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Macroeconomic effects of Interest Rate in Nigeria: A Rolling Impulse Response Approach

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Abstract

The study examines the macroeconomic effects of interest rate shocks in Nigeria using a rolling impulse response method within a structural vector autoregressive (SVAR) framework. It fills a gap in understanding how interest rate fluctuations affect key economic indicators, including GDP growth, inflation, and exchange rate (EXC), by assessing their reactions to interest rate changes over various time periods. Results indicate that interest rate shocks significantly influence GDP growth, inflation, and exchange rate initially, with these effects fading within 4-6 months. The varied responses across different periods reflect changing economic conditions. The study suggests that policymakers should adopt a flexible approach to interest rate management, considering the current economic context. Additionally, ongoing monitoring of how key economic indicators react to interest rate changes is essential for effective policy development.

Keywords: Interest Rate, MPR, Rolling Impulse Response, Exchange Rate, Economic Growths

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INTRODUCTION

The Nigerian economy operates within a multifaceted structure influenced by numerous internal and external forces. A pivotal element in this structure is the Central Bank of Nigeria's (CBN) interest rate policy, which significantly impacts macroeconomic stability and growth. In recent years, the CBN has implemented several interest rate hikes to manage capital movements, stabilize the national currency, and address inflationary pressures (Lamidi, 2022). This monetary policy strategy, however, presents a complex challenge for policymakers as they strive to balance the effects of interest rate adjustments on inflation control and economic development (Haruna & Chiebonam, 2022).

Raising interest rates is a conventional approach to mitigating inflationary pressures. However, this strategy comes with potential drawbacks, such as increased borrowing costs for businesses and consumers, which can slow economic growth. Higher interest rates can also dampen consumer spending and investment, potentially leading to recessionary conditions. Furthermore, persistent inflation despite rising interest rates can erode consumer purchasing power and destabilize the economy. Thus, achieving an optimal balance requires careful analysis and sophisticated policy measures aimed at promoting long-term economic development while maintaining inflation within manageable limits.

The CBN's official interest rate, the Monetary Policy Rate (MPR), underpins all other interest rates within the money market and the broader economy. Historical data reveals significant fluctuations in the MPR, reflecting the unstable nature of Nigeria's interest rates. For example, the MPR was 18% in the first quarter of 2000, dropped to 6% in the first quarter of 2010, and then surged to 22.75% in the first quarter of 2024 (CBN Quarterly Bulletin). The recent spike in the MPR corresponds with rising inflationary pressures, which have reached 31.7%.

Despite the extensive body of literature on the relationship between interest rate shocks, inflation, and economic growth, there remains a gap in understanding the dynamic effects of these shocks, particularly when accounting for structural breaks in the economy. The anticipated outcome of this study is to provide a nuanced understanding of the impact of fluctuating interest rates on Nigeria's macroeconomic landscape. This study aims to bridge this gap by examining how inflation and output growth respond to interest rate shocks, utilizing the rolling impulse response (RIR) approach within a structural vector autoregressive (SVAR) framework. By elucidating the dynamic responses of inflation and

output growth to interest rate shocks, this research aims to offer valuable insights and policy recommendations that can guide efforts toward achieving macroeconomic stability in Nigeria.

Conceptual Framework

1. Concept of Interest Rate

According to Crowley (2007) and Ngure (2014), interest rates are a fee paid on borrowed assets or the cost incurred by a borrower for using money borrowed from a lender (financial institution). Interest rates are given as a percentage rate over a one-year period by Sayedi (2013). According to Karl et al. (2009), interest rates are determined by macroeconomic variables, which is consistent with Irungu's (2013) assertion that interest rates are important economic elements that affect an economy's ability to expand economically. The pressure of inflation and inflationary expectations on interest rates can lead to an increase in lending rates, which in turn decreases credit demand and the capacity of commercial banks to lend. According to Irungu's (2013) account, interest rates are the cost of money.

Interest rates were also described by Babalola (2021) as a benefit of delaying paying off debt or paying less for immediate needs. On the other hand, the Neo-classicals held that the supply and demand for loanable money or credits dictated the interest rate. While Keynes describes interest as a compensation for parting with liquidity for a certain period rather than hoarding, they believe that the price of credit is controlled by the supply and demand of loanable money. According to Adebiyi (2017), interest rates are the yield on equity or opportunity cost associated with postponing present spending for the future. The prime lending rate, the discount rate, and the rate on savings deposits are a few instances of interest rates (Owolabi et al., 2016). The Mundell-Fleming model states that raising interest rates is required to stop inflation and stabilize exchange rate depreciation, which helps to avert a number of negative economic effects. There are several reasons why the policy of high interest rates is deemed significant.

a. It tells the market about the authorities' determination to avert the market's anticipated sharp exchange rate movement in light of the current economic conditions, which lowers inflationary expectations and breaks the vicious cycle of inflation and exchange rate depreciation.

b. It limits the depreciation of the currency rate by making domestic financial assets more appealing, which attracts capital inflow.

c. By lowering the amount of imports, it not only lowers the level of domestic aggregate demand but also strengthens the position of the balance of payments. The way interest rates behave greatly influences investment activity and, consequently, a nation's ability to thrive economically. The rate of interest charged when borrowing money from the market determines investment, but the amount of investment heavily influences economic growth.

There are two types of interest rates: nominal and real. It is possible to assess the nominal interest rate in naira rather than in terms of products. The real interest rate, which is determined by subtracting the inflation rate from the nominal interest rate, is adjusted for inflation and represents the yield in naira per year for every naira invested. According to Okoye and Eze (2013), the interest rate is the proportion of the borrowed amount that is paid in interest per unit of time. The interest rate is the cost of obtaining financing, expressed in naira per year per naira borrowed. He goes on to say that term and maturity are the primary elements that determine interest rate differences because, when maturity and liquidity are taken into account together with other factors, a wide range of financial instruments and interest rates will result.

2. Concept of Inflation

One of the most commonly used expressions in economic discourse is inflation, although there are several misconceptions about the idea. Although there are several schools of thought on inflation, economists generally agree that it is an ongoing increase in prices. Inflation, expressed simply, is the term used to describe an ongoing general increase in the cost of goods and services. According to an index like the consumer price index (CPI) or the implicit price deflator for the gross national product (GNP), it can be characterized as "a continuing rise in prices." A common way to characterize inflation is as "too much money chasing too few goods." The buying power of money decreases with inflation. When the economy experiences inflation, over time, a particular quantity of naira will have less buying power (Evans, 2019).

There are two important terms to remember while defining inflation. First, is aggregate or general, meaning that rather than being limited to an increase in the price of a particular item or set of related commodities, the price increase that qualifies as inflation must affect the whole basket of products in the economy. This suggests that price fluctuations alone,

or in any combination of prices, cannot be attributed to the occurrence of inflation. But occasionally, circumstances might occur where a shift in one price could result in an increase in the others (Lamidi, 2022).

Nigeria's annual inflation rate surged to a new high of 31.7% in February 2024, surpassing market estimates of 31% and up from 29.9% in January. This was mostly caused by the withdrawal of oil subsidies and the depreciation of the naira. The liberalization of the foreign exchange market in June 2023 was followed by a 69% depreciation of the naira in mid-February 2024, which greatly affected Nigeria's import-dependent economy and increased import costs (Ayodele & Taiwo, 2023).

3. Concept of Economic Growth

Accoridng to Owolabi, &Adegbite (2016) economic growth comprises increases in material output over a very short period of time, often one year. In modern economics, economic expansion is characterized as a rise in yearly value-expressed material output, as measured by the GDP or government revenue growth rate. Growth is feasible since it does not change the economic trajectory. As a result, economic growth encompasses not only an increase in material output but also all additional socioeconomic activities and changes caused by the impact of both economic and non-economic forces.

Economic growth is a wide word that refers to increases in a country's actual gross domestic product (GDP). As a result, growth may be measured by the increase of real GDP or gross national product (GNP) during a certain time period. Individuals in a country may afford to spend more because GDP or the value of the products and services generated has increased. If a country wishes to raise its goods and services production, its ability to generate must be enhanced. In a broader sense, economic growth necessitates an investigation of the causes that result in a continual rise in production capacity. The ability of people to live comfortably is directly influenced by economic growth. Earnings rise along with increased purchasing power for consumers as production capacity rises. They work together to increase productivity by creating more and getting paid more money. As a result of higher factor productivity, real GDP grows quickly, and the cycle keeps going (Haruna & Chiebonam, 2022).

Theoretical Literature

1. The Classical Interest Rate Theory

According to classical theory, savings and investment are the sole drivers of interest rates. The idea says that interest rates are regulated by the dynamics of supply and demand for money. Thus, money given to investors for capital goods investment originates from other people's current income savings. By deferring consumption, they free up resources for capital-intensive manufacturing. The theory also posits that savings are interest-elastic. As a result, the higher the interest rate, the greater the incentive for individuals to save. That is, for individuals to be enticed to save more, and prevent from spending their whole income, a larger rate of interest must be given. In order to encourage people to save more and stop from spending their whole income, a greater rate of interest must be supplied. According to Uchendu (1993), the classical approach considers interest rates as the return or yield on equity, or the opportunity cost of delaying present spending. Fisher (1974) observes that time choice and the marginal efficiency of capital are important factors of interest rates. In general, the classical theory holds that interest rates are the price paid for saving capital, which is controlled by the demand and supply of saves. The demand for capital is mostly from investors who borrow for productive purposes, whereas the supply comes from wage workers. When the borrower determines that productivity is equal to the interest rate, he quits borrowing. He does this by comparing the prevailing rate of interest with the marginal efficiency of capital.

2. The Keynesian Theory of Interest

The Keynesian theory of interest rates views interest as a compensation for parting with liquidity for a certain period of time, rather than a savings opportunity. Individuals may choose what to spend and what to preserve from their income. The former is based on what Keynes called the tendency to consume. Given this, a certain percentage will be kept and retained in cash or non-interest-paying bank accounts. Keynes refers to an individual's liquidity preference as the amount he or she is willing to lend. According to Keynes' theory, demand for liquidity is governed by three motives. There are three reasons why people prefer to hold cash: transactional, precautionary, and speculative. Transactional motives involve ensuring basic and current transactions, while precautionary motives involve preparing for unexpected problems. Speculative motives involve speculating on future market movements, such as interest rates and bond prices. The interest rate is determined

by the demand for money (more precisely, the liquidity desire for the speculative motive) and the supply of money. The interest rate is defined by the degree of compensation for storing money in bonds or other assets rather than cash. It is governed by the relationship between investment and savings. The Keynesians also argue that the link between variations in the quantity of money and prices is non-proportional and entirely indirect, via the interest rate. (Irungu, 2013).

The strength of Keynesian theory stems from the combination of monetary theory and value theory, on the one hand, and the theory of output and employment via the interest rate, on the other. When the supply of money increases, the interest rate reduces, resulting in a rise in overall investments and demand, which raises production and employment. The theory identified a relationship between the real and monetary sectors of the economy, describing equilibrium in the goods and money markets. The theory also looked at the link between money supply and price levels throughout periods of unemployment and full employment. As a result, as long as there is a degree of unemployment, output and employment will fluctuate in proportion to the quantity of money, but prices will remain constant. At full employment, nevertheless changes in the amount of money cause a corresponding shift in price (CBN, 2012).

3. The Theory of Loanable Fund

The demand and supply of loanable funds are key factors in determining interest rates, according to the neo-classical loanable funds theory, considered an extension of the classical theory. Interest rates will fall low when there is a greater supply of funds than there is a greater demand, and vice versa. As a result, the point at which the supply and demand of loanable funds are equal yields the equilibrium interest rate. People's savings and the money supply added by banks creating credit would both have an impact on the amount of money available for lending, or credit. Savings, then, is the quantity of loanable funds (S) and the fresh money supply that comes from commercial banks creating credit (M). The entire quantity of loanable money equals S + M. The demand for loanable funds would be decided by the amount of demand for investment expenditure (I) and the market for money hoarding. Thus, I + H represents the overall demand for loanable money. If hoarded money grows, the availability of cash decreases, and vice versa. According to the loanable funds theory, the interest rate is set when the demand for loanable funds (I + H) equals the supply of loanable funds (S + M). This clearly demonstrates that the theory is an

extension of the classical theory, which claims that the interest rate is a function of savings and investment (Ngure, 2014).

This study adopted the neoclassical loanable funds theory which is a cornerstone concept in economics that explains how interest rates and the supply and demand for savings and investment interact in financial markets. This theory provides insights into how changes in interest rates, driven by monetary policy actions such as hikes in the Monetary Policy Rate (MPR) and other lending rates, can impact total demand, investment, inflation, and economic growth.

According to the neoclassical loanable funds theory, the interest rate in a market economy is determined by the equilibrium between the supply of savings and the demand for investment funds. Savers supply funds to financial markets through savings, while borrowers demand funds for investment purposes such as business expansion or purchasing capital goods. The equilibrium interest rate is the rate at which the quantity of savings supplied equals the quantity of investment demanded. The combined effects of changes in investment, total demand, and inflation can influence overall economic growth. A slowdown in investment and aggregate demand can lead to lower GDP growth rates, as businesses adjust to the higher cost of borrowing and reduced demand for their goods and services. However, the impact on economic growth may vary depending on other factors such as fiscal policy, exchange rates, and external shocks.

4. Theoretical framework

The neoclassical loanable funds theory provides theoretical underpinnings for understanding how interest rate changes affect saving, investment, and financial market dynamics, which can be empirically tested and validated with the use of dynamic framework using time series data on Nigerian macroeconomic variables. the Neoclassical Loanable Funds Theory provides a framework for understanding how interest rates are determined in financial markets based on the interaction between the supply of and demand for loanable funds. This theory offers valuable insights into the role of interest rates in influencing saving, investment, and equilibrium outcomes in the economy, highlighting the importance of market forces in allocating resources efficiently and promoting economic growth (Adebiyi, 2017).

Symbolically, the loanable funds theory can be expressed as; $r = f(I,S,M,H)$ (3.1)

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

Empirical Review

In analyzing the macroeconomic consequences of interest rate hike in Nigeria. Some studies were empirically examined. In this study, Ayodele and Taiwo (2023) evaluated the behavioral effects of interest rates. From 1987 until 2020, quantifiable data were gathered from secondary sources. The financial sector's development was modeled as a linear function of interest rates, which were represented by lending interest rates, deposit interest rates, monetary policy rates, and treasury bill rates. The autoregressive distributed lags model was described and estimated using the integration bound test, which revealed evidence of a long-run link between the variables. The findings revealed that lending interest rates were the most significant influencers of financial sector growth in the long run, while deposit interest rates, monetary policy, and treasury bill rates were not as influential in the short run. Furthermore, the error correction mechanism demonstrated that any momentary divergence from balance experienced by interest rate substitutes returned to equilibrium in the long term at a rate of 35%. Additionally, the residuals were shown to be homoscedastic by the post-estimation test and to be uncorrelated by the autocorrelation test. Thus, the study came to the conclusion that lending interest rates were a significant factor in the financial sector's growth and suggested that, since the financial sector has already undergone deregulation, lending interest rates should be left to be determined by supply and demand in the market rather than being artificially fixed by banks, which frequently use this as a means of extortion. This will lessen the current significant negative impact that lending rates have on the financial sector's growth.

Chukunalu & Harvest (2023) looked into how interest rates and currency rates affected Nigeria's economic expansion from 1981–2021. Real gross domestic product is the dependent variable, whereas the prime lending rate, currency rate, savings deposit rate, and total investment were the independent factors. Data, were then analyzed using the Error Correction Model (ECM) method since it was discovered that the variables were cointegrated and stationary at initial difference. The findings showed that throughout the time under examination, both the prime lending rate and the exchange rate slowed Nigeria's economic development, but only the exchange rate did so considerably. But while

investments and the savings deposit rate both raised economic growth, only investment did so much. The model calculated a model fitness of 90.03 percent and a speed of adjustment of 16.4%. The study's conclusion was that the Nigerian economy was negatively impacted by the prime lending rate and the currency rate.

Lamidi (2022) assessed the correlation between certain macroeconomic factors and interest rates in Nigeria. The study looked at the effects of Budget Deficit (BD), Economic Growth (GRGDP), Inflation Rate (INF), Exchange Rate (EXCHR), and Private Investment (INV) on Interest Rate (INTR) in Nigeria in an effort to better understand the factors that affect interest rates and signal pertinent policies that can influence interest rates in the economy. The stationarity test findings showed that other variables are only stationary at first difference, while only INF is stationary at level. Since the budget deficit had no discernible impact on the interest rate at 5%, the findings are consistent with the Keynesian theory. Both the growth of the economy and inflation had a statistically significant influence on interest rates at the 5% level. The analysis suggests that the exchange rate and level of investment should not be utilized as policy factors to impact interest rates in Nigeria.

The impact of interest rates on the industrial sector of the Nigerian economy was ascertained by Haruna and Chiebonam in 2022. The features of the variables of interest in this study were examined using the descriptive survey design. The data was collected from Nigeria's central bank's monetary and real sector records. from quarter 3 of 2010 to quarter 1 of 2020. The GDP of the industrial sector was used as the dependent variable, while data on the Interbank Lending Rate (IBR), Open Buy Bank Rate (OBB), Standing Lending Facility Rate (SLF), Standing Deposit Facility (SDF), and 91 Clays Treasury Bill Interest Rate (91 TBR) were used as independent variables. Interest rates were the independent variables, while industrial sector GDP a measure of economic growth in the sector was the dependent variable. It is evident from comparing the p-values of the coefficients to the different significance levels that standing lending and deposit facilities have a big impact on the economic growth of the industrial sector. Consequently, the research recommended that banks provide the highest interest rates in order to optimize their profit margin as a profit-making organization and support the expansion of credit available to the economy's productive sector. Monetary policy of central banks ought to be based on this as well.

Olaniyan, Adegboyo Owoniya, and Alaketu (2021) looked at how interest rates and economic development affected a company's choice to invest in Nigeria between 1989 and

2019. In accordance with the premise theories examined, the study broke down interest rate and economic growth into external borrowing, exchange rate, inflation rate, and gross domestic product. The study used the auto-regressive distributed lag (ARDL) approach to examine the data based on the variables' mixed level of stationarity as shown by the unit root test. The study computed the ARDLECM after the bound test demonstrated the existence of co-integration, or a long-run link, between all of the explanatory factors and the dependent variable. The results of the analysis indicate that interest rates, foreign borrowing, exchange rates, and economic growth have a special long-term connection. The outcome also showed that there isn't any solid empirical support for the hypothesis that interest rates and investment choices in Nigeria are related. It was determined that the government needed to implement policies that would spur economic development and pay attention to how interest rates behaved in the economy. This would direct the creation of private sector development policies in Nigeria, facilitating the country's participation in the global economy.

Miftahu (2019) evaluated the influence of interest rates on Nigerian economic development using yearly time series data from 1980 to 2017. This phenomenon is extremely fascinating both theoretically and in terms of comprehending financial market mechanics. The Vector Autoregression (VAR) model and the Granger causality test were used to estimate model coefficients and determine the causal link between the variables. The VAR-based impulse response function and accompanying variance decomposition estimates reveal a negative link between interest rates and economic development in Nigeria. Furthermore, the Granger causality test confirmed the existence of a bidirectional causal link between interest rates and economic development. As a result, monetary authorities should have established and implemented interest rate policies that encourage investment while also considering other factors that impede investment growth. To achieve the targeted growth rate in Nigeria, monetary authorities and policymakers should implement growth-oriented policies that have the ability to drive the economy toward higher productivity and sustained economic growth.

Evans (2019) investigated if there is a threshold beyond which the influence of interest rates on economic and investment growth shifts. The threshold estimate technique is utilized for Nigeria from 2006 to 2017. The results reveal that the data clearly identifies two thresholds. The anticipated interest rate thresholds for GDP growth and investment growth are 21.1% and 22.6%, respectively. That is, the interest rate helps favorably to

economic growth when it is less than 21.1%, but it becomes a big worry once it exceeds 21.1%. Similarly, interest rates contribute effectively to investment growth when they are less than 22.6%, but become a big worry once they exceed 22.6%. The natural conclusion is that Nigeria, like other developing nations, should strive to reach interest rate regimes that do not stifle development and investment by implementing policies that set interest rates on the appropriate track below the predicted thresholds.

Conversely, Moyo and Le Roux (2018) examined how, between 1990 and 2015, changes in interest rates affected investments and savings, which in turn affected the economic development of SADC nations. The research examined the impact of interest rate fluctuations on savers, the relationship between saves and investments, and whether or not investments promoted economic growth. To check for cointegration, the researchers used ARL hounds tests for each country using the Pooled Mean Group (PMG) estimate approach. The study's results include that cointegration for each of the three factors is present in the majority of nations and that interest rate changes have a favorable effect on economic development through investments and savings. The research concludes that real interest rates should be determined by market factors.

Rapu et al. (2017) investigated interest rate changes and real output behavior in Nigeria using a Bayesian Vector Autoregressive (BVAR) model with quarterly data from 2000:Q4 to 2015:Q3. The influence of monetary policy transmission (interest rate fluctuations) on real production outcomes was evaluated. Although the simulation study yielded varied results, the functions for impulse response showed that positive shocks to the monetary policy rate (MPR) had a negative and minor influence on output. Reducing the MPR from 13 to 10% would result in an increase in output growth from 2.35 percent in Q3 2015 to 3.84 percent in Q3 2016. In contrast, when the MPR went up from 13 to 14 percent, output increased, albeit slowly, from 2.35 to 3.16 percent over the same period. The study showed that policy rate adjustments might be utilized as a significant instrument to increase production growth, particularly if inflation is low and steady.

METHODS

This study employs a quantitative approach to analyze the dynamic effects of interest rate shocks on inflation and economic growth in Nigeria, with a focus on the period from 2000Q1 to 2024Q2. Quarterly data from the Central Bank of Nigeria (CBN) Quarterly

Bulletin and other relevant sources. The key variables include the monetary policy rate (MPR), inflation rate, and output growth (GDP). Additional control variables may include exchange rates, and other relevant macroeconomic indicators.

Model Specification

The model specification follows a vector autoregressive (VAR) framework to analyse the macroeconomic consequences to interest rate hike in Nigeria. Equation (1) is specified in line with the model of Pradhan and Arvin (2015). The equation is a structural model specified within the Vector Error Correction Model.

$$\begin{bmatrix} \Delta MPR_t^{\pm} \\ \Delta INF_t \\ \Delta EXC_t \\ \Delta GDP_t \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \\ \alpha_4 \end{bmatrix} + \sum_{k=1}^{q-1} \begin{bmatrix} \beta_{11k}(L)\beta_{12k}(L)\beta_{13k}(L)\beta_{14k}(L) \\ \beta_{211k}(L)\beta_{22k}(L)\beta_{23k}(L)\beta_{24k}(L) \\ \beta_{31k}(L)\beta_{32k}(L)\beta_{33k}(L)\beta_{34k}(L) \\ \beta_{41k}(L)\beta_{42k}(L)\beta_{43k}(L)\beta_{44k}(L) \end{bmatrix}$$

$$\begin{bmatrix} \Delta MPR_{t-k} \\ \Delta INF_{t-k} \\ \Delta EXC_{t-k} \\ \Delta GDP_{t-k} \end{bmatrix} + \begin{bmatrix} \lambda_1 ECT_{t-1} \\ \lambda_2 ECT_{t-1} \\ \lambda_3 ECT_{t-1} \\ \lambda_4 ECT_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \end{bmatrix} \quad (1)$$

where MPR is monetary policy rate, INF is the inflation rate, *exchange rate (EXC),*and GDP is the gross domestic product as proxy for economic growth. Δ is the first difference operator Ls; t=1,…,T; αs are constant; βs; and λs are estimated parameters. εt (t= 1 …, 4) are disturbance terms; ECTt-1 is the lagged error correction mechanism. λs are the equilibrium adjustment mechanisms. Short-run causality is calculated from the lagged dynamic explanatory variables, and the long-term causality calculated through the co-integrating lagged parameters.

Furthermore, within the VECM framework specified in equation (1), the Impulse Response Function and the Forecast Error Variance Decomposition (FEVD) technique are adopted. In the context of this study, the IRF indicates the direction or future paths of Macroeconomic engendered by the explanatory variables. On the other hand, the FEVD reveal the degree of variability in economic growth and Inflation as a result of changes in the other variables.

According to Cao and Zhou (2010), the IRF is derived from a vector MA (∞). The explicit form is given by:

$$y_t = \mu + \varepsilon_t + \emptyset_1 \varepsilon_{t-1} + \emptyset_2 \varepsilon_{t-2} + \cdots \quad (2)$$

The matrix Øs is interpreted as:

$$\partial y_{t+s\therefore\partial\varepsilon\prime_t} = \emptyset_s \quad (3)$$

In equation (3), the rows and columns of component of Øs captures the impact of one unit change due to an innovation at period *t* (ε_{jt}) ceteris paribus. Thus, $\partial y_{it+s\therefore\partial\varepsilon\prime_{jt}}$ as a function of *s* is known as the Impulse Response Function (IRF). A plot of the row *i*, column *j* element as a function of *s* describes the cumulative effect of variable *i* of an innovation *j* (Bjorland, 2010).

Likewise, the FEVD of the variables associated with each shocks is describe in equation (4) as the mean square error (MSE) matrix of the s-shape ahead forecast (Liitkepohl, 1993) as:

$$MSE\ (y_{t-s\therefore t}) = E[(Y_{t+s} - y_{t+s})(Y_{t+s} - y_{t+s\therefore t})'] = \sum_{i=0}^{s-1} \emptyset_i \aleph \emptyset_i' = \sum_{i=0}^{s-1} \emptyset_i \emptyset_i' \quad (4)$$

Estimation Technique

The objective will be analyzed using an econometric technique. Specifically, the Granger causality test, IRF, and FEVD techniques within a VECM framework will be adopted to evaluate the three objectives respectively. The econometric analysis will be commenced with evaluating the time-series statistics of the selected variables using both the Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) tests.

Table 1. Variables of Interest and Measurement

Variables	Acronym	Measurement	Source
Monetary Policy Rate	MPR	Controlling the amount of money accessible in an economy and the mechanisms via which new money is provided.	Central Bank of Nigeria (2023)
Inflation Rate	INF	The rate of change in prices	Central Bank of Nigeria (2023)
Exchange rate	EXC	An exchange rate measures the value of one currency in relation to another currency. It indicates how much of one currency is needed to purchase a unit of another currency.	Central Bank of Nigeria (2023)
Gross Domestic Product	GDP	Standard regressor of economic growth	Central Bank of Nigeria (2023)

Source: Compiled by the author.

RESULTS AND DISCUSSION

Table 2. Unit Root Test

	Augmented Dickey-Fuller (ADF)			
Variables	**First Difference**	**5% critical value**	**I(d)**	**Decision**
MPR	-6.4614	-2.9511	I(1)	stationary
INF	-4.0810	-2.9571	I(1)	stationary
EXC	-4.6333	-2.9763	I(1)	stationary
GDP	-5.2681	-2.9540	I(1)	stationary

Source: Author's Output

From table 2 above, all the variables (MPR, INF, EXC, GDP) in the analysis are non-stationary in their levels but become stationary after taking the first difference. This means they are integrated of order one, I(1). The results suggest that these variables need to be differenced once to achieve stationarity, which is a common requirement before conducting further time series analysis.

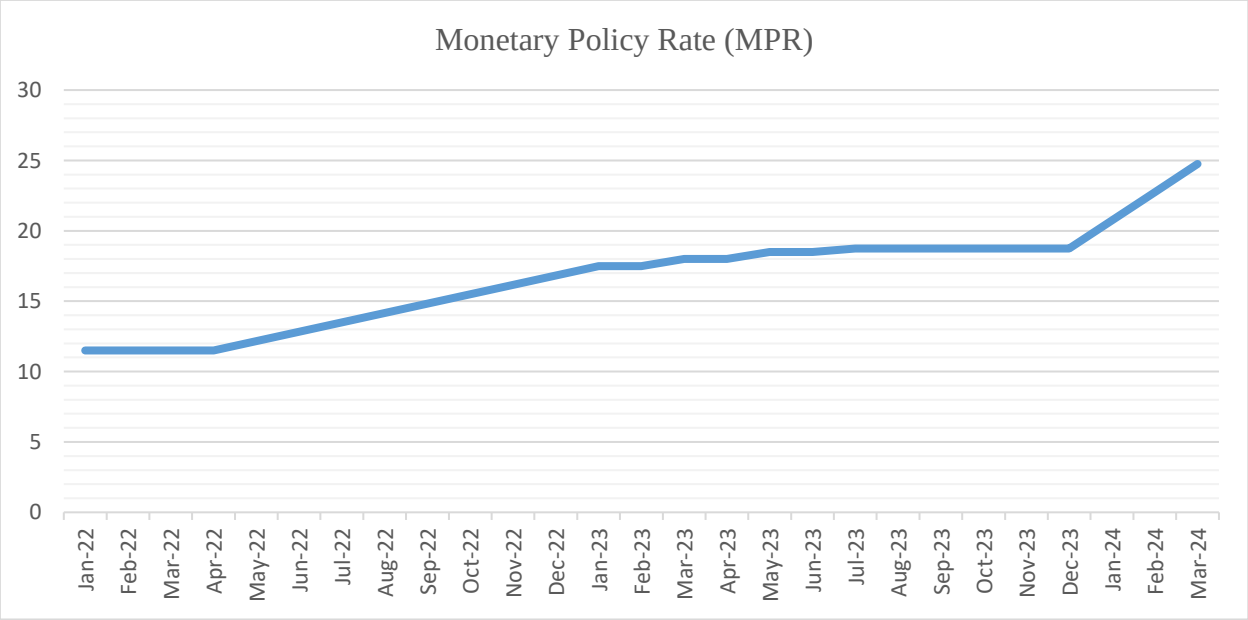


Fig 1. Trend of Monetary Policy Rate (MPR) in recent time

Source: Author's Output

Impulse Response Analysis (Rolling Window)





Plot 1 indicates that an interest rate shock has a significant initial impact on GDP growth, which can be either positive or negative. However, this impact tends to dissipate over time, with GDP growth stabilizing after about 4-6 months. The variability in the responses highlights the different economic conditions and contexts within each rolling window period, suggesting that the effect of interest rate changes on GDP growth is not uniform across different time periods.

Plot 2 indicates that an interest rate shock has a significant initial impact on inflation, which can be either positive or negative. However, this impact tends to diminish over time, with

inflation stabilizing after about 4-6 months. The variability in the responses highlights different economic conditions and contexts within each rolling window period, suggesting that the effect of interest rate changes on inflation is not uniform across different time periods. This variability may be due to various factors, such as changes in monetary policy, external economic shocks, or other macroeconomic conditions specific to each time window

The outcome of this study is in agreement with the study of Miftahu (2019) evaluated the influence of interest rates on Nigerian economic development while the outcomes differ with the works of Moyo and Le Roux (2018) which examined how, between 1990 and 2015, changes in interest rates affected investments and savings, which in turn affected the economic development of SADC nations, Rapu et al. (2017) interest rate changes and real output behavior in Nigeria using a Bayesian Vector Autoregressive (BVAR) model and Olaniyan, Adegboyo Owoniya, and Alaketu (2021) looking at how interest rates and economic development affected a company's choice to invest in Nigeria between 1989 and 2019.

CONCLUSION

The analysis of interest rate shocks on Nigeria's macroeconomic indicators reveals several critical insights. First, the significant initial impact of interest rate shocks on GDP growth, inflation, and exchange rate underscores the sensitivity of these variables to monetary policy changes. However, the effects of these shocks are not uniform across different time periods and tend to dissipate within 4-6 months. This variability is likely influenced by changes in economic conditions, external shocks, and shifts in monetary policy over time. Based on the conclusions drawn from the empirical analysis, several recommendations are proposed for policymakers:

1. Deregulate lending interest rates to allow them to be determined by market forces. This can reduce the extortionate practices of banks and enhance the efficiency of the financial sector.
2. Develop comprehensive monetary policies that consider the interplay between interest rates, exchange rate, inflation, and economic growth. Such policies should aim to create a stable macroeconomic environment conducive to investment and sustainable growth.

3. Establish and maintain interest rates within identified thresholds to avoid adverse impacts on GDP and investment growth. Continuous monitoring and adjustment of these rates are crucial to align with economic objectives.
4. Encourage investment through interest rate policies that promote savings and investment. This involves creating a favorable interest rate environment that balances the needs of savers and investors, thereby driving economic development.
5. Conduct regular assessments of the interest rate policies and their impacts on the economy. Use empirical data to make informed adjustments that align with the evolving economic landscape and policy goals.

Availability of data and material

Data will be provided on request

Competing interests

There is no conflict of interest among the authors

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Authors' contributions

Conceptualization, methodology and literature review of the study was done by Dr. Iyabo while Jacob Angahar handled analysis, conclusion and recommendations,

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