

An Empirical Analysis of The Effect of Monetary Policy on Inflation in Nigeria; 1970 – 2018

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ABSTRACT

This study empirically analysed the effect of monetary policy on inflation in Nigeria; 1970 – 2018. The objective is to determine the effectiveness of monetary policy instruments on inflation in Nigeria. In doing this, relevant literature was reviewed and theoretical relationship between monetary policy and inflation was established following the quantity theory of money by Irving Fisher. The study employed time series data sourced from the statistical bulletin of Central bank of Nigeria (CBN) 2018. Stationarity test was also conducted on the time series data to determine the order of integration using Augmented Dickey Fuller (ADF) test. The unit root test revealed that inflation rate was stationary at level i.e. $I(0)$ while monetary policy rate, treasury bill rate and cash reserve ratio were stationary at first difference i.e. $I(1)$. The estimated results showed that there is cointegration between monetary policy variables and inflation rate in Nigeria. The results revealed that Monetary Policy Rate (MPR) was statistically significant in the short run after first difference, which indicates that monetary policy rate (MPR) exerts significant effect on inflation in Nigeria in the short run. Based on these findings, the study concluded that monetary policy variables alone are not sufficient enough in maintaining price stability in Nigeria. Therefore, the Federal government, Central Bank of Nigeria (CBN) and policy makers should simultaneously use monetary and fiscal policy instruments to maintain price stability in Nigeria.

Keywords: monetary policy and inflation.

INTRODUCTION

Monetary policy has always been seen as a fundamental instrument over the years for the attainment of price stability. Thus, in the pursuit of this objective, the managers of monetary policy have often set targets on intermediate variables which include the short-term Monetary Policy Rate (MPR), Cash Reserve Ratio (CRR) and Treasury Bill Rate. Among these intermediate variables of monetary policy, the MPR is argued to have a greater influence on the economy through its effect

on the value of money supply, domestic inflation, real domestic production, capital flows and financial stability. Changes in the MPR directly affect the growth of money supply in the economy (CBN, 2008). The central bank is the authority with the mandate of manipulating monetary policy with the objective of achieving desired macroeconomic objectives which includes; the achievement of price stability with respect to both domestic and external prices. In the same vein, it uses inflation rate to track movement in the domestic price level and cash reserve ratio is also used as a tool in stabilizing the cash flow in the economy. In ensuring price stability, the Central Bank of Nigeria implements policies through the deposit money banks (DMBs) that guarantee the orderly development of the economy through appropriate changes in the level of money supply. The reserves of the banks are influenced by the Central Bank through its various instruments of monetary policy. These instruments include the cash reserve requirement, minimum rediscount rate (now monetary policy rate), liquidity ratio, open market operations, primary operations and among others to influence the movement of reserves (Feridun, Folawewo & Osinubi 2005).

Monetary policy has emerged as one of the most critical government responsibilities as it provides a flexible and powerful instrument for achieving medium-term stabilisation objectives, and it can be adjusted quickly in response to macroeconomic developments (Jonathan and Philip, 2010). The reduction of money supply is the traditional means through which central banks fight, moderate or prevent inflation. This is based on the quantity theory of money which postulates that inflation is always and everywhere a monetary phenomenon. The quantity theory of money states that the change in the price level is directly and proportionately related with the change in money supply. Specifically, it is based on the perception that the impact of an increase in money supply is transmitted directly to inflation.

The problem of inflation has become a significant one for Nigeria particularly during the past twenty years. Since the first oil shock in the mid-1970s, the average inflation rate in Nigeria has been close to 20 percent a year. Some years have even experienced inflation rates of more than 20 percent. During the 1980's and a greater part of the first half of the 1990's, the Nigerian economy suffered from considerable inflationary pressures either in relative or absolute terms. While the average rate of inflation was only 14.6 percent per annum over the 1970 – 1980 periods, it averaged 19.0 percent per annum in the 1980's and a staggering average rate of 42 percent per annum between 1990 and 1995. This was climaxed in 1995 at 72.8 percent (Batini, 2004).

The management of the price level is vital because in an inflationary economy, it is difficult for money to act as a medium of exchange and store of value without adverse effects on output, employment and income distribution. Inflation causes uncertainty about future prices, and it discourages savings and investment (Feridun, *et al.* 2005). The economic implication of spiralling domestic prices cannot be over emphasized as they constitute an important issue of macroeconomic management, especially in the area of economic growth and welfare. Some of the far-reaching but harmful macroeconomic consequences of inflation are distorted economic signals, leading to depressed investment atmosphere, purely speculative and short-term investment decisions, and inequitable distribution of income. This is because inflation causes excessive relative price variability and misallocation of resources. It reduces real income of labour and favours the real property class. Furthermore, the yield on investment declines while government policy objectives is adversely affected as the real size of its budget shrinks with rising inflation, thereby impairing

economic growth. Therefore, it is capable of bringing about shocks and the impact of which is worth investigating (Batini, 2004).

Consequently, the effectiveness of monetary policy in taming inflationary trends in developing economies such as the Nigerian economy has been in doubt although appreciable progress has been made in this regard since the introduction of various financial sector reform programs in 1986. Also, economists have disagreed on whether price stability and money supply should be the central objective of macroeconomic policies or whether these policies should serve broader monetary policy goals (Nwosa, Olaiya and Amassoma, 2011).

However, it is only in a period of price stability that investors and consumers can interpret market signals correctly. Typically, in periods of high inflation, the horizon of the investor is very short, and resources are diverted from long-term investments to those with immediate returns and inflation hedges, including real estate and currency speculation. Milton Friedman, a major proponent of the monetary school of thought, guided the opinion that money supply is a key factor affecting the wellbeing of any economy. It is in view of this that this study examines the effect of monetary policy on inflation in Nigeria between 1970 and 2018.

Statement of the Research Problem

Models on the determinants of inflation in developing economies usually postulate a money demand function and then specify how expansionary monetary policy leads to rise in the price level (Simwaka, Ligoya, Kabango & Chikonda 2011). Since the Central Bank Act of 1958 was promulgated, the Central bank of Nigeria has been saddled with the responsibility of formulating and implementing monetary policy to enhance economic growth and price stability. To live up to its bidding, the CBN Act of 1958 has facilitated the emergence of active money market in the country. Since the CBN Act of 1958, there have been various regimes of monetary policy in Nigeria (tight and loose monetary policy) and these have been used to influence growth and price stability. The economy has also witnessed business cycles (periods of booms or expansion and recession or contraction).

However, there has always been inflationary pressure in the economy. High rate of inflation is inimical to the growth process of an economy. In Nigeria, inflation has constantly affected the economic activities, from its impact on the cost of production to its dampening effect on aggregate demand for goods and services. Therefore, the question of whether monetary policy has been effective in the attainment of price stability still beckons for answers. Hence, several empirical works have been conducted to investigate whether inflation could be controlled by monetary policy. For instance, the results from the study conducted by Chaudhry, Ismail, Farooq & Murtaza (2015) favours monetarist approach in that money supply is the main cause of inflation while any increase in interest rate is responsible for reducing inflationary pressure in Pakistan. Also, the study of Simwaka, *et al* (2011) explored the factors of monetary aggregates that caused rise in inflation rate in Malawi. Studies from Muritala (2011); Sulaiman (2015); Philip and Isiaq (2012) as well as Akabom-Ita (2012) showed that inflation is always and everywhere a monetary phenomenon implying that inflation is usually triggered by expansionary monetary policy.

Also, in the study conducted by Matthew (2015), findings revealed that money supply impacted negatively on inflation rate in Nigeria, which implies that expansionary monetary policy leads to

inflation in Nigeria. Studies by Simwaka *et al* (2011) and Chaudhry, *et al* (2015) also arrived at the same conclusion, but it is important to state that inferences cannot be drawn from the findings of the research conducted outside Nigeria and applied to the economy without empirical verification. From the above background, the specific objectives of this study are stated below:

- i. To examine the relationship between monetary policy and inflation rate in Nigeria.
- ii. To examine the effect of Monetary Policy Rate (MPR) on inflation rate in Nigeria.
- iii. To assess the impact of Treasury Bill Rate on inflation rate in Nigeria.
- iv. To examine the effect of Cash Reserve Ratio on inflation rate in Nigeria.

LITERATURE REVIEW

This section examines the conceptual review, the review of empirical works, and the theoretical framework.

Conceptual Review

The concept of monetary policy and inflation are examined in this section as they are the two key concepts investigated in the study.

Concept of Monetary Policy

Monetary policy is a deliberate action of the monetary authorities to influence the quantity, cost and availability of money credit in order to achieve desired macroeconomic objectives of internal and external balances (CBN, 2011). Sani, Amusa and Agbeyangi (2012) defined monetary policy as the combination of measures taken by monetary authorities (e.g. the CBN and the ministry of finance) to influence directly or indirectly both the supply of money and credit to the economy and the structure of interest rate for economic growth, price stability and balance of payment equilibrium. The action is carried out through changing money supply and/or interest rates with the aim of managing the quantity of money in the economy. The importance of money in economic life has made policy makers and other relevant stakeholders to accord special recognition to the conduct of monetary policy.

The Central Bank of Nigeria is the organ that is responsible for the conduct of monetary policy in Nigeria. Monetary policy can either be expansionary or contractionary, depending on the overall policy thrust of the monetary authorities. Monetary policy is expansionary when the policy adopted by the central bank increases the supply of money in the system and contractionary, when the actions reduce the quantity of money supply available in the economy or constrains the growth or ability of the deposit money banks to grant further credit. The primary objective of monetary policy is the realization of stable non-inflationary growth. This gives the citizens confidence in the future value of their money, so that they can make sound economic and financial decisions. Low and stable inflation also helps to prevent inflationary boom and bust cycles that could result in a recession and higher unemployment (CBN, 2011).

Concept of Inflation

Inflation is a persistent and appreciable rise in the general level of prices (Jhingan, 2003). Therefore, for a rise in the general price level to be considered inflation, such a rise must be constant, enduring and sustained. The rise in the price should affect almost every commodity and should not be temporal. But Aminu and Anono (2012) are more explicit referring to inflation as a continuing rise in prices as measured by an index such as the Consumer Price Index (CPI) or by the implicit price

deflator for Gross National Product. Thus, a practical definition of inflation would be persistent increase in the general price level which is considered too high and therefore unacceptable (Mbutor, 2010).

In an inflationary economy, it is difficult for the national currency to act as medium of exchange and a store of value without having an adverse effect on income distribution, output and employment (CBN, 1984). Inflation is characterized by a fall in the value of the country's currency and a rise in her exchange rate with other nation's currencies. This is quite obvious in the case of the value of the Naira (N), which was N1 to \$1 (one US Dollar) in 1981, but fell to N160 to \$1 in 2014. This decline in the value of the Naira coincides with the period of inflationary growth in Nigeria, and is an unwholesome development that has led to a drastic decline in the living standard of the average Nigerian.

There are three approaches to measure inflation. These are the Gross National Product (GNP) implicit deflator, the Consumer Price Index (CPI) and the wholesome or producer price index (WPI or PPI). The period to period changes in these two latter approaches (CPI and WPI) are regarded as direct measures of inflation. There is no single-one of the three that rather uniquely best measures inflation. The Consumer Price Index (CPI) approach, though it is the least efficient of the three is used to measure inflation rates in Nigeria as it is easily and currently available on monthly, quarterly and annual basis (CBN, 1991).

Empirical Review

This section handles the empirical review; it examined and summarized the works of other scholars relating to monetary policy and inflation. The study of Abiodun, Folawewo & Osinubi (2005) titled monetary policy and macroeconomic instability in Nigeria: a rational expectation approach was carried out based on a rational expectation framework that incorporates the fiscal role of exchange rate. The model used for this study is the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model. Using quarterly data spanning over 1980: 1 to 2000: 4, and applying time series test on the data used, the study shows that the effort of monetary policy at influencing the finance of government fiscal deficit through the determination of the inflation tax rate affects both the rate of inflation and the real exchange rate, thereby causing volatility in their rates. The study reveals that inflation affects volatility of its own rate as well as in the rate of real exchange. The policy import of the study is that monetary policy should be set in such a way that the objective it is to achieve is well defined.

Similarly, Emerenini & Eke (2014) investigated the determinants of inflation in Nigeria using a monthly data from January 2007 to August 2014. To achieve this, secondary data were collected from the statistical bulletin of Central Bank of Nigeria (CBN). Also, a multiple regression model was designed for econometric analysis and ordinary least square (OLS) method was adopted because of its best linear unbiased estimator (BLUE) property. The result showed that expected inflation, exchange rate and money supply influenced inflation, while annual treasury bill rate and monetary policy rate though rightly signed did not influence inflation in Nigeria within the period under investigation. The estimated model displayed that all the explanatory variables used for the analysis accounted for 90% variation in explaining the direction of inflation as regards to increase or decrease. The co-integration test showed that a long-term relationship existed among the variables. The study revealed that open market operation using annual Treasury bill rate as proxy has not

been effective in managing inflation; therefore, the study recommended that schemes that will make it more effective should be adopted maybe by offering competitive rates.

The work of Sulaiman (2015) examined the price stability effect of Nigerian monetary policy from 1981 to 2012. The Error Correction Mechanism (ECM) model was employed after conducting a number of diagnosis test and ensured that the data were stable. The results of the analysis showed that monetary policy has not played prominent role in ensuring price stability. Treasury bill rate and interest rate are significant factors to reduce price instability while exchange rate and liquidity ratio reduce price instability, but are not significant. However, Monetary Policy Rate is seen to be a significant contributor of price instability. The study therefore recommended that restricted monetary policies should be put in place so as to bring inflation rate to a reasonable low level and the interest rate policies should be implemented in a way that will strengthen the purchasing power of the Naira.

The study of Matthew (2015) examined the impact of monetary policy on inflation in developing countries. The Augmented Dickey Fuller (ADF) Unit Root test was performed on the time series data to determine the stationarity level of the tie series; while the causal relationship between inflation and monetary policy variables was determined using the Granger Causality Test and the relevance of monetary policy indicators in explaining changes in the general price level was investigated using the Ordinary Least Squares (OLS) technique which contains annual data for the period 1986-2013. The model used for the study is a linear regression model. The Unit Root result revealed that inflation and economic growth data series were stationary at level; while monetary policy rate, broad money supply and exchange rate were stationary at first difference implying the short-run effect of monetary policy variables on inflation in Nigeria. The Granger Causality result indicated that a uni-directional relationship exists between inflation (INF) and monetary policy rate (MPR) running from MPR to INF and between economic growth (proxied by Gross Domestic Product-GDP) and INF running from INF to GDP; that independence was suggested between broad money supply (M2) and INF as well as between exchange rate (ER) and INF at 5% level of significance. The OLS result found that monetary policy rate has an insignificant positive impact on inflation; broad money supply impacts negatively and insignificantly on inflation; ER insignificantly impacts negatively on INF; and economic growth was found to significantly impact positively on INF in Nigeria. Thus, the results provide evidence of the price puzzle and confirm that monetary policy is not effective in stabilizing prices in Nigeria. Thus, it is recommended that monetary policy in Nigeria would be effective in taming inflation if financial inclusion is strengthened and new non-bank models are sought in ensuring that the monetary authority has good control of money supply and other monetary indicators.

Chaudhry, Ismail, Farooq and Murtaza (2015) investigated the impact of money supply growth on the rate of inflation in Pakistan. Annually time series data ranges form 1973-2013 is employed for the analysis. The model of the study works out the short-run and the long-run impact of money growth on the rate of inflation in Pakistan. Autoregressive Distributed Lag (ARDL) Model was used, depending upon the time series properties of data that confer mixed order of integration. Diagnostic and stability tests confirm that models are econometrically sound and stable. The results go over the main points; interest rate and money supply are important policy variables for controlling inflation in the long-run while it is the national output level which put downward pressure on

inflation rate in the short-run. The study recommended that economic planners should target inflation through proper control of interest rate, money supply and country output level.

In a related study, Ujuju and Etale (2016) examined the role of monetary policy instruments in controlling inflation in Nigeria. The study adopted interest rate, minimum rediscount rate, liquidity ratio, and cash reserve ratio as proxy for monetary policy instruments and the independent variables. These were regressed against inflation rate, the dependent variable. Secondary time series panel data for the period covering 1982 to 2011 were collected from the Central Bank of Nigeria (CBN) Statistical Bulletin in 2011. The study employed multiple regression model using E-views 7 computer software to analyze data obtained on the study variables. Four hypotheses were tested and the null hypotheses were accepted based on the regression results. The results indicate a positive relationship between cash reserve ratio (CRR), minimum rediscount rate (MRR) and inflation rate (INF). The study found that interest rate, minimum rediscount rate, liquidity ratio and cash reserve ratio had no significant influence on inflation. The study recommended that Nigeria shift from being a consumption driven (import) economy to production based (export) economy for the impacts of these policies to achieve desired results.

Tamunonimim (2016) empirically examined the effectiveness of monetary policy in controlling inflation in Nigeria. Annual time series data, sourced from Central Bank of Nigeria (CBN) Statistical Bulletins (1985–2012) were used to analyze and estimate the three multiple regression models drawn up, with the aid of Software Package for Social Sciences (SPSS). The study modeled inflation rate in Nigerian (dependent variable) as a function of monetary policy (independent variables) made up of monetary policy rate (MPR), treasury bill rate (TBR), savings rate (SR), prime lending rate (PLR), maximum lending rate (MLR), growth of narrow money supply (M1g), growth of broad money supply (M2g), net domestic credit (NDC), net credit to government (NCG) and credit to private sector (CPS). The result shows collinearity that corresponds with the Eigen value condition index, and variance constants were less than 0.5. The Durbin Watson statistic shows the absence of multiple autocorrelation and negative autocorrelation, while the variance inflation factors (VIFs) indicate the absence of autocorrelation. The results show that MPR, TBR, PLR, MLR, and NDC are not statistically significant, while SR, M1g, M2g, NCG and CPS are statistically significant in explaining the changes in Inflation rate in Nigeria. The implication of this finding is that some monetary policy instruments are effective in managing inflation while others are not. The study therefore recommend that contractionary monetary policy aimed at curtailing excess money in circulation should be used to moderate inflation in Nigeria.

In a similar study, Okwori & Abu (2017) examined the efficacy of monetary policy in curbing inflation in Nigeria. Time series data between 1986 and 2015 were used and the Vector Error Correction Model was employed to give empirical content to the stated objectives. The study found out that monetary policy is significant in curbing inflation threshold in Nigeria, however the effect of monetary policy variables are weak in controlling inflation. This is as a result of the large proportion of informal sector which culminates into a high currency outside bank economy that is largely not affected by monetary policy tools. Also, non-popularity of monetary policy tools as a result of financial illiteracy accounts for its ineffectiveness. The Monetary Policy Rate (MPR) is not statistically significant which has also affected its transmission mechanism to commercial banks interest rate. This is as a result of commercial banks' excess reserves which downplay the efficacy of the MPR in affecting interest rate and money supply. The study recommends amongst others that;

first, the CBN should narrow the asymmetric corridor around the MPR to check commercial banks excess reserves. Required cash ratio and liquidity ratios should be adjusted regularly to curtail banks excess reserves; second, the CBN should embark on enlightenment campaigns in financial literacy to buttress popularity of monetary policy tools. Finally, commercial banks should expand their coverage to reduce the number of un-banked and under banked persons in the economy in order to reduce the dominance of the informal sector.

Finally, Akarara, & Azebi (2018) investigated the effectiveness of selected monetary policy tools in the control of inflation in Nigeria. Data used are monthly data covering the period January, 2009 to December, 2016 sourced from Central Bank of Nigeria statistical bulletin 2016. The study estimated the Augmented Dickey-Fuller (ADF) unit root test, Johansen Cointegration test and the Error Correction Model (ECM). Result of the ADF showed that all the variables are integrated of order I(1), except for the Error Correction Term (ECT) which is stationary of order I(0). The Johansen cointegration test result revealed the presence of a long-run relationship between inflation rate and the selected monetary policy variables. The ECM result revealed that the estimated model has a self-equilibrating mechanism of 12%. The study concluded that Treasury Bill Rate (TBR) is an effective tool in controlling inflation both in the short and long run. While Exchange Rate (EXR) and Money Supply (MS) are very effective monetary policy tools in the control of inflation in the short run. Monetary Policy Rate (MPR) is effective in the long run. Therefore, it is recommended that the monetary authority in Nigeria should regulate EXR and MS in controlling inflation to achieve a short-term result. TBR should be used to control the rate of inflation both in the short and long-run, while MPR should be used to control inflation for a long-term result. Keywords: Inflation, Money Supply, Exchange Rate, Monetary Policy Rate, Error Correction Model The empirical reviewed so far have been able to identify areas that need to be covered in this study as well as the variables to be included, analysed and the methodology to be adopted in this study.

Theoretical Framework

This study adopted the quantity theory of money by Irving Fisher (1911) which explained that inflation is directly proportional to the quantity of money stock. This is because the theory established the basis for controlling inflation with money supply.

The starting point of the quantity theory of money is the popular identity,

$$MV=PY \quad - \quad - \quad - \quad (2.1)$$

Where:

M = money supply,

V = velocity of money in circulation,

Y = real national output, and

P = aggregate price level.

From equation 2.1, we can derive another equation as follows:

$$P = \frac{MV}{Y} \text{ or } V = \frac{PY}{M} \quad - \quad - \quad - \quad (2.2)$$

Sequel to the above, the proportional relationship between the money stock and general price level (inflation) can be shown in the elasticity of the price level with respect to the money supply is:

$$E_{pm} = \frac{\partial P}{\partial M} \times \frac{M}{P} \quad - \quad - \quad - \quad (2.3)$$

Differentiating equation 2.1 totally yields:

$$M\partial V + V\partial M = P\partial Y + Y\partial P \quad - \quad - \quad - \quad (2.4)$$

But Y and V are constant at full employment i.e. change in Y and V is zero at full employment. Thus equation 2.4 yields:

$$V\partial M = Y\partial P \quad - \quad - \quad - \quad (2.5)$$

$$\frac{\partial P}{\partial M} = \frac{V}{Y} \quad - \quad - \quad - \quad (2.6)$$

Substituting equation 2.6 into 2.3 yields:

$$E_{pm} \frac{V}{Y} \times \frac{M}{P} \quad - \quad - \quad - \quad (2.7)$$

Substituting equation 2.2 into equation 2.7 yields:

$$E_{pm} = \frac{1}{Y} \times \frac{PY}{M} \times \frac{M}{P} = 1 \quad - \quad - \quad - \quad (2.8)$$

Equation 2.8 above depicts that there is a direct proportional relationship between the general price level (inflation) and the growth rate of money supply, when velocity and output are constant. i.e., in a regression of inflation on money supply growth, the coefficient of money is estimated to be unity (1). The proportionality relationship implies that a permanent increase in money growth leads to an equal increase in the rate of inflation (general price level).

METHODOLOGY

This study used of secondary data. Data on Inflation Rate (INF), Monetary Policy Rate (MPR), Treasury Bill Rate (TBR) and Cash Reserve Ratio (CRR) were obtained from Central Bank of Nigeria (CBN) Statistical Bulletin for the year 2009 and 2018.

Model Specification

The econometric model; Autoregressive Distributed Lag Model (ARDL) used for this study is adapted from work of Chaudhry, Ismail, Farooq and Murtaza (2015). The functional relationship between inflation and monetary policy instruments are expressed below:

$$INF = f(MPR, TBR, CRR) \quad - \quad - \quad - \quad 3.0$$

Where:

INF = Inflation Rate (Proxy of Consumer Price Index, CPI)

MPR = Monetary Policy Rate

TBR = Treasury Bill Rate

CRR = Cash Reserve Ratio

F = functional relationship

The model finds the short-run and long-run impacts of monetary policy variables on inflation in Nigeria as follows:

$$INF_t = \beta_0 + \beta_1 MPR + \beta_2 TBR + \beta_3 CRR + \mu_t \text{ --- (3.1)}$$

Where:

INF = Inflation Rates

MPR = Monetary Policy Rate

TBR = Treasury Bill Rates

CRR = Cash Reserve Ratio

μ_t = Disturbance term;

β_0 = intercept term;

β_1, β_2 , and β_3 , = stimulus coefficients that measuring percentage change in response.

A priori Expectation

$\beta_1, \beta_2, \beta_3 < 0$

The Autoregressive Distributed Lag (ARDL) model used in this study is expressed by further restructuring the model in 3.1 and it is given as follows:

$$\begin{aligned} \Delta INF_t = & \delta_0 + \delta_1 INF_{t-1} + \delta_2 MPR_{t-1} + \delta_3 TBR_{t-1} + \delta_4 CRR_{t-1} + \sum_{i=j}^a \gamma_1 \Delta INF_{t-i} \\ & + \sum_{i=j}^b \gamma_2 \Delta MPR_{t-i} + \sum_{i=j}^c \gamma_3 \Delta TBR_{t-i} + \sum_{i=j}^d \gamma_4 \Delta CRR_{t-i} + \mu_t \text{ --- (3.2)} \end{aligned}$$

Where

δ_0 = Constant Parameter

Δ = First difference operator

δ_i, γ_i = Vector of the parameter of the lagged values of the explanatory variables.

μ_t = Error term

The terms with the summation signs (Σ) in equation 3.2 above represent the error correction dynamics while the first part of the equation with δ_i correspond to the long-run relationship. If the calculated F – statistic exceed the upper critical value, the null hypothesis of no co-integration will be rejected irrespective of whether the variables are I(0) or I(1). If it is below the lower value bound, the test is inconclusive (Pesaran and Pesaran (2001).

Unit Root Test

To detect the presence or otherwise of unit root, we consider a variable that has a unit root represented by a first order autoregressive AR (1):

$$Y_t = \beta Y_{t-1} + \mu_t \text{ --- (3.3)}$$

Where Y_t is the level variable, Y_{t-1} is the first lag of the dependent variable (Y_t), β is the parameter and μ_t is the white noise error term assumed to be normally distributed with zero mean and constant variance and also assumed to be serially uncorrelated. To identify stationarity or non-stationarity of the variables used in this research, the researcher adopted the conventional Augmented Dickey- Fuller (ADF) unit root test based on the model expressed below:

$$\Delta Y_t = \beta_0 + \beta_1 Y_{t-1} + \alpha_i \sum \Delta Y_{t-i} + \mu_t - - - (3.4)$$

Where:

ΔY_t = Differenced value of a given time series variable

β_0 = Constant Parameter

β_1 = Coefficient of the first lag value of the series variable

Y_{t-1} = First lag value of a series variable

α_i = Coefficient of the lag values of the differenced time series variable

ΔY_{t-i} = Lag values of the differenced series variable

μ_t = Error term.

Co-integration Test

The study employed autoregressive distributed lag (ARDL) bounds testing procedure to test the long-run relationship between monetary policy instruments and inflation rate. The ARDL has several advantages over other conventional techniques of co-integration such as Engle and Granger (1987). In line with the above, the Autoregressive Distributed Lag Model (ARDL) model stated in 3.2 is re-stated below:

$$INF_t = \delta_0 + \delta_1 INF_{t-1} + \delta_2 MPR_{t-1} + \delta_3 TBR_{t-1} + \delta_4 CRR_{t-1} + \sum_{i=j}^a \gamma_1 \Delta INF_{t-i} + \sum_{i=j}^b \gamma_2 \Delta MPR_{t-i} + \sum_{i=j}^c \gamma_3 \Delta TBR_{t-i} + \sum_{i=j}^d \gamma_4 \Delta CRR_{t-i} + \mu_t - - (3.5)$$

Once a co-integration relationship has been ascertained the long-run and short run parameters of the co-integration equation are then estimated. The long run co-integration relationship was estimated using the following specification:

$$INF_t = \delta_0 + \delta_1 INF_{t-1} + \delta_2 MPR_{t-1} + \delta_3 TBR_{t-1} + \delta_4 CRR_{t-1} + \mu_t - - - (3.6)$$

Error Correction Mechanism (ECM)

In order to estimate the short-run relationship between the variables and the speed of adjustment of the model to equilibrium, the corresponding error correction equation was estimated as expressed below:

$$INF_t = \gamma_0 + \sum_{i=j}^a \gamma_1 \Delta INF_{t-i} + \sum_{i=j}^b \gamma_2 \Delta MPR_{t-i} + \sum_{i=j}^c \gamma_3 \Delta TBR_{t-i} + \sum_{i=j}^d \gamma_4 \Delta CRR_{t-i} + \gamma_5 ECM_{t-i} + \mu_t - - - (3.7)$$

Where, ECM is the Error correction term of one period lag estimated from equation 3.7 while the coefficient γ_5 measures the speed of adjustment of the model's convergence to equilibrium.

Causality Test

This section handles the causality that runs from Inflation rate (INF) to Monetary Policy Rate (MPR), Treasury Bill Rate (TBR) and Cash Reserve Ratio (CRR). Thus, the study uses Pairwise Granger

causality test to ascertain the direction of causality between the aforementioned variables and the models for the Granger Causality are given below:

$$INF_t = \sum_{i=1}^n \alpha_i MPR_{t-1} + \sum_{j=1}^n \beta_j INF_{t-j} + \mu_{1t} - - - - (3.8)$$

$$MPR_t = \sum_{i=1}^n \gamma_i MPR_{t-1} + \sum_{j=1}^n \delta_j INF_{t-j} + \mu_{2t} - - - - (3.9)$$

$$INF_t = \sum_{i=1}^n \alpha_i TBR_{t-1} + \sum_{j=1}^n \beta_j INF_{t-j} + \mu_{1t} - - - - (3.10)$$

$$TBR_t = \sum_{i=1}^n \gamma_i TBR_{t-1} + \sum_{j=1}^n \delta_j INF_{t-j} + \mu_{2t} - - - - (3.11)$$

$$INF_t = \sum_{i=1}^n \alpha_i CRR_{t-1} + \sum_{j=1}^n \beta_j INF_{t-j} + \mu_{1t} - - - - (3.12)$$

$$CRR_t = \sum_{i=1}^n \gamma_i CRR_{t-1} + \sum_{j=1}^n \delta_j INF_{t-j} + \mu_{2t} - - - - (3.13)$$

ANALYSIS OF RESULTS

Cointegration Test Results

The unit root test conducted revealed that Inflation rate (INF) was stationary at level, i.e. $I(0)$ while MPR, TBR and CRR were stationary at first difference, i.e. $I(1)$. Having conducted the unit root test and the optimum lag selection, F-statistic test for cointegration is required to determine whether there is cointegration among the variables captured in the unrestricted error correction version of the ARDL model. This has been estimated using the bound testing approach and the results are presented in Table 4.1.1.

From table 4.1.1, the bound test results reveal the existence long run cointegration among the variables. When inflation rate is the dependent variable, i.e. in the function F_{INF} (INF/MPR, TBR, CRR), the null hypothesis that there is no cointegration between monetary policy variables and inflation rate (INF) is rejected at both 5% as the F-statistic, 5.0815 is greater than the critical value 3.9412 at lower bound level and 4.7019 at upper bound level, indicating there is cointegration between monetary policy variables and inflation rate.

Table 1: Cointegration Test Results

Dependent Variable	Function	F-statistic
INF	$F_{INF} (INF/MPR, TBR, CRR)$	5.0815** (0.000)
Asymptotic Critical Value for Rejecting Null Hypothesis		
Critical Value	At 5%	At 10%
Lower Bound	3.5281	2.9148
Upper Bound	4.7019	3.9412

Note: Significant at 5% (**) and 10% (*). The values in parenthesis are probability values.

Source: Estimated using Microfit 5.0.

The results revealed that there is cointegration between monetary policy rate variables and inflation in Nigeria as the F-statistic is higher than the asymptotic critical value at the 5% level.

Results of Estimated Long-run Coefficients

Owing to the fact that the existence of cointegration among the variables has been established, the long-run relationship between inflation and monetary policy variables has also been estimated using the ARDL approach with ARDL (2,2,0,0) specification selected based on Akaike Information Criterion. The results are presented in Table 4.2.1.

Table 2: Result of Estimated Long-run Coefficient (Dependent Variable: INF)

Independent Variables	Coefficients	Standard Error	T-Ratio (Prob)
MPR	0.83899	1.3712	0.61186 (0.544)
TBR	0.31119	1.2093	0.25734 (0.798)
CRR	-0.10423	0.43697	-0.23854 (0.813)

Note: The values in parenthesis are probability values.

Source: Computed using Microfit 5.0

From the results as reported in Table 4.2.1, it reveals that the null hypothesis of no cointegration between monetary policy rate (MPR) and inflation rate in Nigeria cannot be rejected as can be seen from the P-value (0.544). The result of the estimated coefficient of monetary policy rate (0.83899) shows a positive but statistically insignificant long-run relationship between monetary policy rate and inflation rate in Nigeria. Furthermore, on Treasury Bill Rate (TBR) and inflation rate, the p-value (0.798) implies that the null hypothesis should be accepted indicating absence of significant long-run relationship between inflation rate and treasury bill rate in Nigeria though the coefficient, 0.31119 is positive. On the contrary, the study revealed that Cash Reserve Ratio (CRR) negative and insignificant relationship with Inflation rate in Nigeria with a p-value of 0.813 which indicates that the null hypothesis is to be accepted as well and as such there is no long-run relationship between CRR and inflation in Nigeria.

Therefore, the results indicate that there is no significant long-run relationship between monetary policy and inflation in Nigeria; and that monetary policy shock does not transmit significant effect on inflation through any of the chosen variables in the long run.

Results of Estimated Short-run Relationship between Monetary Policy and inflation rate

The short-run relationship between monetary policy and inflation rate is estimated using the error correction model and the results are presented in table 4.3.1 as follows.

Table 3: Results of Error Correction Mechanism (Dependent Variable: ΔINF)

Independent Variables	Coefficients	Standard Error	T-Ratio (Prob)
$\Delta MPR1$	-1.5269**	0.62867	-2.4289
			(0.020)
ΔTBR	0.18944	0.72857	0.26002
			(0.796)
ΔCRR	-0.063454	0.26657	-0.23804
			(0.813)
ecm (-1)	-0.60876***	0.14275	-4.2647
			(0.000)

Note: Significant at 1% (***) and 5% (**). The values in parenthesis are probability values.

Source: Computed using Microfit 5.0

Table 4.3.1 shows the results from the Error Correction Model (ECM) which helps to measure the speed of adjustment of the variables to monetary policy. The error correction mechanism confirmed that the price level slowly adjusts to changes in the monetary policy instruments. The Error Correction coefficient is approximately -0.61 has the expected negative sign and it is also statistically significant at 1% considering the probability value which is 0.000. The value of the ECM implies a high speed of adjustment to equilibrium after a shock. Based on the result, approximately 61% of disequilibria from the previous year's shock converge back to the long-run equilibrium in the current year. For the respective explanatory variables, contrary to the long-run estimation, the short-run results show the existence of a significant negative relationship between Monetary Policy Rate (MPR) and inflation rate at 5% level of significance. But, the coefficient of Cash Reserve Ratio (CRR) and the coefficient of Treasury Bill Rate (TBR) are not significant. In summary, the short-run results indicate that monetary policy transmits significant effects on inflation rate in Nigeria through the Monetary Policy Rate (MPR) channel.

Results of Post Diagnostic Tests

To justify the adequacy of the estimated ARDL model, post-estimation diagnostic tests for serial correlation and heteroscedasticity were carried out and the outcome is presented in Table 4.4.1.

Table 4: Results of the Diagnostic Test of the Selected ARDL Model

Test of Serial Correlation of Residuals		
L M Version	CHSQ(2)	4.2445 (0.120)
F Version	F(2,37)	1.8366 (0.174)
Autoregressive Conditional Heteroscedasticity Test of Residuals		
L M Version	CHSQ(2)	3.6458 (0.162)
F Version	F(2,37)	1.5557 (0.225)

Note: The values in parenthesis are probability values.

Source: Computed using Microfit 5.0

From table 4.4.1, the Langrange Multiplier (LM) test was adopted and the p-value is 0.120 which is not significant and indicating that the null hypothesis of no serial correlation is accepted. This is indeed a desirable result proving the adequacy of the estimated ARDL model. Also, on the test for heteroscedasticity, autoregressive conditional heteroscedasticity test was carried out and the null hypothesis which says that the model is homoscedastic could not be rejected going by the p-value (0.162). This indicates that the model is not heteroscedastic. In a nutshell, the two post-estimation tests have complemented each other in justifying the adequacy of the estimated ARDL model.

Pairwise Granger Causality Test

Pairwise Granger causality test was conducted to determine whether or not causality runs between the variables and the direction of such causality. The results from the test are presented in table 4.5.1.

The results from the Pairwise Granger Causality test conducted. Based on the results, the null hypothesis that MPR does not Granger-cause INF is rejected and the alternative is accepted. This is based on the statistical significance of the P-value at 5% level of significance. But there is only uni-directional relationship between MPR and INF which implies that causality only runs from MPR to INF but does not run from INF to MPR.

Table 5: Pairwise Granger Causality Test Results

S/no	Null hypothesis:	Obs	F-statistic	Prob.
1	MPR does not Granger Cause INF	47	4.23817**	0.0211
	INF does not Granger Cause MPR		2.15253	0.1288
2	TBR does not Granger Cause INF	47	3.46346**	0.0405
	INF does not Granger Cause TBR		1.97807	0.1510
3	CRR does not Granger Cause INF	47	0.39507	0.6761
	INF does not Granger Cause CRR		1.57613	0.2188
4	TBR does not Granger Cause MPR	47	1.43017	0.2507
	MPR does not Granger Cause TBR		0.05914	0.9427
5	CRR does not Granger Cause MPR	47	0.34168	0.7125
	MPR does not Granger Cause CRR		0.42771	0.6548
6	CRR does not Granger Cause TBR	47	0.92346	0.4051
	TBR does not Granger Cause CRR		0.24927	0.7805

Note: Significant at 5% (**)

Source: Computed using Eviews 9

Similarly, causality runs from TBR to INF but does not run from INF to TBR. This is another case of uni-directional relationship between TBR and INF. Causality does not run from INF to CRR neither does it run from CRR to INF. Also, there is no causality running between TBR and MPR as contained in the results as well.

Finally, there is no other form of causality that exists as can be seen from the result, and there is no situation of bi-directional causality between the variables which implies that causality did not run both ways among the variables.

Discussion of Findings

This study has empirically examined the effects of monetary policy on the inflation rate in Nigeria from 1970 to 2018 using time series analysis. Unit root test was conducted through Augmented Dickey Fuller (ADF) to test for the stationarity of the variables. Due to the outcome of our unit root tests which reveal a mixture of integration order, i.e. I(0) and I(1) among our variables, bound testing approach to cointegration with an autoregressive distributed lagged (ARDL) model became an unavoidable estimation procedure; being a technique capable of providing consistent estimation when variables are integrated of different orders. The discussion of the outcome examines how the results of this research are in line with or different from similar studies previously conducted; and it takes the form of two dimensions: firstly, on the long-run effects of monetary policy on inflation rate; secondly on the short-run relationship among the variables.

To start with, the ARDL testing approach confirmed the existence of cointegration between monetary policy variables and inflation rate in Nigeria. In other words, there is a long-run relationship between inflation and monetary policy variables which in this study are Monetary Policy Rate (MPR), Treasury Bill Rate (TBR) and Cash Reserve Ratio (CRR). This is in line with the findings of Sulaiman (2015) and Chaudhry, *et al.*, (2015) which also established that there is a long run cointegration between inflation and monetary policy variables. The estimated results also show that in the second lag period, Monetary Policy Rate (MPR) has positive and statistically significant relationship with inflation at 5% level of significance. But, Treasury Bill Rate (TBR) has positive but insignificant relationship with inflation while Cash Reserve Ratio (CRR) has negative and insignificant relationship with inflation rate in the result in the current period.

On the long-run relationship among the variables, contrary to the finding of Akarara, & Azebi (2018) which revealed that MPR has positive and significant impact on inflation rate in the long-run, the ARDL result of this study shows that Monetary Policy Rate (MPR) has positive but statistically insignificant long-run relationship with inflation rate. This finding agrees with the study by Matthew (2015) which revealed that MPR has positive and insignificant impact on inflation rate in Nigeria during period of observation. The study by Emerenini & Eke (2014) which revealed that MPR has statistically insignificant impact on inflation rate also agrees with this study.

Also, contrary to the finding of Akarara, & Azebi (2018) which revealed that Treasury Bill Rate (TRB) has negative and significant impact on inflation rate, the findings on this study revealed that Treasury Bill Rate (TBR) exerts positive but statistically insignificant effect on inflation rate. This finding conforms totally with the research conducted by Tamunonimim (2016) which revealed that Treasury Bill Rate (TBR) has positive and insignificant effect on Nigerian inflation rate.

The results also revealed a negative and statistically insignificant long-run relationship between Cash Reserve Ratio (CRR) and inflation rate in Nigeria which partly agrees with the study by Ujuju and Etale (2016) and Okwori & Abu (2017) which revealed that Cash Reserve Ratio has positive but insignificant impact on inflation rate in Nigeria. But based on the finding of this study, it means none of the monetary policy variables transmits long-run effect on inflation in Nigeria between the periods under observation.

On the short-run relationship, it has been discovered that the error correction term is negative and statistically significant. This is in conformity with earlier studies by Sulaiman (2015) and Chaudhry, *et al.*, (2015). From the result, monetary policy rate in the first lagged period is statistically significant and it has negative relationship with inflation, but in the current period, monetary policy is not significant at 5% level of significance. This is in line with the work of Emerenini & Eke (2014) which revealed that MPR is negative and statistically significant in exerting effects on inflation rate in short run but the study is in contrast with the study of Akarara, & Azebi (2018).

Conversely, in the short run, treasury bill rate has positive and insignificant effect on inflation throughout the period of observation. This result is in line with Tamunonimim (2016) but is in contrast with the study of Emerenini & Eke (2014). Similarly, the result revealed that in the short run, CRR has negative and insignificant impact on inflation rate in Nigeria. This finding is in line with the work of Ujuju and Etale (2016) and Okwori & Abu (2017) which also revealed that CRR has insignificant impact on inflation in Nigeria.

Finally, the Pairwise Granger Causality test indicated that causality only runs from Monetary Policy Rate (MPR) and Treasury Bill Rate (TBR) to Inflation Rate (INF). This implies that both MPR and TBR Granger cause inflation and causality does not run among the rest variables.

CONCLUSION AND RECOMMENDATIONS

The study concluded that monetary policy has significant impact on the level of inflation in Nigeria during the period under observation. This is due of the results obtained in this study which revealed that there is long run relationship between monetary policy variables and inflation in Nigeria.

The study also concluded that current monetary policy rate does not have significant impact on the current level of inflation in Nigeria. From the result, previous MPR transmit effect to inflation in the current period only but in the short run.

Also, the treasury bill rate has no significant impact on inflation at any time period, previous or current, both in the short run and in the long run. By this result, it means that the activities of the open market have not significantly affected the level of inflation in Nigeria.

Another conclusion that can be drawn from this study is that Cash Reserve Ratio (CRR) in the short run and in the long run has no significant impact on the level of inflation in Nigeria.

Finally, the study concluded that there is a causal relationship between the level of inflation and monetary policy variables in Nigeria.

The study revealed that open market operation using annual treasury bill rate as proxy has not been effective in managing inflation; therefore, schemes to make it more effective should be adopted maybe by offering competitive rates.

From the findings, it is evident that monetary policy alone is not sufficient and reliable enough for maintaining price stability in Nigeria. Therefore, it should be supplemented by fiscal measures such as government spending and taxation and other non-monetary measures. Based on all the studies reviewed and in line with the findings of this study, it is glaring that to control inflation in Nigeria; the government should adopt both monetary and fiscal policy measures simultaneously. By so doing, price stability will be collectively regulated and maintained in Nigeria.

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