Economic and Financial Review

Volume 55 | Number 1 Article 3

3-2017

Interest Rate Dynamics and Real Output Behaviour in Nigeria: A Simulation Analysis

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Abstract

The declining output growth observed from the second quarter of 2014, which led to calls for a more expansionary monetary policy despite rising inflationary pressure, necessitated a reassessment of the impact of interest rate on real output growth in Nigeria. Using a Bayesian Vector Autoregressive (BVAR) model and quarterly data from 2000:Q4 to 2015:Q3, the effect of monetary policy transmission (interest rate dynamics) on real output performance was estimated. Although results of the simulation analysis were somewhat mixed, those of the impulse response functions indicated that positive shocks to monetary policy rate (MPR) produced a negative and small impact on output. Specifically, reducing the MPR from 13 to 10 per cent, would lead to an increase in output growth from 2.35 per cent in 2015Q3 to 3.84 per cent in 2016Q3. However, when the MPR was raised from 13 to 14 per cent, output grew albeit at a slower rate from 2.35 to 3.16 per cent during the same period. The authors concluded that policy rate adjustment could be used as a major tool to boost output growth, especially if inflation is low and stable.

Keywords: Monetary Policy, Output, VAR, Inflation, Growth, Simulation
JEL Classification Numbers: E17, E52, E58

I. Introduction

GDP growth has been trending downward, from 6.54 to 2.84 per cent in the second quarter of 2014 and third quarter of 2015, respectively, indicating a burst in the business cycle. The declining economic growth has been occasioned by declining government fiscal revenues, following the fall in the price of crude (Nigeria's main export commodity) since mid-2014. This has resulted to declining public and private investment expenditures, thus putting output growth under severe strain. The situation has been aggravated further by the implementation of the Treasury Single

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Account (TSA), leading to large liquidity withdrawals from the banking system. This action has impaired the financial intermediation role of banks, with the resultant debilitating effect on output growth, arising from decreased lending to the private sector and, subsequent, dwindling investment expenditure.

The use of monetary policy to smoothen fluctuations in business cycles has gained prominence in both developed and developing countries, including Nigeria. Short-term interest rate remains the key instrument of monetary policy to manage business cycles in order to influence the movement of macroeconomic variables, like real output, inflation and unemployment, in the desired direction. Fluctuations in business cycles, short-term interest rates and other monetary aggregates are used as operating targets.

Changes in the central bank policy rate are expected to influence money market interest rates and alter the cost of funds. Specifically, to affect bank lending and deposit rates, which are imperative in shaping the consumption and investment behaviour of economic agents, what is required is to change the policy rate, depending on the macroeconomic goal in focus. It is pertinent to note that market rates are, however, known to be sticky on account of their delayed response to changes in the policy rate; and thus, hinders the effective transmission of monetary policy impulses to the real economy (Ogundipe and Alege, 2013).

The effectiveness of the policy rate in affecting the behaviour of banks and achieving the ultimate objectives of monetary policy is determined by the speed and magnitude of the adjustments in bank lending and deposit rates. In other words, the response of real output depends on the response of banks' interest rates to monetary policy shocks. The interest rate pass-through of monetary policy changes works through the instrumentality of aggregate demand, as it affects such important variables, like consumption, investment, savings and inflation under the assumption that households do not smoothen their consumption (Ogundipe and Alege, 2013). Since real interest rates reflect the price of capital, changes in the policy rate are expected to impact on real output in Nigeria through the bank lending and interest rate channels. The response of consumption and investment behaviours to adjustments in the short-term interest rates also suggests that changes in the policy rate have implications for inflation expectations.

Given the foregoing and the established evidence that short-term interest rate could be used to influence real output behaviour, the issue of concern is whether this position holds for Nigeria, considering the need to reverse the trend of declining output and, at the same time, tame rising inflation. Various studies have been carried out the impact of a monetary policy shocks on output. While some studies (see for example, Xu and Chen, 2012; Were and Tiriongo, 2012; Robinson and Robinson, 1997) observed declining output, following interest rate hikes, others (such as Ganev et al., 2002; Aksoy and León-Ledesma, 2005; Cheng 2006) found that the impact of interest rate changes on output was quite small and, sometimes, negligible. The Nigerian studies (Ezeanyeji, 2014; Udoka and Anyingang, 2012) are few with divergent revelations. There is, therefore, the need for a reassessment, considering the changing policy environment, data and global dynamics that have serious implications for the Nigerian economy.

Consequently, the specific questions of interest are: what is the extent and direction of the impact of interest rate changes on aggregate output and employment in Nigeria? Can a change in the policy rate be used to reverse the declining trend in output growth and rising inflation, simultaneously?

The main objective of the paper, therefore, is to examine the response of real output in Nigeria to the dynamics in short-term interest rates, with a view to providing better understanding and suggesting policies to address the adverse impact of business cycle fluctuations in Nigeria. The paper is structured into six sections with the introduction provided in Section 1. Section 2 reviews the theoretical and empirical literature; while Section 3 gives the stylised facts on the interest rate policy regimes, output growth and other relevant macroeconomic variables in Nigeria. Section 4 discusses the methodology, including the estimation procedures and the specification of the model. The empirical results and policy implications are discussed in Section 5, while Section 6 provides the concluding remarks and policy recommendations.

II. Literature Review

II.1 Theoretical Framework

II.1.1 Theories of Interest rate

Bannock, et. al. (1998) defined interest rate as the price a borrower has to pay to enjoy the use of cash, which he or she does not own; and the return a lender

enjoys for deferring consumption or parting with liquidity. Interest rate has also been conceived by economists as the rate of return on capital. It can be distinguished into the natural and market rates. While the market rate of interest is the rate at which funds can be borrowed in the market, the natural rate of interest refers to the rate of return on capital investment.

The importance of interest rate centres on its equilibrating influence on supply and demand in the financial sector. Colander (2001) and Ojo (1993) confirmed this, stating that the channeling of savings into financial assets and individuals incurring financial liabilities is highly influenced by interest rate premium on those financial assets and liabilities. Furthermore, the interlocking linkage between the financial and real sectors establishes the developmental role of interest rate. It is through this linkage that the effect of interest rate on the financial sector is transmitted to the real sector. Consequently, the monetary authorities, in the pursuit of monetary policy to achieve price stability, influence the level of savings and availability of credit by adjusting the policy rate.

II.1.1.1 The Classical Theory of Interest Rate

In the classical theory, savings and investment are regarded as the only determinants of the rate of interest. The theory explains that interest rate is determined through the forces of demand and supply of funds. Thus, money lent out to investors for investment in capital goods is made available from the savings of other people out of their current incomes. By postponing consumption, they make available resources for the production of capital goods. The theory further assumes that savings are interest-elastic. Therefore, the higher the rate of interest, the more the savings people will be induced to make. That is, for people to be induced to save more, and refrain from consuming their entire income, a higher rate of interest will have to be offered.

Uchendu (1993) opines that the classical theory views interest rate as the return or yield on equity or opportunity cost of deferring current consumption. Fisher (1974) notes that time preference and marginal productivity of capital are key determinants of interest rates.

In general, the view of the classical theory is that interest rate is the price paid for saving capital, which is determined by its demand for, and supply of savings. The demand for capital comes mostly from investors who borrow for

productive activities, while the supply comes from income earners. The borrower compares the market rate of interest with the marginal productivity of capital and stops borrowing when he believes productivity is equal to the rate of interest.

II.1.1.2 The Loanable Funds (Neo-classical) Theory

The neo-classical loanable funds theory, which is an extension of the classical theory, emphasises the demand for, and supply of loanable funds in the determination of interest rate. When the supply of fund is higher than the demand, interest rates will be low and vice versa if the demand outweighs supply. Thus, the equilibrium interest rate is given at the point where both supply and demand for loanable funds are equal.

The supply of funds available for lending (credit) would be influenced by the savings of the people, as well as the additions to the money supply through credit creation by banks. Thus, savings constitutes the supply of loanable funds (S), and new money supply resulting from credit creation by commercial banks (M). The total supply of loanable funds is equal to S + M. The demand side of the loanable funds would be determined by the demand for investment expenditure (I) and the demand for hoarding money (H). Thus, I + H is the total demand for loanable funds. If the hoarded money increases, there would be a reduction in the supply of funds, and vice versa.

According to the loanable funds theory, the rate of interest is determined at the point where the demand for loanable funds (I + H) equates the supply of loanable funds (S + M). This clearly shows that the theory is an extension of the classical theory, which states that the rate of interest is a function of savings and investment.

Symbolically, the loanable funds theory can be expressed as;

$$r = f(I,S,M,H) \quad (1)$$

where;

r = the rate of interest
I = Investment expenditure
S = Savings
M = Credit creation by commercial banks
H = Demand for hoarded money

II.1.1.3 Keynes (Liquidity Preference) Theory of Interest Rate

The Keynesian theory of interest rate perceives interest to be the reward for parting with liquidity for a specified period, rather than savings. Individuals have the choice of what to consume and what to save from their income. The former depends on what the Keynesian theory calls the propensity to consume. Given this, a certain proportion will be saved, which will either be held as cash or non-interest-paying bank deposits. How much an individual will part with or lend depends upon what Keynes calls liquidity preference. According to the Keynesian theory, demand for liquidity is determined by three motives: (i) the transactionary motive, where people prefer to hold cash to assure basic and current transactions; (ii) the precautionary motive, where people prefer to hold cash in case of unexpected problems/contingencies; and (iii) the speculative motive, where people desire to hold their resources in liquid forms so as to speculate market movements, concerning future changes in interest rates and bond prices.

The demand for money (specifically, the liquidity preference for the speculative motive) and supply of money determine the rate of interest. The rate of interest is determined by the level of reward for keeping money in bonds or other assets rather than keeping it in cash. It is determined by the interaction between investments and savings. The Keynesians also believe that the relationship between changes in the quantity of money and prices is non-proportional and absolutely indirect, through the rate of interest.

The strength of Keynesian theory lies in its integration of monetary theory and value theory, on the one hand, and the theory of output and employment through the rate of interest, on the other hand. Thus, when the quantity of money increase, the rate of interest falls, leading to an increase in aggregate investment and demand, thereby raising output and employment. The theory observed a link between the real and monetary sectors of the economy – an economic phenomenon that describes equilibrium in the goods and money market. The theory also examined the relationship between the quantity of money and prices under situations of unemployment and full employment. Accordingly, so long as there is unemployment, output and employment will change in the same proportion as the quantity of money, but there will be no change in prices. At full employment, however, changes in the quantity of money will induce a proportional change in price (CBN, 2012).

II.1.1.4 The Taylor Rule

The Taylor rule (1999) is a monetary policy rule, which prescribes how a central bank should alter nominal interest rates in a systematic manner in response to changes in inflation and output, as well as other macroeconomic activities. Specifically, it stipulates that for every one percent rise in inflation, the nominal interest rate should be raised by more than one percent.

The Taylor rule assumes the following form:

$$i_t = 2 + \pi_t + g_\pi (\pi t - \pi^{*}) + g_x x_t$$

Where;

it is the nominal policy rate,

2 is a constant term, which is the long-run or equilibrium real rate of interest,

π^* is the central bank's inflation objective,

π_t is the current period inflation rate, and

X_t is the current period output gap.

Gπ and gx are parameters to be estimated

The Taylor's rule assumes that the central bank's inflation target remains unchanged at 2.0 per cent, and over time, there is improvement in monetary policy because the central bank has responded more vigorously to deviations of inflation from the 2.0 per cent value, by increasing the magnitude of the coefficient gπ on the inflation term $(\pi t - \pi^{*})$ (Hetzel, 2000). The central bank aims at stabilising inflation around its target level, while output around its potential. Positive deviations of the two variables from their target or potential level would be associated with a tightening of monetary policy, while negative deviations would be associated with loosening of monetary policy (Hofmann and Bogdanova, 2012).

The output gap is further illustrated with the following;

$$x_t = - ?(i_t - \pi_t - r) + \upsilon_t \quad (2)$$

$$\pi_t = \pi_{t-1} + \lambda x_{t-1} + e_t \quad (3)$$

$$i_t = g_0 + g_\pi \pi_t + g_x x_t \quad (4)$$

Equation (2) is the IS function, which relates the output gap to the real rate of interest. The Phillips curve is depicted in Equation (3), and it relates inflation to the output gap. The reaction function of the central bank is captured in equation (4) and it takes the form of a Taylor rule.

Overall, the Taylor rule suggests that central banks should raise interest rates when inflation is above planned target or when GDP growth is too high and above potential. Conversely, the central banks should lower rates, when inflation is below the target level or when GDP growth is too slow and below potential.

II.1.2 Monetary Policy Transmission Mechanism

Monetary policy is a deliberate action of the monetary authorities to influence the value, quantity, cost and availability of money in an economy in order to achieve the desired macroeconomic objectives of internal and external balances (CBN, 2011a). The need to regulate money supply is premised on the fact that there should be a stable relationship between money supply and economic activity, such that if the former is not limited to what is required to support productive activities, the undesirable effects of inflation will arise.

The primary objective of monetary policy is price stability. In most economies, the central bank is usually charged with the responsibility of conducting monetary policy, and they have remained focused on achieving internal and external balances, as well as promoting non-inflationary growth in output. Thus, monetary policy measures are specifically designed to ensure stable inflation rates, stimulate growth in the productive sectors and reduce pressure on the balance of payments.

Central banks achieve the broad objectives of monetary policy through the use of certain monetary policy instruments, which could be direct or indirect. With the direct instruments, a central bank can direct commercial banks on the maximum percentage or amount of loans (credit ceilings) to different economic sectors or activities. Interest rate caps, liquid asset ratio and issue credit guarantee to preferred loans are other direct monetary policy tools to ensure that available savings is allocated and investment directed in particular directions as desired by the central bank. The indirect instrument, on the other hand, involves the use of reserve requirements, open market operations,

discount window operations, among others, by the central bank to control money supply (CBN, 2011b).

Since one of the major objectives of monetary policy is to stimulate growth in the productive sectors, it is imperative that such policies should be effectively transmitted to the real economy. There is an interlocking linkage between monetary policy and the real sector, which establishes the developmental role of interest rates. Through this linkage, the effect of monetary policy/interest rate is transmitted to the real sector. Consequently, the central banks, in their pursuit of monetary policy, try to influence the level of savings and availability of credit by influencing the policy rate.

The monetary policy process presupposes that changes in the supply of money will work through some intermediate variables through which some effects are transmitted to the ultimate objectives of monetary policy. Therefore, monetary policy is formulated with some assumptions of the path through which it would follow in order to impact on the real economy. This path is referred to as the transmission mechanism of monetary policy. It defines the various channels through which policy-induced changes in the nominal money stock or the short-term nominal interest rate affects prices and output in the economy. The transmission mechanism of monetary policy has been conceptualised in many ways. According to the European Central Bank (2015), it is the process through which monetary policy decisions affect the economy, in general, and the price level in particular. This mechanism is characterised by long, variable and uncertain time lags, which makes it difficult to predict the precise effect of monetary policy actions on the economy and price level. Similarly, CBN (2010), notes that, the transmission mechanism of monetary policy traces the relationship between changes in the supply of money and real variables, such as output, employment, and prices of goods and services.

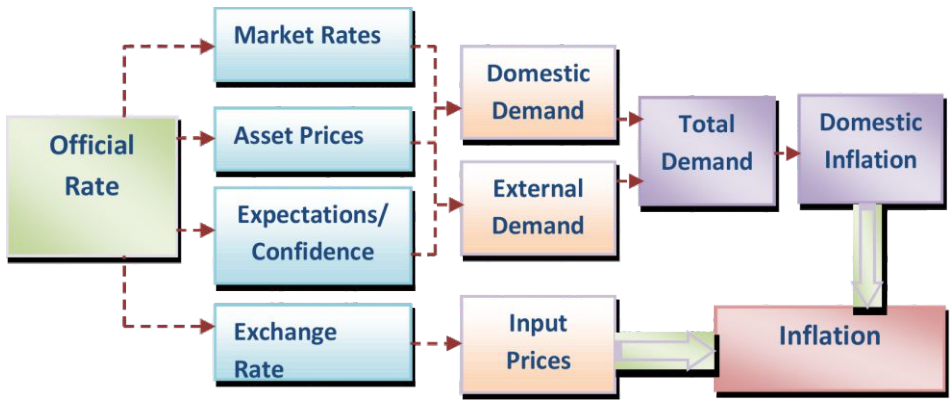
According to Ireland (2005) monetary transmission mechanism describes how policy-induced changes in the nominal money stock or the short-term nominal interest rate impact real variables, such as aggregate output and employment. Petursson (2001) describes the transmission mechanism of monetary policy as the process through which changes in the central bank policy rate are transmitted to the economy, affecting aggregate demand, inflation expectations and the rate of inflation. Similarly, Taylor (1999) simply

states that it is the process by which monetary policy decisions are transmitted in real GDP and inflation.

Andries (2012) emphasises that central banks affect developments in the real economy, by means of a transmission mechanism of monetary impulses. He believes that a better understanding of the transmission mechanisms of monetary policy would require an analysis of the factors that influence it. He opines that the transmission of monetary policy to the real sector defers from one geographical area to another and from one period to another. For example, in low income countries, the effectiveness of interest rate and credit channels are limited due to lack of proper institutional framework, reduced depth of financial markets; and high costs of funds. Similarly, the effectiveness of exchange rate channel is undermined by the frequent interventions of the central bank in the foreign exchange market.

The literature identifies five major channels of monetary policy transmission. These include: interest rate, credit, exchange rate, asset prices and expectation channels. Figure 2.1 describes how monetary policy is transmitted to the economy.

Figure 2.1: Monetary Policy Transmission Mechanism



Source: Bank of England

The Interest Rate Channel

The interest rate channel is often referred to as the 'traditional' channel of monetary policy transmission and forms the framework for this study. It is the main channel of monetary policy transmission and was first postulated by the

Keynesian view of how monetary policy effects are transmitted to the real economy through the interest rate. According to the traditional Keynesian interest rate channel, a policy-induced increase in the short-term nominal interest rate leads first to an increase in long-term nominal interest rates. Thus, adjustments in short-term rates are transmitted to the medium and long-term interest rates. Investors will act to arbitrage away differences in risk-adjusted expected returns on debt instruments of various maturities. When nominal prices are slow to adjust, movements in nominal interest rates translate into movements in real interest rates. Firms, observing that their real cost of borrowing has increased, reduce their investment expenditures. Similarly, households, facing higher real borrowing costs, reduce consumption; thus, aggregate demand, output and employment decline. Mishkin (1995) observes that the traditional Keynesian view of transmission of monetary tightening is expressed as follows;

$$\mathbf{M}\downarrow \rightarrow \mathbf{i}\uparrow \rightarrow \mathbf{I}\downarrow \rightarrow \mathbf{Y}\downarrow$$

Where;

M= Money supply
i = real interest rate
I = Investment Spending
Y = Output

A contractionary monetary policy leads to an increase in real interest rate, which, in turn, raises the cost of capital, causing a decline in investment spending, which then reduces aggregate demand and output (Mishkin, 1995).

The Credit Channel

The credit channel consists of two channels of monetary policy transmission – the bank lending and balance sheet channels. The bank lending channel operates through the supply of bank loans. Banks tend to rely on deposits as a principal source of funding for lending, while many small firms rely on bank loans as a principal source of funds for investment. A contractionary monetary policy by the central bank increases bank reserves and reduces the supply of loans for small or medium-sized bank-dependent business, which are compelled to search for new lenders and establish new credit relationships. These constraints increase their external finance premium and affect their spending decisions.

Schematically, the monetary policy effect is as follows;

$$\mathbf{M} \downarrow \rightarrow \mathbf{BD} \downarrow \rightarrow \mathbf{BL} \downarrow \rightarrow \mathbf{I} \downarrow \rightarrow \mathbf{Y} \downarrow$$

Where;

M= Money Supply
BD = Bank Deposits
BL = Bank Loans
I = Investment Spending
Y = Output

However, the central bank can regulate the availability of bank loans in two principal ways; by raising reserve requirements with the prime intention of reducing the loanable funds to borrowers; and by conducting open market sales of government securities aimed at reducing commercial banks' reserves since depositors will substitute deposits with the more attractive financial assets.

The balance-sheet channel, on the other hand, is based on the well-established fact that a borrower with a stronger financial position pays a lower external finance premium, as the present value of an investment is more sensitive to a given interest rate change, when the stream of payment is longer. Changes in policy do not affect only market interest rates but also the financial positions of borrowers. A tight monetary policy raises interest rates and weakens borrowers' balance sheets, which invariably reduces net cash flows. Rising interest rates, also, lead to decline in asset prices, which among other things, reduce the value of the borrower's collateral. There could be indirect effects of a tight monetary policy, which arise from the deterioration in consumers' expenditure. The revenue of firm's will decline, while its fixed costs do not adjust in the short run. Over time, this financing gap thus erodes the firm's net-worth and credit-worthiness (Mishkin, 1995; and Ishioro, 2013).

The Exchange Rate Channel

In open economies, such as Nigeria, the effects of monetary policy could be transmitted to output and prices through the exchange rate. According to Mishkin (1995), this channel involves interest rate effects because when domestic real interest rates rise above its foreign counterparts, it makes local currency deposits to become more attractive relative to deposits dominated

in foreign currencies. This leads to a rise in the value of domestic currency deposits, relative to other currency deposits, that is, an appreciation of the local currency. The higher value of the local currency makes domestic goods more costly than foreign goods, thus causing a decline in net exports, and hence, aggregate output.

The relationship is presented thus:

$$\mathbf{M}\downarrow \rightarrow \mathbf{i}\uparrow \rightarrow \mathbf{ER}\uparrow \rightarrow \mathbf{NX}\downarrow \rightarrow \mathbf{Y}\downarrow$$

Where;

M= Money supply
i = Interest Rates
ER = Exchange Rates
NX = Net Exports
Y = Output

The strength of the exchange rate channel, however, depends on the responsiveness of the exchange rate to monetary shocks, the degree of openness of the economy and the exchange rate arrangement of the country. Under a floating exchange rate regime, an expansionary monetary policy would depreciate domestic currencies, and increase the prices of imports. However, the managed floating regime often results to a relatively weak transmission process in affecting real output and prices.

The Asset Price Channel

The asset price channel, also known as the portfolio balance channel, comprises the equity price channel, and the housing and land price channel. Equity price channel is further sub-divided into two: the investment effect, popularly explained by the Tobin's Q theory; and the wealth effect on consumption, advanced by the Modigliani's life-cycle income hypothesis. This channel is based on the monetarists' paradigm and objects the Keynesian paradigm of analysing monetary policy effects on the economy by focusing on only one relative asset price, the interest rate. Instead, the monetarists posit that it is vital to assess how monetary policy affects the universe of relative asset prices and real wealth.

The Tobin's Q theory explains how monetary policy affects the economy through its effects on the valuation of equities. The Q is defined as the market value of firms divided by the replacement cost of capital. If Q is high, the market price of firms is high, relative to the replacement cost of capital, and new plant and equipment capital is cheap relative to the market value of business firms. Thus investment spending will rise because the firm can buy a lot of new investment goods with only a small issue of equity. However, when the Q is low, firms will not purchase new investment goods because their market value is low, relative to the cost of capital (CBN, 2010).

According to the Tobin's Q theory, an expansionary monetary policy reduces interest rates, making bonds less attractive relative to equities, thereby raising the price of equities. This leads to an increase in the market value of companies, in relation to their cost of capital. Thus, companies are encouraged to issue new shares at higher prices, and use the proceeds for the purchase of investment goods (CBN, 2010).

The transmission of monetary policy through the equity price channel is schematically shown thus;

$$\mathbf{M}\uparrow \rightarrow \mathbf{Pe}\uparrow \rightarrow \mathbf{q}\uparrow \rightarrow \mathbf{I}\uparrow \rightarrow \mathbf{Y}\uparrow$$

Where;

M= Money supply
Pe = Equity Prices
q = Ratio of market value of firms to replacement cost of capital
I = Investment
Y = Output

The other sub-channel in the assets prices channel is the wealth effect on consumption, which was modeled on the life-cycle income hypothesis, developed by Modigliani (Modigliani, 1971). Since consumption is a function of lifetime resources, a rise in stock prices, translates to higher financial wealth higher consumption of households. The monetary transmission mechanism is depicted thus:

$$\mathbf{M}\uparrow \rightarrow \mathbf{Pe}\uparrow \rightarrow \mathbf{W}\uparrow \rightarrow \mathbf{C}\uparrow \rightarrow \mathbf{Y}\uparrow$$

Where;

M= Money Supply
Pe = Equity Prices
W = Wealth
C = Consumption
Y = Output

Housing and land prices are also important channels of wealth, such that a rise in their prices, relative to replacement costs, leads to a rise in Tobin's Q for housing, which stimulates production. Also, since housing and land prices are key components of wealth, a rise in their prices will increase wealth and raise consumption. Monetary expansions, which raise housing and land prices through such mechanisms, lead to rise in aggregate demand. This makes the housing and land channels key mechanisms for the transmission of monetary policy (Mishkin, 1996).

The Expectations Channel

Monetary policy decisions also affect expectations for prices and the future performance of the economy. This is because individuals and firms determine their prices based on such expectations. Inflation expectations are transmitted to the economy when individuals bargain for higher wages and when firms adjust their prices in response to their perception of how future prices would trend. Inflation expectations affect interest rates, which in turn affects aggregate supply and demand through the other channels. However, the effects of expectations on monetary policy rest on the credibility of central bank's actions to tame future inflation expectations by pushing down current inflation. If the commitment of monetary policy to reduce inflation is credible, its effectiveness is enhanced by its potential to reshape inflation expectations.

II.2 Empirical Literature

Empirical findings on the impact of interest rate on real output behaviour differ. Robinson and Robinson (1997) using the structural vector auto-regression (SVAR) model and monthly data for the period examined the channels through which monetary policy was transmitted in Jamaica, since the liberalisation of the economy. The study found that 1 per cent shocks to repo

rate had important short-run effects on both prices and economic activity, as the inflation rate decelerated within two months by approximately 0.1 per cent per month, while real economic activity declined by approximately 2.0 per cent in four months.

Findings by Christiano et. al., (1998), using the VAR methodology and quarterly data from 1965:3-1995:2 for the US indicated that a decline in the key interest rate controlled by the Federal Reserve tended to boost output over two to three years, but the effect die-off thereafter so that the long-run effect was confined to only prices. Aron and Muellbauer (2002), applied the multi-step forecasting model to study inflation and output in South Africa using quarterly data from 1963:1 to 2001:2. The result showed an important link between interest rates and output, with low inflation rate associated with higher openness of the economy, low wholesale prices relative to consumer prices, high real exchange rate, low real mortgage payments, as well as low real interest rates, output gap and indirect tax rate.

Xu and Chen (2012) examined the effect of interest rate on aggregate demand in China using quarterly data from 1998:Q1 to 2009:Q4 and monthly data from July 2005 to February 2010. They found that a change in the policy rate, transmitted to bank lending rates, influenced aggregate domestic demand, investment, and eventually output in China. Similarly, Hafer and Kutan (2002), in a study of 20 countries, using quarterly data from 1990-1998 and applying the VAR technique, found that, although interest rates generally played an important role in explaining output, in about half of the countries, money accounted for more of the variance in real output than nominal interest rates.

Starr (2005) in studying four core Commonwealth of Independent States (CIS) countries (Russia, Ukraine, Belarus and Kazakhstan), used quarterly data for 1995:1 to 2003:4 and the VAR methodology and found little evidence of real effects of monetary policy on output in these countries, with the notable exception that interest rates had a significant impact on output in Russia. Were and Tiriongo (2012), using the simple VAR model and annual data, covering the period 2007 to 2011 for Kenya, found that, following a monetary policy shock, real GDP declined after 10 periods (months), whereas there was no significant impact on domestic price.

Ganev et. al., (2002), using the autoregressive distributed lag (ARDL) approach and monthly data from 1995-2000 from ten countries in the Central and Eastern Europe (CEE), found no evidence that changes in interest rate affected output, though there was some indication that changes in the exchange rate did.

Similarly, Aksoy and León-Ledesma (2005) tested for the long-term relationships between monetary indicators and real output, using an autoregressive specification and annual data for the United Kingdom from 1948-2001 and the United States from 1947-2001. The results showed that there was no empirical evidence to support the existence of long-term relationships between the relevant policy indicators and real output. Various tests showed that there was neither significant nor stable long-term relationship between short-term interest rates and real output in the UK and the US.

Cheng (2006) examined the impact of a monetary policy shocks on output, prices, and the nominal effective exchange rate for Kenya, using data spanning 1997–2005 and the VAR technique. His findings suggested that an exogenous increase in the short-term interest rate tended to be followed by a decline in prices and an appreciation in the nominal exchange rate, but had an insignificant impact on output.

In the case of Zambia, Odhiambo (2009) examined the dynamic impact of interest rate reforms on economic growth and its influence on financial deepening using annual time series data from 1969 to 2006. The study employed two models, including error correction model (ECM), and found that financial deepening, which resulted from interest rate liberalisation, Granger-caused economic growth.

Bayangos (2010) re-specified a dynamic, structural, economy-wide macro econometric model, using annual data for the period 1999 to 2009 in the Philippines and found that the impact of a monetary policy tightening on real output appeared to be relatively moderate and that the lags was quite long, while the impact on the price level appeared to be stronger and shorter, compared to the impact on the real output.

Using SVAR methodology with quarterly data for the period 1971-2009, Ćorić, Perović, and Šimić (2012) studied the effects of a monetary policy shock on output and prices in 48 countries. The result of the cross-country output regressions suggested that the effect of a monetary policy shock on output was, on average, smaller in countries that were more correlated with the global economy.

In Nigeria, Ezeanyeji (2014) applied the ordinary least square (OLS) technique in assessing agricultural productivity using annual data covering the period 1986 to 2010. The authors findings suggested that interest rate played a significant role in enhancing economic activities. Similarly, Udoka and Anyingang (2012), employed the ordinary' least square (OLS) methodology and annual data for Nigeria from 1970-2010, found an inverse relationship between interest rate and economic growth in Nigeria.

Ojima and Fabian (2015) used multiple regression and annual data from 1986 to 2012 to investigate the impact of interest rate on investment in Nigeria. The results revealed that high interest rate negatively affected investment. Specifically, a 1.0 per cent increase in interest rate would reduce investment by 14.0 per cent. However, Idoko and Kpeyol (2010) assessed the impact of interest rate deregulation on economic growth in Nigeria. Using an autoregressive model and data from 1970 - 2009, the result showed that deregulated interest rate had insignificant impact on economic growth.

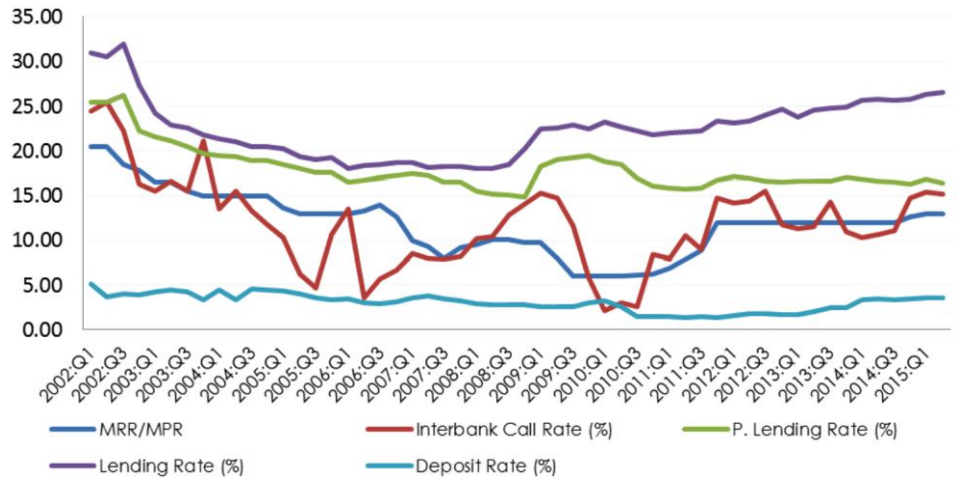
III. Stylised Facts on Interest Rate Dynamics and Real Output in Nigeria

A key objective of monetary policy has been the attainment of both internal and external balance of payments. A major policy instrument used is interest rate. Thus, with a regime of more active monetary policy interest rate where rates are reviewed every two months in order to ensure savings mobilisation and investment promotion, price stability consistent with economic growth and development remain the target of the monetary authority. The CBN uses the MPR (formally MRR) as the official interest (anchor) rate on which all other interest rates in the money market and the economy revolve. Adjustment of policy rate by central bank has implications for the behaviour of other macroeconomic aggregates. Consequently, we present the following stylised facts on interest rate dynamics and real output behaviour in Nigeria.

III.1 Trend in Interest Rates

The trend in interest rates from 2002:Q1 to 2015:Q2 are shown in Figure 3.1. The movement in the anchor rate, MRR/MPR is seen to be driving all other rates, as expected except the interbank call rate, which exhibits more volatility than other interest rates. The behaviour of interbank call rate is due to the fact that it is used largely to address liquidity issues and meet requirements placed on them among DMBs. While interest rates have generally been trending downwards from 2002 to 2008, they have been on a rising trend from 2009 up to 2015, although the MPR only maintained a steady upward trend from 2011.

Figure 3.1: Trends in Interest Rates (2002:Q1 - 2015:Q2)

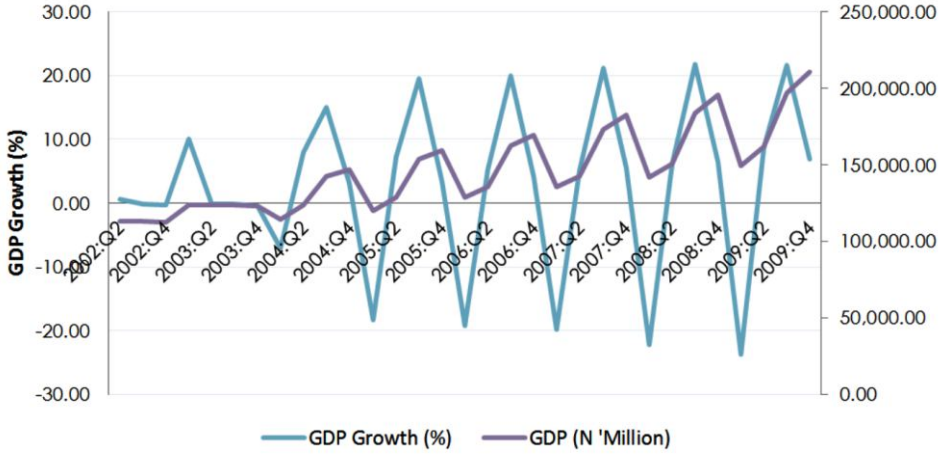


Source: Central Bank of Nigeria (Annual Reports)

III.2 Trends in Output and Output Growth

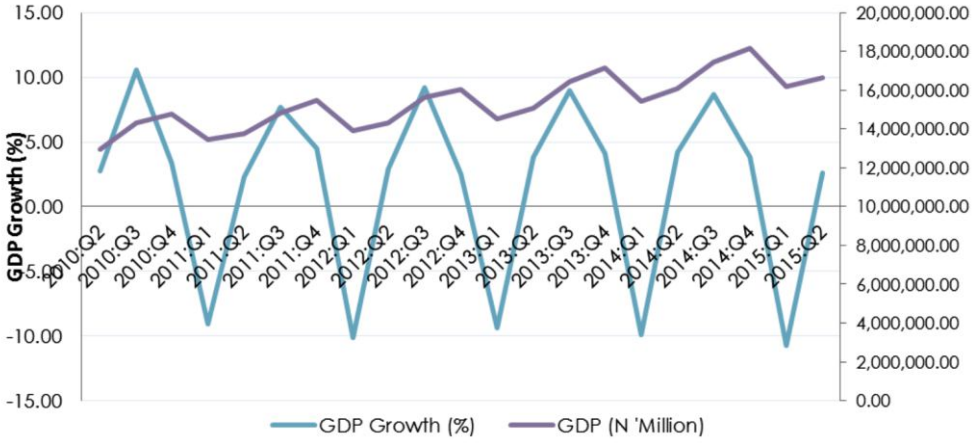
The trends in output and output growth were shown in Figure 3.2A and 2B between 2002 and 2009 and from 2010 to 2015, respectively. It can be seen that output had been trending upward, with accompanying booms and bust in business cycles both before and after the rebasing of the GDP. The Growth rates mirrored the oscillations in output in both periods. The Figure showed a trending down of output since Q1 of 2015.

Figure 3.2A: Trends in Output and Output Growth (2002:Q2 -2009:Q4)



Source: Central Bank of Nigeria (Annual Reports)

Figure 3.2B: Trends in Output and Output Growth (2010:Q2 -2015:Q2)



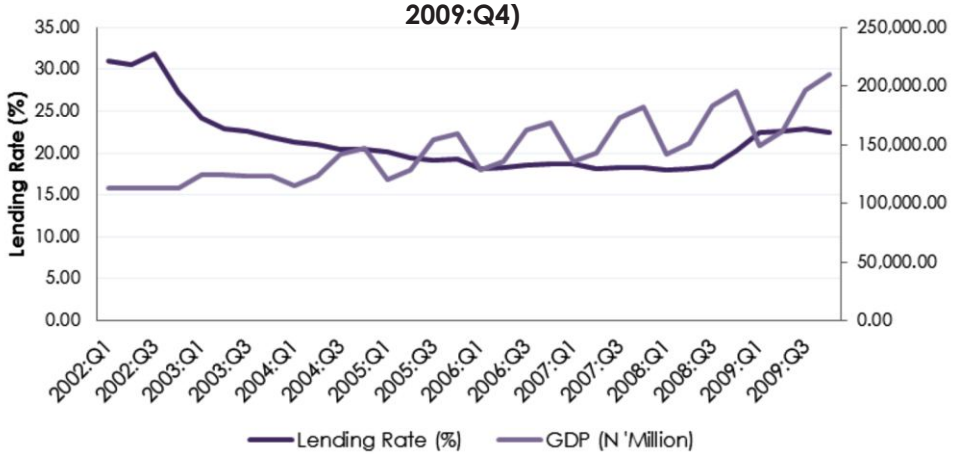
Source: Central Bank of Nigeria (Annual Reports)

III.3 Interest Rate and Output

Figures 3.3A and 3.3B showed the relationship between the maximum interest rate and movement in output before and after GDP rebasing, respectively. From the graphs, output did not seem to be responding as expected to movements in interest rates, as they tended to move in the same direction before rebasing. Although changes in money market interest rates were imperative in shaping the consumption and investment behaviour of economic agents, it did not seem to be the case with output in Nigeria, as

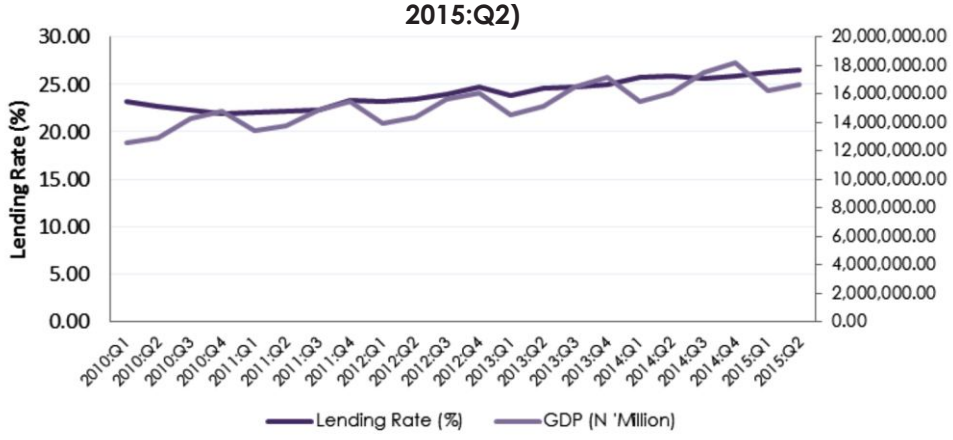
output seemed to be trending upward, with rising lending rates, albeit with the boom and bust cycles.

Figure 3.3A: Relationship between Lending Rate and Output (2002:Q1 - 2009:Q4)



Source: Central Bank of Nigeria (Annual Reports)

Figure 3.3B: Relationship between Lending Rate and Output (2010:Q1 - 2015:Q2)



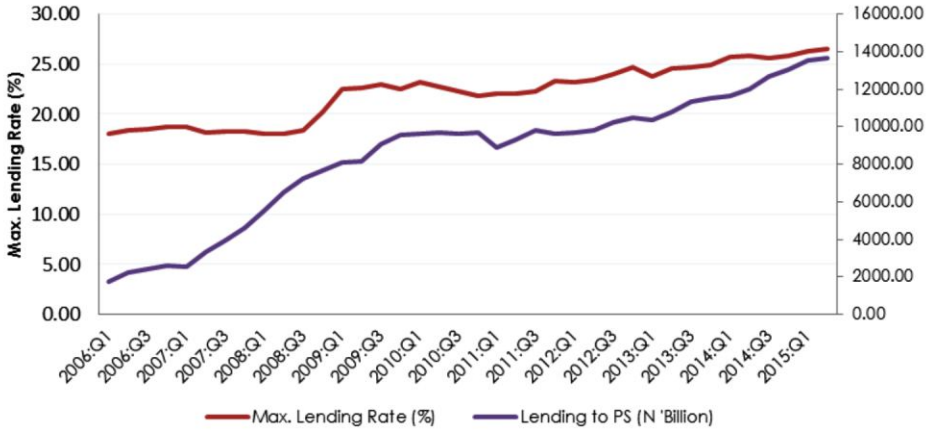
Source: Central Bank of Nigeria (Annual Reports)

III.4 Interest Rate and Lending to the Private Sector

Figure 3.4 showed the relationship between interest rate and lending to the private sector for the period 2006 and 2015. The trend showed that lending to private sector was increasing with rising interest rates, contrary to expectation.

This indicated that lending decisions of banks might not have been responding to changes in interest rates, as expected.

Figure 3.4: Relationship between Interest Rate and Lending to the Private Sector (2006:Q1 - 2015:Q2)

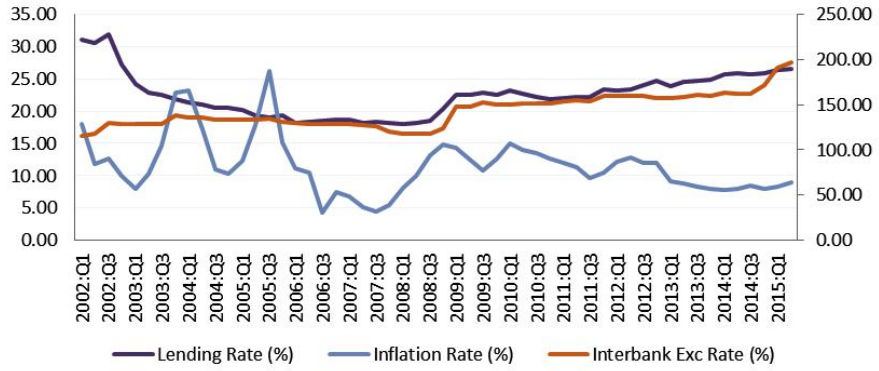


Source: Central Bank of Nigeria (Annual Reports)

III.5 Interest Rate, Inflation and Exchange Rate

Figure 3.5 showed the relationship between interest rate, inflation and Exchange Rate for the period 2002 and 2015.

Figure 3.5: Relationship between Interest Rate, Inflation and Exchange Rate (2002:Q1 -2015:Q2)



Source: Central Bank of Nigeria (Annual Reports)

IV. Data and Methodology

IV.1 Data

Data included monetary policy rate, lending rate, money supply, interbank exchange rate, inflation and output growth. The data were obtained from the Central Bank of Nigeria statistical database. Quarterly data of the variables, spanning 2000:Q4 to 2015:Q3, were used in the estimation of the model. Precisely, based on the interest rate channel, the monetary policy rate was used as the control variable, which transmitted its impulses to lending rate and captured the loan rates that influenced credit to the private sector. To ensure that the variables were devoid of measurement error, some of the data were transformed to keep them in the same magnitude. The data were subjected to diagnostic checks, to ensure that the inferences drawn from the results were not misleading.

IV.2 Model Specification

The study employed the CBN (2015) and Migliardo (2010) Bayesian vector autoregressive (BVAR) modelling approach to estimate the effect of monetary policy transmission mechanism (interest rate dynamics) on real output performance in Nigeria for the period 2000:Q4 to 2015:Q3. The strength of the methodology over the traditional VAR approach is that it is less-restrictive, as it does not suffer from the curse of dimensionality problem and it is better for forecasting (Migliardo, 2010). The approach, in this study, however, differs in terms of the identification method applied, which was based on the interest rate channel of monetary policy transmission mechanism.

The belief is that money supply mechanism follow policy rate adjustment process, which affects ultimately output performance along the pass-through to the lending rate, monetary aggregate, inflation and, ultimately, output behaviour.

Thus, the basic VAR model is expressed as follows:

$$y_t = \alpha_0 + \sum_{j=1}^{p} \gamma_j y_{t-j} + \varepsilon_t \qquad (1)$$

In equation 1, y_t represent a set of n endogenous variables with a lag order, p across t observations; ε_t, an n x 1 unobservable vector of errors, assumed to be white noise ($i.i.d\ \ N(0, \Sigma_t)$); α is an n x 1 vector of constants; and γ_j is an $n \times n$ matrix of coefficients for the j^{th} lag of order p.

Imposing restriction on equation 1, to follow the Bayesian normal distribution approach gives,

$$Y_{(nT\times 1)} = (I_n \otimes X)\beta + \varepsilon \qquad \varepsilon \sim N(0, \Sigma \otimes I_T) \tag{2}$$

Y represents a T × M matrix, stacking in columns T observations on each endogenous variable next to each other such that ε and E designate the stacking of the errors in conformity with y and Y, respectively.

Taking $x_t = (1, y_{t-1}^{'}, \ldots, y_{t-T}^{'})$ and $X = \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_T \end{bmatrix}$

Thus, the vector of nT x 1, $y = vec(y_t)$, shows the stacking of T observations on the first endogenous variable and, subsequently, the T observations on rest of the other endogenous variables, in that order.

This can also be expressed in a metric-variate form with the T observations for each endogenous variable stacked in columns next to each order as follows:

$$Y_{(T\times n)} = X_{(T\times(np+1))}\beta_{((np+1)\ x\ n)} + E_{(T\times n)}\ E \sim N(0, \Sigma) \tag{3}$$

According to Canova (2007), Koop and Korobilis (2009) and Rummel (2013), equation (2) enables the decomposition of the likelihood function of the VAR of lag order p into the product of a normal density for β, given the OLS estimates of the VAR coefficients $(\hat{\beta})$ the Σ and a Wishart density for $\Sigma^{-1}(\Sigma)$. This is expressed as:

$$p(\beta \mid \Sigma, y) \sim N\left(\hat{\beta}, \Sigma \otimes (X^{'}X)^{-1}\right) \tag{4}$$

and

$$p\left(\Sigma^{-1} \mid y\right) \sim W\left(S^{-1}, T-K-n-1\right) \quad (5)$$

Where $K=1+np$, $\hat{\beta}=(X' X)^{-1} X'Y$ is the OLS estimate of β, $\hat{\beta}=vec(\hat{\beta})$ and:

$$S = \left(Y - X\hat{\beta}\right)'\left(Y - X\hat{\beta}\right) \quad (6)$$

From the foregoing, if the set of parameters, (β, Σ) is denoted by θ, the prior distribution is given as $\pi(\theta), l(y \mid \theta)$, the likelihood function, and $\pi(\theta \mid y)$, the posterior distribution of θ given the endogenous variable set $\mathbf{y}$ is obtained as follows:

$$\pi(\theta \mid y) = \frac{\pi(\theta) l(y \mid \theta)}{\int \pi(\theta) l(y \mid \theta) d\theta}$$

Where $\int \pi(\theta) l(y \mid \theta) d\theta$ is normalising constant, such that the posterior is proportional to the product of the likelihood function and the priors.

IV.3 Estimation Technique and Procedure

In evaluating the transmission mechanism of monetary policy impulses to the real output based on the BVAR approach, we conducted our analysis in two stages. First, we specified and estimated the VAR model based on the Bayesian technique and derived the impulse response functions and variance decomposition.

The BVAR model is specified as;

$$\mathbf{Z}_{i,t} = \mathbf{\Pi Z}_{i,t-p} + \varepsilon_t \qquad \forall \qquad i = 1,2$$

Where $\mathbf{Z}'_{1t} = [MPR\ PLR\ M2\ INF\ RES\ RY]$ is the vector of endogenous variables for the equation. We assumed that changes in MPR transmitted to the prime lending rate (PLR), broad money supply, exchange rate (EXR), inflation rate and output growth (GDP). The subscript 'p' represented the lag order of the BVAR. Π_p is the 6 X p matrix of the BVAR parameters to be estimated.

In estimating the BVAR, we started with the choice of appropriate lag length by conducting diagnostic tests. After series of iterative processes, using

conventional lags length selection criteria, including FPE, HQ and SIC, a lag length of one was found appropriate for the endogenous variables. This lag length is justifiable since our data is of quarterly frequency and it hedged against possible challenges, such as loss of degree of freedom. Consequently, priors were imposed on parameters to shrink the parameter set. Following Lutkepohl (2007), the Litterman/Minnesota prior type was utilised, given that it accounted for posterior independence between equations and had a fixed residual variance-covariance matrix, which indicated that the data employed followed a random walk process.

Since priors helped to capture the tightness of the information about the distribution, the hyper-parameters specification type was chosen, which enabled the assignment of values to the lambdas (λ 's) and residual (μ), based on the available information at our disposal. In the Litterman/Minnesota prior type, λ_1 was the overall tightness on the variance (of the first lag) and controlled the relative importance of sample and prior information. If λ_1 is small, prior information dominates the sample information. Similarly, λ_2 represents the relative tightness of the variance of other variables, while $\lambda_3 > 0$ represents the relative tightness of the variance lags. Setting $\lambda_2 = 0$ implies the VAR is collapsed to a univariate models. Thus, in selecting suitable values, different combinations were examined for the lambdas, ranging from 0 to 1. Thus, $\lambda_1 = 0.7, \lambda = 0.99$ and $\lambda_3 = 1$ were utilised given that the data used were non-stationary. This allowed for the persistence in the decay in the lags. Furthermore, the estimates of the regression were used to compute the impulse response functions and the variance decomposition of the Bayesian VAR.

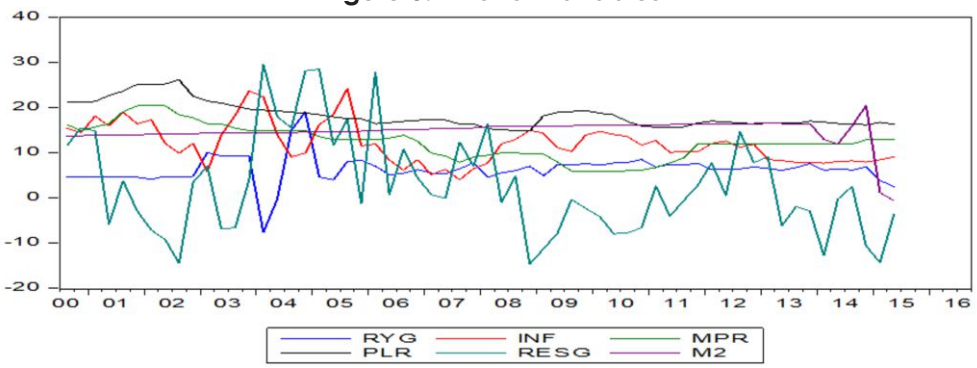
Second, we carried out sample forecasts and simulation of the policy variable from the estimates generated from the Bayesian VAR, in relation to the adjustments in the policy variable. Given that MPR is used as the policy variable, it was applied as the control variable.

V. Empirical Analysis

V.1 Diagnostic Tests

The graphical plot of all the variables was shown in Figure 5.1. This showed that most of the variables had random walk properties. Furthermore, the BVAR model which was utilised to track the transmission channel and the impact of MPR adjustments on other variables was estimated after conducting preliminary checks on the data. Nonetheless, given that Bayesian[1] VAR was insensitive to lag selection, stability of the model and identification restrictions, we followed economic theory to set appropriate structure for the transmission of the impulses. Again, we utilised the Litterman (1986) formulation approach[2], after preliminary check on the data, to set the (hyper-parameter) priors for the data.

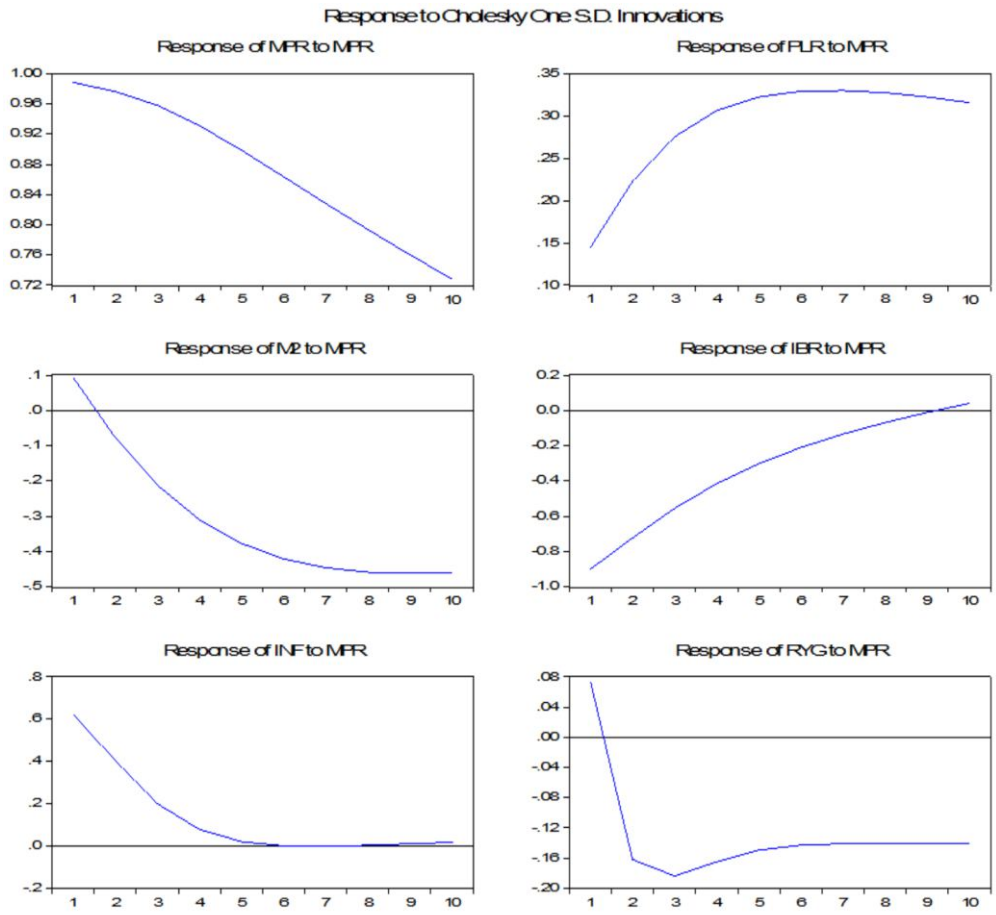
Figure 5.1 Plot of Variables



[1] *BVAR uses priors to deal with the restriction of the hyper-parameters.*

[2] *Litterma's prior holds that variables behave like a random walk with an unknown deterministic component.*

Figure 5.2: Response of Interest Rate, Inflation and Output Growth to Shock in MPR



V.2 Analysis of Results

V.2.1 Response of the Variables in Impulse Response Function (IRF) and Variance Decomposition

The results of the impulse response functions and forecast error variance decomposition based on the cholesky factorisation approached were presented in Figure 5.2 and Table 5.1, respectively. The result indicated that a one standard deviation shock to the monetary policy rate would bring about a positive change in the lending rate but a decline in broad money supply. This essentially follows the typical transmission mechanism in monetary economics. Similarly, a positive shock in the policy rate increases inflation in the first month

before it gets insulated and moderated in the preceding months. Nonetheless a positive shock to the policy variable produces negative but small impact on output over time before the impact dies off after a one period/quarter period policy lag. This development is seen to decelerate output gradually the next six quarters. In other words, macroeconomic variables such as prime lending rate, money supply, interest rate and output are sensitive to the dynamics of the policy rate. The IRF also shows that a one period shock in MPR produces immediate impact on lending rate and inflation but a small lag impact on output. Thus, the modest impact on output follows the interest rate channel indicating the ability of policy rate adjustments in stimulating output.

V.2.2 Forecast Error Variance Decomposition

To justify the result of the impulse response function, the variance decomposition which helped to reveal the share of variation in each of the endogenous variables due to shocks to the control variable was also presented and the result is quite revealing. The result shows that the shocks to MPR exerted impact on lending rate, inflation and output growth. This supported the results of the impulse response functions. It indicated that variation in MPR exerted significant impact on itself (99.0 per cent) and less than (1.0 per cent) on other variables in the first quarter, reinforcing the policy lag effect. This also indicated that the magnitudes of the impact of the shocks were not very high in the immediate. (Table 5.1).

Table 5.1: Forecast Variance Decomposition Results

FVD MPR: Quarter/Period	S.E.	MPR	PLR	M2	IBR	INF	RYG
1	0.988363	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	1.395529	99.10100	0.080201	0.001615	0.026384	0.574670	0.216128
3	1.704063	98.07071	0.221161	0.016401	0.083938	1.420570	0.187223
4	1.955923	97.09773	0.361712	0.043191	0.159314	2.195897	0.142155
5	2.167297	96.26731	0.477056	0.074964	0.244931	2.806546	0.129195
6	2.347435	95.59163	0.564365	0.106858	0.338442	3.263603	0.135106
7	2.502765	95.04559	0.628154	0.136635	0.439982	3.603188	0.146455
8	2.638076	94.59610	0.673863	0.163570	0.550514	3.858754	0.157201
9	2.757011	94.21439	0.705973	0.187624	0.671119	4.055283	0.165616
10	2.862376	93.87868	0.727788	0.209008	0.802728	4.210131	0.171668

V.3 Simulation Analysis

To further estimate the impact and magnitude of the changes in MPR on key macroeconomic variables, we conducted a simulation exercise based on the baseline and three alternative scenarios. Scenario one was the reduction in MPR by 100 basis points, on the other hand, scenario 2 was a reduction of MPR by 300 basis point, while scenario 3 was an increase in MPR by a 100 basis points. The results showed that if MPR remained unchanged at 13.0 per cent, PLR is expected to decline from 16.42 per cent in 2015Q3 to 15.96 per cent in 2015Q4 and further to 15.03 per cent by the end of 2016Q3. Similarly, inflation rate is expected to fall to 8.76 per cent and 7.61 per cent by the end of 2015Q3 and 2016Q3, respectively. In the same vein, output growth would increase slightly to 2.57 per cent and 3.33 per cent, over the projected period. The implication of this is that both the lending and inflation rates would moderate, while output growth would increase marginally over the period.

Table 5.2: Baseline and Scenario Analysis of the Liquidity Channel

	Baseline (13%)			Reduce MPR to 12% (100BSP)			Reduce MPR to 10% (300BSP)			Increase MPR to 14% (100BSP)		
	PLR	INF	RY	PLR	INF	RY	PLR	INF	RY	PLR	INF	RY
2015Q1	16.84	8.5	3.95	16.84	8.5	3.95	16.84	8.5	3.95	16.84	8.5	3.95
2015Q2	16.42	9.17	2.35	16.42	9.17	2.35	16.42	9.17	2.35	16.42	9.17	2.35
2015Q3	16.42	9.2	2.35	16.42	9.2	2.35	16.42	9.2	2.35	16.42	9.2	2.35
2015Q4	15.96	8.76	2.57	15.88	8.77	2.66	15.72	8.79	2.84	16.05	8.74	2.48
2016Q1	15.60	8.29	2.88	15.45	8.31	3.01	15.17	8.35	3.27	15.74	8.27	2.75
2016Q2	15.29	7.91	3.14	15.10	7.92	3.30	14.71	7.95	3.60	15.48	7.89	2.99
2016Q3	15.02	7.61	3.33	14.79	7.61	3.50	14.33	7.62	3.84	15.26	7.61	3.16

In scenario 1, a reduction in MPR by100 basis points to 12 per cent would lower prime lending rate to 15.88 and 14.79 per cent in 2015Q4 and 2016Q3, respectively. Inflation is expected to fall to 8.77 and 7.61per cent at end of 2015Q4 and 2016Q3 while output growth is expected to rise to by 2.66 per cent in 2015Q4 and 3.50 per cent at the end of 2016Q3, if the monetary policy rate was reduced to 12 per cent. In the same vain, a further reduction of the MPR by 300 basis points (i.e. to 10.0 per cent) is expected to bring lending rate to 15.72 and 14.33 per cent in 2015Q4 and 2016Q3, respectively, reinforcing the interest rate sensitivity to money supply mechanisms. This, however, is expected to reduce inflationary pressure to 8.79 and 7.62 per cent over the same period.

Nevertheless, the inflationary impact of reducing MPR by 300 basis points was higher than the 100 basis points corroborating the tendency of inflation rising, due to increased money supply. Thus, for a hawkish central bank, whose primary mandate is price stability, tightening appeared to be the best option to control inflation. However, this is expected to boost output growth from 2.35 to 2.84 per cent in 2015Q4 and 3.84 in 2016Q3. This result suggested that output growth can be triggered by a significant reduction of the policy rate.

On the other hand, an increase in the policy rate by 100 basis points is expected to raise lending and inflation rates to 16.05 per cent and 8.74 by end 2015Q4 respectively. Similarly, output growth is projected to slow down to 2.48 per cent and 3.16 per cent in 2015Q4 and 2016Q3, respectively. This was below the baseline projection and the other scenarios due to the increase in policy rate. This indicated that MPR played a significant role in stimulating output growth.

From the foregoing, it is evident that adjustment in policy rate is a major tool to influence output in Nigeria. This is because a downward review in the policy rate is expected to lead to a downward trend in prime lending rate and, this in turn, will impact on investment as many economic agents can afford to borrow funds for investment purposes. Ultimately, this will also have a positive impact on output growth.

VI. Conclusion

The study established the existence of a direct relationship between output performance and monetary policy rate in Nigeria. This implies that policy rate adjustments could be used to enhance real output growth and reduce unemployment. On the basis of these findings, the monetary authority should monitor effectively developments in the financial markets (money, capital and foreign exchange markets) to gauge adequately market sentiments in setting the policy rate. The monetary authority should also endeavour to formulate policies that would guarantee a sustainable and sound financial system since the efficient functioning of the financial system, is indispensable to achieving output and growth and reducing unemployment. Furthermore, the MPC should consider output behaviour in setting the policy rate for the economy.

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