ADDIS ABABA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

IMPACT OF CREDIT SHOCK ON OUTPUT AND PRICE IN CASE OF ETHIOPIA: SVAR APPROACH

BY: MAWEK TESFAYE

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BY: MAWEK TESFAYE

A project submitted to the School of Graduate Studies of Addis Ababa University in Partial fulfillment of the requirement for the Degree in Master of Arts in Applied Economic Modeling and Forecasting

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This is to certify that the paper prepared by Mawek Tesfaye entitled: Impact Of Credit Shock on Output and Price in case of Ethiopia: SVAR Approach, and submitted in partial fulfillment of the requirement of the Degree of Master of Arts in Applied Economic Modeling and Forecasting complies with the regulations of the University and meets the required standards with respect to originality and quality.

BY: MAWEK TESFAYE

Approved by **Signature**

Syed Hasan (PhD) _____

JUNE 2014

ADDIS ABABA

DECLARATION

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

Declared by

Name: Mawek Tesfaye

Signature: _____

Date: 17-June-2014

Confirmed by Advisor

Name: Syed Hasan(PhD)

Signature: _____

Date: 17-June-2014

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Abstract

Using the Structural Vector Autoregression (SVAR) method, this paper analyses the impact of domestic credit shock on Ethiopian economy for the period 1998 to 2013 using quarterly data. Totally six variables are included in our VAR model, four from domestic economy and two from external economy. A number of restrictions were imposed on the contemporaneous relationship of variables to identify the unique dynamic response of inflation and output to the credit innovations. As a result, these shocks were used to generate the structural impulse response and forecast error variance decomposition functions for assessing the dynamic impacts of credit shock on country's real gross domestic product and CPI. The impulse response shows that positive credit shock affect CPI positively for long period of time (about five year)and affect real GDP negatively at the beginning (output puzzle) and then positively after third quarter. Whereas, variance decomposition found that the own innovation of domestic variables, except domestic credit, has the highest proportion both in short-term and long-term forecast error. Innovations of CPI take the highest proportion in explaining forecast error of domestic credit relative to other endogenous variables. Based on the find of the study policy implication forwarded are, taking into account the relative impact of credit shock on output and price monetary policy can stimulate output and stabilize price through instruments that affect credit of banking system.

Key words: Ethiopia, Structural VAR, Domestic Credit, Output and Price

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List of Acronyms and Abbreviations

ADF – Augmented Dickey Fuller

CSA – Central Statistics Agency

EIA – Ethiopian Investment Agency

ERCA – Ethiopian Revenue and Custom Authority

IMF – International Monetary Fund

lncpi – natural logarithmic of Consumer Price Index

lnrdc – natural logarithmic of Real Domestic Credit

lnrgdp – natural logarithmic of Real Gross Domestic Product

lnwfp - natural logarithmic of world food price

lnwop - natural logarithmic of world oil price

MoFED – Ministry of Finance and Economic Development

NBE – National Bank of Ethiopia

PP – Philips Perron

rir – Real Interest Rate

WB – World Bank

Chapter one

1. Introduction

1.1. Background of the Study

Recently there are plenty of literatures, both theoretical and empirical, that support role of monetary policy in stimulating effect on real output and employment under condition of less than full employment level, at least in the short run. Nevertheless, the mainstream classical economists argue that money is neutral or does not affect the real output but only affect the nominal variables. However, other schools of thought such as Keynesian[1] and neoclassical, after then has reaches consensus on the stimulating effect of monetary policy on output in the short run (Brian Snowdon and Howard R. Vane, 2005).

However, economists less agree on the transmission mechanism of monetary policy (B. Bernanke, 1988). The conventional classification of monetary transmission channels in crude term divided in to four channels. Namely, interest rate channel, exchange rate channel, expectation channel and credit channel (Mishkin 1995). Following B. Bernanke and M. Grether (1995) credit channel of monetary transmission mechanisms is divided into balance sheet channel and bank lending channel. They ignore credit channel as self-standing monetary transmission mechanism rather treat as a channel that amplify and propagate the interest rate channel.

According to Bernake and Grether, Bank lending channel focuses on the possible effect of monetary policy on the lending ability and decision of commercial banks (Depositary Corporations). Whereas, balance sheet channel of monetary policy transmission mechanism examines the effects of monetary policy measures on the cash flow and income statement of borrowers.

Domestic credit by banking system is the main counter part of money on the balance sheet of banks, so the same relationship expected to holds between credit and output as that of money and output. Bank lending is the main source of external financing for small firms generally and specifically for

[1] *According to Keynes effective demand created by increase in quantity of money will lead to increase in output and employment with no effect on output until full employment level.*

developing countries. Financial sector of less developed country is characterized by regulated interest rate, no or limited stock market, underdeveloped secondary market and financial asset holding of household are limited, among others. As a result, central banks rely on direct type instruments of monetary policy frequently. Direct type here to mean intervention by central banks with intention to control the monetary aggregates directly developments. Direct intervention includes credit ceiling, selling and buying of bonds/certificates by central banks and direct intervention into foreign market. These make the role of credit as a monetary policy variable most important.

As mentioned earlier, banks lending is the major sources of domestic credit supply in developing countries generally and Ethiopia particularly. Commercial banks major source of funds for extending loans comes from deposit they mobilized from government and non-government (i.e public enterprises, cooperatives, private and sometimes foreign) sectors. On the other hand, the amounts of saving depend on the opportunity cost of saving and income of the agents, among other determinants. Implying that credit supply or loanable fund is determined by the output of the economy. In addition, the amounts of credit extended to the economy alter the level of investment, which ultimately affects the output level and hence the price level.

despite the fact that Ethiopia economy witness high economic growth recently (MoFED annual report, 2012) still it is characterized by low per capita income, under developed financial sector and capital constraint economy. The role of domestic credit in supplementing this growth is not trivial. As IMF article IV report for the year 2012 acknowledged the recent growth of Ethiopian economy, they mentioned the economic growth as public enterprises lead growth. When we look at the share of public enterprise from total credit the bulk of credit is extended to public enterprises, which strength the idea of contribution of credit to economic growth of the country. Moreover, like many developing countries Ethiopian economy is also credit constraint economy this is mainly due to underdeveloped financial sector of the country, among other reasons. According to World Bank ranking of ease of doing business in terms of getting credit Ethiopia ranked 105^{th} in 2013 out of 189 countries, supporting the argument that credit availability is challenging in the country for private sector. This is not only because of low supply of credit but also due to credit rationing activity of financial institution which raises as a result of asymmetric information on the side of lender about their borrowers behavior. In addition to determining output level in the economy, credit also affects the price level. The immediate impact of increase in credit leads to high level of demand. Demand

created due to surge in credit leads to high price level. This effect is significant especially if the credit goes to projects that have long gestation.

National Bank of Ethiopia (NBE) is the institution that has mandate to stabilizing price, exchange rate and financial sector of the country, as can be understood from mission of the bank, to do so NBE takes different policy measure at different time. During 2008/09 and 2011/12, inflation rate was high in the country; annual inflation rate was 55.2 percent and 38.0 percent during the aforementioned years respectively as measured by consumer price index. During this time, among the major policy measures taken by NBE credit ceiling in March 2008 that last for 2 years and zero direct advance to government in 2011/12 fiscal year to curb the then inflation rate is worth mentioning. This implies the considerable importance of credit in altering inflation rate and its significance as policy variable.

To summarize the credit in the economy is affected by the prevailing economic growth in addition to government policy, since increase in economic growth is accompanied by high saving rate (that increases the availability of loanable fund). On the other hand, the rise in credit stimulates the economic growth by increasing the investment level. In addition, at least with short time horizon the increase in credit lead to high demand that leads to inflationary pressures. Similarly, expected inflation can determine the credit demand by changing real interest rate.

1.2. Statement of the Problem

Monetary policy of Ethiopian is designed, like other countries, to achieve stable price and exchange rate, and leads to developed financial sector and hence foster the economic growth of the country. NBE as a responsible institution to design monetary policy of the country set reserve money as operational target and broad money as intermediate target based on the assumption that demand for money is stable. For this reason, the change in broad money accommodates movement of reserve money, which varies due to domestic credit and net foreign asset of NBE. Therefore, to make the growth rate of reserve money within the target NBE uses T-bills, reserve requirement, credit ceiling, determining credit to government, forex market intervention and, etc as monetary policy tools.

The role of credit as monetary policy tools especially to combat inflation is high in Ethiopia. Through affecting credit supplies directly or indirectly by central bank. Different literatures find out

that the effect of credit shock on output and price in credit constraint countries country, like Ethiopia, is significant relative to credit abundant economy (see McCallum (1991), Galbraith (1996) and Balke (2000)). This is due to differ in extent of information asymmetries. This imperfection of credit market affect also the way monetary policy transmitted to aggregate demand (Christina D. Romer and David H. Romer, 1996).

The share of credit to government and public enterprise from total domestic credit is significant in Ethiopia. In addition, government owned financial intermediaries extend considerable amount of credit into the economy. Then the high importance of credit as monetary policy variable and dominance of government and public enterprise in borrowing from banking system raise the need to identifying the effects of credit shock on output and price so that it support the design of sound policy making process.

Moreover, despite enormous literature on the effect of money on output and price in Ethiopian case there are only limited work done on the effect of domestic credit shock on output and price. The existing literature also conducted either on the impact of credit on output (Murty, Sailaj, Wondaferahu, 2012 et al) or on the impact of credit on price separately. Therefore, this particular work tries to narrow the literature gaps.

1.3. Objective of the Study

Recently SVAR approach is widely used for policy analysis to show dynamic relationship between variables by imposing theoretical based restriction on variables to identify VAR model. As mentioned above the role of bank credit in fostering economic growth and determining price level is less studied area in Ethiopian case, despite the fact that the role of financial sector is significant in supporting economic growth of the country through improving the payment system, mobilizing saving and transferring funds where it's valuable more (extending credit), among others. Therefore, the general objective of the study is to examine the impact of unexpected domestic credit shock on output and price by using SVAR approach. Under this general objective, the paper has the following specific objective that tries to address in the study;

- To examine the trend of credit, output and price, and tries to look their relationships.
- To discuss the monetary policy operation of Ethiopia, and role of financial sector in enhancing economic growth.

- To look at the long run relationship or co-integration between credit, output and price.
- To examine the response of output and price, to domestic and foreign variable shocks.

1.4. Scope of the Study

Financial sector includes formal financial sectors that are regulated by rule and law of the country which govern the operation of the sector and informal financial sectors. A formal financial sector includes Depositary Corporation (i.e. central banks and commercial banks) and non Depositary Corporations (i.e. insurances, microfinance, specialized banks etc). An Iinformal financial institution includes ekub, Idir etc. In this study, we focus only on the credit extended by formal financial sector on output and price level of Ethiopian economy by emphasizing on the time ranging from September 1997 to June 2013.

1.5. Significance of the study

The result of this study is expected to help among all the policy makers at NBE and other researcher interested in the same or related areas. In addition it will be used as input in policymaking process to predict the possible impact of credit shock (either policy induced or market driven) on GDP and CPI.

1.6. Organization of the Study

The rest of paper is organized as follows; chapter two reviews literature related with the study both theoretical and empirical literatures, which helps us in our model specification. Following literature review, in chapter three we develop our econometrics model then in chapter four data is described and analyzed so that it pave ways for interpreting the econometric result which is discussed in the fifth chapter. Finally, chapter six conclude and recommendations are forwarded based on the result of the study.

1.7. Limitation of the Study

Like most research studies, this paper is also not free from limitation. Lack of quarterly GDP series is the first challenge face the researcher. To solve this problem and continuo with quarterly data attempts are made by researcher. Bias comes because of GDP disaggregation should be taken into account and caution should be taken when using the result of this research paper for policy input

(like supporting the outcome of this research with other research papers outcome). In addition, similar caution is needed due to the bias comes because of computing interest rate series. Finally, time shortage is also one possible factor that diminishes the quality of the paper, it would have been better if enough time were available.

Chapter two

2. Literature review

2.1. Theoretical literature review

2.1.1. Monetary policy framework

Central bank of a country is responsible to design monetary policies depending on the existing issues and future countries development strategy. Therefore, they set policies and use different tools to achieve their goals. Central bank's target different variables at different levels, the variables they target may differ from country to country but in crude term, there are three targets at different level. Employment creation, economic growth, stable prices are the final target (goal) of most central banks. Instead of targeting goal variables directly, they have intermediate targets that link operational targets and final goals of monetary policy, intermediate targets include monetary aggregates, exchange rate or interest rate. The other target which closely monitored by central banks and central banks have more control is called operational targets, includes reserve money or short-term interest rate. Monetary policy makers employ different tools to achieve their targets, which includes open market operation, discount windows and reserve requirement. By using these tools, they affect operational target variables then intermediate targets. Finally, the change in final target alters the goal variables. (Mishkin, 2004)

2.1.2. Monetary Transmission Mechanisms

The monetary transmission mechanism describes how policy-induced changes in the nominal money stock impact real variables, such as aggregate output and employment (The Palgrave Dictionary of Economics). Similarly, Taylor (1995) defines monetary transmission mechanism as a process through which monetary policy decisions are transmitted into changes in income and inflation. Monetary transmission operates through the effects that monetary policy has on interest rates, exchange rates, credit and expectation generally.

Interest rate channel: Traditional Keynesian view of monetary transmission mechanism through interest rate work as follows, expansionary monetary policy (fall in interest rate) make cost of borrowing lowers causing both business and household investment spending to surge thereby

increase in aggregate demand and then rise in output. Here, real long-term interest rate has major impact on investment spending (not nominal or short-term interest rate).

Exchange rate channel: With globalization and flexible exchange rate regime, more attention is paid to examine how monetary policies affect the economy through exchange rate channel. Expansionary monetary policy, mostly low real interest rate, make domestic currency denominated deposit less attractive relative to foreign currency denominated deposit which lead to depreciation of domestic currency relative to foreign currency. Depreciation in turn makes domestic goods cheaper in international market which foster export and the output.

Credit channel: Credit channel of monetary transmission mechanism incorporates bank loans into IS/LM model, economist like B.Bernanke and M.Gertler claimed that credit channel is not treated as self standing monetary transmission mechanism channel rather its belongs to interest rate channel because credit impact the economy indirectly through interest rate. Generally, credit channel can be classified in to two channels due to B.Bernanke and M.Gertler (1995). The first one is bank-lending channel, which focus on the potential impact of monetary policy measure on the supply of loan by commercial banks. The other channel under credit is balance sheet channel, which stresses the potential impact of changes in monetary policy on borrowers' balance sheets and income statements, including variables such as borrowers' net worth, cash flow and liquid assets.

The idea behind credit channel of monetary transmission mechanism is, central bank's policy alter the decision of commercial banks regarding supply of loan. This idea is comes in contrast to money view, where there is no reference to loan supply shocks (see Bernanke and Gerther, 1995). As A.Markidou and E.Nikolaidou (2006) put it the major shortcoming of money view is the considerable difficulty in the identification of a quantitatively meaningful effect on aggregate spending and investment that the theory indicates it should influence. The credit channel has emerged to fill the gap.

2.2. Empirical literature review

There are only limited empirical literature conducted on monetary transmission mechanism of Ethiopia let alone the methodology they employ (irrespective of whether SVAR methodology is used or not), especially published research papers. Therefore, in this section we try to look at the existing research papers conducted on Ethiopian case with focuses on the impact of credit and

money shocks on output and price, or related area and paper conducted on other countries case, particularly East Africa, using similar methodology with ours.

However, worldwide the relationship between monetary aggregates on one hand and output and inflation on the other hand is one of the most studied areas in monetary economics. The early works by Friedman and Schwartz (1963) conclude that changes in money aggregates leads changes in income in the U.S. Moreover, Romer and Romer (1989), unlike other research papers which employ statistical tools to examine the effect of money expansion on real output they employ narrative approach which focuses on evidence derived from theory. Similarly, for Australia, Sheppard (1973), Davis and Lewis (1977) and Boehm (1983) all found that monetary aggregates' leading real activity but using statistical tools. In addition, Sims (1972) using VAR methodology found out that money led income in granger causality test for U.S.

During early period, money dominates the literature examining monetary transmission mechanism. However, B.Bernanke and A. Blinder (1988) on their research paper "credit, money and aggregate demand" they try to modify the conventional monetary transmission mechanism that give high role for liability side of banks balance sheet so as to permit balanced treatment and giving equal emphasis for asset side of banks balance sheet including loan, bond.

Recently, Leon Berkelmnas (2006) using SVAR approach including seven variables, two foreign and five domestic variables, try to examine the impact of credit and monetary policy shock on output and price in case of Australia. Almost all variables included in this study is integrated of order one. VAR model is employed at level following Sim (1989) and Doan (1990) recommendation, though the variables have unit root. The study found out that the response of credit and price to monetary policy shock is relatively slow and even slower than that of output. On the other hand, in response to macroeconomic consequence of credit shock output, exchange rate and price are moderately affected but it would be higher in absence of monetary policy response.

In contrary to developed economies empirical finding for African case shows that monetary transmission mechanism are full of puzzle, even though some empirical finding witness the puzzles are also there for developed countries. H. Davoodi, S.Dixit and G. Pinter (2013) examined the MTM in the east African community, where reserve money and policy rate are two frequently used instrument of monetary policy. They find that MTM in the region is weak when using standard statistical inference but somewhat strong when using non-standard inference method. Based on

their review of empirical literature they conclude that MTM is strong in Kenya relative to other countries in the region, though only for prices, while it is generally week in the rest of east African community. Cheng (2006) applied both recursive and non-recursive structural vector autoregression (SVAR) to monthly data in Kenya for 1997–2005 and found some evidence for the presence of the traditional transmission channels. For example, cheng (2006) using monthly data for Kenya find out that the existence of both price and output puzzle in the short term. In general, contractionary monetary policies (short-term interest rate) have significant impact on price and less impact on output. In contrary, Maturu, Maana, and Kisinguh (2010) applied the same methodology as Cheng (2006) to study MTM in Kenya using quarterly data and M3 as monetary policy instrument. They find that an exogenous shock to M3, an expansionary monetary policy, has no effect on real output, but leads to rising prices for almost 18 months, which is also statistically significant.

Similarly, Mugume (2011) examine monetary transmission mechanism, applying structural VAR models to quarterly data for 1999–2009, and found all channels of monetary transmission to be ineffective. In particular, the interest rate channel remains weak, even though there is some evidence for a transmission of Treasury bill rate changes to lending interest rates.

A.Yohannes and R.Gottschalk (2010) in there paper entitled "Macro-econometric Model of Ethiopia" consider private sector credit (which includes term loans and banks overdraft loan) as a function of private investment, export and import of goods, and lending interest rate. Therefore, they employ the error correction model to examine the long run and short run dynamics of private sector credit and they find out that in the long run international trade explain credit better than domestic investment activity and lending interest rate. Finally, they conclude that interest rate is not a real problem for private sector credit.

Similarly, K. Murty, K. Sailaja and W.Demissie (2011) examined the long run impact of bank credit on economic growth in Ethiopian case using multivariate Johansen cointegration approach the study covers the period from 1971/72-2010/11. Specifically, the study is focused on the impact of bank credit to private sector in affecting long run economic growth. Variables included in this study are; GDP per worker, per capita capital stock, bank credit to private sector, deposit liability of banks to GDP ratio, openness to trade measured as sum of import and export as a share of nominal GDP. The result obtained from this study shows that there is positive and statistically significant long run relationship between bank credit and economic growth in Ethiopia. In addition, deposit liability also affects long run economic growth through banks service of resource mobilization.

Chapter Three

3. Methodology and Data

3.1. Data

Four endogenous domestic variables and two foreign variables are included in our study. The domestic variables included to represent domestic economy, namely, domestic credit, gross domestic product, consumer price index, and lending interest rate. On the other hand, foreign variables are included to capture the impact of external economic shock on domestic economy. Foreign variables included are world crude oil price and world food price index. The series used for our model is on quarterly basis.

Data source for foreign variables is World Bank database whereas; domestic variables data are obtained from National Bank of Ethiopia, Ministry of Finance and Economic Development (MoFED), Ethiopia Revenue and Custom Authority (ERCA) and Ethiopian Investment Agency (EIA). Moreover, attempts are made by researcher to make the data tailored to the study. The data used and transformations related to variables are discussed as follows;

Real GDP (lnrgdp): We do have GDP data only in annual series, so effort are made to disaggregate it into quarterly basis. Hence, expenditure side accounts (i.e. Consumption, Government expenditure, Investment and Net Export) are used to disaggregate the annual GDP into quarterly series. Based on CSA monthly household consumption survey of 2003 quarterly private consumption are calculated by summing respective three months and the share of each quarters to annual consumption are used to disaggregating household final consumption for all sample periods. The underlying assumption to follow this procedure is that consumption pattern is expected not to change. Whereas, the share of quarterly current expenditure share from annual expenditure are used to disaggregate annual government consumption.

The second component of GDP is investment. We used the share of each quarter to total capital expenditure of government to disaggregate annual government capital formation. Private investment data are obtained by subtracting capital expenditure from gross capital formation then similar methods that are used to disaggregate government capital formation are used to disaggregate private capital formation. Export and import data are obtained on annual basis from MoFED and

ERCA. However, the series shows little difference and since we have quarterly series from ERCA we used the share of each quarter from annual export and import to disaggregate data obtained from MoFED. Finally, by summing up each component obtained by disaggregation we estimate quarterly nominal GDP series and deflate it by CPI to get real GDP series.

Real Lending Interest rate (rir): The existing simple average interest rate (average of maximum and minimum interest rate) of the banking system from NBE's bulletin fail to shows as the real cost of borrowing and lack variation overtime, so, researcher stick to find other proxy for cost of borrowing. Therefore, real lending interest rates measured as ratio of total commercial banking interest incomes to total commercial banks lending. To convert this ratio into real we deduct quarterly price level and then use the obtained result as real lending interest rate.

Real Domestic credit (lnrdc): we got quarterly gross banking domestic credit (before deducting the government deposit with depositary corporations) from NBE database. Like GDP series we deflate nominal domestic credit by quarterly CPI to obtain its real counterpart.

CPI (lncpi): Consumer Price Index is obtained from CSA on quarterly basis and the base year used is to index is December 2011.

World crude oil price and food price (lnwop and lnwfp): Obtained from World Bank database on monthly series and converted to quarterly frequency by simple average the monthly values.

Most of the domestic variables are expected to characterize by seasonality's and deterministic time trend. Therefore, in addition to the aforementioned variables, quarterly dummies and time trend are included in our VAR model. However, before including seasonal dummies, we employ LR test to check whether to include dummies or not, that will be discussed in the methodology part. Moreover, all variables are transformed by natural logarithms except interest rate series.

3.2. Stationarity Test

Stationarity property of time series data should be checked prior to any estimation, so in this study we used augmented dickey fuller test (ADF) and Philips Perron test (PP) to check for existence of unit root in our series. We used lag length suggested by Schwarz information criteria in regression for unit root test. In addition the issue of detrended or trended data in regression for unit root test we rely on graphical inspection and significance of trend and constant term in unit root test regression. Then the following hypothesis is tested;

H_0 : unit root present

H_1 : no unit root

The results of these tests are depicted in the table below;

Table 3.1: ADF and PP test Results at level*

Variables	ADF test		PP test	
	With trend	**Without trend**	**With trend**	**Without trend**
Lnwop	-4.021 (0.013)	-1.351 (0.600)	-3.088 (0.118)	-0.975 (0.757)
Lnwfp	-3.587 (0.039)	-0.305 (0.918)	-2.708 (0.237)	-0.335 (0.913)
Lnrgdp	-2.527 (0.315)	0.507 (0.986)	-6.618 (0.000)	-1.403 (0.575)
Rir	-7.457 (0.000)	-6.844 (0.000)	-7.444 (0.000)	-6.844 (0.000)
Lnrdc	-2.524 (0.316)	-1.639 (0.457)	-2.524 (0.316)	-1.657 (0.448)
Lncpi	-1.464 (0.832)	1.805 (0.998)	-1.472 (0.829)	1.759 (0.999)

Source: *own computation using Eviews 7*

*numbers in parenthesis are p-value of the test

The above table shows as that ADF test (at 5 percent of significance level) find that lnwop, lnwfp and rir are trend stationary at level (only rir is stationary both with and without trend). In contrary to ADF test, PP test at the same significance level found out that only lnrgdp (trend stationary) and rir is stationary. The rest of variables are found to be non-stationary. Therefore, the next step is to check for amounts of differencing needed to convert it into stationary series. The table below depicts the ADF and PP test statistics and its P-values at first difference of variables that are found to be non-stationary at level;

Table 3.2: ADF and PP test Results at first difference*

Variables	ADF test		PP test	
	With trend	**Without trend**	**With trend**	**Without trend**
Lnwop	-6.370 (0.000)	-6.416 (0.000)	-5.471 (0.000)	-5.543 (0.000)
lnwfp	-6.096 (0.000)	-6.036 (0.000)	-5.322 (0.000)	-5.266 (0.000)
lnrgdp	-12.791 (0.000)	-12.758 (0.000)	-22.047 (0.000)	-20.882 (0.000)
lnrdc	-8.688 (0.000)	-8.721 (0.000)	-8.711 (0.000)	-8.725 (0.000)
lncpi	-7.695 (0.000)	-7.139 (0.000)	-7.694 (0.000)	-7.134 (0.000)

Source: *own computation using Eviews 7*

*numbers in parenthesis are p-value of the test

As depicted in the above table the rest variables become stationary both by ADF and PP test after first differencing, so they are integrated of order one, I(1).

3.3. Lag Length Selection and Diagnostic Tests

We used standard lag length selection criterion to choose for number of lag included in our model. Therefore, information criteria, likelihood based test and wald lag exclusion test are used. The information criterions are Akaike information criterion (AIC), Schwarz information criterion (SIC) and Hannan-Quinn information criterion (HQ), whereas the likelihood based tests includes, final prediction error test (FP) and sequential modified likelihood ration test (LR) are used. Using lag length favored by each criterion, we undertake residual diagnostic test so that it enables us to choose the best model.

Given the sample size and frequency of our data, we select maximum lag of four and conduct the test. Therefore, SIC and HQ criterion favors lag one whereas LR and FP test choose two lags. Highest lag is selected by AIC, three lag. Using the selected different lag length we conduct the following residual based specification tests; Breusch–Godfrey LM test of autocorrelation (H_0: no autocorrelation), Jarque-Bera non normality test (H_0: normality) and White heteroskedasticity test without cross term (H_0: homeskedastic). The results of the tests are summarized in the table below.

Table 3.3: Residual Diagnostic Test Results at Different Lag Length[2]

Tests	Test statistics for Lag 1	Test statistics for lag 2	Test statistics for lag 3
Breusch-Godfrey LM_1 autocorrelation test	63.48(0.00)	42.67(0.21)	46.64(0.11)
Joint Jarque-Bera non normality test	86.68(0.00)	23.69(0.02)	27.45(0.01)
White Heteroskedasticity test without cross terms	1289.30(0.16)	605.63 (0.53)	886.38(0.27)

Source: Own computation based on Eviews 7 result

[2] Number in parenthesis are p-value

As clearly shown in the above table, lag length two for our VAR model seems good since it passes autocorrelation and heteroskedasticity diagnostic test. Moreover, Wald test for lag exclusion is also reject the null hypothesis of joint insignificancy of the second lag (with p-value 0.000) and accept the null of insignificance of third lag (with p-value 0.1010). The residual of our model is non-normal at 5 percent of significance level and since non-normality of the error term makes only the inference invalid but the coefficient estimated is still consistent we do not consider it as a serious problem. Therefore, we employ lag length two in our reduced VAR model.

3.4. Cointergation Test

If we have non-stationary variables of the same order and if some linear combination between them is stationary we can say the variables are cointegrated or have long run relation. Therefore, to test whether our variables are cointegrated or not we conduct Johansen multivariate cointegration test for non stationary variables to uncover the number of cointegrating equation. Hence, we used the two likelihood ratio based tests; maximum eigenvalue test and trace test. The test result is depicted in the following table:

Table 3.4: Johansen Multivariate Co-integration test Results[3]

Null hypothesis	Trace test		Maximum eigenvalue test	
	Alternative hypothesis	Trace statistics	Alternative hypothesis	Max-Eigen statistics
$H_{0:}$ r=0	$H_{1:}$ r≥1	89.7 (0.000)	$H_{1:}$ r=1	38.0 (0.015)
$H_{0:}$ r≤1	$H_{1:}$ r≥2	51.7 (0.021)	$H_{1:}$ r=2	20.4 (0.317)
H_0: r≤2	$H_{1:}$ r≥3	31.3 (0.033)	$H_{1:}$ r=3	17.5 (0.15)
H_0: r≤3	$H_{1:}$ r≥4	13.8 (0.088)	$H_{1:}$ r=4	12.5 (0.094)
H_0: r≤4	$H_{1:}$ r≥5	1.4 (0.245)	$H_{1:}$ r=4	1.4 (0.245)

Source: *own Computation*

The cointergation test is conducted by including intercept terms and allowing trend term in the data. As a result, trace test found out three cointegrating equation whereas, maximum eigenvalue test discover only one cointegrating equation. In general, we can conclude that there is cointegrating relationship between our variables **(see Appendix A.1).**

[3] Number in parenthesis are P-value of the corresponding statistics

3.5. Model Specification

After Sims (1980) influential paper VAR methodology become popular in time series econometrics. VAR model is mostly used for forecasting and to know the dynamic response of variables to different shocks. However, Cooley and Leroy (1985) criticized VAR methodology by its atheoretical identification system which lead to the development of SVAR models by economists like Sim(1986), Bernanke (1986), Blanchard and Qua *et al* (1989), they used VAR methodology by basing the identification on theory. Currently SVAR methodology is widely used in time series econometrics particularly in identifying monetary transmission mechanisms.

It is not possible to estimate SVAR equation directly (like equation 1) by following conventional estimation methodology due to the correlation between error terms and endogenous variables so first we estimate reduced form VAR model by OLS method. Besides, SVAR is over parameterized so, we must place enough restriction to recover structural parameters and get unique impulse.

Finally, to interpret our result we used two VAR tools; impulse responses function and forecast error variance decomposition and the result are analyzed. Impulse response function tells us the response of one or all variable in the system to exogenous shocks whereas, forecast error variance decomposition determine the contribution of each variables in explaining the h period a head forecast error of variables.

3.7. Reduced form of VAR

Following Sims (1980), Doan (1992)[4] and et al recommendation we estimate VAR at level given that the variables contain unit root and cointegrated. They argue that in VAR model our interest is not parameter estimation rather it is to determine the interrelationship between variables, in addition, they claim that differencing will through away the co-movement between the variables and it leads to impose invalid restriction[5].

Our model is assumed to be have the following structural form;

$$A y_t = \sim_0 + \quad _1 y_{t-1} + \ldots + \quad _p y_{t-p} + c z_t + B £_t \qquad (1)$$

[4] See W. Enders,2nd edition, page 301
[5] See J. Hamilton 3rd edition, page 652

Where, A is 6 X 6 instantaneous parameters and normalized to have unit elements on the main diagonal. y_t = (world crude oil price, world food price, real GDP, real lending interest rate, real domestic credit and CPI) is 6 X 1 vector of all endogenous variables. y_{t-p} is 6 X 1 vector of lag of our endogenous variable and p is lag order of auto regressive process included in our VAR model, in our case two lags are included based on lag length criterion discussed above. z_t contain all deterministic terms, in our case three seasonal dummies and time trend are included; ε_t is 6 X 1 innovation term of our structural model and assumed to be distribute as $£_t \sim (0, I_n)$; α_0 are constant term, B is 6 X 6 diagonal matrix and, all β's and C are coefficients of respective variables.

Our reduced form VAR is assumed to be like this:

$$y_t = A^{-1}\sim_0 + A^{-1}\ {}_1 y_{t-1} + \ldots + A^{-1}\ {}_p y_{t-p} + A^{-1} C Z_t + A^{-1} B £_t$$

In compatible form, the reduced form of VAR can be written as:

$$y_t = ¤_0 + ¤_1 y_{t-1} + \ldots + ¤_p y_{t-p} + ¨ Z_t + e_t \qquad (2)$$

Defining $A^{-1}\sim_0 = ¤_0$, $A^{-1}\ {}_1 = ¤_1$, $A^{-1}\ {}_p = ¤_p$, ¨ =A^{-1}C and $A^{-1} B £_t = e_t$. Where, e_t is 6 x 1 observable error terms of our reduced form VAR model $e_t \sim (0, \Sigma_e)$. Σ_e is variance covariance matrix of reduced form model residual and assumed to be symmetric matrix.

Prior to estimating equation (2) we check whether inclusions of dummies improve our model or not. To check it we conduct LR test with null hypothesis of no seasonal dummy and we calculate the LR statistics manually, the statistics have the following form;

$$LR_{stat} = (T - n)[\ln |\Sigma_r| - \ln |\Sigma_{unr}|] \sim x^2(q)$$

Where, T is the number of observation (62 after adjustment); n is number of equation multiplied by lags in each equation plus deterministic terms and constant (17 in our case); $|\Sigma_r|$ and $|\Sigma_{unr}|$ are determinants of residual covariance of restricted and unrestricted model respectively. The LR statistics have chi-square distribution with q degrees of freedom; q is number of equation multiplied by number of dummies (i.e. 18). The computed LR statistics is equal to 47.6 (LR_{stat}=47.60) wich is compared with chi-square critical value of 5% significance level of equal to 28.87 (x^2(18) at 5%

equal to 28.87). The statistics value is greater than critical value so, we reject the null and proceed with model including dummies.

Therefore our reduced form VAR model include six endogenous variables with two lags for each endogenous variable, constant, time trend and three seasonal dummy are estimated using OLS **(see appendix A.2)**

3.8. Parameter Stability Test

After reduced form of VAR is estimated, model stability test should be checked. Model stability is necessary for prediction and econometric inference (B. Hansen, 1991). If the VAR is not stable some results may become invalid, for instance impulse response standard errors are unacceptable in case of unstable VAR. Therefore, to look at the stability of our reduced form VAR model we used inverse roots of characteristics auto regressive polynomial. The result obtained from the test shows that our VAR model satisfies stability condition and all roots lies inside the unit circle **(see appendix A.3)**.

3.9. Identification of SVAR

We can only observe the reduced form VAR but our interest is on the structural model so, we must recover the structural model parameter, equation (1), from the observed reduced form VAR, of equation (2). Instead of identifying the structural VAR coefficients, SVAR identification focuses on the errors of the system, which are interpreted as (linear combinations of) exogenous shocks ((Lutkpohl, 2005).

There are two types of identifying restriction; short run restriction and long run restriction. The popular method for short run restriction is called AB model, familiarized by Amisano & Giannini (1997). We employ AB model to place zero restriction in our contemporaneous relation matrix, only then we can specify unique innovation and hence unique impulse response (Lutkpohl, 2005).

The error terms of structural VAR equation (1) and reduced form VAR are related in the following way:

$$B\,£_t = A\,e_t$$

From this equation the distribution of structural model and reduced model related as

$$e_t = A^{-1} B \pounds_t$$
$$e_t \sim (0, \Sigma_e)$$
$$e_t \sim (0, A^{-1} B I_n B^{l} A^{-1 l}) \quad \text{Because } \pounds_t \sim (0, I_n)$$

A matrix is assumed to have unit element in the main diagonal so, it contains 'n^2-n' (where n is number of endogenous variables) unknown elements. On the other hand B matrix is assumed to be diagonal matrix, having only 'n' unknown elements whereas variance covariance matrix of structural model ($\sum_{\pounds}$) is identity matrix. Therefore, totally we do have n^2 unknowns in our SVAR (n^2-n element of A plus n element of B). On the other hand, variance covariance matrix of reduced form ($\sum_e$) is symmetric so it contain (n^2+n)/2 distinct elements. Hence, to recover n^2 unknowns from (n^2+n)/2 known's order condition require n (n-1)/2 unique restrictions (i.e. n^2-(n^2+n)/2) on A matrix (Rothenberg, 1971).

Numerically order (necessary) condition requires us to set 15 contemporaneous restrictions whereas the rank (sufficient) condition necessitate linear independency of restricted coefficient (Helmut Lutkepohl, 2004). Therefore, based on theory and stylized facts for Ethiopia we impose the following restriction.

$$\begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ A_{21} & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & A_{36} \\ A_{41} & A_{42} & A_{43} & 1 & A_{45} & A_{46} \\ A_{51} & 0 & A_{53} & 0 & 1 & A_{56} \\ A_{41} & A_{62} & 0 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} e_1^{\ln wop} \\ e_2^{\ln wfp} \\ e_3^{\ln rgdp} \\ e_4^{rir} \\ e_5^{\ln rdc} \\ e_6^{\ln cpi} \end{pmatrix} = \begin{pmatrix} B_{11} & 0 & 0 & 0 & 0 & 0 \\ 0 & B_{22} & 0 & 0 & 0 & 0 \\ 0 & 0 & B_{33} & 0 & 0 & 0 \\ 0 & 0 & 0 & B_{44} & 0 & 0 \\ 0 & 0 & 0 & 0 & B_{55} & 0 \\ 0 & 0 & 0 & 0 & 0 & B_{66} \end{pmatrix} \begin{pmatrix} \pounds_1^{\ln wop} \\ \pounds_2^{\ln wfp} \\ \pounds_3^{\ln rgdp} \\ \pounds_4^{rir} \\ \pounds_5^{\ln rdc} \\ \pounds_6^{\ln cpi} \end{pmatrix}$$

Where e_i and $\pounds_j$ are error terms of reduced from model and structural model respectively. The coefficient A_{ij} indicates that variable *j* affects variable *i* contemporaneously, whereas for zero coefficient it mean variable j does not affect variable i contemporaneously. Ordering of error terms are as follows;

$$\begin{pmatrix} £_1^{\ln wop} \\ £_2^{\ln wfp} \\ £_3^{\ln rgdp} \\ £_4^{rir} \\ £_5^{\ln rdc} \\ £_6^{\ln cpi} \end{pmatrix} = \begin{pmatrix} \textit{shock to world oil price} \\ \textit{shock to world food price} \\ \textit{shock to real GDP} \\ \textit{shock to real interest rate} \\ \textit{shock to real domestic credit} \\ \textit{shock to consumer price index} \end{pmatrix}$$

Our restrictions begin by setting zero restriction on contemporaneous effect of domestic variable on both foreign variables, since Ethiopia is small economy it's fair to assume that both foreign variables doesn't affected by all domestic variables contemporaneously. Zha (1999) and Dungey and Pagan (2000) called this form of strict treatment as the foreign block exogenity. But, we assumed that world oil price have immediate impact on world food price contemporaneously. In the third row of the above matrix we assume that GDP is affected instantaneously only by shock on CPI implying output have only sluggish response to different shocks. On the fourth row we assumed that all included variables immediately affect real lending interest rate indirectly through their effect on price and credit. The fifth row, domestic credit, is assumed to be affected immediately by all domestic variables but only world food price and real interest rate. Finally, we restrict so that domestic variables does not affect CPI is contemporaneously because like real GDP price is also respond only slowly to domestic variables shock.

Restrictions we impose here is more than required by order condition to just identify the model require. We set 18 restriction when only 15 is required to just identify the model but nothing is wrong to over restrict rather if over identification restriction have been imposed should the following test should be checked for validity of over identification.

$$a_{LR} = N(\ln\left|\tilde{\Sigma}_e^r\right| - \ln\left|\tilde{\Sigma}_e\right|)$$

Where $\left|\tilde{\Sigma}_e^r\right|$ and $\left|\tilde{\Sigma}_e\right|$ are determinants of estimated residual covariance matrix of restricted and unrestricted model respectively and N is sample size. Under the null hypothesis that the restrictions are valid, it has an asymptotic χ^2-distribution with degrees of freedom equal to the number of over-identifying restrictions (H. Lutkepohl, 2005). The result of this test is discussed in chapter five after the SVAR parameters and innovations are estimated.

Chapter Four

4. Discussions and Results

4.1 Descriptive Analysis

4.1.1. Monetary Policy Operation of NBE and the Role of Credit

Ethiopian Monetary policy strategy is categorized under monetary aggregate targeting. NBE set reserve money as operational target and follow up its daily development. Since reserve money or high-powered money is obtained entirely from the balance sheet of banks, NBE has information advantage with short period lags. As discussed in the introduction part of chapter one money demand function is assumed to be stable so, based on this assumption the intermediate target is broad money that lay between operational target and final target of monetary policy. The final target includes stable price level and foster economic growth of the country, among others.

Monetary policy tools used by NBE to control the development of reserve money and hence, broad money includes weekly Treasury Bills auction market, reserve requirement ratio, intervention in foreign exchange market, setting minimum deposit rate, credit ceiling are the majors. Using those tools most of the time NBE, determine the amount of credit disbursed in to the economy. For instance, through sale of T-bills it can affect credit of commercial banks to government, through changing reserve requirement ratio can alter the amount of loanable fund available and money creating power of commercial banks and through changing minimum deposit rate can change the level of credit since the deposit rate manifest itself on lending rate.

4.1.2. Financial Sector of Ethiopia

Financial sector development is crucial for one country economic development. They promote economic development by allocation of limited resource to most productive sectors and through capital accumulation. Ethiopia formal financial sector is composed of 1 central bank (NBE), 18 depositary commercial banks (2 of them are government owned), 1 government owned specialized bank (DBE), 31 microfinance and 16 insurance companies are operate as of June, 2013. Even though it is advised by international institutions such as IMF and World Bank to open the economy so that it is possible to reap the benefit of globalization, still the financial sector of the country is closed for foreign sectors. The main reason behind is the domestic institutions especially banks are

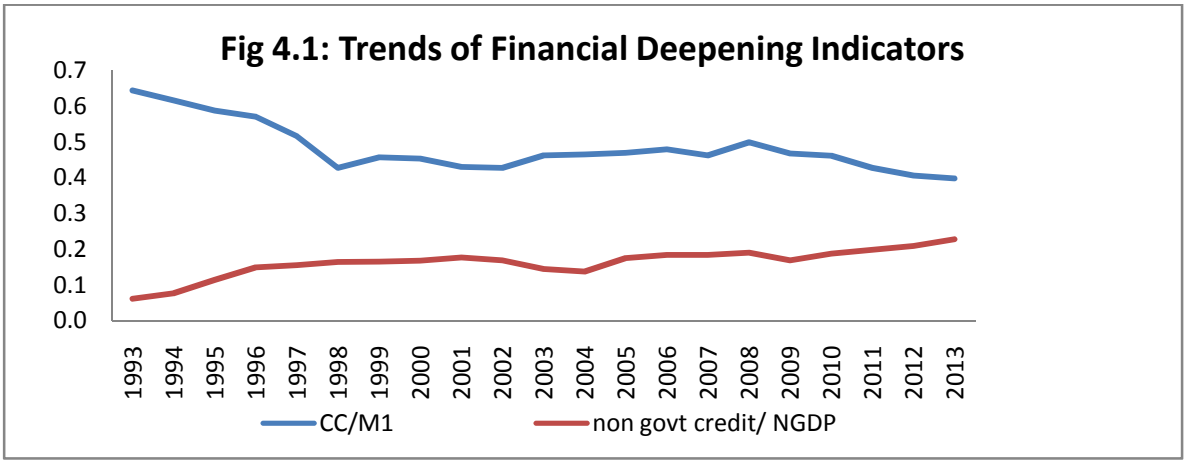


Fig 4.1: Trends of Financial Deepening Indicators
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
CC/M1
non govt credit/ NGDP

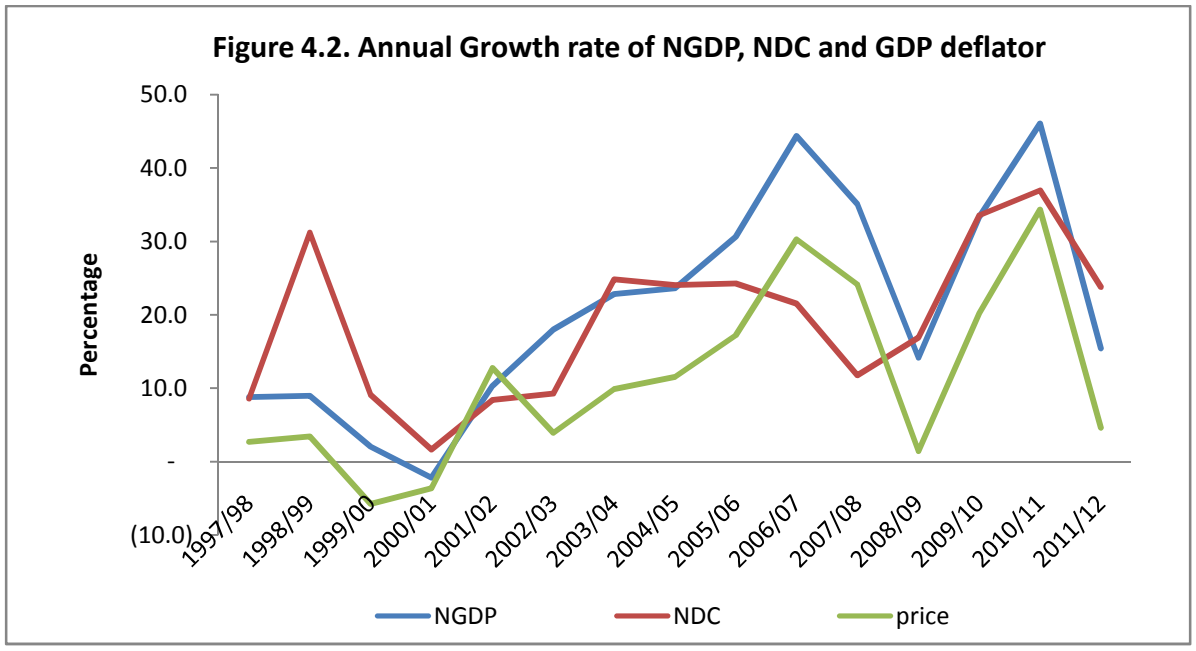
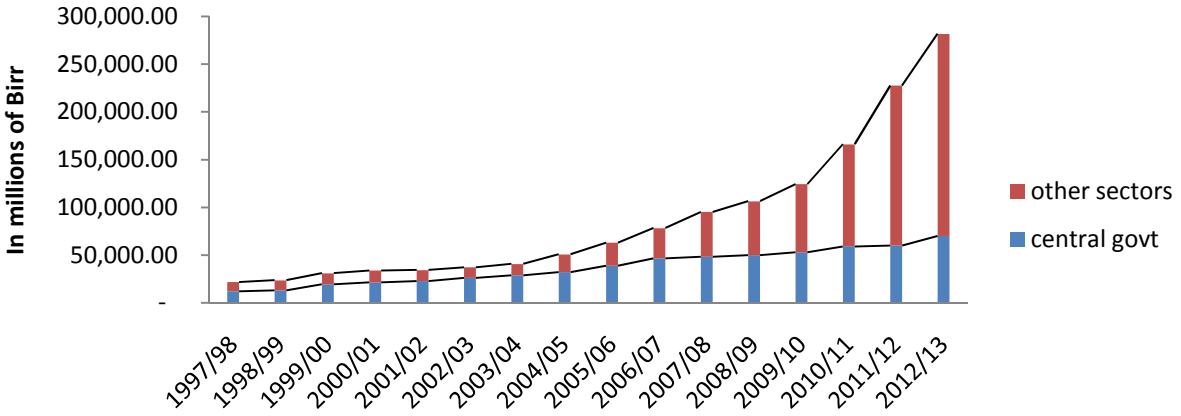


Figure 4.2. Annual Growth rate of NGDP, NDC and GDP deflator
Percentage
50.0
40.0
30.0
20.0
10.0
-
(10.0)
1997/98
1998/99
1999/00
2000/01
2001/02
2002/03
2003/04
2004/05
2005/06
2006/07
2007/08
2008/09
2009/10
2010/11
2011/12
NGDP
NDC
price

Figure 4.3: Gross Credit by Banking Sector to Central Govt and Other Sectors



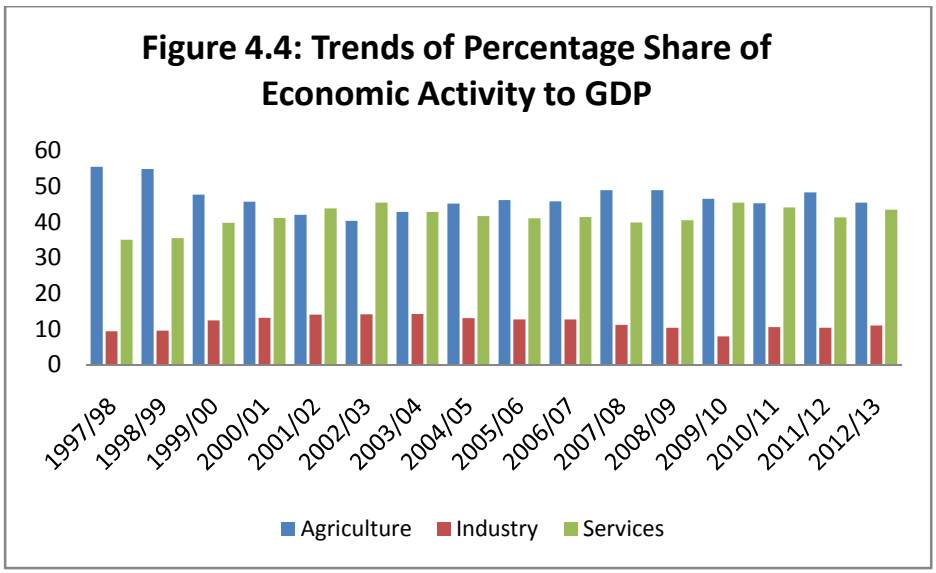


Figure 4.4: Trends of Percentage Share of Economic Activity to GDP
60
50
40
30
20
10
0
1997/98
1998/99
1999/00
2000/01
2001/02
2002/03
2003/04
2004/05
2005/06
2006/07
2007/08
2008/09
2009/10
2010/11
2011/12
2012/13
Agriculture
Industry
Services

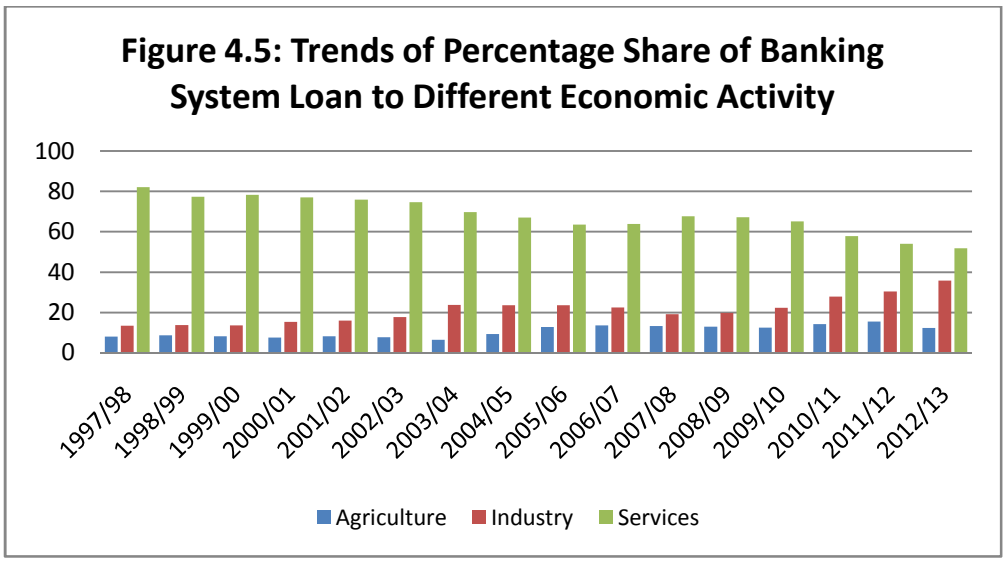


Figure 4.5: Trends of Percentage Share of Banking System Loan to Different Economic Activity
100
80
60
40
20
0
1997/98
1998/99
1999/00
2000/01
2001/02
2002/03
2003/04
2004/05
2005/06
2006/07
2007/08
2008/09
2009/10
2010/11
2011/12
2012/13
Agriculture
Industry
Services

4.2. Econometrics Results

After our reduced form VAR is estimated with appropriate lag length and checked for diagnostic test and stability of our model. We impose sufficient restriction, as discussed in chapter three, to identify our SVAR model. Then, variances of structural innovations and contemporaneous parameters (unrestricted instantaneous parameters) estimated by method of scoring algorithm (analytical derivatives) suggested by Amisano and Giannini (1992). Therefore, in this section structural model results are analyzed using impulse response function and forecast error variance decomposition. The result of structural parameter estimates of the matrices A and B are given by;

$$A=\begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ -0.157 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0.671 \\ 1.623 & 1.154 & -0.845 & 1 & -4.936 & 93.635 \\ -0.086 & 0 & -0.009 & 0 & 1 & 0.875 \\ -0.095 & 0.214 & 0 & 0 & 0 & 1 \end{pmatrix} \quad B=\begin{pmatrix} 0.127 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0.051 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0.100 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.290 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0.023 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0.037 \end{pmatrix}$$

As discussed in the methodology part variance covariance matrix of structural model is assumed to be identity and B matrix is diagonal matrix so, we can consider the diagonal elements of B matrix as standard deviation of residual of structural model.

The over identification test statistics with chi-square distribution is found to be $X^2(3) = 4.569$ and the p-value of the test is 0.206 so we accept the null hypothesis of valid over identification at any fair significant levels, frequently at 1 and 5 percent significance level **(see Appendix A.4)**.

4.2.1. Impulse Response Function of Structural Model

Impulse response function tells us the response of one or some variables due to exogenous shock (unexpected shock) of one of the variables in the model (H.Lutkepokl, 2005). In our case, we classify exogenous shock or innovation in to three categories. The first form of shock is external shock, which is captured by world oil price and world food price index shock. The second category of shock is monetary policy shock, captured by real credit and real lending interest rate shock and the third form of shock is domestic economy shock, which is captured by real GDP and CPI innovation. However, in interpretation of our model results we emphasis on the response of GDP and CPI due to credit shock on the one hand, and external shock on the other hand. To do so, we

Variables	Lnwop	lnwfp	Lnrgdp	Rir	Lnrdc	Lncpi
Standard deviation	0.13	0.05	0.10	0.29	0.02	0.04

Response to Structural One S.D. Innovations ± 2 S.E.

Figure 5a: Response of LNRGDP to LNRDC

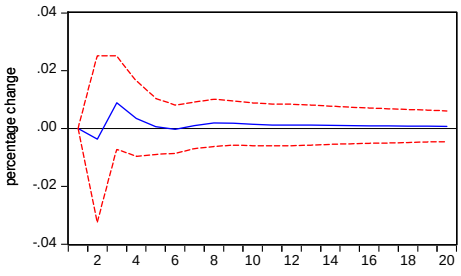


Figure 5b: Response of LNCPI to LNRDC

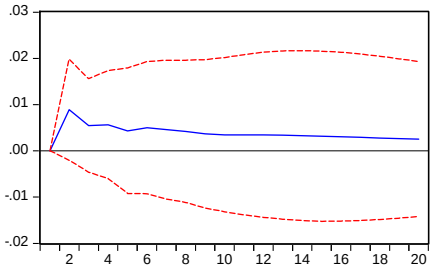
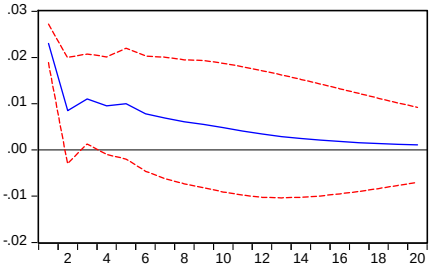


Figure 5c: Response of LNRDC to LNRDC



Source: Own computation using Eviews 7

The above figures shows us the impulses of real domestic credit on real GDP, CPI and real domestic credit, itself, for about five years (20 quarter). Based on our restriction, credit shock does not instantaneously affect real GDP. As shown in the figure 5a, positive shock in credit (measure of expansionary monetary policy) decreases real GDP up to quarter two, and afterwards it increase real GDP until sixth quarter and then the effect is die out. Implying shock in credit does not have long run impact on real GDP but in short run it shows upward and down ward trend, decreasing until the second quarter and increasing after third quarter. The lowest response of real GDP to positive credit shock is at the second quarter. 2 percent unexpected increase in credit lead to decrease of real GDP by 0.4 percent. On the other hand, the positive response of real GDP is higher during third quarter, stimulating output by 0.9 percent. After third quarter, the effect is decreasing and reach zero during sixth quarter. The decrease in output at the beginning period because of positive credit shock is output puzzle because it is contrary to our expectations, and a theory.

Similarly, figure 5b shows us the response of CPI to positive credit shock. The response of CPI is in line with our expectations. Positive credit shock affects CPI positively this can be justified by the increase in credit create more demand and hence price. The impact on CPI reaches its peak point after second lags to reach 0.9 percent increase of CPI to unexpected 2 percent shock of credit. After second quarter the effect is start to decline to die out. However, as compared to response of real GDP the response of CPI takes a long time to die out even after 5 year it have 0.3 percent positive impact.

Like CPI response, the own impact of credit is also positive, and it takes a long time to die out. During the first quarter credit increase equivalently with one standard deviations of structural model residual of credit, which is equal to 0.2 percent. The own effect declines to 0.009 percent during second quarter and further decline as lag length increase to reach 0.001 after five year and then die out.

External Shock: To begin with our expectation, positive oil price shock is expected to affect credit and price positively on the one hand, and output negatively. This is due to, since the government is subsidizing oil price positive oil price raise the money needed for subsidy. To finance increased budget, because of surge in oil price, government need credit from banks since one source of financing its budget need is domestic borrowing. Moreover, the surge in world oil price is directly transmitted into domestic economy. On the other hand, positive shock in credit is expected to hamper domestic economic activity by raising the production and transportation cost.

Response to Structural One S.D. Innovations ± 2 S.E.

Figure 6a: Response of LNRGDP to LNWOP shock

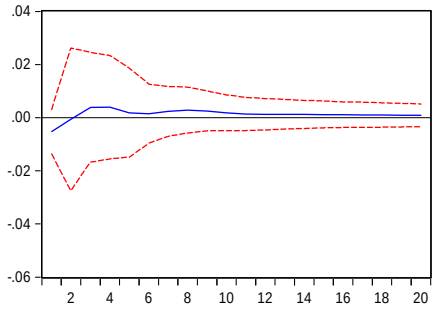


Figure 6b: Response of LNCPI to LNWOP shock

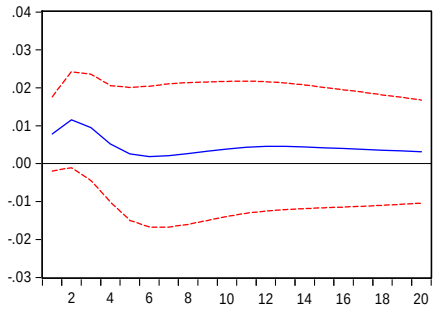


Figure 6c: Response of LNRDC to LNWOP shock

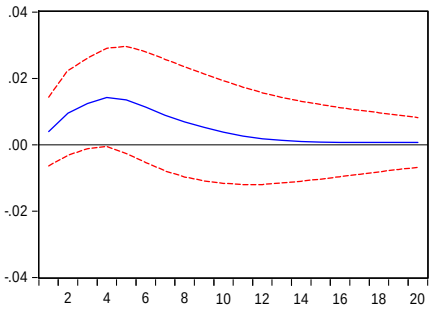


Figure 7a: Response of LNRGDP to LNWFP shock

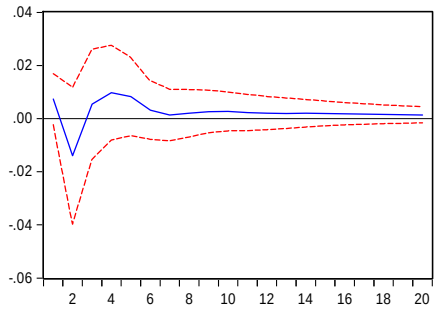


Figure 7b: Response of LNCPI to LNWFP shock

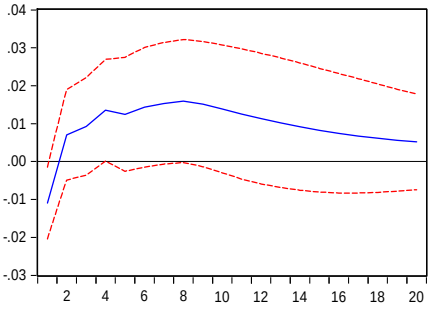
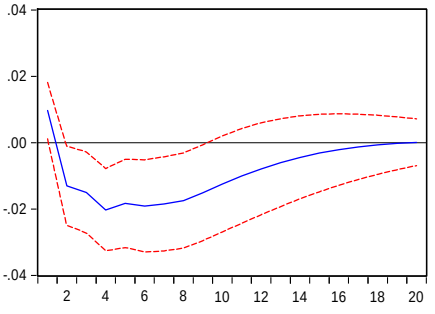


Figure 7c: Response of LNRDC to LNWFP shock



Percentage Change

Source: Own computation using Eviews 7

4.1.2. Forecast Error Variance Decomposition

Another means to observe the dynamic interrelationship between variables, in addition to impulse response, is to look at the forecast error variance decompositions. Which provides us information about the relative importance of each random innovation in affecting the variables in the VAR. Saying it in another words, forecast error variance decomposition describes what proportion of a shock to a specific variable is related to either its own innovations or those associated with other dependent variables at various forecast time horizons in the system. The variance decompositions for four different forecast horizons (one quarter and two quarter; and one and five years) are reported in Table 7. Each column reports, for a different domestic variable, the proportion of the forecast error that is explained by structural shocks to each of the six explanatory variables, listed on the left hand side of the table (so, for a given time horizon, the entries in a given column sum to one hundr

Table 4.2: Structural Variance Decompositions of Domestic Variables

Innovation	Forecast (quarters)	Proportion of forecast error variance for variable		
		Lnrgdp	**Lnrdc**	**Lncpi**
lnwop	1	0.258	0.930	4.061
	2	0.245	4.125	7.432
	4	0.489	10.126	5.846
	20	0.784	10.390	3.510
lnwfp	1	0.502	5.545	7.903
	2	2.187	10.249	6.456
	4	3.143	19.777	8.208
	20	4.017	31.302	16.494
lnrgdp	1	93.647	0.046	0.000
	2	89.988	0.033	2.547
	4	87.653	6.875	29.617
	20	86.598	19.468	56.464
rir	1	0.000	0.000	0.000
	2	1.207	0.796	0.983

	4	1.453	0.483	1.429
	20	1.533	0.296	1.775
lnrdc	1	0.000	31.712	0.000
	2	0.117	23.443	3.011
	4	0.875	17.879	2.634
	20	0.991	12.769	2.317
lncpi	1	5.593	61.767	88.035
	2	6.256	61.353	79.570
	4	6.387	44.860	52.266
	20	6.077	25.775	19.441

Source: own computation based on Eviews result

Both in short term and long term, GDP's own shocks are important for GDP forecast errors followed by CPI at the second level. Similarly, for inflation its own shocks are responsible for almost all of the short-term forecast error. Over longer horizons, shocks to GDP are increasingly important. Shocks to the domestic credit have been only a small part of GDP and CPI forecast errors, relatively it explains forecast error of CPI more than that of GDP. Over short horizons, the forecast errors for credit are explained by shocks to CPI and credit itself unlike other domestic variables (GDP and CPI) foreign variables had relatively better explain forecast error of domestic credit. Innovations to the international variables become more important as time passes across the spectrum of domestic variables, especially for domestic credit and CPI.

During the first quarter almost all, 93.6 percent forecast error of GDP comes from innovations of GDP itself, however, this figure decreases to 90.0, 87.7 and 86.6 percent during second, fourth and twentieth quarters respectively. Next to GDP, innovation of CPI had better explain the forecast error of GDP as compared to other endogenous variables. During the first, second fourth and twentieth quarter the proportion of CPI to GDP forecast error is 5.6, 6.3, 6.3 and 6.1 percent respectively, whereas, the contribution of domestic credit is insignificant. The proportion of forecast error due to credit is highest during twenty-quarter ahead forecast, which is only one percent.

Similarly, the short-term forecast error of CPI is attributed to innovations of CPI itself, which accounts for 88.0, 79.6 and 52.3 percent of the first, second and fourth quarter forecast error. Nevertheless, the share of GDP in explaining forecast error of CPI increase at long period horizon.

The proportion of GDP is 2.5, 29.6 and 56.5 percent during the second, fourth and twentieth ahead forecast error. Even though, the proportion of credit is more in case of CPI than GDP still it is insignificant. It explains only 3.0, 2.6 and 2.3 percent of second, fourth and twentieth period forecast error of CPI.

Unlike GDP and CPI forecast error the own contribution of domestic credit is low. Rather CPI takes the highest share in explaining forecast error of credit. It have 61.8, 61.4, 44.9 and 25.8 percent proportion in first, second, fourth and twentieth quarter ahead forecast error. Followed by the own effect of domestic credit, which is having share of 31.7, 23.4, 17.9 and 12.8 percent in the first, second, fourth and twentieth ahead forecast respectively. In the long-term forecast error (20 period ahead forecasts) world price have 31.3 percent share, which is the highest one from foreign variables explaining the forecast error of domestic variables. This figure is 4.0 and 16.5 percent for the case of GDP and CPI respectively.

Chapter Five

5. Conclusion and Policy Implication

Employing quarterly series, we try to examine the dynamic impact of credit shock on output and price. Even though, our interest is on impact of credit we also look at the impact of external variables shock on domestic variables, particularly on GDP, price and credit. One thing need attention in this study is that, we used quarterly series for our SVAR methodology. However, GDP is not obtained in quarterly basis so, researcher disaggregates it. Therefore, caution needed when result of this study is used for policy input. Because, there may be bias that comes due to disaggregation method.

As discussed in the main body of the paper different proxies we were used for financial deepening indicator witness that, the financial sector of Ethiopia is improving overtime, even though still at infant stages. Accompanied by improved financial sector and government development strategy domestic credit shows increasing trend. In addition to augmenting economic growth, credit is important policy variables in price stabilization process. Different case of high inflation level discussed is followed by serious policy on domestic credit.

The trend of price and domestic credit gives some sign of co-movement between them; however, it is difficult to trace this kind of relationship between output and credit trend, implying credit is closely related with price than output and raise needs for econometrics model to know their relationship. So, econometric methodology, SVAR, is employed to look at the relationship between variables of our interest. Despite the fact that, some of our series have unit root we just ignore it and include the series at level not to remove the co-movement between variables by differencing. Then we impose restriction of exogenity of foreign variables and policy variables only affect output and price with lag to identify our model. After estimation, Structural Impulse responses and Variance decompositions are used to analysis the results.

The impulse response of output for credit shock during the initial period, second quarter, since we restrict the first quarter to be zero, is negative which is puzzle relative to our expectation and what theories says. However, after third quarter the responses of output became positive, reach its highest point, and begin to decrease and die out after six quarter. Unlike the response of real GDP, the response of CPI to credit shock does not have upward and downward trend. Two percent

unexpected shocks in domestic credit affect CPI by 0.9 percent during the second quarter (the highest response) and the effect die out after approximately five years. On the other hand, the highest response of GDP to 2 percent positive credit shock is 0.9 percent during third quarter and whereas the lowest response is negative 0.4 during the second quarter. The responses of GDP are die out too early, at the six lag, relative to CPI responses.

On the other hand, the own effect of output and price shock on forecast error are significant at the short term. In contrary, the short-term forecast error of domestic credit is attributed to CPI, implying much of the forecast error of credit is come from CPI. The proportion of forecast error of domestic variable explained by external variable is low both for short term and long-term forecast but it slightly increase in the long-term forecast error.

Therefore, the major conclusion we can draw from this study is that positive credit shock affects outputs (in net terms) and price growth positively hence, by balancing there effect monetary policy can stimulate economic growth via credit expansion. In addition credit shock also affect domestic price significantly so it can be used as policy variables and attention should be taken about the positive effect of expansionary credit policy on price. Not only policy induced credit growth we are talking about rather includes economy induced also so, bringing the informal sector that extends credit in to the formal system will increase the benefit to the economy by channeling fund to the more productive sector.

Given the limitations of this paper researcher recommends further study, using different proxy for interest rate data, method of GDP disaggregation and including other variables that are important in monetary policymaking processes, such as exchange rate. Therefore, if the result of this study is supported by other studies it would be more important to use it as policy input.

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Appendices

Table A.1: Johansen's Cointegration Test Results

Date: 04/01/14 Time: 21:56

Sample (adjusted): 1998Q4 2013Q4

Included observations: 61 after adjustments

Trend assumption: Linear deterministic trend

Series: LNWOP LNWFP LNRGDP LNRDC LNCPI

Exogenous series: D1 D2 D3

Warning: Critical values assume no exogenous series

Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.463863	89.70093	69.81889	0.0006
At most 1 *	0.283701	51.67567	47.85613	0.0210
At most 2 *	0.249316	31.32254	29.79707	0.0331
At most 3	0.184983	13.82958	15.49471	0.0877
At most 4	0.021924	1.352236	3.841466	0.2449

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

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

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.463863	38.02526	33.87687	0.0151
At most 1	0.283701	20.35312	27.58434	0.3172
At most 2	0.249316	17.49296	21.13162	0.1500
At most 3	0.184983	12.47735	14.26460	0.0940
At most 4	0.021924	1.352236	3.841466	0.2449

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

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

Table A.2: Reduced Form VAR estimation Result

Vector Autoregression Estimates
Date: 04/01/14 Time: 19:19
Sample (adjusted): 1998Q3 2013Q4
Included observations: 62 after adjustments
Standard errors in ( ) & t-statistics in [ ]

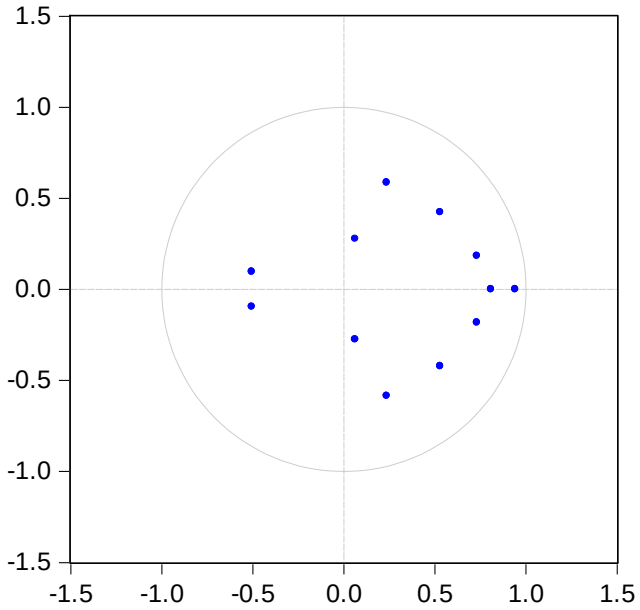
	LNWOP	LNWFP	LNRGDP	RIR	LNRDC	LNCPI
LNWOP(-1)	1.060598	-0.052564	0.145716	0.676052	0.119247	-0.006769
	(0.17868)	(0.07726)	(0.14602)	(5.45435)	(0.05771)	(0.05483)
	[5.93585]	[-0.68032]	[0.99789]	[0.12395]	[2.06648]	[-0.12345]
LNWOP(-2)	-0.292817	0.052603	-0.121576	2.326373	-0.048691	-0.025104
	(0.15511)	(0.06707)	(0.12677)	(4.73505)	(0.05010)	(0.04760)
	[-1.88776]	[0.78425]	[-0.95905]	[0.49131]	[-0.97196]	[-0.52743]
LNWFP(-1)	0.245616	1.026448	-0.290480	-32.86175	-0.410831	0.318605
	(0.31255)	(0.13515)	(0.25543)	(9.54092)	(0.10094)	(0.09591)
	[0.78585]	[7.59481]	[-1.13722]	[-3.44429]	[-4.07004]	[3.32201]
LNWFP(-2)	-0.592700	-0.334775	0.477609	17.84001	0.221703	-0.158069
	(0.36221)	(0.15663)	(0.29602)	(11.0571)	(0.11698)	(0.11115)
	[-1.63633]	[-2.13739]	[1.61344]	[1.61345]	[1.89521]	[-1.42215]
LNRGDP(-1)	0.245483	0.194218	0.123357	-5.527865	0.007018	0.063281
	(0.19437)	(0.08405)	(0.15885)	(5.93354)	(0.06278)	(0.05965)
	[1.26294]	[2.31072]	[0.77655]	[-0.93163]	[0.11180]	[1.06096]
LNRGDP(-2)	0.063513	0.376871	-0.042636	-3.907431	0.041900	0.035271
	(0.21478)	(0.09288)	(0.17553)	(6.55646)	(0.06937)	(0.06591)
	[0.29571]	[4.05783]	[-0.24290]	[-0.59597]	[0.60404]	[0.53517]
RIR(-1)	0.078524	-0.002314	0.040569	-1.570395	-0.015625	0.017516
	(0.06053)	(0.02617)	(0.04947)	(1.84776)	(0.01955)	(0.01857)
	[1.29729]	[-0.08840]	[0.82011]	[-0.84989]	[-0.79926]	[0.94301]
RIR(-2)	-0.001682	-0.001556	0.000596	0.302976	0.003234	-0.002888
	(0.00517)	(0.00224)	(0.00423)	(0.15790)	(0.00167)	(0.00159)
	[-0.32524]	[-0.69561]	[0.14106]	[1.91874]	[1.93613]	[-1.81953]
LNRDC(-1)	-0.368792	-0.329682	-0.359361	-28.28495	0.446416	0.298903

	(0.81017)	(0.35033)	(0.66212)	(24.7317)	(0.26165)	(0.24861)
	[-0.45520]	[-0.94105]	[-0.54275]	[-1.14367]	[1.70613]	[1.20231]
LNRDC(-2)	0.065598	0.148337	0.557793	16.96879	0.278814	-0.181195
	(0.76502)	(0.33081)	(0.62521)	(23.3532)	(0.24707)	(0.23475)
	[0.08575]	[0.44841]	[0.89217]	[0.72662]	[1.12848]	[-0.77186]
LNCPI(-1)	7.819442	-0.720538	3.469898	-163.7444	-1.781304	2.782870
	(5.74975)	(2.48630)	(4.69899)	(175.519)	(1.85694)	(1.76436)
	[1.35996]	[-0.28980]	[0.73844]	[-0.93292]	[-0.95927]	[1.57727]
LNCPI(-2)	-8.104940	0.550196	-3.347016	175.0023	1.818133	-1.889440
	(5.77782)	(2.49844)	(4.72193)	(176.376)	(1.86601)	(1.77297)
	[-1.40277]	[0.22022]	[-0.70882]	[0.99221]	[0.97434]	[-1.06569]
C	2.680050	-7.859773	16.37431	538.4997	6.207568	-5.642494
	(11.0630)	(4.78384)	(9.04123)	(337.713)	(3.57290)	(3.39476)
	[0.24225]	[-1.64298]	[1.81107]	[1.59455]	[1.73740]	[-1.66212]
D1	0.008922	-0.004503	0.031168	-1.419644	-0.037713	0.014813
	(0.06950)	(0.03005)	(0.05680)	(2.12170)	(0.02245)	(0.02133)
	[0.12837]	[-0.14982]	[0.54871]	[-0.66911]	[-1.68010]	[0.69454]
D2	-0.078041	0.046359	0.060760	2.347963	0.017352	-0.021814
	(0.06567)	(0.02840)	(0.05367)	(2.00472)	(0.02121)	(0.02015)
	[-1.18835]	[1.63249]	[1.13210]	[1.17122]	[0.81811]	[-1.08247]
D3	0.011956	0.045249	0.194491	0.793659	0.028445	-0.008720
	(0.06118)	(0.02645)	(0.05000)	(1.86750)	(0.01976)	(0.01877)
	[0.19544]	[1.71048]	[3.89008]	[0.42499]	[1.43971]	[-0.46451]
@TREND	0.019167	0.000958	0.010480	0.155446	0.002697	-0.001908
	(0.00856)	(0.00370)	(0.00699)	(0.26125)	(0.00276)	(0.00263)
	[2.23956]	[0.25900]	[1.49840]	[0.59500]	[0.97564]	[-0.72658]
R-squared	0.975555	0.982329	0.951689	0.608599	0.980973	0.996178
Adj. R-squared	0.966863	0.976046	0.934512	0.469434	0.974208	0.994819
Sum sq. resids	0.723883	0.135356	0.483481	674.5580	0.075504	0.068162
S.E. equation	0.126832	0.054844	0.103653	3.871715	0.040962	0.038919
F-statistic	112.2400	156.3435	55.40444	4.373226	145.0042	733.0204
Log likelihood	49.98386	101.9622	62.49602	-161.9688	120.0578	123.2288
Akaike AIC	-1.063995	-2.740715	-1.467614	5.773187	-3.324446	-3.426737
Schwarz SC	-0.480749	-2.157469	-0.884367	6.356434	-2.741199	-2.843491

Mean dependent	3.828889	4.281037	25.31343	-1.092817	25.76193	3.698716
S.D. dependent	0.696740	0.354356	0.405045	5.315374	0.255055	0.540692

Determinant resid covariance (dof adj.)	2.34E-14
Determinant resid covariance	3.42E-15
Log likelihood	504.7729
Akaike information criterion	-12.99267
Schwarz criterion	-9.493195

Figure A.1: Inverse Roots of AR Characteristic Polynomial



Structural VAR Estimates

Date: 04/01/14 Time: 19:19

Sample (adjusted): 1998Q3 2013Q4

Included observations: 62 after adjustments

Estimation method: method of scoring (analytic derivatives)

Convergence achieved after 18 iterations

Structural VAR is over-identified (3 degrees of freedom)

Model: Ae = Bu where E[uu']=I

Restriction Type: short-run pattern matrix

A =

1	0	0	0	0	0
C(1)	1	0	0	0	0
0	0	1	0	0	C(10)
C(2)	C(5)	C(7)	1	C(9)	C(11)
C(3)	0	C(8)	0	1	C(12)
C(4)	C(6)	0	0	0	1

B =

C(13)	0	0	0	0	0
0	C(14)	0	0	0	0
0	0	C(15)	0	0	0
0	0	0	C(16)	0	0
0	0	0	0	C(17)	0
0	0	0	0	0	C(18)

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	-0.156832	0.051178	-3.064437	0.0022
C(2)	1.623416	0.353371	4.594089	0.0000
C(3)	-0.085606	0.023565	-3.632741	0.0003
C(4)	-0.095415	0.039237	-2.431771	0.0150
C(5)	1.154457	0.751669	1.535858	0.1246
C(6)	0.214075	0.090738	2.359268	0.0183
C(7)	-0.844907	0.367156	-2.301220	0.0214
C(8)	-0.008765	0.029185	-0.300310	0.7639
C(9)	-4.936288	1.596527	-3.091891	0.0020
C(10)	0.671289	0.327318	2.050881	0.0403
C(11)	93.63519	1.740174	53.80796	0.0000
C(12)	0.875088	0.079254	11.04150	0.0000
C(13)	0.126832	0.011390	11.13553	0.0000
C(14)	-0.051110	0.004590	-11.13553	0.0000
C(15)	-0.100307	0.009008	-11.13553	0.0000
C(16)	-0.289775	0.026023	-11.13553	0.0000
C(17)	0.023051	0.002070	11.13553	0.0000
C(18)	0.036517	0.003279	11.13553	0.0000

Log likelihood	442.8806		
LR test for over-identification:			
Chi-square(3)	4.569132	Probability	0.2062

Estimated A matrix:

1.000000	0.000000	0.000000	0.000000	0.000000	0.000000
-0.156832	1.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	1.000000	0.000000	0.000000	0.671289
1.623416	1.154457	-0.844907	1.000000	-4.936288	93.63519

-0.085606	0.000000	-0.008765	0.000000	1.000000	0.875088
-0.095415	0.214075	0.000000	0.000000	0.000000	1.000000

Estimated B matrix:

0.126832	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.051110	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.100307	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.289775	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.023051	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.036517

Response to Structural One S.D. Innovations ± 2 S.E.

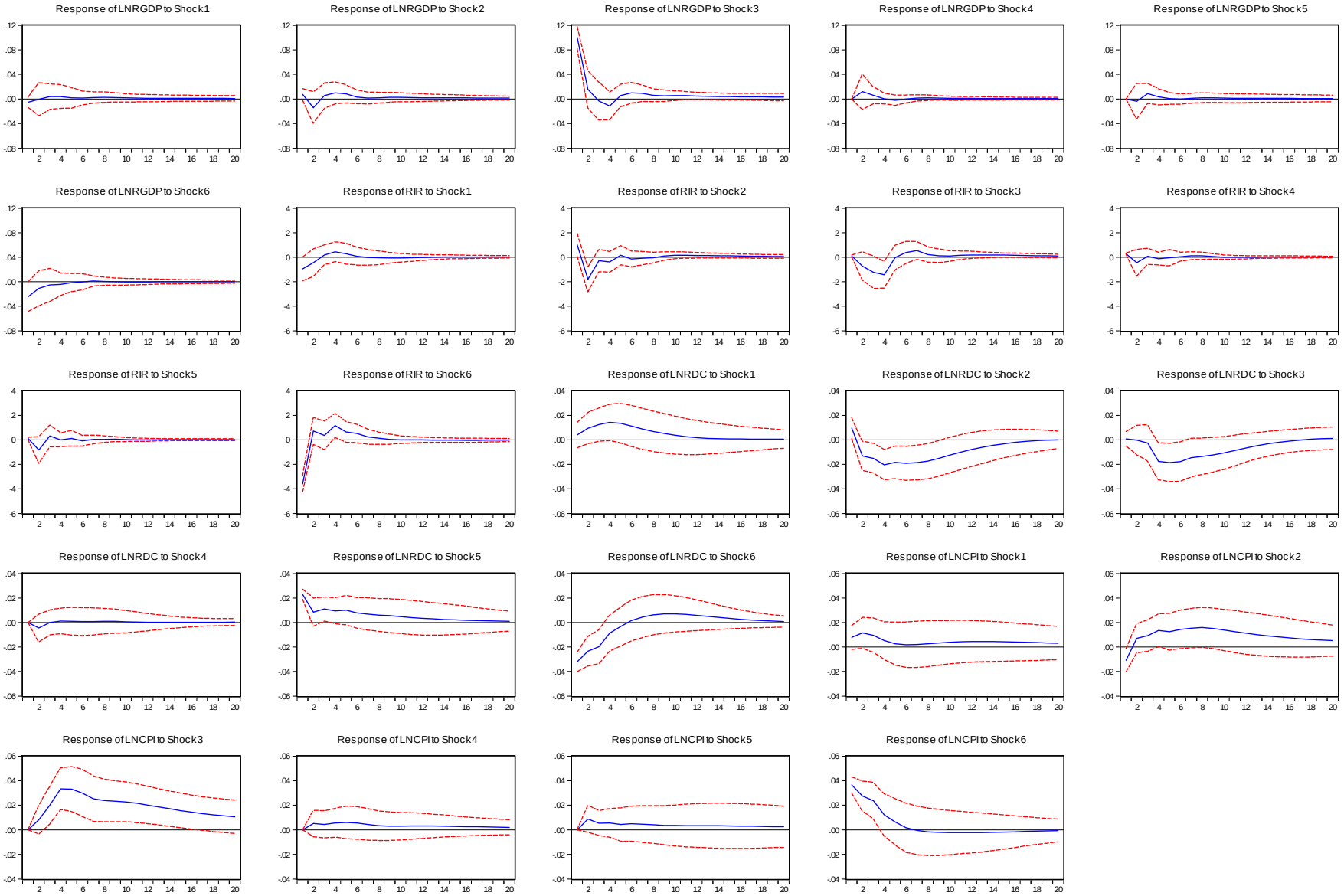


Table A.4: Structural Forecast Error Variance Decomposition

Variance Decomposition of LNRGDP:

Period	S.E.	Shock1	Shock2	Shock3	Shock4	Shock5	Shock6
1	0.126832	0.258027	0.502113	93.64694	0.000000	1.72E-33	5.592918
2	0.181514	0.245379	2.186672	89.98797	1.206618	0.117426	6.255934
3	0.206497	0.368588	2.401602	88.57354	1.486128	0.792913	6.377229
4	0.218819	0.488942	3.142777	87.65333	1.453022	0.874941	6.386992
5	0.223947	0.512456	3.679683	87.11284	1.478429	0.870485	6.346105
6	0.229334	0.525232	3.729685	87.12963	1.464681	0.863167	6.287602
7	0.235598	0.565256	3.715106	87.13583	1.470163	0.865359	6.248284
8	0.240090	0.628124	3.730529	87.03188	1.494295	0.891689	6.223484
9	0.242532	0.675285	3.774137	86.92650	1.507250	0.915721	6.201108
10	0.243862	0.698568	3.818802	86.85964	1.513119	0.929469	6.180405
11	0.244601	0.710848	3.847284	86.82473	1.516834	0.937984	6.162324
12	0.245025	0.720961	3.870293	86.79403	1.520527	0.946561	6.147630
13	0.245295	0.731480	3.893919	86.76020	1.523511	0.955267	6.135619
14	0.245501	0.741754	3.918709	86.72616	1.525472	0.963057	6.124849
15	0.245675	0.750956	3.941377	86.69671	1.526840	0.969367	6.114752
16	0.245827	0.759029	3.960615	86.67220	1.528113	0.974686	6.105355
17	0.245958	0.766256	3.977001	86.65089	1.529468	0.979466	6.096919
18	0.246069	0.772775	3.991569	86.63149	1.530804	0.983864	6.089497
19	0.246165	0.778591	4.004734	86.61386	1.532000	0.987823	6.082990
20	0.246251	0.783728	4.016510	86.59817	1.533023	0.991316	6.077257

Variance Decomposition of RIR:

Period	S.E.	Shock1	Shock2	Shock3	Shock4	Shock5	Shock6
1	0.054844	5.996826	6.929002	0.052934	0.560017	0.086349	86.37487
2	0.082486	5.389561	21.04082	2.578763	1.428902	3.451272	66.11068
3	0.108038	5.092985	19.61052	9.265092	1.331276	3.601917	61.09821
4	0.122239	5.123198	17.34224	15.78951	1.201520	3.077284	57.46625
5	0.126901	5.324604	17.08798	15.48094	1.184989	3.078597	57.84289
6	0.128858	5.264148	16.88412	15.77768	1.170210	3.047218	57.85662
7	0.130262	5.192957	16.67249	16.63927	1.209565	3.009500	57.27622
8	0.131291	5.185739	16.62612	16.76096	1.254631	3.006462	57.16609
9	0.131912	5.191231	16.64636	16.78504	1.264185	3.015348	57.09784
10	0.132226	5.196908	16.71480	16.79188	1.262640	3.013097	57.02068
11	0.132379	5.194754	16.78258	16.84648	1.260575	3.007279	56.90833
12	0.132466	5.186153	16.82857	16.93136	1.258091	3.001261	56.79457

13	0.132518	5.176119	16.86236	17.02507	1.255879	2.995671	56.68490
14	0.132546	5.168221	16.88917	17.11144	1.254591	2.990945	56.58564
15	0.132562	5.162223	16.90827	17.19133	1.253993	2.986900	56.49728
16	0.132572	5.157695	16.92017	17.26092	1.253939	2.983614	56.42366
17	0.132579	5.154599	16.92733	17.31666	1.254242	2.981226	56.36595
18	0.132586	5.152811	16.93215	17.35855	1.254704	2.979680	56.32210
19	0.132593	5.151981	16.93564	17.39004	1.255164	2.978744	56.28843
20	0.132599	5.151724	16.93804	17.41475	1.255576	2.978190	56.26172

Variance Decomposition of LNRDC:

Period	S.E.	Shock1	Shock2	Shock3	Shock4	Shock5	Shock6
1	0.103653	0.930105	5.545194	0.046129	0.000000	31.71192	61.76665
2	0.107023	4.125395	10.24875	0.033399	0.795890	23.44318	61.35338
3	0.107937	7.489518	14.11968	0.229948	0.589963	20.86111	56.70978
4	0.109190	10.12628	19.77693	6.875454	0.482780	17.87875	44.85982
5	0.109698	11.63370	22.39109	11.83347	0.416478	16.53975	37.18551
6	0.110214	12.04785	25.04932	15.12682	0.367601	15.24175	32.16666
7	0.110640	11.96633	27.41949	16.57618	0.341556	14.41178	29.28468
8	0.110884	11.62780	29.19886	17.61182	0.329163	13.74817	27.48418
9	0.111086	11.26760	30.24813	18.39687	0.320464	13.30756	26.45937
10	0.111279	10.96173	30.80342	18.98369	0.311980	13.01949	25.91969
11	0.111449	10.73772	31.09877	19.31992	0.304834	12.84923	25.68952
12	0.111585	10.58683	31.25688	19.47753	0.299960	12.75606	25.62275
13	0.111695	10.49267	31.33292	19.53019	0.296970	12.71385	25.63340
14	0.111793	10.43849	31.36001	19.53156	0.295295	12.70322	25.67142
15	0.111886	10.41014	31.36242	19.51082	0.294475	12.70974	25.71241
16	0.111972	10.39688	31.35444	19.48593	0.294213	12.72341	25.74512
17	0.112050	10.39150	31.34252	19.46709	0.294343	12.73822	25.76633
18	0.112119	10.38980	31.32919	19.45817	0.294777	12.75124	25.77682
19	0.112180	10.38960	31.31561	19.45892	0.295449	12.76142	25.77900
20	0.112233	10.38986	31.30238	19.46750	0.296297	12.76862	25.77534

Variance Decomposition of LNCPI:

Period	S.E.	Shock1	Shock2	Shock3	Shock4	Shock5	Shock6
1	3.872226	4.061456	7.903481	0.000000	2.67E-31	2.70E-32	88.03506
2	4.513187	7.432300	6.456252	2.547404	0.982982	3.010905	79.57016
3	4.716989	7.499979	6.701626	12.26820	1.172023	2.859813	69.49836
4	5.103316	5.845584	8.208093	29.61693	1.428771	2.634269	52.26636
5	5.154453	4.759818	8.852349	40.05058	1.666147	2.380693	42.29041

6	5.197644	4.100276	10.15798	45.49311	1.807971	2.349800	36.09087
7	5.234188	3.722909	11.77665	47.99911	1.835115	2.344234	32.32199
8	5.242313	3.463618	13.36022	49.60154	1.787290	2.317860	29.46948
9	5.245778	3.298487	14.52079	50.93814	1.731255	2.267019	27.24432
10	5.249336	3.210412	15.26414	52.14355	1.692281	2.222959	25.46666
11	5.254517	3.187408	15.72370	53.13392	1.677652	2.197608	24.07971
12	5.259787	3.204855	16.01551	53.91227	1.679478	2.190173	22.99772
13	5.264899	3.241213	16.20257	54.51948	1.689860	2.194274	22.15260
14	5.269596	3.283575	16.31965	55.00126	1.703472	2.205363	21.48668
15	5.273865	3.326965	16.39188	55.38501	1.717917	2.221046	20.95719
16	5.277502	3.369502	16.43677	55.69155	1.731836	2.239662	20.53068
17	5.280391	3.409890	16.46484	55.93928	1.744553	2.259640	20.18179
18	5.282593	3.447023	16.48160	56.14394	1.755857	2.279668	19.89192
19	5.284273	3.480263	16.49042	56.31656	1.765845	2.298946	19.64797
20	5.285590	3.509500	16.49397	56.46399	1.774681	2.317092	19.44076

Factorization: Structural