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Dynamic Interaction Between Saving, Investment and Economic Growth in Ethiopia

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Abstract
The study investigates the dynamic interaction among domestic savings, investment and economic growth in Ethiopia with in the period 1992/93 to 2019/20 by utilizing quarterly time series data obtained from National Bank of Ethiopia (NBE). The Vector Error Correction Model (CVECM) results indicated that there was a positive long run relationship among savings, investment and economic growth in Ethiopia. Granger causality from domestic investment and real GDP to domestic savings and domestic investment granger causes economic growth. The response of domestic investment to a positive shock of real GDP is positive. Investment and money supply responds positively to shocks of domestic saving. Exchange rate responds negatively to shock of investment. In the short run the reaction of saving to shocks of real GDP and investment was positive and negative respectively. While in the long run the effect becomes vice versa. Shocks of saving generate negative effect in the short run and insignificant effect on economic growth in the long run. Real GDP responds negatively to shocks of interest rate and exchange rate. Besides, the variance decomposition results show that the variation of economic growth is largely explained by shocks to itself and investment. The variation in saving emanates from money supply, domestic savings, real GDP and investment. Investment deviation is also emanated from Real GDP and saving. Thus, government and stakeholders are supposed to practice macroeconomic policies that will promote economic growth and gross domestic investment and thus saving will increase
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1. Introduction

Economic growth is the ability of an economy to increase its productive capacity through which it becomes more capable of producing additional units of goods and services and has been considered as one of the most important development indicators for analyzing the level of community welfare and economic status (Ilugbemi et al 2019). Economic growth and development to an excellent extent are determined by the speed of growth in domestic savings, investments and output of products and services which incorporates real GDP per capital, human development amongst others (Olanrewaju et al., 2015).

The relationship between savings, investments and economic growth is noticeable since investment is a catalyst for industrialization and economic growth. Understanding this linkage; investment is made possible by another catalyst in savings Ilugbemi et al., 2019. In addition (Groce et al, 2016) state that, domestic savings reinforces to higher investment and accordingly higher growth rate. A study conducted by (Omoregie & Ikpesu, 2017) noted that while the positive link which exists between savings, investment and growth is well recognized in empirical literature, the growth rate observed in most less developed countries (Africa) relative to other continent of the world is a concern for developmental economist. This concern arose because of the disparity between the growth rate recorded and the level of investment, which could be due to corruption (i.e. over invoicing, inflated public sector contract etc. that has led to the actual level of investment being lower than the reported).

Since savings and investment has been regarded as the two vital macro-economic variables with micro economic foundations for achieving price stability and promoting employment opportunities thereby contributing to sustainable economic growth (Shimelis, 2014), the need to have an in-depth knowledge of the dynamic interaction between savings, investment and economic growth is crucial as it will aid policy makers in designing and employing appropriate macroeconomic policies. This entails identifying which of the economic variables required attention in order to attain macroeconomic goals and objectives as well as the various implications of those policies (Omoregie & Ikpesu, 2017).

Even with difference of opinion in theories, a number of empirical researches are conducted on the relationship between savings, investment and economic growth nexus in different countries in different time

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periods, while these researchers are not extensive, and the findings or conclusions of some of them are not consistent with one another. More over most empirical works on the relationship between savings, investment and economic growth are based on panel or cross –country regressions and may be criticized in view of the fact that they impose cross- sectional homogeneity on coefficients that in reality may vary across countries because of differences in institutional setups, domestic policy measures, and political, social and economic structures. The result obtained from panel or cross –section regressions represents only an average relationship, which may or may not be appropriate to individual countries in the sample (Shimelis, 2014). Therefore, country specific studies are needed to fill the gap by throwing more insight on the effect of savings and investment on economic growth in Ethiopia.

In line with this, most researchers conducted in Ethiopia observed the relationship between savings, investment and economic growth by commonly testing for bi-variate Co integration and Granger causality separately between savings and economic growth, or between investment and economic growth (Mohanty A. K., 2018), (Getenet, 2017), (Zelalem, 2018) and (Mohanty A. K., 2017). While few studies only investigate the association between savings, investment and economic growth (Shimelis, 2014)and (Gebeyehu, 2010) but none has examined the dynamic interaction between these variables by totally accounting for the feedback effect among the variables, hence, the uniqueness of this study, and will employed the Dynamic Vector Auto Regression (VAR) approach , which is best fit for this study because of the behaviour of variables used in the study. The other limitation of the existing empirical studies in Ethiopia they did not show the degree of responsiveness of Economy growth and investment to changes in saving of an economy and the transmission mechanisms to other macro-economic variables. Even if there are different factors affecting savings, investment and economic growth , this study aimed to including monetary policy shocks like interest rate, exchange rate, money supply and inflation rate into the model between saving, investment and growth in order to examined the dynamic interaction between this variables. The omission of relevant variables leads to econometric problems. In addition monetary variables influence the behaviours of real economy in various ways, including saving and investment activities.

To this end, this research seeks to make contributions to this debate by using Ethiopia as a case study. The above empirical review from Ethiopia suggests that the dynamic interaction between savings, investment and economic growth has not been well exploited; as such our understanding of the relationship between these variables is limited. Generally, there are four contribution of the present study to the relevant literature considering Ethiopia as a case study in the Sub –Saharan region of Africa and among the least developed countries of the world. One, Policy makers face a dilemma in achieving simultaneously both saving, investment and economic growth and to solve this controversy this research introduces new evidence about the relationship, and it will show how monetary policy shock is transmitted to macroeconomic variables by employing dynamic VAR framework, Vector error correction model (VECM) and structural VAR, thereby filling methodological Gap .To the best of the knowledge of the researchers, no study has employed this technique among the studies conducted in Ethiopia on the subject matter and this makes the study different from the previous papers in Ethiopia and Sub –Saharan countries. Two the study will also reinvestigate the long run relationship between savings, investment and economic growth by including additional variables in the model. Three , this study measure degree of responsiveness change in various macro- economic variables due to change in other macro-economic variables of an economy.

Thus , the main objective of this study is to analyze the dynamic interaction between savings, investment and economic growth in a case of Ethiopia.

The remaider of the paper preceeds as follows: section two highlights literetaure review, in section three, research design, data and sources and methology are discussed, section four presents results and discussion of the paper and the last section five provides the conculusion and recommendations of the study.

2. Literature Review

2.1. Concepts, definitions and Monetary Policy Transmission Mechanism

2.1.1. Concepts and Definition of Saving, Investment and Economic Growth

(Todaro P. , 2003) defines economic growth as a long-term rise in capacity to supply increasing diverse economic goods to its population, this growing capacity based on advancing technology and the institutional and ideological adjustments that it demands. According to him, there are three principal components that are inherent in the definition: The sustained rise in the national output is a manifestation of economic growth, and the ability to provide a wide range of goods is a sign of economic maturity; advancing technology provides the basis or preconditions for continuous economic growth; and the realization of the potential for growth inherent in new technology, institutional and attitudinal adjustment that must be made technological innovation without concomitant social innovation is like a bulb.

Saving is a maintaining part of current income for use in the future. (Mohan, 2006) defined savings as a fraction of disposable income that has not been used on consumption of final goods and services but invested or accumulated directly in capital equipment or in paying off a home mortgage, or indirectly through purchase of securities on financial markets. Growth of an economy requires injection of investments and this is achievable through domestic and/or foreign savings.

2.1.2. Monetary Policy Transmission Mechanism

Monetary policy plays an important role in achieving the ultimate economic objectives of sustainable growth, full employment, price stability and a healthy balance of payments. In the pursuit of these goals, the central bank sets intermediate objectives for monetary policy. The intermediate goals are regarded as channels through which monetary policy is transmitted to the macro economy with the aim of influencing the ultimate objectives (Yabatfenta, 2019).

Among macroeconomic variables, the exchange rate is one of the intermediate objectives through which monetary policy is transmitted to achieve the ultimate goals of monetary management. Because, the exchange rate channel is one of the primary transmission channels of monetary policy in open economies, especially those with flexible exchange rate regimes. A monetary expansion would tend to reduce the real interest rate and lead to a depreciation of the currency, which would increase exports, reduce imports and finally leads to increase economy i.e. currency depreciation affects the growth of exports and gross domestic product. Therefore, in countries that are open and have flexible exchange rates, the exchange rate channel can be a powerful transmission mechanism for monetary policy. Different countries' central bank reported that the exchange rate channel is among the more important transmission mechanisms for monetary policy (Mohanty M. S., 2014)

Interest rate means any bank lending rate or any rate at which a lender charge and it has an important role in our everyday lives and can greatly affect our buying power (Kanwal et.al, 2014). When there is lower interest rate this leads to the quantity of money in circulation increases. Trends of east African real interest rate are fluctuated and this fluctuation is due to the variation of inflation from year to year because real interest rate is the difference between nominal interest rate and inflation, which is nominal interest rate, is almost stable and then its impact for variation of real interest rate is not that much significant. Variation of inflation is due to the change in money supply because the main cause of inflation is money supply in the economies (Aslam & Awan, 2018).

Money supply is defined as total stock of money available in the economy in a given period of time that includes currency in circulation, demand deposits, small time denominations and longtime denominations etc. But broad money supply includes money that can be used for spending (M1) and items that can be quickly converted to M1.

2.2. Review Of Empirical Literatures

(Taghavi & Pahlavani, 2018) analyzed the relationship between saving and investment with economic growth in terms of structural breaks using Iran`s economic annual time-series data from 1960 to 2016. In doing so, Zivot & Andrews unit root test (1992) and Lumsdine & Papel unit root test (1997) have used to determine structural changes and for estimating the model the ARDL method is used. The results of the research showed the existence of a long-run equilibrium between savings, investment and economic growth in Iran in terms of structural failure. According to the ARDL method, gross national income and gross fixed capital formation have a meaningful and positive relationship with economic growth. Thus, a one percent increase in savings and investment will increase economic growth by 0.16 and 0.15 percent respectively.

Joshi et al., 2019 examined the relationship amongst saving, growth and investment in the context of Nepal using an annual dataset for 1975–2016. The data were first analyzed for possible structural breaks using the Zivot and Andrews (1992) model. Cointegration has been identified using the Johansen, Gregory–Hansen, and ARDL approaches. The empirical evidence indicates a stable long-run relationship between savings, investment, and economic growth in the presence of structural breaks but only when economic growth is the dependent variable. This indicates that the long-run relationship is running from savings and investment to economic growth in Nepal.

Study conducted by (Ngouhouo & Mouchili, 2014) examined the nature of the relationship between savings, investment and economic growth in Cameroon from 1980 to 2010 and tested in a Vector Auto Regressive Model & Toda-Yamamoto (1995) Granger non causality test. The result of the study shows that, there is a unidirectional causal relationship from investment to savings, from growth to savings, and finally from growth to investment. Meanwhile, there is no causal link from savings to investment, savings towards growth and investment to growth in Cameroon.

Another study conducted by (Hishongwa, 2015) analysed the dynamic relationship between domestic savings, investment and economic growth in Namibia, by employed vector auto-regression. The result of the study found that; shocks to savings affect savings, investment and economic growth positively and significantly. In addition, shocks to investment significantly affected investment and savings in the short run, but they are insignificant in explaining economic growth. Further, shocks to economic growth significantly influenced savings, investment and economic growth. Second, the variance decomposition results show that the variation in savings is largely explained by shocks to savings, investment and economic growth, in that respective order of size. Furthermore, the variation in investment is explained significantly by shocks to all three the variables although it can be noted that savings and economic growth are more important in explaining investment in the long run than investment. The variations in economic growth are not explained by investment shocks in both the short and long runs. In brief, savings shocks are more important in explaining variations in economic growth than economic growth in the long run.

The other research done by (Sekantsi & Kalebe, 2015)examined the relationship among saving, investment and economic growth in Lesotho for the period 1970 to 2012. The authors employed autoregressive distributed lag (ARDL) bounds testing approach to co integration and vector error correction model (VECM) based Granger causality test; the result of the study showed that the existence of co integration among the variables and short-run causal flow from economic growth to saving. However, in the long-run, they provided evidence of Granger causality from saving to economic growth. Furthermore, the results indicate the existence of short-term and long-term Granger causality from saving to investment in addition to short-term and long-term causal flow from investment to economic growth. The findings not only suggest that saving precedes and drives short-term and long-term capital accumulation but also contributes to long-term economic growth in Lesotho. In addition, there is empirical evidence for investment-led growth. Therefore, increased capital accumulation is likely to contribute to enhancing sustainable economic growth.

(Mndeme, 2015) examined interdependence between domestic investment, savings and economic growth in Tanzania using co-integration and VECM by using time series data of 42 years from 1972 to 2012. The result of the study indicates no evidence of the existence of short run or long run correlation between savings and investment. The weak short run positive correlation is observed between savings and per capita GDP. Moreover, there is long run positive correlation between investment and per capita GDP. Interestingly short term external debt found to have a long run significant positive correlation to both investment and savings but on the other hand significant negative correlation between EDS and per capita GDP in short run. Long term external debt found negatively correlated with investment over the long run. Granger causality result provides strong evidence of joint influence of variables than individual causality. The shock imposed on investment found to have positive long lasting effect on itself, savings and per capita GDP unlike savings shocks which dies away after short period on investment and long lasting negative impact on per capita GDP. Moreover, shock on per GDP is having long lasting effect on itself, investment and savings. We therefore suggest proactive policy which would encourage investment and promote growth. As a result, over the long run domestic saving will automatically increase and lead to sustainable economic growth.

(Namoloh, 2017) examined the interaction between saving, investment and economic growth in Namibia. The Johansen cointegration test revealed a long-run relationship between the study variables with one cointegrating equation. The long run analysis was followed by Granger causality tests to understand short-run causal relationships between the variables. Impulse response functions and variance decompositions were also estimated to examine the interaction between the variables. The results from the Vector Error Correction Model showed that there was a positive long-run relationship between economic growth and investment, & savings and investment in Namibia. The Granger causality test revealed a causal relationship between saving and investment, consistent with the long-run analysis.

According to the study conducted by (Omoregie & Ikpesu, 2017)investigated the dynamic interaction between savings, investment and economic growth in Nigeria within the period 1981 to 2014 by employed the impulse response function (IRF) and the variance decomposition of VAR as well as the granger causality test. The result of the study shows positive influences between the variables. The causality test however revealed that a uni-directional relationship running from GDP to GDS only exist, which suggest that GDP granger cause GDS. Generally, the outcomes of the study signal that GDP significantly influence the GDS in the Nigerian economy. Further result of the study revealed that GDS do not result to GDI and GDI do not result to GDP.

(Shimelis, 2014) carried out a research on savings, investment and economic growth in Ethiopia evidence from ARDL approach to co- integration and TYDL Granger causality tests. The author tried to examine the causal relationship among saving, investment and economic growth in Ethiopia using annual time series data from 1969/70- 2010/11 in multivariate framework. Result from the ARDL bounds testing indicates that there exists co- integeration among gross domestic saving, gross domestic investment, real gross domestic product, labour force and human capital when RGDP is taken as dependent variable. Labour and investment have significant positive effect on economic growth of Ethiopia both in short run and long run while GDS and human capital are statistically insignificant.

According to (Mohanty A. K., 2018) conducted study to investigate the interaction between Gross domestic saving and economic growth in Ethiopia using annual time series data from the period 1976 to 2017. The study employed autoregressive distributed lag (ARDL) approach to co-integration test and the augmented Granger causality test approach developed by Toda and Yamamoto (1995). The result of the study showed ARDL bounds to the co integration test concludes that Gross Domestic Savings and economic growth are co-integrated, and therefore holds a long run relationship which exists between them. Error correction model also identifies a short run relationship. In addition, the Toda and Yamamoto version of Granger causality test reveals that causality runs from economic growth to gross domestic savings, implying that economic growth proceeds and Granger causes saving. Finally, the study recommends that government and policy makers should focus on more income policies that would accelerate economic growth so as to increase savings.

(Zelalem, 2018) carried out a research on Analysis of the Nexus between Gross Domestic Savings and Economic Growth in Ethiopia (time series analysis from the period 1976-2017). The study employs a more robust augmented granger causality test approach developed by Toda and Yamamoto (1995). The result of (Zelalem, 2018)shows that a stable long relationship exists between savings and economic growth in Ethiopia. The causal empirical results revealed that the growth rate of real GDP per capita Granger cause real gross domestic saving in Ethiopia. This can be concluded that Ethiopia tends to have higher level of income (RGDP) first in order to generate higher rate of domestic saving.

When we come to the case of Ethiopia, the general observation is that little empirical attention is given on the area and many studies was based on saving- economic growth nexus (Mohanty A. K., 2018), (Zelalem, 2018), (Getenet, 2017) and others , while few scholars (Gebeyehu, 2010) and (Shimelis, 2014) conducted on the relationship between savings, investment and economic growth , although the variables of interest and the methodology that will be employed and the time period for this study is different from those researchers.

Despite the abundance of studies on savings, investment and growth in other countries, their results cannot be generalized in the context of Ethiopia because of the difference between political systems, financial systems, policies and regulations, and other country specific factors affect this relationship. Due to this, this study analysed this relationship in the context of Ethiopia. Accordingly, this study will employ Vector autoregressive (VAR) and Vector Error Correction model (VECM) to show short run and long run dynamic interaction between savings, investment and economic growth and Structural VAR for showing the transmission channel of macroeconomic monetary policy shocks like exchange rate policy, interest rate policy, and inflation and money supply policies from one to the other. This study also differs from others in its methodological difference to show the dynamics and the transmission channel which have not been done by other studies. It will a;so provide information based on recent evidence on the relationship between savings, investment and growth in Ethiopia by adding new thing that is more elaborating the nexus between these variables.

3. Research Methodology

3.1. Design of the study

Design is a description of the approach to be used to reach objectives and clearly indicate the methods of data collection as well as the techniques for data collection. In this regard the study used an explanatory or causal research design in order to achieve its stated objectives. Because, it is the most fitted design for investigating the dynamic interaction between saving, investment and economic growth.

3.2. Sample Data and sources of Data

The span of the study covers the periods between 1992/93 and 2019/20. Sample time span was selected because of the availability of statistical 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. The original series collected in quarterly frequency and the changed data covers of 112 observation starts from 1992/93-2019/20. According to (Blanchard & Perotti, 2002) the use of quarterly data facilitates identification of structural shocks, minimizes the likelihood of structural break and allows for important intra-year dynamics.

Widely used standard econometric software packages for the models include EViews 10; which makes it possible to make use of this methodology in relatively simple and straight forward ways.

3.3. Model Specification

To enlighten the possible dynamic interaction between savings, investment and economic growth and monetary policy transmission mechanism, this study will postulated the specification with some modifications investigations (Budha, 2012), (Gebeyehu, 2010) (Ngouhouo & Mouchili, 2014) (Nwanne, 2016), Odey et al ., 2017, (Omoregie & Ikpesu, 2017). Thus in light of the existing literatures, the theoretical model used to examine the dynamic relationship between these variables of interest is stated as follows:

$$GDS = \beta_0 + \alpha_{\beta 1} \ln GDs_{t-i} + \beta_2 \ln GDI_t + \beta_3 ln\, GDP_t + \beta_4\, INF_t + \beta_5 ln\, MS_t + \beta_6\, IR_t + \beta_7\, Ex_t + \varepsilon 1_{t-} \quad 3.1$$

$$GDI = \gamma_0 + \gamma_1 \ln GDI_{t-i} + \gamma_2 \ln GDP_t + \gamma_3\, lnGDS_t + \gamma_4\, INF_t + \gamma_5 ln\, MS_t + \gamma_6\, IR_t + \gamma_7\, Ex_t + \varepsilon 2_{t-} \quad 3.2$$

$$GDP = \alpha_0 + \alpha_1 \ln GDP_{t-i} + \alpha_2 \ln GDI_t + \alpha_3\, lnGDS_t + \alpha_4\, INF_t + \alpha_5 ln\, MS_t + \alpha_6\, IR_t + \alpha_7\, Ex_t + \varepsilon 3_{t-} \quad 3.3$$

Where, t is the period and t-i represents past periods with i being the number of lags, determined by minimizing the selection criterion. GDP stands for gross domestic product, GDS for gross domestic savings, GDI for gross fixed capital formation or Investment, Ms_t for money supply, IRt is the real interest in period t; Ext is the exchange rate in year t; INFt is the inflation rate in year t; α0, β0 et γ0 are constant parameters. ε1t, ε2t and ε3t Are error terms (stochastic variables); and α, β and γ (1…7) are coefficients of variables. Monetary policies are used as control variables to capture macroeconomic effect in the model.

3.4. Method of data analysis and Econometric estimation techniques

3.4.1. Vector autoregressive (VAR) model specification

VAR model is a general frame work used to describe the dynamic behavior of the economy in time series analysis. If time series are not stationary then the VAR framework needs to be modified to allow consistent estimation of the relationship among the series. It is a means of avoiding limitation of classical approach.

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

$y_{t=}\ c + \pi_1 y_{t-1} + \pi_2 y_{t-2} + \ldots + \pi_p y_{t-p} + \varepsilon_{it}$ ………………… (3.4)

general equation of VAR model

Where $y_{t=(GDI,Ex,INF,MS,IR,GDS,GDP)}$; where C is a vector of $k \times 1$ constant matrix; $\pi_i\ (i = 1,2, \ldots., p)$ 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 $\varepsilon_t \sim iid(0, \Omega)$.

A lag length selection is the number of previous observation in a time series that will be used as a predicator in the VAR model. In estimating the VAR model, determining the lag length is essential element so that to choose the appropriate lag length in the VAR different method could be supplemented like Akaike information criterion (AIC) based on data congruency based on some information, and Hannan-Quinn (HQ). 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).

3.4.2. Tests of VAR model

3.4.2.1. Unit Root testing

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, 2008). Stationary is important for the development and assurance of estimation of the of VAR model.

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.

$\Delta y_t = a + \mu_t + \beta - 1 y_{t-1} + \sum_{i=1}^{p} \gamma_i\ \Delta y_{t-1} + \varepsilon_t$ ……………… 3.5

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

Test of autocorrelation, normality test and stability test also included in the model by using Breusch-Godfrey, Jarque -Berra, CUSUM square test are supplemented in these diagnostics test respectively.

The VAR model can also be analyzed through Granger causality test, impulse response function, and forecast error variance decomposition.

3.4.2.2. Granger causality test

The VAR model is advantageous because of it explains the past and causal relationship among multivariable over time and its prediction. Granger causality is a statistical concept of causality involving improved prediction of one time series by incorporating knowledge of a second time series, then the latter is said to have a causal inference on the first (Granger C. W., 1969) and (Lütkhephol, 2005). Let variable y_1 is found to helpful for predicting another variable, hence y_1 is a granger cause y_2 andy_3; otherwise, it is said to fail to granger cause y_2 andy_3.

3.4.3. Structural vector autoregressive model (SVAR) frame work

When the VAR first was presented, it was argued that an advantage was that it does not need any prior assumptions needed for a structural model. For a structural model to be estimated certain restrictions are needed about which variables are allowed to affect each other. It is not possible to estimate a simultaneous model where all variables are considered endogenous. The main purpose for the development of SVAR methodology is to handle the limitations of VAR model (see (Kilian & L¨utkepohl, 2016). Structural VAR models are obtained from reduced form of VAR. Especially the model is developed to show the impact of structural shocks on dynamic model (Kilian & L¨utkepohl, 2016).

Structural VAR models have four main applications. First, they are used to study the average response of the model variables to a given one-time structural shock. Second, they allow the construction of forecast error variance decompositions that quantify the average contribution of a given structural shock to the variability of the data. Third, they can be used to provide historical decompositions that measure the cumulative contribution of each structural shock to the evolution of each variable over time. Finally, the models allow the construction of forecast scenarios conditional on hypothetical sequences of future structural shocks (Kilian L. , 2011). More over; Structural vector auto regressive (SVAR) model are widely employed tool for the analysis of the monetary transmission mechanism (Christiano, Eichenbaum, & Evans, 1999). In our case the interaction between monetary policy shocks, that is, saving; Investment and economic growth dynamics. And also it is important for analyzing the dynamics of a model by subjecting it to an unexpected monetary policy shock and for computing the structural impulse response.

And this study is based on the theory of monetary transmission mechanism and draws from the model specification of the above VAR models for structural modeling of a structural shock. The reduced-form of VAR (p) model as representing data generated by the structural VAR (p) model;

$$B_0 y_t = \alpha_{i,j} + B_1 A_i y_{t-1} + \cdots \cdots + B_p A_i y_{t-p} + w_{it} ------------- (3.6)$$

Where, y_t is the $K \times 1$ vector of observed time series data, $t = 1, \ldots, T$, and the deterministic terms have been suppressed for convenience. Furthermore, B_i, $i = 1, \ldots, p$, is a $K \times K$ matrix of autoregressive slope coefficients, the $K \times K$ matrix B_0 reflects the instantaneous relations among the model variables, and the $K \times 1$ vector of mean zero structural shocks w_t is serially uncorrelated with a diagonal covariance matrix Σw of full rank such that the number of shocks coincides with the number of variables.

The reduced-form representation of model (3.6) can be obtained by pre multiplying both sides of (3.5) by $B_0{}^{-1}$, results in the model (see Gottschalk (2001), Hamilton, (1995), (Kilian & L¨utkepohl, 2016))

$$y_t = \lambda + A_1 y_{t-1} \cdots\cdots + A_p y_{t-p} + u_t ------------- (3.7)$$

Where; $A_i = B_0{}^{-1} B_i$ and $u_t = B_0{}^{-1} w_t$, $\lambda = B_0{}^{-1}\alpha$ and it can be estimated by maximum likelihood (ML) estimation methods.

Estimation of the matrix B_0 requires additional restrictions on the data generating process (DGP) based on economic theory. If the matrix B_0 can be solved for, given these restrictions and the data, we say that the structural VAR model parameters, $(B_0, B_1, \ldots, B_p, \Sigma w)$, are identified or, equivalently, that the structural shocks $wt = B_0 u_t$ are identified.

In compact form, an SVAR system relates to the following relations:

$$A_0 u_t = B w_t --------------- (3.8)$$

The equation (3.8) is known as the AB model (Amisano and Giannini 1997). Where A_0 is $(n \times n)$matrix of contemporaneous relations between endogenous variables, B is $(n \times n)$ matrix that linearly relates the SVAR residuals to the structural innovations, u_t is vector of reduced-form residual, and w_t is vector of structural shocks. The residual u_t in the reduced form is presumed to be white noise. Therefore, we can estimate the AB model by OLS (ordinary list square).

The structural innovations w_t can be derived from errors ut of the reduced form, but certain restrictions must be placed on the system. In details, $\frac{n(n-1)}{2}$ Where n is the number of variables in the model; restrictions must be imposed on $A0$ matrix to be able to identify the structural shocks (McCoy, 1997).

3.4.3.1. Recursively identified structural VAR model

According to (Kilian & L¨utkepohl, 2016) in estimating the response of economic variables to the temporary shocks, this paper employed recursively identified structural model. This means current structural shocks cannot be simultaneously affected by the preceded ordering variables. We can assume that variables are affected by following a sequential chain of shocks, or the matrix A_0 is diagonal (that is, the structural shocks are orthogonal) and takes the form of a lower triangular matrix as follows:

$$\begin{pmatrix} u_t{}^{ex} \\ u_t{}^{ir} \\ u_t{}^{Ms} \\ u_t{}^{INf} \\ u_t{}^{GDS} \\ u_t{}^{GDI} \\ u_t{}^{Gdp} \end{pmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ b_{21} & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ b_{31} & b_{32} & 1 & 0 & 0 & 0 & 0 & 0 \\ b_{41} & b_{42} & b_{43} & 1 & 0 & 0 & 0 & 0 \\ b_{51} & b_{52} & b_{53} & b_{54} & 1 & 0 & 0 & 0 \\ b_{61} & b_{62} & b_{63} & b_{64} & b_{65} & 1 & 0 & 0 \\ b_{71} & b_{72} & b_{73} & b_{74} & b_{75} & b_{76} & 1 & 1 \end{bmatrix} * \begin{pmatrix} w_t{}^{e}x \\ w_t{}^{ir} \\ w_t{}^{mS} \\ w_t{}^{Inf} \\ w_t{}^{GDS} \\ w_t{}^{GDI} \\ w_t{}^{GDP} \end{pmatrix}$$

Where, $(u_t{}^{ex}, u_t{}^{ir}, u_t{}^{GDS}, u_t{}^{GDI}, u_t{}^{ms}, u_t{}^{inf},\ and\ u_t{}^{rgdp})$, are the structural disturbance, that is, exchange rate shocks, interest rate shocks, domestic saving shocks, domestic investment shocks, money supply, the price shocks, and real GDP shocks respectively; and $(w_t{}^{ex}, w_t{}^{IR}, w_t{}^{GDS}, w_t{}^{GDI}, w_t{}^{ms}, w_t{}^{inf}, and\ w_t{}^{rgdp})$, are the residuals in the reduced form equations, which represent unexpected movements (given information in the system) of each variable.

Precisely in the above recursive model, the first variable is assumed to response to its own shocks. The second one is affected by shocks of the previous variable and its own, and so forth. When using recursive model, researchers make assumptions that policy makers only use the available information to design monetary policy

(Raghavan et al., 2012).

Identification of restrictions for the recursive model is based on the economic theory that postulates and by employing over identified restrictions. In over identified restrictions methodology; it is important not to stick one model which may be wrong. However, this type of structural VAR model no longer admits a Cholesky representation and must be estimated by alternative numerical methods (Kilian & L¨utkepohl, 2016).

In some cases, conditions that will not available fully developed theoretical model, in this case identification may be achieved by using extraneous information or by using selective insights from economic theory. Based this information of Kilian, and L¨utkepohl, we develop the above recursive form of SVAR model.

In our model, the data vector is $\{ex, ir, gds, gdi, ms, inf, rgdp\}$, where, Ex is nominal exchange rate expressed the form of foreign currency to domestic currency ($/Birr); Ir indicates domestic interest rate; Gds is Gross domestic saving, Gdi indicates domestic investment, Ms is money supply $(M_0 + M_1)$; Inf is general inflation rate and rgdp indicates is output.

Thus the paper assumes that

- Exchange rate is contemporaneously unaffected by the shocks of other variables in the system.
- Interest rate in the system is assumed to be affected by the contemporaneous shocks of exchange rate and the lags itself.
- On the other hand, we assumed money supply is contemporaneously affected by the positive innovations of exchange rate, interest rate and its own lag. Positive innovation shocks such as exchange rate, interest rate, money supply, and lagged of inflation rate are assumed to be affect the current inflation rate in the system.
- In the fifth equation of gross domestic saving can be contemporaneously influenced by the positive innovations of exchange rate, interest rate, inflation, money supply and its own lag in the system.
- Gross domestic investment equation can be contemporaneously influenced by the positive innovations of exchange rate, interest rate, inflation, money supply, gross domestic saving and its own lag in the system.
- Finally in the output equation, output is assumed to be contemporaneously influenced by all variables in the system.

After identifying the structural shocks it is important analyzing and interpreting these macroeconomic shocks by using structural VAR tools in the structural model, that is, structural impulse responses and forecast error variance decompositions.

3.4.3.2. Impulse response function

Impulse response function shows how one variable might react to sudden changes in the other variable. It also traces out the responsiveness of the dependent variables in the VAR to shocks to each of the variables. So, for each variable from each equation separately, a unit shock is applied to the error, and the effects upon the VAR system over time are noted The (i,j)th element of the matrix Φs , 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},…..) 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. The equation is borrowed from (Kilian & L¨utkepohl, 2016) by considering VAR(1) representation of VAR(p) process and it is obtained from responses to VAR forecast errors are the following.

$\Phi i = (\Phi_{jk,i}) = JA^iJ'$, where Φi is a forecast error of the model and a k×k matrix. And J≡ $(I_k , 0_{k\times k,(p-1)})$ the response of the variable *j* = 1, . . . , *K* in the VAR(*p*) system to a unit shock U_{kt} , k = 1, . . ., K, i periods ago.

The response of an economic variable to a shock in period *t* at horizon *h* is obtained as the sum $\sum_{i=0}^{h} \theta_{mk,i}$ this is taken from (L¨utkepohl, 2005).

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.

On the other hand let y_t be an m vector time series generated by the following pth order VAR model: $y_t = J(L)y_{t-1} + \varepsilon_t$, where $J(L) = \sum_{i=1}^{p} J_i L^{i-1}$, and t = 1,2,……..n

Impulse response describes the response of $y_{i,t+s}$ to a one time impulse in y_{it} with all other variables dated t. Hence $y_t = \mu + \varepsilon_t + \psi_1\varepsilon_{t-1} + \psi_2\varepsilon_{t-2} + \ldots\ldots + \psi_n\varepsilon_{t-n}$…………………… 3.9

Where $\psi_s = \frac{\partial y_{t+s}}{\partial \varepsilon_t'}$

3.4.3.3. Forecast error variance decomposition

Forecast error variance decomposition - It provides information about the relative importance of each orthogonized 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:

$y_{t+s} - (y_{t+s/t})^{hat} = \varepsilon_{t+s} + \psi_1\, \varepsilon_{t+s-1} + \psi_2\, \varepsilon_{t+s-2} + \ldots\ldots + \psi_{x-1}\varepsilon_{t+1}$ ……………..3.10

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

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.

Consider a K×K VAR(p) model $y_t = \sum_{i=1}^{p} \Phi_i\, y_{t-i} + \varepsilon_t$,where ε_t is independent and identically distributed error term with zero mean and covariance matrix Σ. Assuming weak stationarity, y_t obtains the infinite order moving average representation :$y_t = \sum_{j=0}^{\infty} AJ\varepsilon_{t-j}$

The limit of forecast variance decomposition, as $h \to \infty$, 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,…….,K at a horizon h is $MSPE = MSPE_J^K(h) = \sum_{J=0}^{K} (\theta^2{}_{kj,0} + \ldots, + \theta^2{}_{kj\,,\,h-1})$where MSPE =Prediction mean squared error.

The ratio of the contribution shock J to the forecast error variance of the variable K will be in the structural variance decomposition:

$$\frac{MSPE^{K}{}_{j}\,(h)}{MSPE^{K}\,(h)}$$

By multiplying these fractions by 100 we obtain percentages.

3.4.4. 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 also accounts short run and long run effects and correct disequilibrium. According to (Asteriou & Hall, 2011), VECM is also a means of reconciling the short run behavior of the economic variable with its long run behavior. The VECM equation which taken from (Moriyama, 2008)can be specified as in the following;

$\Delta y = \emptyset(L)\,\Delta y_t + \lambda y_{t-1} + \varepsilon$ ……………………………………………………….. 3.11

The Δy represents the change in the vector of all variables in the system which includes , saving (lnGDS), economic growth(lnrGDP), investment(lnGDI), exchange rate (Ex), interest rate (IR), money supply(lnMS), inflation(INF).The lag operator is represented by $\emptyset$(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:

$ECM_{1,t-1} = Ex_{t-1} + \beta_0 + \beta_1 \ln GDS_{t-1} + \beta_2 \ln GDI_{t-1} + \beta_3\, INF_{t-1} + \beta_4 \ln MS_{t-1} + \beta_5 \ln GDP_{t-1} + \beta_6\, IR_{t-1}$ …………………….……….. 3.12

$ECM_{2,t-1} = IR_{t-1} + \beta_0 + \beta_1 \ln GDS_{t-1} + \beta_2 \ln GDI_{t-1} + \beta_3\, INF_{t-1} + \beta_4 \ln MS_{t-1} + \beta_5 \ln GDP_{t-1} + \beta_6\, Ex_{t-1}$……………………… 3.13

$ECM_{3,t-1} = GDP_{t-1} + \beta_0 + \beta_1 \ln GDS_{t-1} + \beta_2 \ln GDI_{t-1} + \beta_3\, INF_{t-1} + \beta_4 \ln MS_{t-1} + \beta_5\, IR_{t-1} + \beta_6\, Ex_{t-1}$ ……………………………………….. 3.13

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

$Ex_{t-1} = -\beta_0 - \beta_1 \ln GDS_{t-1} - \beta_2 \ln GDI_{t-1} - \beta_3\, INF_{t-1} - \beta_4 \ln MS_{t-1} - \beta_5 \ln GDP_{t-1} - \beta_6\, IR_{t-1}$ ……… ……...3.14

$IR_{t-1} = -\beta_0 - \beta_1 \ln GDS_{t-1} - \beta_2 \ln GDI_{t-1} - \beta_3\, INF_{t-1} - \beta_4 \ln MS_{t-1} - \beta_5 \ln GDP_{t-1} - \beta_6\, Ex_{t-1}$ ……… ……………………….3.15

$GDP_{t-1} = -\beta_0 - \beta_1 \ln GDS_{t-1} - \beta_2 \ln GDI_{t-1} - \beta_3\, INF_{t-1} - \beta_4 \ln MS_{t-1} - \beta_5\, IR_{t-1} - \beta_6\, Ex_{t-1}$…... ……… …………………..3.16

Before directly going to the model specification first it is necessary to transform the variables under study into Log data to avoid biased coefficients and standard errors and then biased inference which gives misleading result. Depending on the above literature the functional form can take the following forms.

GDP= f (GDS, GDI, INF, Ms, Ex, IR)

To capture economic growth using GDP, used log of GDP, as log difference of GDP implies economic growth. Correspondingly, all the regressors are expressed in logarithms as follows.

$$GDP_t = B_0 + B_1 lnGDS_t + B_2 lnGDI_t + B_3 INF_t + B_4 lnMS_t + B_5 Ex_t + B_6 IR_t + e_t \text{............} 3.17$$

IR =f(GDS, GDI, INF, MS,Ex,GDP). The econometric model can be shown as:

$$IR_t = B_0 + B_1 lnGDS_t + B_2 lnGDI_t + B_3 INF_t + B_4 lnMS_t + B_5 E_t + B_6 lnGDP_t + e_t \text{..........} 3.18$$

Ex = f(GDS,GDI,INF,MS,GDP,IR).

It can also be shown as

$$Ex_t = B_0 + B_1 lnGDS_t + B_2 lnGDI_t + B_3 INF_t + B_4 lnMS_t + B_5 lnGDP_t + B_6 IR_t + e_t \text{.........} 3.19$$

All computations will be performed by using widely used standard econometrics software package of E-views 10 window.

4. Results and Discussions

4.1. Macroeconomics Development Performance of Ethipoian Economy

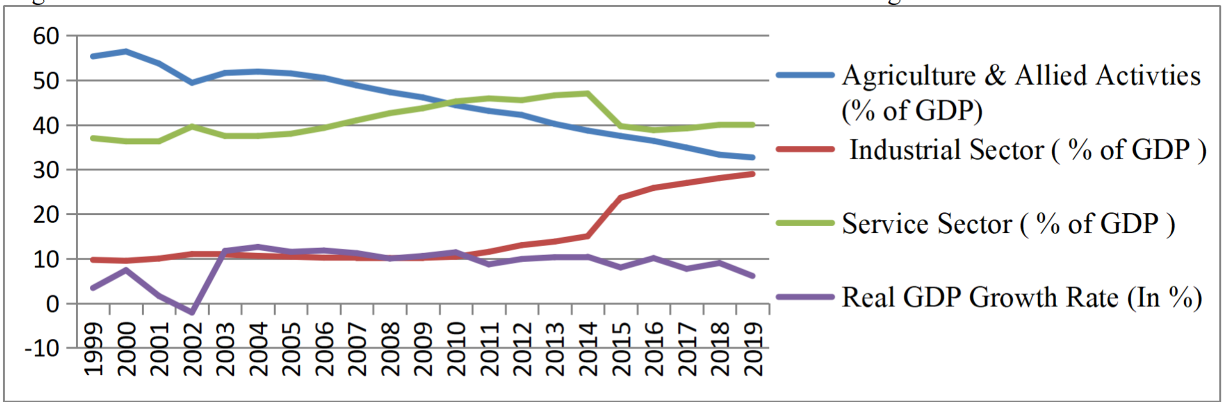
This part focuses on a brief overview of macroeconomic development and performance of Ethiopian economy and attempts to analyze the trend of the variables of interest. Descriptive analysis of the relationship between savings, investment and economic growth and monetary policy variables will be done intend to lay the foundation and set a prior expectation of the empirical analysis in chapter five.

4.1.1. Overall Macroeconomic Progress from 1992 to 2019

As it can be seen in the following figure 4.1, after being stagnant for many decades, Ethiopia's economy has experienced robust and continuous growth over the last decade since 2003. Real GDP per capita growth in Ethiopia was not only low on average, it was also highly volatile, with both high positive and negative growth rates throughout the decade. The outcome reflected a combination of factors including recovery from a lengthy civil war, war with Eritrea (towards the end of the decade), and volatile weather combined with heavy reliance of Ethiopian agriculture on rainfall and its very large contribution to total GDP. Since the mid-2000s, on the contrary, Ethiopia has enjoyed accelerated and sustained economic growth for more than a decade now, where growth rates exceeded global averages.

According, National Bank of Ethiopia quarterly bulletin of 2020/21 report, Ethiopian real GDP grew at the rate of 10.8 percent annually, one of the highest in Africa, from 2003 to 2014. However, in 2015 the real GDP growth rate was declined to 8.0 percent which is lower than the rate in 2014 of 10.4 percent due to the occurrences of severe drought (El Niño) in the country. Real GDP growth slowed to an estimated 6.1% in 2019 from 9% in 2018, caused by social unrest and fiscal consolidation to stabilize the public debt. An important attribute of this high growth episode is that it has been resilient to various shocks such as drought and international economic crisis. This is contrary to the historical susceptibility of the economy to such shocks: war in the 1990s and very early 2000s and drought in 1975, 1985, 1997, and 2003 have had adverse effects on the Ethiopian economy.

Figure 4. 1 Three main economic sectors Contribution to real GDP and real GDP growth rate



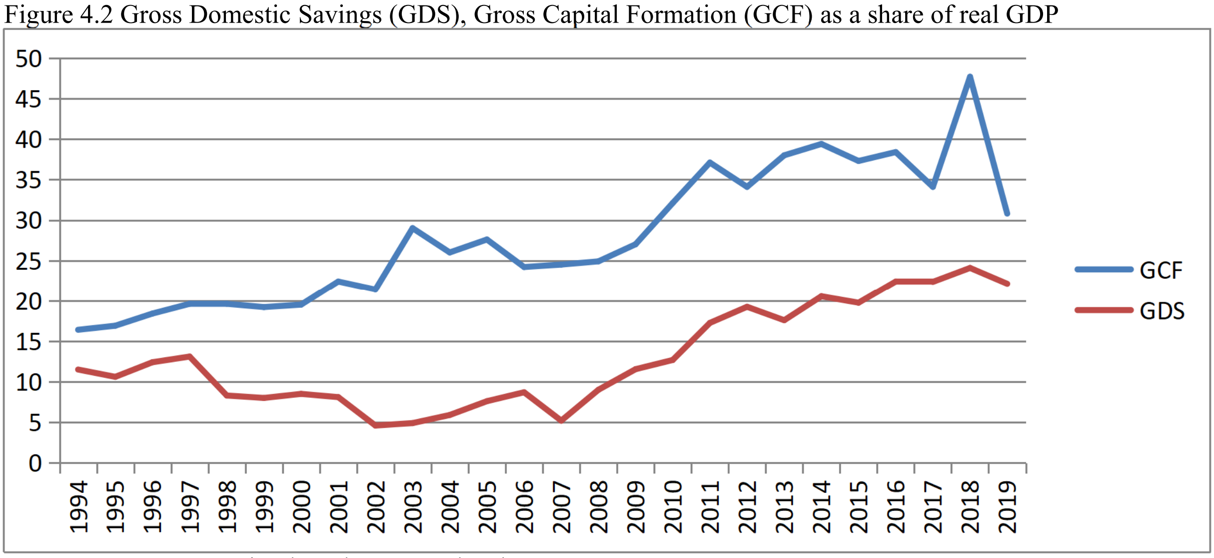
Source: Own computation from NBE data.

4.1.2. Developments in Savings, Investment and Economic Growth in Ethiopia

The Ethiopia's past growth has certainly been driven in strong part by public sector investment (Ethiopia Macroeconomic Handbook , 2019). Ethiopia stands out among most African and developing countries for its consistently high investment rates in recent years. Total investment to GDP averaged 39 percent of GDP for the four years between FY 2013/14 and FY 2016/17, compared to a Sub-Saharan African average of 20 percent of GDP, Middle East average of 29 percent of GDP and an Asian average of 30 percent of GDP. Among African countries, Ethiopia has the one of the highest rate of investment.

Assessment of the historical developments (Figure 6.2 below) in domestic saving, investment spending and economic growth in the nation showed that Ethiopian economy has pass through different phases of savings, investment and economic growth over the previous three decades. Gross capital formation (formally gross domestic investment) to GDP ratio stood 16.4 percent in 1994 and climbed to all time high 47.7 percent in 2018 while domestic saving to GDP ratio rose from 11.5 percent to all time high 24.1 percent over the same period. More over; about 32.5 percent average domestic investment as percentage of GDP was observed during the past seventeen years between 2003/04 to 2019/20 with the highest 47.7 percent in 2018 and lowest 24.2 percent in 2006. According to GTP one, gross domestic saving (GCF) was forecasted to take average 27.5 percent of GDP share during the plan period (2010/11-2014/15) and 28.2 percentage of GDP in 2014/215 whereas it achieved average 36.34 percent during the plan period and 39.2 percent at the end of plan period (2014/15). This shows the plan is accomplished prior to the GTP plan period finished. On the other hand, gross domestic saving to GDP ratio was expected to be 11.9 percent for the five years average and 15 percent in 2014/15 while registered 20.5 percent in 2014/15 and average 16.5 percent during the plan period. In spite of gross domestic saving to GDP ratio is above the plan target and accomplished prior the plan period is ended, still it is low as contrast to the gross domestic investment rate.

Figure 4.2 Gross Domestic Savings (GDS), Gross Capital Formation (GCF) as a share of real GDP



Source: own computation based on NBE data base

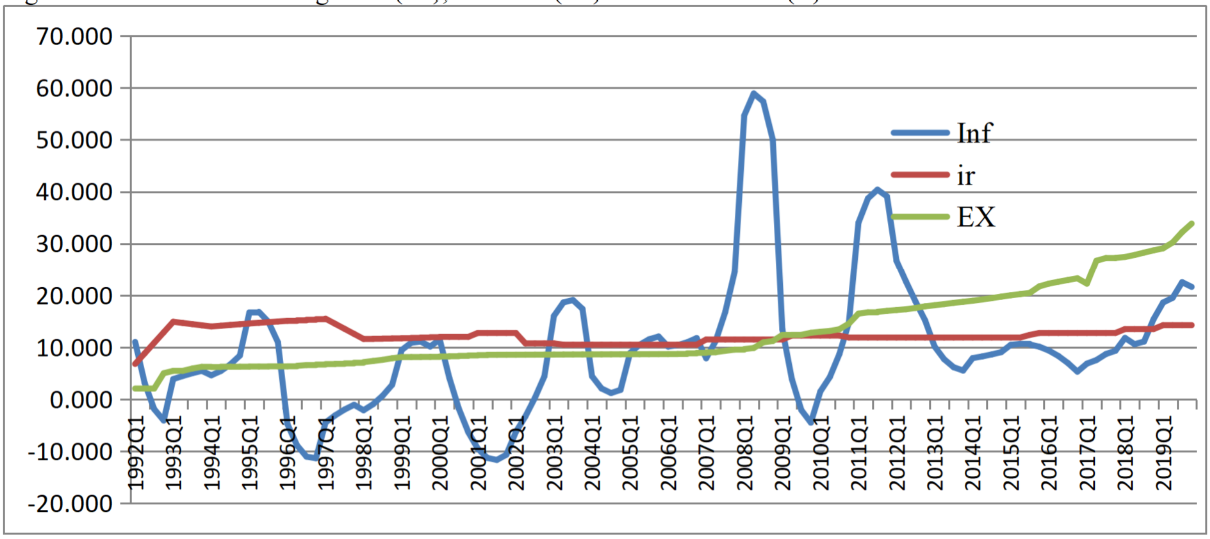
A review of the financing of past growth reveals that high growth was fuelled by high investment rates, which in turn was made possible by a jump in both domestic savings and external debt accumulation. Looking at the past five years, average investment to GDP ratios of near 37 percent have led to average growth rates of near 9 percent over the same period, indicating that roughly 4 percent of GDP in new investment is driving approximately 1 percentage point of GDP in growth. Moreover, of the 37 percent average investment to GDP ratio seen in the last five years, the equivalent of 22 percent of GDP was funded from domestic savings, while the remaining 15 percent of GDP was covered via externally-generated resources in the form of remittances, grants, loans and FDI. In essence, the momentum of Ethiopia's growth has been driven by keeping high investment rates at 34-39 percent of GDP (which translated to growth rates of 8-10 percent) and by financing that high investment with both an expanded pool of domestic savings (24 percent of GDP in FY 2017-18 from below 10 percent of GDP a decade ago) and through much increased financing resources (particularly debt) from the rest of the world (Ethiopia Macroeconomic Handbook , 2019). The presence of more investment than domestic savings creates a need of foreign financing. Studies shows external debt in developing countries plays an important role in filling a gap between savings and investment by (Chenery, 1996) as cited from (Mndeme, 2015). The result of low domestic saving and high necessary investment are leading to persistent fiscal deficits and growing indebtedness (African Develpment Bank , 2019).

To sum up, developments in domestic saving, investment and economic growth in the country showed that Ethiopian economy has pass through different phases of savings, investment and economic growth over the study period. Both gross domestic saving and investment percentage of GDP vary in the same direction. That is these macroeconomic variables reveal similar patterns even if the direction of causality among the two cannot be determined from this trend analysis.

4.1.3. Developments in Money Supply, Interest rate, exchange rate and Inflation

Broad money supply (M2 measures domestic liquidity and its components includes Quasi money (saving & time deposit) and narrow money supply (demand deposit & currency outside banks). At the beginning of 1992 broad money supply (M2) was 9. 235 billion birr and grows on average by 4 percent. As at end of 2010/11, it reached Birr 145.4 billion reflecting 39.2 percent growth over last year, largely due to 104.2 percent surge in net foreign assets and 29.8 percent growth in domestic credit (NBE, 2019). According to National Bank of Ethiopia quarterly bulletin of 2019/20 report, broad money supply (M2) expanded to Birr 1,037.64 billion at the end of fourth quarter. This was mainly driven by 22.1 percent expansion in domestic credit against 132.3 percent contraction in net foreign assets (NFA). Figure 4.3 below demonstrates review of inflation, interest rate, and exchange rate data over the quarter century.

Figure 4. 3 Trends of Exchange rate (Ex), Inflation (Inf) and interest rate (Ir)



Source: Own computation from NBE data

Historically Ethiopia has been one of the low inflation economies with average inflation rate of less than 5 per cent. Since 2006 however Ethiopia has no longer been considered a low inflation country and in July 2008 an all-time high inflation rate of 64 per cent was recorded. The major causes were the then high fuel and food prices shocks, weaker foreign exchange earnings, and rising demand for imports that depleted international reserves of the country. The highest price increase was observed in food, housing, fuel and transport services, making the urban poor the most vulnerable to the effects of inflation. Owing to strong policy measures and abated world price shocks inflation rates declined during the years 2010 and 2011.Inflation re-emerged in 2012 and reached a peak of about 40 per cent in September 2012 (Getaneh, 2017). Similarly according to (African Develpment Bank , 2019) report, Ethiopian inflation pressure came from significant public spending, the 15 percent currency devaluation, shortage of foreign currency, and limited food supply.

As shown on the figure, the sharpest increase in inflation rate took place in the year 2008 and the rate arrived at the highest (59%) percent) at the second quarter of the year. It also demonstrates that trends in inflation rate have been a combination of high and low movements in opposite direction. After reviewed the data, we get that average inflation rate over the past 26 years has been just about 10.2 percent. Making center of attention on the last 17 years, similar to the time of high economic growth in the economy, we get that double-digit inflation has been registered in 10 out of 17 years. The most recent year- on year inflation data reading demonstrates inflation rate of the economy is rising. According to (Ethiopia Macroeconomic Handbook , 2019) a rapid freeing of some administratively set prices, excessive monetary growth, and rising global oil prices could push inflation rate. It also shows that the years when the real interest rate reach its least, coincided with those of the highest double-digit inflation rates.

Ethiopia had a fixed exchange rate of 2.07 birr/$US for nearly two decades before the 1992 reform. At the beginning of the reform period, it devalued its currency to 5 birr/$US and the auction-based exchange rate was introduced in 1993, it was conducted on a biweekly basis as a "Dutch auction" (discriminatory price), where the marginal rate, which clears the market, is taken as the ruling rate for the subsequent two weeks and lately a weekly auction in fixed exchange rate. Currently the exchange rate is determined through an interbank foreign exchange rate market in daily (Alemayehu, 2001). The nominal exchange rate is continuously deprecates and in 2017 the country officially devaluate its currency by 15 percent. Since 1992, managed floating exchange rate regime is being experienced in Ethiopia and central bank intervenes to depreciate the currency. During the study period the exchange rate has elevated from 6.1972 to 33.8507**.**

The nominal interest rate was on average 14.8 percent from the beginning of 1994 to 1997. Thereafter, the interest (lending) rate shows ups and downs and it becomes 10.5 in the past four years following the war with Eritrea and the rise in inflation rate. In the fourth quarter of 2019/20, average saving deposit rate remained at 8.0 percent while average lending rate stood at 14.25 percent. On the other hand, weighted average time deposit rate declined by 0.13 percentage point on annual basis. Hence, considering the 21.6 percent inflation in June 2020, all deposit and lending rates as well as T-bills yield remained negative in real terms (NBE, 2019). In recent years the headline inflation is found to be higher than the interest rate. In general, the movement of the real Interest rate follows the opposite movement of the inflation rate may imply that the nominal interest rate was institutionally determined by the monetary authorities throughout the study period.

To sum up the above discussion exchange rate (the nominal exchange rate is continuously depreciated) and broad money supply rises from time to time. On the other hand, the headline inflation and interest (lending) rate has showed ups and downs.

4.2. Econometrics Analysis

This part discusses the results of data analysis using econometric tools as per the methodology summarized in chapter three. Empirical estimation result of structural vector autoregressive (SVAR) and vector error correction model (VECM) models are discussed. Accordingly, the results and interpretations of unit root test of the data, the optimum lag length, co integration test result followed by estimation of (VECM) and their Granger causality results are provided. Moreover, the dynamic interaction and casual relationship between variables included in the model is investigated through (SVAR) model .Finally, the diagnostic test result that checks accuracy of the model is presented.

4.2.1. Unit Root Test Result

In econometrics when dealing with time series data, unit root test is the standard practice and the first thing of time series analysis to determine the order of integration of the variables. It is necessary to assess whether the series is stationary or not. So as to get rid of spurious regression and this abnormality primarily unit root test should be conducted on each of the variables under study to check the presence of unit root or not. Plotting of the data is one of the simple diagnostic techniques to test stationarity of time series variables. In this regard, the variables are plotted counter to time and most of variables are non- stationary at levels as indicated by graphical view of variables trend (see Appendix A1).

Various formal statistical tests could be employed like ADF, Phillips Perron (PP), GLS transformed Dickey Fuller (DFGLS) , Richardson and stock point optimal (ERS), and Ng and Peron (NP) to determine whether the series in the group are stationary . However, this study applied two types of widely recognized and the most popular unit root tests of ADF and PP tests to ensure the stationarity of our data .

The null hypothesis is that the variable under investigation has a unit root against the alternative that it does not. The decision rule for both the ADF and PP tests is that we reject the null hypothesis of stationary if the tau statistic value exceeds the critical (tabulated) value at a chosen level of significance (in absolute term). The results of ADF and PP test of unit root both at level and first difference for each series are presented in table 4.1 and table 4.2 respectively.

The results obtained from ADF test presented in table 4.1 postulates that all variables are not stationary in the level series. Similar test was afterwards applied to their first differences and the outcomes are as well summarized in table below.

Table 4.1 .ADF Unit Root Test Result

	Augmented Dickey Fuller test				
Variables	@ level		@ first difference		Order of integration
	t- statistics	Critical value	t- statistics	Critical value	
LrGDP	-0.867432	3.490772	-4.303939	-3.490772***	I(1)
LGDI	0.965958	-3.495677	-2.99262	-2.890037**	I(1)
LGDS	0.92256	-3.493129	-4.31041	-3.493129***	I(1)
Ex	3.306016	-3.49021	-9.366707	-3.490772***	I(1)
Inf	-1.898298	-3.495677	-7.86568	-3.495021***	I(1)
Ir	-3.065272	-3.490772	-6.443693	-3.490772***	I(1)
Lms	2.791562	-3.49021	-11.42363	-3.490772***	I(1)

Source: own computation from Eviews 10.

*Note: *, **, *** indicates significance at 10%, 5% and 1% level of significance respectively.*
The result illustrates that they are stationary at 1 percent significance level and investment (LGDI) becomes stationary at 5 percent significance level.

Table 4.2 Phillips-Perron Test Result

	Phillips-Perron test				
Variables	@ level		@ first difference		Order of integration
	t- statistics	Critical value	t- statistics	Critical value	
LrGDP	-0.397624	-3.49021	-4.303939	-3.490772***	I(1)
LGDI	1.288155	-2.887665	-6.046541	-3.4907723***	I(1)
LGDS	1.196312	-3.49021	-5.562803	-3.490772***	I(1)
Ex	3.50355	-3.49021	-9.468217	-3.490772***	I(1)
Inf	-3.258045	-3.49021	-6.219686	-3.490772***	I(1)
Ir	-3.49021	-3.999198	-6.247232	-3.490772***	I(1)
Lms	3.114704	-3.49021	-11.43842	-3.490772***	I(1)

Source: Own computation from Eviews 10.
*Note: *, **, *** indicates significance at 10%, 5% and 1% level of significance respectively.*

Both ADF and PP unit root test investigation result above verify that the same set of variables becomes stationary following first differencing, whereas only interest rate (IR) becomes stationary at I (0) in pp unit root test. In view of the fact that all the variables except Ex in PP test are non-stationary at levels and integrated of order one, this implied the possibility of the prevalence of co- integrating relation between economic variables.

4.2.2. Optimal Lag Length

Following examining stationarity of the data, it is essential to recognize the optimal lag length to estimate the VAR/SVAR model. The most commonly used criteria for selecting optimal lag length of Akakie information criteria (AIC), Schwartz information criteria (SIC), Hannan- Quinn Information Criterion (HQ), the sequential modified LR test statistic (LR), and Final prediction error (FPE) are used in this study. Table 4.3 below demonstrates optimal lag selection criterion results.

Table 4. 3.Appropriate lag length selection criterion results

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-789.7252	NA	0.006030	14.75417	14.92801	14.82466
1	338.5804	2089.455	1.26e-11	-5.232970	-3.842235	-4.669078
2	458.9156	207.2441*	3.40e-12*	-6.553993*	-3.946366*	-5.496695*
3	489.4119	48.56810	4.93e-12	-6.211331	-2.386811	-4.660627
4	515.1769	37.69331	8.00e-12	-5.781055	-0.739641	-3.736945

*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

As shown on Table 4.3 above, AIC chooses two to be optimal lag length .This information criterion deemed most appropriate for this study based on the sample size. In addition the lag length is confirmed by other two information criteria (HQ and SC). Two other measures (FPE and LR) also show the same lag length. Too many lags may consume degree of freedom also may result into multicollinearity problem (Brooks, 2008) as sited by (Mndeme, 2015). (Kilian & L¨utkepohl, 2016) Indicates the use of inconsistent lag order selection procedures such as the FPE or sequential testing procedures affects the asymptotic distribution of the slope parameters conditional on the estimated lag orders. It may seem that this problem could be avoided by the use of consistent lag order selection criteria such as the SIC or HQC.

To confirm whether the selected lag length is optimal or not, we employed Wald lag exclusion test. This test carried out the verification for appropriateness of each lag chosen by the above listed information criteria. For each lag the Chi-square (Wald statistic) of all series are reported separately and jointly below. Result of the test revealed that second lags of all the endogenous variables are significant both separately and jointly. This implies that the uses of the first lags of the variables in the models are valid[1].

4.2.3. Co- Integration Test

The primary objective of the study is to indicate the dynamic interaction between savings, investment and economic growth. To capture this interdependence with monetary policy variables, the VAR model is a dynamic multivariate model and treats a set of variables equally. The dynamic interaction between these variables can be addressed using VAR models which are established to indicate the short-run dynamic disequilibrium among these variables.

[1] The lag exclusion table is presented in the appendix A2

It is important to see whether or not the variables are co- integrated or not at the same order of integrated variables after testing for unit root and the optimal lags length. Co-integration test is generally applied to series which are non- stationary but integrated of the same order. The following step is to determine the presence of long-run relationship between variables. Conventionally there are two tests for co-integration commonly used; Engle and Granger approach and Johansen approach. However, the Johansen approach is stated to be superior over Engle and Granger especially if variables portray feedback relationship and if there is a possibility of more than one co-integrating vectors (Brooks, 2008) as sited by (Mndeme, 2015).

Johansson's co- integration technique provides two test statistics which are trace test and maximum Eigen value statistics. The outcomes of both the trace and maximum Eigen value tests are used to confirm that the inferences drawn about the presence of a long-run relationship are shown below.

Table 4.4. Trace Test and Maximum Eigen Value Test results

	Trace Test					Maximum Eigen value Test			
Hypothesized No. of CE(s)	Eigen value	Statistic	Critical Value	Prob.	Hypothesized No. of CE(s)	Eigen value	Statistic	Critical Value	Prob.
None*	0.320771	132.2393	125.6154	0.0185	None	0.320771	41.38734	46.23142	0.151
At most 1	0.236357	90.85192	95.75366	0.1037	At most 1	0.236357	28.85314	40.07757	0.5016
At most 2	0.215479	61.99878	69.81889	0.1792	At most 2	0.215479	25.96695	33.87687	0.3228
At most 3	0.134904	36.03183	47.85613	0.3947	At most 3	0.134904	15.50583	27.58434	0.7073
At most 4	0.0955	20.526	29.79707	0.3879	At most 4	0.0955	10.73994	21.13162	0.6732
At most 5	0.053584	9.786064	15.49471	0.2976	At most 5	0.053584	5.892779	14.2646	0.627
At most 6*	0.035732	3.893285	3.841466	0.0485	At most 6	0.035732	3.893285	3.841466	0.0485
* Indicates rejection of the hypothesis at the 0.05 level.									

Source: own computation from E-views (Version 10)

Table 4.4 shows co- integration test results using Trace and Maximum Eigen Value test. In order to test the result, the test statistics are contrasted with critical values. We reject the null hypothesis if the calculated test statistics are greater than the critical values and accepting the alternative hypothesis of there are more than zero or at least one co-integrating equation.

As shown from the table, three co-integrating equation are there by using Trace test result while no co-integrating equations by using the Maximum Eigen Value test. Trace test is to be preferred or more powerful than maximum Eigen value (Burke and Hunter, (2005), Palgrave, (2014) and (Hishongwa, 2015). Therefore, this implies that the study specifies and estimates VECM with one co-integrating equation and we can say that the existence of long run relation between our macroeconomic variables.

4.2.4. Vector Error Correction Model (VECM) Estimation

The presence of co- integration points out the existence of long run equilibrium among variables of interest. In this regard the Johansen co integration test as indicated above acknowledged that the included variables of time series data has three and two co integrating vector which implies a long-run economic relationship between the variables. This entailed that, VECM mechanism is suited for further investigation. It contains information on both the long run equilibrium and short run dynamic interaction between variables. Therefore, let's present this interaction prior to going the discussion of variance decomposition & impulse response and compare with SVAR. VECM estimation output consists of two parts. The first component sets long run equilibrium equation (co-integration vector and the second part short run dynamic coefficients and error correction terms

Table 4.5 . Vector Error Correction Estimates
(cointEq1)
Vector Error Correction Estimates
Date: 04/16/21 Time: 03:28
Sample (adjusted): 1992Q3 2019Q4
Included observations: 110 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Co integrating Eq:	CointEq1
LRGDP(-1)	1.000000
LGDS(-1)	-0.056688
	(0.54881)
	[-0.10329]
LGDI(-1)	-3.530577
	(0.98421)
	[-3.58724]
IR(-1)	0.483329
	(0.07821)
	[6.18023]
INF(-1)	-0.021613
	(0.00713)
	[-3.03314]
LNMS(-1)	3.133023
	(0.71484)
	[4.38284]
EX(-1)	-0.109237
	(0.06893)
	[-1.58483]
C	-17.36712

Error Correction:	D(LRGDP)	D(LGDS)	D(LGDI)	D(IR)	D(INF)	D(LNMS)	D(EX)
CointEq1	-0.003176	0.028977	0.022500	-0.246589	2.552782	0.002072	0.117935
	(0.00258)	(0.01138)	(0.00791)	(0.05320)	(0.90081)	(0.00627)	(0.09818)
	[-1.23209]	[2.54561]	[2.84482]	[-4.63509]	[2.83388]	[0.33053]	[1.20116]
D(LRGDP(-1))	0.678784	0.095469	0.188713	-0.165106	28.59984	-0.213689	-0.178183
	(0.07394)	(0.32647)	(0.22684)	(1.52583)	(25.8358)	(0.17978)	(2.81600)
	[9.18073]	[0.29242]	[0.83192]	[-0.10821]	[1.10699]	[-1.18861]	[-0.06328]
D(LGDS(-1))	0.027184	0.496339	0.025498	0.633338	-3.827569	0.005438	0.283538
	(0.02371)	(0.10469)	(0.07274)	(0.48929)	(8.28481)	(0.05765)	(0.90301)
	[1.14655]	[4.74098]	[0.35052]	[1.29440]	[-0.46200]	[0.09432]	[0.31399]
D(LGDI(-1))	-0.067401	-0.074369	0.445889	0.256869	0.969999	0.168994	-0.901397
	(0.03473)	(0.15335)	(0.10655)	(0.71670)	(12.1353)	(0.08444)	(1.32270)
	[-1.94080]	[-0.48497]	[4.18481]	[0.35841]	[0.07993]	[2.00124]	[-0.68148]
D(IR(-1))	-0.007452	-0.013418	-0.011649	0.475497	0.510677	0.003633	0.202666
	(0.00342)	(0.01510)	(0.01049)	(0.07058)	(1.19509)	(0.00832)	(0.13026)
	[-2.17884]	[-0.88853]	[-1.11017]	[6.73693]	[0.42731]	[0.43688]	[1.55585]

D(INF(-1))	0.000263	-0.000586	0.000134	-0.018153	0.461125	-0.000459	0.007968
	(0.00026)	(0.00113)	(0.00078)	(0.00526)	(0.08911)	(0.00062)	(0.00971)
	[1.03042]	[-0.52026]	[0.17071]	[-3.44945]	[5.17489]	[-0.73995]	[0.82038]
D(LNMS(-1))	-0.061576	0.038415	0.096439	2.391584	1.957391	-0.113450	0.585440
	(0.04063)	(0.17941)	(0.12466)	(0.83851)	(14.1978)	(0.09880)	(1.54751)
	[-1.51552]	[0.21412]	[0.77363]	[2.85220]	[0.13787]	[-1.14832]	[0.37831]
D(EX(-1))	0.001834	0.002812	0.000180	0.083423	0.534207	-0.001321	0.035484
	(0.00271)	(0.01195)	(0.00830)	(0.05586)	(0.94576)	(0.00658)	(0.10308)
	[0.67751]	[0.23528]	[0.02173]	[1.49356]	[0.56485]	[-0.20072]	[0.34423]
C	0.011527	0.018288	0.009628	-0.133554	-0.714282	0.047722	0.261295
	(0.00303)	(0.01339)	(0.00930)	(0.06258)	(1.05962)	(0.00737)	(0.11549)
	[3.80139]	[1.36583]	[1.03486]	[-2.13413]	[-0.67409]	[6.47220]	[2.26240]
R-squared	0.566674	0.335381	0.362018	0.524020	0.267304	0.074637	0.060369
Adj. R-squared	0.532351	0.282738	0.311485	0.486319	0.209268	0.001341	-0.014057
Sum sq. resids	0.026920	0.524890	0.253403	11.46520	3287.101	0.159167	39.05127
S.E. equation	0.016326	0.072090	0.050089	0.336923	5.704871	0.039698	0.621809
F-statistic	16.51010	6.370849	7.163957	13.89924	4.605878	1.018299	0.811126
Log likelihood	301.2615	137.8943	177.9458	-31.71920	-342.9337	203.5223	-99.12497
Akaike AIC	-5.313845	-2.343533	-3.071741	0.740349	6.398794	-3.536769	1.965909
Schwarz SC	-5.092897	-2.122584	-2.850793	0.961297	6.619743	-3.315820	2.186857
Mean dependent	0.023899	0.037710	0.032224	0.049318	0.167769	0.043044	0.288915
S.D. dependent	0.023874	0.085121	0.060365	0.470092	6.415511	0.039724	0.617484

4.2.5. The Long run model

The incidence of co- integration as indicated by Johnson co- integration test reveals that we can estimate long run equilibrium relationships between economic variables. The coefficients of co- integrating equation signify the long run relationship in VEC model estimation. The result can be written as follow;

$LRGDP_{t-1} = 17.367 + 0.0567\, lnGDS_{t-1} + 3.531\, lnGDI_{t-1} - 3.133 lnMs_{t-1} + 0.022\, INF_{t-1} - 0.483 IR_{t-1} + 0.101 Ex_{t-1}$---4.1

The above equation provides long run relationship and shows that, along run positive relationship between GDS, GDI and RGDP. This result is in line with the finding of (Gebeyehu, 2010), (Mndeme, 2015), (Nwanne, 2016), (Namoloh, 2017) (Yibeltal, 2019) In mechanical terms, a one percent increase in domestic saving and investment(GCF) leads to increase economic growth in our country by 0.057 percent and 3.53 percent respectively. Real GDP is thus relatively sensitive to domestic investment than saving in the long run. Positive correlation is also found between economic growth and exchange rate and inflation in the long run. Whereas negative relationship was found among economic growth and money supply & interest rate. Specifically, a one percent increase in INF and Ex leads real GDP to rise by 0.11 percent and 0.483 percent respectively. Besides, a one percent increase in Ms and IR, leads to real GDP fall by 3.13 percent and 0.48 percent in respectively. Consequently, a raise in interest rate (IR) leads to increase saving in the long run. This makes investment to decline and the shrink in investment leads to reduce real GDP in the long run.

4.2.6. Short Run Dynamics for Error Correction Model Estimates

The relationship between savings, investment and economic growth can be shown by VECM model. The second part of estimation result indicated on above table holds error correction terms and short run coefficients. The error correction component (CointEq1) also known as adjustment coefficients in the VECM estimation result signifies the speed of adjustment to the equilibrium. A short run adjustment of the variation of the variables from their long run values is measured. Specifically, it should lie between 0 and 1 and should be negative in signs indicating a move back to equilibrium (Brooks, 2008).

Thus, from the result it can be seen that error correction term economic growth is -0.003176, which is significant with significant with large t- statistics. This can be interpreted as the previous period deviation from the long run equilibrium is corrected in the current period as an adjustment speed of 0.32 percent.

In short run the relation between economic growth and gross domestic saving is positive which the same direction in the long run is. That is, a one percent in domestic saving leads real GDP to rise by 2.7 percent. On the other hand the impact of domestic investment in the short run is negatively and significantly on real GDP. Money supply and interest rate affects the economic growth negatively in the short run where as inflation and exchange rate affects economic growth positively. That is encouragement of the nation to devaluate its currency leads economic growth in the short run.

In the short run the balance of payment is independent from explanatory variables. In other words, all variables in the model are insignificant in explaining the balance of payment variation in the short run. However, the adjustment coefficient of the error correction term is negative and statistically significant.

In the short run real GDP significantly affected by foreign exchange rate reserve. The estimated result from the short run model indicates that a one percent change in foreign exchange rate reserve led to a decrease in real GDP by -0.018808 percent. However, in the short run other variables including the exchange rate and balance of payment in our model have insignificant effect.

4.2.7. Granger Causality (Block Exogeneity Wald Tests)

According to (Kilian & L¨utkepohl, 2016), a proposal for assessing the dynamic relationship between economic variables based on the VAR model was made by Granger (1969). Consequently, this study employed VAR Granger Causality/Block Exogeneity Wald Tests to investigate the causality between Ex, Inf, Ir, Ms, rRGDP, lnGDS, and lnGDI. Table 6.8 reports the VAR granger causality result between variables included in the system.

The result of the test indicated that, Money supply, gross domestic saving and investment Granger causes exchange rate in the short run. This means that the past value of money supply, domestic saving and investment have projecting power in leading the current value of exchange rate. In short run inflation is Granger caused by money supply and gross domestic investment. Interest rate is also granger caused by inflation, money supply and real GDP in the short run. Gross domestic investment is granger caused by money supply unidirectional in the short run.

In addition money supply, gross domestic investment and real GDP granger causes gross domestic saving in short run. This denotes that, the presence of unidirectional Granger causality among domestic investment and savings and this causality comes from gross domestic investment. This implies that, the present change in domestic investment is affected by the past history (lagged value) of domestic savings. Furthermore, there is a presence of a unidirectional causality from real GDP to domestic saving. This means the past history of economic growth has predicting power in affecting the current value of gross domestic savings. This is the perspective of the Keynesian theory which believes that economic growth give rise to savings and in line with the works of (Shimelis, 2014), (Yibeltal, 2019), (Zelalem, 2018) and Mohanty, 2018 in case of Ethiopia. In addition the result is also consistent with other studies conducted by (Ngouhouo & Mouchili, 2014) for Cameron, (Sekantsi & Kalebe, 2015) for Lesotho, (Bolarinwa & Obembe, 2017) for Ghana and Burkina Faso (Omoregie & Ikpesu, 2017) for Nigeria who found causality is from economic growth to domestic savings.

A unidirectional relationship is also found among domestic investment and real GDP signifying that the lags of investment granger cause economic growth. This result supports Harrod Domar model and new growth theories which gives belief to the vital role of capital formulation in promoting the economic growth of the nation. The outcome supports the finding of (Ngouhouo & Mouchili, 2014) for the case of Cameron, (Omoregie & Ikpesu, 2017) for the case of Nigeria. Lag of money supply and interest rate are as well identified to granger cause real GDP. Lags of exchange rate, interest rate, domestic investment and savings and real GDP granger caused by all variables in the system. This provides that these macroeconomic variables are affected to a great extent by jointly. To establish whether the causal association among variables is negative or positive as well as the magnitude of this interaction we employed impulse response and variance decomposition in the next sub section.

Table 4.6 .Granger causality (Block Exogeneity Wald Tests) results

	DEPENDANT VARIABLES								
		D(Ex)	D(INF)	D(IR)	D(LNMS)	D(LGDI)	D(LGDS)	D(LRGDP)	Joint
D(Ex)	Chi sequre (c2)		1.528604	2.628377	5.75528**	7.8899**	5.7556**	2.903378	18.8438*
	Prob.		0.4657	0.2687	0.0563	0.0194	0.0563	0.2342	0.0924
D(INF)	(c2)	3.392582		0.104208	6.26865**	4.81074*	2.335877	0.797556	14.45554
	Prob.	0.1834		0.9492	0.0435	0.0902	0.311	0.6711	0.2726
D(IR)	(c2)	2.6155	10.31679***		5.688031*	4.307965	0.605782	4.968164*	36.30413***
	Prob.	0.2704	0.0058		0.0582	0.116	0.7387	0.0834	0.0003
D(LNMS)	(c2)	0.954843	0.200431	0.135077		2.278625	0.045122	1.807731	8.819189
	Prob.	0.6204	0.9046	0.9347		0.32	0.9777	0.405	0.7183
D(LGDI)	(c2)	1.866168	1.076574	0.460548	26.30661***		1.571107	3.947435	37.83807***
	Prob.	0.3933	0.5837	0.7943	0.0000		0.4559	0.1389	0.0002
D(LGDS)	(c2)	0.87081	2.831031	0.8105	17.7706***	5.134496*		8.531735**	36.48003***
	Prob.	0.647	0.2428	0.6668	0.0001	0.0767		0.014	0.0003
D(LRGDP)	(c2)	0.948556	0.8708	11.0842***	12.2254***	6.51367**	1.064184		27.24085***
	Prob.	0.6223	0.647	0.0039	0.0022	0.0385	0.5874		0.0071

Source: Own computation from E-view 10.

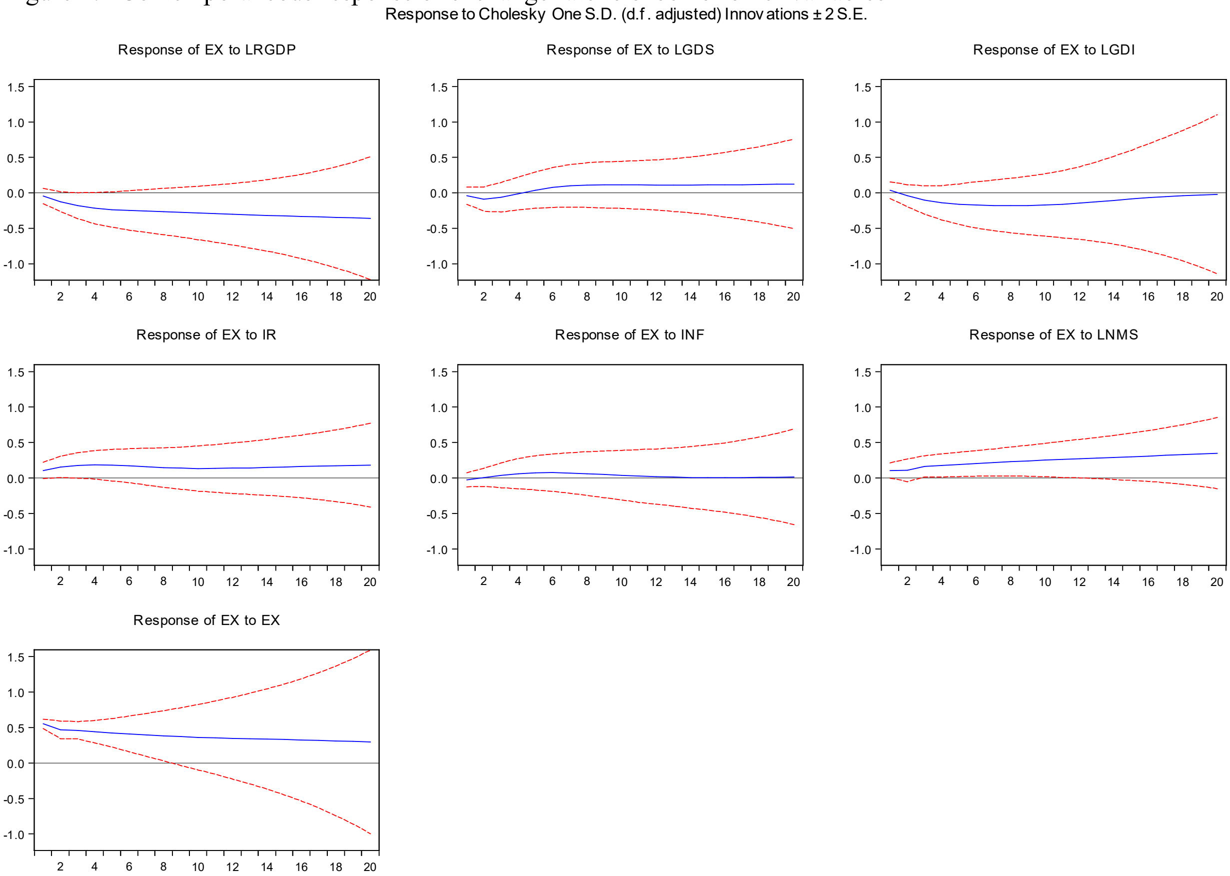
4.3. Monetary policy Variables Response to the change in policy shocks

After that we employed recursively identified SVARs model. Therefore, we intended to examine the interaction or the impulse responses of each variable in response to random innovation shocks in the SVAR model. This methodology signifies the dynamic interaction among the variables and identifies the reaction of each dependent variable in the model when a unit shock is applied to each variable. The impulse response function to savings, investment and economic growth to various shocks was calculated using E-view version 10. We intended to investigate the reaction of these variables to future changes of any of the seven variables.

The response of Exchange rate to shocks

From figure (4.1), it is observed that a positive innovation to the real GDP and gross domestic investment caused a negative impact on exchange rate. The reaction of exchange rate to shocks of interest rate, money supply and gross domestic saving noted to be positive. According to Monetary theory of exchange determination the rate is determined based on the supply and demand of money. In theory, citrus paribus, an increase in money supply in international (foreign) exchange market leads to decrease (depreciate) the currency. Higher interest rate also leads lower demand of money, in relation to supply of money. This makes the domestic currency weaker. In addition decrease of exchange rate tends to change aggregate demand left from traded to non- traded goods, entailing a raise in the real interest rate to keep internal balance. A positive innovation to inflation caused a positive impact on exchange rate, but gradually declined. Positive shocks in exchange rate itself also influences highly.

Figure 4.1 Contemporaneous response of exchange rate to shock of other variables



Source: Own computation from E-view 10.

The response of Money supply to Shocks

Figure 4.2 below plots the response of money supply to a random innovation of a positive shock. The response of money supply to positive innovations of domestic saving and investment is positive. The response of money supply to positive innovation of inflation is directly related. That is, positive association; a positive shock in inflation leads to the positive reaction of money supply. Then again the reaction of money supply on the interest rate shock reported to be negative. This implied money supply and interest rate have inversely relationship, which is in line with economic theory. A positive shock in real GDP results in a negatively respond by money supply in the first ten quarters before it has a positive effect. In the long run money supply responds positively to economic growth, that is, a positive shock to output leads to increase in money supply. Finally, the reaction of

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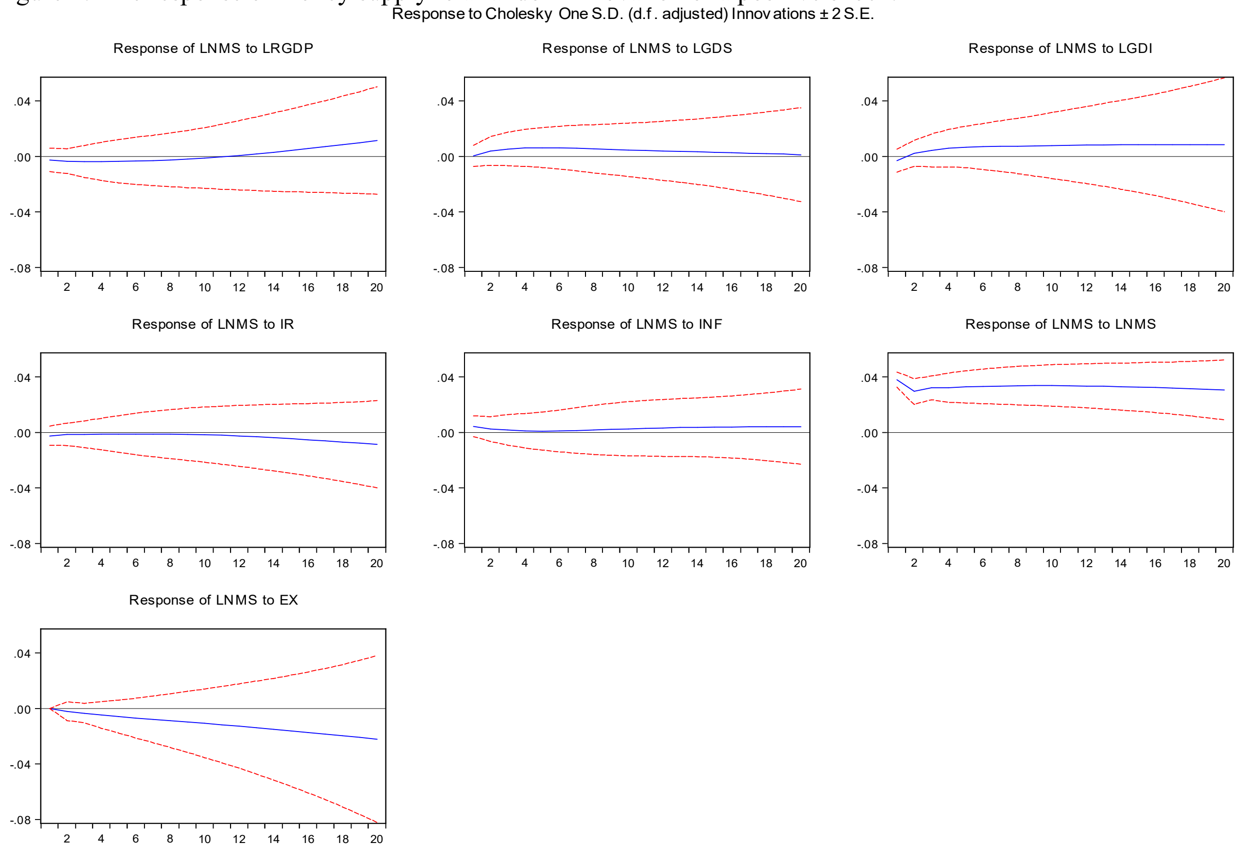
money supply to shock of exchange rate noted to be positive with long lasting effect.

Figure 4.2 the response of money supply to a random innovation of a positive shock.



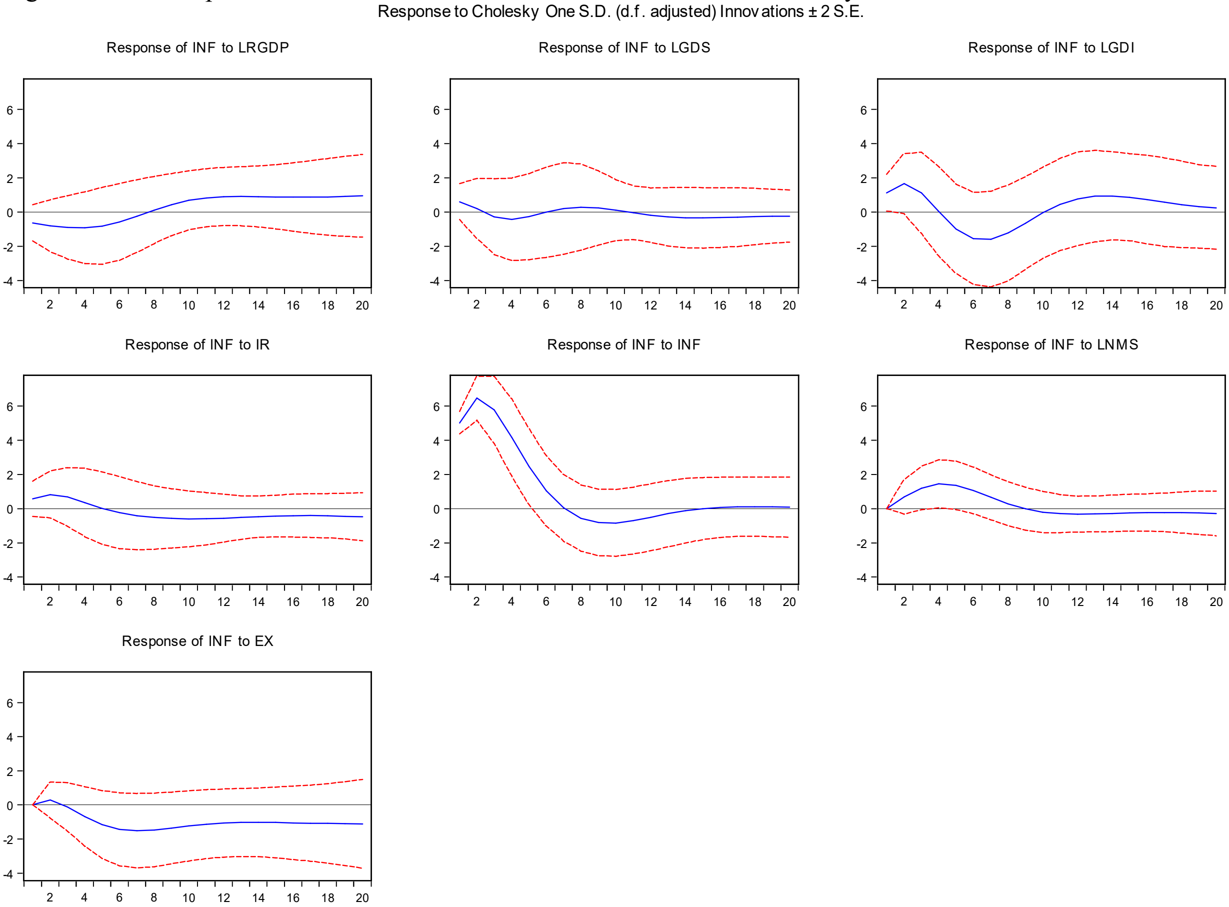
Source: Own computation from E-view 10.

The response of inflation to shocks

Figure 4.3 below plots the response of inflation to a random innovation of a positive shock. In the beginning, the reaction of inflation to shock of real GDP noted to be negative. Through, after eight quarters the effect is positive. The response of inflation to positive innovations of exchange rate is negative. A positive random shock in domestic saving leads to decrease in inflation. When savings increase, expenditure on goods and services would diminish. This means that, more money is accumulating and spends a smaller amount. As result velocity of money circulation would diminish and therefore producers of goods and services income reduce which would leads to reduce (inflation) the price level. An increase in domestic investment increases inflation. An increase in investment boosts the production of goods and services which in turn increases money income and saving. A raise in money income enhances effective demand and then raises inflation.

The reaction of inflation to a positive random shock of interest rate noted to be negative. A positive shock in inflation result in a positively respond by money supply in the first ten quarters before it declines. This is for the reason that, surplus supply of money in the market leads to raising the demand for goods and services which in turn has a positive impact on inflation.

Figure 4.3 .The response inflation to a random shock of other variables in the system.

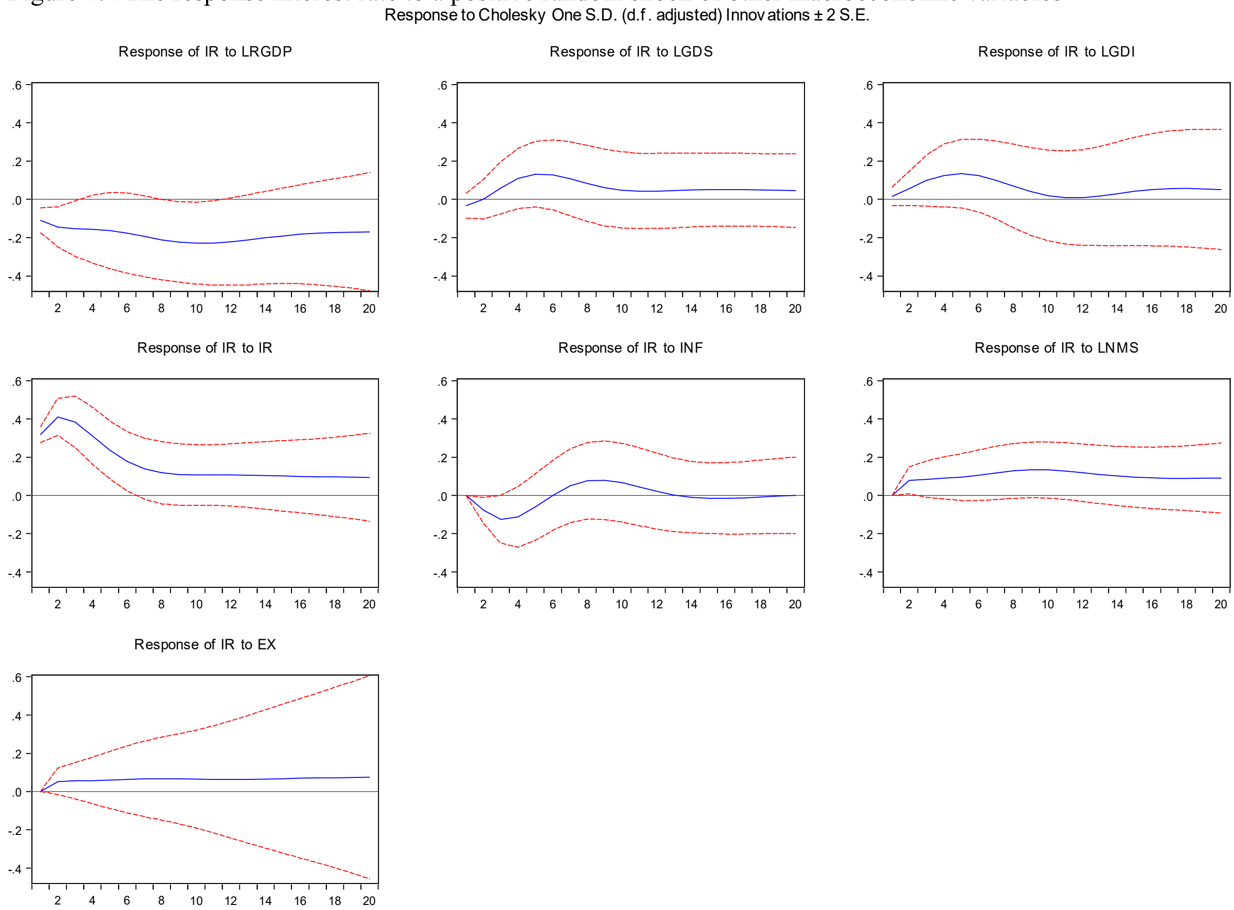


Source: Own computation from E-view 10.

The response of interest rate to shocks

Figure 4.4 plots the response of interest rate to a positive shock of other macroeconomic variables in the system. The reaction of interest rate to shock of domestic saving and investment, money supply and exchange rate noted to be positive. This result coincides with McKinnon and Shaw (1973) view of high interest rate raises the amount of domestic fund (credit), which in turn raises investment by encouraging savings. Whereas, the response of interest rate to economic growth is negative. Initially the reaction of interest rate to the shocks of inflation is positive but declines. After 6th quarter the effect becomes negative but dies away from 14th quarter.

Figure 4.4 The response interest rate to a positive random shock of other macroeconomic variables



Source: Own computation from E-view 10.

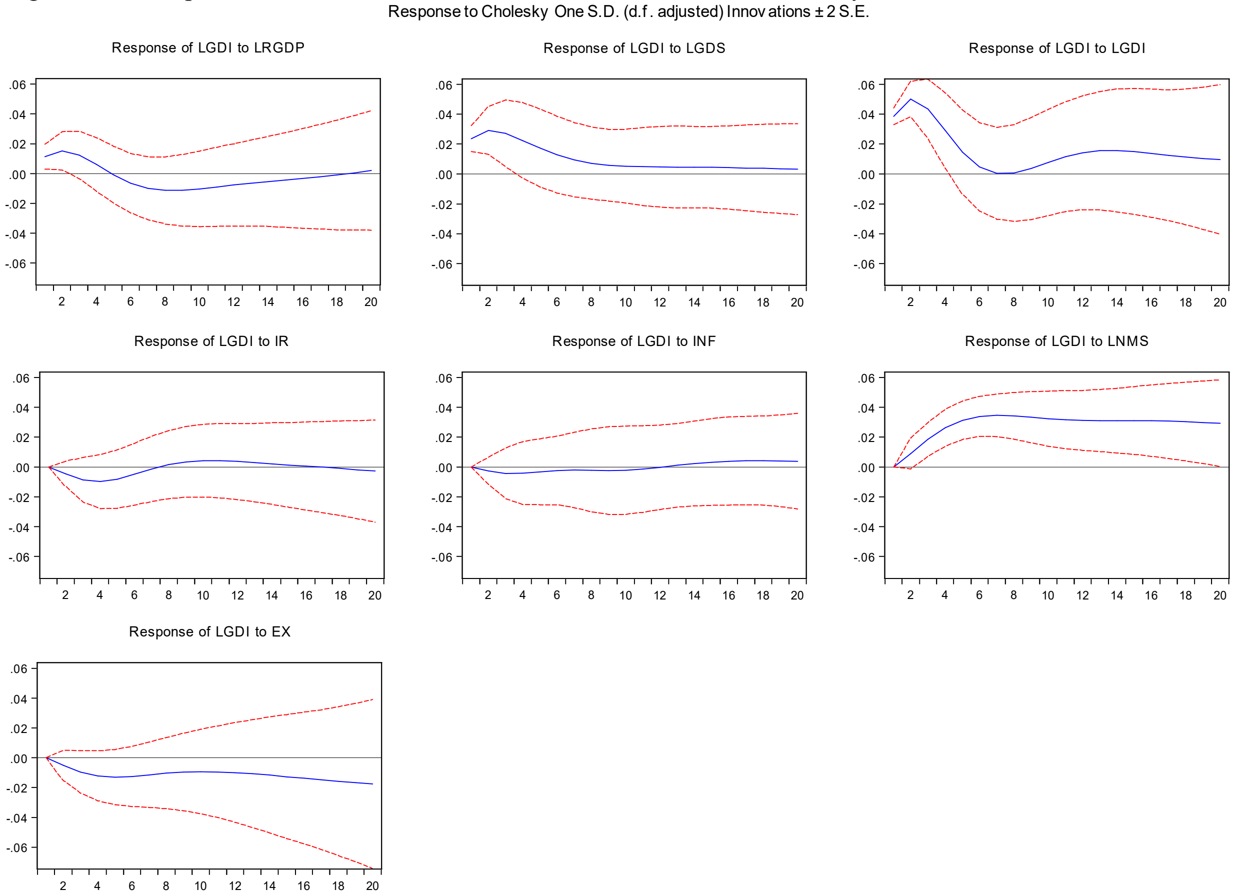
The response of Investment to shocks

Figure 4.5 illustrates how domestic investment responds to a shock to other macroeconomic variables. The response of domestic investment to a positive innovation of real GDP is directly related in the first five quarters. However after 6th quarter the effect is negative but becomes positive starting from 18th quarter, which is in line with the finding of (Mndeme, 2015) in Tanzania, (Namoloh, 2017) in Namibia, (Omoregie & Ikpesu, 2017) in Nigeria and (Shimelis, 2014) and (Yibeltal, 2019) in Ethiopia.

A positive Shocks of domestic saving leads to the positive response of domestic investment, but gradually decreasing. This result is in agreement with prior anticipations and has theoretical and practical sense that increased in savings entails that availability of fund increased, making it possible to convert to investment. According to Harrod- Domar and the MacKinnon models a raise in savings in the economy led to a raise in investment. Empirically, this positive relationship is also demonstrated in the study of (Mndeme, 2015) in Tanzania, (Hishongwa, 2015) and (Namoloh, 2017) in Namibia, (Omoregie & Ikpesu, 2017) in Nigeria and (Shimelis, 2014) and (Yibeltal, 2019) in Ethiopia.

The response of interest rate (lending rate) to a sudden increase in investment is positive in the beginning, but the effect becomes positive in middle period before it becomes negative in later periods. Economic theory suggested a negative relationship between investment and lending rates, which is consistent with (Namoloh, 2017) in Namibia. The direction of investment response to inflation innovation is negative, but weak in the beginning and becomes positive in later periods. The reaction of investment on the money supply shock reported to be positive. When money supply increased saving increased and in turn increases investment flow. In theory (Keynes, 1936) had enlightened that when supply of money raises interest rate declines, investment and real GDP boosts. This result is in line with the suggestion made by Demilie and Fikru(2015) in Ethiopia. Finally, the response of exchange rate shock on investment results a negative impact that is transitory and last throughout for 20 quarters.

Figure4.5 the response investment to a random shock of other variables in the system



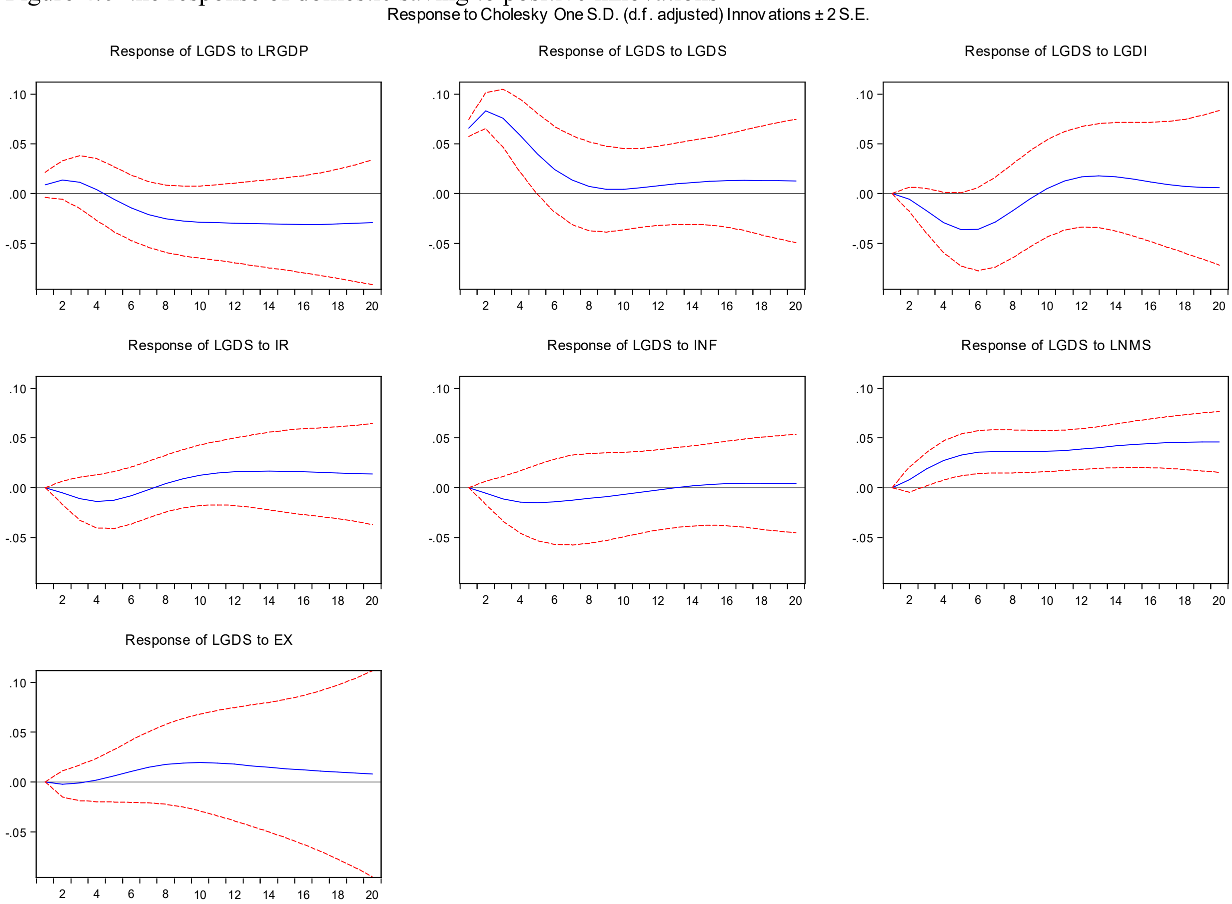
Source: Own computation from E-view 10.

The response of Savings to shocks

Figure 6.6 uncovers the impact of shock of other macroeconomic variables on domestic savings. The reaction of saving to shocks of real GDP noted to be positive in the beginning. Hypothetically, this supports Keynesian theory that is economic growth leads to increased savings. While after six quarters the effect is negative. The response of saving to a shock of investment is negative in the beginning, while the effect is positive after 8th quarter. This result is consistent with the common perception that domestic saving boosts investment. Empirically, this positive relationship is also demonstrated in the study (Mndeme, 2015) in Tanzania, (Namoloh, 2017) in Namibia, (Omoregie & Ikpesu, 2017) in Nigeria, and (Shimelis, 2014) and (Yibeltal, 2019) in Ethiopia.

Initially, a rise in interest rate led to fall in domestic savings, whereas the effect becomes positive after six quarters. Increases in interest rate encourage economic agents to postpone present consumption in order to yield future interest income from the savings. This positive relationship is consistent with is empirical findings by (Namoloh, 2017) in Namibia. It is also manifested from the figure that money supply and exchange rate generate a positive effect on savings, which is revealed by the positive reaction of saving to a shock to supply of money and exchange rate during the entire period. While inflationary pressure affects saving negatively.

Figure 4.6 the response of domestic saving to positive innovations



Source: Own computation from E-view 10.

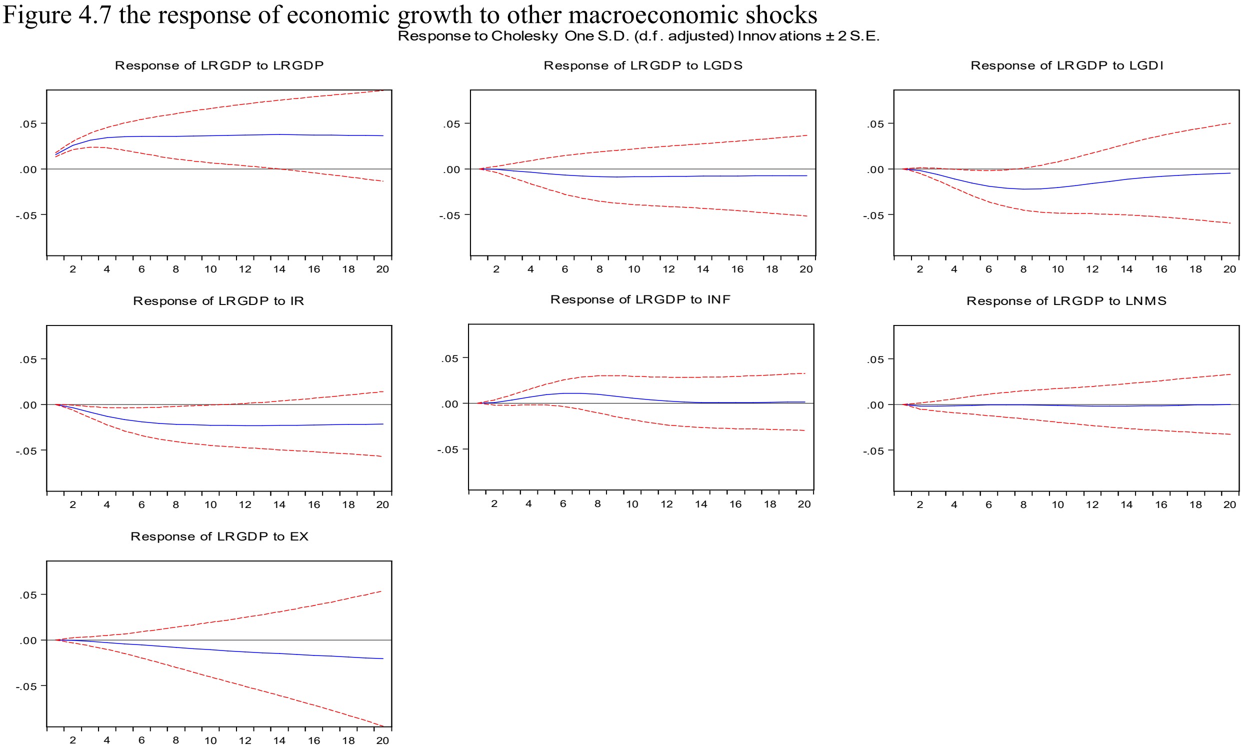
The response economic growth to shocks

Figure 4.7 below provides an assessment of the response of economic growth to other macroeconomic shocks. It is evident from this table that shocks of domestic saving generate negative effect in the beginning and constant (insignificant) effect on economic growth is noted from quarter six, while investment affects economic growth negatively, but declining. This result is consistent with the finding of (Daniman, 2012) in Turkey, (Hishongwa, 2015) in Namibia, (Nwanne, 2016) in Nigeria and Joshi et al., (2019) in Nepal.. Then again the result contradicts with the finding of (Namoloh, 2017) in Namibia, (Omoregie & Ikpesu, 2017) in Nigeria, (Yibeltal, 2019) in Ethiopia.

Real GDP responds negatively to shocks of interest rate. Empirically, this result is also demonstrated in the study of Ahmed et al. (2016) in Pakistan, Yigermal (2018) in Ethiopia, Ezeaku et al. (2018) and Miftahu(2019) in Nigeria. The reaction of real GDP to shocks of inflation noted to be positive in the beginning, but declines. This result is corresponding to the suggestion made Lupu (2016) that inflation exerts on positive impact on economic growth in Romania

Money supply shock generates weak effect on economic growth. This finding is consistent with the suggestion made Precious and Palesa(2014) that money supply is insignificant monetary policy instrument that drives growth in south Africa, Mutuku and Koech(2014) in Kenya, Fasanya et al.(2013) and Imoughele and Ismaila (2014) in Nigeria, Sun(2017) in People's Democratic Republic of Lao. A positive shocks of exchange rate leads to a negative effect on real GDP throughout the whole period. This indicates that a positive random innovation on exchange rate has a contractionary effect on real GDP. Empirically, this negative relationship among real GDP and exchange rate is also demonstrated in the study of Aslam (2016) in Sri Lanka , Yigermal (2018) in Ethiopia, Olu and Idih (2015 ,Ezeaku et al. (2018) ,Ufoeze (2018) and Miftahu(2019) in Nigeria.

Figure 4.7 the response of economic growth to other macroeconomic shocks



Source: Own computation from E-view 10.

Impulse Response function for VECM

To investigate the dynamic interaction among variables, the impulse response function of the vector error correction model is compared with the SVAR model in appendix C1. The response of real GDP to positive shocks of investment, saving, money supply, and interest rate is negative in VECM model, while the response of exchange rate and inflation is positive. This result supports the outcome in the SVAR model.

Shocks of domestic investment generate positive effect on real GDP, money supply, saving and interest rate, while the effect is noted to be negative on exchange rate and inflation. That is, the result is more or less supports the outcome in the SVAR model.

The contemporaneous effect of positive shocks in real GDP, money supply and interest rate led to a positive response by domestic savings. The response of saving to the positive shock in investment, inflation and exchange rate is negative. The finding in VECM model opposes the outcome of SVAR model in the shocks of investment and exchange rate which saving responds.

4.3.1. Variance Decomposition

To trace the effect of a random shock to one endogenous variable on the other variable Impulse response is used, while variance decomposition separates the variation and demonstrates how much of the forecast error variance of each variable explained by the shocks of other variables.

The result of the variance decomposition over a 20 –quarter time period is selected to represent the short run and long run effect on a table in Appendix B3.

As can be seen from the table, variation in real GDP is largely explained by its own shock which accounts for more than 97.7 percent in the first period, but this then fluctuates over time. The effect finally reaches approximately 59.74 percent in the last quarter. Subsequently, interest rate, investment and exchange rate are the second, third and 4th major contributor explaining real GDP's variation. In the first year, they account for around 1.4 %, 0.4%, and 0.37%, and they increased to 19.3%, 9.3%, and 7.6% respectively in the long run. On the other hand inflation, money supply and savings do not have any significant effect on growth variation.

Forecast errors in domestic saving are caused by deviations in the money supply, domestic savings, real GDP and investment. Moreover, the 20th quarter period forecast error, it can be seen that money supply, real GDP and investment have more impact with 35.06 percent, 17.79 percent and 8.34 percent respectively whereas the remnant is accounted for by the other macroeconomic variables. The suggestion of this result is that in the long run, money supply, investment and economic growth begin to impact more on the domestic savings.

The variance decomposition contribution of domestic investment to itself decreases with time from 68.61% in short run to 25.69 % in the long run. In addition real GDP and saving explain around 6.08 % and 25.5% in short run and decreased to 3.8% and 10.18% in the long run respectively. While the variance contributions of money supply and exchange rate to investment increases with time from 1.37% and 0.44% in short run to

50.37% and 8.31 % in long run respectively. From this, we can understand that long term money supply seems to have high contribution than in the long run. Inflation and interest rate contributes low variation both in short run and long run.

Variations in the interest rate are due to variations in real GDP, saving, investment, exchange rate, money supply and inflation. All the variables in the model contribute to its forecast error, but the great deviation comes from real GDP and money supply followed by its own.

At the beginning of forecasting time horizon a high variations of inflation comes from the variations of its own, real GDP, saving and investment. While the variation in exchange rate rise when the forecasting horizon increases and becomes the second largest part of the forecast error variance. But the variations in savings are very small in explaining the variations of inflation rate. This is less than one percent in all other forecasting time period.

The deviation in money supply is highly explained by its own innovations followed by the variations in the exchange rate and investment during the end of the forecast horizon. The table also shows that deviations in the exchange rate are due to deviations in money supply, real GDP, interest rate and interest rate. Real GDP and money supply contributes significantly to its variations in the last time horizon by accounting 23.3 percent and 19.13 percent respectively following exchange rate itself by great portion of 42.66 percent. The remnant is accounted for by the other macroeconomic variables.

4.3.2. Monetary policy transmission channels

In this section different channels of monetary transmission mechanisms with some information about Ethiopian economy structure and monetary policy are discussed. The empirical outcomes indicated that exchange rate channel played a vital role in monetary transmission channel. This is no longer a stunning finding. A recursively identified restrictions on all macro-economic variables included in the model plays a role as discussed above.

The exchange rate channel connects the economy via real GDP, money supply, interest rate, domestic investment and saving. Within this exchange rate channel real GDP, money supply and investment have leading function in determining exchange rate. It is additionally one of the most necessary policy variables, which determines capital and trade flow inflation, international reserve and remittance of an economy. The commencing of floating exchange rate has directed renewed interest to the consequences of devaluation on the change stability of each develop and less developed nations (Yigermal, 2018).As a result, it is necessary for the central bank to control the exchange rate deviation.

.Monetary policy factors like the money supply, inflation and interest rate had a larger impact on economic growth of the country. Mainly, these monetary factors were found to have an impact on output level as shown in the impulse response and variance decomposition results. The possibility that money supply could be the cause of inflation following and the existence of price puzzle can recommend the inadequate capability of central bank to use monetary policy to control inflation.

In the investment channel, devaluation reduces investment flows. Thus, devaluation raises interest rate; an increase in interest rate decreases the money supply and cause return on investment to fall. This situation restricts the capacity of firms to finance their activities as the cost of capital raises because of increase in interest rate and increase in the cost of investment. Therefore, a decrease in domestic investment is possible to happen and cause economic growth to fall.

4.3.3. Model Stability and Diagnostic Tests

Residual vector LM test for autocorrelation, normality test, Hetroscedasticity test of residuals and stability tests are carried out for examining adequacy of model prior to use for associated tests. To show the stability of the model both CUSUM test are commonly practiced.

5. Conclusion and Recommendation

5.1. Conclusion

Interaction between savings, investment and economic growth has been a crucial concern to the development economists and there exists considerable debate both theoretically and empirically over the nature of long run relationship between them. Various studies in literature have examined the relationship between these variables by commonly testing for bi-variate Co integration and Granger causality separately between savings and economic growth, or between investment and economic growth. Yet, little attention has been given to investigate the dynamic interaction between savings, investment and economic growth in multivariate framework in Ethiopia. Therefore, the study aimed at investigating theoretically and empirically the dynamic interaction between domestic saving, investment and economic growth in Ethiopia. Quarterly data from the period ranging from 1992/1993Q1 to 2019/20Q4 on Real Gross domestic saving (RGDS), Real Gross Domestic Product per capita (RGDP), Gross Capital formation or domestic investment (GDI), Inflation rate (INF), exchange rate (Ex), interest rate (IR) and money supply(MS) were utilized to estimate. Co-integration analysis, structural Vector auto regressive (SVAR), Vector Error Correction Model (VECM), Granger causality and variance decomposition response were used to examined not only correlation and causality but also dynamic behavior on the interaction between these variables.

ADF and PP unit root tests shows that all variables are non- stationary at level and ,on the other hand, stationary at first difference which reveals that all the variables included in the model are integrated at first order , that is, I(1). Johansen co- integration test shows that the existence of co- integration between variables which is an indication of long run economic association between the variables. VECM result indicates the existence of a long –run positive relationship among savings, investment and economic growth in Ethiopia. Short run relationships also exist among variables. The long run analysis is followed by a causal analysis. To found causal relationship, this study employed the widely used granger causality, which indicates that there is the presence of unidirectional Granger causality from domestic investment and real GDP to domestic savings and domestic investment granger causes economic growth. This means the past history of economic growth has predicting power in affecting the current value of gross domestic savings. This is the perspective of the Keynesian theory which believes that economic growth give rise to savings

Causality also exists from Money supply, gross domestic saving and investment to exchange rate in the short run. Inflation is Granger caused by money supply and gross domestic investment. Interest rate is also granger caused by inflation, money supply and real GDP. Gross domestic investment is granger caused by money supply unidirectional. Money supply granger causes gross domestic saving Lag of money supply and interest rate are as well identified to granger cause real GDP. Recursive identification cholosky decomposition is used in the SVAR model to validate the result.

The response of exchange rate to a random positive innovation of real GDP and gross domestic investment is reported to be a negative impact. Whereas, the reaction of exchange rate to shocks of interest rate, money supply, inflation and gross domestic saving noted to be positive. A positive shock in real GDP results in a negatively respond by money supply in short run before it has positive effect. In the long run money supply responds positively to shocks of economic growth, saving, investment and inflation. While the reaction of money supply to shock of exchange rate and interest rate noted to be negative. The response of inflation to positive innovations of saving, money supply interest rate and exchange rate is negative in the long run. While the reaction of inflation to shock of real GDP and investment noted to be negative. The reaction of interest rate to shock of saving, investment, money supply and exchange rate noted to be positive. Whereas, the response of interest rate to economic growth and inflation is negative.

The response of domestic investment to a positive innovation of real GDP is positive in the first five quarters. However after 6th quarter the effect is negative but becomes positive in the long run. A positive Shock of domestic saving leads to the positive response of investment and money supply. According to Harrod- Domar and the MacKinnon models a raise in savings in the economy led to a raise in investment. The response of interest rate (lending rate) to a sudden increase in investment is positive in the beginning, but the effect becomes positive in middle period before it becomes negative in later periods. In theory (Keynes, 1936) had enlightened that when supply of money raises interest rate declines, investment and real GDP boosts. The response of exchange rate shock on investment results a negative impact.

In the short run the reaction of saving to shocks of real GDP and investment noted to be positive and negative respectively. Hypothetically, this supports Keynesian theory that is economic growth leads to increased savings. While in the long run the effect becomes vice versa. An increase in interest rate led to an increase in domestic savings in the long run. A rise in interest rate encourages economic agents to postpone present consumption in order to yield future interest income from the savings. Positive reaction of saving to a shock to supply of money and exchange rate is also reported in the same period.

Shocks of domestic saving generate negative effect in the short run and constant (insignificant) effect on economic growth is noted in the long run, while investment affects economic growth negatively, but declining. Real GDP responds negatively to shocks of interest rate and exchange rate. Money supply shock generates weak effect on economic growth. The reaction of real GDP to shocks of inflation noted to be positive in the beginning, but declines.

From the variance decomposition representation of economic growth equation, a great variation in real GDP emanates from itself and investment along with interest rate and exchange rate. The variation in saving comes from money supply, domestic savings, real GDP and investment. Investment deviation is also emanated from Real GDP and saving in short run and decreased the long run. Therefore there is a linkage between domestic savings, investment and economic growth.

5.2. Recommendations

Based on the results obtained from the previous chapter and the conclusion, the following study recommendations are drawn. Granger causality result revealed that domestic investment Granger causes economic growth and also that domestic investment and real GDP collectively Granger causes domestic savings. In connection with this the result also finds evidence of response to shocks and variations of saving emanates from real GDP and investment. This means that policies that increase investment and real GDP led to arise in saving. The variation and response to shocks of investment comes from economic growth and savings as indicated by causality result, impulse response and variance decomposition. Thus, government and stakeholders are supposed to practice macroeconomic policies that will promote economic growth of our country, and gross domestic saving and thus investment will increase.

This result is as well in line with the Keynesian school of thought view which hypothesized that a raise in saving is a result of economic growth. To this perspective, to increase gross domestic saving, the government must attain economic growth. We, consequently, recommend that the governments of Ethiopia be supposed to practice policies that bring about economic growth, for instance increase in government expenditure on infrastructural facilities, industry parks, education, health, research and development, among others. This will automatically increase gross domestic saving. As a result, a rise in domestic saving increases the amount of fund available for investment as well lead to enhance capital formation and investment. This will in the end improve the general welfare of the people.

The result further revealed that exchange rate channel connects the economy via real GDP, money supply, interest rate, domestic investment and saving. So that, the government should consider a policy that promote productivity, expansion of import substituting industries and diversify export promoting investments which are alternative policies for devaluation prior to devaluating its currency. The country is planned to become manufacturing hub in Africa so that, first it needs to promote import substituting investments; the alert in to export oriented investments based on productive planning. Therefore devaluation will be effectual. So that National Bank of Ethiopia should take measures in controlling devaluation and inflationary pressures in the country.

The third policy implication is that, in view of the fact that inflation has unfavorable consequence, the National Bank of Ethiopia should be kept at the level that cannot source unfavorable effects on saving and investment behaviors. The government also recommended to influence commercial banks of the country to reduce lending rate as result potential investors can raise their investment and increase production capacity of the nation.

Generally, proactive policies which would promote investment and promote growth are suggested. Accordingly, over the long run domestic saving will eventually raise and lead to sustainable growth of the economy. It is to be noted that monetary policy could be used to influence savings in the economy through their effects on investment and economic growth

Finally, policy implication and outcome of this research are conditional on variables included in the model, time period of the data and underlying situation of the model employed for the estimation. This is, given the exclusion of some relevant determinants and lack of quarter data on some variables. Second the research tried to specify the magnitude of the response of saving, investment, economic growth and other macroeconomic variables transmission channels and did not investigate deeply monetary policy effectiveness. Lastly the study recommends further research needed to find other factors that would promote economic growth on Ethiopia. Other macroeconomic factors such as external saving or FDI, external debt demographic factors and other variables might be determining factors of saving, investment and growth and might affect the dynamic interaction among these variables. It would also be interesting to employ a Different methodology like DSGE models to contrast the results via the result of this study.

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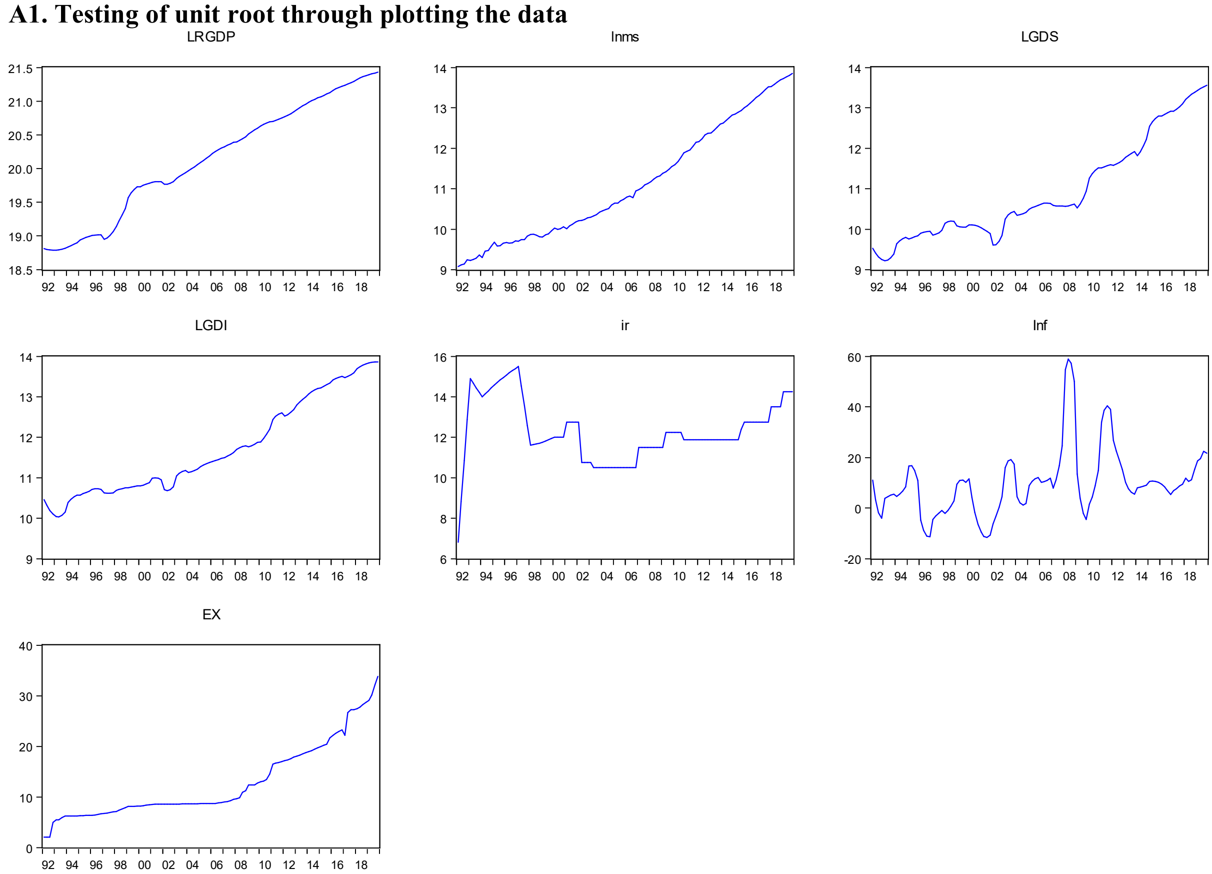
APPENDICES
Appendix. A
A1. Testing of unit root through plotting the data



A2. Lag exclusion Wald test

VAR Lag Exclusion Wald Tests
Date: 04/11/21 Time: 06:25
Sample: 1992Q1 2019Q4
Included observations: 110

Chi-squared test statistics for lag exclusion:
Numbers in [ ] are p-values

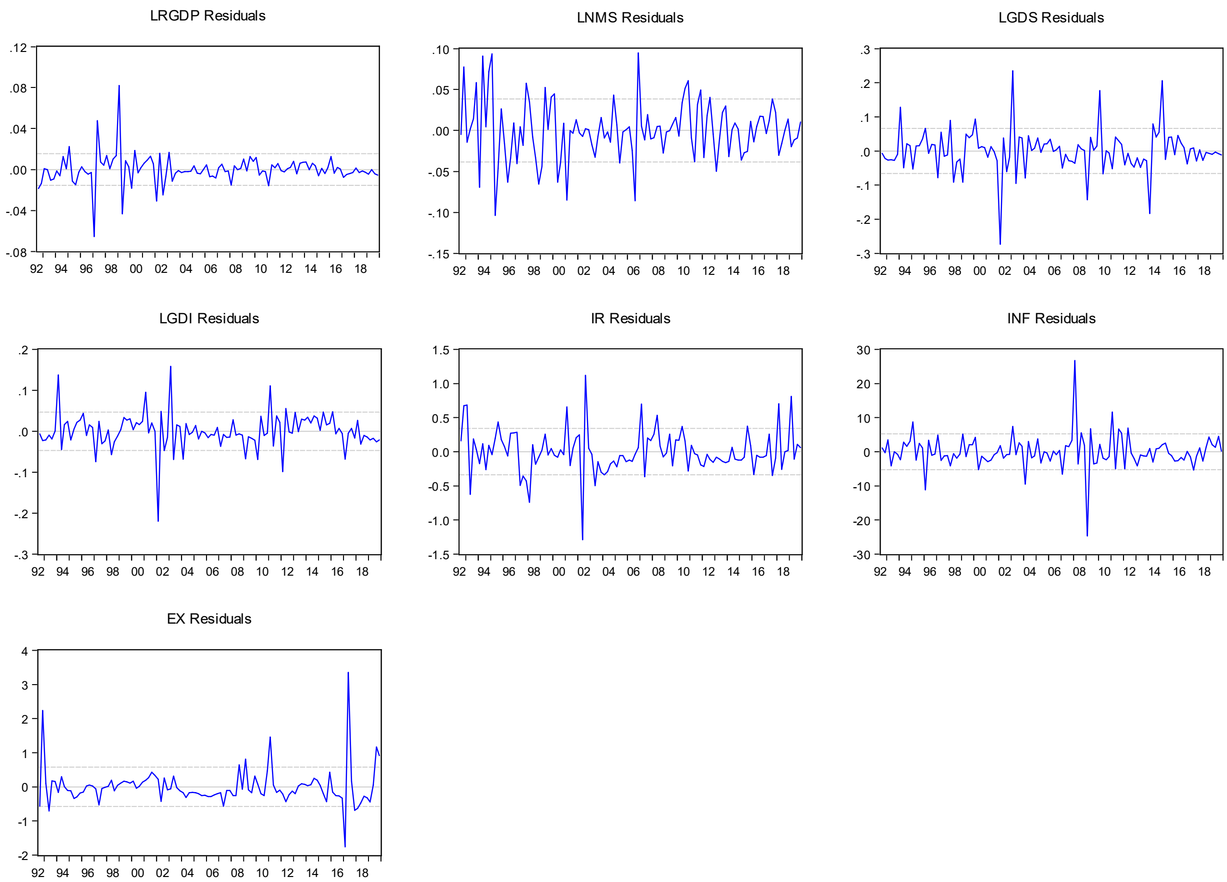
	LRGDP	LNMS	LGDS	LGDI	IR	INF	EX	Joint
Lag 1	611.6279	66.48726	231.0715	268.5433	317.6948	237.4369	94.66622	1831.500
	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
Lag 2	104.3201	6.519036	42.20089	57.56751	74.58551	46.49216	8.883201	330.0447
	[0.0000]	[0.4806]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.2612]	[0.0000]
df	7	7	7	7	7	7	7	49

A3. VAR Residual Serial Correlation LM Tests

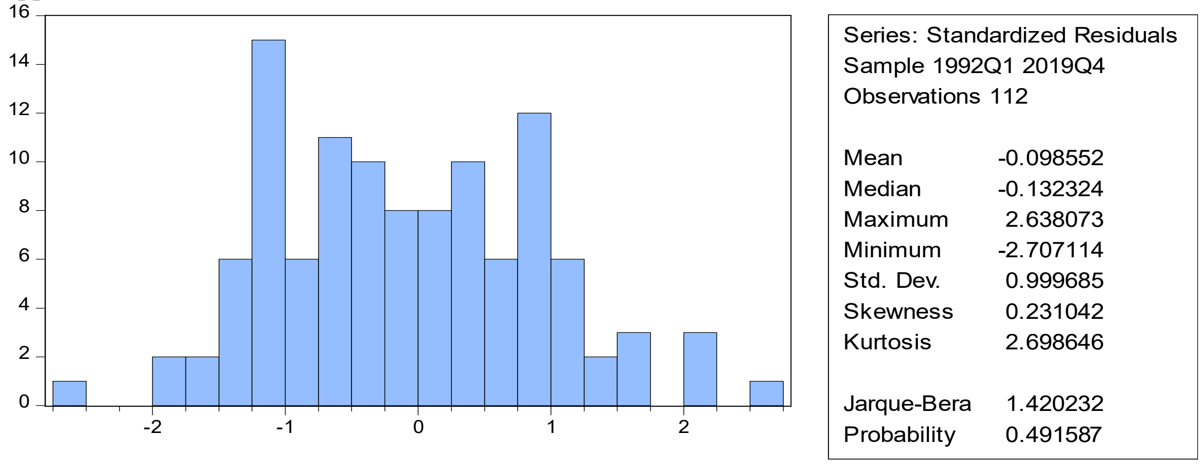
VAR Residual Serial Correlation LM Tests
Date: 04/11/21 Time: 06:39
Sample: 1992Q1 2019Q4
Included observations: 110

Null hypothesis: No serial correlation at lag h						
Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	58.13111	49	0.1744	1.200421	(49, 420.7)	0.1758
2	31.37302	49	0.9764	0.628321	(49, 420.7)	0.9766
3	52.81351	49	0.3290	1.083968	(49, 420.7)	0.3309

A4. Residual test via plotting following to first difference



Appendix B.



B3: Variance decomposition in the Structural VAR model.

Variance Decomposition of LRGDP:								
Period	S.E.	LRGDP	LGDS	LGDI	IR	INF	LNMS	EX
1	0.015547	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.030336	97.71420	0.055658	0.368883	1.406953	0.060245	0.368825	0.025233
3	0.045103	92.60697	0.229525	1.906950	4.204587	0.583967	0.329963	0.138039
4	0.059647	85.76483	0.496473	4.395827	7.191636	1.591653	0.251007	0.308577
5	0.073814	78.79193	0.829550	7.258340	9.728943	2.694799	0.181547	0.514894
6	0.087348	72.78516	1.185593	9.954133	11.68159	3.504551	0.134084	0.754882
7	0.100004	68.15478	1.519769	12.15085	13.16073	3.874295	0.104004	1.035574
8	0.111653	64.86458	1.799675	13.70223	14.31821	3.866643	0.085488	1.363166
9	0.122299	62.68412	2.011825	14.59432	15.26654	3.629226	0.075535	1.738430
10	0.132041	61.33867	2.159296	14.90273	16.07009	3.299593	0.072923	2.156703
11	0.141011	60.57664	2.254836	14.75597	16.75975	2.966297	0.076183	2.610313
12	0.149337	60.19337	2.313935	14.29971	17.34883	2.669842	0.082793	3.091522
13	0.157125	60.03480	2.350292	13.66670	17.84402	2.419835	0.089778	3.594576
14	0.164455	59.99257	2.373892	12.95923	18.25122	2.211963	0.094769	4.116365
15	0.171392	59.99556	2.390876	12.24488	18.57768	2.038409	0.096651	4.655948
16	0.177987	60.00069	2.404307	11.56162	18.83220	1.892099	0.095522	5.213553
17	0.184291	59.98454	2.415233	10.92638	19.02456	1.767515	0.092216	5.789562
18	0.190349	59.93647	2.423681	10.34328	19.16465	1.660349	0.087754	6.383812
19	0.196206	59.85365	2.429398	9.809725	19.26186	1.567117	0.082978	6.995271
20	0.201905	59.73747	2.432278	9.320323	19.32452	1.484969	0.078405	7.622034

Variance Decomposition of LGDS:								
Period	S.E.	LRGDP	LGDS	LGDI	IR	INF	LNMS	EX
1	0.066439	1.721955	98.27804	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.108113	2.253367	96.43063	0.271275	0.221869	0.232011	0.553168	0.037683
3	0.135830	2.148930	92.19075	1.774768	0.781285	0.808032	2.267848	0.028392
4	0.154513	1.725978	85.50308	4.936921	1.388394	1.494922	4.912798	0.037909
5	0.168246	1.568984	77.70993	8.777886	1.714441	2.061187	8.003889	0.163682
6	0.178983	2.042990	70.51867	11.73011	1.709106	2.436182	11.06424	0.498706
7	0.187590	3.129638	64.71275	12.99667	1.565620	2.655261	13.87248	1.067580
8	0.194840	4.593566	60.12079	12.84813	1.495959	2.761176	16.37252	1.807861
9	0.201569	6.170123	56.22327	12.07544	1.599221	2.772743	18.56088	2.598320
10	0.208411	7.667466	52.63632	11.35706	1.860329	2.701215	20.46420	3.313414
11	0.215626	8.997778	49.24395	10.95717	2.209383	2.568579	22.15076	3.872368
12	0.223166	10.15627	46.09204	10.79916	2.577666	2.407714	23.71339	4.253760
13	0.230857	11.17623	43.24671	10.69622	2.921792	2.249959	25.23117	4.477918
14	0.238538	12.09180	40.72890	10.51723	3.222308	2.114313	26.74406	4.581390
15	0.246097	12.92189	38.51749	10.22748	3.474130	2.005476	28.25330	4.600233
16	0.253464	13.67062	36.57419	9.855897	3.678881	1.918798	29.73803	4.563592

17	0.260584	14.33436	34.86148	9.450193	3.840858	1.846799	31.17343	4.492873
18	0.267409	14.90862	33.34831	9.049559	3.965240	1.783469	32.54201	4.402797
19	0.273904	15.39174	32.00889	8.677175	4.057288	1.725534	33.83661	4.302769
20	0.280052	15.78582	30.82030	8.343390	4.121929	1.671855	35.05844	4.198253

Variance Decomposition of LGDI:

Period	S.E.	LRGDP	LGDS	LGDI	IR	INF	LNMS	EX
1	0.046686	5.881484	25.50532	68.61320	0.000000	0.000000	0.000000	0.000000
2	0.076965	6.087805	23.72097	67.89863	0.358193	0.112551	1.377279	0.444571
3	0.096169	5.587798	23.16124	64.09496	1.037413	0.271114	4.591058	1.256414
4	0.107638	4.781023	22.82160	58.46335	1.662428	0.365600	9.620264	2.285743
5	0.115457	4.161371	22.08033	52.42690	1.944610	0.392503	15.73523	3.259061
6	0.122061	4.007003	20.86766	47.05857	1.898015	0.387970	21.81057	3.970208
7	0.128167	4.237489	19.47678	42.68205	1.731498	0.379317	27.09439	4.398477
8	0.133777	4.610409	18.17075	39.17958	1.603587	0.377914	31.42165	4.636118
9	0.138893	4.933592	17.03705	36.41334	1.547431	0.381746	34.90929	4.777553
10	0.143670	5.123094	16.05441	34.31803	1.529946	0.380234	37.71134	4.882942
11	0.148286	5.174330	15.17959	32.81215	1.514039	0.366279	39.96569	4.987924
12	0.152842	5.119390	14.38523	31.74480	1.482087	0.345065	41.80597	5.117452
13	0.157349	4.996660	13.66121	30.92950	1.433207	0.330225	43.35796	5.291229
14	0.161767	4.836364	13.00470	30.20798	1.373684	0.333046	44.72049	5.523739
15	0.166053	4.657714	12.41282	29.48679	1.310446	0.355692	45.95303	5.823511
16	0.170178	4.471841	11.88030	28.73476	1.248858	0.392194	47.07859	6.193462
17	0.174136	4.286106	11.39982	27.95938	1.192879	0.433617	48.09599	6.632206
18	0.177934	4.107507	10.96317	27.18227	1.145830	0.472620	48.99295	7.135655
19	0.181596	3.944379	10.56206	26.42361	1.110924	0.505303	49.75530	7.698431
20	0.185150	3.806529	10.18883	25.69598	1.091399	0.530826	50.37155	8.314892

Variance Decomposition of IR:

Period	S.E.	LRGDP	LGDS	LGDI	IR	INF	LNMS	EX
1	0.338524	10.39271	0.900265	0.230296	88.47672	0.000000	0.000000	0.000000
2	0.567464	10.16821	0.320692	1.070721	83.77846	1.847053	1.963381	0.851490
3	0.729867	10.54995	0.858463	2.464461	78.41952	4.041757	2.544406	1.121440
4	0.840439	11.40288	2.328911	4.064977	72.94090	4.843046	3.098677	1.320601
5	0.917019	12.73656	4.030237	5.546592	67.95039	4.507531	3.692404	1.536285
6	0.975102	14.53435	5.293209	6.534953	63.43002	3.986684	4.439674	1.781108
7	1.024843	16.72930	5.895228	6.880669	59.27417	3.851895	5.340066	2.028672
8	1.071068	19.18540	5.990709	6.725661	55.48926	4.038996	6.320931	2.249040
9	1.114903	21.71623	5.833789	6.340134	52.17127	4.240404	7.269077	2.429099
10	1.155809	24.13423	5.605334	5.927456	49.39541	4.274885	8.088237	2.574450
11	1.193083	26.29822	5.393723	5.568859	47.15651	4.150895	8.731967	2.699822
12	1.226530	28.13472	5.230971	5.275526	45.37766	3.958824	9.202422	2.819880
13	1.256509	29.63344	5.121118	5.046971	43.95007	3.772724	9.530708	2.944968
14	1.283678	30.82903	5.054238	4.889186	42.76983	3.619975	9.757209	3.080535
15	1.308722	31.77965	5.014838	4.804772	41.75738	3.495872	9.919468	3.228016
16	1.332205	32.54871	4.988268	4.782202	40.86064	3.387015	10.04715	3.386014
17	1.354527	33.19240	4.964461	4.797121	40.04893	3.284587	10.16104	3.551459
18	1.375952	33.75345	4.938632	4.822191	39.30495	3.186287	10.27381	3.720682
19	1.396638	34.26001	4.909978	4.836600	38.61844	3.093109	10.39155	3.890310
20	1.416672	34.72792	4.879845	4.830024	37.98251	3.006265	10.51558	4.057851

Variance Decomposition of INF:

Period	S.E.	LRGDP	LGDS	LGDI	IR	INF	LNMS	EX
1	5.256670	1.458339	1.348531	4.639948	1.180125	91.37306	0.000000	0.000000
2	8.610753	1.420498	0.564870	5.435415	1.348681	90.49675	0.625742	0.108045
3	10.56177	1.665489	0.444263	4.750851	1.311969	90.04801	1.694855	0.084562
4	11.51979	2.035202	0.511230	3.994543	1.195486	88.83637	3.010753	0.416416
5	11.98663	2.345093	0.524021	4.361427	1.104348	86.28557	4.073045	1.306497
6	12.27690	2.458429	0.499569	5.759040	1.092149	82.97557	4.618824	2.596416
7	12.50006	2.409715	0.508527	7.180138	1.165280	80.04019	4.730132	3.966020

8	12.67494	2.352270	0.544933	7.915867	1.305215	78.04291	4.648709	5.190092
9	12.81281	2.420145	0.567519	8.000743	1.485664	76.78483	4.549349	6.191745
10	12.93367	2.654482	0.563953	7.853243	1.678621	75.77971	4.490162	6.979831
11	13.05397	3.014975	0.554932	7.825744	1.859125	74.68545	4.461706	7.598066
12	13.17868	3.431299	0.564473	8.022063	2.011141	73.42884	4.440393	8.101796
13	13.30383	3.847211	0.599467	8.359247	2.130193	72.10586	4.413250	8.544770
14	13.42325	4.236303	0.650879	8.705339	2.220926	70.83771	4.379247	8.969601
15	13.53320	4.596327	0.705023	8.969557	2.292254	69.69127	4.342471	9.403094
16	13.63365	4.937475	0.752214	9.122187	2.353462	68.67117	4.306934	9.856555
17	13.72713	5.273548	0.789022	9.175301	2.412455	67.74527	4.275077	10.32933
18	13.81716	5.617410	0.816507	9.156803	2.475504	66.87193	4.248348	10.81350
19	13.90696	5.979152	0.837646	9.093295	2.547402	66.01613	4.228053	11.29832
20	13.99893	6.365473	0.855674	9.003587	2.631448	65.15466	4.215682	11.77348

Variance Decomposition of LNMS:

Period	S.E.	LRGDP	LGDS	LGDI	IR	INF	LNMS	EX
1	0.038653	0.423787	0.013260	0.586478	0.399812	1.313793	97.26287	0.000000
2	0.049100	0.740729	0.655428	0.555660	0.327566	1.049393	96.48310	0.188128
3	0.059357	0.877564	1.265888	0.911792	0.275723	0.812315	95.39033	0.466383
4	0.068364	0.933534	1.770671	1.455420	0.240270	0.641545	94.11485	0.843709
5	0.076742	0.939963	2.094695	1.939230	0.215384	0.524442	93.01474	1.271543
6	0.084541	0.919081	2.270450	2.320509	0.196959	0.447153	92.11327	1.732580
7	0.091861	0.878448	2.337571	2.610375	0.183246	0.400270	91.37357	2.216524
8	0.098765	0.822031	2.333679	2.838431	0.174051	0.378311	90.72968	2.723819
9	0.105315	0.754335	2.286757	3.028582	0.170209	0.376759	90.12305	3.260310
10	0.111562	0.682224	2.215751	3.195305	0.173379	0.390937	89.50818	3.834227
11	0.117555	0.614812	2.132392	3.345038	0.185992	0.416208	88.85195	4.453610
12	0.123335	0.562584	2.043377	3.479256	0.211076	0.448423	88.13042	5.124860
13	0.128941	0.536393	1.952215	3.597214	0.251911	0.484171	87.32602	5.852076
14	0.134408	0.546684	1.860600	3.697861	0.311625	0.520808	86.42546	6.636957
15	0.139769	0.603019	1.769326	3.780830	0.392886	0.556383	85.41853	7.479031
16	0.145054	0.713826	1.678849	3.846697	0.497733	0.589529	84.29736	8.376006
17	0.150293	0.886281	1.589572	3.896794	0.627532	0.619378	83.05628	9.324159
18	0.155513	1.126243	1.501969	3.932851	0.783018	0.645463	81.69179	10.31867
19	0.160741	1.438190	1.416600	3.956631	0.964363	0.667630	80.20268	11.35390
20	0.166004	1.825170	1.334084	3.969677	1.171252	0.685945	78.59023	12.42365

Variance Decomposition of EX:

Period	S.E.	LRGDP	LGDS	LGDI	IR	INF	LNMS	EX
1	0.576425	0.583907	0.468858	0.375744	3.369452	0.222315	3.257713	91.72201
2	0.780787	2.882150	1.580345	0.453787	5.719374	0.129853	3.664107	85.57038
3	0.962792	5.456245	1.463764	1.428951	7.099592	0.235140	5.234882	79.08143
4	1.120667	7.789763	1.091669	2.612252	7.938628	0.447686	6.297097	73.82291
5	1.262216	9.670927	0.946830	3.678108	8.300064	0.670918	7.239459	69.49370
6	1.390045	11.16909	1.064086	4.547975	8.334695	0.834544	8.102215	65.94740
7	1.506862	12.40982	1.320070	5.250613	8.171605	0.919685	8.952770	62.97544
8	1.614924	13.50133	1.602565	5.811385	7.916777	0.937658	9.804068	60.42621
9	1.716061	14.51275	1.851489	6.231508	7.643019	0.910511	10.65200	58.19873
10	1.811591	15.48043	2.048889	6.499789	7.394395	0.859079	11.48705	56.23037
11	1.902462	16.41872	2.199183	6.610943	7.193472	0.798624	12.30297	54.47609
12	1.989435	17.32946	2.314586	6.576029	7.048216	0.738409	13.09851	52.89479
13	2.073215	18.20893	2.407450	6.422006	6.957254	0.682898	13.87621	51.44525
14	2.154486	19.05228	2.487378	6.184219	6.913840	0.633417	14.64052	50.08835
15	2.233875	19.85580	2.560776	5.897611	6.908808	0.589708	15.39617	48.79113
16	2.311907	20.61765	2.631355	5.590657	6.932629	0.551042	16.14711	47.52955
17	2.388968	21.33748	2.700873	5.283177	6.976636	0.516780	16.89591	46.28915
18	2.465299	22.01577	2.769821	4.987069	7.033574	0.486501	17.64352	45.06375
19	2.541011	22.65317	2.837979	4.708384	7.097704	0.459901	18.38948	43.85338
20	2.616103	23.25017	2.904808	4.449482	7.164660	0.436673	19.13228	42.66192

Cholesky Ordering: LRGDP LGDS LGDI IR INF LNMS EX

B4: Impulse response for vector error correction model.