The Impact of Interest Rate Channel of Monetary Policy on Output and Prices in Nigeria: An Unrestricted VAR Approach

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Abstract

This paper uses the vector auto-regression analytical method to examine the interest rate channel of monetary policy and to compare the period after the Structural Adjustment Period (1986Q1-1999Q1) with the period of the civilian administration (1999Q2-2012Q4) in Nigeria. The results of the second period indicate that monetary tightening leads first to an immediate fall in real output in the first 3 months reaching a maximum decline in 9 months. The first period indicates that real output start to decline after 6 months reaching a maximum decline in 12months. In response to monetary policy, for the second period, domestic prices did not start to decline until after 6months and it never returns to equilibrium. The findings for the first period indicate that prices started to rise after 4months and reach its peak in 12 months after the shock. We found evidence of interest channel in the two periods but monetary policy is more effective in the latter period compared to the earlier period.

Key Words: Monetary Policy, Output, Prices, Interest Rate.
JEL Classification: E52
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1.0 Introduction

There are few studies on monetary transmission mechanism in Nigeria relative to what is experienced in advanced economies. The study of this subject helps in exposing the changes in the time series properties of output, unemployment and inflation as a feed back to monetary policy decisions of government.

How has the problem of growth and price stability which monetary policy is meant to address faired since 1986 (after the Nigerian Structural Adjustment Program -SAP) when government introduced a fundamental shift in policy and ways of managing the nation's resources? And what has been the changes in the real output and domestic prices after the assumption of office by the civilian government (1999-2012)? Consequently, how monetary policy has determined the path of growth in real output and prices in Nigeria should be a major concern for government.

The answers to the issues raised depend on the ability of the monetary policy committee of the nation to trace the best channel which best propagates monetary policy innovations, the

lag period for policy actions to take effect and which disturbance is the real cause of the variability in output and inflation.

The pattern of changes in the real output and domestic prices in Nigeria for the period 1986Q1-1999Q1 and 1999Q2-2012Q4 respectively are as shown in figures I-IV, Appendix. Our illustration shows that the pattern of behavior of real output in these two periods does not depict sustained growth because in the first period immediately after SAP the changes in the pattern of real growth has been that of moderate fluctuations especially from 1989-1998.

In the second period real output dropped slightly in 1999 but started to experience reasonable increase from 2004 with wider fluctuations from one year to another in the period 2004-2012. Domestic prices in Nigeria have been generally on the increase in the two periods under consideration. The sharp increase in 1993Q3 dropped in 1995Q1 but started to rise again reaching a peak similar to that of 1994 by 1998. The trend in domestic prices from 1999 has been increasing but this is gradual compared to the former period (see figures III and IV).

There are number of transmission channels through which monetary policy affects macroeconomic variables: for example interest rate channel, money channel, exchange rate channel, bank lending channel, equity channel and real estate channel (Mishkin 1995).

The need to determine the most effective channel from the past times series data is to use such empirical evidence to forecast the future. If the shocks to the economy are kept unchecked, the economy will only become successively volatile and the problems of growth and price instability will persist. Otherwise it is sensible to assume a reasonable stability to last.

Studies in developed economies in this area are replete in the literature. For example, Bhuiyian (2008) found that policy shocks transmit to real output in Canada through interest rate channel and output start to decline in a maximum period of six months. In the UK report of the Monetary Policy Committee (1999) suggest that real output start to fall after the initial policy change and reaches the maximum in about one year and three months. And a study by Caprole and Soliman (2005) which assesses the asymmetric effects on monetary policy in some European nations found that monetary policy shocks affects real output with different intensities in these countries- response of output to monetary policy ranges between 1-8 quarters. In some emerging economies response of output to policy from evidence ranges between 2-9 quarters (see Elena (2012), Cambazoglu and Gunes (2011), Asir, Noor, Yasir and Hastam (2005)).

Chuku (2009) on Nigeria found that monetary innovation has modest effects on output and prices. Others who conducted similar studies on Nigeria are Saibu and Nwosa (2011), Ammasona, Wosa and Olaiya (2011), and Ogun and Akilo (2010) although based their study on bank lending channel. They all found that monetary policy affects output and inflation but did not specify the rate of response of output and prices to monetary policy shocks.

In this paper, we seek to contribute to the debate by investigating the response of output and prices to monetary policy shocks through interest rate channel and also compare the effects of monetary policy on output and prices in the periods- 1986Q1-1999Q1 (Military rule) with 1999Q2- 2012Q4 (civilian administration). Unlike previous studies, we determine and specify the periods it takes output and prices to respond to monetary policy shocks in the respective periods.

The rest of the paper is organized as follows. In section 2, we discuss the conceptual issues; section 3 is based on the methodology of the study while sections 4 and 5 contain the results and conclusion.

2.0 Conceptual Framework

The conceptual framework of the conduct of monetary policy can be traced to the classical economists like Marshall 1923, Say 1821 and Fisher 1911. They in one way explained the link between money supply and prices as a direct link. Keynes (1935) came up with the idea that relationship is not direct but that adjustments in the interest rate by the monetary authority affect the macroeconomic variables like real output, employment and domestic prices. And because of price rigidities and rational expectations, changes in nominal interest rates may cause movements in both short-term and long-term real interest rates. Given that real interest rate reflects cost of capital and corporate investment. Further, interest rate also influences investment spending like spending on household goods and investment goods. In a modern economy, actions of the Central bank in regulating supply of money and credit influence's economic agents portfolio decisions, aggregate demand and consequently inflation.

This transmission mechanism of monetary policy works through not just one but many channels that affect different variables and markets at various speed and intensities. This makes the transmission mechanism of monetary policy a complex study as described by Bernanke and Getler (1995) "inside the black box".

A framework for the analysis of money and interest rate channels of monetary transmission mechanism from Mishkin (1996) is represented in figure V. This illustrates the steps and interest rate channel in a monetary transmission channel in a developing nation like Nigeria.

The first stage of the interest rate channel concerns interest rate interactions. In other words this is the impact of the policy interest rate on the market interest rate. The second stage corresponds to the effect of the nominal market interest rate on the real rates and then to real sector (prices and output) as represented in figure V.

Changes in the short-term nominal interest rate induced by a central bank result in a corresponding change in the real interest rate on both short- and long-term bonds owing to nominal price rigidities. Hence, expansionary monetary policy, which lowers the short-term even in a world with rational expectations (Mishkin, 1996). This implies that policy actions of the monetary authorities in the current period cause changes in the money market rates. Changes in these rates in turn affect investment decisions (goods and labour markets) and ultimately the aggregate output and general price level.

3.0 Methodology

3.1 Model of the Study

In the standard form, a VAR contains a set of K endogenous variables $y_t = (y_{1t},...,y_{kt},...,y_{Kt})$ for k =1, . . ., K. The VAR (p) process is then defined as:

$$y_t = A_1 y_{t-1} + ... + A_p y_{t-p} + u_t \quad . \quad . \quad . \qquad (1)$$

with y_{t-p} being vector of endogenous variables, A_i are (K *x* K) coefficient matrices for $i = 1, . . . ,p$ and u_t is a K-dimensional process with $E(u_t) = 0$ and time invariant positive definite covariance matrix $E\left(u_t u_t^T\right) = \sum_u$ (white noise).

In this paper, we share the view of Robinson and Robinson (1997) and express the specific form of the structural VAR that is specified for estimation of the inter-relationship between the variables in the form:

$$\Delta GDP_t = \beta_{11}\Delta GDP_{t-1} + \cdots + \beta_{1q}\Delta GDP_{t-q} + \gamma_{11}\Delta CPI_{t-1} + \cdots + \gamma_{1q}\Delta CPI_{t-q} + \phi_{11}\Delta NMS_{t-1} + \cdots + \phi_{1q}\Delta NMS_{t-q} + \delta_{11}\Delta MPR_{t-1} + \cdots + \delta_{1q}\Delta MPR_{t-q} + \alpha_1 + \varepsilon_{1t} \quad . \quad . \quad . \qquad (2)$$

$$\Delta CPI_t = \beta_{21}\Delta GDP_{t-1} + \cdots + \beta_{2q}\Delta GDP_{t-q} + \gamma_{21}\Delta CPI_{t-1} + \cdots + \gamma_{2q}\Delta CPI_{t-q} + \phi_{21}\Delta NMS_{t-1} + \cdots + \phi_{2q}\Delta NMS_{t-q} + \delta_{21}\Delta MPR_{t-1} + \cdots + \delta_{2q}\Delta MPR_{t-q} + \alpha_2 + \varepsilon_{2t} \quad . \quad . \quad . \qquad (3)$$

$$\Delta NMS_t = \beta_{31}\Delta GDP_{t-1} + \cdots + \beta_{3q}\Delta GDP_{t-q} + \gamma_{31}\Delta CPI_{t-1} + \cdots + \gamma_{3q}\Delta CPI_{t-q} + \phi_{31}\Delta NMS_{t-1} + \cdots + \phi_{3q}\Delta NMS_{t-q} + \phi_{31}\Delta MPR_{t-1} + \cdots + \phi_{3q}\Delta MPR_{t-q} + \alpha_3 + \varepsilon_{3t} \quad . \quad . \quad . \qquad (4)$$

$$\Delta MPR_t = \beta_{41}\Delta GDP_{t-1} + \cdots + \beta_{4q}\Delta GDP_{t-q} + \gamma_{41}\Delta CPI_{t-1} + \cdots + \gamma_{4q}\Delta CPI_{t-q} + \phi_{41}\Delta NMS_{t-1} + \cdots + \phi_{4q}\Delta NMS_{t-q} + \delta_{41}\Delta MPR_{t-1} + \cdots + \delta_{4q}\Delta MPR_{t-q} + \alpha_4 + \varepsilon_{4t}. \quad . \quad . \qquad (5)$$

Where GDP is the natural logarithm of real domestic product in Nigeria in year t at 1984 constant prices, CPI is the natural logarithm of the composite consumer price index in Nigeria, NMS is the natural logarithm of the of the narrow money supply and MPR is the monetary policy rate. Other notations are; t is time as a proxy for technological change, β, δ, γ, ϕ and α are parameters of the model to be estimated and finally ε_i (i=1, .., 4) are vectors of innovations.

3.2 Data and Estimation Procedure

In this study we estimate an unrestricted VAR with four variables on the aggregate economy for the two periods of study being compared. The data include the real aggregate output, monetary policy rate, consumer price index and narrow money supply (M1) for the period 1986Q1-1999Q1 and 1999Q2-2012Q4. Our VAR model is used to determine the dynamic relationship between the endogenous variables without any restriction. The model captures the feedback effect allowing current and past values of the variable in the system.

The augmented Dickey-Fuller (ADF) test statistics were used to determine stationarity of study variables. This entails the estimation of the following regression according to (Dickey and Fuller, 1979).

$$\Delta Y_t = \beta_1 + \delta Y_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta Y_{t-i} + \varepsilon_t \quad . \quad . \quad . \qquad (6)$$

Where ε_t is a pure white noise error term and $\Delta Y_{t-1} = (Y_{t-1} - Y_{t-2})$, $\Delta Y_{t-2} = (Y_{t-2} - Y_{t-3})$ etc. The null hypothesis is that $\delta = 0$ (has a unit root) and alternative is that $\delta < 0$ (stationary). The optimum lag length for each of the variables has been chosen using the automatic lag selection option which is based on the Schwarz information criterion (SIC). The test is said not to be stationary if the ADF test reveals that the Null Hypothesis $\delta = 0$ could not be rejected against an alternative that $\delta < 0$, and stationary if otherwise.

The VAR model is indentified based on recursive Choleski decomposition. In respect of each system, we follow the order: real GDP, consumer price index, M1 and MPR respectively for

each of the period's being compared. To generate the impulse response Hamilton (1994) infers that if a VAR of our study with a vector MA (∞) is expressed in the form:

$$y_t = \mu + \varepsilon_t + \psi_1 \varepsilon_{t-1} + \psi_2 \varepsilon_{t-2} + ... \quad (7)$$

The matrix ψ has the interpretation

$$\frac{\delta y_{t+s}}{\delta \varepsilon_t'} = \psi_s ; \; . \quad . \quad . \quad (8)$$

Which implies that the row *i* and column j element of ψ identifies the consequences of a unit increase in the j[th] variable's innovation at date t (ε_{jt}) for the value of the i[th] variable at the time t+s (y_i, t+s), holding all other innovations at all dates constant.

This approach allows the identification of monetary policy shocks by taking the residuals from the reduced form interest rate equations and regressing them on the residuals from the real output, consumer price equations and narrow money supply for the respective periods. The choice of optimal lag order was determined based on Schwarz information criteria (SIC). This is to avoid the following problems: if the lag length is too small, the model will be mis-specified and if it is too large, the degrees of freedom will be lost.

4.0 VAR Results

4.1 Indicator of Monetary Policy

Our attempt to estimate the VAR requires that we choose an indicator of monetary policy. And this section analyzes the information content of the monetary policy rate and money supply aggregate (M1) as a predictor of real gross domestic product and domestic prices allowing the variables to interact without restrictions.

In order to estimate the VAR and determine the measures of economic activity (real GDP and domestic prices) we estimate the unit root tests on individual variables and then proceed to estimate the impulse response of the study variables. The sample period is divided into two: 1986Q1-1999Q1and 1999Q2-2012Q4. The periods allow us to compare the impact of monetary policy in the post SAP period and the period of the current civilian administration.

4.2 Unit Root Test

Augmented Dickey Fuller (ADF) tests were conducted to verify the stationarity (presence of unit roots) in the individual series of the model in which all variables are in logarithm except Minimum lending rate. The results of the unit root tests for the two periods are summarized in Table 1 and 2 (Appendix) indicate that all the variables are stationary at the first difference

except real GDP for the period 1986Q1-1999Q1 which was stationary at the second difference.

4.3 Impulse Response

To explain how the monetary policy actions affects the macro economy through the interest rate channel, Figures VI-VII shows the impact of an unexpected 1% increase in the policy rate on real output and domestic prices in the periods of study. In accordance with the VAR analysis for the first period 1986Q1-1999Q1 (figure VI) the real output in response to contraction in monetary policy rose initially within the first quarter (3months) after the shock. But after 6months it started to decline becoming negative after 9months and later reaching equilibrium in about 22months.

In the second period (1999Q2-2012Q4) the response of real output to monetary policy indicates an immediate decline in real output in the first quarter immediately after the shock (3months) and it did not start to rise until about 9 months reaching equilibrium after 12months (see figure VII).

The results of response of domestic prices to monetary policy in the first period differ relative to the second. The first period indicates that prices started to rise after 4 months, rose sharply after 6 months reaching about 0.04 per cent as a result of the monetary policy shock (see figure VI).

Evidence of response of domestic prices to monetary policy in figure VII (second period) indicates that domestic price response to monetary policy occurs after 6months when prices start to decline and it never returns to equilibrium even after 24months.

5.0 Conclusion and Recommendation

In this paper we conducted an investigation on the impact of monetary policy on real output and domestic prices in Nigeria comparing two periods: 1986Q1-1999Q1 and 199Q2-2012Q4. Our empirical findings tend to suggest that interest rate channel exists in Nigeria in the two periods of study. However, interest rate channel appears to be more effective in the latter period compared to the former.

Our results also suggest that the use of monetary policy to control real output and domestic prices is evolving in a developing country like Nigeria. This implies an improvement in the interest rate channel as a measure of monetary policy because it enhances the management and integration of the Nigerian financial system. In view of these findings, the need to further

harmonize the capital markets and the banking system is highly recommended so as to further strengthen a market controlled system of economic management in Nigeria.

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Appendix

Fig. I

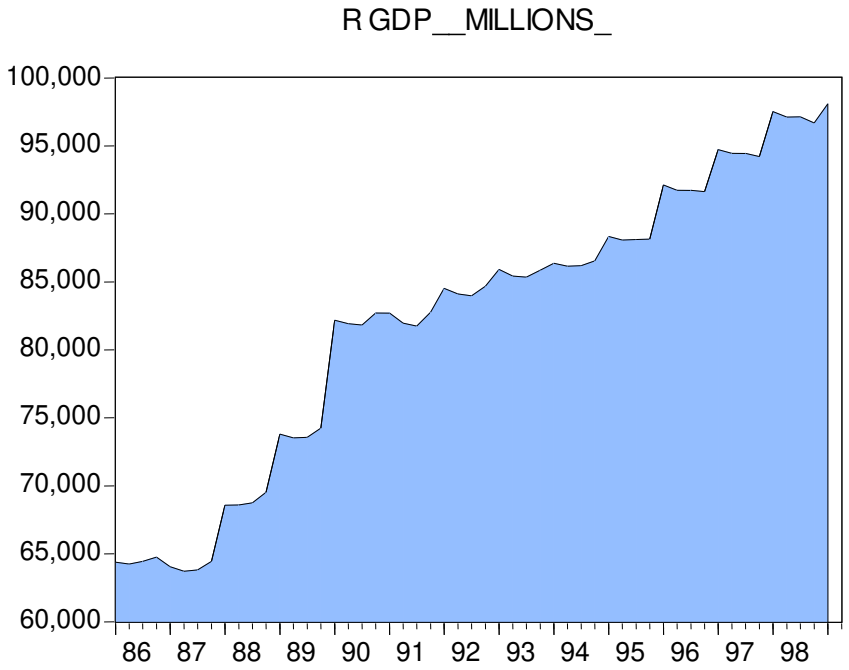

Fig. II

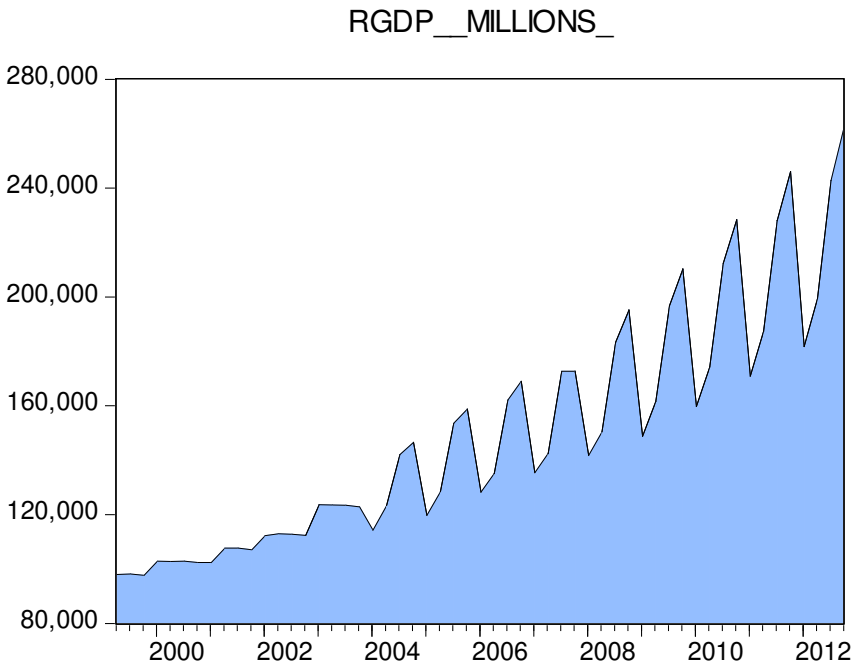

Fig. III

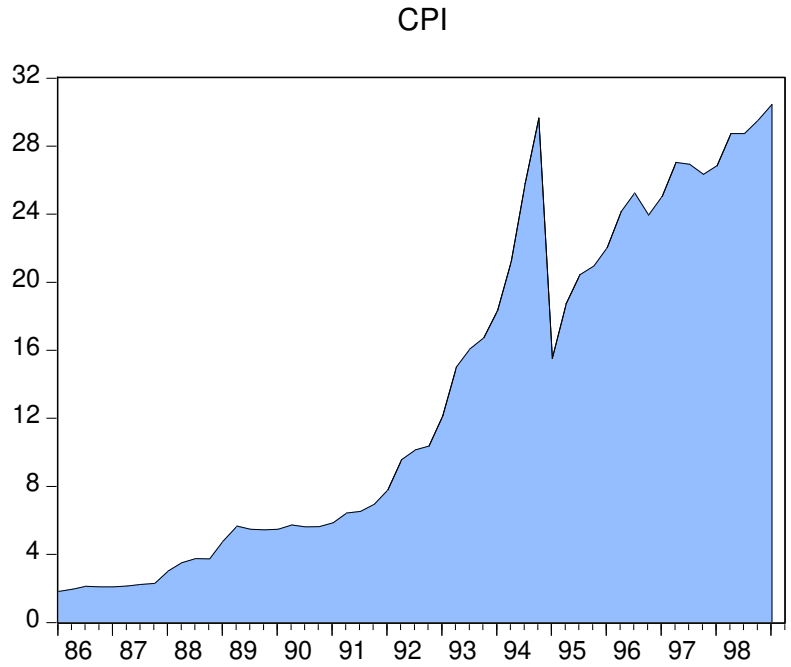

Fig. IV

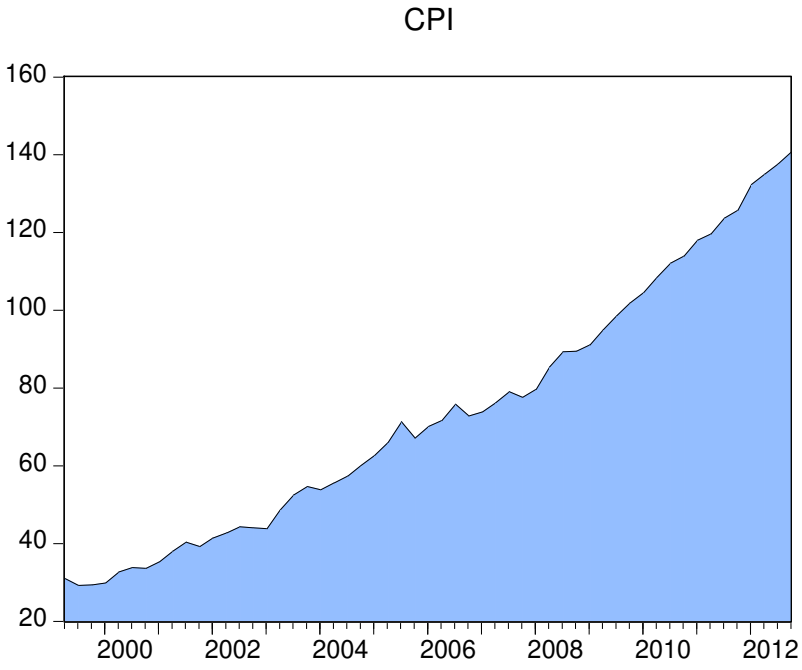

Fig. V Interest rate Channel

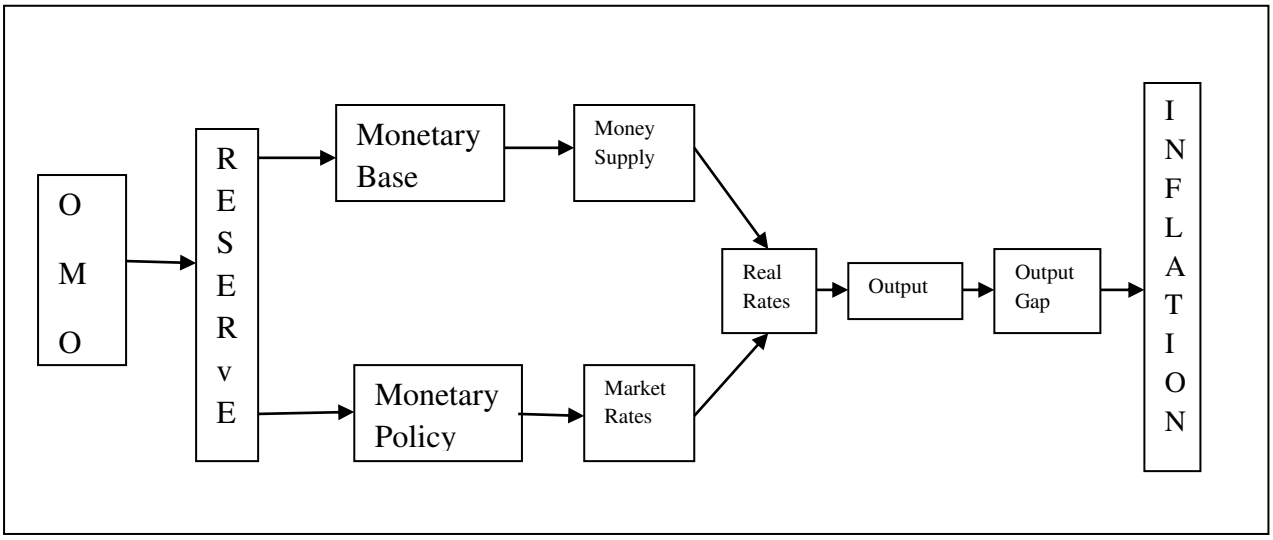

Table 1: Results of Unit Root Tests

	ADF Statistics		
	1986Q1-1999Q1		
Variables	Test	Lag	Remarks
Lnrgdp	-12.03	2	1(2)
Lncpi	-7.57	0	1(1)
lnM1	7.42	0	1(1)
MPR	-6.48	0	1(1)
Critical Values @ 1%			
lnrgdp	-3.57		
lncpi	-4.15		
lnM1	-3.57		
MPR	-3.57		

Table 2: Results of Unit Root Tests

	ADF Statistics		
	1999Q2-2012Q4		
Variables	Test	lag	Remarks
Lnrgdp	-6.41	4	1(1)
Lncpi	-7.99	2	1(1)
lnM1	-10	0	1(1)
MPR	-6.47	0	1(1)
Critical Values @ 1%			
lnrgdp	-3.57		
lncpi	-3.57		
lnM1	-3.56		
MPR	-3.56		

Figure VI Impulse Responses of RGDP and CPI to Choleski One Standard Deviation shock to MPR 1986Q1-1999Q1

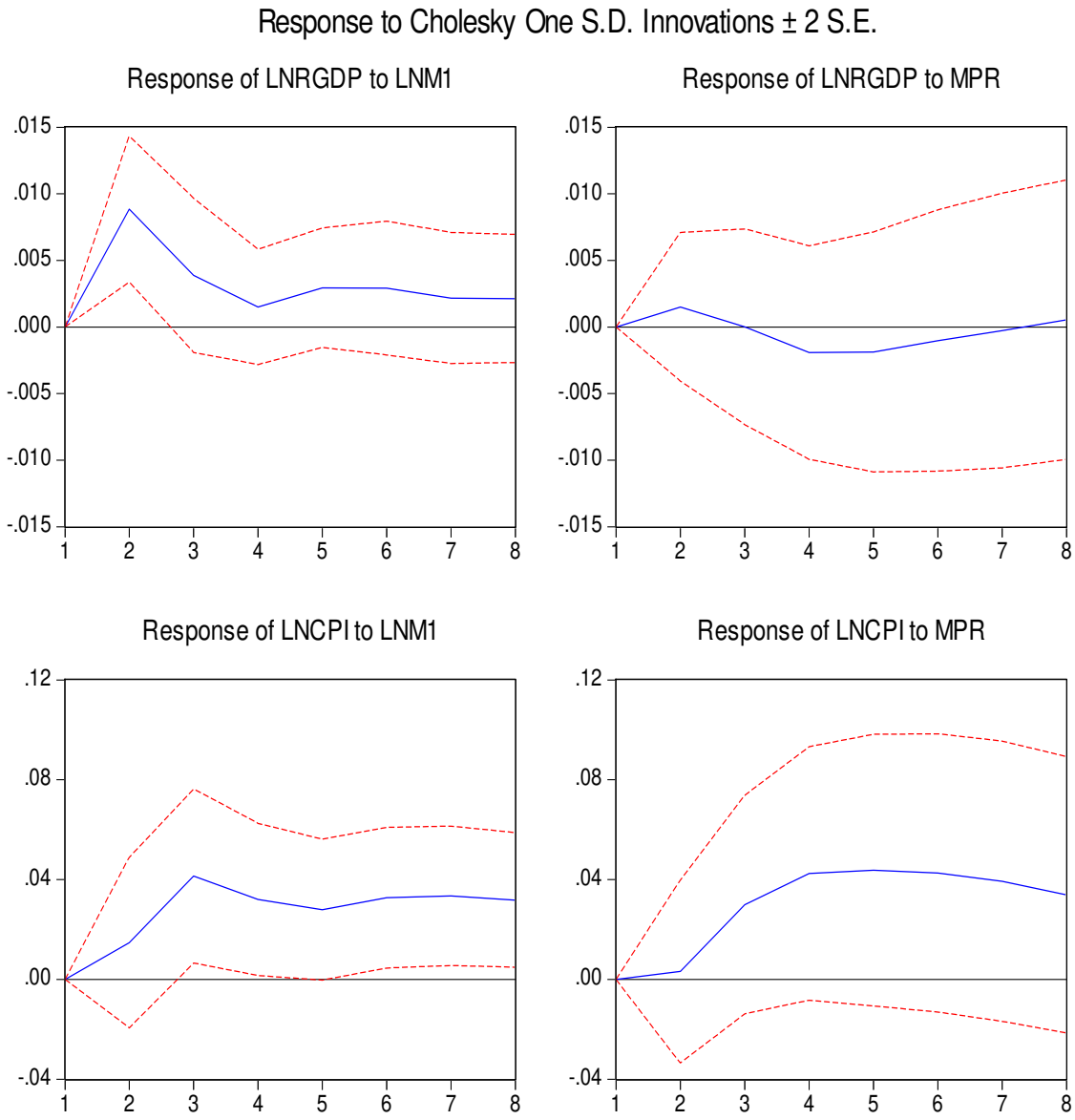
Response to Cholesky One S.D. Innovations ± 2 S.E.
Response of LNRGDP to LNM1
Response of LNRGDP to MPR
Response of LNCPI to LNM1
Response of LNCPI to MPR
.015
.010
.005
.000
-.005
-.010
-.015
.12
.08
.04
.00
-.04
1
2
3
4
5
6
7
8

Figure VII: Impulse Responses of RGDP and CPI to Choleski one Standard Deviation shock to MPR 1999Q2-2012Q4