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Does Monetary Policy Stimulates Macroeconomic Performance during Economic Downturn in Nigeria?

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Abstract: This study investigated the relationship between monetary policy and macroeconomic performance in Nigeria during 1981-2018. The stochastic properties of the time series data were examined using both conventional and unit root tests with structural breaks to account for shift dummy in the series. Their results indicates that the series are combination of both I(0) and I(1) in the same specification which prompted the use of ARDL. The results revealed that in the short run, lag value of inflation rate, exchange rate appreciation and unexpected appreciation (i.e., shift_dummy) could reduce inflation rate while lower MPR and high volume of money in circulation could stimulate inflation rate. Also, lag value of unemployment rate, high MPR and exchange rate depreciation significantly stimulate unemployment rate while unexpected appreciation reduce it. Low MPR and exchange rate depreciation could stimulate GDP growth rate while unexpected appreciation in exchange rate retards GDP growth in Nigeria. In the long run, inflation rate is constrained by exchange rate appreciation while depreciation promotes growth but stimulate unemployment rate in Nigeria. Also, MS2 stimulates inflation and unemployment rate but produce negative effect on GDP growth in Nigeria. Based on the results, the policy implications were drawn for Nigeria. Monetary authority should use its policy instruments to minimize pressures on the exchange rate, inflation and foreign reserves. This could be done by design policy measures that promote the value of Naira and check exchange rate fluctuation. Also, monetary policy instruments must be as supportive so as to ensure price stability, reduce unemployment rate and consequently brings about economic growth.

Keywords: Monetary Policy, Macroeconomic Performance, Business Cycle, Nigeria

Introduction

The concept of business cycle is universal to most capitalist countries of the world. An economy passes through the phases of boom, recession, recovery and depression. For each of the negative phases such as recession and depression, monetary policy, essentially implemented by the Central Bank of Nigeria (CBN) is one prominent remedial policy adopted to remove the structural rigidity in the economy and all the indicators that may lead to disequilibrium. It is obvious that balancing the objectives of price stability with output growth, especially in the face of external headwinds, remains a challenge to monetary policy and CBN, particularly in developing countries (Emefiele, 2019). In Nigeria, monetary policy has been in use since the CBN was saddled with the responsibility of formulating and implementing monetary policy by Central Bank Act of 1958 (Chimezie, 2012). This role has facilitated the emergence of active money market where treasury bills, a financial instrument used for open market operations and raising debt for government has grown in volume and value becoming a prominent earning asset for investors and source of balancing liquidity in the market. Fundamentally, the goals of monetary policy are to promote maximum sustainable output and employment and maintaining price stability in the economy (Chimezie, 2012). The task of stabilizing

output in the short-run and maintaining price stability in the long-run requires CBN to estimate the current economic conditions and compare with that in the medium-term. If gap exists between the estimates and the goals, it is required of CBN to decide on how forcefully to act to close the gap.

Monetary policy is defined as discretionary actions undertaken by monetary authority (usually through the CBN) designed to influence supply of money, cost of money (interest rate) and the ease with which, at any given interest rates, money can be borrowed usually the availability of money. In another dimension, Falade and Folorunso (2015) described it as a deliberate effort of the monetary authority to control the money supply and the credit conditions in order to achieve certain macroeconomic objectives which might be mutually exclusive. It is a macroeconomic instrument used by monetary authority to pursue the goal of establishing macro-economic stability as a basis for accelerating the pace of economic recovery and promoting sustainable growth in the country. It is also considered a vital instrument which a country can deploy for the maintenance of domestic price and exchange rate viability, as a critical condition for the achievement of a sustainable economic growth and external viability (Amassoma *et al*., 2011).

In Nigeria, various regimes of monetary policy has been practised. At one time, contractionary monetary regime was employed while expansionary regime at another time to regulate the economy. However, the reported growth has not been sustainable as there is evidence of growing poverty among the populace. For instance, Nigerian economy is faced with a lot of irregularities such as high unemployment, low investment and high inflation rate and these factors militate against the growth of the economy. Instability of basic macroeconomic indicators is generally understood to have worsened in Nigeria. Inflation rate, for instance, rose from 9.6% in January 2016 to over 18.7% in January 2017. Also, with the drop in foreign exchange inflows, the exchange rate at the parallel market rose significantly from about ₦200/US$ in August 2015 to ₦525/US$ in February 2017 (Emefiele, 2019). Although both have since fallen to 11.24% in September, 2019 and N305/$1 since 2017, still, they could not ensure sustainable growth.

The external reserves fell from about US$31bn in April 2015 to US$23bn in October 2016, though increased to US$42bn since 2018. However, activities in the industrial sector witnessed a break as manufacturers struggled to get access to basic inputs required in the production process. The real GDP growth plunged sharply from 6.2% in 2014 to a 1.6% contraction in 2016. This made Nigeria to effectively slip into a technical recession in the second quarter of 2016 and maintained negative growth in subsequent quarters of that year (Emefiele, 2019). Therefore, the question on whether monetary policy measures impact on the Nigerian economy is still a burning issue. Therefore, the main subject of this study is to explore if the CBN's monetary policy could stimulate macroeconomic performance under structural rigidity/imbalance in Nigeria.

The contribution of this paper to the existing literature on the relationship between monetary policy and macroeconomic performance are articulated to include the following. First, with existence of considerable number of studies on monetary policy instruments and their effects on the macroeconomic variables, most studies only examined the impact of monetary policy with a focus specifically on certain monetary policy tool. For instance, only exchange rate was used by a number of studies (Morande and Schmidt, 2002; Nwosa, 2016; Olori, 2017), while only money supply was used by Udah (2008); Bakare (2011); Denbel *et al*. (2016). In some similar studies, Ahiabor (2013), Imoughele and Ismaila (2015), Imoughele and Ismaila (2016) among others combined money supply, interest rate and exchange rate as monetary policy tools. In another dimension, Nenbee and Madume (2011) used Money Supply (MOS), Minimum Rediscount Rate (MRR) and Treasury Bills (TRB) while Fasanya *et al*. (2013) considered both exchange rate and external reserve. This study improves on the previous studies by considering three monetary policy variables (Monetary Policy Rate (MPR), broad Money Supply (MS2) and Exchange Rate (EXR). The rationale for the inclusion of these variables is because they are used as measurement of economic performance both internally and externally. Second, most of the previous studies considered a particular macroeconomic indicator such as inflation, unemployment or economic growth, with the exception of Balogun (2007), Chukwu (2009) and Denbel *et al*. (2016) who specifically focused on inflation and economic growth. However, this study is an extension by exploring the possible impact of monetary policy tools on three different macroeconomic variables (inflation, unemployment and economic growth). Third, this study introduces structural breaks into the analysis to be able to see whether shift dummy has significant impact on these macroeconomic indicators. This is an innovation that this study introduced.

This therefore serves as an improvement on the existing studies. The remainder of the paper is organized as follows. Section two provides an overview of monetary policy instruments in Nigeria. Section three briefly reviews some of the related literature. Section four introduces the methodological framework and the sources of data for the study. Empirical results are discussed in section five and section six concludes the paper.

Stylized Facts on Performance of Monetary Policy Indicators in Nigeria

This subsection discusses the performance of monetary policy instruments that have been employed in regulating the macroeconomic variables over time in Nigeria. The trend of monetary policy indicators such as money supply, exchange rate and monetary policy rate are shown in Fig. 1 to 3, respectively. The money supply as a measure of total money in circulation grown to an average of ₦9131.28millon by the end of mid-1980s prior the structural adjustment programme (SAP) era in Nigeria. The growth of money supply has been astronomical especially in the last one and half decade (1995-2010) averaged ₦3.57 trillion during the post-SAP era. This indicate that monetary aggregate in Nigeria since 1980 till 2010 has recorded geometric growth across series of monetary policy regimes in Nigeria and this has further driven the growth rate in general prices of goods. For instance, inflation rate during the period recorded 21.38% on average. In addition, between the period 2011 and 2018, money supply in Nigeria averaged ₦18.13 trillion.

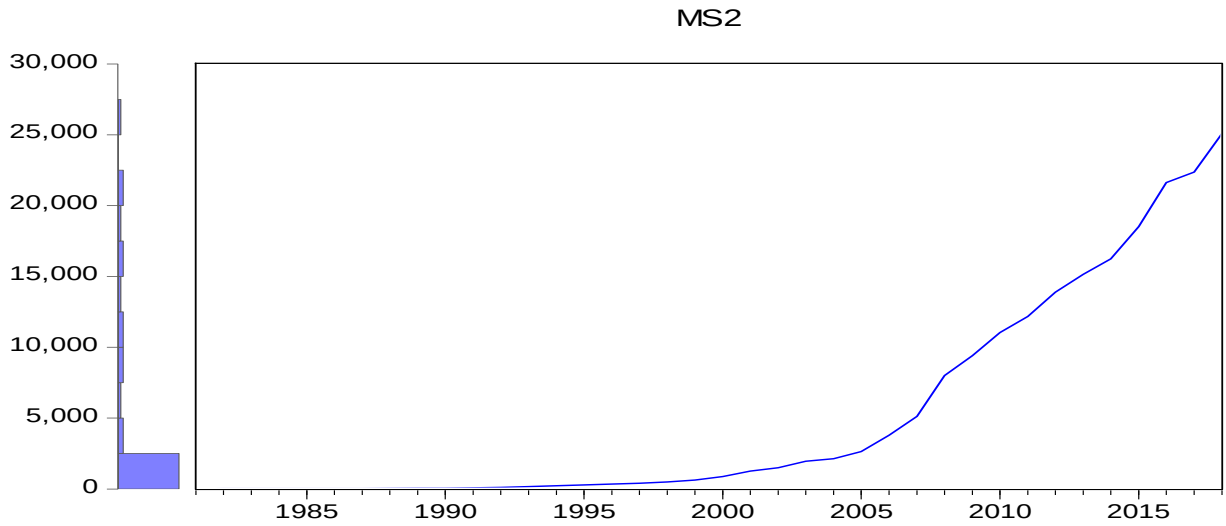

Fig. 1: Trend of money supply; Source: Central Bank of Nigeria Statistical Bulletin, 2018

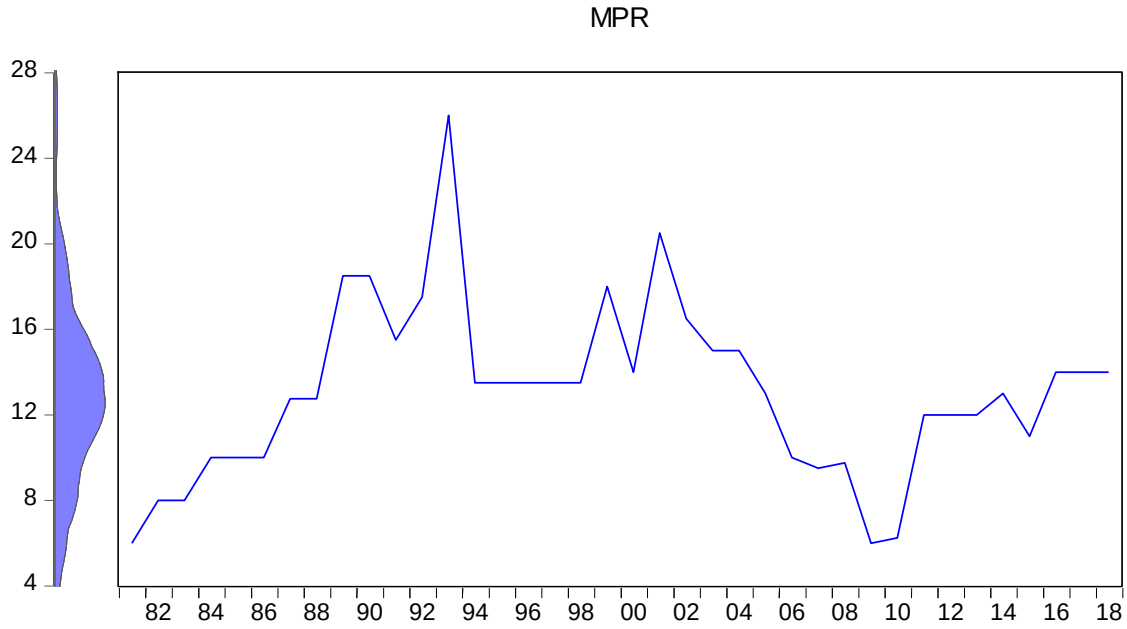

Fig. 2: Trend of monetary policy rate; Source: Central Bank of Nigeria Statistical Bulletin, 2018

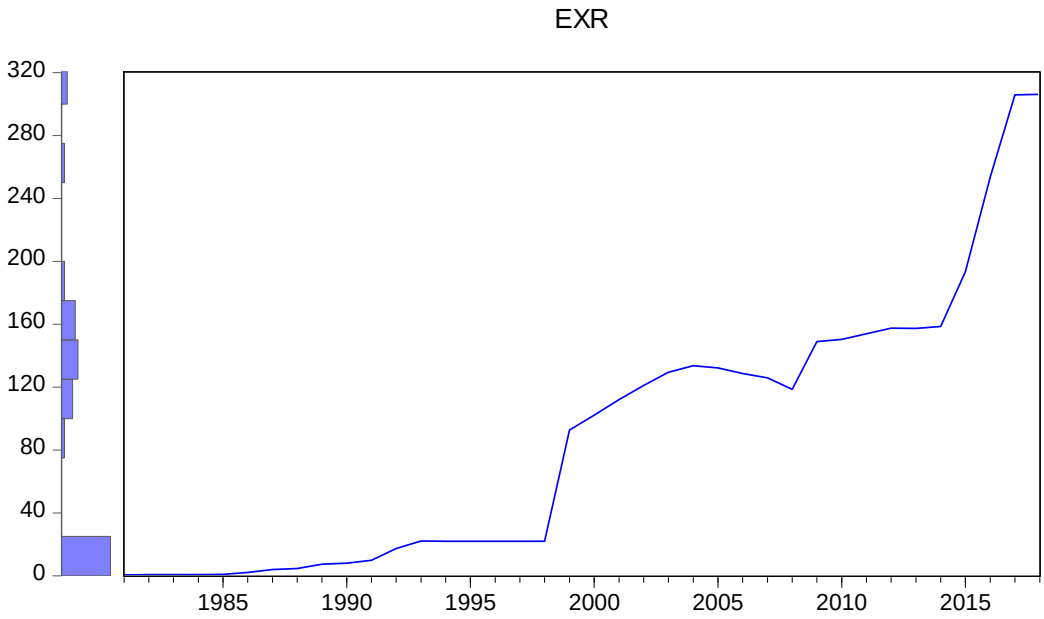

Fig. 3: Average official exchange rates in Nigeria; Source: Central Bank of Nigeria Statistical Bulletin, 2018

The monetary policy rate as a short-term instrument employed by the CBN to regulate the lending activities of the commercial banks and stabilizes the total available money in circulation is considered as another monetary policy indicators. Its performance has been cyclical across episodes of monetary policy regimes and structural adjustment era. In the post-independence era (1960-1969), the monetary policy rate was stable and averaged 4.79% and further declined to 4.30% between 1975 and 1979 as an expansionary move. However, the accelerated increase in money supply in the early 1980s prior to the deregulated era (SAP) a more contractionary monetary policy was adopted and this resulted to the increase in MPR to the level of 7.6%. The contractionary policy was maintained all through the 1980s till mid of 1990s when the MPR peaked at 26% in 1993 which marks the end of SAP era in Nigeria. As the growth in spread to the MPR increase, the monetary authority in Nigeria embarked upon series of contractionary and expansionary policies to stabilize money supply as well as facilitates investment by reducing lending rate through the MPR. In the last one and half decade (1995-2018), MPR averaged 12.89% compared to 15.4% recorded in the SAP era (1985-1994) and during the period of declining trend in MPR, the money supply growth has experienced significant increase. This implies that monetary stability has been emerged as a contemporary issue in the Nigeria's monetary system despite the tightening measures the system adopted in the last decades.

Exchange rates have witnessed a lot of fluctuations in Nigeria. At one time, it appreciates such that less of local currency is used to purchase a dollar and at another time, depreciation crops up when more of local currency is needed to chase a dollar. The volatile nature of exchange rates has induced uncertainty and risk in investment decision with destabilizing impact on the general macroeconomic performance. Based on this, Nigerian government has put some efforts in place to maintain a stable exchange rate but the country is continually experiencing exchange rates volatility over the period of time. The exchange rate statistics in Nigeria as presented in Fig. 3 showed that throughout the 1980s', the value of naira depreciated significantly. For instance, it depreciated from N0.55 in 1980 to N0.89 in 1985 and further to N8.04 in 1990, all against the US dollar. The depreciated value of naira between the periods of 1985 and 1990 accounted for about 803.37% loss in value and this was attributed to the agreement signed with International Monetary Fund (IMF) in 1986 to implement its conditionalities, which are otherwise called Structural Adjustment Policy (SAP).

However, in 1994 during Abacha tenure, the deregulation policy pegged Naira at N21.89 against the US dollar and this was maintained till 1999 when another deregulation pushed it to N86.32 = $1.00. In year 2000, exchange rates depreciated further to N101.70 and N132.89 per dollar in 2004 accounted for about 17.82% and 30.67% loss in value. In 2005, the value of naira appreciated by about 1.23% gain against the dollar when the exchange ratio fell from N132.89 in 2004 to N131.27 in 2005. The appreciation further till 2008 while exchange rates fell to N118.55 per dollar, accounted for about 12.10% increase in value (gain against dollar). Again, towards the end of 2008 when the global financial crisis took its

toll, the value of naira depreciated significantly to an average value of N148.90 per dollar till the end of 2009. Between 2010 and 2018, depreciation of naira continued persistently from N150.30 in 2010 and N306.08 in 2018, accounted for about 103.7% loss in value against dollar. This resulted particularly from poor performance of oil prices in the world market. As a result, the problem of insufficient dollars emanates and has been preventing Nigerian government to actively defend the naira and keep it stable.

Literature Review

The extents to which monetary policy instruments influence the macroeconomic indicators especially price stability, full employment and ultimately economic growth in the economy have been under discussion over the years. To have a clear look of how these indicators were influenced by monetary policy, this study provides some empirical findings cut across the developed and developing countries. In the developed countries, for instance, Coenen *et al*. (2003) explored the nexus between price stability and monetary policy effectiveness when nominal interest rates are bounded at zero for the European Central Bank. The paper employed stochastic simulations of a small structural rational expectations model and found that subjecting an economy to stochastic shocks similar in magnitude to those experienced in the U.S during 1980s and 1990s, the consequences of the zero bound are negligible for target inflation rates as low as 2%. However, the effects of the constraint are non-linear with respect to the inflation target and produce a quantitatively significant deterioration on the performance of the economy with targets between 0 and 1%. The variability of output increases significantly and that of inflation also rises somewhat. While determining the relationship among GDP growth, money supply and price levels in Jordan for the period 1976-2009, Al-Fawwaz and Al-Sawai'e (2012) used Johansen co-integration and the Error Correction Mechanism. Their results showed that short-term relationship does not exist between money supply (M1) and GDP growth in Jordan. Conversely, monetary policy instruments have not made any meaningful impact on the Jordanian macroeconomic variables, though the findings revealed existence of causal relationship between money supply and inflation, with low degree of (0.21).

On the same scenario, the findings in the developing countries reveal different result. Nouri and Samimi (2011), for instance, adopted Levine and Renelt growth model to explore the relationship between money supply and economic growth in Iran over the period 1974-2008. The findings showed the existence of a positive and significance relationship between aggregate money supply and economic growth in Iran. In another dimension, Miguel and Liviatan (1988) examined the effectiveness of adopting stabilization measures in managing inflation for selected Latin American countries. The authors applied OLS technique and their findings failed to show any relationship between money supply and inflation. Therefore, they concluded that the use of nominal variables, notably money supply, is necessary but not sufficient condition for successful inflation management. Yien *et al*. (2017) examined the dynamic relationship between monetary policy and economic growth for Malaysia during 1980-2015, using VAR Granger Causality method. They observed that interest rate granger caused growth per capita, money supply, inflation, unemployment and foreign direct investment. More so, the study demonstrates that changing monetary policy approach in Malaysia from monetary targeting to interest rates targeting is a fruitful policy implementation. Finally, their results showed bidirectional causality between unemployment and growth per capita in Malaysia.

In Sub-Saharan African, a number of studies have been undertaken to assess the possible effects of monetary policy on macroeconomic indicators. Some of these studies include: Balogun (2007) who in a panel study analysis involving 5 West African Monetary Zone Countries (WAMZ) assessed the effect of monetary and exchange rate policies on the indicators of domestic economic performance for each of the country (GDP and Inflation). The author used VAR approach and found adverse effects of both monetary and exchange rate policies on economic growth and inflation. This is because domestic monetary policy captured by money supply and credit to government hurt real domestic output of these countries rather than promoting their growth. Ahiabor (2013) used OLS technique to explore the relationship between monetary policy and inflation in Ghana for the period 1985-2009. The findings revealed a long-run positive relationship between money supply and inflation, exchange rate and inflation while negative relationship between interest rate and inflation. Precious and Palesa (2014) used Johansen co-integration and the Error Correction Mechanism to explore the monetary policy effects both in the short-run and long-run on economic growth in the South African economy. Their findings showed that money supply, repo rate and exchange rate are insignificant monetary policy instruments that drive growth in South Africa even though they are positively signed whereas inflation is significant. However, Dingela and Khobai (2017) with the aid of Autoregressive Distributed Lag (ARDL)-bounds testing approach found a significant positive relationship between money supply and economic growth both in short run and long run. Also, over the period 1970/71-2010/11, Denbel *et al*. (2016) used the tri-variate granger causality with VECM. They found bi-directional causal relationship between inflation and money supply while uni-directional causal relationship

between economic growth and inflation in the long-run. In the short run, however, there is presence of uni-directional causality between money supply and inflation, which implying that money supply causes inflation in Ethiopian economy.

Specifically, in Nigeria, Feridun *et al.* (2005) used quarterly data spanning from 1980:1 to 2000:4 to examine the efficacy of monetary policy in controlling inflation rate and exchange rate instability in Nigeria. Their analysis was based on a rational expectation framework that incorporates the fiscal role of exchange rate. Their findings showed that the effort of monetary policy to influence financing of government fiscal deficit through the determination of the inflation-tax rate affects both inflation and the real exchange rate, hence causing volatility in their rates. Bakare (2011) examined the determinants of money supply growth and its implications on inflation in Nigeria using quasi-experimental research design approach. The results of the regression showed that credit expansion to the private sector determines money supply growth by the highest magnitude in Nigeria. Also, the findings show that changes in money supply are concomitant to inflation in Nigeria and strongly support the need for regulating money supply growth in the economy. Contrary to this, studies such as: Amassoma *et al.* (2011), Okwo *et al*. (2012) using the same methodological approach observed that monetary policy has insignificant influence on price instability in Nigeria. However, on the nexus between monetary policy and real gross domestic product, Fasanya *et al.* (2013), Udude (2014) and Olori (2017) found that Nigeria's economic growth is significantly driven by monetary policy instruments.

On the link between unemployment and monetary policy, Essien *et al.* (2016) employed a Vector Autoregressive (VAR) framework for the period 1983q1–2014q1. In their analysis, the authors incorporated the effect of structural breakpoints into the VAR model as dummy variables. Their findings showed that a positive shock to policy rate raises unemployment over a 10 quarter period. Towards achieving inclusive growth in Nigeria, Nwosa (2016) employed OLS technique to examine the effect of monetary, fiscal and foreign exchange policy) on unemployment and poverty rates for the period 1980-2013. The analysis shows that unemployment rate is mainly influenced by exchange rate (monetary policy) while poverty rate is influenced by fiscal policy.

Methodology

Analytical Framework

In this study, the Autoregressive Distributive Lags (ARDL) of Pesaran *et al.* (2011) is utilized. The methodology estimates the impacts and applies the bounds testing approach to ascertain whether long-run relationship exists between/among the variables in the model. One of the advantages of the ARDL approach is that it can be used to model mixture of both I(0) and I(1) in the same specification, which is not acceptable using traditional approaches, such as Johanson's and Engel Granger's technique. Also, ARDL bounds testing approach is more suitable and provides better results for small sample size. Using this approach, the dynamics of both the short-run and long-run parameters including the speed of adjustment when there is shock are estimated simultaneously within the same framework. Moreover, it subverts the problem of over-parameterization, as robust lag lengths are crucial to this approach. However, the shortcoming of ARDL approach is its inability to incorporate I(2) variables in its analysis (Nkwatoh, 2014).

Pesaran *et al.* (2001) and Nkwatoh (2014) support that the ARDL approach begins with an examination of the Vector Auto-regressive (VAR) of order *p*, denoted VAR (*p*) often represented as:

$$Z_t = \mu + \sum_{i=1}^{p} \beta_i z_{t-i} + \varepsilon_t \tag{1}$$

where, z_t is a vector of both x_t and y_t; y_t representing the dependent variables of the different models, x_t is the vector of matrix representing a set of explanatory variables. The principle is that y_t must be an I(1) variable, but the regressor x_t can either be I(0) or I(1).

According to Noman (2014), ARDL was developed to accommodate current and previous lags of the dependent variable (AR) while various distributive lags of the explanatory variables (DL). In its basic form, an ARDL regression model looks thus:

$$\begin{aligned} y_t &= \beta_0 + \beta_1 y_{t-1} + ... + \beta p y_{t-p} + \alpha_0 x_1 \\ &+ \alpha_1 x_{t-1} + \alpha_2 x_{t-2} + ... + \alpha_q x_{t-q} + \varepsilon_t \end{aligned} \tag{2}$$

where, y_t is the dependent variable, x_t is an explanatory variable and ε_t is a disturbance error term. The model is autoregressive because y_t is explained (in part) by lagged values of itself. Also, it has a distributed lag component in the form of successive lags of the '*x*' explanatory variable. Sometimes, the current value of x_t itself is excluded from the distributed lag part of the model's structure. In this study, the dependent variables are Inflation Rate (INFR), Unemployment Rate (UNEMPR) and economic growth rate (RGDPR). The explanatory variables are the vector of variables that constitute monetary policy instruments. The instruments considered include: Monetary Policy Rate (MPR), broad Money Supply (MS2) and Exchange Rate (EXR). The functional

relationship between monetary policy and the selected macroeconomic variables is specified as follows:

$$\inf r = f\left(exr, mpr, ms2\right) \tag{3}$$

$$unempr = f\left(exr, mpr, ms2\right) \tag{4}$$

$$rgdpg = f\left(exr, mpr, ms2\right) \tag{5}$$

Mathematically, the econometric specification of the ARDL with the influence of structural breaks for the above relation is shown in (6), (7) and (8):

$$\begin{aligned}\Delta \inf r_t &= \beta_0 + \beta_1 \inf r_{t-1} + \beta_2 \ln exr_{t-1} + \beta_3 mpr_{t-1} \\ &+ \beta_4 ms2_{t-1} + \beta_5 exr\_dummy_{t-1} + \sum_{i=1}^{p} \beta_6 \Delta \inf r_{t-1} \\ &+ \sum_{i=1}^{p} \beta_7 \Delta \ln exr_{t-1} + \sum_{i=1}^{p} \beta_8 \Delta mpr_{t-1} + \sum_{i=1}^{p} \beta_9 \Delta ms2_{t-1} \\ &+ \sum_{i=1}^{p} \beta_{10} \Delta exr\_dummy_{t-1} + \mu_t\end{aligned} \tag{6}$$

$$\begin{aligned}\Delta unempr_t &= \beta_0 + \beta_1 unempr_{t-1} + \beta_2 \ln exr_{t-1} + \beta_3 mpr_{t-1} \\ &+ \beta_4 ms2_{t-1} + \beta_5 exr\_dummy_{t-1} + \sum_{i=1}^{p} \beta_6 \Delta unempr_{t-1} \\ &+ \sum_{i=1}^{p} \beta_7 \Delta \ln exr_{t-1} + \sum_{i=1}^{p} \beta_8 \Delta mpr_{t-1} + \sum_{i=1}^{p} \beta_9 \Delta ms2_{t-1} \\ &+ \sum_{i=1}^{p} \beta_{10} \Delta exr\_dummy_{t-1} + \mu_t\end{aligned} \tag{7}$$

$$\begin{aligned}\Delta rgdpg_t &= \beta_0 + \beta_1 rgdpg_{t-1} + \beta_2 \ln exr_{t-1} + \beta_3 mpr_{t-1} \\ &+ \beta_4 ms2_{t-1} + \beta_5 exr\_dummy_{t-1} + \sum_{i=1}^{p} \beta_6 \Delta rgdpg_{t-1} \\ &+ \sum_{i=1}^{p} \beta_7 \Delta \ln exr_{t-1} + \sum_{i=1}^{p} \beta_8 \Delta mpr_{t-1} + \sum_{i=1}^{p} \beta_9 \Delta ms2_{t-1} \\ &+ \sum_{i=1}^{p} \beta_{10} \Delta exr\_dummy_{t-1} + \mu_t\end{aligned} \tag{8}$$

The short-run estimate from the error correction mechanism derived from the long-run relationship is presented in Equation (9), (10) and (11):

$$\begin{aligned}\Delta \inf r_t &= \phi_0 + \phi_1 \Delta infr_{t-1} + \phi_2 \Delta \ln exr_{t-1} + \phi_3 \Delta mpr_{t-1} \\ &+ \phi_4 \Delta ms2_{t-1} + \phi_5 \Delta exr\_dummy_{t-1} + \delta ect_{t-1} + \varepsilon_t\end{aligned} \tag{9}$$

$$\begin{aligned}\Delta unempr_t &= \phi_0 + \phi_1 \Delta unempr_{t-1} + \phi_2 \Delta \ln exr_{t-1} + \phi_3 \Delta mpr_{t-1} \\ &+ \phi_4 \Delta ms2_{t-1} + \phi_5 \Delta exr\_dummy_{t-1} + \delta ect_{t-1} + \varepsilon_t\end{aligned} \tag{10}$$

$$\begin{aligned}\Delta rgdpg_t &= \phi_0 + \phi_1 \Delta rgdpg_{t-1} + \phi_2 \Delta \ln exr_{t-1} + \phi_3 \Delta mpr_{t-1} \\ &+ \phi_4 \Delta ms2_{t-1} + \phi_5 \Delta exr\_dummy_{t-1} + \delta ect_{t-1} + \varepsilon_t\end{aligned} \tag{11}$$

where, Δ represents the first difference operator; μ_t is a white-noise disturbance error term; t is the time; i denotes the lag(s) being considered; β and ϕ are parameter coefficients to be estimated in the long-run and short-run respectively; ECT is the error correction term, δ is the ECT coefficient, which must be negative, less than zero and significant sign for causality to exist in the long-run and *exr_dummy* represents a dummy for exchange rate which assumes the value of 0 and 1 based on the break period. Furthermore, the ARDL bounds test approach for the long-run relationship was based on the Wald test (F-statistic), by imposing restrictions on the long-run estimated coefficients of one period lagged level of each of the explanatory variables to be equal to zero, that is, (H_0: $\beta_0 = \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$) for equation (9), (10) and (11). None of the variables is logged except EXR.

A'priori specification: the expected signs of the coefficients of the explanatory variables are:

$\phi_1 = \frac{\partial \Delta \ln exr}{\partial \Delta \inf r} > 0$; $\phi_2 = \frac{\partial \Delta mpr}{\partial \Delta \inf r} < 0$; while $\phi_3 = \frac{\partial \Delta \ln ms}{\partial \Delta \inf r} > 0$

$\phi_1 = \frac{\partial \Delta \ln exr}{\partial \Delta unempr} < 0$; $\phi_2 = \frac{\partial \Delta mpr}{\partial \Delta unempr} > 0$; while $\phi_3 = \frac{\partial \Delta \ln ms}{\partial \Delta unempr} < 0$

$\phi_1 = \frac{\partial \Delta \ln exr}{\partial \Delta rgdpg} > 0$; $\phi_2 = \frac{\partial \Delta mpr}{\partial \Delta rgdpg} < 0$; while $\phi_3 = \frac{\partial \Delta \ln ms}{\partial \Delta rgdpg} > 0$

Estimation Technique and Procedures

The processes to this estimation procedure begin with the examination of the stochastic properties of the data in which descriptive statistics and unit root test are performed. The unit root test is necessary in order to avoid a spurious regression that may give a good fit and predict a statistical significance relationship between variables where none really exist (Mahadeva and Robinson, 2014). The variables used for the analysis are subjected to different unit root tests so as to determine stationary or non-stationary of the series. The motivation behind the variety of tests is to find reliable and consistent results. Therefore, apart from the conventional unit root tests of Augmented Dickey Fuller (ADF) and the Phillips-Perron (PP), this study also considers the Dickey Fuller (DF-GLS) and Ng-Perron tests. These are all designed to overcome the difficulties of low power and size distortions inherent in the conventional unit root tests (Maddala and Kim, 1998). In addition to the conventional methods, unit root tests with structural breaks (Perron 2006 and Zivot-Andrews (ZA)) were conducted to determine unexpected shift in time

series that can lead to unreliable estimates. In each of these tests performed, the null hypothesis with intercept and trend was considered to determine whether each of the variables in the model being analysed is stationary or not. However, in the empirical analysis, we considered structural break for only exchange rate among the three monetary policy variables in the models. This is because there is tendency for the existence of collinearity when including more than one dummy in a time series analysis. Based on this, we included a dummy variable (exr_dummy) into the model to account for this structure break.

Data Description and Sources

The study utilizes time series data on two monetary policy instruments and three macroeconomic indicators. The monetary policy instruments include monetary policy rate (*mpr*), money supply (*ms2*) and exchange rate (*exr*), while the macroeconomic indicators are real gross domestic product growth rate (*rgdpg*), unemployment rate (*unempr*) and inflation rate (*infr*). The entire data set covered the period 1981 to 2018 for which data are available. The data were obtained from three sources: CBN Statistical Bulletin, UNCTADstat and also from World Development Indicators (WDI).

Empirical Results and Discussion

Preliminary Analysis

Table 1 reports the summary statistics for each of the variables used in the model for the period (1981-2018). The statistics presented include the mean, median, maximum, minimum, standard deviation, skewness, kurtosis and Jarque-Bera. As it is observed, the standard deviations of *MS2* and *EXR* are relatively higher than the other variables. This implies that these monetary policy instruments are more volatile compared to other. Also, among the macroeconomic variables, inflation rate is unpredictable compare to others. The skewness test which measure the asymmetry of the distribution of the series shows positive skew values for all the variables. This indicates that the variables are skewed to the right and that the right tails are longer. The result of kurtosis statistics which measures the peakedness or flatness of the distribution of the series indicates that *GDPGR, INFR, MPR* and *MS2* are highly leptokurtic as kurtosis statistics of each of them is greater than 3. However, the distribution of *UNEMPR* and *EXR* are highly platykurtic relative to the normal. Finally, the calculated Jarque-Bera statistics and *p*-values in Table 1 are used to test the null hypothesis for normal distribution (H_0: Yearly distribution is normally distributed). Given this, the *p*-values indicate that the null hypothesis of normality is accepted for only *EXR* while rejected for other variables. This connotes that these variables apart from *EXR* are not distributed normally.

Unit Root Tests

In testing the time series properties of the variables in the model, this paper performed a univariate regression analysis using conventional unit root tests (ADF, PP DF-GLS and Ng-Perron) and unit root tests with structural breaks (Perron 2006 and Zivot-Andrews tests) in order to ascertain whether each of these variables has unit root (non-stationary) or does not have unit root (stationary series). Following the summary results of the unit root tests presented in Table 2, it is clearly shown that the variables considered are a mixture of stationary I(0) and non-stationary I(1) series. Given this scenario, there is therefore a need for long-run relationship among the variables in each of the models, which the use of ARDL is capable of capturing.

In using ARDL approach, there is also a need to determine the optimal lag length using five different information criteria which are: Akaike Information Criterion (AIC), Schwartz Information Criterion (SIC), Hannan-Quinn Information Criterion (HQ), Final Prediction Error (FPE) and Sequential Modified LR test Statistic. From the result presented in Table 3, the optimal lag length suggested for the stochastic equation is three, i.e., $p^* = 3$ is chosen.

Bound Test

To determine the existence of long-run relationship or trend between macroeconomic variable in each model (inflation rate, GDP growth rate and unemployment rate) and selected monetary policy instruments (*MPR, MS2 and EXR*), a co-integration analysis is performed using ARDL bounds test. In the case, the null hypothesis of no co-integration (H_0: $\beta_0 = \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$) is tested. In each of the models (inflation rate, GDP growth rate and unemployment rate), the results in Table 4 depict that the Wald F-statistic of 5.28, 6.12 and 13.01 fall above both the upper and lower critical bounds of 5.06 and 3.74 at 1% level of significance as established by Pesaran *et al.* (2001). Based on this, we reject the null hypothesis and conclude that there is a long-run relationship between the series in each of the models between 1981 and 2018.

Long-Run Analysis of the Impact of Monetary Policy Instruments on Macroeconomic Indicators

In testing for the long-run contribution of each of the explanatory variables on the dependent variable of concern, the long-run estimates of the relationship being analysed are presented in Table 5. For inflation model, the results show that EXR coefficient is negative and statistically significant at 1%. This suggests that a 1% appreciation of Naira reduces inflation rate in the domestic economy by 17.8%. The fundamental argument behind such scenario is that when Naira exchange rate appreciates against hard

currency, Nigeria's exports become inelastic in the foreign markets while encourage imports. Consequently, aggregate supply (both domestic produced and imported goods) in the domestic economy increases and this may be capable to absorb the domestic demand (aggregate demand) and thereby reduce inflation rate. Conversely, depreciation of Naira is expected to boost export and thus stimulate GDP growth rate in the long-run. This is shown in column 3, where exchange rate has significant positive relationship with the GDP growth rate.

Table 1: Descriptive statistics of the variables

	Mean	Median	Max	Mini	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Observations
GDPGR	4.260	4.206	21.347	-6.625	4.905	0.905	5.435	14.576***	38
UNEMPR	11.756	10.600	24.280	4.650	5.961	0.866	2.632	4.968*	38
INFR	19.324	12.547	72.835	5.382	17.255	1.742	4.837	24.569***	38
MPR	13.066	13.250	26.000	6.000	4.100	0.669	4.231	5.235*	38
EXR	88.662	97.399	306.080	0.610	87.193	0.799	2.964	4.046	38
MS2	5153.380	753.700	25079.700	14.470	7536.500	1.338	3.431	11.629***	38

Source: Computed

Table 2: Summary and decision for unit root tests

Variables	ADF	PP	DF-GLS	Ng-Perron	ZA	Perron 2006	Decision
GDPGR	I(0)	I(0)	I(0)	I(0)	I(0)	I(0)	I(0)
UNEMPR	I(0)	I(1)	I(0)	I(0)	I(1)	I(0)	I(0)
INFR	I(0)	I(1)	I(0)	I(0)	I(0)	I(0)	I(0)
MPR	I(1)	I(1)	I(1)	I(1)	I(1)	I(0)	I(1)
EXR	I(1)	I(1)	I(1)	I(1)	I(1)	I(0)	I(1)
MS2	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)

Source: Derived from Table A1 and A2 in the appendix. Note: The decision made in each of the tests is based on the estimation results with consideration to intercept and trend. I(0) represents stationary of a variable (i.e., significant at level) while I(1) denotes non-stationary (i.e., significant at first difference).

Table 3: Maximum lag length table

VAR lag order selection criteria
Endogenous variables: *RGDPG UNEMPR EXR MPR INFR MS2*

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-658.6399	NA	1.26e+09	37.97942	38.24605	38.07146
1	-485.9995	276.2246*	528040.6*	30.17140	32.03782*	30.81569*
2	-453.2111	41.21970	767939.5	30.35492	33.82112	31.55145
3	-407.5854	41.71496	775840.2	29.80488*	34.87087	31.55366

Source: Computed. Note: * indicates lag order selected by the criterion

Table 4: ARDL bounds test for co-integration analysis

Dependent variable	Inflation rate Wald F-statistic: 5.2756; K = 4		GDP growth rate Wald F-statistic: 6.1224; K = 4		Unemployment rate Wald F-statistic: 13.0105; K = 4	
F-statistic Bounds level	Lower bound I(0)	Upper bound I(1)	Lower bound I(0)	Upper bound I(1)	Lower bound I(0)	Upper bound I(1)
1% critical bounds value	3.74	5.06	3.74	5.06	3.74	5.06
5% critical bounds value	2.86	4.01	2.86	4.01	2.86	4.01
10% critical bounds value	2.45	3.52	2.45	3.52	2.45	3.52

Source: Computed

Table 5: ARDL long-run coefficients estimate

Variable	Inflation rate	GDP growth rate	Unemployment rate
LEXR	-17.834(-3.282)***	4.321(2.445)**	4.211(4.612)***
EXR_dummy	-27.407(-1.828)*	4.690(1.857)*	-11.387(-3.881)***
MPR	3.655(3.673)***	-0.437(-2.300)**	-0.373(-2.039)**
MS2	0.002(2.044)**	-0.001(-4.484)***	0.001(6.834)***
C	-6.652(-0.571)	2.331(1.051)	9.157(4.483)***

Source: Computed. Note: *** implies significant at 1%, while ** implies significant at 5% and * significant at 10%. Also, exchange rate was only logged under unemployment model

The positive relationship of exchange rate with unemployment rate is contrary to the theoretical expectation. This may be explained by the fact that exchange rate depreciation could generate either positive or negative impact on macroeconomic performance of country that adopts it. For instance, reaping the benefits of devaluation may be difficult for such an economy like Nigeria that is import dependent in nature. This is because most of the domestic firms/industries that are expected to absorb the teeming population have shut down their operations due to high competition. This eventually brings about high rate of unemployment and promotes economic downturn in the long-run. Considering the long-run contribution of MPR on the selected macroeconomic variables, the results show significant positive relationship with inflation but negative relationship with GDP growth rate and unemployment rate. None of the estimates conforms to the a'priori expectations except for GDP growth rate. For instance, a 1% increase in MPR increases inflation rate by 3.66% while a 1% reduction in MPR increases unemployment rate by 0.37%. However, a 1% reduction in MPR is expected to boost investment and thus stimulates GDP growth rate by 0.44%. Turing to the impact of exchange rate dummy (i.e., shift dummy) on macroeconomic indicators, the estimates shows that across the specifications, shift dummy was found to be statistically significant. This connotes that an unexpected appreciation of Naira could possibly reduce economic downturn associated with hyper-inflation and unemployment rate while unexpected depreciation tends to stimulate GDP growth rate in the long-run.

The long-run contribution of MS2 on the selected macroeconomic variables is also shown in Table 5. The results show existence of a positive relationship between inflation rate and money supply. Essentially, this conforms to the theoretical expectation because an increase in money supply stimulates inflation rate and vice versa. This argument is also supported by Irving Fisher quantity theory of money, who emphasise that an increase in the volume of money in circulation (given a constant velocity of flow of money and full employment) will lead to a corresponding increase in the general price level and consequently a fall in the value of money. Significant negative impact of MS2 on GDP growth rate and positive impact on unemployment rate are contrary to a'priori expectation. Although, the coefficients are very low such that a 1% increase in MS2 reduces GDP growth rate by 0.001% but increase unemployment rate by 0.001%.

Short-Run Analysis of the Impact of Monetary Policy Instruments on Macroeconomic Indicators

From Table 6, the preliminary econometric checks for each of the models reveal no serial autocorrelation as evident from a Durbin-Watson statistic of 1.64, 2.10 and 1.90. This is also supported by the Breusch Godfrey serial correlation LM test probability of 2.20, 0.99 and 0.19, respectively. The heteroskedasticity test performed for each model reveals a value of 0.72, 1.44 and 0.60 with probability of 0.62, 0.24 and 0.70, respectively. This indicates the existence of homoscedasticity in the series of each model. The F-statistic shows that the overall fitness of the models are 7.08, 3.84 and 117.99 at 1% significant level. The results of R-squared are 0.68, 0.61 and 0.98, respectively. This connotes that in the short-run, changes in inflation rate, GDP growth rate and unemployment rate are accounted for by the variation in the monetary policy instruments with consideration to structural break in exchange rate. Ramsey Reset stability test with a probability value of 0.07, 0.11 and 0.71 suggests the stability of each of the models except for inflation. This is an indication that inflation in Nigeria has not been stable over time and this could be attributed to devaluation policy brought by Structural Adjustment Programme (SAP) in 1986.

In terms of short-run impact of monetary policy instruments on selected macroeconomic indicators, Table 6 Column 2 shows the results of short-run dynamics of the effectiveness of monetary policy instruments on inflation rate. The ECM term of -0.85 has negative sign, less than zero and statistically significant. The estimates support the existence of a long-run relationship among the variables. Also, the results indicate that distortion in the short-run will require an adjustment rate of 85% to be able to bring monetary policy instruments and inflation rate to a long-run equilibrium. Moreover, the results of short-run dynamics of the effectiveness of monetary policy instruments on GDP growth rate and unemployment rate in Columns 3 and 4 indicate that at 1.25 and 0.59, departure from long-term growth path due to a certain shock will speedily adjust itself to its long-run equilibrium.

It is observed from Table 6 Column 2 that the lag value of inflation rate in period one D(INFR(-1)) has significant positive impact in explaining the current inflation rate in the short-run. This may be true for Nigeria because inflation rate has been recording an increasing trend over time. To this effect, existing situation associated with high rate of inflation in the last few years may be responsible for current period inflation rate in the country. The negative coefficient of exchange rate signifies appreciation of Naira against hard currency. This is inconsistent with theoretical underpinning. By implication, Naira appreciation constrains inflationary trend in the economy as it reduces exports and stimulate imports, thereby leading to excess of goods in the domestic economy. This eventually brings about a reduction in inflation rate in the short-run.

Table 6: Short-run and error correction representation of the selected ARDL model

Variable	Inflation rate	GDP growth rate	Unemployment rate
D(INFR(-1))	0.518(3.329)***		
D(GDPGR(-1))		0.227 (1.445)	
D(UNEMPR(-1))			0.407 (3.461)***
D(LEXR)	-15.225(-3.114)***	6.209(0.616)	2.496(5.154)***
D(LEXR(-1))		26.226(2.758)**	
D(EXR_dummy)	-23.397(-1.806)*	-2.595(-0.354)	-1.469(-1.109)
D(EXR_dummy(-1))	-	-21.842(-2.906)***	-13.836(-5.914)***
D(MPR)	0.070(0.104)	-0.547(-2.488)**	-0.057(-0.936)
D(MPR(-1))	-2.828(-3.848)***	-	0.121(1.945)*
D(MS2)	0.002(2.031)**	-0.001(-4.253)***	-0.001(-3.128)***
ECM(-1)	-0.854(-5.647)***	-1.252(-5.812)***	-0.593(-5.037)***
R-square	0.677	0.606	0.979
Dubin-Watson stat	1.639	2.096	1.904
F- statistic	7.079(0.000)	3.838(0.003)	117.998(0.000)
LM test	2.20(0.13)	0.99(0.39)	0.19(0.83)
Heteroskedasticity test: ARCH(5)	0.72(0.62)	1.44(0.24)	0.60(0.70)
Ramsey RESET test	2.30(0.07)	2.09(0.11)	0.38(0.71)

Source: Computed.
Note: *** implies significant at 1%, while ** implies significant at 5% and * significant at 10%. Also, only exchange rate was logged across the estimations.

Also, significant negative coefficient of shift dummy (exr_dummy) implies that unexpected appreciation of Naira could reduce inflation rate following the argument earlier discussed. The lag value of MPR in period one D(MPR(-1)) exerts significant negative impact on inflation rate and this conforms to the theoretical expectation. Following the transmission mechanism, it is clear that lower MPR increases money supply in circulation and therefore increase inflation rate. During such period, investment is expected to rise while economic downturn is overcome in the economy. The estimates further suggest that a 1% reduction in MPR in period one stimulates inflation rate by 2.83% in the short-run. Money supply in the current period has a significant positive impact on inflation and follows the a'priori expectation as it is expected to overcome the downturn in the economy. Although the magnitude is very small. The result supports a corresponding increase in inflation rate by 0.002% due to a unit increase in money supply in the short-run.

On the relationship between GDP growth rate and monetary policy instruments reveal in Column 3, it is observed that lag value of real GDP growth rate in period one D(RGDPG(-1) has positive but insignificant impact on current growth rate. Exchange rate depreciation indicated by its lag positive value in period one D(LEXR(-1)) conforms to the a'priori expectation. This implies that Naira depreciation in period one, ceteris paribus, encourages exports, boost investment, overcome the economic downturn and thus promote growth in the short-run. However, significant negative impact of shift dummy in period one D(EXR_dummy(-1)) connotes that unexpected appreciation of Naira could retard growth rate and could not overcome economic downturn in the short-run. Significant negative coefficient of MPR conforms to the theory and further suggests that a 1% reduction in MPR could significantly overcome the recession and stimulate growth by 0.55% in the short-run, ceteris paribus. The negative coefficient of MS2 does not follow the theoretical expectation. Evidence has shown that reduction in money supply (MS2) is associated with high MPR and in consequence raises interest rate and produce adverse effect on investment. When investment is impaired, lower growth will also be recorded in the economy.

The short-run analysis for unemployment model in Column 4 reveals that the lag value of unemployment in periods one D(UNEMPR(-1)) has significant positive impact in explaining the current unemployment rate in the country. This may also be true as the issue of unemployment has been a daunting challenge facing Nigeria. On annual basis, it tends to be increasing and has been recording double digit over a decade. Exchange rate has a positive relationship with unemployment and it is statistically significant. The result suggests that all things being equal, 1% depreciation of Naira will bring about 2.5% increase in unemployment rate. This is contrary to the theoretical expectation but obviously reflects the situation in Nigeria. For instance, since 1999 that exchange rate depreciated to ₦92.7 from ₦21.9/US$1 in 1997, unemployment rate during this period stood at double digit (10.2%) and surprisingly recorded 23.1% in 2018 while exchange rate also depreciated to ₦306/US$1. This scenario could be buttressed by the fact that over reliance on imported finished and semi-finished goods which jeopardize significantly job creation in the country and also high demand for foreign exchange to get these goods imported. Thus, it is clear from the above argument that

depreciation of Naira could not ensure overcoming economic downturn, rather worsening it, since Nigeria is an import oriented economy. However, the lag value of shift dummy in period one D(EXR_dummy(-1)) is negative and statistically significant but not conform with the theory. By implication, unexpected appreciation of Naira reduces unemployment rate and thus overcome the downturn in the short-run. Also in Column 4, the lag value of MPR in period one D(MPR(-1)) has significant positive relationship with unemployment and follows the a'priori expectation. The result further suggests that a 1% increase in MPR in the previous period is associated with economic downturn, thereby stimulates current unemployment rate by 0.12% and vice-versa. Finally, significant negative impact relationship between MS2 and unemployment rate also conforms to the theory. This further suggests that a unit reduction in money supply is an ingredient of recession and has tendency to stimulate unemployment rate in the country by a very marginal percent (i.e., 0.001%).

Conclusion and Policy Recommendations

This study analysed the relationship between monetary policy instruments and macroeconomic indicators in Nigeria relying on annual data spanning 1981 to 2018. Exploiting techniques from the time series literature, our results revealed that in the short run, lag value of inflation rate, exchange rate appreciation and unexpected appreciation (i.e., shift_dummy) could reduce inflation rate while lower MPR and high volume of money in circulation could stimulate inflation rate in Nigeria. Also, lag value of Unemployment Rate (UNEMPR), high MPR and exchange rate depreciation significantly stimulate unemployment rate while unexpected appreciation in exchange rate reduce unemployment rate. GDP growth rate could only be stimulated by exchange rate depreciation and low MPR while unexpected appreciation in exchange rate retards GDP growth in Nigeria. In the long run, inflation rate is constrained by exchange rate appreciation while depreciation promotes growth but stimulate unemployment rate in Nigeria. Also, MS2 stimulates inflation and unemployment rate but produce negative effect on GDP growth in Nigeria. More so, MPR stimulates inflation rate while reduce unemployment rate and GDP growth rate though these estimates do not conform the theoretical expectation. Generally, the results reveal that monetary policy instruments influence macroeconomic indicators both positively and negatively though depend on the existing situation in Nigeria.

The benefits of this study therefore reveal that the monetary authority should be conscious of instruments used with a view of improving economic performance. This would benefit Nigeria in the area of tackling unemployment situation, particularly among the youths, maintaining stable prices so as to promote welfare. All these are essential ingredients for ensuring growth in the economy. For any monetary intervention to make any meaningful impact on the economy, it must have a pass through effect on product market (i.e., agriculture and manufacturing sectors). How the market responds to monetary authority's instruments (exchange rate, MPR and money supply) will go a long way in achieving the macroeconomic benefits which this study has shown in the analysis.

The policy implications is that since long-run relationship exists between macroeconomic variables, especially inflation and economic growth which are greatly influenced by exchange rate volatility (i.e. devaluation or deprecation of local currency against foreign currency) and money supply, monetary authority should use its policy instruments to minimize pressures on the exchange rate, inflation and foreign reserves. This could be done by design policy measures that promote the value of Naira and check exchange rate fluctuation. From the findings, it is clear that lagged value of each macroeconomic variables (inflation, unemployment and GDP growth rate) is a major determinant of current period scenario. Given this, monetary authority with the aid of monetary policy instruments must be as supportive so as to ensure price stability, reduce unemployment rate and consequently brings about economic growth. Finally, on the importance of MPR towards stimulating macroeconomic performance, it is necessary that the monetary authority designs its monetary policy instruments to be aligned with the other aspects of the Federal Government's macroeconomic programme. Such alignment would deploy liquidity management tools to reduce inflationary pressure and stimulate economic growth.

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Author's Contributions

Bashir Adelowo Wahab: Handled the introduction, methodology, empirical results as well as conclusion and policy recommendations section.

Sam-Siso Ebasi Okrinya: Worked on stylized facts together with literature review section.

Ethics

This research paper has been conducted with utmost level of independence and originality. The authors are highly responsible for the entire information provided in the study.

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Appendix

Table A1: Conventional Unit Root Test Results: ADF, PP, DF-GLS and Ng-Perron tests

Method	Augmented Dickey Fuller (ADF)		Phillip-Perron (PP)		DF-GLS			
variables	Level	1st Difference	Level	1st Difference	Level	1st Difference		
GDPGR	-3.926228**	-6.035079***	-3.898334**	-25.00752***	-3.985767***	-8.614869***		
UNEMPR	-3.592220**	-6.972133***	-3.124048	-10.89323***	-3.701028**	-7.165743***		
INFR	-3.962409**	-6.151122***	-2.824720	-10.34002***	-3.953842***	-6.160250***		
MPR	-3.196615	-8.388052***	-3.119838	-8.512880***	-2.855844	-8.570295***		
EXR	-1.945782	-4.548282***	-1.129134	-4.380083***	-2.192045	-4.666180***		
MS2	-1.256134	-3.712966**	-1.295592	-3.712966**	-1.598444	-3.635355**		
Ng-Perron								
	MZa		MZt		MSB		MPT	
GDPGR	-15.6798*	-15.6618*	-2.76804*	-2.79634*	0.17654***	0.17854***	6.00004***	5.83036***
UNEMPR	-14.8829*	-17.3361**	-2.69591*	-2.93623**	0.18114***	0.16937***	6.30922***	5.30398***
INFR	-24.8151***	-41.4841***	-3.52242***	-4.55145***	0.14195	0.10972	3.67223	2.21178
MPR	-10.1667	-15.7153*	-2.25450	-2.80253*	0.22175***	0.17833***	8.96366***	5.80219***
EXR	-14.7637*	-17.1169*	-2.47307	-2.89013*	0.16751***	0.16885***	7.53477***	5.53470***
MS2	-8.71770	-13.9449	-1.92611	-2.62321*	0.22094***	0.18811***	10.9986***	6.63370***

Source: Computed. Note: the optimal lag selection for ADF is based on Akaike Information criterion with maximum lag at 1, while the spectral estimation of PP is based on Newey-West bandwidth selection. *** implies significant at 1%, while ** implies significant at 5% and * significant at 10%.

Table A2: Unit root tests with structural breaks

	Zivot-Andrews (ZA test, 1992) one-break		Perron 2006 with one break	
Variables/method	TB	t-stat	TB	t-stat
GDPGR	2002	-5.46404**	2001	-4.797397***
UNEMPR	2009	-4.22589	2012	-6.010684***
INFR	1996	-6.81872***	1994	-5.575975***
MPR	1994	-3.23338	2003	-4.157467***
EXR	1999	-3.38261	2014	-3.258666*
MS2	2004	-3.58179	2006	-0.215607

Source: Computed. Note: t indicates the t-statistic and TB denotes the structural break dates. The critical values for Perron (2006) are given at the 1%, 5% and 10% significance levels as -3.9759, -3.4185 and -3.1314. The critical values are given at the 1% and 5% significance levels as -5.57 and -5.08 for the Zivot-Andrews one-break unit root test.