hypothesis states that in case of highly indebted poor countries the debt service payments are very high it trims down the funds that can be used to augment investment that is high debt service payments crowds out investment and slow down the process of economic growth (Hoffman et al.,1991). Direct effect of debt hypothesis states that high level of debt reduces the productivity of the existing capital and that will decrease the level of output (Fosu,1996).

Debt Lafer curve theory states that debt and growth have nonlinear relationship on the assumption that there is an optimal level of debt that promotes growth, but beyond debt threshold level retards growth. Cohen, (1993) suggests that the debt lafer curve used to show the relationship between the face value of debt and investment indicates that the outstanding debt increases beyond threshold leads to repayment capacity to decline.

2.2.2 Devaluation and external debt

In modern approach devaluation has a contractionary impact on output growth (Edward,1989; Gylafson and Risager 1984 ; Krugman and Taylor,1978) because of the reason that may contribute to contract the aggregate demand of a devaluating developing country is that changes in income distribution that favor economic sectors with low marginal propensity to consume, a decline in investment, a decline in real wealth, an increase in debt and debt service payment, and low government expenditure of revenue. And through aggregate supply side in the form of the price of imported inputs which affects the supply of domestic goods because devaluation which increase the price of imported inputs.

Currency devaluation will have an impact on reducing external debt in the developing economies through increasing exports and thus improve the current account balance (Assibey-Yeboah et al.,

2016). While others argued that devaluation which increases external debt. For a small country which stresses the effect of devaluations on interest payments on the foreign debt by taking imputed parameter data (Gylfason & Risager ,1984).

According to Dornbush ,(1986) describes in a developing country given the present level of external debt and the fact that much of it is owed by the government or is government-guaranteed an exchange rate devaluation may also lead to strong inflationary pressure.

Since most of the time exchange rate is determined by foreign exchange and debt is denominated in foreign currency. When devaluating countries have over borrowed and the debt burden increase in terms of domestic currency so that devaluation increases external debt this leads to devaluation has a contractionary effect on output for countries with external debt when denominated in foreign currency (Domac , 1997).

2.2.3 Devaluation and economic growth

On the view of absorption approach states that if currency devaluation is to improve at economy's trade balance national output must increase relative to absorption. Currency devaluation have also an impact on the national output through employment and terms of trade (Pilbeam,2006).

Employment effect- meaning if the economy is below full employment level, then there will be an increase in net exports following devaluation through foreign trade multiplier this leads an increase in the national income. However if the Marshall Lerner condition is not met, then net export would fall leads to national output decrease. As a result, the overall effect is ambiguous.

Terms of trade effect-- meaning it is the ratio of export and import price in the domestic currency. Devaluation tends to decline the terms of trade by making domestic goods cheaper in foreign market and foreign goods more expensive in the domestic market and therefore the terms of trade lowers the national output. Hence, the effect of devaluation on the income of the devaluating countries is unclear even if there is increasing net export earnings, the decline terms of trade works to reduce the national income because of the amount of expenditure on import is more dominant than the gain from exports.

Expectation effect – it is possible that economic agents regard the increase in prices induced by devaluation as likely to spark further price rises. This would lead to an increase in direct absorption would worsen the balance of payment which leads to affect the output of the nation.

2.2.3.1 Devaluation, external debt and economic growth Nexus

In the devaluation, external debt and economic growth series, there could be channels through which one causes to the other. In the devaluation theory export increases, and demand for import decreases because of the price effect. In the international trade, a country is competitive which has least cost commodities relative to others. This leads to encourage investment through increasing export (increases demand for export) since export is cheap and the foreign exchange earnings will increased, thus current account will be improved. Thus, devaluation encourages investment and economic growth will be high because investment is emanating from devaluation. Additionally, the adoption effect has important to motivate and expand economic growth by adopting technology, foreign exchange practice which boosts economic growth based on elasticity approach.

Devaluation and external debt are important policy for economic growth of developing countries in the international economics and finance. Devaluation reduces external debt through boosting exports and generates revenue so that the country repays its debt within the given time. This reduces the accumulation of debt, and debt servicing leads to keep the deterioration of economic growth in the future. However, when devaluation persists for a long time and the devaluating country experience's over borrowing the country unable to pay its debt within the required period because devaluation reduces the value of domestic currency and the amount of expenditure in terms of domestic currency is high to service debt leads to dampen economic growth through debt servicing and accumulation of debt.

The external debt and economic growth channel is important creating investment (act as an aid for economic growth), increasing the productivity of capital, technological transfer (capital goods), with supplementing proper debt management policy leads to spurring economic growth.

First, in October 1992, the devaluation of currency, which inflated the Ethiopia currency denominated external debt by 185%. During the Derg regime had pegged its exchange rate i.e.

one USD was exchanged for Birr 2.07. However, the current government has devaluated Ethiopian currency for the first time by 141% in 1992. Therefore, the US dollar denominated debt increased from USD 4.3billion to USD 4.7 billion between 1992 and 1993 fiscal year, much more than USD 300billion increment as new debt; whereas the nearly threefold increase in Birr denominated debt stock from Birr 6.6 billion to Birr 18.8billion (Birhanu, 1999).The government has been making frequent devaluation though not to the extent of the initial one, currently one USD is exchanged for Birr 28.86.

Second, the government also borrowed new loans, particularly to support the completion of the Structural Adjustment Program in the country. This newly contracted debt has also great contribution for increment the debt stock of the country leads to affect economic growth.

Third, capitalization of arrears, the arrears arose due to failure of repaying were capitalized and rescheduled, which further increased debt stock of the country and thus affect economic growth.

Devaluation increases external debt because debt is denominated in dollar. When countries have hudge external debt and devalue its currency the debt burden increase in terms of domestic currency, thus devaluation has contractionary effect on economic growth with external debt and denominated in a foreign currency.

Since devaluation is one policy package to correct economic distortion and open up the economy to foreign trade in 1960's so that Ethiopia devalue its currency in 1990's to achieve the objectives. In the present time devaluation is debatable issue on economic growth. Devaluation improves the current account and increase employment, it will have an expansionary demand side and supply side effects due to devaluation, the domestic products are cheaper than foreign products. If a country produces products using imported goods price increase resulting from devaluation.

To sum up, different studies suggested that different arguments on currency devaluation, external debt and output can be summarized as follows:

There is debatable issue about the relation between devaluation, external debt and output. Some of them argued that the devaluating countries increases external debt because the debt can be denominated in foreign currency so that in these countries increases external debt and which deteriorates the current account leads to reduce output. Others argued that the devaluating countries reduce external debt in the developing countries through boosting exports leads to current account will be improved leads to output increases so that it has a capable to pay the debt and output increases in the long run, provided that the MLC is met.

2.3 Empirical literature

There are many literatures which argue about the impact of devaluation on external debt and output. Empirically different researchers give different results of the impact of devaluation, external debt on economic growth. For some countries positive impact, others negative impact, and in some case also no impact. The following relation shows empirical studies as follows:

2.3.1 Devaluation and external debt

Currency devaluation contributes to reduction of demand for import and increase export which leads to improve the current account balance and helps to reduce external debt in developing countries (Assibey-Yeboah et al., 2016).

According to Cooper ,(1971) investigated that contractionary effect of devaluation in the case of highly indebted countries with external debt denominated in foreign currency will experience an increase in the domestic currency cost of servicing debt.

According to IMF, (2017) report Ethiopia faces about \$1.5 billion external public debt service payment's coming during 2017/18 and significant contribution over the medium term. High level of foreign debt leads to devaluation the national currency.

A study conducted by Kouladoum, (2018) examined that External debt positively affects real exchange rate, but debt servicing negatively affects real exchange rate in Chad starting from the period 1975-2014.

External debt reduces economic growth when debt ratio exceeds the debt threshold level and external debt boosts economic growth before debt ratio reaches to debt threshold level in

emerging economies (Vu et al., 2019). Moreover, (Changyong et al., 2012) investigates that if the debt transformation rate is low when the debt ratio rises over a certain point; economic growth will be hindered and may even trigger economic crisis.

According to Céspedes, L. et al., (2004) examined that the interaction of dollarized debt and net worth complicates an economy's response to external shocks. Flexible exchange rate does play a useful insulating role against real external shocks and the conventional ranking of fixed and flexible exchange survives an adverse shock always calls for real devaluation.

Palić et al., (2018) examines that the long run impact of depreciation on external debt is positive and statistically significant in Croatia. This possible depreciation could have overall negative effects on Croatia and other small open economies. According to Gylfason and Risager,(1983) examined that currency devaluation will increase debt servicing obligation and similar to a negative supply shock, generates stagflationary effects.

Okoye, et al., (2017) investigates there is a significant positive correlation between economic growth and exchange rate, external debt in Nigeria. Fosu,(1996) stated as high level of debt may even reduce the productivity of the existing capital that will decrease the level of output. (Hofman & Reisen, 1991) stated as high debt service payment crowds out the investment and slows down the process of economic growth.

Both hard currency debt and capital inflows are associated with crises that lower growth temporarily and permanently reduce output compared to the long run trends (Bordo, M. D., et al. 2010). As shown by (Allayannis, G., et al. 2003) assessed that the use of synthetic local currency debt (hedged foreign currency debt) is associated with the biggest drop in market value due to currency derivative market illiquidity during the crisis. Firms with heavily exposure to short term foreign currency debt before devaluation experienced relatively low levels of post devaluation investment (Aguilar, 2005). The above association exhibits that there is a relationship between currency devaluation, foreign debt and output.

Both in the short run and in the long run, a reduction in debt stock would have significantly increased growth performance of the indebted countries the series starts from 1970-2007(Siddique et al.,2015).

According to Kharusi & Ada, (2018) found that external debt has an adversely impact on economic growth of Oman's economy by employing ARDL approach from the period 1990-2015. However, external debt has positively contributed to economic growth of Nigeria by employing ECM from the period 1990-2010 (Sulaiman & Azeez, 2012).

Debt crisis in least developing countries are very well known macroeconomic problem. Some scholars suggest that debt crisis arose only because of global economic dislocation. While others argued that mismanagement by the debtor countries is the other main reason. Debt crisis had an adverse impact on Nigeria economy using OLS multiple regression technique from the period 1970-2006 (Udoka and Anyingang, 2010).

Mohamed, (2018) investigated that external debt is positively contributed to the Sudan economy, while exchange rate and foreign direct investment have negative effect by supplementing VECM starting from the series 1969-2015.

Cohen and Daniel, (1993) examined that the level of debt is not the factor to explain the decline investment in highly indebted countries by taking 81 developing countries as a sample and employing OLS but if Cohen uses VAR model he can explain short run and long run relation and he will get superior results that the amount of debt which affects investment and thus economic growth because VAR avoids the limitation of classical approach. On the other hand, Perasso and Giancarlo (1992) investigates that Good domestic policies have a stronger impact on increase investment and growth in highly indebted countries than reducing debt service obligation in least developed countries for the period 1982-1989.

Okaro, (2017) examined that there is a positive significant relation between currency devaluation and external debt in Nigeria. Were, M. (2001) examined as external debt stock has a negative impact on private investment and economic growth. External debt has positive impact on Ethiopian economic growth (Hanna, 2013).

High level of foreign debt leads to devaluation of the national currency. Increase in the retirement of workers, continues industrial stinker and poor education system, this leads to the

economy of Nigeria getting depressed (Ayayi and Oke , 2012). Countries with highly indebted, devaluation will have a negative impact on economic growth(Kim &Ying,2007).

Currency devaluation increases external debt through decline in the balance of payment which leads to reduction in output (Okaro,C. 2017; Yigermal,2018). Similarly, Gylfason & Risager ,(1984) investigates that for small countries which stress the effect of devaluations on interest payments on the foreign debt by taking imputed parameter data.

Teklu et al., (2014) analyzed as In the long run, external debt as a percentage of GDP has inverse and significant relationship with RGDP and in the short run, has no significant impact using VECM from the period 1970-2013. In addition, external debt as a percentage of GDP has positive and significant impact on capital formation in the long run and negative in the short run.

As Boboye and Ojo (2012) stated as external debt burden had an adverse effect on the nation income and per capita income of the nation. Similarly as of Ramakrishna (2003) examined that there is a negative and nonlinear relationship between external debt and growth in Ethiopia.

Lin and Sosin (2001) examined as foreign debt and the growth rates of per capita GDP were inversely related at high level of significance in developing countries. A study conducted by Habimana, (2005) investigated that the effect of external debt burden has negative effect on capital accumulation in Rwanda by supplementing Engel Granger Two step approach from the period 1965-2001.

External debt and economic growth is positively related and external debt has aided to stimulate economic growth in Tanzania by employing OLS multiple regression analysis and Johansen co-integration from the perid1972-2015 (Marobhe, 2019).

To sum up, devaluation has negative impact on highly indebted countries when debt is denominated in the foreign currency through debt servicing payment which reduces output. While others are argued external debt is important in case of devaluation when the borrowed nation uses the debt for productive investment and supplemented with debt management policy

which increases output. In addition, the effect of debt burden may vary across countries in a given period and across period in a given country.

2.3.2 Devaluation and output

Devaluation is one policy package to correct economic deterioration; however it works either positive or negative or null effect on output. Devaluation works positively for some countries and works negatively for other countries especially in developing countries or it does not exert any effect of devaluation on aggregate output. Thus, impact of devaluation has no clear effect on output.

The study conducted by Mironov, (2015) investigated that devaluation leads to a more severe recession in the Russian economy because of low propensity to economic agents, low price elasticity and structural problems in the Russian economy in 2014 and 2015 judging by average consensus forecasts.

As per Domac, (1997) examines that unanticipated devaluation has positive impact on economic growth while anticipated devaluation are contractionary in the first year, but statistically insignificant and do not exert any significant effect on output in Turkey from the period 1960-1990. On the other hand, El-Ramly et al., (2008) examined that devaluations have an initial contractionary effect on output through expenditure switching mechanism in Egypt.

According to Momodu et al., (2016) examined as currency devaluation has expansionary effect in the short run and improve the balance of payment but the monetary consequence of devaluation ensures that increase in output and improve the balance of payment is neutralized by the rise in price in the long run in Nigeria.

Devaluation increases output in the short run and it has neutral impact in Nigeria economy in the long run (Momodu, A. et al. 2016). Devaluation is generally expansionary in developed countries and contractionary in developing countries (Gylfason and Risager, 1984).

According to El-Ramly et al., (2008) examined that devaluation has an initial contractionary impact on output and real exchange rate variation affects also output negatively in Egypt if there is no intervention by employing VAR model from the period 1982-2004. On the other hand,

Kyophilavong et al., (2019) examined that currency devaluation promotes economic growth in Laos's economy by employing VECM from the period 1992-2013 using quarterly data.

According to Taye,(1999) examines devaluation would help improve the current account balance, while output and employment are decreasing, because of expenditure reducing effect of devaluation than expenditure switching and expansion of output. (Medina, 2015) investigates that there is positive relationship between devaluation and export in the short run nevertheless, devaluation does not decrease Ethiopian imports.

Tirsit,(2011) examined as devaluation has a negative effect on the GDP per capita on one side and it has also a positive effect in the lag year on the other side in the Ethiopian economy using OLS method and ADF test from the period1980-2010.

According to Yilkal,(2014) examined that in the long run, currency devaluation has contractionary effect and in the short run, it has neutral effect on output in Ethiopia using quarterly time series data from 1997/98 up to 2009/10 and supplementing VAR model.

Furthermore, Fassil, (2017) examined that devaluation deteriorates the trade balance of Ethiopia in the short run and improves it in the long run which satisfies the MLC using VECM from the period 1970-2014.

A research conducted by Yigermal, (2018) investigated that the effect of currency devaluation has contractionary on output in Ethiopia using quarterly time series data from the period 2000/2001Q1 up to 2016/2017Q4 and employing SVAR model.

To sum up, devaluation has expansionary effect on output from classical view, while in the modern view it has contractionary effect on output using different methodology and different time period by different researchers. Hence, the expected sign of devaluation on external debt, external debt on output and devaluation on output will be positive, negative and negative in my paper respectively.

CHAPTER THREE

3.1 Data and Methodology

3.2 The Data

The study is based on a macro data covering the period from 1991-2018. The sources of the secondary data are ; National bank of Ethiopia (NBE), Ministry of Finance and Economic Development (MOEFD), and Ethiopian Economic Association (EEA).

In the model, the included variables GDP, E, PI, Eexp, ED, MS are collected from NBE, MOFED, and EEA because of the availability of data to get in these source is important to obtain the required data of the variables and to keep the consistency of data in the endogenous sources and the series starts from 1991-2018.

3.3 Method of data analysis

For the better accomplishment of the study and in order to achieve the objective both the econometrics and descriptive methods of analysis were employed. In case of descriptive method of data analysis incorporates the trend of real gross domestic product (RGDP), and exchange rate (devaluation), and external debt with the help of graphs.

3.4 The Econometric model

In econometrics method of analysis, the following specified activities would be carried out. As the topic is supplemented time series so that different tests has been required. Like, stationary test, lag order selection test, co integration test, normality test, serial correlation test, stability test since the data is time series, stationary of the variables is important. The study employed VAR model which is one of the most widely adopted in macroeconomics because of it allows the variable to freely interact between themselves in time series analysis and it is easy to use models for the analysis of multivariate in time series. It also gives precise results compared to univariate time series (Ragnar, 2011). It is important also for describing the dynamic behavior of the economy and for structural inferences and policy analysis. VECM is also employed to show the short run and long run relation between the variables. VECM is important also used to correct

errors in the regression and also to tie the short run behavior of economic growth to its long run value. I supplemented also software using Eviews from the period 1991-2018.

Generally, analyzing time series data to show long run relationship of the variable using VAR model is vital for it is a dynamic multivariate model and equally treats the variable so that it involves the following essential steps: stationary test, Co-integration test, lag length selection, and also VECM would also supplemented in order to correct errors between short run and long run disequilibrium.

3.4.1 Model specification

The study employs VAR model that capture the effect of devaluation on the external debt and output, and the nexus between devaluation, external debt and output because it is a means of overcoming limitation of classical approach (Sims, 1980) cited in Ramly and Abdel-Haleim (2008).

3.4.2 Vector autoregressive (VAR) model specification

VAR is a general frame work used to describe the dynamic behavior of the economy in time series analysis. VAR is an alternative traditional simultaneous equation system method, and all included variables are assumed to be jointly endogenous. Thus, in a VAR (p) each component of the vector X depends linearly on its own lagged values up to p period as well as on the lagged values of all other variables up to order p (Sims,1980). It is often used for forecasting.

For a set of K time series variables $y_t=(y_{1t}, \dots \dots \dots, y_{kt})$, a VAR model captures their dynamic interactions. The basic model of order ρ (VAR(ρ)) has the form:

$$y_t = C + \pi_1 y_{t-1} + \pi_2 y_{t-2} + \dots + \pi_p y_{t-p} + \varepsilon_{it} \dots \dots \dots (3.1) \text{ general equation}$$

of VAR model

Where $y_t = (PI, Eexp, INF, MS, E, ED, GDP)$; where C is a vector of $k \times 1$ constant matrix; π_i ($i = 1, 2, \dots, p$) is $(K \times K)$ coefficient matrices and the innovation vector ε_t is the linearly unpredictable component of y_t , given an information set consisting of the lagged values of all model variables. And $\varepsilon_t \sim iid(0, \Omega)$.

3.4.2.1 Tests of VAR model

Because of the dynamic correlation between the variables in the VAR model it is important to check whether the m residual series (where $m = \varepsilon_1, \varepsilon_2, \dots \dots \varepsilon_n$) in the VAR model are white noise or not. Hence, different tests would be required like test on serial correlation, pair wise granger causality test, and homoscedasticity properties of time series data, unit root test.

Different tests are employed in the time series analysis. Unit root test (stationarity) is vital before empirical estimation. Because it helps to knowing the behavior of the variable through order of integration in order to set up an econometric model and make inferences. It also helps to examine the properties of the prior to the construction of an econometric model and make inferences (Sjö, B. 2008). Stationary is important for the development and assurance of estimation of the of VAR model.

A lag length selection is the number of previous observation in a time series that would be used as a predictor in the VAR model. In estimating the VAR model, determining the lag length is essential element so that choose the appropriate lag length in the VAR is vital, and then different method were supplemented like Akaike information criterion (AIC) based on data congruency based on some information, Hannan-Quinn (HQ), Schwarz information criterion (SIC), Final prediction error (FPE) and Likely hood ratio test (LR).

In a standard time series econometrics, the stochastic process is said to be stationary if its mean and variance are constant over time and the value of the covariance between two time periods depends only the gap between the two time period rather than the actual time (Gujarati, 2004).

Augmented Dickey Fuller test is the conventional method of unit root test whether the variable is stationary or not in the presence of unit root in a series. Phillip-Peron tests also another method to test unit root test. ADF and Phillip Peron test are supplemented to determine a unit root test of stationarity based on the following general equation of ADF which contain constant and lagged difference.

$$\Delta y_t = a + \mu_t + \beta - 1y_{t-1} + \sum_{i=1}^p \gamma_i \Delta y_{t-1} + \varepsilon_t \dots\dots\dots (3.2)$$

From the equation at $\beta - 1 = 0$, there is non-stationary (unit root) in the null hypothesis against the alternative hypothesis of the time series is stationary at $\beta - 1 < 0$. Thus, rejection of the null means there is stationarity.

Co-integration test

In time series analysis, Co integration among the variables shows the presence of long run relationship in the system. Co integration is characterized by two or more variables of I(1) shows a common long run economic relation. Co integration in VAR, suppose the K variables Y_1, Y_2, \dots, Y_k collected in the vector Y are I(1), in such case, there will be no co integration at all or there exists one or two up to k-1 linearly independent co integration vectors.

The elements of a k-dimensional vector Y are co integrated of order (d,c), $Y \sim CI(d, c)$, if all elements of Y are integrated of order d, I(d), and if there exists at least one non-trivial linear combination z of these variables, which is I(d-c), where d, c > 0 holds, that is if and only if $\beta'Y_t = z \sim I(d-c)$. The vector β is denoted as co integration vector. The co integration rank r is equal to the number of linearly independent co integration vectors. The co integration vectors are the columns of the co integration matrix B, with $B'Y_t = Z_t$ (Engel and Granger, 1987).

In this study the objective is to show short run and long run relationship between variables so that, the study employed co integration test. In case where variables are difference stationary, it can estimate the model by first difference, but it shows only the short run behavior of the variable. Hence, employed co integration is important in order to include the long run behavior. The test were conducted using Johansen methodology because it gives the exact number of co integration relation (Lütkepohl *et al.*, 2001) as cited by (Yigermal, 2018).

Test of autocorrelation, normality test and stability test also included in the model by using Breusch-Godfrey, Jarque -Berra, AR roots table and graph, and CUSUM chart are supplemented in these diagnostics test respectively. The VAR model can be analyzed through impulse response function, and forecast error variance decomposition.

Impulse response function

IRF shows how one variable might react to sudden changes in the other variable. The $(i,j)^{th}$ element of the matrix ψ_s , when treated as a function of s traces out the expected response of $y_{i,t+s}$ to a unit change in y_{jt} holding constant all past values of y_t since the change in y_{it} given $(y_{t-1}, y_{t-2}, \dots)$ is measured by the innovation U_{it} , the elements of Φ_s represent the impulse response component of y_t with respect to the U_t innovations.

Impulse response is a method of examining interrelationship among variables in the VAR. It indicates the time profile of the effects of a shock to one variable on the contemporaneous and future values of all endogenous variables. As indicated by Alemayehu et al., (2009) describes that impulse response can be used as to examine the dynamic behavior of the VAR or assess the policy impact of the variables that constitute the VAR.

Impulse response describes the response of $y_{i,t+s}$ to a one time impulse in y_{it} with all other variables date t . Hence $y_t = \mu + \varepsilon_t + \psi_1 \varepsilon_{t-1} + \psi_2 \varepsilon_{t-2} + \dots + \psi_n \varepsilon_{t-n} \dots \dots \dots$ (3.3)

Where $\psi_s = \frac{\partial y_{t+s}}{\partial \varepsilon_t}$

Forecast error variance decomposition - It provides information about the relative importance of each orthogonalized random innovation in affecting the variation of the variables in each forecast errors. It estimates how much of your forecast errors can be attributed to unpredictability in each variable in the VAR. Forecasting errors in a VARs period in to the future can be obtained as:

$$y_{t+s} - (y_{t+s/t})^{hat} = \varepsilon_{t+s} + \psi_1 \varepsilon_{t+s-1} + \psi_2 \varepsilon_{t+s-2} + \dots + \psi_{s-1} \varepsilon_{t+1} \dots \dots \dots (3.4)$$

And the mean squared error $(MSE(y_{t+s/t})^{hat} = \Omega + \psi_1 \Omega \psi_1' + \psi_2 \Omega \psi_2' + \dots + \psi_{s-1} \Omega \psi_{s-1}'$

Where $\Omega = E(\varepsilon_t, \varepsilon_t')$

Forecast error variance decomposition uses in identifying the degree of one variable influence and the other variable in the system by breaking down. Variables in the system will have a forecast error and the error in forecasting can be attributed to the present and past values of the variable in question and the past and present values of all other variables in the system.

The limit of forecast variance decomposition, as $h \rightarrow \infty$, is the variance decomposition of y_t in a stationary model because it converges to the unconditional covariance matrix of y_t . Hence, for stationary system one may construct forecast error variance decomposition for horizon infinity.

In the integrated case the prediction mean squared error diverges when the forecast horizon goes to infinity, but the forecast error variance decomposition remains valid up to a finite maximum horizon of H . Therefore, the contribution shock J to the MSPE of y_{kt} , $k=1,2,\dots,K$ at a horizon h is $MSPE = MSPE_J^K(h) = \sum_{j=0}^K (\theta_{kj,0}^2 + \dots + \theta_{kj,h-1}^2)$ where $MSPE$ = Prediction mean squared error. The ratio of the contribution shock J to the forecast error variance of the variable K will be $\frac{MSPE_J^K(h)}{MSPE^K(h)}$.

3.4.2.2 Vector error correction model (VECM)

VECM is a special case of the VAR for variables that are stationary in their difference. It accounts any co-integrating relationship among the variables. It accounts also short run and long run effects and correct disequilibrium. Asterious and Hall (2011) stated as VECM is a means of reconciling the short run behavior of the economic variable with its long run behavior. The VECM equation which I borrowed from Moriyama (2008) can be specified as in the following;

$$\Delta y = \phi(L) \Delta y_t + \lambda y_{t-1} + \varepsilon \dots \dots \dots (3.5)$$

The Δy represents the change in the vector of all variables in the system which includes (E) exchange rate, external debt(lnED), economic growth (lnGDP), private investment(lnPI), expenditure on education (lnEexp), money supply(lnMS). The lag operator is represented by $\phi(L)$ and λ represents the long run relationship between the variable in the model.

The error correction of the variable in the long run can be obtained as:

$$ECM_{1,t-1} = E_{t-1} + \beta_0 + \beta_1 \ln Eexp_{t-1} + \beta_2 \ln PI_{t-1} + \beta_3 \ln MS_{t-1} + \beta_4 \ln rGDP_{t-1} + \beta_5 \ln ED_{t-1} \dots \dots \dots (3.6)$$

$$ECM_{2,t-1} = ED_{t-1} + \beta_0 + \beta_1 \ln Eexp_{t-1} + \beta_2 \ln PI_{t-1} + \beta_3 \ln MS_{t-1} + \beta_4 \ln rGDP_{t-1} + \beta_5 E_{t-1} \dots \dots \dots (3.7)$$

$$ECM_{3,t-1} = rGDP_{t-1} + \beta_0 + \beta_1 \ln Eexp_{t-1} + \beta_2 \ln PI_{t-1} + \beta_3 \ln MS_{t-1} + \beta_4 \ln ED_{t-1} + \beta_5 E_{t-1} \dots\dots\dots (3.8)$$

$$ECM_{4,t-1} = Eexp_{t-1} + \beta_0 + \beta_1 \ln rGDP_{t-1} + \beta_2 \ln PI_{t-1} + \beta_3 \ln MS_{t-1} + \beta_4 \ln ED_{t-1} + \beta_5 E_{t-1} \dots\dots\dots (3.9)$$

$$ECM_{5,t-1} = MS_{t-1} + \beta_0 + \beta_1 \ln rGDP_{t-1} + \beta_2 \ln PI_{t-1} + \beta_3 \ln Eexp_{t-1} + \beta_4 \ln ED_{t-1} + \beta_5 E_{t-1} \dots\dots\dots (3.10)$$

Therefore, in VECM the disequilibrium condition to be corrected in the long run and it is assumed to be zero so that the equation can be obtained as follows:

$$E_{t-1} = -\beta_0 - \beta_1 \ln Eexp_{t-1} - \beta_2 \ln PI_{t-1} - \beta_3 \ln MS_{t-1} - \beta_4 \ln rGDP_{t-1} - \beta_5 \ln ED_{t-1} \dots\dots\dots (3.11)$$

$$ED_{t-1} = -\beta_0 - \beta_1 \ln Eexp_{t-1} - \beta_2 \ln PI_{t-1} - \beta_3 \ln MS_{t-1} - \beta_4 \ln rGDP_{t-1} - \beta_5 E_{t-1} \dots\dots\dots (3.12)$$

$$rGDP_{t-1} = -\beta_0 - \beta_1 \ln Eexp_{t-1} - \beta_2 \ln PI_{t-1} - \beta_3 \ln MS_{t-1} - \beta_4 \ln ED_{t-1} - \beta_5 E_{t-1} \dots\dots\dots (3.13)$$

$$Eexp_{t-1} = -\beta_0 - \beta_1 \ln rGDP_{t-1} - \beta_2 \ln PI_{t-1} - \beta_3 \ln MS_{t-1} - \beta_4 \ln ED_{t-1} - \beta_5 E_{t-1} \dots\dots\dots (3.14)$$

$$MS_{t-1} = -\beta_0 - \beta_1 \ln rGDP_{t-1} - \beta_2 \ln PI_{t-1} - \beta_3 \ln Eexp_{t-1} - \beta_4 \ln ED_{t-1} - \beta_5 E_{t-1} \dots\dots\dots (3.15)$$

In addition, the model specification used the Log data to avoid biased coefficients and standard errors and then biased inference which gives misleading result and it is presented in the following way:

Depending on the above literature the functional form can take the following forms.

$$GDP = f(Eexp, PI, M^S, E, ED)$$

To capture economic growth using GDP, I use log of GDP, as log difference of GDP implies economic growth. Correspondingly, all the repressors except, E are expressed in logarithms as follows.

$$\ln rGDP_t = \beta_0 + \beta_1 \ln Eexp_t + \beta_2 \ln PI_t + \beta_3 \ln MS_t + \beta_4 E_t + \beta_5 \ln ED_t + e_{it} \dots \dots \dots 3.16$$

β 's are parameters and e_t is white noise error term assumed to be normally and independently distributed with zero mean and constant variance. Based on the above definition and literature the expected sign of the variable is as follows:

External debt and exchange rate are negative. Like as stated in (Lizando& Montiel,1989; Tirist,2011; and Oniore,Gyang,Nnar,2016) exchange rate devaluation has contractionary impact on output. In addition, external debt has negative impact on economic growth in SSA nation. The remaining variables expected to be positive.

ED =f(Eexp, PI , MS,E,GDP). The econometric model can be shown as:

$$\ln ED_t = \beta_0 + \beta_1 \ln Eexp_t + \beta_2 \ln PI_t + \beta_3 \ln MS_t + \beta_4 E_t + \beta_5 \ln GDP_t + e_{it} \dots \dots \dots (3.17)$$

Based on the above explanation from the literature, the expected sign also given as: except GDP all variables are positive. Debt and growth have negative relationship and nonlinear in Ethiopia (Ramarkishina, 2003).

The debt dynamics is based on a model developed by Cuddington (1996) and draws on the model developed by IMF (2001).The model expanded the analysis of developing countries by incorporating seignorage as well as external financing are the sources of financial fiscal deficit in developing countries. By using the budget constraint for developing countries the change in external debt between period t and t-1 expressed as the following:

$$\ln ED_t = \left[\frac{(1+r_t) \varepsilon a_{t-1}}{(1+g_t)} ED_{t-1} + \frac{(r_t-g_t)}{(1+g_t)} ED_{t-1} \right] - S_t \dots \dots \dots (3.18)$$

ε Refers to exchange rate effect, it is expected that the depreciation of the exchange rate will raise the cost of borrowing and value of external debt in domestic terms. r refers to interest rate effect measures the difference between interest payment and growth rate of GDP. And S refers to

primary budget balance. This shows the series between external debt, exchange rate, interest rate and primary budget balance. And based on the above literature the equation is presented:

$E = f(E_{exp}, PI, MS, GDP, ED)$. It can also be shown as

$$E_t = \beta_0 + \beta_1 \ln E_{exp}_t + \beta_2 \ln PI_t + \beta_3 \ln MS_t + \beta_4 \ln GDP_t + \beta_5 \ln ED_t + e_{it} \dots \dots \dots (3.19)$$

Like in the above case, the expected outcome can be obtained as follows: E_{exp} , PI , GDP , ED are positive and MS , are negative. As of (Salvatore, 2013) an increase in the country's money supply causes its currency to depreciate and a decrease in the country's money supply causes its currency to appreciate. Lastly, the model specification can be obtained as in the following manner:

A vector autoregressive of order 1, VAR(1) model is specified as : $\ln y_t = c + \pi \ln y_{t-1} + \varepsilon_t$

It could be expanded as in the following way:

$$\begin{aligned} \ln rgdp_t &= c_1 + \pi_{11} \ln rgdp_{t-1} + \pi_{12} \ln ED_{t-1} + \pi_{13} E_{t-1} + \varepsilon_{1t} \\ \ln ED_t &= c_2 + \pi_{21} \ln rgdp_{t-1} + \pi_{22} \ln ED_{t-1} + \pi_{23} E_{t-1} + \varepsilon_{2t} \\ E_{t-1} &= c_3 + \pi_{31} \ln rgdp_{t-1} + \pi_{32} \ln ED_{t-1} + \pi_{33} E_{t-1} + \varepsilon_{3t} \end{aligned} \quad (3.20)$$

From the equation the coefficient indicates that the effect of one variable over the other. The variables are $\ln rgdp$, $\ln ED$, and E . That is the π 's represent coefficients of $\ln rgdp$, $\ln ED$, and E .

3.5 Definition of the variables

Both theoretical and empirical literature proposes number of variables that have significant effect on devaluation and external debt.

- GDP is gross domestic output which measures economic growth in terms of real GDP.
- E_{exp} refers to government expenditure on education.
- PI is private investment it can measure as physical capital consists of domestic and foreign investment.
- MS is money supply is in terms of nominal: It is the total amount of in the given economy. Higher money supply which increase price and dampen the economic growth.
- E is exchange rate; is the ratio of one currency in terms of another currency (birr per dollar). It can be used as a proxy for devaluation.
- ED is external debt which is an element of total debt in a country that is owed to creditors from the foreigners.

CHAPTER FOUR

Ethiopian economy- an Overview

This chapter discusses the macro-economic situation of Ethiopian economy for the period 1991-2018 related to the major variables included in the study.

4.1 Exchange rate in Ethiopia

Exchange rate is the price of ETB in terms of USD. It can be defined as domestic currency per unit of foreign currency, and foreign currency per unit of domestic currency as cited by (Yilkal,2014) from (Fentahun,2011). The official exchange rate of Ethiopian currency with US dollar was created, with the official exchange rate of 2.48 birr per United State dollar, on July 23, 1945 (Degefa.D,2001).

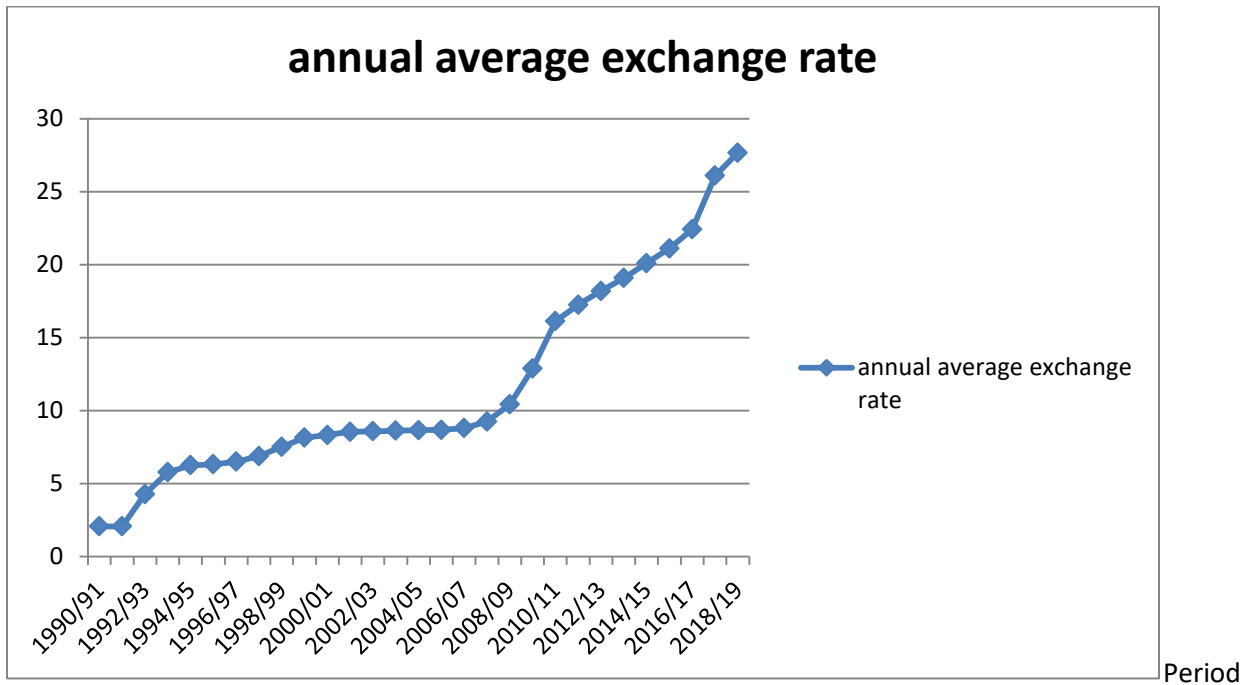
Since 1992, Ethiopia allowed to follow managed floating exchange rate system by considering the fundamental economic situations of the country. In such case, the National Bank of Ethiopia frequently intervenes to balance appreciation or depreciation of its currency. The gap between the unofficial and official rate also declined compared to the period when the exchange rate was fixed. The rate of depreciation against other foreign currencies increased in the fiscal year 2007/08 compared to the previous years. In the 2009/10 and September 2010/2011 the Ethiopian Birr was depreciated to 23.7% and 16.5% respectively against the US dollar. This huge devaluation was expected to “decrease overvaluation and increase competitiveness” (IMF, 2010; MOFED, 2009) as cited by (Tirist,2011).

The main objective of exchange rate policy in Ethiopia is to be competitive in the international market, to avoid external imbalances, and to reduce the parallel exchange rate premium (Zerayehu,2006).

Devaluation policy in Ethiopia began during the transitional government. Exchange rate is changed from fixed to flexible in order to achieve the country’s goal in the post 1992. Currently; the birr is highly depreciated from time to time as I see in the graph below.

Figure4 1: Exchange rate of ETB against USD 1990-2018

Exchange rate



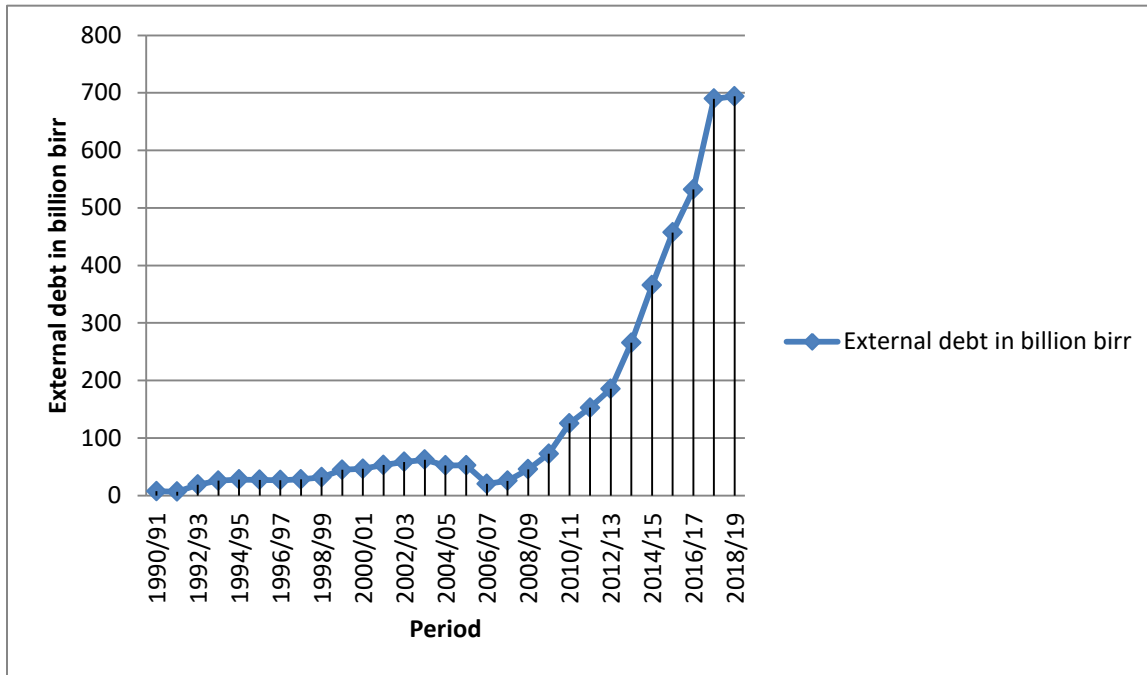
Source: Own computation data from NBE (2016) and annual report of NBE

From the graph 4.1 it is seen that the devaluation of Ethiopian birr per dollar officially began during the transitional government. In this period Ethiopia decided to devalue the currency from 2.07 to 5 birr per dollar in 1992 and it increase its exchange rate from time to time indicates that decline value of domestic currency.

4.2 External debt

Most developing countries including Ethiopia characterized by scarcity of capital, low saving rate, low technological advancement so that to fill this gap they need borrowing from external countries. As see from the graph below external debt stock has increased from year to year in Ethiopia. During 2015/16, the external debt stock has reached about 457.26 billion birr or 23 billion USD. In 2016/17, the external debt stock has also reached 532.12 billion birr or 23.75 billion USD indicates that external debt has increasing from time to time which owned from multilateral, bilateral and commercial creditors.

Figure 4.2 External debt in Ethiopia from 1990-2018 (in billion Birr)



Source: Own-computation based on annual report of NBE and MOFED

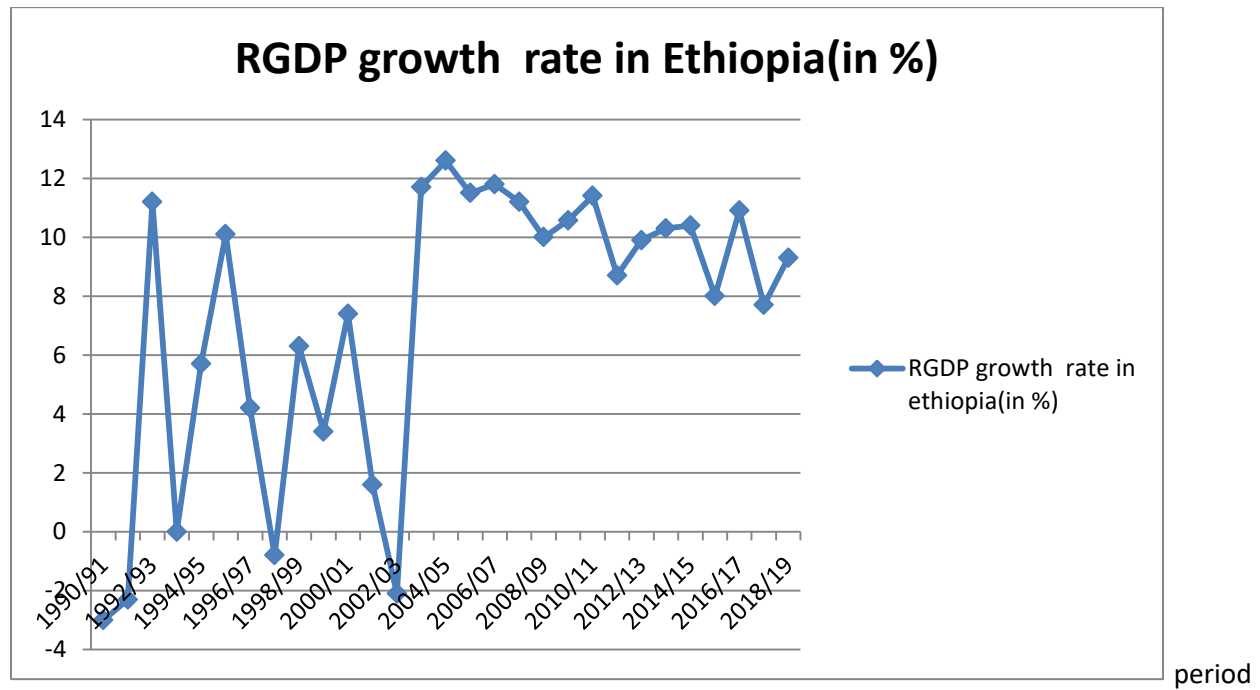
4.3 Economic growth rate of Ethiopia

As indicated by Chris Michelson Institute (CMI), (2006) reports that the Ethiopian economic growth rate is likely to remain high despite large fluctuation in agricultural production. Ethiopia followed highly aggressive expansionary macroeconomic policy initiating extended fixed investment, much beyond a narrow public expenditure boom in 2003. According to the official data Ethiopia’s development performance over the past decade has been one of the most successful among low-income countries. The country achieved a significant and high economic growth over the past decade especially from 2003-2005 and 2012-2015 has registered a notable and sustained growth rate in the graph shown below. Alemayehu and Degefa (2005) stated as the Ethiopian GDP has decreased because of political disputes as cited by (Tirsit,2011).

In 2017/18 growth has declined because of political uncertainty and restrictive macroeconomic policy. In order to achieve robust growth and address external vulnerabilities tightening macroeconomic policy and reform to set up a private sector activity is important as announced by Prime Minister Abiy Ahmed (IMF,2018 report).

Figure4 3 Ethiopian Real GDP growth from 1990-2018

RGDP growth rate



Source: own computation from NBE annual report (2017/18) and MOFED

Ethiopia GDP growth rate is registered a high and significant economic growth bounded strongly by 11.7% and 12.6% in 2003/04 and 2004/05 respectively. However, in 2002/03 the real GDP growth rate is decreased by 2.1% at the same year inflation is increased by 10.9%. The country has achieved also an annual average growth rate of 10.84% from 2004-2015 which is a significant and sustained growth rate in Ethiopia. The Ethiopian economy registered 7.7 percent growth in 2018 which is lower than the 10.9 percent recorded in 2017 and relative to the previous period high growth registered in the above graph.

4.4 Money supply

Money supply and economic growth are increased in the year between 2003-2005 and 2012-2015. In the same year, inflation has decreased especially at the end of 2014/15 decreased by 50%.

The annual growth rate of domestic liquidity is measured by money supply (broad money) and it has reached about birr 573.4 billion at the end of 2016/17. This is because of an increase in external asset and domestic credit by 76.7% and 28.7% growth respectively. The main goal of the monetary policy is to maintain inflation in a single digit that is annual average inflation is lowered from 9.5 to 7.2 in this year to be maintained (NBE,2016/17annual report).

4.5 Private investment

Investment has an important role for the country's economic growth. Private investment is one component of total investment. The amount of private investment in terms of capital composed of domestic and foreign investment. In Ethiopia in 1992/93-2010/11 the total amount of private investment in terms of capital has reached about birr 806.3 billion out of these birr 424.1 billion attributed to domestic investors and 382.2 goes to foreign investors (NBE,2010/11 annual report; Ethiopian investment agency). During 2016/17, the total amount of investment in terms of capital reached about birr 8.9 billion out of these 99.8 percent were private owned. However, the annual growth rate of private investment is lowered by 41.9%.

4.6 Expenditure on education

In the endogenous growth model, education is the most important component of human capital for sustained economic growth. Education is vital to for innovation, to increase productivity of the output, to release the inner genius. In 2011/12 and 2012/13 the amount of capital expenditure to education sector reached birr 13523.3 in million and birr 14342.3 in million respectively. The amount of capital invested on education sector reached birr 18213.6 in million in 2013/14 (MOFED, 2015). Hence, this shows that the government gives attention to education for further development. In 2015/16 the aggregate expenditure on education sector was birr 67.9 billion in nominal value. This is an impressive achievement which begs calls for maintaining the share of government expenditure on education (MOE 2006-2016 report).

CHAPTER FIVE

Results and Discussion

In this section, the estimation result from the Vector autoregressive and Vector error correction models are discussed and different tests are presented. Exchange rate (official), money supply, real gross domestic product, and private investment collected from annual publication of NBE. Expenditure on education is collected from MOFED report, and external debt is also collected from national bank of Ethiopia from the period 1991-2018.

5.1 Unit root test

In econometrics, in the time series study, identifying the variable is stationary or not is the usual and vital trend. Because to escape from spurious regression or avoid wrong inferences in the regression. Hence, to avoid spurious regression primarily unit root test should be conducted to check the presence of unit root or not various tests could be employed like ADF, PP, Dickey-Fuller GLS (ERS), Ng Peron. However, in my study ADF and PP tests could be employed because of they are more conventional. The result of unit root test is conducted by ADF and PP test and obtained below in table 5.1 and 5.2 respectively.

Table 5.1 Unit root test by Augmented Dickey Fuller test

Variable	Augmented Dickey Fuller test					Order of integration
	At level		At first difference			
	t-statistics	Critical value	t- statistics	Critical value	Prob*.	
E	2.312526	-3.689194	-3.098033	-2.976263 ^{**}	0.0387	I(1)
LNEXTDEB	-0.455276	-3.689194	-4.385845	-3.699871 ^{***}	0.0019	I(1)
LNRGDP	3.036769	-3.711457	-7.911752	-3.699871 ^{***}	0.0000	I(1)
LNEXPEDU	-1.995871	-3.689194	-5.180439	-3.699871 ^{***}	0.0003	I(1)
LNLM2	0.758896	-3.689194	-5.040575	-3.699871 ^{***}	0.0004	I(1)
LNPI	-1.815054	-3.689194	-6.430056	-3.699871 ^{***}	0.0000	I(1)

Source : own-computation

Note that: ***,**, * refers to level of significance at 1%,5%, and 10% respectively.

: Prob*. Indicates that the probabilities of each variable at first difference for ADF tests.

As can be seen from the table, the variables are not stationary at level on both ADF and PP tests and it cannot be rejected the null. In this case to make stationary differencing should be conducted. And the variables are stationary at 1% and 5% level of significance and integrated of the same order I(1).Hence , by using the guide line the t-statistics are greater than critical value and the P values of the variables are significant (which is less than 5%) indicates reject the null after their first difference consideration.

Table5 2Unit root test by Philips- Peron test

Variable	Phillips- Perron test					Order of integration
	At level		At first difference			
	t-statistics	Critical value	t- statistics	Critical value	Prob*.	
E	1.916980	-3.689194	-3.098033	-2.976263**	0.0387	I(1)
LNEXTDEB	-0.455276	-3.689194	-4.424513	-3.699871***	0.0017	I(1)
LNRGDP	2.489453	-3.689194	-7.911752	-3.699871***	0.0000	I(1)
LNEXPEDU	-2.012968	-3.689194	-5.180439	-3.699871***	0.0003	I(1)
LNLM2	0.758896	-3.689194	-5.039893	-3.699871***	0.0004	I(1)
LNPI	-1.782573	-3.689194	-6.326566	-3.699871***	0.0000	I(1)

Source: own-computation

Note that: ***,**, * indicates that level of significance at 1%,5%, and 10% respectively.

: Prob*. Indicates that the probabilities of each variable at first difference for PP tests.

Generally, The ADF and PP test indicates that the variables are non - stationary at level shows that it cannot be rejected the null. However, both tests used intercept and first difference and after supplementing differencing in Eviews all variables are stationary on both ADF and PP test at 1% and 5% level of significance with the same variable. Therefore, the null can be rejected. The ADF and PP tests are important to determine the order of integration for all variables. Moreover, the variables are all stationary at first order. Generally, stationarity shows that the assurance of estimation of the VAR model.

5.2 Optimal lag length

In order to estimate the VAR model appropriate lag length selection is vital. Various methods could be used for choosing optimal lag length such as Likelihood Ratio test statistics (LR), Final prediction error (FPE), Akaike information criteria (AIC), Schwartz information criteria (SC), Hannan Quinn information criteria and (HQ) are used in the study. Among these criteria AIC and are chosen for the criteria. It is presented in the appendix 2.

From the appendix 2 , AIC chosen for the criteria in this study, because of the least figure the better the model and it is also more common and preferable below 60 observations. The table provides 1 optimal lag length at 5 percent level of significance.

5.3 Co integration test

The primary objective of the study is to show the short run and long run between variables. In standard econometrics of time series study, performing co integration is required next to stationarity and lag length criteria. In case, where the variables are at difference stationary, it can estimate the model by first difference but it shows only the short run behavior of the variable. This verifies that in time series analysis, Co integration among the variables shows the presence of long run relationship in the system. Test for co integration is required because differencing the variables to attain stationarity generates a model that does not show the long run behavior of the variables. It can be testing either Engel granger or Johansen approach. Hence, co integration tests to be conducted in order to include long run relationship behavior. However, Johansen approach is used than Engel- Granger for it is better to evaluate many co integrating vectors and it gives also the exact number of co integrating relation (Lutekepol et al.,2001) as cited by (Yigermal,2018).

As I saw in the table, the variables in the equations are I(1). Thus, it is possible to conduct co integration test. It can be analyzed by the guide line that is if trace statistics is greater than 5 percent critical value reject the null (co integration) otherwise no co integration between variables. It is reported in the appendix.

As can be seen in the appendix shows there is co integration between the variables because as a rule of thumb the trace statistics is greater than 5% critical value or the maximum Eigen value greater than 5percent critical value and all variables are integrated of the same order.

The Johansen test indicates co integration between variables and I saw that the trace statistics and maximum Eigen value is greater than the 0.05 critical value, tell us rejection of the null hypothesis for the five co integration equation hence, there is long run co integration between the variables (see in appendix7).

After some post estimation techniques, some tests to be estimated, testing the error terms are normally distributed and the test shows that the error terms are normally distributed using Jarque- Berra test where ($p > 0.05$) and it is normally distributed (see in Appendix 3). In addition, the error terms are not correlated each other meaning no autocorrelation problem and hetroscedasticity is also tested and, thus there is homoscedastic (see in appendix 4&5).

5.4 Vector error correction model estimation result and interpretation

The VECM is important to see the adjustment gap between short run and long run. It is important to capture the percentage of the disturbance created in the short run. The coefficients are expected to lie between 0 and 1 tell us what proportion of the disequilibrium in the variable in one period is corrected in the next period if the coefficients are statistically significant and negative. The short run will be corrected each year by 100percent if the coefficients are 1 and 0 means it takes long period to adjust the gap between the short term and long run equilibrium.

VECM is a means of reconciling the short run behavior of economic variable with its long run behavior. It is a special case of the VAR for variables that are stationary in their difference (I(1)). Hence, the VEC can also take in to account any co integrating relationship. And the sort run dynamics can be described by error correction model.

Since all variables are non - stationary at level and are stationary at first difference shows that they have long run relationship and co integrated .From the above co integration test indicates that the existence of five co integrating vectors in the model, thus we estimate the long run equilibrium relationship among the variables in the Johansen test.

The long run error correction model for the five co integrated equation can obtained as in the VECM estimation as follows:

$$ECM_{1,t-1} = E_{t-1} + 69.13 - 8.19lnPI$$

$$ECM_{2,t-1} = Extdeb_{t-1} + 3.56 - 1.50lnPI$$

$$ECM_{3,t-1} = RGDP_{t-1} - 5.22 - 0.75lnPI$$

$$ECM_{4,t-1} = Expedu_{t-1} + 5.97 - 1.31lnPI$$

$$ECM_{5,t-1} = MS_{t-1} + 20.66 - 3.39lnPI$$

In the long run errors are assumed to be zero then the result could be written as:

$$E_{t-1} = -69.13 + 8.19lnPI$$

$$Extdeb_{t-1} = -3.56 + 1.50lnPI$$

$$RGDP_{t-1} = 5.22 + 0.75lnPI$$

$$Expedu_{t-1} = -5.97 + 1.31lnPI$$

$$MS_{t-1} = -20.66 + 3.39lnPI$$

Therefore, from the above result, in the long run, PI is significant element to explain the exchange rate. This is confirmed by the t- statistics value of -5.53. In mechanical terms, a 1percent change in PI increases the exchange rate by 8.19percent. It indicates that the rise in PI has encourages a nation to devalue its currency in the long run. Similarly, the PI has a significant long run effect on external debt, RGDP, expenditure on education and money supply. This is confirmed by their t- statistics value of -5.27,-5.98, -13.5, and -5.99 respectively. Specifically, in the long run the impact of PI on External debt is positive and significant. The percentage change in increase in PI increases External debt by 1.50 percent. PI has also positive impact and significant on RGDP. In the long run, a1percent change in increase in PI leads to increase RGDP by 0.75 percent. And it is consistent with literature used in my study that is supported by in the new growth theory model, Khan & Reinhart ,(1990) in LDC's, Afonso, A & Aubyn,(2014) in OECD countries, and Suhendra & Anwar, (2017) in Indonesia. The impact of PI on Expenditure on education and money supply is also positive and significant .That is a 1percent

change in increase PI leads to increase Expenditure on education and money supply by 1.31percent and 3.39percent respectively.

From the appendix 8 estimation , the coefficient of exchange rate is -0.38 and it is statistically significant. External debt has positive effect and significant in the short run on exchange rate. That is a 1percent change in increase external debt leads to increase exchange rate by 1.047 percent. This supported with the study in the literature (Kouladoum, J. C, 2018) in Chad. The effect of Expenditure on education affects exchange rate and external debt positively and significant in the short run. That is in the short run, a 1percent change in increase in expenditure on education leads to increase exchange rate and external debt by 0.51 and 0.28 percent respectively. And private investment affects expenditure on education negatively and significant. And the effect of PI on exchange rate is negative in the short run but it is insignificant.

Private investment is also affected by exchange rate and expenditure on education positively and significant. And it is also negatively and significant affected by external debt in the short run. In other words, in the short run, a 1percent change in increase exchange rate and expenditure on education leads to increase private investment by 0.50 percent and 0.86 percent respectively. This is similar with the study Abate,(2016) in Ethiopia. But, the variables like real GDP and money supply have insignificant effect in the short run and no need of interpretation.

5.5 Impulse response and variance decomposition

As explained earlier, the VAR model analyzed by Impulse response function and variance decomposition. Thus, I used these instruments in order to achieve the objective. Both are useful in assessing how shocks to economic variables reverberate through the system and are produced after VECM and VAR estimation obtained.

Impulse response function has different characteristics some have no zero values start and others start zero value in the appendix 11 table. The impulse response is estimated for 28 periods and the variable comes to equilibrium in the long run. It shows that the increment to each variable due to one shock of other variables taking in to account and all the interaction between variables.

In the appendix 11, initially, the response of real GDP shock is emanating from exchange rate is negative, but it is statistically insignificant. Thus, devaluation has inconclusive effect on real

GDP in the short run. And this requires further investigation. However, in the long run, devaluation starts to increase real GDP but real GDP increases at decreasing rate. Even though real GDP is negative, devaluation has expansionary effect in the long run. The result is in line with the short run VECM and long run co integration estimation. This is supported by Marshall Lerner Condition theory and Mendel-Fleming Model. However, economic growth has increased at decreasing rate. The result is similar with Narayan & Narayan, (2007) in Fiji, which is also supported by IMF,(2014) report, Okaro,(2017) in Nigeria, Fassil, (2017) in Ethiopia and Kyophilavong et al., (2019) in Laos economy. In addition, in the long run devaluation has expansionary effect on output though it increases at decreasing rate in my study which is inconsistent with the hypothesis.

In the short run, the response of external debt shock is resulting from exchange rate is negative, that is devaluation reduces external debt but it is insignificant so that devaluation has inconclusive effect on external debt in the short run and again it needs further investigation, while in the latter period, devaluation increases external debt although it increases at decreasing rate. The result is in line with the short run VECM and long run co integration result. The result is supported by Dornbush, (1986), Yilkal,(2014) in Ethiopia, Assibey-Yeboah et al., (2016) in developing economies, and Okaro,(2017) in Nigeria, Moreover, the result is confirmed with the hypothesis in the long run.

In addition, from the impulse response function table, the impact of real GDP shock is arises from external debt is positive in the short period, but in the long run which dampen the economic growth. Meaning, external debt has positive impact on output in the short run and negative impact in the long run. External debt adversely affects economic growth in the long run. The result is consistent with Agenor & Montiel,(1996) ,Were,M ,(2001) in Kenya,Teklu et al., (2014) in Ethiopia, Ramzan & Ahmad, (2014). Moreover, my study also supported with debt affects economic growth through Debt lafer curve theory and Debt overhang theory but it is inconsistent with Hanna, (2013) in Ethiopia, Marobhe, (2019) in Tanzania and Rashid & Muhammed, (2014) in Pakistan stated as external debt has positive impact on economic growth.

Variance decomposition

Variance decomposition provides information about the relative importance of each orthogonalized random innovation in affecting the variation of the variables in each forecast errors. It depicts the proportion of movements in one variable that are due to errors in own shocks and to each other variables in the system. Variance decomposition measures the contribution of each type of shock to the forecast error variance.

Table 5.3 Variance decomposition of lnRGDP

Period	S.E.	E	LNEXTEDEB	LNRGDP	LNEXPEDU	LNLM2	LNPI
1	0.125760	0.241102	0.250079	99.50882	0.000000	0.000000	0.000000
2	0.149751	1.552309	5.127595	78.49110	1.360556	7.235793	6.232646
3	0.170860	1.499830	4.686066	78.17582	1.251959	9.093980	5.292341
4	0.187873	1.886844	4.799818	73.65139	1.055002	13.29387	5.313075
5	0.206101	2.412529	4.412100	70.62903	1.118604	16.55284	4.874891
6	0.226270	3.403647	4.025264	66.31261	2.008152	19.62680	4.623524
7	0.250070	4.758619	3.566167	61.60776	4.071515	21.59541	4.400531
8	0.277953	6.415126	3.132784	56.49486	7.119797	22.51683	4.320600
9	0.309947	8.172290	2.746912	51.55482	10.72701	22.44334	4.355633
10	0.345414	9.879054	2.434689	47.08728	14.39835	21.69406	4.506567
11	0.383401	11.42601	2.196891	43.29263	17.78423	20.55967	4.740565
12	0.422785	12.76861	2.027197	40.19509	20.69902	19.27837	5.031711
13	0.462453	13.90005	1.913871	37.74253	23.08941	17.99985	5.354285
14	0.501401	14.83606	1.845297	35.84278	24.97783	16.80833	5.689700
15	0.538792	15.60050	1.811018	34.39971	26.42251	15.74223	6.024032
16	0.573985	16.21877	1.802453	33.32516	27.49253	14.81337	6.347722
17	0.606538	16.71436	1.812694	32.54425	28.25562	14.01893	6.654153
18	0.636194	17.10787	1.836266	31.99512	28.77288	13.34894	6.938918
19	0.662866	17.41691	1.868813	31.62739	29.09720	12.79048	7.199195
20	0.686599	17.65639	1.906872	31.40011	29.27332	12.32991	7.433388
21	0.707549	17.83895	1.947689	31.27995	29.33850	11.95402	7.640892
22	0.725947	17.97531	1.989096	31.23979	29.32330	11.65057	7.821930
23	0.742070	18.07463	2.029431	31.25757	29.25238	11.40856	7.977430
24	0.756216	18.14465	2.067465	31.31550	29.14525	11.21823	8.108899
25	0.768688	18.19193	2.102353	31.39938	29.01693	11.07111	8.218289
26	0.779775	18.22196	2.133579	31.49806	28.87868	10.95987	8.307847
27	0.789742	18.23924	2.160897	31.60298	28.73868	10.87823	8.379971
28	0.798827	18.24749	2.184278	31.70768	28.60270	10.82078	8.437077

Source: own computation

From the estimation table 5.7, it depicts that the forecast error of real GDP is near to the variable itself and independent in the initial period. That is the variables approximately exhibit strong exogenous impact in predicting in the future. And real GDP showed weak influence to explain

itself in the long run. Thus, the forecast error variance of real GDP is explained about 31.17percent in the long run. The overall effect of money supply and private investment is weak on real GDP. After the first period, the variables have weak influence on real GDP. The deviation explained by real GDP decreases to 31.24 per cent in the 22th period from 99.5percent in the first period and it increase to 31.7percent. The deviation in economic growth explained by the variation in exchange rate is 0.24percent and it increases approximately to 18.25percent. And the variation of real GDP is due to the contribution of external debt and its contribution is very low relatively other independent variables. The deviation of real GDP arises from money supply, expenditure on education and private investment. That is, the variation of real GDP is explained by the variation of money supply, expenditure on education and private investment is insignificant and explained by zero percent in the first period. However, the variation in real GDP explained by money supply expenditure on education and private investment in the last period is 10.8percent, 28.6percent and 8.43percent respectively.

Table5 4 Variance decomposition lnExternal debt

Period	S.E.	E	LNEXTDEB	LNRGDP	LNEXPEDU	LN M2	LNPI
1	0.283630	25.32857	74.67143	0.000000	0.000000	0.000000	0.000000
2	0.343518	34.79543	59.53542	0.023944	1.646039	0.387908	3.611252
3	0.377115	37.22971	50.87522	0.215530	2.885180	2.890670	5.903689
4	0.397315	36.66038	45.92999	0.195458	2.747093	6.743638	7.723450
5	0.413917	34.18011	42.32001	0.334915	2.981601	11.97617	8.207192
6	0.437626	30.70532	37.86340	1.108158	5.709279	16.99484	7.619000
7	0.476126	27.26148	31.98775	2.582393	11.48221	20.24947	6.436695
8	0.531412	24.66962	25.68534	4.495018	18.74120	21.05457	5.354251
9	0.600166	23.13176	20.17197	6.391781	25.47274	20.08693	4.744811
10	0.676667	22.38726	15.94103	8.049875	30.69294	18.32599	4.602912
11	0.755135	22.11131	12.90983	9.424184	34.33430	16.43931	4.781062
12	0.830877	22.07059	10.80310	10.56034	36.69850	14.73134	5.136140
13	0.900544	22.13078	9.356565	11.51578	38.12767	13.29800	5.571196
14	0.962058	22.22131	8.369643	12.33856	38.90125	12.14204	6.027195
15	1.014417	22.30756	7.701747	13.06201	39.22586	11.23300	6.469832
16	1.057485	22.37396	7.256270	13.70743	39.25083	10.53233	6.879173
17	1.091767	22.41503	6.966354	14.28727	39.08484	10.00272	7.243783
18	1.118212	22.43074	6.784793	14.80807	38.80810	9.610724	7.557569
19	1.138016	22.42407	6.677507	15.27289	38.47998	9.327255	7.818297
20	1.152463	22.39956	6.619502	15.68328	38.14336	9.127438	8.026862
21	1.162790	22.36233	6.592438	16.04079	37.82712	8.990497	8.186822
22	1.170097	22.31737	6.583127	16.34804	37.54787	8.899742	8.303848
23	1.175292	22.26892	6.582498	16.60922	37.31182	8.842537	8.385002
24	1.179078	22.22010	6.584747	16.83005	37.11719	8.810060	8.437863

25	1.181969	22.17281	6.586521	17.01729	36.95696	8.796760	8.469663
26	1.184328	22.12780	6.586134	17.17809	36.82185	8.799545	8.486591
27	1.186409	22.08498	6.582855	17.31917	36.70279	8.816806	8.493408
28	1.188403	22.04378	6.576346	17.44629	36.59274	8.847460	8.493382

The above table can be explained by in the similar fashion indicates that the forecast error of the external debt is explained by 74.67percent in the past and it is strong endogenous. The variation explained by external debt decreases from 74.67percent in the first period to 6.57percent in the last period. Thus 6.57percent of forecast error variance external debt is weakly endogenous to explain itself in the future. Education is explained forecast error of variance of external debt is strong and real GDP is explained external debt moderately strong. While the influence of money supply and private investment is weak. The deviation of external debt explained by the variation in exchange rate is 25.3percent in the first period and 22.04percent in the last period. The contribution of real GDP, money supply, expenditure on education and private investment is insignificant and explaining 0percent on external debt in the first period. But, in the last period, the deviation of external debt arising from real GDP, money supply, expenditure on education and private investment is 17.4percent, 8.84percent, 36.59percent and 8.49percent respectively.

CHAPTER SIX

Conclusion and policy implication

6.1 Conclusion

The study is based on theoretical and empirical aspect on the series between devaluation, external debt and economic growth in Ethiopia. The estimation is based on Johansen co integration, VECM, impulse response and variance decomposition employed for the analysis. In addition, the VAR model is also adopted and estimated based on the annual data from 1991-2018.

The study was analyzed using VECM, impulse response, and variance decomposition. Specifically, the short run was analyzed using VECM, and the long run analyzed using impulse response graph. Variance decomposition is also used for the analysis of the variation of variables with the other variables.

In the short and long run exchange rate affects real GDP. In the short run, exchange rate affects real GDP negatively though statistically insignificant. In the long run, exchange rate has an expansionary effect on economic growth but real GDP increases at decreasing rate using impulse response function (IRF). Because of devaluation, citizens turn to domestic products and produce more output in the long run. Although real GDP is increasing at decreasing rate in the long run, it shows that expansionary trend. This is supported by IMF strategy, Marshal Lerner condition theory, Mendel Fleming theory and empirical studies like Okaro, (2017) in Nigeria, Fassil, (2017) in Ethiopia and Kyophilavong et al., (2019) in Laos's economy.

Devaluation reduces external debt in the short run but statistically insignificant. In the long run, devaluation increases external debt in the impulse response analysis graph. This can happen because of debt is denominated in dollar and when countries have large external debt and devalue its birr the debt burden increases in terms of birr. It increases the amount spent by the government in servicing external debt this leads to unable to pay its debts servicing and it's described by debt overhang hypothesis.

External debt affects real GDP positively, but insignificant in the short run VECM and from impulse response function. It can be used as to stimulate economic growth and to bridge resource

gap. This is supported by Sulaiman & Azeez,(2012) in Nigeria. However, in the long run, external debt retards economic growth at a constant rate positively. This is because of bad debt management policy and over borrowing. Countries are vulnerable to small economic shocks for the state economy is limited. Malfunctioning government policy also contributes to reduce economic growth. The result is consistent with previous studies by Were,M ,(2001) in Kenya, Teklu et al., (2014) in Ethiopia, and Kharusi & Ada ,(2018) in Oman's economy.

In this study, in the long run, expenditure on education, private investment, money supply, and external debt are main determinants of economic growth of Ethiopia. Expenditure on education and private investments are positively contributes to Ethiopian economic growth. Moreover, money supply and external debt reduces economic growth but growth is positive in the long run. Thus, government should focus on expenditure on education and private investment policies relative to devaluation and external debt. This is supported by the endogenous growth theory.

In the variance decomposition table, the contribution of exchange rate and external debt is very low. That is real GDP is weakly explained by exchange rate and external debt in the short run. This shows that there is no more relation between real GDP, exchange rate and external debt in the short period. However, the contribution of exchange rate is high to real GDP. The variation in real GDP arises from variation in exchange rate. Moreover, in the variance decomposition of external debt, in the first period, external debt is weakly explained by exchange rate and real GDP. This indicates that there is no more linkage between external debt, exchange rate and real GDP in the short run. However, the contribution of exchange rate and real GDP is increased in the long run on external debt. That is the variation of external debt arises from the variation of exchange rate and real GDP in the last period. Hence, this indicates that there is relationship between external debt, exchange rate and real GDP in the long run.

6.2 Policy implication

Currency devaluation is one option to correct economic problems which is described by IMF, WB, and SAP. The study confirms that devaluation is one option to promote economic growth in Ethiopia although real GDP is increasing at decreasing rate in the long run. Because devaluation is associated with foreign currency supply, it improves the current account. However, it shouldn't be the first option to economic growth of Ethiopia for it has side effects of inflation on

output. Therefore, the government should give attention on import substitution strategy; good environment and availability of infrastructure, political stability, and focus on the quality of exported goods are an alternative policy to devaluation to escape from domestic inflation and to expand output. Policy should be implemented based on fiscal and monetary policy in order to achieve a realistic exchange rate for birr. In addition, the government should give attention spending on education through effective and efficient tax administration system, creating smooth relationship with other countries. Besides, government encourages investors through creating political stability, reduce tax, and allow credit and loan, proper macroeconomic policies should be implemented in order to boost economic growth.

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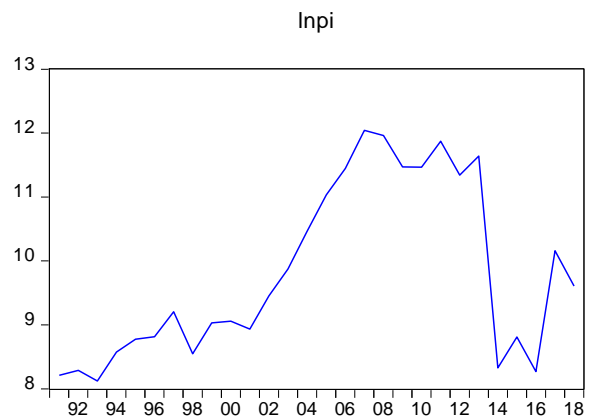
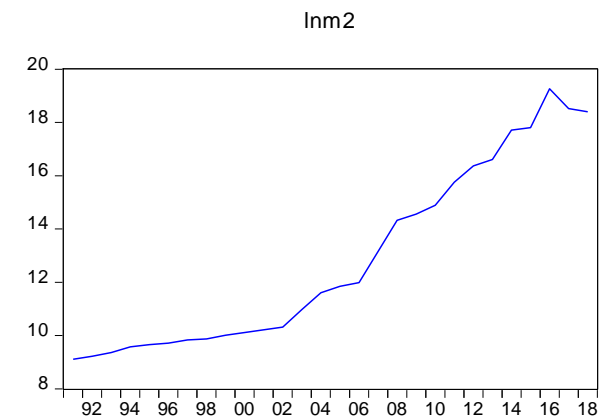
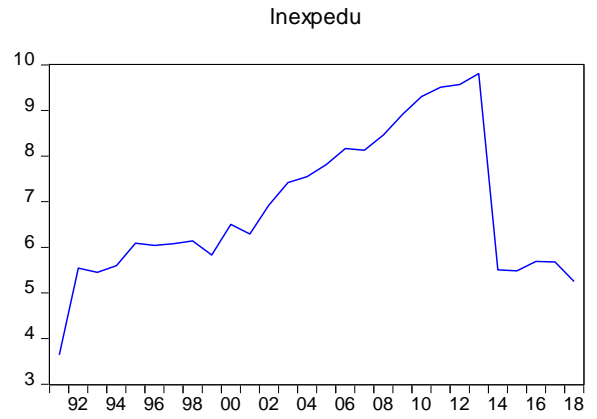
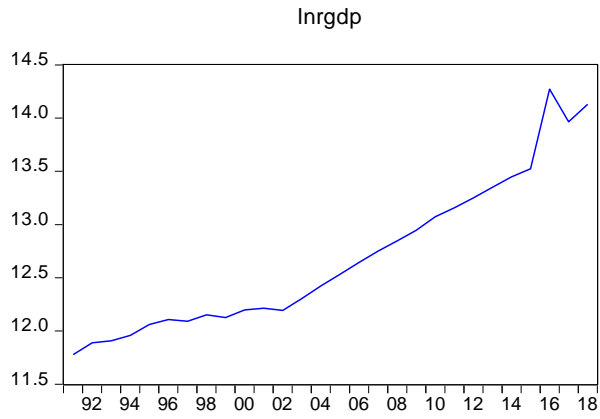
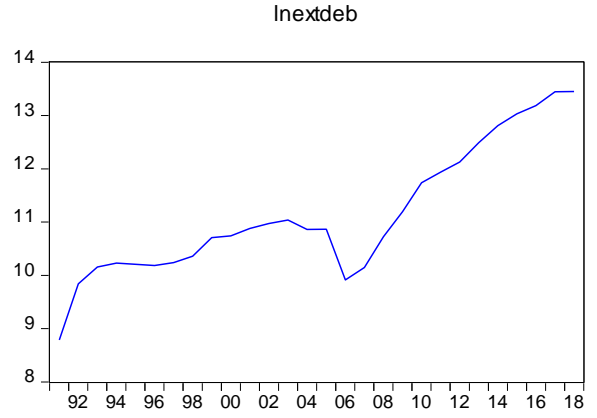
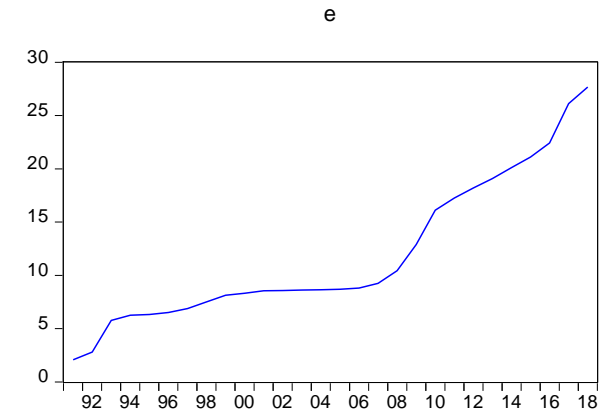
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Appendix

1. Graph at level of variables (non-stationary)



2. Optimal lag length criteria

VAR Lag Order Selection Criteria

Endogenous variables: E LNEXTDEB LNRGDP LNPEDU LNM2 LNPI

Exogenous variables: C

Date: 06/15/19 Time: 10:41

Sample: 1991 2018

Included observations: 27

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-165.9150	NA	0.013669	12.73445	13.02241	12.82007
1	-20.58170	215.3087*	4.47e-06*	4.635682*	6.651428*	5.235069*

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

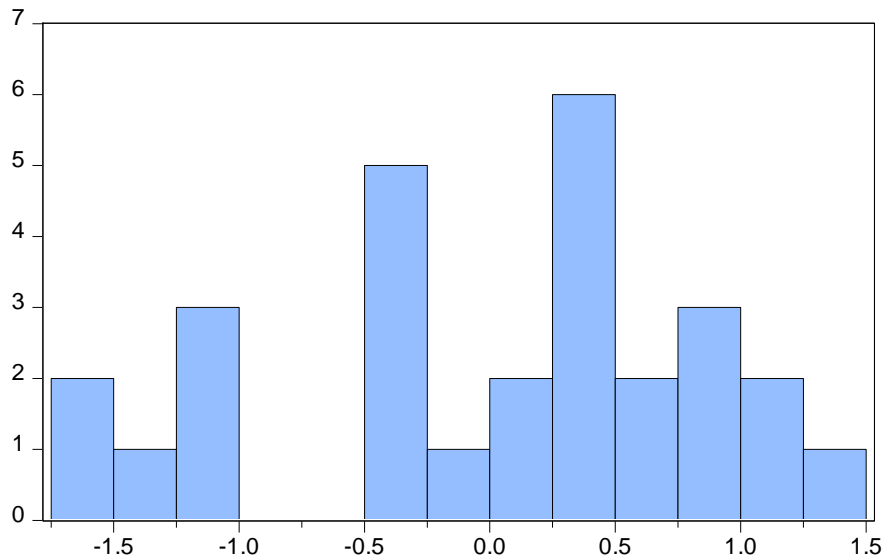
FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

3. Normality(1)



Series: Residuals	
Sample 1991 2018	
Observations 28	
Mean	-3.30e-14
Median	0.232916
Maximum	1.440305
Minimum	-1.743156
Std. Dev.	0.868302
Skewness	-0.487871
Kurtosis	2.257891
Jarque-Bera	1.753263
Probability	0.416182

Normality test(2)

VEC Residual Normality Tests

Orthogonalization: Cholesky (Lutkepohl)

Null Hypothesis: Residuals are multivariate normal

Date: 06/15/19 Time: 10:47

Sample: 1 28

Included observations: 26

Component	Skewness	Chi-sq	Df	Prob.*
1	0.872974	3.302363	1	0.0692
2	-0.645967	1.808186	1	0.1787
3	0.035328	0.005408	1	0.9414
4	-0.168353	0.122819	1	0.7260
5	0.181300	0.142436	1	0.7059
6	-0.136407	0.080630	1	0.7764
Joint		5.461842	6	0.4861

Component	Kurtosis	Chi-sq	Df	Prob.
1	4.214614	1.598228	1	0.2062
2	3.484463	0.254263	1	0.6141
3	2.201237	0.691190	1	0.4058
4	3.325491	0.114773	1	0.7348
5	2.362217	0.440665	1	0.5068
6	2.853304	0.023313	1	0.8786
Joint		3.122432	6	0.7933

Component	Jarque-Bera	Df	Prob.
1	4.900591	2	0.0863
2	2.062449	2	0.3566
3	0.696599	2	0.7059
4	0.237592	2	0.8880
5	0.583101	2	0.7471
6	0.103943	2	0.9494
Joint	8.584274	12	0.7380

*Approximate p-values do not account for coefficient Estimation

4. Autocorrelation (serial correlation)

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.299827	Prob. F(1,22)	0.5895
Obs*R-squared	0.389913	Prob. Chi-Square(1)	0.5323

Test Equation:

Dependent Variable: RESID

Method: Least Squares

Date: 06/23/19 Time: 09:34

Sample: 1991 2018

Included observations: 28

Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.150108	1.101471	0.136279	0.8928
E	-0.001609	0.021812	-0.073767	0.9419
LNEXTDEB	-0.009341	0.097994	-0.095319	0.9249
LNEXPEDU	0.015429	0.048015	0.321340	0.7510
LN2	0.008025	0.028490	0.281671	0.7808
LNPI	-0.023994	0.066869	-0.358821	0.7231
RESID(-1)	0.173518	0.316890	0.547565	0.5895
R-squared	0.013445	Mean dependent var		-1.67E-15
Adjusted R-squared	-0.255615	S.D. dependent var		0.103046
S.E. of regression	0.115468	Akaike info criterion		-1.273144
Sum squared resid	0.293322	Schwarz criterion		-0.943107
Log likelihood	25.46059	Hannan-Quinn criter.		-1.169781
F-statistic	0.049971	Durbin-Watson stat		1.910582
Prob(F-statistic)	0.999372			

Serial correlation (2)

VEC Residual Serial Correlation LM Tests

Date: 06/15/19 Time: 10:46

Sample: 1991 2018

Included observations: 28

Null hypothesis:
s: No serial correlation at lag h

Lag	LRE* stat	df	Prob.	Rao F-stat	Df	Prob.
1	42.76028	36	0.2035	1.178812	(36, 15.9)	0.3732

Null hypothesis:
s: No serial correlation at lags 1 to h

Lag	LRE* stat	df	Prob.	Rao F-stat	Df	Prob.
1	42.76028	36	0.2035	1.178812	(36, 15.9)	0.3732

*Edgeworth expansion corrected likelihood ratio statistic.

5. Heteroscedasticity test

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.670850	Prob. F(5,23)	0.1817
Obs*R-squared	7.726966	Prob. Chi-Square(5)	0.1719
Scaled explained SS	3.473166	Prob. Chi-Square(5)	0.6275

Test Equation:

Dependent Variable: RESID^2

Method: Least Squares

Date: 06/05/19 Time: 09:50

Sample: 1991 2018

Included observations: 28

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-34.34498	15.77853	-2.176690	0.0400
LNEXTDEB	-0.498341	0.477834	-1.042915	0.3078
LNRGDP	3.783268	1.686242	2.243609	0.0348
LNEXPEDU	0.244849	0.303297	0.807290	0.4278
LNLM2	-0.523905	0.328353	-1.595553	0.1242
LNPI	-0.219919	0.397495	-0.553264	0.5854

R-squared	0.266447	Mean dependent var	0.857013
Adjusted R-squared	0.106979	S.D. dependent var	1.042679
S.E. of regression	0.985330	Akaike info criterion	2.990311
Sum squared resid	22.33012	Schwarz criterion	3.273199
Log likelihood	-37.35951	Hannan-Quinn criter.	3.078908
F-statistic	1.670850	Durbin-Watson stat	2.052408
Prob(F-statistic)	0.181681		

Heteroscedasticity(2)

VEC Residual Heteroskedasticity Tests (Levels and Squares)

Date: 06/15/19 Time: 10:47

Sample: 1991 2018

Included observations: 27

Joint test:

Chi-sq	Df	Prob.
474.5185	462	0.3336

Individual components:

Dependent	R-squared	F(22,3)	Prob.	Chi-sq(22)	Prob.
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res1*res1	0.973938	5.095924	0.1022	25.32239	0.2819
res2*res2	0.891523	1.120709	0.5393	23.17960	0.3916
res3*res3	0.939131	2.103913	0.2973	24.41740	0.3257
res4*res4	0.872633	0.934271	0.6180	22.68845	0.4195
res5*res5	0.993917	22.28012	0.0130	25.84184	0.2585
res6*res6	0.842736	0.730737	0.7215	21.91114	0.4652
res2*res1	0.932524	1.884555	0.3340	24.24562	0.3345
res3*res1	0.931984	1.868504	0.3370	24.23158	0.3352
res3*res2	0.708945	0.332152	0.9481	18.43257	0.6801
res4*res1	0.968824	4.237569	0.1297	25.18941	0.2881
res4*res2	0.963354	3.584703	0.1600	25.04719	0.2948
res4*res3	0.674539	0.282623	0.9686	17.53802	0.7330
res5*res1	0.854962	0.803831	0.6822	22.22902	0.4463
res5*res2	0.790653	0.515013	0.8476	20.55698	0.5482
res5*res3	0.980899	7.002877	0.0668	25.50338	0.2736
res5*res4	0.942705	2.243669	0.2772	24.51033	0.3211
res6*res1	0.903800	1.281134	0.4826	23.49879	0.3740
res6*res2	0.941887	2.210181	0.2818	24.48907	0.3221
res6*res3	0.732180	0.372799	0.9283	19.03669	0.6431
res6*res4	0.865003	0.873756	0.6469	22.49007	0.4310
res6*res5	0.896940	1.186784	0.5148	23.32044	0.3838

6. Stability test

6.1 AR Roots table

VAR stability condition check

Roots of Characteristic Polynomial

Endogenous variables: E LNEXTDEB

LNRGDP LNEXPEDU LNM2 LNPI

Exogenous variables: C

Lag specification: 1 1

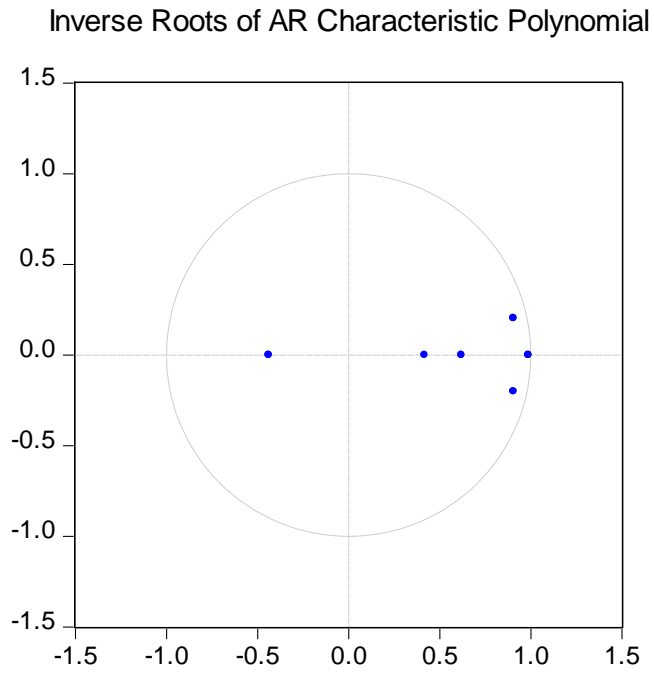
Date: 06/04/19 Time: 14:22

Root	Modulus
0.987316	0.987316
0.906152 - 0.201988i	0.928391
0.906152 + 0.201988i	0.928391
0.621144	0.621144
-0.437398	0.437398
0.417217	0.417217

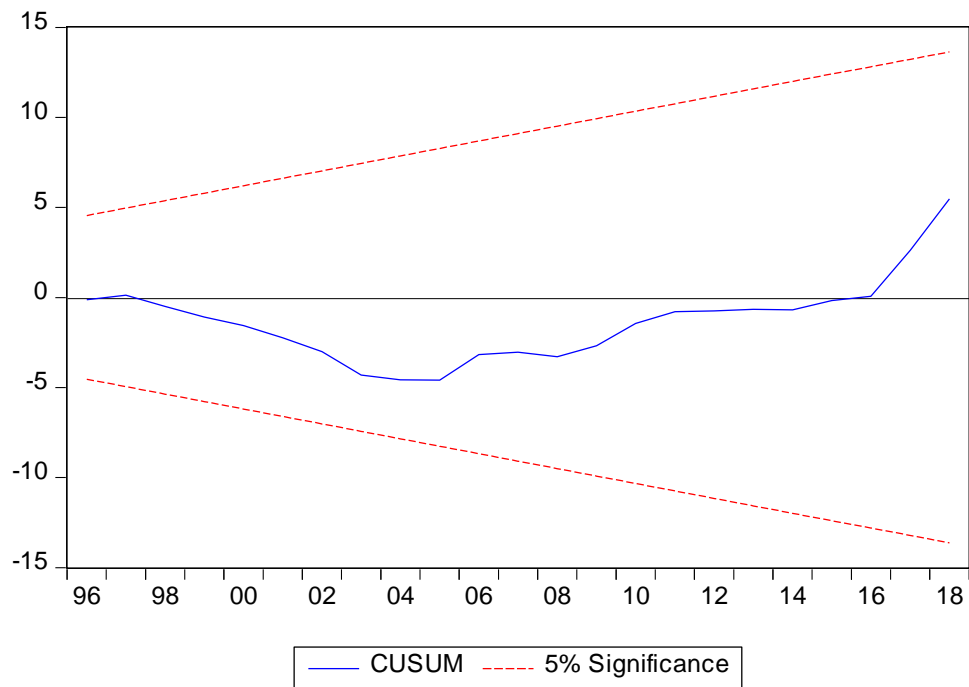
No root lies outside the unit circle.

VAR satisfies the stability condition.

6.2 AR roots graph



6.3 CUSUM chart



7. Johansen co integration test

Date: 06/01/19 Time: 08:19
 Sample (adjusted): 1992 2018
 Included observations: 27 after adjustments
 Trend assumption: Linear deterministic trend
 Series: E LNEXTDEB LNRGDP LNEXTEDU LNM2 LNPI
 Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.896875	186.7167	95.75366	0.0000
At most 1 *	0.833322	125.3777	69.81889	0.0000
At most 2 *	0.720647	77.00197	47.85613	0.0000
At most 3 *	0.617813	42.56942	29.79707	0.0010
At most 4 *	0.458246	16.59963	15.49471	0.0340
At most 5	0.001855	0.050143	3.841466	0.8228

Trace test indicates 5 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.896875	61.33900	40.07757	0.0001
At most 1 *	0.833322	48.37573	33.87687	0.0005
At most 2 *	0.720647	34.43255	27.58434	0.0056
At most 3 *	0.617813	25.96979	21.13162	0.0096
At most 4 *	0.458246	16.54949	14.26460	0.0214
At most 5	0.001855	0.050143	3.841466	0.8228

Max-eigenvalue test indicates 5 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

8. Vector Error Correction

Vector Error Correction Estimates

Date: 06/01/19 Time: 08:23
 Sample (adjusted): 1992 2018
 Included observations: 27 after adjustments
 Standard errors in () & t-statistics in []

Cointegrating Eq:	CointEq1	CointEq2	CointEq3	CointEq4	CointEq5
E(-1)	1.000000	0.000000	0.000000	0.000000	0.000000

LNEXTPEDU(-1)	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
LNRM2(-1)	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000
LNPI(-1)	-8.190025 (1.48140) [-5.52856]	-1.489266 (0.28225) [-5.27638]	-0.754911 (0.12620) [-5.98197]	-1.314531 (0.09725) [-13.5169]	-3.394481 (0.56611) [-5.99613]	
C	69.13228	3.560548	-5.220498	5.979809	20.66178	
Error Correction:	D(E)	D(LNEXTPEDU)	D(LNRM2)	D(LNPI)		
CointEq1	-0.381503 (0.14725) [-2.59085]	0.215723 (0.09274) [2.32606]	-0.007127 (0.04054) [-0.17580]	0.594871 (0.31800) [1.87067]	-0.004791 (0.17984) [-0.02664]	0.007685 (0.25715) [0.02988]
CointEq2	-0.338748 (0.42967) [-0.78839]	-1.012783 (0.27062) [-3.74250]	0.232833 (0.11830) [1.96817]	1.393186 (0.92790) [1.50143]	-0.181395 (0.52478) [-0.34566]	1.446083 (0.75036) [1.92719]
CointEq3	4.490132 (1.66394) [2.69850]	-0.421256 (1.04800) [-0.40196]	-1.584169 (0.45813) [-3.45793]	-6.853328 (3.59341) [-1.90719]	-2.186381 (2.03226) [-1.07583]	0.974781 (2.90584) [0.33546]
CointEq4	0.158697 (0.35479) [0.44730]	0.000335 (0.22345) [0.00150]	-0.166905 (0.09768) [-1.70866]	-2.872695 (0.76619) [-3.74933]	0.203721 (0.43332) [0.47014]	-1.106939 (0.61959) [-1.78658]
CointEq5	0.142916 (0.16989) [0.84123]	0.058262 (0.10700) [0.54450]	0.271712 (0.04677) [5.80893]	-0.398421 (0.36689) [-1.08594]	0.526201 (0.20750) [2.53597]	-0.784575 (0.29669) [-2.64445]
D(E(-1))	0.130938 (0.10896) [1.20171]	-0.062619 (0.06863) [-0.91246]	-0.001967 (0.03000) [-0.06557]	0.398562 (0.23531) [1.69379]	-0.075110 (0.13308) [-0.56440]	0.504471 (0.19028) [2.65116]
D(LNEXTPEDU(-1))	1.047847 (0.40701) [2.57451]	0.171351 (0.25634) [0.66844]	0.183460 (0.11206) [-1.63716]	-1.540767 (0.87897) [-1.75293]	-0.184649 (0.49710) [-0.37145]	-1.826076 (0.71078) [-2.56910]
D(LNRM2(-1))	-2.214036 (2.09392) [-1.05737]	-1.050764 (1.31881) [-0.79675]	0.513201 (0.57651) [0.89018]	4.103563 (4.52199) [0.90747]	0.619132 (2.55742) [0.24209]	0.272067 (3.65674) [0.07440]
D(LNPI(-1))	0.508920 (0.21496) [2.36746]	0.280653 (0.13539) [2.07291]	0.054006 (0.05919) [0.91248]	1.506916 (0.46423) [3.24602]	-0.136480 (0.26255) [-0.51983]	0.867934 (0.37541) [2.31198]
D(LNM2(-1))	-0.064923 (0.42049) [-0.15440]	0.389085 (0.26484) [1.46915]	-0.170158 (0.11577) [-1.46976]	1.331532 (0.90809) [1.46630]	-0.342172 (0.51357) [-0.66626]	1.331488 (0.73433) [1.81319]

D(LNPI(-1))	-0.393833 (0.24382) [-1.61523]	-0.226845 (0.15357) [-1.47717]	-0.007386 (0.06713) [-0.11002]	-1.958675 (0.52656) [-3.71977]	0.303040 (0.29780) [1.01761]	-1.243376 (0.42580) [-2.92006]
C	0.846576 (0.18257) [4.63696]	0.142109 (0.11499) [1.23585]	0.135477 (0.05027) [2.69515]	-0.802747 (0.39428) [-2.03599]	0.501573 (0.22299) [2.24936]	-0.557020 (0.31884) [-1.74704]
R-squared	0.927370	0.726288	0.768829	0.623538	0.495345	0.679903
Adj. R-squared	0.874107	0.525566	0.599303	0.347467	0.125264	0.445165

9. Alpha and Beta co- integration (Johansen test)

Unrestricted Cointegrating Coefficients (normalized by $b^*S11*b=l$):

E	LNEXTDEB	LNRGDP	LNEXPEDU	LMN2	LNPI
1.461869	0.097759	-22.92362	-2.957977	1.522570	3.906982
0.716077	-0.805679	-0.361924	0.178538	-1.449861	0.295230
1.247780	-2.884102	-1.986049	-1.889196	-1.152404	1.970354
0.441738	-3.052502	-0.900831	0.541942	0.196130	0.230032
0.168515	-4.407624	5.944578	3.615927	0.332421	-5.185295
-1.984117	-0.526591	8.789376	4.279889	2.136380	-5.820296

Unrestricted Adjustment Coefficients (alpha):

D(E)	-0.215070	-0.464125	0.183638	0.092040	-0.026981	-0.003290
D(LNEXTDEB)	0.032288	-0.103640	0.162344	0.049330	0.109048	0.001411
D(LNRGDP)	0.072653	-0.076740	-0.045358	-0.001607	-0.006393	0.002333
D(LNEXPEDU)	0.181986	-0.021617	0.450075	-0.356076	-0.356001	0.007668
D(LNM2)	0.116482	-0.081638	-0.158096	0.164098	0.048464	0.011991
D(LNPI)	-0.109193	0.151417	0.213664	-0.380889	-0.234211	0.009202

10. Variance decomposition of VAR

Period	S.E.	E	LNEXTDEB	LNRGDP	LNEXPEDU	LMN2	LNPI
1	0.749113	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	1.031021	77.78534	0.679867	18.94724	1.272425	0.138506	1.176626
3	1.188944	65.34685	2.983748	22.03392	4.081239	4.665396	0.888852
4	1.338507	53.66867	3.409375	27.09695	4.657720	10.35960	0.807678
5	1.483009	43.89362	3.443312	30.07114	3.925367	18.00399	0.662570
6	1.655101	35.40613	3.099403	32.48431	3.598803	24.86796	0.543400
7	1.878120	28.69966	2.641699	33.25637	5.322215	29.50379	0.576271
8	2.167599	24.06130	2.172870	32.70979	9.239016	30.97797	0.839048

9	2.522706	21.34664	1.788850	31.30291	14.23697	29.99484	1.329790
10	2.931501	20.00437	1.515688	29.67586	19.15340	27.69410	1.956586
11	3.376242	19.48680	1.344957	28.18446	23.34477	25.00144	2.637569
12	3.838350	19.40227	1.253189	26.97936	26.63727	22.41285	3.315057
13	4.300858	19.51982	1.218243	26.07852	29.09248	20.13101	3.959931
14	4.749611	19.71442	1.222642	25.45066	30.85087	18.20260	4.558809
15	5.173637	19.92267	1.253825	25.04966	32.05828	16.60837	5.107187
16	5.565161	20.11418	1.302847	24.83092	32.84118	15.30650	5.604376
17	5.919388	20.27581	1.363292	24.75549	33.30226	14.25180	6.051344
18	6.234160	20.40336	1.430413	24.79080	33.52302	13.40279	6.449631
19	6.509528	20.49717	1.500599	24.90970	33.56782	12.72369	6.801015
20	6.747278	20.55994	1.571034	25.08961	33.48757	12.18438	7.107464
21	6.950449	20.59550	1.639507	25.31160	33.32246	11.75973	7.371220
22	7.122878	20.60813	1.704313	25.55991	33.10393	11.42881	7.594902
23	7.268795	20.60221	1.764199	25.82163	32.85614	11.17426	7.781557
24	7.392484	20.58186	1.818330	26.08643	32.59699	10.98175	7.934642
25	7.498040	20.55085	1.866260	26.34638	32.33908	10.83950	8.057930
26	7.589202	20.51240	1.907882	26.59575	32.09072	10.73791	8.155352
27	7.669265	20.46919	1.943363	26.83067	31.85681	10.66916	8.230807
28	7.741060	20.42335	1.973076	27.04879	31.63991	10.62689	8.287994

Variance
Decompositi
on of
LNEXTDEB:

Period	S.E.	E	LNEXTDEB	LNRGDP	LNEXPEDU	LMN2	LNPI
1	0.283630	25.32857	74.67143	0.000000	0.000000	0.000000	0.000000
2	0.343518	34.79543	59.53542	0.023944	1.646039	0.387908	3.611252
3	0.377115	37.22971	50.87522	0.215530	2.885180	2.890670	5.903689
4	0.397315	36.66038	45.92999	0.195458	2.747093	6.743638	7.723450
5	0.413917	34.18011	42.32001	0.334915	2.981601	11.97617	8.207192
6	0.437626	30.70532	37.86340	1.108158	5.709279	16.99484	7.619000
7	0.476126	27.26148	31.98775	2.582393	11.48221	20.24947	6.436695
8	0.531412	24.66962	25.68534	4.495018	18.74120	21.05457	5.354251
9	0.600166	23.13176	20.17197	6.391781	25.47274	20.08693	4.744811
10	0.676667	22.38726	15.94103	8.049875	30.69294	18.32599	4.602912
11	0.755135	22.11131	12.90983	9.424184	34.33430	16.43931	4.781062
12	0.830877	22.07059	10.80310	10.56034	36.69850	14.73134	5.136140
13	0.900544	22.13078	9.356565	11.51578	38.12767	13.29800	5.571196
14	0.962058	22.22131	8.369643	12.33856	38.90125	12.14204	6.027195
15	1.014417	22.30756	7.701747	13.06201	39.22586	11.23300	6.469832
16	1.057485	22.37396	7.256270	13.70743	39.25083	10.53233	6.879173
17	1.091767	22.41503	6.966354	14.28727	39.08484	10.00272	7.243783
18	1.118212	22.43074	6.784793	14.80807	38.80810	9.610724	7.557569
19	1.138016	22.42407	6.677507	15.27289	38.47998	9.327255	7.818297
20	1.152463	22.39956	6.619502	15.68328	38.14336	9.127438	8.026862
21	1.162790	22.36233	6.592438	16.04079	37.82712	8.990497	8.186822
22	1.170097	22.31737	6.583127	16.34804	37.54787	8.899742	8.303848
23	1.175292	22.26892	6.582498	16.60922	37.31182	8.842537	8.385002
24	1.179078	22.22010	6.584747	16.83005	37.11719	8.810060	8.437863
25	1.181969	22.17281	6.586521	17.01729	36.95696	8.796760	8.469663
26	1.184328	22.12780	6.586134	17.17809	36.82185	8.799545	8.486591
27	1.186409	22.08498	6.582855	17.31917	36.70279	8.816806	8.493408
28	1.188403	22.04378	6.576346	17.44629	36.59274	8.847460	8.493382

Variance
Decompositi

on of LNREGDP:							
Period	S.E.	E	LNEXTEDEB	LNREGDP	LNEXPEDU	LNME2	LNPI
1	0.125760	0.241102	0.250079	99.50882	0.000000	0.000000	0.000000
2	0.149751	1.552309	5.127595	78.49110	1.360556	7.235793	6.232646
3	0.170860	1.499830	4.686066	78.17582	1.251959	9.093980	5.292341
4	0.187873	1.886844	4.799818	73.65139	1.055002	13.29387	5.313075
5	0.206101	2.412529	4.412100	70.62903	1.118604	16.55284	4.874891
6	0.226270	3.403647	4.025264	66.31261	2.008152	19.62680	4.623524
7	0.250070	4.758619	3.566167	61.60776	4.071515	21.59541	4.400531
8	0.277953	6.415126	3.132784	56.49486	7.119797	22.51683	4.320600
9	0.309947	8.172290	2.746912	51.55482	10.72701	22.44334	4.355633
10	0.345414	9.879054	2.434689	47.08728	14.39835	21.69406	4.506567
11	0.383401	11.42601	2.196891	43.29263	17.78423	20.55967	4.740565
12	0.422785	12.76861	2.027197	40.19509	20.69902	19.27837	5.031711
13	0.462453	13.90005	1.913871	37.74253	23.08941	17.99985	5.354285
14	0.501401	14.83606	1.845297	35.84278	24.97783	16.80833	5.689700
15	0.538792	15.60050	1.811018	34.39971	26.42251	15.74223	6.024032
16	0.573985	16.21877	1.802453	33.32516	27.49253	14.81337	6.347722
17	0.606538	16.71436	1.812694	32.54425	28.25562	14.01893	6.654153
18	0.636194	17.10787	1.836266	31.99512	28.77288	13.34894	6.938918
19	0.662866	17.41691	1.868813	31.62739	29.09720	12.79048	7.199195
20	0.686599	17.65639	1.906872	31.40011	29.27332	12.32991	7.433388
21	0.707549	17.83895	1.947689	31.27995	29.33850	11.95402	7.640892
22	0.725947	17.97531	1.989096	31.23979	29.32330	11.65057	7.821930
23	0.742070	18.07463	2.029431	31.25757	29.25238	11.40856	7.977430
24	0.756216	18.14465	2.067465	31.31550	29.14525	11.21823	8.108899
25	0.768688	18.19193	2.102353	31.39938	29.01693	11.07111	8.218289
26	0.779775	18.22196	2.133579	31.49806	28.87868	10.95987	8.307847
27	0.789742	18.23924	2.160897	31.60298	28.73868	10.87823	8.379971
28	0.798827	18.24749	2.184278	31.70768	28.60270	10.82078	8.437077

Variance Decompositi on of LNEXPEDU:							
Period	S.E.	E	LNEXTEDEB	LNREGDP	LNEXPEDU	LNME2	LNPI
1	0.939347	0.239377	1.707685	0.857939	97.19500	0.000000	0.000000
2	1.229935	0.985590	2.290773	0.872293	94.99315	0.207914	0.650279
3	1.421157	2.412592	2.280268	1.484001	92.39316	0.259214	1.170765
4	1.559711	4.024839	2.260652	1.920334	89.67661	0.277119	1.840447
5	1.662379	5.424481	2.222262	2.363893	87.28288	0.253541	2.452941
6	1.736240	6.525548	2.213038	2.704750	85.29293	0.233623	3.030106
7	1.786371	7.296543	2.226435	2.966301	83.73895	0.248758	3.523016
8	1.817473	7.773420	2.259219	3.137383	82.58713	0.319812	3.923040
9	1.834547	8.012303	2.300599	3.231227	81.78126	0.457619	4.216992
10	1.842705	8.085688	2.340455	3.263732	81.24512	0.659610	4.405394
11	1.846769	8.071023	2.369181	3.259659	80.89030	0.912173	4.497658
12	1.850775	8.041864	2.380310	3.247285	80.62430	1.191842	4.514400
13	1.857577	8.056759	2.371555	3.253915	80.36318	1.470645	4.483948
14	1.868654	8.150435	2.345152	3.300202	80.04494	1.722226	4.437046
15	1.884173	8.330899	2.306766	3.396245	79.63801	1.927722	4.400354
16	1.903273	8.583725	2.263578	3.541050	79.14134	2.078659	4.391648
17	1.924479	8.881174	2.222332	3.724956	78.57686	2.176438	4.418237
18	1.946117	9.191969	2.188010	3.933611	77.97864	2.229384	4.478385
19	1.966661	9.488631	2.163357	4.151710	77.38285	2.249085	4.564370

20	1.984946	9.751301	2.149047	4.365619	76.82097	2.247336	4.665723
21	2.000270	9.968647	2.144188	4.564719	76.31643	2.234210	4.771805
22	2.012379	10.13697	2.146917	4.741800	75.88365	2.217184	4.873478
23	2.021401	10.25848	2.154928	4.892883	75.52869	2.201036	4.963982
24	2.027725	10.33937	2.165901	5.016768	75.25056	2.188187	5.039217
25	2.031887	10.38794	2.177797	5.114456	75.04292	2.179281	5.097608
26	2.034458	10.41307	2.189053	5.188540	74.89581	2.173827	5.139696
27	2.035959	10.42295	2.198652	5.242593	74.79745	2.170805	5.167553
28	2.036812	10.42427	2.206117	5.280599	74.73574	2.169159	5.184122

Variance
Decompositi
on of LNM2:

Period	S.E.	E	LNEXTEB	LNRGDP	LNEXPEDU	LMN2	LNPI
1	0.420480	5.950526	3.902848	53.39084	9.264127	27.49166	0.000000
2	0.555803	7.526440	3.351628	41.51009	5.628985	41.31080	0.672054
3	0.686436	8.556812	2.269621	40.11123	5.574160	42.87107	0.617098
4	0.835427	10.43608	1.650551	36.24650	9.395569	41.19382	1.077483
5	1.010094	12.24159	1.244296	33.23416	15.00156	36.65888	1.619509
6	1.203714	13.91558	1.039112	30.50256	20.32535	31.88893	2.328475
7	1.408652	15.28789	0.947263	28.48814	24.66848	27.57324	3.034993
8	1.616545	16.39543	0.931343	27.01318	27.92389	24.01118	3.724977
9	1.820495	17.26805	0.958518	26.00348	30.25591	21.14885	4.365183
10	2.014937	17.95313	1.012558	25.33975	31.86108	18.87969	4.953798
11	2.195837	18.48661	1.082252	24.94190	32.91595	17.08522	5.488060
12	2.360535	18.89882	1.161079	24.74313	33.55987	15.66713	5.969958
13	2.507628	19.21298	1.244441	24.69460	33.90040	14.54650	6.401079
14	2.636776	19.44762	1.329126	24.75788	34.01983	13.66209	6.783460
15	2.748501	19.61759	1.412650	24.90302	33.98163	12.96612	7.118990
16	2.843979	19.73516	1.493068	25.10585	33.83508	12.42110	7.409742
17	2.924825	19.81064	1.568839	25.34674	33.61846	11.99726	7.658055
18	2.992904	19.85283	1.638795	25.60973	33.36119	11.67077	7.866694
19	3.050164	19.86926	1.702129	25.88201	33.08530	11.42241	8.038891
20	3.098510	19.86635	1.758392	26.15363	32.80663	11.23669	8.178300
21	3.139708	19.84943	1.807468	26.41722	32.53583	11.10118	8.288872
22	3.175334	19.82285	1.849533	26.66763	32.27940	11.00592	8.374663
23	3.206751	19.79007	1.884991	26.90161	32.04078	10.94293	8.439631
24	3.235113	19.75374	1.914404	27.11732	31.82138	10.90570	8.487461
25	3.261378	19.71590	1.938416	27.31396	31.62144	10.88885	8.521438
26	3.286337	19.67809	1.957698	27.49135	31.44077	10.88769	8.544401
27	3.310632	19.64152	1.972903	27.64970	31.27912	10.89800	8.558755
28	3.334773	19.60714	1.984644	27.78944	31.13636	10.91588	8.566531

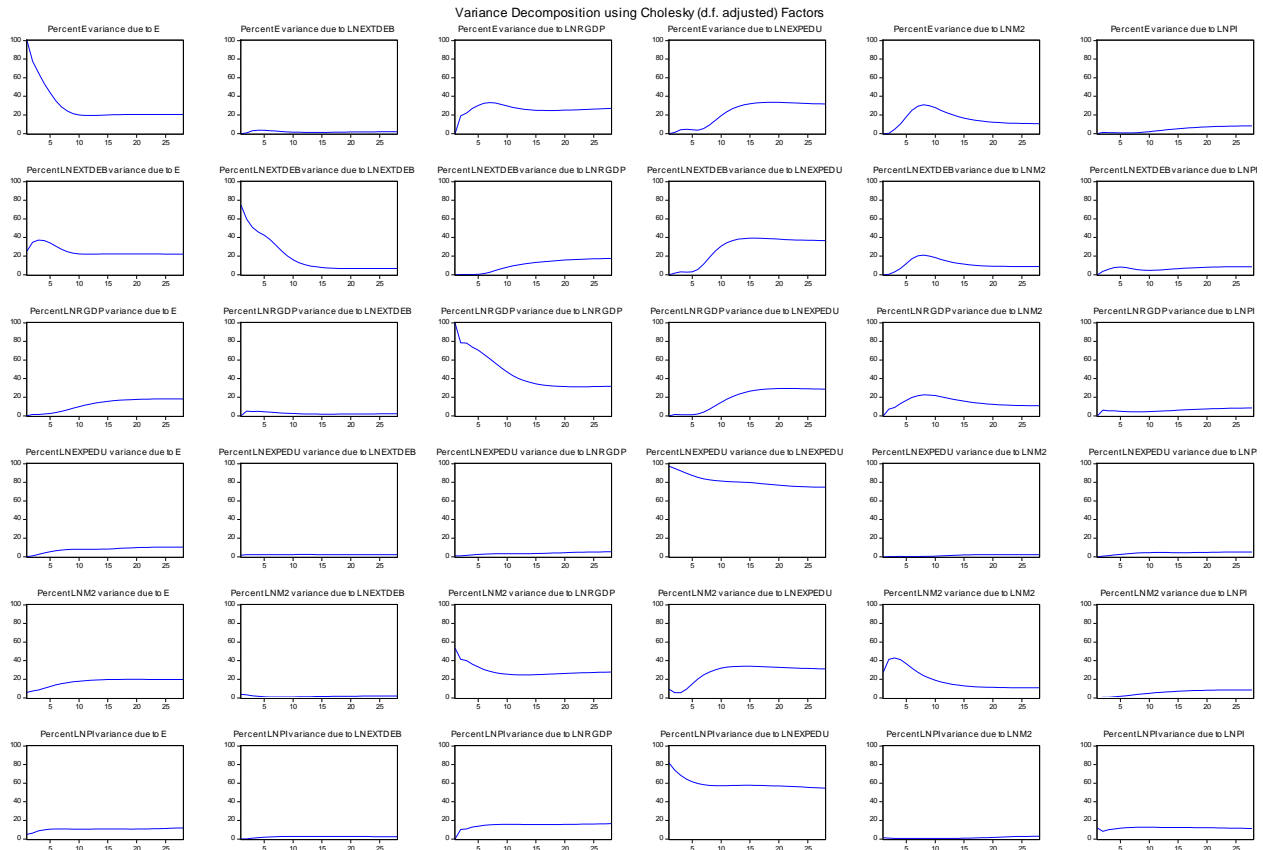
Variance
Decompositi
on of LNPI:

Period	S.E.	E	LNEXTEB	LNRGDP	LNEXPEDU	LMN2	LNPI
1	0.763052	5.013806	0.095216	0.031987	81.63659	1.416345	11.80605
2	1.074709	6.352584	0.064106	10.43336	74.09989	0.841168	8.208895
3	1.247886	8.774068	1.009024	10.92595	68.50121	0.631858	10.15789
4	1.357337	9.871958	1.473961	12.85367	64.43598	0.569165	10.79526
5	1.419922	10.54496	1.950556	13.77472	61.55471	0.549250	11.62580
6	1.454357	10.79569	2.263850	14.63898	59.58756	0.583466	12.13045
7	1.471810	10.84032	2.504522	15.19992	58.33911	0.629136	12.48699
8	1.480741	10.77945	2.662694	15.57918	57.63889	0.677597	12.66219
9	1.486263	10.70071	2.759966	15.77498	57.34399	0.710998	12.70936

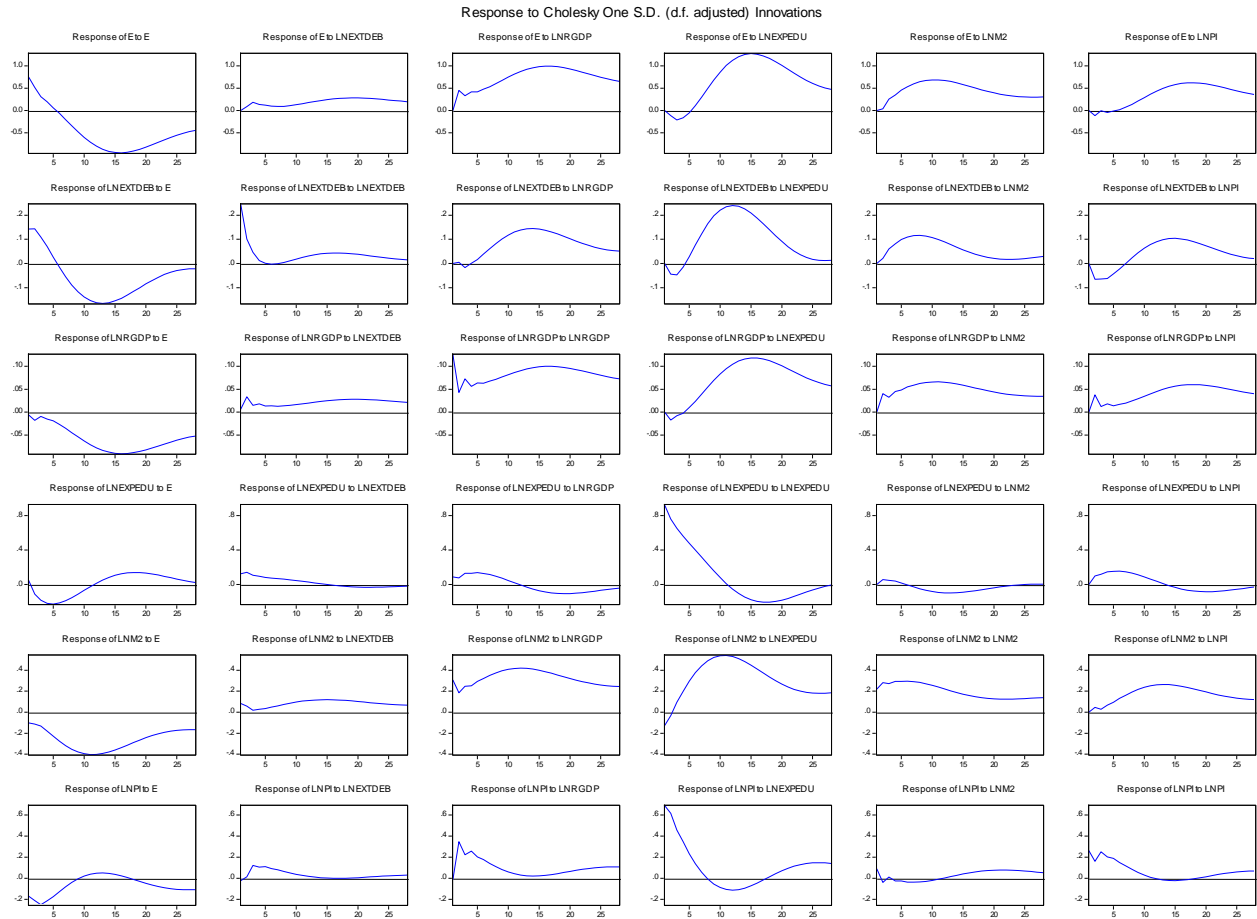
10	1.491162	10.65033	2.807349	15.83826	57.31059	0.725608	12.66786
11	1.496397	10.64304	2.821018	15.81180	57.41531	0.724739	12.58409
12	1.501848	10.67030	2.815089	15.74086	57.55991	0.719805	12.49404
13	1.506937	10.71215	2.801258	15.66059	57.67999	0.725907	12.42010
14	1.511117	10.74832	2.787066	15.59471	57.74148	0.758125	12.37030
15	1.514169	10.76512	2.775994	15.55535	57.73388	0.828488	12.34116
16	1.516306	10.75877	2.768177	15.54562	57.66136	0.943876	12.32219
17	1.518120	10.73521	2.761567	15.56270	57.53518	1.105009	12.30034
18	1.520440	10.70775	2.753180	15.60082	57.36804	1.306280	12.26393
19	1.524139	10.69334	2.740229	15.65366	57.17076	1.536593	12.20542
20	1.529949	10.70822	2.720979	15.71609	56.95068	1.781160	12.12287
21	1.538320	10.76412	2.695197	15.78497	56.71171	2.024019	12.01998
22	1.549350	10.86581	2.664139	15.85935	56.45537	2.250707	11.90462
23	1.562794	11.01067	2.630143	15.93988	56.18221	2.450389	11.78671
24	1.578128	11.19001	2.596018	16.02800	55.89315	2.616931	11.67590
25	1.594656	11.39151	2.564434	16.12511	55.59037	2.748829	11.57975
26	1.611623	11.60185	2.537475	16.23191	55.27759	2.848280	11.50290
27	1.628316	11.80885	2.516424	16.34812	54.95981	2.919860	11.44694
28	1.644142	12.00280	2.501748	16.47246	54.64285	2.969222	11.41092

Cholesky Ordering: E LNEXTDEB LNRGDP LNP EXPEDU LNM2 LNPI

10.1 Graph of Variance Decomposition



11. Impulse response



12. Structural break

Chow Breakpoint Test: 1997

Null Hypothesis: No breaks at specified breakpoints

Varying regressors: All equation variables

Equation Sample: 1991 2018

F-statistic	0.665334	Prob. F(6,16)	0.6788
Log likelihood ratio	6.236822	Prob. Chi-Square(6)	0.3972
Wald Statistic	3.992003	Prob. Chi-Square(6)	0.6778

Chow Breakpoint Test: 2000

Null Hypothesis: No breaks at specified breakpoints

Varying regressors: All equation variables

Equation Sample: 1991 2018

F-statistic	1.288413	Prob. F(6,16)	0.3172
Log likelihood ratio	11.03680	Prob. Chi-Square(6)	0.0872
Wald Statistic	7.730477	Prob. Chi-Square(6)	0.2585

Chow Breakpoint Test: 2002

Null Hypothesis: No breaks at specified breakpoints

Varying regressors: All equation variables

Equation Sample: 1991 2018

F-statistic	1.529793	Prob. F(6,16)	0.2313
Log likelihood ratio	12.69553	Prob. Chi-Square(6)	0.0481
Wald Statistic	9.178756	Prob. Chi-Square(6)	0.1638

Chow Breakpoint Test: 2005

Null Hypothesis: No breaks at specified breakpoints

Varying regressors: All equation variables

Equation Sample: 1991 2018

F-statistic	1.740261	Prob. F(6,16)	0.1757
Log likelihood ratio	14.06576	Prob. Chi-Square(6)	0.0289
Wald Statistic	10.44156	Prob. Chi-Square(6)	0.1072
