

# The Impact of Monetary Policy Rate on Inflation in Nigeria

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## Abstract

This work investigated the determinants of inflation in Nigeria using a monthly data from January 2007 to August 2014. The ordinary least square (OLS) method was adopted because of its best linear unbiased estimator (BLUE) property. The result showed that expected inflation, exchange rate and money supply influenced inflation, while annual treasury bill rate and monetary policy rate though rightly signed did not influence inflation in Nigeria within the period under investigation. The estimated model displayed that all the explanatory variables used for the analysis accounted for 90% variation in explaining the direction of inflation as regards to increase or decrease. The co-integration test showed that a long term relationship existed among the variables and they were stationary at order one I (1).

**Keywords:** Inflation, Co-integration, Keynesian and Monetary Policy

## 1.0 Introduction

The sustained increase in the general price level of goods and services in an economy over a period of time can be defined as inflation. In any economy, the problem of inflation has always remained an issue due to its effect on economic activities. This could partly be that, when the general price level rises, the value of money falls, because what each unit of a currency can buy decreases. In country that is experiencing an inflationary trend a lot of reasons have been adduced that could be its causes. Some of these causes are increase in demand in excess of supply, increase in cost of production and some structural problems in the economy. In measuring inflation, there are two main indices used to measure inflation. These are the Consumer Price Index (CPI) and Producer Price Index (PPI). The CPI indicates the change in the purchasing power of a consumer; the PPI measures the change in the purchasing power of the producers of those goods.

In Nigeria, one of the cardinal objectives of Central Bank of Nigeria is to maintain price stability in the economy. This is done by ensuring that rate of inflation is maintained within a certain bound to enable a strong economic activity in all facets of the economy. In this context, one of the main principal tools of monetary policy being used by the Central Bank of Nigeria to control economic activities is the monetary policy rate, introduced in December, 2006. *“The Monetary Policy Committee of the Central Bank of Nigeria introduced MPR to replace the MRR which from past experience had not been sufficiently responsive to CBN’s policy initiatives, especially in tackling the problem of excess liquidity in the system. MPR hinges on an interest rate corridor, provides for the CBN lending facility as well as the acceptance of overnight deposit from operators at specified rates. Under MPR, the CBN discount window could be accessed by market operators (Discount Houses and Deposit Money Banks), that are in need of funds to meet liquidity shortages and those with excess liquidity could deposit the funds overnight”*. (Central Bank of Nigeria, Communiqué no. 48, 2006).

Since the introduction monetary policy rate to replace the minimum rediscount rate to manage economic activities in the country more especially price stability, there is need to evaluate how effective this tool of the Central Bank of Nigeria and in combination with other instruments of monetary policy to manage and maintain price stability in Nigeria. Therefore, this study, the determinants of inflation in Nigeria, will be studied using monetary policy variables (Broad money supply, Exchange rate, one year Treasury bill rate and Monetary policy rate). Although, a lot of work has been done in this area, the key interest is to find out if monetary policy rate in combination with other instruments of Central Bank of Nigeria can determine variation or direction of inflation in the country. At this rate, there is need to ask this question, has the replacement of minimum rediscount rate with monetary policy rate in association with other key monetary variables being effective in achieving a fundamental objective of the Central Bank of Nigeria – price stability? Other sub-questions are: (i) What is the relationship between inflation and expected inflation in Nigeria? (ii) What is the relationship between inflation and broad money supply in Nigeria? (iii) What is the relationship between inflation and exchange rate in Nigeria? (iv) What is the relationship between inflation and monetary policy rate in Nigeria?

Although, inflation is a worldwide phenomenon, whose rate and effects, vary from country to country. The inflation trends in Nigeria had constituted one of the devastating problems since late 1980s. In Nigeria, some of the macroeconomic variables determining inflation are said to be exchange rate, openness of the economy and money supply. This study therefore, shall look into the impact of MPR on inflation in Nigeria and at its policy implication.

## 2.0 Literature Review

### 2.1 Theoretical Literature:

The determinants of inflation have been well researched based different school of thoughts. A lot of theories have been propounded on this issue and some of them are:

#### 2.1.1. Monetarist Theory

This theory states that money supply has a major influence of inflation. This means as money supply increases due to growth in production and employment, this creates an inflationary condition in an economy. The monetarist explaining this phenomenon using the theory of natural rate of unemployment believes that increases in the money supply will exert an increasing impact production and employment in the short run and not in the long run. Therefore, there will be a positive relationship between inflation and money supply. Nevertheless, the natural rate of unemployment conditioned that given resources employment, number of firms and the type of technology in use, the equilibrium output, employment and level of employment are certainly definite. Consequently, an increasing money supply will result in the reduction of natural rate of unemployment and increase in production, in the short run. While, in the long run this will lead to an increasing inflation.

#### 2.1.2. Quantity Theory of Money

The relationship between national income evaluated at market price and the velocity of money circulation can said to be equal relationship. The equation shows a positive relationship between price level and money supply, and this can be represented using the quantity equation  $MV=PY$ .

M is the stock of money in circulation

V is the velocity of circulation

P is the general price level

Y is the total income.

Given an economy based on this theory, there will be a proportionate relationship between the money supply and the price level. This means that an increase in money supply by a certain percentage is expected to increase price level by the same percentage. This ordinarily means that expansion in money supply causes inflation.

#### 2.1.3. Structuralism Theory

The inelasticity in the structures of the economy is the main drive of inflation based on this theory. This is mainly obtainable in the developing countries. This is as result of inelasticity in capital formation, institutional framework, labour force, production level, agricultural sector and unemployment structures. Therefore, inflation sets in due to inefficiency in the structures of the economy.

#### 2.1.4. Keynesian Theory

The Keynesian postulation clearly stated in the book, *The General Theory of Employment, Interest and Money* published in 1940. Keynes stated that an aggregate demand driven by increase in private investment, increase in private consumption and increase in government expenditure when an economy is at its full employment lead to an increase in the general price level. This means an aggregate demand level over and above the full employment of production level will create an inflationary trend.

The Keynesian position is that if people expect any expansion in demand to lead to an increase in output and employment, then it will. This happens because firms will take on more people in anticipation of an increased level of demand for their product.

## 2.2. Empirical Literature

Dania (2013), in her work studied the determinants of inflation in Nigeria, time series econometric technique (Error Correction Model) was used to capture the convergence of the inflation determining factors to achieving long run equilibrium. Yearly data between 1970 and 2010 was used, and found that expected inflation, measured by lagged term of inflation, money supply, significantly determine inflation, while trade openness, capturing the tendencies of imported inflation, income level, exchange rate and interest rate were found not be significant with all showing signs that conform with apriori in the short run. In the long run likewise, none of the variables was found to be significant.

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.

Hossain and Islam (2013) examined the determinants of inflation using data from 1990 to 2010 in Bangladesh with the ordinary least square method. The empirical result showed that money supply, one year lagged value of interest rate positively and significantly affect inflation. The result also indicated that one year lagged value of money supply and one year lagged value of fiscal deficit significantly and negatively influence over inflation rate. There was an insignificant relationship between interest, fiscal deficit and nominal exchange rate. The explanatory variables accounted for 87 percent of the variation of inflation in during the period.

Odusanya and Atanda (2010) using data annual data from 1970 to 2007 to investigate the determinants of inflation in Nigeria, the result revealed that growth rate of GDP, growth of money supply, real share of import, first lagged of inflation rate and interest rate exert positive influence on inflation rate. While, only growth of GDP and preceding inflation rate have significant effect on current inflation rate in Nigeria during that period.

Maku and Adelowokan (2013) in their work using annual data from 1970 to 2011 examined the determinants of inflation in Nigeria by employing the partial adjustment model. The result indicated that fiscal deficit and interest rate exert decelerating pressure on dynamics of inflation rate in Nigeria. While, other macroeconomic indicators such as real output growth rate, broad money supply growth rate, and previous level of inflation rate further exert increasing pressure on inflation rate in Nigeria. The real output growth and fiscal deficit were found to be significant determinants of inflation rate in Nigeria during the period.

Ratnasiri (2009) investigated the main determinants of inflation in Sri Lanka over the period 1980 to 2005 using vector autoregressive analysis. The results shows 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.

Enu and Havi (2014) studied the macroeconomic determinants of inflation in Ghana using a co-integration approach. The found out that in the long run, population growth and service output affect inflation positively. However, foreign direct investment, foreign aid and agricultural output increase inflation impact negatively. Also, in the short run, the past two years inflation had a significant impact on the current inflation. The population growth and foreign direct investment's past records had both positive and negative impact on current inflation. Nevertheless, they were not significant.

### 3.0 Methodology

The method that will be employed to establish a relationship between inflation and monetary policy instruments is the ordinary least square method (OLS). Nevertheless, before estimating the model, the properties of the variables will be substantiated in terms stationarity and long term relationship. The econometric tools that will be used for these verifications are the Augmented Dickey-Fuller test for stationarity and Johansen co-integration test for long term relationship given that the variable are integrated of the same order, especially order one I(1). In addition, the direction of causality among these variables will be ascertained using the Granger Causality test. The data for individual variable included in this work was obtained from the statistical bulletin of the Central Bank of Nigeria, 2013 and quarterly publications of 2014. The scope is a monthly data from January, 2007 to August, 2014, while the variables are:

1. Inflation Rate (INF)
2. Exchange Rate (EXC)
3. Broad Money Supply (MS2)
4. Annual Treasury Bill Rate (TBR)
5. Monetary Policy Rate (MPR)

#### 3.1. Model Specification

In order to establish the relationship between inflation and these monetary policy instruments, ordinary least square model for this study will be

$$INF = f(INF(-1) EXC MS2 TBR MPR).....(1)$$

This can be explicitly written as

$$INF_t = \beta_0 + \beta_1 INF_{t-1} + \beta_2 EXC_t + \beta_3 MS2_t + \beta_4 TBR_t + \beta_5 MPR_t + \mu_t ..... (2)$$

Therefore, to avoid the problem of autocorrelation equation can be transformed using the natural logarithm, and thus:

$$LNINF_t = \beta_0 + \beta_1 LNINF_{t-1} + \beta_2 LNEXC_t + \beta_3 LNMS2_t + \beta_4 LNTBR_t + \beta_5 LNMPR_t + \mu_t ..... (3)$$

Where:

- lninf = natural logarithm inflation rate
- lninf(-1) = natural logarithm of expected inflation
- lnexc = natural logarithm of nominal exchange rate
- lnms2 = natural logarithm of broad money supply
- lntr = natural logarithm of annual treasury bill rate
- lnmpr = natural logarithm of monetary policy rate
- t = current time

$\beta_i$  = parameters of the explanatory variables.

From the model, the expected signs of these parameters are  $\beta_1 > 0, \beta_2 > 0, \beta_3 > 0, \beta_4 < 0$  while,  $\beta_5 < 0$

### 3.2. Unit Root Test

There are several tests that can be applied to test for the stationarity of these variables, but in this study, the Augmented Dickey-Fuller test will be applied and is given by the equation

$$\Delta Y_t = \beta_0 + \beta_1 t + \phi Y_{t-1} + \sum_{j=1}^p \alpha_j \Delta Y_{t-j} + \varepsilon_t, \quad t = p+1, \dots, T$$

Where p lags of  $\Delta Y_{t-j}$  are added to remove serial correlation  
 Hypothesis

$$H_0: \phi = 0 \quad (\text{there is a unit root in the series})$$

$$H_1: \phi < 0 \quad (\text{there is no unit root in the series})$$

The hypothesis is tested on the basis of t-statistic of the coefficient of  $\phi$

Decision rule: Reject  $H_0$  if test statistic is less than critical values, otherwise do not reject (Abdullahi et al, 2011).

### 3.3. Co-integration Test

If  $r = n$  and A is unrestricted, the maximized log likelihood is given by Banerjee et al. (1993) as:

$$\ln = K - \left(\frac{T}{2}\right) \sum_{i=1}^n \log(1 - \lambda_i)$$

Where  $k = -\left(\frac{T}{2}\right) \left( n \left( 1 + \log 2\pi \right) + \log |s_\infty| \right)$ . For a given value of  $r < n$ , only the first r Eigen values should be positive, and the restricted log likelihood is

$$L(r) = K - (T/2) \sum_{i=1}^r \log(1 - \lambda_i)$$

A likelihood ratio test of the hypothesis that there are r cointegration vectors against the alternative that there are n is thus given by

$$n_r = 2 \left( L(n) - L(r) \right) = -T \sum_{i=r+1}^n \log(1 - \lambda_i)$$

This is known as the trace statistic, and testing proceeds in the sequence  $n_1, n_2, \dots, n_{n-1}$ . A cointegrating rank of r is selected if the last significant is  $n_{r-1}$ , which thereby rejects the hypothesis of n-r+1 unit roots in A. The trace statistic measures the importance of the adjustment coefficients  $\beta$  on the eigenvectors to be potentially omitted. An alternative test of the significance of the largest Eigen value is

$$\zeta_r = -T \log(1 - \lambda_{r+1}), \quad r = 1, 2, \dots, n-1$$

This is known as the maximal-Eigen value or  $\lambda$ -max statistic (Terence and Raphael, 2008)

Decision Rule: Accept  $H_0$ : (there is no significant cointegration relationship) if t-statistic is greater than the asymptotic critical – value or if the p-value is less than the level of significance otherwise accept  $H_1$ : (there is a significant cointegration relationship) if test statistic is less than the asymptotic critical values or if the p – value is greater than the level of significance. Testing sequence terminates if the null hypothesis cannot be rejected for the first time (Abdullahi et al, 2011).

### 3.4. Granger Causality

The directions of causality between these variables will be investigated using the pairwise Granger Causality test. Causality can be categorized into three; unidirectional causality, bidirectional causality and no causality in a bivariate model.

## 4.0 Results

### 4.1. Unit Root

The variables were verified for stationarity by subjecting them to unit root test using Augmented Dickey-Fuller test for stationarity test

**Table 1.0: Stationarity test of the variables**

Level test I(0)		Critical values		
ADF Stat.	Variables	1%	5%	10%
-1.628904	Lninf	-3.503879	-2.893589	-2.583931
-2.992262	Lnms2	-3.503879	-2.893589	-2.583931
-1.748074	Lnexc	-3.504727	-2.893956	-2.584126
-2.069939	Lntbr	-3.504727	-2.893956	-2.584126
-0.835304	Lnmpr	-3.503879	-2.893589	-2.583931
Level test I(1)				
-8.514849	Lninf	-3.504727	-2.893956	-2.584126
-9.376027	Lnms2	-3.504727	-2.893956	-2.584126
-5.761088	Lnexc	-3.504727	-2.893956	-2.584126
-7.32035	Lntbr	-3.504727	-2.893956	-2.584126
-3.694341	Lnmpr	-3.506484	-2.894716	-2.584529

Author's computation and Eviews 7.1 Output

In table 1.0, the variables at their level form showed unit root, especially at 1%. The first differenced series of the variables showed stationarity, which means, that they are integrated of order one I (1).

### 4.2. Co-integration Test

In order to ascertain if there was a long term relationship existing among these variables, a co-integration test was carried out using the Johansen cointegration test.

**Table 2.0 : Trace test**

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.306604	79.56894	69.81889	0.0068*
At most 1	0.221816	46.98127	47.85613	0.0603**
At most 2	0.148913	24.66075	29.79707	0.1739
At most 3	0.104409	10.31029	15.49471	0.2576
At most 4	0.005559	0.496111	3.841466	0.4812

Author's computation and Eviews 7.1 output

**Table 3.0: Test (Maximum Eigenvalue)**

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.306604	32.58767	33.87687	0.0706**
At most 1	0.221816	22.32053	27.58434	0.2044
At most 2	0.148913	14.35046	21.13162	0.3370
At most 3	0.104409	9.814183	14.26460	0.2244
At most 4	0.005559	0.496111	3.841466	0.4812

Author's computation and Eviews 7.1 output

The trace test in table 2.0 showed that the hypothesis of no cointegration among the variables can be rejected and at least one cointegrating equation at 5% and two cointegrating equations at 10% exist. The maximum eigenvalue test in table 3.0, confirmed the presence long run relationship among the variables of interest with at least one cointegrating equation at 10%.

### 4.3. Granger Causality Test

**Table 4.0: Granger Causality test of the variables**

Null Hypothesis:	Obs	F-Statistic	Prob.
LNEXC does not Granger Cause LNINF LNINF does not Granger Cause LNEXC	90	0.99330 2.34309	0.3746 0.1022
LNMS2 does not Granger Cause LNINF LNINF does not Granger Cause LNMS2	90	0.17948 0.79150	0.8360 0.4565
LNTBR does not Granger Cause LNINF LNINF does not Granger Cause LNTBR	90	0.05861 0.70587	0.9431 0.4965
LNMPR does not Granger Cause LNINF LNINF does not Granger Cause LNMPR	90	0.80492 0.30414	0.4505 0.7386
LNMS2 does not Granger Cause LNEXC LNEXC does not Granger Cause LNMS2	90	3.49093 0.88203	0.0349 0.4177
LNTBR does not Granger Cause LNEXC LNEXC does not Granger Cause LNTBR	90	1.87306 2.85180	0.1599 0.0633
LNMPR does not Granger Cause LNEXC LNEXC does not Granger Cause LNMPR	90	1.58430 0.22059	0.2111 0.8025
LNTBR does not Granger Cause LNMS2 LNMS2 does not Granger Cause LNTBR	90	1.04462 0.35348	0.3563 0.7033

Author's computation and Eviews 7.1 output

The Granger causality analysis presented in table 4.0 showed that at 5% significance level that most of the variables do not cause each other under pairwise Granger Causality test. It was equally interesting to find out that none of the variables Granger caused LNINF. Nevertheless, there was only one case of unidirectional causality between two variables. This is, LNMS2 and LNEXC. There was no case of bidirectional causality at 5% significance level.

### 4.4. Model Estimation

In estimating the model, ordinary least square method was used to identify the nature of relationship that existed between INF and other variables using monthly data of January, 2007 to August, 2014 extracted from the statistical bulletin of Central Bank of Nigeria.

**Table 5.0 Model Estimation Results**

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.067149	0.555068	-0.120975	0.9040
LNINF(-1)	0.897200	0.045139	19.87623	0.0000
LNEXC	-0.447251	0.149008	-3.001528	0.0035
LNMS2	0.167046	0.057888	2.885676	0.0049
LNTBR	-0.017379	0.031272	-0.555741	0.5798
LNMPR	-0.053718	0.065784	-0.816579	0.4165
R-squared	0.903787	Mean dependent var		2.303020
Adjusted R-squared	0.898128	S.D. dependent var		0.329410
S.E. of regression	0.105139	Akaike info criterion		-1.603402
Sum squared resid	0.939613	Schwarz criterion		-1.437851
Log likelihood	78.95478	Hannan-Quinn criter.		-1.536612
F-statistic	159.6922	Durbin-Watson stat		1.864951
Prob(F-statistic)	0.000000			

Author's computation and Eviews 7.1 output

The estimated model equation from table 5.0 is given as:

$$LNINF_t = -0.0671 + 0.8981LNINF_{t-1} - 0.4473LNEXC_t + 0.1670LNMS2_t - 0.0174LNTBR_t - 0.0537LNMPR_t$$

The interpretation of the model based on the selected economic variables as shown in table 5.0 above, the  $R^2$  of 0.9038 which indicates 90% of total variation in the dependent variable can be explained by the explanatory variables. The adjusted  $R^2$  of 0.8981 or 90%, showed that the explanatory variables were robust in explaining the variation in inflation within the period.

The Durbin-Watson statistic of 1.8650 which is close to 2.0 indicates no presence of autocorrelation in the data. Nonetheless, the F-statistic has a value of 159.69 with probability value of 0.0000, which means, it is statistically significant at 5% and the model is a good fit. Therefore, the explanatory variables have a joint significant effect in determining the movement of inflation rate in Nigeria within the period of interest.

In addition, the estimated coefficient (0.897200) of expected inflation rate showed the right sign and, is positive and statistically significant. This is in line with the works of Dania (2013), Odusanya and Atanda (2011) and, Maku and Adelowokan (2013) regarding the influence of this variable on inflation in Nigeria. This means that a 1% increase in expected inflation will cause inflation to rise by 0.89%.

The coefficient of exchange rate (-0.447251) did not show the expected positive sign for an import dependent country like Nigeria. The coefficient shows a negative sign and it is statistically significant. This result agrees with the work of Iya and Aminu (2014) but in contrast with the work of Dania (2013) concerning this variable and its relationship with inflation within the period in Nigeria. A 1% increase in exchange rate will reduce inflation by 0.45%.

The estimated coefficient of money supply (0.167046) is rightly signed. It is positive and statistically significant. This is in conformity with result obtained in the works of Maku and Adelowokan (2013), Dania (2013), Iya and Aminu (2014), Odusanya and Atanda (2010) in Nigeria and Ratnasiri (2009) in Sri Lanka, more so with economic theory. This by implication means that a 1% increase in money supply will increase inflation by 0.17%.

The treasury bill rate coefficient (-0.017379) is rightly signed. It is negative but not statistically significant. This means that independently as a variable no relationship existed between the variable and inflation within the stated period.

The estimated coefficient of monetary policy rate (-0.053718) is rightly signed. It is negative but not statistically significant. Therefore no relationship existed between inflation and monetary policy rate during the period under investigation.

## 5.0 Conclusion and Recommendation

The paper focused on the determinants of inflation in Nigeria using monthly data (Jan.2007 – Aug.2014) extracted from the statistical bulletin of Central Bank of Nigeria. The Ordinary Least Square (OLS) was applied

to ascertain the relationship existing between inflation and monetary policy rate, including money supply, exchange rate, and treasury bill rate. The result of the study showed that expected inflation, money supply and exchange rate had influence on inflation within the period under consideration. Nevertheless, interestingly the policy interest rate (monetary policy rate) used for macroeconomic stability does not have any statistical relationship with inflation as an independent variable. This means that replacing minimum rediscount rate with monetary policy rate has not proved to be more effective than the minimum rediscount rate. The same is for annual Treasury bill rate. At any rate, combining monetary policy rate with other macroeconomic monetary policy tools proved effective in determining the behavior of inflation during the period.

### Recommendation

Based on the study, the following recommendations are necessary to manage inflation using these variables.

Government should manage information on key macroeconomic variables or factors very well. It has been found from the study that the major driver of inflation is expected inflation. Good news about these variables is important.

In addition, monetary authority should find an effective means of reducing money supply in the system and make best use exchange rate to mitigate inflation.

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

Finally, the monetary authority should re-assess the effectiveness of monetary policy rate given its ineffectiveness as a tool to manage inflation in Nigeria during the period.

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