Effects of Monetary Policy Shocks in Nigeria: Evidence from Structural VAR Modeling

[1]ADOFU, Ilemona and [2]SALAMI, Abdulganiyu

Abstract

This paper empirically examines the effects of monetary policy shocks on some selected macroeconomic variables in Nigeria, over the period of 1983 to 2015. The data used are sourced from Central Bank of Nigeria Bulletin, Nigeria Bureau of Statistics portal and World Bank portal. The paper used structural vector autoregressive technique to model and estimate contemporaneous impact and response of interest rate shocks to other macroeconomic variables. Impulse response function revealed that interest rate-shock has a negative impact on real GDP and money supply. It is also observed that inflation rate responds positively to positive shocks in interest rate and money supply, an outstanding contribution to the price puzzle debate in the monetary shock studies. It is therefore recommended that monetary policy authority in Nigeria be more vigilant in fixing interest rate because of its significant effects on other macroeconomic variables.

Key Words: Monetary, Policy, Shocks, Macroeconomic, Development, Stability.

1.0 Introduction

Monetary policy plays a major role in determining the nature of the macroeconomic activities of every country. As a result of the numerous impacts of monetary policy on the general economic activities, different monetary measures are being applied to restructure, reposition and rehabilitate the ailing economies of many developing countries, like Nigeria. Monetary policies are essential for achieving macroeconomic objectives like sustenance of economic growth and accelerated development, maintenance of sound financial system, reduction, and possibly eradication, of unemployment, reduction in the level of inflation, maintenance of healthy balance of payment, increase in the rate of industrialization, maintenance of good exchange rate policy, and maintenance of price stability. Monetary policy has significant effect on price level, income level, national productivity, inflationary level exchange rate and general economic activities.

The responsibility of coordinating and managing monetary policy in Nigeria is performed by Central Bank of Nigeria (CBN), which is the apex financial institution in the country. It uses some monetary instruments like bank rate, open market operation, liquidity ratio and moral suasion to achieve the macroeconomic targets. In addition to its financial role in the economy, the body advises federal

[1] Department of Economics, Federal University Lafia. ilemonaadofu@yahoo.com
[2] Department of Economics, Federal University Lafia. salamiabdulganiyu@gmail.com

government on the appropriate policy mix, budget planning and implementation, and cordial relationship among local and international financial institutions. In addition to the above monetary instruments used by CBN, the federal government of Nigeria has used many macroeconomic policies like Structural Adjustment Programme and Millennium Developments Goals to streamline her monetary policy towards maximum macroeconomic performance.

Given the roles of monetary policy in the macroeconomic activities of every country, many researchers have adopted different models like Co-integration, Granger Causality, Vector-autoregressions and recently Structural Vector Autoregressions (SVAR) to investigate its nature of associations with other macroeconomic variables. Given the dearth of literature applying SVAR on monetary in Nigeria, this study adopts the model to investigate the effects of monetary policy shocks on some macroeconomic variables.

2.0 Literature Review

2.1Theoretical Literature

In the course of reviewing literature, it was found that there are many theories that explain the relationship between monetary policy and other macroeconomic variables. This study will review some common ones to give credence to the work.

The earliest work on monetary theory is quantity theory of money that was popularized by Irving fisher. The theory states that increase in money supply leads to corresponding increase in price. This argument is similar to the views of the monetarists who support the idea of significant role of money determining prices and income level. A contrary opinion about the role of money was put forward by the Keynesians who argued that money, on its own, does not determine the level of price and income. Instead, change in income causes change in money stock through change in demand for money.

In the recent time, many empirical studies have shown new directions and built new theories to explain the effect monetary policy on the general macro economy. The most relevant ones to this study are Price puzzle and long run neutrality of money.

The concept of long run neutrality implies a situation where monetary instruments do not have long run effects on other macroeconomic variables. This is consistent to the argument of the Keynesian economists. Further debates about the theory can be found in McCallum 1984 and Cochrane 1995.

The concept of price puzzle has also generated a lot of debates among macroeconomic researchers. It was first discovered in the study conducted by Sim 1972. It refers to a situation where a contractionary monetary policy leads to

increase in price, or when an expansionary monetary policy leads to decrease in price. Different conflicting arguments about the theory can be found in Eichenbaum 1992, Giordani 2004,and Castelnuovo and Surico 2006.

2.2Empirical Literature

Structural Vector Autoregression (SVAR) became a popular econometric method for investigating the behavior of monetary policies in the nineties. Since then, many researchers like Balke and Emery (1994), and Blanchard and Perotti (2002) have used different versions of the model to explain the relationship between macroeconomic variables. The reviewed SVAR studies below show how it has been used.

Sims (1992) used a recursive vector autoregressive model to investigate the effects of monetary policy in France, Germany, Japan, United Kingdom and United States. His findings gave rise to a phenomenon called price puzzle, in which a contractionary monetary policy leads to lower money and output, while consumer price index increases. However, he observed that addition of more variable to the model leads to decrease in the price puzzle effect. In attempt to correct for the puzzle in their studies, Giordani (2001) and Eichenbaum (1992) have also respectively shown that addition of output gap and commodity prices to their respective structural VAR models can mitigate price puzzle.

Bernanke and Mihov (1998) used the SVAR approach to investigate the effect of monetary policy on the short term interest rate (liquidity effect), and long run effect of monetary policy on the economy. They used short and long run restrictions of SVAR model to verify the two puzzles in the same model. It was discovered that monetary policy influences interest rate in the short run, and insignificantly affect macroeconomic activities in the long run. They observed that using different variants of VAR models result in insignificant change in the estimates.

Uhlig (2005) used new agnostic structural VAR method to estimate the effects of monetary policy shocks in the United States. They modified the conventional Structural VAR by imposing sign restrictions on the impulse responses of prices, non-borrowed reserves and the federal funds rate in response to a monetary policy shock. They found that contractionary monetary policy shocks have no clear effect on real GDP, and account for a small fraction of the forecast error variance in the federal funds rate. They also observed that GDP price deflator and commodity price index fall in response to a monetary policy shock. Their study laid credence to neutrality of monetary policy, as other macroeconomic variables response weakly to monetary policy shocks.

Berkelmans (2005) used SVAR to investigate the relationship between credit, monetary policy shocks and some key macroeconomic variables in Australia. He found that the response of credit and inflation to monetary policy shock is

relatively slow, and even slower than that of output. They also observed that monetary policy shocks make output and the exchange rate to be hardly affected by a credit shock. Changes in credit are also moderated as a result of monetary policy's response.

Zanetti and Wei Li (2016) used structural VAR analysis to examine monetary policy shocks on the macroeconomic variables in the United Kingdom. Their used the combination of foreign and domestic variables to incorporate the impact of external instrument in the domestic monetary analysis. They used block exogeneity restrictions on domestic variables to investigate the effects of monetary policy shocks from the standpoint of domestic economy. They found that monetary policy shocks have large and persistent effects on output, yields of long maturities and domestic economy. Their analysis shows that inflation and exchange rate respond sharply to monetary policy shocks.

3.0 **Data and Methodology**

3.1Data Description

This study uses an external variable (world oil prices) and five domestic variables (real gross domestic product, inflation rate, exchange rate, interest rate and money supply). The data were sourced from World Bank data portal, CBN statistical bulletins and NBS data portal. The sample period covers from 1983:1-4 – 2015:1-4. Though the data were not quarterly all through, the annual data were transformed to quarterly using Eviews to allow for stable estimations and analyses. Year 2010 is chosen as the base for the real variables.

In line with Sims (1992), Berkelmans (2005), Baxa (2010) and many other users of SVAR model, the endogenous variables are entered into SVAR models in their levels. It is argued that non-stationarity of endogenous variables does not affect SVAR models. Real GDP, money supply (M2) and oil prices are in log form while exchange rate, inflate rate and interest rate are entered in their natural form.

3.2 Methodology

3.2.1 **General VAR Model**

The generalized VAR model consists of a set of K endogenous variables. For a set of n time series variables:

$$y_t = (y_{1,} y_{2,} \ldots y_{nt}),$$

a VAR model of order p (VAR(p)) can be written as:

$$y_t = c + A_1 y_{t-1} + A_2 y_{t-2} + \ldots + A_p y_{t-p} + u_t$$

Where Y_t is a k × 1column vector the endogeneous variables, c is a k × 1 vector of constants, A_i 's are K × [illegible] coefficient matrices (for every i = 1,…,p) and u_t is a k × 1 vector of error terms.

3.2.2 **Structural VAR Model**

The structural vector-autoregressive of macroeconomic model can be expressed as:

$$A\phi_t = C(L)\phi_{t-1} + B\varepsilon_t \qquad (2)$$

where ϕ is a vector of endogenous macroeconomic variable which are unemployment rate , real gross product output, inflation, exchange rate, money supply and interest rates).

The matrices of parameters comprise of: A, which is the contemporaneous relations among the variables in the mode; C(L), which is the lag polynomial that allows dynamic adjustment and B, which is the contemporaneous relationships among the structural disturbances £, such that when **B** = $\mathbf{I_n}$ the identity matrix. Then, shocks to one variable do not directly impact on other variables in the model. Since the structural model is not directly observable, a reduced form of the underlying structural model can be estimated instead.

$$\phi_t = A^{-1} C(L)\phi_{t-1} + u_t \qquad (3)$$

where

$$Au_t = B\varepsilon_t \qquad (4)$$

Equation (4) shows that the disturbances in the reduced-form model u, a combination of the underlying structural shocks and are not easy to interpret unless a direct link can be made to the structural shocks.

The restriction on matrix A ensures that there is a strict causal ordering in the contemporaneous relationships between the endogenous variables while the formulation of B ensures that the shocks are independent of each other. The results of structural vector-autoregressive models are usually analyzed by Impulse

Response Functions (IRFs) and Forecast Error Variance Decomposition Functions (FEVD).

Impulse Response Function: This traces out the responsiveness of the variables in the structural VAR model to shocks to each of the variables. It shows the response of variable to shock in itself and shock to other variables in the model.

Forecast Error Variance Decomposition: This is used to show the proportion of movements in the endogenous variables of a VAR model that occurs due to its own shocks versus shocks to other variables in the model. In other words, it determines how much of the forecast error variance of a given variable is explained by innovations to each explanatory variable in the model. The results of a SVAR model are usually presented using either or combination of both IRF and FEVD. This study uses the two instruments for the analysis of the statistical significant variables

3.2.3 Identification of the Structural VAR

Structural shocks in a SVAR can be identified by placing some restrictions on contemporaneous relations among the endogenous variables in the model. This is necessary to correct the course of dimensionality, the growing number of parameters and lags in multiplicative manner, which is associated with the general VAR (Berkelmans 2005 and Duo Qin 2008).The nature of the restriction is based economic theory and empirical literatures.

The SVAR structure below shows the order of the variables in the VAR model, before the subsequent estimation of the SVAR. It is used to investigate the effect of monetary policy shocks on the other key macroeconomic variables.

$$BX_t = \begin{pmatrix} b_{11} & 0 & 0 & 0 & 0 & 0 \\ b_{21} & b_{22} & 0 & 0 & 0 & 0 \\ b_{31} & b_{32} & b_{33} & 0 & 0 & 0 \\ b_{41} & b_{42} & b_{43} & b_{44} & 0 & 0 \\ b_{51} & 0 & 0 & b_{54} & b_{55} & 0 \\ b_{61} & b_{62} & b_{63} & b_{64} & 0 & b_{66} \end{pmatrix} \begin{pmatrix} oil\ price \\ real\ GDP \\ Inf \\ M2 \\ Int \\ Neer \end{pmatrix}$$

The above matrices place restrictions on the contemporaneous relationships among the variables. Here, ‘oil price’ is the world oil prices, ‘real GDP’ is output measured by real gross domestic product, ‘Inf’ is the inflation rate, ‘M2’ is broad monetary aggregate ‘Int’ is monetary policy instrument (interest rate) and ‘Neer’ is nominal exchange rate of naira to dollar. In the model, oil price is the foreign (external) variable that that has contemporaneous effect on other key macroeconomic variables in the model. The remaining variables are forming the domestic block. It is assumed the foreign variable affects all the domestic

variables contemporaneously, since Nigeria is an oil-dependent nation. This model implies that monetary policy instrument (interest rate) reacts contemporaneously to shocks in oil prices and money supply. Due to information lag and theoretical underpinnings, the policy instrument is assumed not to contemporaneously respond to real GDP and inflation shocks.

4.1 **Empirical Results and Discussion**

4.2 **Impulse Response Functions**

Figure 1 reports the impulse response functions for the structural shocks of the endogenous variables used in this study. The graphs are explained going column by column, moving from the top to the bottom of each column. The first column shows the reaction of the variables to a positive shock to the log of world oil prices, while other columns follow. The response of each variable to itself is not interpreted, even though it is present in the result.

The response of real GDP to a positive shock in oil price-shock is positive for the first five quarters. It reaches peak at the third quarter falls slowly to zero and becomes zero after the fifth quarter, it is only statistically significant within the first two quarters. It has a negative effect on inflation and interest rate within their first seven quarters and become positive after their seventh quarters. It has a positive effect but statistical insignificant impact on money supply, and a negative but statistical insignificant impact on exchange rate.

A positive innovation to real GDP has an increasing positive effect on oil prices till the sixth quarter, after which it falls and reaches zero at the tenth quarter. The real GDP-shock pushes up inflationary trend a little and starts falling after the first two quarters, falls till the seventh quarter and zero at the eight quarter. It is statistically significant only within the first eight quarters.

The impact of inflation-shock on oil price is negative within the first three quarters. Its effect on real GDP and money supply is positive, statistically significant through-out the first ten quarters for real GDP and seven quarters for money supply. It is not statistically significant for interest rate and nominal exchange rate.

An unexpected increase in money supply has a positive impact and statistical significance on real GDP and inflation for the first ten quarters, It has negative but statistically significant for interest rate and nominal exchange rate. Its effect is also statistically insignificant for oil prices.

Interest rate-shock has a negative impact on oil price, real GDP, and money supply but statistically insignificant for the variables. But for nominal exchange rate, it is negative and statistically significant within the first quarter; reaches zero at the fourth quarter and become positive and statistically insignificant afterwards.

The impulse response of real GDP, inflation, interest rate and money supply to a positive innovation to nominal exchange rate is negative and statistically insignificant. It is positive and statistically significant within first quarter of interest rate.

4.3 **Forecast Error Variance Decomposition**

The results of FEVDs in Figure 2 of the appendix corroborate that of the IRFs explained above .It shows the proportion of movements of the endogenous variables explainable by their own shocks and that of other variables.

Since oil price is an external variable, determined by factors outside Nigerian economy, its shocks may not be fully influenced by domestic variables. As specified in the model, it has contemporaneous effect on all other variables, and non-reversal. This can be justified by small variations in the estimates of other variables in the first FEVDs table.

The second table shows that a shock to real GDP is highly explained by variation in oil prices, inflation rate and money supply. The last four quarters of the table shows that money supply plays a very significant role in the movement of real GDP.

As expected, the third table shows that inflation rate is best explained by changes in real GDP and money supply. The influence of real GDP is stronger at the first seven quarters while that of money supply is stronger in the last there quarters.

The fourth table shows that movement in money supply rate is explained by fluctuations in real GDP, inflation rate and oil prices. The influence of real GDP is strongest in the first four quarters and that of inflation from fifth quarter onwards.

The fifth table shows that innovation to interest rate is explained by changes in oil prices, money supply and real GDP. The influence of oil price is stronger throughout the first ten quarters followed by that of real GDP.

As expected, fluctuation to exchange rate of naira to dollar is mostly explained by changes in real GDP, oil price and interest rate. The effect of real GDP is highest, interest rate in the first four quarters and oil prices in the last seven quarters, reaches zero at the fifth quarter, and positive afterwards.

5.0 Robustness Check

To ensure the stability and reliability of the results, two different lag lengths suggested by AIC (10 lags) and SBC (2 lags) were used to run the SVAR models. The two models have similar results; variation in the lags does not affect the outcomes. The IRFs with 2 lags are reported in the study. Also, a unit circle test is performed to check if the residuals of the variables will fall within the circle, the

result in figure 3 shows that all characteristic roots of the model lie within the unit circle, suggesting that our model is stable.

6.0 Conclusion and Recommendation

This study investigates the contemporaneous effect of monetary policy on key macroeconomic variables in Nigeria. The findings reflect realities in Nigerian economy, and in line with similar studies that adopted SVAR modeling approach. Using interest rate as the monetary policy, IRFs and FEVDs are used to show its impacts on other endogenous variables, and investigate the relationships among other variables.

It is found that interest rate has a negative impact on output. This explainable by the fact the increasing interest rate in Nigeria discourages borrowings from financial institutions for productive activities. It is one of the major reasons why large scale and small scale businesses are dying, factories closing up and other prospective entrepreneurs getting discouraged from starting businesses due to non-availability of fund. This is similar to the findings of Demchuk, Łyziak, Przystupa, Sznajderska, andWróbel (2012), and Haug, Jędrzejowicz, and Sznajderska (2013).

The responses of variance decompositions show that changes in interest rate are influenced by shocks to oil price, money supply and real GDP. This conforms to reality of Nigerian economy. Oil price-interest shock works through money supply medium; increase in oil price influences the money supply, and subsequently the interest rate is usually increased by the monetary authority. Considering the magnitude of the impact, shocks to the interest rate form a small part of forecast errors of real GDP, inflation and money supply (in line with the finding of Uhlig 2005), but a larger portion of exchange rate fluctuation.

Another important finding of this study is its contribution to the price puzzle debate. It is found that inflation rate respond positively to positive shocks in interest rate and money supply. This is in line with theoretical expectation, and shows that price puzzle does not occur in this case. The addition of the external variable (oil price) has cautioned such puzzle, similar to the findings of Giordani (2001) and Eichenbaum (1992).

This suggests that monetary policy makers have to strengthen and use appropriate level of interest rate in the economy. To enhance the development of small and medium scale enterprises and increase local productivity, a lower interest rate is necessary. The policy makers also have to take cognizance of the relationship between interest rate and inflation rate. The small but persistent positive response of inflation rate to interest rate shock shows that interest rate plays a significant role in the inflationary rate.

References

Abubakar, I., (2016), Dynamic Effects of Fiscal Policy on Output and Unemployment in Nigeria: An Econometric Investigation. CBN Journal of Applied Statistics; 7(2)101-122

Balke, N.S., and Emery, K. M. (1994), Understanding the price puzzle," Economic and Financial Policy Review, Federal Reserve Bank of Dallas, issue Q IV, pages 15-26.

Baxa, J. (2010), What the Data Say about the Effects of Fiscal Policy in the Czech Republic?. Mathematical Methods in Economics. 24-29.

Berkelmans, L. (2005). Credit and monetary policy: An Australian SVAR. Research Discussion Paper no. 2005-06, Reserve Bank of Australia

Bernanke, B. S. and Mihov, I (1998), Measuring Policy. Quarterly Journal of Economics 133(3): 869-902

Blanchard, O., and Perotti, R. (2002), An Empirical Characterization of the Dynamic Effects of Changes in Government Spending And Taxes On Output," The Quarterly Journal of Economics, MIT Press, vol.117 (4)1329-1368.

Castelnuovo, E., and Surico, P. (2006), The price puzzle: fact or artefact?," Bank of England working papers 288, Bank of England

Christiano, L. J., Eichenbaum, M., and Evans, L., (1999), Monetary policy shocks: What have we and to what end?," Handbook of Macroeconomics, in: J. B. Taylor & M. Woodford (ed.), Handbook of Macroeconomics, edition 1, volume 1, chapter 2, pages 65-148 Elsevier.

Cochrane (1995) Identifying the output effects of monetary Policy, Unpublished, University of Chicago.

Demchuk, O., Łyziak, T., Przystupa, J., Sznajderska, A., and Wróbel E., (2012), Monetary Policy Transmission Mechanism in Poland. What do we Know in 2011? Working Paper 116, National Bank of Poland series.

Eichenbaum, M., (1992), Comments on 'Interpreting the macroeconomic time series facts: the effects offacts: The effects of monetary policy. European Economic Review, 36(5), 1001-1011.

Giordani, P., (2001), Essays in monetary economics and applied econometrics. Ph.D. Dissertation, Stockholm School of Economics.

Giordani, P., (2004), An alternative explanation of the price puzzle. Journal of Monetary Economics, 51(6), 1271-1296.

Giordano, R., Momigliano, S., Neri, S., and Perotti, R. (2007), The effects of fiscal policy in Italy: Evidence

Harris, R. and Solaris, R. (2003), Applied Times Series Modelling and Forecasting. Wiley Publisher. United States.

Harvey (1990), The Econometric Analysis of Economic Time Series, 2nd Edition, MIT Press: Cambride, MA.

Haug A., Jędrzejowicz T., and Sznajderska A. (2013), Combining monetary and fiscal policy in an SVAR for a small open economy. Working Paper 168, National Bank Poland. Poland.

McCallum, B. (1984), On Low frequency estimates of long run relationships in Macroeconomics. Journal of Monetary Economics, 14, 3-14.

Qin, Duo (2011). “Rise of VAR Modelling Approach”. Journal of Economic Surveys. 25(1):156– 174.

S. N. Essien, G A. Manya, M. O. A. Arigo, K. J. Bassey1, S. F. Ogunyinka, D. G. Ojegwo, and F. Ogbuehi (2016), Monetary Policy and Unemployment in Nigeria: Is there a Dynamic Relationship? CBN Journal of Applied Statistics ; 7(1b), 209-231.

Safaei J and NE Cameron (2003), ‘Credit channel and credit shocks in Canadian macrodynamics – a structural VAR approach’, Applied Financial Economics, 13(4), pp 267–277.September.

Sims, Ch. A., (1992) Interpreting the macroeconomic time series facts : The effects of monetary policy," European Economic Review, Elsevier, vol. 36(5), pages 975-1000.

Uhlig H., (2005), What are the effects of monetary policy on output? Results from an agnostic identification procedure. Journal of Monetary Economics (52) 381-419.

Zanetti, F., and Wei Li (2016), The Effect of Monetary Policy Shocks in the United Kingdom: an External Instruments Approach. Discussion Paper Series. Number 812 University of Oxford.

Figure 1: Impulse Response Functions of the Variables

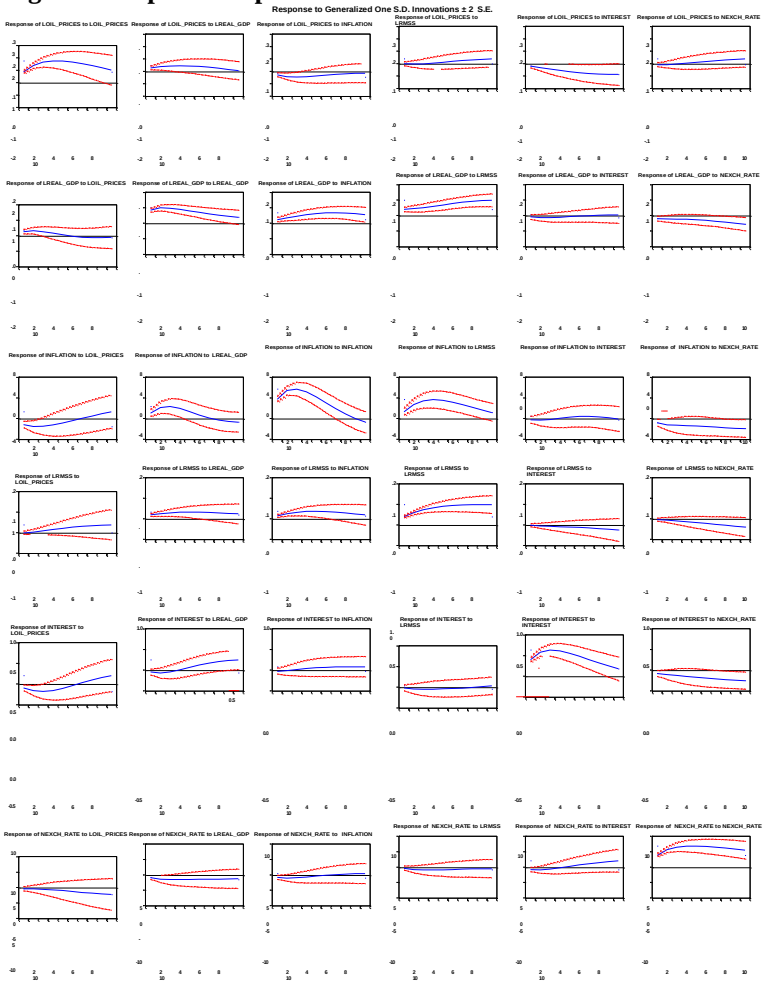

Figure 2 Forecast Error Variance Decomposition of the Variables

3	0.233464	99.02996	0.236555	0.306160	0.023702	0.049911	0.353710
4	0.294463	98.03116	0.308060	0.659276	0.110877	0.214016	0.676608
5	0.346086	96.60839	0.359825	1.115181	0.307396	0.565469	1.043737
6	0.389230	94.74241	0.414470	1.622911	0.653843	1.146883	1.419481
7	0.425081	92.46836	0.491608	2.121863	1.178566	1.965813	1.773788
8	0.454818	89.86046	0.610016	2.555879	1.890698	2.998050	2.084896
9	0.479511	87.01456	0.788240	2.884427	2.775937	4.196365	2.340468
10	0.500095	84.03513	1.042104	3.088728	3.796509	5.500456	2.537077

Variance Decomposition of LREAL_GDP:

Period	S.E.	LOIL_PRIC...	LREAL_GDP	INFLATION	LRMSS	INTEREST	NEXCH_R...
1	0.083887	9.508556	90.49144	0.000000	0.000000	0.000000	0.000000
2	0.130523	10.00972	89.19892	0.627082	0.081447	0.003857	0.078970
3	0.164326	9.050474	88.69505	2.065687	0.052534	0.002498	0.133755
4	0.190468	7.536985	87.80318	4.162539	0.368943	0.007170	0.121181
5	0.212632	6.126812	85.51537	6.603551	1.621182	0.028815	0.104265
6	0.233198	5.116030	81.50301	8.962546	4.128737	0.071740	0.217933
7	0.253417	4.490696	76.08422	10.86732	7.808432	0.132186	0.617143
8	0.273769	4.089274	69.88186	12.12122	12.28160	0.199485	1.426555
9	0.294337	3.754542	63.49448	12.71030	17.06837	0.259553	2.712763
10	0.315076	3.404991	57.34214	12.73937	21.73484	0.299572	4.479082

9	13.87611	5.105251	15.49393	52.89704	20.19734	1.495058	4.811376
10	14.33122	5.628591	15.21019	49.60942	21.04818	1.416959	7.086657

Variance Decomposition of LRMSS:

Period	S.E.	LOIL_PRIC...	LREAL_GDP	INFLATION	LRMSS	INTEREST	NEXCH_R...
1	0.039386	0.025957	24.39950	2.800817	72.77373	0.000000	0.000000
2	0.072052	0.242449	18.64018	7.106042	74.00958	0.000793	0.000954
3	0.104989	0.946966	15.35627	10.30055	73.38112	0.009708	0.005391
4	0.137542	1.905662	13.07143	12.23630	72.71181	0.021740	0.053063
5	0.169098	2.942394	11.24340	13.17087	72.41916	0.026434	0.197749
6	0.199337	3.953687	9.687526	13.38242	72.45733	0.021817	0.497225
7	0.228198	4.884099	8.344756	13.09745	72.65386	0.017766	1.002070
8	0.255778	5.705372	7.193310	12.49123	72.83198	0.033388	1.744723
9	0.282247	6.404081	6.217832	11.69777	72.85600	0.091731	2.732593
10	0.307781	6.975329	5.400805	10.81749	72.64521	0.214060	3.947102

Variance Decomposition of INTEREST:

Period	S.E.	LOIL_PRIC...	LREAL_GDP	INFLATION	LRMSS	INTEREST	NEXCH_R...
1	0.401441	5.404368	0.218615	1.996374	4.76E-05	92.38060	0.000000
2	0.709475	7.056252	0.181931	1.429065	0.128731	91.17523	0.028794
3	0.956642	7.564934	0.106999	1.074064	0.394300	90.81889	0.040816
4	1.145416	7.183329	0.306559	0.832526	0.787175	90.85740	0.033011
5	1.287449	6.324659	0.865442	0.668699	1.280296	90.83157	0.029338
6	1.395559	5.440241	1.734957	0.572578	1.813881	90.37681	0.061538
7	1.480477	4.900750	2.803565	0.547811	2.308870	89.27937	0.159637
8	1.550045	4.926209	3.944019	0.604024	2.692183	87.48705	0.346511
9	1.609542	5.576820	5.042066	0.749811	2.919596	85.07575	0.635953
10	1.662387	6.788410	6.010327	0.986728	2.986686	82.19445	1.033395

Variance Decomposition of NEXCH_RATE:

Period	S.E.	LOIL_PRIC...	LREAL_GDP	INFLATION	LRMSS	INTEREST	NEXCH_R...
1	3.798237	1.052271	4.500584	3.698445	0.245152	7.763449	82.74010
2	6.820598	0.774141	5.330348	2.367780	0.079841	5.463445	85.98444
3	9.474749	0.716487	5.260085	1.608176	0.049382	3.746263	88.61961
4	11.79479	0.816322	4.885349	1.143435	0.049893	2.578027	90.52697
5	13.83590	1.069512	4.442256	0.853716	0.055197	1.873662	91.70566
6	15.64263	1.477812	4.020854	0.670697	0.059180	1.533231	92.23822
7	17.24665	2.028897	3.650231	0.551775	0.061557	1.466734	92.24081
8	18.67073	2.694730	3.334372	0.470879	0.063481	1.602687	91.83385
9	19.93242	3.437501	3.067770	0.413155	0.066242	1.887576	91.12775
10	21.04650	4.216642	2.842311	0.370881	0.071072	2.282030	90.21706

Cholesky Ordering: LOIL_PRICES LREAL_GDP INFLATION LRMSS INTEREST NEXCH_RATE

Figure 3 Lag Length Selection Criteria for SVAR Estimation

VAR Lag Order Selection Criteria
Endogenous variables: LOIL_PRICES LREAL_GDP INFLATION LRMSS INTEREST NEXCH_RATE
Exogenous variables: C
Date: 04/18/17 Time: 01:42
Sample: 1983Q1 2015Q4
Included observations: 122

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1685.131	NA	44187.52	27.72346	27.86136	27.77947
1	-308.0286	2596.176	1.25e-05	5.738174	6.703493	6.130257
2	-167.5832	250.9598	2.27e-06	4.025955	5.818689*	4.754108
3	-146.1339	36.21770	2.91e-06	4.264490	6.884641	5.328715
4	-131.6338	23.05759	4.22e-06	4.616947	8.064514	6.017242
5	5.335470	204.3312	8.34e-07	2.961714	7.236697	4.698079
6	81.51216	106.1478	4.54e-07	2.303079	7.405478	4.375516*
7	93.05842	14.95335	7.27e-07	2.703960	8.633775	5.112468
8	106.0122	15.50209	1.17e-06	3.081767	9.838998	5.826345
9	222.5347	127.9837	3.57e-07	1.761727	9.346374	4.842376
10	299.1030	76.56833*	2.18e-07*	1.096672*	9.508735	4.513392

* 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

Figure 4: Robustness and Stability Check of the Residuals