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The Fine-Tuning Role of Monetary Policy in Achieving Single Digit Inflation in Nigeria

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Abstract :

This study empirically investigates the influence of monetary policy in achieving single digit inflation rate in Nigeria. This study employs the vector error correction model (VECM) using monthly data spanning from January 2002 to December 2016. The Johansen Co-integration test showed a stable long run relationship between monetary policies and inflation in Nigeria. The VECM estimates proved that monetary policies (MPR and MLR) have short run effect on inflation in Nigeria while other variables did not and the speed of adjustment was very slow meaning that inflation in Nigeria will react very slowly to monetary policy in Nigeria.

Key Words: Monetary Policy, Vector Error Correction Model (VECM), Johansen Co-integration test, Forecasts Error Variance Decomposition (FEVDs), VEC Granger Causality/Block Exogeneity Wald Tests Results

INTRODUCTION

1.1 Introduction

Nigeria as an emerging economy is faced with economic challenges just like other economies. One of the economic challenges faced by Nigeria is Inflation. Inflation which can be simply defined as the continuous increase in the general price level of goods and services is a concern not only to policy makers but also to both domestic and foreign investors. Inflation is an economic phenomenon which describes too much money chasing too few goods. The impact of inflation on aggregate demand is that it raises consumption expenditure, decreases the value of investment and increases government expenditure. It can also be said that inflation causes the purchasing power of money to fall. Friedman (1963) argued that "inflation is always and everywhere a monetary phenomenon in the sense that it is and can be produced only by a more rapid increase in the quantity of money than in output". Hence, it has to be properly managed by the monetary authorities via the use of monetary policy.

Over the years, inflation rate in Nigeria has been fluctuating between double digit and single digit. This has caused shocks in all the sectors of the economy. Masha (2000) indicated that the high inflation episodes in Nigeria since the 1970s were largely driven by the growth of money supply and

some factors reflecting the structural characteristics of the economy. These factors included climatic conditions, wage increases, the structure of production, currency devaluation and changes in terms of trade. Ezirim (2005) showed with the aid of econometrics that monetary factors cause inflation in emerging market like Nigeria. This is in agreement with the monetary theorists. According to Oyejide (2002), macroeconomic instability appears to be intrinsically and directly related to excessive inflation and therefore, the most important contribution that monetary policy can make to be sustenance of macroeconomic stability is to ensure price stability

It should be noted that for the effective use of monetary policy, there must be a smooth functioning financial system in general and a well- developed money market in particular. According to Andreas (2010), the dent for the effectiveness of monetary policy in Nigeria is deepened in its underdeveloped financial market. When money markets do not function well, financial stability and the transmission of monetary policy are at risk with potentially severe adverse consequences for the real economy. Although it has been argued that the use of monetary policy for removing persistent inflationary and deflationary gaps are more prone to exacerbating fluctuations in the economy but the Monetarist argues that as against fiscal policy, monetary policy possesses greater flexibility and it can be implemented rapidly.

There have been researches over time to see the effect of monetary policy on inflation in Nigeria. The aim has been to show if monetary policy is positive and significant in determining inflation in Nigeria. Calomiris and Domowitz (1989) found out from their study on money demand and the inflation process in Brazil, that changes in money do not predict changes in the price level whereas changes in the price level do predict changes in money. In many other developing countries, studies show that one of the dominant predictors of inflation is the growth of money (Owoye, 1997). Although these researches return puzzling results, it is evident from their analysis that there seems to be a consensus about the impacts of monetary policy shocks on output and prices in developing economies. Interestingly, for a developing economy like Nigeria, the potentials for using monetary policy innovations to engender real economic effects are less clear which in the past, central bankers and academia has tried to clarify, using single-equation, simultaneous-equations and (or) the narrative approach. The ambiguity may stem from the inherent imperfections in the goods, money and labour markets, and flexible nature of prices amongst others (Balolgun, 2007; Odusola, 2005; Uchendu, 1996; Adamgbe, 2004 and Nnanna, 2001).

The monetarist view, however, has not always been widespread according to Butt and Jamal (1988) and Chaudhary and Ahmad (1996) as their literature are replete with many other factors that could affect the level of inflation. Mordi et al (2007) grouped these factors into fiscal (financing of budget deficits), balance of payments or supply side factors (exchange rate movements) and institutional factors (the level of independence of the monetary authority). Others were structural factors, agro climatic conditions and inflation inertia. On this note, this study seeks to examine the impact of both monetary and real shocks on inflation in Nigeria. The purpose of the study is to examine the potential role of monetary policy in the achievement of single digit inflation in Nigeria using a vector error correction model (VECM). The study of the role of monetary policy in achieving single digit inflation rate in Nigeria is very important because low inflation rates facilitate economic growth. This study seeks to examine how some monetary policy instruments and economic variable influence inflation.

This study would statistically enrich and add to the existing body of knowledge in the area of monetary policy and its contributions to inflation and the economic growth of Nigeria.

1.2 RESEARCH OBJECTIVES

The general objective of this research is to examine the role monetary policy plays in achieving single digit inflation in Nigeria. The specific objectives of the research include:

1. To analyze the role or impact of monetary policy in achieving a single digit inflation rate in Nigeria.
2. To examine what extent monetary shock relative to real shock determines inflation in Nigeria.
3. To determine the mix of policy instruments to be adopted in achieving a single digit inflation rate in Nigeria.

2.THE REVIEW OF LITERATURE

The Monetarist theory of inflation posits that inflation has a monetary character because it results from the rise of the quantity of money although, a change in price may not show up at the same time as the rise in the quantity of money (Friedman 1963). An algebraic expression was used to proof that change in money supply (ΔM) is equal to change in price (ΔP). The Keynesian theory of inflation opposes the monetarist theory. According to Keynes, as money supply increases, speculative motive to demand for money increase thus, interest rate is reduced. The Keynesian theory of inflation takes a rise in prices as a cause of the increase in the supply of money instead of taking the increase in the supply of money as a cause of the rise in prices. The Structural theory of inflation posits that inflation especially in developing countries can result from a number of special problems and not just excessive money growth. The special problems include agricultural, government's budget, foreign exchange and physical infrastructural bottlenecks. According to the structuralists, these structural imbalances (special problems) in these developing country makes aggregate demand-supply model of inflation inapplicable to them. The Demand pull inflation emphasized that the increase in aggregate demand as the source of demand-pull inflation. This type of inflation occurs when money supply is growing faster than the economy's capacity to produce goods and services. Lastly the Cost push theory of inflation posits arises as a result of an increase in the price of input used in producing that commodity. According to this theory, the basic cause of inflation is the rise in money wages more rapidly than the productivity of labour.

One of the theories of monetary policy reviewed is the Taylor's Rule. Taylor's rule states that "keep the real short term constant as a neutral policy stance and make a surcharge (discount) when the output gap is positive (negative) and/or inflation is above (below) a target rate" (Taylor 1993). Taylor's rule simply links mechanically the level of the policy rate to deviations of inflation from its target and of output from its potential (the output gap). This implies that central bank aims at stabilizing inflation around its potential. Transmission mechanism of monetary policy and some empirical literatures of inflation and monetary policy were reviewed.

Adenekan and Nwanna (2004) investigated the dynamic interrelationships among prices, money and exchange rates, as well as the role of each variable in the determination of inflation in Nigeria. They adopted co-integration and error correction techniques and annual time series data for the period 1959 to 2002. The study supported the monetarist arguments as the fundamentals to the explanation of

inflation in the country, and that activities in the monetary sector ultimately transmit to the exchange rate regime through the inflationary consequences of monetary expansion. Inflation inertia, at 0.64, was the most important determinant of inflation in Nigeria. Mordi et al (2007) showed that monetary expansion resulting either from an increase in domestic credit or government fiscal operations, mainly determines inflation in Nigeria. They added that inflation was also being affected by exchange rate depreciation and increases in food output. They found inflation inertia to be prevalent and persistent. Muco Sanfey and Taci (2004) examined the effectiveness of monetary policy measures in controlling inflation during the transition period in Albania. They concluded that exchange rate was effective in keeping inflation low during the transition period. But the introduction of more monetary policy instruments resulted to more stable and predictable movements in money supply and price levels. Olubusoye and Oyaromade (2008) analyzed the main sources of fluctuations in inflation in Nigeria utilizing the error correction mechanism and annual data from 1970 to 2003. They indicated that lagged CPI, expected inflation, petroleum prices and real exchange rate significantly propagate the dynamics of inflationary process in the country. They added that efforts of the monetary authorities to achieve price stability would continuously be disrupted by volatility in the international price of crude oil.

Ratnasiri (2009) investigated the main determinants of inflation in Sri Lanka over the period 1980 to 2005 using vector autoregressive analysis. The results show that money supply growth and rice price increase are the main determinants of inflation in Sri Lanka in the long run. In contrast, it evident that exchange rate depreciation and output gap had no statistically significant effect on inflation. However, in the short run, rice price was the most important variable as it was a totally endogenous variable. Money supply growth and exchange rate were not so important variable as they were weakly exogenous in the adjustment process. Output gap did not have a statistically effect on inflation in both the long run and short run. Omotosho and Doguwa (2012) indicated that periods of high inflation volatility were associated with periods of specific government policy changes, shocks to food prices and lack of coordination between monetary and fiscal policies. They added that the announcement of fuel price hikes, announcement of an upward review in the wages of public sector workers, food crises and exchange rate instability also led to major positive inflationary shocks in the economy.
Raymond (2014) examined the impact of money supply, interest rate, cash reserve ratio, liquidity ratio and exchange rate on inflation in Nigeria. Data covering the period 1980 to 2010 were tested using OLS technique. The study revealed that liquidity ratio and interest rate were effective in combating inflation, while cash reserve ratio, money supply and exchange rate are not. Iya and Aminu (2014) investigated the determinants of inflation in Nigeria between 1980 and 2012 using the ordinary least square method. The result revealed that money supply and interest rate influenced inflation positively, while government expenditure and exchange rate influenced inflation negatively. They suggested that for a good performance of the economy in terms of price stability may be achieved by reducing money supply and interest rate and also increase government expenditure and exchange rate in the country. Gbadebo and Mohammed (2015) examined the effectiveness of monetary policy as a measure to control inflation in Nigeria. Time series data collected for the period 1980 to 2012 were tested using co-integration analysis and error correction model. The study identified interest rate, exchange rate, money supply and oil price as major causes of inflation in Nigeria. They also found that money supply showed significant positive impact on inflation in both the short and long run. Thus they concluded that monetary impulses caused inflation in Nigeria.

3.DATA AND ESTIMATION METHODOLOGY

3.1 Data

The data used for the study are monthly time series data spanning from 2002 January to 2016 December. Monthly time series provides us with high frequency data. EXCHR and FP will be logged as other variables are already in percentage form. This is done for easy comparison among variables in log form and variables in percentage form. The data was sourced from CBN statistical bulletin (statistics live data). This study adopts 6 variables. The data on each variable is monthly time series. They include, Inflation rate, Monetary Policy Rate, Treasury Bill Rate, Exchange Rate, Fuel Price and Maximum Lending Rate.

Table 1. Descriptions Variables

Variable Code	Variables Names	Descriptions
INFL	Inflation Rate	The inflation rate is measured using the traditional proxy which is the Consumer Price Index (CPI) with the base year at November 2009 =100. The symbol of inflation rate in this study is INFL. The specific objective of this study is to bring inflation rate to a single digit. Hence inflation rate is one of the major variable in this study.
MPR	Monetary Policy Rate	The monetary policy rate is measured using the monetary policy rate specified by the Monetary Policy Committee (MPC). The specific objective of this study is to examine the role of monetary policy in bringing inflation to a single digit. The MPR is the principal monetary policy instrument used to control the direction of interest rates and anchor inflation expectations in the economy (CBN, 2013). Hence, the MPR is also one of the major variables in this study.
TBR	Treasury Bill rate	The treasury bill rate is measured using the 91-day treasury bill rate. The treasury bills are issued by CBN and it is backed by the full faith of the federal government of Nigeria. TBR is issued to raise short term funds from the general public for the purpose of financing government deficit (Afrinvest, 2017). If there is inflationary pressure in the economy, CBN will increase the interest rate on treasury bill so as to attract investors, thus mopping excess liquidity in the economy. TBR serves as a control variable for this study.
EXCHR	Exchange Rate	The exchange rate is measured using the inter-bank average exchange rate of the Nigerian Currency (Naira per Dollar).

		Nigeria is a country which depends heavily on import. Depreciation of naira is used to discourage importation. But the depreciation of naira actually fans the flames of inflation as the price of imported commodities rises up. EXCHR serves as a control variable for this study.
FP	Fuel Price	The fuel price is measured using the generally accepted pump price in the country. Fuel price is a major real factor that influences inflation in Nigeria. If the price of fuel goes up, this will cause the price of transportation to go up and its only through transportation that goes can leave the producer and get to the consumers. Hence, this brings about an increase in the general price level and this tends to affect almost all commodities. Fuel price was used in this model because according to the structuralists, inflation in developing countries is not only caused by monetary factors but also structural or real factors. Hence, FP serves as a real factor and as a control variable for this study.
MLR	Maximum Lending Rate	The maximum lending rate is measured using the lending rate given to customers who come for loan. This is different from the prime lending rate. The prime lending rate is that lending rate that is given only to commercial bank's favoured customers while the maximum lending rate is the lending rate given to all other customers. Why we used the maximum lending rate is to incorporate other customers (who are not the favoured customers) who come to ask for loan. Meanwhile, the Maximum lending rate is always higher than the prime lending rate. To reduce inflationary pressures in the economy, the commercial banks have to increase the MLR so as to discourage borrowing (contractionary monetary policy) vice versa. MLR serves as a control variable for this study.

3.2. Estimation Methodology

This study implements tests for stationarity using the Augmented Dickey Fuller (ADF) and the Phillip Perron (PP). This is done so as to test for the absence or presence of unit root in the variables so as to avoid spurious regression which will make the results of the estimation have no economic meaning (Grange & Newbold 1974). Johansen Co-integration will be used to check for the long run or equilibrium relationships between variables. However, the aim of the study is to check for the short run effect of monetary policy on inflation hence the use of VECM. The VEC Granger Causality test is done to determine the joint statistical significance of the lagged values of a single variable in an equation where another variable is the endogenous variable. The Block Exogeneity examines the statistical significance of the lagged variables included in each equation of the system. The VECM

model is estimated in order to determine the speed of adjustment of the vectors of variable in case of a temporary disequilibrium. The analysis of the Forecast Error Variance Decomposition measures the proportion of its total variability due to shocks in the variable itself relative to shocks in other variables in the VEC model, at various forecasting horizons.

This study adopts a 6-variable VECM model in which INFL, MPR, TBR, EXCHR, FP and MLR are simultaneously interrelated. The Vector Error Correction Mechanism (VECM) provides us with the short run dynamics between variables in the model. We are most concerned about the short run effect or immediate impact of monetary policy on inflation because according to Keynes (1923), in the long run we all dead. Our empirical model is

$\Delta V_t = \beta_{it} + \sum_{i=1}^{k} A_{ij}\, \Delta V_{t-j} + \phi_{ij} ECM_{t-j} + \mu_{it}$ ..... (1)

Where;

V_t = vector of variables (INFL, MPR, TBR, EXCHR, FP, MLR)

β = intercepts of autonomous variables

A_i = matrix of coefficients of all the variables in the model

V_{t-j} = vector of the lagged variables

Δ = first difference operator

ϕ_{ij} = adjustment coefficient

ECM_{t-j}= error correction mechanism

μ_t = stochastic error term

This model is estimated to examine the dynamic interrelationship and the speed of adjustment between inflation rate and other variables in the model.

Our equations of the model include;

$\Delta INFL_t = \beta_1 + \sum_i^k \alpha_1\, \Delta INFL_{t-j} + \sum_i^k \delta_1 \Delta MPR_t + \sum_i^k \psi_1 \Delta TBR_t + \sum_i^k \gamma_1 \Delta EXCHR_t + \sum_i^k \lambda_1 \Delta FP_t + \sum_i^k \Omega_1 \Delta MLR_t + \phi_1 ECM_t + \mu_1$ ..... (2)

$\Delta MPR_t = \beta_2 + \sum_i^k \delta_1 \Delta MPR_{t-j} + \sum_i^k \alpha_1\, \Delta INFL_t + \sum_i^k \psi_1 \Delta TBR_t + \sum_i^k \gamma_1 \Delta EXCHR_t + \sum_i^k \lambda_1 \Delta FP_t + \sum_i^k \Omega_1 \Delta MLR_t + \phi_1 ECM_t + \mu_1$ ..... (3)

$\Delta TBR_t = \beta_1 + \sum_i^k \psi_1 \Delta TBR_{t-j} + \sum_i^k \alpha_1\, \Delta INFL_t + \sum_i^k \delta_1 \Delta MPR_t + \sum_i^k \gamma_1 \Delta EXCHR_t + \sum_i^k \lambda_1 \Delta FP_t + \sum_i^k \Omega_1 \Delta MLR_t + \phi_1 ECM_t + \mu_1$ ..... (4)

$\Delta EXCHR_t = \beta_1 + \sum_i^k \gamma_1 \Delta EXCHR_{t-j} + \sum_i^k \alpha_1\, \Delta INFL_t + \sum_i^k \delta_1 \Delta MPR_t + \sum_i^k \psi_1 \Delta TBR_t + \sum_i^k \lambda_1 \Delta FP_t + \sum_i^k \Omega_1 \Delta MLR_t + \phi_1 ECM_t + \mu_1$ ..... (5)

$\Delta FP_t = \beta_1 + \sum_i^k \lambda_1 \Delta FP_{t-j} + \sum_i^k \alpha_1\, \Delta INFL_t + \sum_i^k \delta_1 \Delta MPR_t + \sum_i^k \psi_1 \Delta TBR_t + \sum_i^k \gamma_1 \Delta EXCHR_t + \sum_i^k \Omega_1 \Delta MLR_t + \phi_1 ECM_t + \mu_1$ ..... (6)

$\Delta MLR_t = \beta_1 + \sum_i^k \Omega_1 \Delta MLR_{t-j} + \sum_i^k \alpha_1\, \Delta INFL_t + \sum_i^k \delta_1 \Delta MPR_t + \sum_i^k \psi_1 \Delta TBR_t + \sum_i^k \gamma_1 \Delta EXCHR_t + \sum_i^k \lambda_1 \Delta FP_t + \phi_1 ECM_t + \mu_1$ ..... (7)

4.4.1.APRIORI EXPECTATION

$\alpha, \delta, \Psi, \Omega < 0$; $\gamma, \lambda > 0$

The coefficients of INFL, MPR, TBR and MLR are theoretically expected to be negatively signed while the coefficients of EXCHR and FP are theoretically expected to be positively signed based on the study.

4.PRESENTATION AND ANALYSIS OF EMPIRICAL RESULTS

This section presents the summary statistics and regression result of our estimated model, the analysis and interpretation of our regression result. It also presents the policy implication of the findings.

4.1 Summary of Descriptive Statistics

Table 2: Summary of Descriptive Statistics

	INFL	MPR	TBR	LNEXCHR	LNFP	MLR
Mean	11.74583	11.97917	10.13539	5.003751	4.038868	22.96200
Median	11.14500	12.00000	9.950000	5.007016	4.174387	22.80500
Maximum	28.21000	20.50000	24.50000	5.735701	4.976734	32.27000
Minimum	3.000000	6.000000	1.040000	4.735848	3.258097	17.17000
Std. Dev.	4.523240	3.407381	4.555577	0.198071	0.473014	3.498807
Skewness	0.975792	0.181482	0.340611	1.611630	0.126989	0.433153
Kurtosis	4.307112	3.072105	3.151843	6.515554	1.921975	2.652401
Jarque-Bera	41.37915	1.027069	3.653387	170.6139	9.199822	6.534845
Probability	0.000000	0.598377	0.160945	0.000000	0.010053	0.038105
Sum	2114.250	2156.250	1824.370	900.6752	726.9963	4133.160
Sum Sq. Dev.	3662.286	2078.234	3714.838	7.022560	40.04983	2191.256
Observations	180	180	180	180	180	180

Table 2 presents the summary of descriptive statistics for the variables. It shows that the averagevalue of Inflation rate is approximately 11.75 with a standard of 4.52 ranging from 3 to 28.21. Monetary Policy Rate has an average value of 11.98 with a standard deviation of 3.41 ranging from 6 to 20.5. Treasury Bill Rate has an average value of 10.14 with a standard deviation of 4.56 ranging from 1 to 24.5. The log of exchange rate has an average value of 5. 003 with a standard deviation of 0.2 ranging from 4.74 to 5.74. The log of fuel price has an average value of 4. 04 with a standard deviation of 0.4 ranging from 3.26 to 4.98. Maximum Lending Rate has an average value of 22.96 with a standard deviation of 3.5 ranging from 17.17 to 32.27.

If the probability value is less than the Jarque Bera chi-square, then the null hypothesis of the regression is not rejected. From the above table, it is apparent that the hypothesis that all the variables are normally distributed cannot be rejected since all the probabilities are less than the Jarque Bera chi-square distribution. The skewness coefficient indicates normal curves for all the variables with the values ranging from -3 to +3. Deducing from the table above, all the variables indicate a normal curve as their values ranges from -3 to +3.

4.2 Unit Root Test

Usually in economic analysis of macroeconomic phenomena, researchers are often faced with the problem of deriving stationarity in the time series variables incorporated in the study of interest given the poor data collation technique in Nigeria. Thus, this prompts the relevance of conducting the unit root test to realize the stochastic process in the time series analysis (Iyoha 2004). Table 3 presents the unit root results obtained adopting the Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) tests. According to Asteriou and Hall (2007), the PP statistics are just modifications of the ADF t-statistics which doesn't take into account the less restrictive nature of the error process. Hence it is essential to use the combination of both tests.

Table 3a: Results of Unit Root Tests

Variables	ADF Test Statistics	95% Critical Value of ADF	Order of Integration	Status	PP Test Statistics	95% Critical Value of ADF	Order of Integration	Status
INFL	-11.695	-2.8776	I(1)	Stationary	-11.637	-2.8776	I(1)	Stationary
MPR	-13.031	-2.8776	I(1)	Stationary	-13.049	-2.8776	I(1)	Stationary
TBR	-10.984	-2.8776	I(1)	Stationary	-10.984	-2.8776	I(1)	Stationary
LNEXCH	-9.005	-2.8777	I(1)	Stationary	-7.257	-2.8776	I(1)	Stationary
LNFP	-14.126	-2.8776	I(1)	Stationary	-14.143	-2.8776	I(1)	Stationary
MLR	-14.269	-2.8776	I(1)	Stationary	-14.261	-2.8776	I(1)	Stationary

Source: Author

Table 3a presents the results of the unit root test for the variables using both the ADF test and PP test. Given the above result, the ADF test proves that only INFL and TBR were stationary at levels while MPR, LNEXCHR, LNFP and MLR were non-stationary at levels but the PP test proves otherwise such that only INFL was stationary at levels while MPR, TBR, LNEXCHR, LNFP and MLR were non-stationary at levels. The decision of stationary was based on the fact that the ADF and PP test statistics were greater than their respective 95% critical value while for non-stationarity they were less than their respective 95% critical value.

Table 3b shows that the ADF and PP test statistic are greater than their respective 95% critical value at first differencing. This means that after the first differencing, ADF and PP test proved all variables to be stationary. Based on this result, the null hypothesis which says that the time series variables are not stationary at 1^{st} difference is rejected, meaning that the series are stationary at their first differences i.e they are integrated of the order one I(1).we are justified to conduct the co-integration and vector error correction model based on the VAR technique for the variables.

4.3 Johansen Co-Integration

The Johansen co-integration is said to determine the number of co-integrated vectors for any given number of non-stationary variables of the same order. This test may be regarded as a long run equilibrium relationship among variables. After conducting the ADF and PP tests, we have to examine whether or not there exists a long run relationship among the variables.

Table 4a: Co-integration Results (Trace and Max. Eigen tests)

Hypothesized (Null) number of co-integrating equations (r)	Eigen values	Trace Statistics	0.05 Critical values	Probability values	Max. Eigen Statistics	0.05 Critical values	Probability values
r = 0*	0.227756	100.2491	95.75366	0.0236	45.74652	40.07757	0.0104
r ≤ 1	0.138576	54.50255	69.81889	0.4400	26.40288	33.87687	0.2967
r ≤ 2	0.087026	28.09966	47.85613	0.8094	16.11540	27.58434	0.6560
r ≤ 3	0.040646	11.98427	29.79707	0.9324	7.344648	21.13162	0.9391
r ≤ 4	0.022045	4.639618	15.49471	0.8458	3.945640	14.26460	0.8650
r ≤ 5	0.003913	0.693979	3.841466	0.4048	0.693979	3.841466	0.4048

*= rejection of the null hypothesis of number of co-integrating equations. Hence, we have one co-integrating equations at 0.05 level

The trace statistics indicated the presence of one co-integrating equation. This means that we can reject the null hypothesis of no co-integrating relationship among the variable at 5% significance level. The Maximum Eigen statistics also indicated the presence of one co-integrating relationship among the variables at 5% significance level. Hence, the proof of the co-integrating equations shows that there is a long run relationship between the variables and they are likely to converge at equilibrium in the long run.

4.4.The VEC Granger Causality/Block Exogeneity Wald Tests

The granger causality test was conducted using the VEC Granger causality/block exogeneity wald tests. It analyzes each of the equation in the VEC model as well as the joint significance of each of the other lagged endogenous variables in that equation.

Table 5: VEC Granger Causality/Block Exogeneity Wald Tests Results

Dependent variable: D(INFL)			
Excluded	Chi-sq	df	Prob.
D(MPR)	1.678042	2	0.4321
D(TBR)	3.680074	2	0.1588
D(LNEXCHR)	3.489839	2	0.1747

D(LNFP)	0.667057	2	0.7164
D(MLR)	3.077011	2	0.2147
All	11.83174	10	0.2965
Dependent variable: D(MPR)			
Excluded	Chi-sq	df	Prob.
D(INFL)	3.303718	2	0.1917
D(MLR)	1.679000	2	0.4319
D(LNFP)	4.473811	2	0.1068
D(LNEXCHR)	5.172020	2	0.0753
D(TBR)	1.095540	2	0.5782
All	13.57623	10	0.1932
Dependent variable: D(TBR)			
Excluded	Chi-sq	df	Prob.
D(INFL)	3.598815	2	0.1654
D(MPR)	1.863281	2	0.3939
D(MLR)	0.506937	2	0.7761
D(LNFP)	0.285606	2	0.8669
D(LNEXCHR)	8.101642	2	0.0174
All	15.13089	10	0.1274
Dependent variable: D(LNEXCHR)			
Excluded	Chi-sq	df	Prob.
D(INFL)	4.330557	2	0.1147
D(MPR)	4.644933	2	0.0980
D(MLR)	3.682289	2	0.1586
D(LNFP)	25.15113	2	0.0000
D(TBR)	1.574366	2	0.4551
All	41.28755	10	0.0000

Dependent variable: D(LNFP)			
Excluded	Chi-sq	Df	Prob.
D(INFL)	1.720660	2	0.4230
D(MPR)	4.182348	2	0.1235
D(MLR)	0.355193	2	0.8373
D(LNEXCHR)	1.865831	2	0.3934
D(TBR)	4.657762	2	0.0974
All	10.80550	10	0.3729
Dependent variable: D(MLR)			
Excluded	Chi-sq	Df	Prob.
D(INFL)	1.270196	2	0.5299
D(MPR)	0.957427	2	0.6196
D(TBR)	3.818550	2	0.1482
D(LNEXCHR)	3.476866	2	0.1758
D(LNFP)	0.884560	2	0.6426
All	10.52157	10	0.3960

Source: Author

From table 5 above, the VEC granger causality test show that in the TBR equation, there is a unidirectional causality between and LNEXCHR at 5% significance. Also, in the LNEXCHR equation, there is a one-way causation from LNFP to LNEXCHR at 5% significance as well as a joint significance for all the overall system also at 5% significance. The block exogeneity test shows that only one variable is not exogenous because the p value of the joint test for the variable which is LNEXCHR is less than 0.05. Only in this case can we reject the null hypothesis of excluding the lags of all the variables in the LNEXCHR equation. Also, we reject the null hypothesis of excluding the lags of all the variables in LNEXCHR in the TBR equation and LNFP in the LNEXCHR equation.

4.5 Vector Error Correction Methodology (VECM)

The VECM was estimated so as to analyze the systematic disequilibrium adjustment process and the short run effect among the variables. From table 5 below, we will access the impacts of each variable on the other variables in absolute terms. The impact of inflation on MPR is -1.70686 and on TBR is -1.58536 which passes the level of 10% significance level in lag 1. Also, the impact of inflation on LNEXCHR is 2.07226 at 5% significance level in lag 1. Inflation impact on itself passes the 1% significance level at 1.57284 in lag 1.

The impact of Monetary Policy Rate on LNEXCHR is -1.86916 which is significant at 10% level in lag 2while its impact on LNFP is -1.73002 which is also significant at 10% level in lag 1. The impact of Treasury Bill Rate on INFL is -1.90606 which is significant at 10% level in lag 1. The impact of TBR on LNFP is 2.00549 and on itself is 2.00889 both passing the 10% level of significance in lag 1 and 2 respectively.

The impact of the log of Exchange Rate on INFL is 1.81364 and on MLR is 1.55906 which are both significant at 10% level in lag 1. Its impact on MPR is 2.26913 which is significant at 5% level in lag 1. Its impact on TBR is 2.40964 and -2.46314 in lag 1and 2 passing the 5% significance level. The impact of LNEXCHR on itself is 8.21405 and -4.32541 which are significant at 1% level in lag 1 and 2 respectively.

The impact of the log of Fuel Price is -1.8801 which is significant at 1% level in lag 1. Its impact on LNEXCHR is 3.60376 and 3.62080 at 1% significance level in lag 1 and 2. The impact of Maximum Lending Rate on INFL is -1.74684 and on itself is 1.51446 which are both significant at 10% in lag 1. Its impact on LNEXCHR is 1.52062 which is significant at 10% level in lag 2.

Table 6: Vector Error Correction Methodology (VECM) Estimates

Explainatory Variables	D(INFL)	D(MPR)	D(TBR)	D(LNEXCHR)	D(LNFP)	D(MLR)
ECM	-0.010767	-0.004311	0.004810	0.000126	0.000309	-0.006076
	[-2.03836]	[-2.70846]	[1.43255]	[2.14055]	[1.57348]	[-3.51327]
D(INFL(-1))	0.123738	-0.040466	-0.079275	0.001816	0.000798	0.007735
	[1.57284]	[-1.70686]	[-1.58536]	[2.07226]	[0.27278]	[0.30029]
D(INFL(-2))	-0.073413	0.018700	-0.044223	-0.000343	0.003666	0.027141
	[-0.93171]	[0.78753]	[-0.88302]	[-0.39074]	[1.25052]	[1.05201]
D(MPR(-1))	-0.067782	-0.026921	0.204202	-0.002873	-0.016939	0.074375
	[-0.25755]	[-0.33944]	[1.22070]	[-0.98005]	[-1.73002]	[0.86307]
D(MPR(-2))	0.335178	0.030994	0.113691	0.005559	0.009978	0.043951
	[1.25539]	[0.38522]	[0.66995]	[1.86916]	[1.00452]	[0.50275]
D(TBR(-1))	-0.249132	0.005753	0.118732	-0.000499	0.009752	-0.061646
	[-1.90606]	[0.14605]	[1.42917]	[-0.34278]	[2.00549]	[-1.44043]
D(TBR(-2))	-0.029392	-0.040913	0.167354	0.001760	0.003926	-0.056910
	[-0.22425]	[-1.03586]	[2.00889]	[1.20566]	[0.80517]	[-1.32611]
D(LNEXCH(-	11.58939	4.369563	9.786992	0.584629	0.048748	3.262056

1))						
	[1.81364]	[2.26913]	[2.40964]	[8.21405]	[0.20505]	[1.55906]
D(LNEXCH(-2))	-7.843670	-1.757102	-9.893884	-0.304461	-0.303412	0.369893
	[-1.24116]	[-0.92265]	[-2.46314]	[-4.32541]	[-1.29050]	[0.17876]
D(LNFP(-1))	-1.727286	0.574843	0.572510	0.085285	-0.068644	0.583858
	[-0.81295]	[0.89779]	[0.42393]	[3.60376]	[-0.86840]	[0.83924]
D(LNFP(-2))	-0.235219	-1.221510	0.467486	0.086953	-0.053494	-0.277215
	[-0.10910]	[-1.88001]	[0.34113]	[3.62080]	[-0.66689]	[-0.39267]
D(MLR(-1))	-0.404016	0.088629	0.055664	0.003360	0.004592	-0.114688
	[-1.74686]	[1.27165]	[0.37866]	[1.30434]	[0.53372]	[-1.51446]
D(MLR(-2))	-0.075005	-0.009353	0.095074	0.003990	-0.001888	0.021500
	[-0.31841]	[-0.13176]	[0.63499]	[1.52062]	[-0.21539]	[0.27875]
C	-0.005646	-0.044663	-0.041339	0.002499	0.012722	-0.037482
	[-0.03617]	[-0.94960]	[-0.41671]	[1.43760]	[2.19099]	[-0.73344]
			Summary Statistics			
R-squared	0.833076	0.970492	0.926933	0.986702	0.977734	0.968284
Adj. R-squared	0.820936	0.968345	0.921619	0.985735	0.976114	0.965978
Sum sq. resids	596.9265	56.99249	251.2047	0.091538	0.864314	65.19660
S.E. equation	1.902035	0.587715	1.233877	0.023554	0.072376	0.628594
F-statistic	68.62293	452.2178	174.4336	1020.232	603.7717	419.7904
Log likelihood	-360.2620	-151.2122	-283.2302	421.4066	221.5856	-163.1816
Akaike AIC	4.193955	1.845080	3.328429	-4.588838	-2.343658	1.979568
Schwarz SC	4.426332	2.077458	3.560807	-4.356461	-2.111281	2.211946
Mean dependent	11.67253	11.88343	10.00416	5.006696	4.047641	22.87000

S.D. dependent	4.494845	3.303306	4.407241	0.197206	0.468300	3.407919

Source: Constructed by authors. Values in [] are t-values.

The R^2 of 0.83, 0.97, 0.92, 0.98, 0.97 and 0.96 in the two lags of the vectors of the variables accounts for at least 83% and at most 98% of the systematic variation in inflation with respect to monetary and real factors. The F- statistics which are 68.6, 452.2, 174.43, 1020.23, 603.77 and 419.7 remain significant at 1% level.

The main aim of VECM is to analyze the adjustment of the inflation to changes in the variables shown by the coefficient of ECM_{t-j}. In absolute terms, MPR and MLR have adjustment coefficients of 0.004311 and 0.006076 respectively. Theoretically, they were rightly signed and significant at both 1% and 5% levels and they were between 0 and 1. This indicates that inflation adjusts to changes in monetary policy rate and maximum lending rate by about 0.43% and 0.60% respectively in a given period. The size of the absolute value of the ECM clearly shows that the speed of adjustment to equilibrium in any case of temporary disequilibrium is very slow. TBR, LNEXCHR and LNFP have adjustment coefficients of 0.004810, 0.000126 and 0.000309 respectively. Theoretically, they were not rightly signed as they are supposed to be negative although they are lie between 0 and 1. However, this indicates inflation adjusts to changes in TBR, LNEXCHR and LNFP by 0.48%, 0.01% and 0.03% and this is considered very slow.

4.6 Results of Forecasts Error Variance Decomposition (FEVDs)

To further examine the short run dynamic properties of INFL, MPR, TBR, log of EXCHR, log of FP and MLR in Nigeria, we examined the forecast error variance decomposition. FEVDs enables us to measure the proportion of its total variability due to shocks in the variable itself relative to shocks in all other variables in the VEC model at various forecasting horizons.

Table 7: Forecast Error Variance Decomposition Estimates

INFL							
Horizons	**S.E.**	**INFL**	**MPR**	**TBR**	**LNEXCHR**	**LNFP**	**MLR**
1	1.954650	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	2.968107	97.64618	0.306235	0.340492	0.497944	0.136562	1.072589
3	3.679617	96.90198	0.226236	0.426161	0.502359	0.129566	1.813696
4	4.219934	96.77580	0.179307	0.329637	0.410080	0.103990	2.201189
5	4.674846	96.58631	0.152019	0.301559	0.347602	0.084771	2.527742
6	5.080411	96.28971	0.130310	0.389668	0.307388	0.071960	2.810960
7	5.445664	95.90695	0.113803	0.592605	0.282755	0.063615	3.040277
8	5.781640	95.45327	0.101012	0.900815	0.265308	0.061349	3.218249
9	6.095766	94.94204	0.092055	1.292350	0.250928	0.065003	3.357622

10	6.392081	94.39155	0.086838	1.739664	0.238505	0.072183	3.471264
MPR							
Horizons	**S.E.**	**INFL**	**MPR**	**TBR**	**LNEXCHR**	**LNFP**	**MLR**
1	0.589033	0.305072	95.54301	0.000000	3.262667	0.139355	0.749892
2	0.845711	1.931149	89.26178	0.390357	7.317169	0.724681	0.374861
3	1.040834	1.962202	87.12909	0.542192	9.601210	0.505914	0.259392
4	1.212321	1.847104	86.14047	1.049177	10.10858	0.654090	0.200586
5	1.367372	1.983034	84.92427	1.856480	10.25825	0.802994	0.174967
6	1.515559	2.177386	83.63045	2.960453	10.16847	0.898190	0.165051
7	1.659093	2.427459	82.16912	4.243919	9.995634	1.003590	0.160280
8	1.799099	2.709317	80.62624	5.614547	9.788491	1.105036	0.156365
9	1.936256	2.989548	79.09591	7.000084	9.556997	1.205514	0.151945
10	2.070507	3.259637	77.62753	8.345943	9.319008	1.300673	0.147209
TBR							
Horizons	S.E.	INFL	MPR	TBR	LNEXCHR	LNFP	MLR
1	1.242388	0.875522	11.21419	86.88906	0.324638	0.461826	0.234765
2	1.908433	2.368954	14.39629	79.31833	2.840480	0.644764	0.431178
3	2.547048	3.349243	16.52052	74.91568	2.746122	1.274722	1.193715
4	3.082721	3.879274	18.29267	72.03293	2.358678	1.654134	1.782308
5	3.528755	4.203274	19.61780	70.32402	2.059464	1.635274	2.160165
6	3.899788	4.415612	20.65435	69.13559	1.884191	1.519259	2.390999
7	4.217176	4.567425	21.42280	68.24437	1.791011	1.412318	2.562080
8	4.496526	4.661357	22.02294	67.53539	1.745379	1.329975	2.704955
9	4.748673	4.709132	22.52205	66.94460	1.724296	1.268637	2.831285
10	4.980340	4.728060	22.95808	66.43338	1.715475	1.220768	2.944236
LNEXCHR							

Horizons	S.E.	INFL	MPR	TBR	LNEXCHR	LNFP	MLR
1	0.021771	0.021992	0.000000	0.000000	99.97801	0.000000	0.000000
2	0.041168	1.917509	0.152829	0.219056	95.44178	1.835257	0.433570
3	0.057043	4.129516	0.093311	0.273486	86.80399	7.230435	1.469264
4	0.069369	5.543535	0.249141	0.302462	80.57388	11.02372	2.307263
5	0.078907	6.597437	0.504803	0.414834	77.27879	12.41653	2.787607
6	0.086876	7.363106	0.688012	0.662276	75.56381	12.69815	3.024652
7	0.094064	7.924539	0.762285	1.032616	74.56587	12.57681	3.137875
8	0.100849	8.388760	0.772738	1.461424	73.81493	12.36614	3.196005
9	0.107356	8.802378	0.756985	1.894219	73.14556	12.17038	3.230478
10	0.113601	9.178060	0.734543	2.304985	72.52439	12.00394	3.254083
LNFP							
Horizons	S.E.	INFL	MPR	TBR	LNEXCHR	LNFP	MLR
1	0.072720	3.929135	0.000000	0.000000	0.873140	95.19773	0.000000
2	0.099975	4.353992	0.257789	0.637424	0.830002	93.61809	0.302703
3	0.120686	6.274985	0.323295	0.898405	1.231547	90.97723	0.294534
4	0.138121	6.785498	0.414327	0.884922	1.626170	89.97612	0.312967
5	0.151982	7.084517	0.464528	0.774135	1.973390	89.38134	0.322094
6	0.164301	7.448949	0.479584	0.663285	2.243485	88.83653	0.328166
7	0.175575	7.826867	0.462470	0.592813	2.415457	88.37169	0.330698
8	0.186167	8.225599	0.437388	0.569136	2.528485	87.90712	0.332268
9	0.196285	8.618848	0.411297	0.584185	2.608668	87.44294	0.334064
10	0.205959	8.994242	0.386684	0.629200	2.670670	86.98339	0.335812
MLR							
Horizons	S.E.	INFL	MPR	TBR	LNEXCHR	LNFP	MLR
1	0.640014	0.041537	0.000000	0.000000	1.446062	0.267450	98.24495

2	0.844035	0.025726	0.003508	0.005587	3.563060	0.215582	96.18654
3	1.025209	0.370523	0.030432	0.009371	5.732464	0.174407	93.68280
4	1.174114	0.624583	0.039824	0.177386	7.008169	0.382282	91.76776
5	1.307803	0.660737	0.033660	0.803793	7.712460	0.713307	90.07604
6	1.433383	0.592271	0.031918	2.079357	8.019334	1.058600	88.21852
7	1.555068	0.505286	0.045486	3.853966	8.126421	1.372032	86.09681
8	1.675164	0.441695	0.073785	5.954858	8.116086	1.652456	83.76112
9	1.794476	0.413500	0.113531	8.204651	8.033988	1.907503	81.32683
10	1.913052	0.417954	0.161065	10.47445	7.907736	2.138447	78.90035

Source: Author

Table 5 above shows the variance decomposition for 10 periods. An examination of the forecast error variance decomposition of INFL shows that the lion's share of the variation experienced by INFL is attributed to its own shock. The contribution of its own shock is 100% in the first period but falls slightly to approximately 94.39% at the end of the 10-period horizon. Also at the tenth period, the variabilities in the shocks of MPR, TBR, LNEXCHR, LNFP and MLR are quite marginal at 0.09%, 1.74%, 0.24%, 0.07% and 3.47%. MLR accounted for the highest shocks in INFL. More generally, the shock of MPR in INFL ranges from 0% to 0.30%, TBR ranges from 0% to 1.74%, LNEXCR ranges from 0% to 0.50%, LNFP ranges from 0% to 0.13% while MLR ranges from 0% to 3.47%. Hence the maximum lending rate is considered to have predominately accounted for the large share of shock in inflation followed by TBR, LNEXCHR, MPR and FP. This indicates that monetary shocks have higher contribution in inflation than real shocks.

The shocks to MPR explained about 95.54% of its own shocks in the first period and later fell to approximately 77.63% at the end of the forecast horizon. INFL accounts for shocks in MPR ranging from 0.3% to 3.25%, TBR ranges from 0% to 8.34%, LNEXCR ranges from 3.26% to 10.25%, LNFP ranges from 0.13% to 1.30% while MLR ranges from 0.14% to 0.74%. The log of exchange rate has the highest shock on MPR although it is quite marginal.

The shocks of TBR show that the variation in its own shock accounts for the ranges between 66.4% to 86.88% with slight decreasing trend over the forecasting period. The variations in the shocks of INFL ranges between 0.87% to 4.72%, while that of MPR ranges between 11.21% to 22.95%, LNEXCHR ranges between 0.32 to 2.84%, LNFP ranges between0.46% to 1.64% while MLR ranges between 0.23% to 2.94%. The predominant source of variation in TBR is in its own shocks and reasonably by the variance of shocks of MPR.

The shocks in LNEXCHR is explained by 99.97% in its own shock declining to 77.52 in the 10th period. The variations in the shocks of INFL ranges between 0.02% to 9.17%, while that of MPR

ranges between 0% to 0.77%, TBR ranges between 0% to 2.30%, LNFP ranges between 0% to 12% while MLR ranges between 0% to 3.25%. The predominant source of variation in LNEXCHR is in its own shocks and marginally by the variance of shocks of INFL.

The shocks in LNFP is explained by 95% in its own shock declining to 87.44 in the 10th period. The variations in the shocks of INFL ranges between 3.92% to 8.99%, while that of MPR ranges between 0% to 0.47%, TBR ranges between 0% to 0.89%, LNEXCHR ranges between 0.83% to 2.67% while MLR ranges between 0% to 0.33%. The predominant source of variation in LNFP is in its own shocks and marginally by the variance of shocks of INFL.

The shocks in MLR is explained by 98.24% in its own shock declining to 78.90 in the 10th period. The variations in the shocks of INFL ranges between 0.02% to 0.66%, while that of MPR ranges between 0% to 0.16%, TBR ranges between 0% to 10.47%, LNEXCHR ranges between 1.44% to 8.12% while LNFP ranges between 0.17% to 2.13%. The predominant source of variation in MLR is in its own shocks and marginally by the variance of shocks of TBR.

4.7 Policy Implication

From the result above, we can say that MPR which is the major variable in the study has a short run effect on inflation with a very slow speed of adjustment of 0.43%. Also MLR has a short run effect on inflation. But TBR, EXCHR and FP does not have short run effect on inflation. Although the speed of adjustment of the monetary variables is very slow and unimpressive, we can say that at an advent of a rise in inflation rate, some monetary factors such as MPR and MLR have short run effect or immediate impact on inflation and they should be used first before considering other instruments. Hence, we can reject the null hypothesis in this study which states that there are no monetary policy instruments that are significant in reducing inflation rate possibly to a single digit in Nigeria.

Another policy implication which follows from the FEVDs is that monetary shocks contribute more than real shocks to inflation. This answers research question 2 of this study. Hence, monetary authorities especially CBN has a largely role to play in bringing inflation down to a single digit.

5.SUMMARY, RECOMMENDATION AND CONCLUSION

5.1 Summary

This study examines the role of monetary policy in reducing inflation to a single digit in Nigeria. MPR was seen to be the major instrument used by CBN to reduce inflation in the economy. Inflation rate, monetary policy rate, Treasury bill rate, exchange rate, fuel price and maximum lending rate were variables used in the study. Fuel price was incorporated in the variable so as to capture part of the real factors that influence inflation in Nigeria. The study employs the vector error correction model using monthly data spanning from January 2002 to December 2016. The results of the Unit root tests showed that MPR, TBR, EXCHR FP and MLR are difference stationary expect for INFL which was stationary at levels and at first differencing. The Johansen Co-integration test showed a stable long run relationship between the variables. The VECM estimates proved that MPR and MLR has short run effect on inflation in Nigeria while other variables did not and the speed of adjustment was very slow meaning that inflation in Nigeria will react very slowly to monetary policy in Nigeria. Conclusively, we can say from the FEVDs, that the primary sources of variation in INFL are due largely to its own shocks and innovations in MLR followed by other monetary factors and lastly the

real factor which is fuel price. The primary sources of variation in MPR are due mainly to its own shocks and innovations in LNEXCH while the primary sources of variation in TBR are due largely to its own shocks and MPR. The primary sources of variation in LNEXCHR are due mainly to its own shocks and innovations in INFL while the primary sources of variation in LNFP are due mainly to its own shocks and innovations in INFL. Lastly, the primary sources of variation in MLR are due mainly to its own shocks and innovations in LNEXCHR.

5.2.Recommendation

In view of the findings of this study, the following recommendations are made

1.) The slow and unsatisfactory nature of the speed of adjustment of monetary factors can be improved upon by improving on the performance of the monetary market. Measures should be taken by monetary authorities to improve on our under developed money market
2.) From our VECM results, it was observed that fuel price which is a real factor has a role to play in relation to monetary factors. Hence when monetary authorities put hands on deck to curb inflation, the government also should do same so as to achieve desired results.
3.) Proper measures should be put in place to check the rapid rise in the prices of commodities so as to also prevent real shocks that could engender inflation.
4.) This study doesn't write off the role of fiscal policy in reducing inflation. Hence, the government should create checks and balance against any propagator of inflation.

Subsequent studies on in area of study should try as much as possible to capture more real factors that could influence inflation.

5.3.Conclusion

We have seen that monetary policy has a predominant and significant role to play in curbing inflation in Nigeria. Hence, in relation to the challenge of inflation in Nigeria, CBN and other monetary authorities have a significant role to play. The Monetary Policy Rate which is the major instrument used currently by CBN to curb inflation could be said from the VECM estimates to be well behaved although its speed of adjustment was very slow and unsatisfactory, hence monetary authorities should make sure that the confidence in Nigeria's money market is increased once again thus developing the underdeveloped money market. Also, the government should be aware that the job of achieving a single digit inflation in Nigeria is not only in the hand of the monetary authorities but also in their hands as we saw that real factors also had its own role to play in curbing inflation. Hence, the government must bear in mind that checks and balances are important to combat any propagator of inflation.

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