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Effect of Monetary Policy on Prices and Output in Nigeria

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ABSTRACT: *The effect of monetary policy on prices and output in any economy cannot be overlooked. This is germane given the implications on various macroeconomic outcomes. In doing this, the Fully Modified Ordinary Least Squares (FMOLS) method was deployed base on the preliminary findings to test the relationship for Nigeria. Findings revealed that money supply and exchange rate exhibit significant effect on prices and output, while monetary policy rate does not. Also, technological innovation and labour force significantly impacted output while gross fixed capital formation did not, Base on the findings, it is recommended that the central bank implement policies that will ease access to forex, stabilize the exchange rate and lessen the hassles for capital goods import, while regulating money supply and monetary policy rate to stabilize the economy.*

KEYWORDS: monetary policy, prices, output
JEL Classification: E00, E31, E23

INTRODUCTION

Monetary management or monetary policy is an essential part of macroeconomic management, usually conducted by the Central Bank of the country saddled with the responsibility for monetary management. Monetary policy thus the use of policy instruments to control the money supply or interest rate in order to achieve macroeconomic goals of price stability, exchange rate equilibrium or economic growth.

Monetary policy is typically concerned with the way in which monetary authorities use the instruments at their disposal to influence the decision of economic agents with the intention of achieving overall macroeconomic stability (Ononugbo, 2012). Folawewo and Osinubi (2006) describes monetary policy as a combination of measures designed to regulate the value, supply and cost of money in an economy, in consonance with the expected level of economic activity. Since its establishment in 1959, the Central Bank of Nigeria (CBN) has continued to play its traditional role which is the regulation of the stock of money in such a way as to promote economic growth. This role is anchored on the use of monetary policy that is usually targeted towards the achievement of full-employment, rapid economic growth, price stability, and external balance.

Studies on monetary policy innovations and output and price movements such as Twinoburyo and Odhiambo (2018) and Nguyen (2019) have shown that monetary policy exerts positive influence on real output, and that this influence becomes stronger in countries with well-developed financial sectors and access to global markets. Conversely, stability in prices of goods and services promotes economic growth and exist when there is sustainably low and stable inflation rate (Adeboye, 2014). Thus, price stability and growth in real output of goods and services remains one of the key macroeconomics alongside balance of payments equilibrium, full employment, etc.

Howbeit, despite the various monetary policy regimes by the central bank of Nigeria (CBN) over the years, inflation still remain the major threat to Nigeria's economy. Also, real output growth remains elusive, and thus the need for a re-assessment of the effect of monetary policy innovations on output and prices in the Nigerian economy becomes pertinent. The study also examines the direction of causality between monetary policy and output, as well as consumer prices in the Nigerian economy. The remaining part of the paper discusses theoretical literature, empirical literature, methodology, results and discussion, as well as conclusion and recommendations.

EMPIRICAL LITERATURE

Rafiq and Mallick (2008) investigated the effect of monetary policy on output in EMU3 (Italy, Germany and France) of the Eurozone. The study employed the Vector Autoregressive (VAR) estimation procedure and findings showed that monetary policy changes are more potent in stimulating economic activity in Germany than the other EMU3 countries. Interest rate changes do not have significant effect on output in Italy and France. However, it was concluded that monetary policy innovations exert moderate and heterogenous impact on output in the EU3. Similarly, Nguyen (2019) investigated the effect of monetary policy on output of developing countries. The study employed a meta regression analysis as estimation technique and results showed that monetary policy tightening exerts negative influence on real output, and the negative influence of monetary tightening is more severe in primary studies examining commodity prices. These findings corroborate that of Rafiq and Mallick (2008).

Olayiwola (2018) also analysed the effect of monetary policy shocks on output and prices in Nigeria. The study employed the ARDL technique in its investigation. Findings showed that monetary policy shocks exhibit positive effect on output in the long-run. However, the positive effect is tenable during periods of economic boom, while periods of recession are characterized by negative effect of monetary policy on output. The study surmised that monetary policy is more effective in stimulating output during periods of economic boom, and becomes more effective to controlling prices during periods of recession.

In their study of monetary policy and economic growth, Twinoburyo (2018) carried out a survey of literature (theoretical and empirical) to establish the relationship. Whereas evidence abounds vis-a-vis the inconclusive nature of the relationship between monetary policy and economic growth, the study found that monetary policy is a potent tool to stimulating

economic growth, most especially I countries with developed financial sectors. On the contrary, monetary policy becomes a less-potent tool to stimulating output or growth in economies characterized by structural rigidities and less-developed financial markets. The paper concludes that monetary policy is an indispensable tool to stimulating long-run and short-run growth.

Xu and Chen (2012) analysed the effect of monetary policy on real estate price growth in China. The study employed the Ordinary Least Square (OLS) and Granger Causality techniques in its investigation. Findings showed that expansionary monetary policy stimulates increases in real estate prices while contractionary monetary policies act on the contrary. It was also found that a bullish stock market increases growth in prices of real estate in China. A similar study on effect of monetary policy on house price inflation was carried out by Gupta and Kabundi (2009). The study used the Factor Augmented Vector Autoregressive (FAVAR) approach to test the relationship and result of the investigation contradicted most previous studies; positive monetary policy shocks exerts negative influence on house price inflation. This result portends that findings from the FAVAR approach do not corroborate conventional VAR results of monetary policy shocks and house price inflation puzzle.

Theoretical Framework

The framework for the study is eclectic and is based on the endogenous growth model and Fischer's quantity theory of money. The endogenous growth model addresses the output model of the study and opines that growth rate of output is determined by some endogenous rather than exogenous factors as earlier postulated by Neoclassical theory of growth. The model explains how spill-over effects of technological innovations spreads among industries/firms and how it accelerates their productivity gains. Accordingly, technology, labour and capital are captured as determinants of output growth. Conversely, the quantity theory of money is adopted to explain price model and postulates a direct relationship between money supply and prices. It assumes a constant velocity of money and shows that the product of money supply and its velocity are equivalent to nominal income. The theory therefore suggests that price level varies directly with the quantity of money in circulation under the assumption that its velocity of circulation and volume of transaction are constant.

METHODOLOGY

Data for this study is sourced from Central Bank of Nigeria (CBN) Statistical Bulletin 2021. The model evaluates the effect of monetary policy on prices and output in Nigeria. The study adapted the model of Okwori and Abu (2017) based on the Endogenous Growth Theory to specify the empirical relationship between monetary policy and output, thus;

$$INF = f(M2, EXCHR, MPR, TBR) \quad (1)$$

The model is adjusted for the current study as shown thus:

CPI = *f* (M2, EXCHR, MPR) (2)

Where:

CPI = Consumer Price Index, M2 = Money Supply, EXCHR = Exchange Rate, MPR=Monetary policy rate.

The stochastic form equation is given as:

$$CPI = \beta 0 + \beta_1 M2\ (t) + \beta_2 EXCHR\ (t) + \beta_3 MPR\ (t) + \mu t \quad (3)$$

The second model of the study based on the endogenous growth model is also presented:

RGDP = *f* (PA, GFCF, LPR, M2, MPR) (4)

Where:

RGDP= Real Gross Domestic Product, LPR = Labour Participation rate , GFCF = Gross Fixed Capital formation, PA = Patent Application (Proxy for Technology), MPR = Monetary Policy Rate, M2 = Money Supply

The stochastic form equation is given as:

$$RGDPG = \beta 0 + \beta_1 PA\ (t) + \beta_2 GFCF\ (t) + \beta_3 LPR\ (t) + \beta_4 M2\ (t) + \beta_5 MPR\ (t) + \mu t \quad (5)$$

Estimation Techniques

The unit root test is performed to test for stationarity in a time series data. A time series data is stationary if its variance and mean are constant overtime and covariance between two periods depends on the lag between two periods while a non-stationary series is a series that has a non-constant mean, variance and auto covariance over time. Stationarity of time series data has the capacity to influence the behaviour or properties of economic or business data hence, carrying out a regression analysis on a non-stationary data would lead to spurious and unreliable results. To test for unit root or stationarity at level and first difference, the Augmented Dickey-Fuller (ADF) is used. Given mixed nature of integration of the variables, Autoregressive Distributive Lag Bound Cointegration Test was used to examine the nature of long-run relationship between the variables. ARDL is a standard least squares regression that includes lags of both the dependent variable and explanatory variables as regressors.

RESULTS AND DISCUSSION

Table 4.1: Descriptive Statistics

	RGDP	PA	LPR	GFCF	CPI	EXCHR	MPR	M2
Mean	33181.57	48.02857	59.11057	30.857	66.98857	115.1209	13.67143	1.02
Median	11332.25	52	56.43	28.37089	40.08	116.8	13.5	23435054
Maximum	127736.8	120	76.34	54.9483	240.14	306.35	26	3.72
Minimum	202.4362	12	54.92	14.1687	0.83	2.96	6	27389.8
Skewness	1.021865	0.744903	1.984363	0.225535	1.025944	0.727469	0.74804	1.011362
Kurtosis	2.612187	3.799532	5.11857	1.635803	2.94532	3.047935	4.863862	2.341123
Jarque-Bera	6.310547	4.169041	29.51539	3.010725	6.144296	3.090417	8.330346	6.599731
Probability	0.042627	0.124367	0	0.221937	0.046322	0.213267	0.015527	0.036888
Observations	35	35	35	35	35	35	35	35

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Table 4.1 above, depicts the summary of the descriptive statistics used in this empirical study. The Table shows that RGDP and CPI which are the dependent variables have a mean value of 33181.57 and 66.9885 per cent. Also, the independent variables which include: Patent Application, labour Participation rate, Gross fixed Capital Formation, Exchange rate, Monetary policy Rate and Money Supply have mean values of 48.02857, 59.11057, 30.857, 115.1209, 13.67143 and 1.02 respectively. The maximum and minimum values of RGDP are 11.75773 and 5.310425 per cent respectively while the maximum and minimum values of CPI are 240.14 and 0.83 respectively. The value of skewness shows that all the variables are skewed to the right. RGDP, PA, LPR, GFCF, CPI, EXCHR, MPR and M2 with respective values of 1.021865, 0.744903, 1.984363, 0.225535, 1.025944, 0.727469, 0.74804 and 1.011362 per cent respectively are described as platykurtic, because their respective values are less than 3.0. The above descriptions of the following variables according to their respective bench marks explain their asymmetric and symmetric distributive nature. Furthermore, the Jarque-Bera probability values for RGDP 0.042627, PA 0.124367, LPR 0.54439, GFCF 0.221937, CPI 0.046322, EXCHR 0.213267, MPR 0.015527 and M2 0.036888 are normally distributed.

Econometric Analysis of Data

Table 4.2.1: Unit root result

Variables	At Level (t-statistics)	First diff (t-statistics)	Critical values (5%)	Probability Values	Order of Integration
RGDP	-4.341608	-	-2.981038	0.0022	I(0)
PA	-0.537689	-5.942043	-2.954021	0.0000	I(1)
LPR	-2.558192	-3.795257	-2967767	0.0076	I(1)
GFCF	-0.853103	-6.574888	-2.954021	0.0000	I(1)
CPI	3.864998	-4.851767	-2.963972	0.0005	I(1)
EXCHR	0.332625	-5.512486	-2.954021	0.0001	I(1)
MPR	-3.185274	-	-2.951125	0.0297	I(0)
M2	3.054158	-6.047590	-2.957110	0.0000	I(1)

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The result of the ADF revealed that RGDP and MPR are stationary at level. And on the other hand, PA, LPR, GFCF, CPI, EXCHR and M2 are stationary at first difference, this is determined by comparing the ADF statistics to their respective critical values at 5% significance level. As shown in the table, the ADF statistics are greater than the respective critical values of the variable at different points of stationarity. This could also be confirmed by their respective probability values at 5% significance level. Given mixed nature of integration of the variables, Autoregressive Distributive Lag Bound Cointegration Test was used to examine the nature of long-run relationship between the variables.

Presentation of Co-integration Tests (Bound Testing Approach)

Table 4.2.2.1: Co-integration Bound Test for Model 1

Consumer Price Index		
	Coefficient	**Degree of Freedom**
F- Statistic	7.040405	3
Critical values	I(0) Bound	I(1) Bound
Significance (5%)	2.79	3.67

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Table 4.2.2.1 shows that the value of F-statistics is greater than the upper bounds of 5% critical values of the model one. This leads to the rejection of the null hypotheses, and the acceptance of the alternative hypothesis. Hence, the test implies that there is a long-run relationship between monetary policy and prices.

Table 4.2.2.2: Co-integration Bound Test for Model 2

Real Gross Domestic Product		
	Coefficient	**Degree of Freedom**
F- Statistic	45.72742	5
Critical values	I(0) Bound	I(1) Bound
Significance (5%)	2.39	3.38

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Table 4.2.2.2 shows that the value of F-statistics is greater than the upper bounds of 5% critical values of the model 2. This also leads to the rejection of the null hypothesis, and the acceptance of the alternative hypothesis. Hence, the tests imply that there is co-integration between monetary policy and output.

Cointegrating Regression Tests of the Models (Fully Modified Least Squares)
Table 4.2.3.1 contains the long run estimates of the relationship between monetary policy and prices.

Table 4.3.1 Long-Run effect of monetary policy on prices

Variables	Consumer price Index Function		
	Coefficient	Standard Error	P- value
M2	2.920100	3.050000	0.0000
EXCHR	0.382258	0.046341	0.0000
MPR	0.125240	0.597902	0.8355
Intercept	-7.792115	9.839125	0.4346
R squared	0.964315		

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Table 4.3.1 shows that money supply is positively associated with consumer price index. It implies that money supply is a long-run significant predictor of consumer price index in Nigeria. It shows that a unit increase in M2 will lead to 2.920100 increase in consumer price index holding other variables constant. Exchange rate is positively associated with consumer price index. It also implies that exchange rate is a long run significant predictor of consumer price index in Nigeria. That means holding other control variable constant one unit increase in exchange rate will cause consumer price index to increase by 0.382258. However, monetary policy rate is not statistically significant at 5 Percent with a probability value of (0.8355) even though it exhibits a positive relationship with consumer price index. The coefficient of determination measures the explanatory power of the regression model. There is a high coefficient of determination of 0.964315 which is 96%. This is an indication that the model is well fitted. Meaning 96% change in prices is explained by the independent variables while the remaining 4% is explained by other variables not captured in the model.

Table 4.3.2 Long-Run effect of monetary policy on output

Variables	Output Function		
	Coefficient	Standard Error	P- value
PA	247.6627	88.66433	0.0093
GFCF	-54.51472	221.9170	0.8077
LPR	765.6269	293.1901	0.0143
M2	0.000232	2.090050	0.0000
MPR	-677.9391	403.4214	0.1040
Intercept	-36128.29	16083.02	0.0328
R- Squared	0.959177		

Sources Author's Computation E-Views 10

Table 4.3.2 shows that gross fixed capital formation and monetary policy rate are negatively associated with economic output. It follows therefore that a unit increase in gross fixed capital formation will lead to 54.51472 decrease in output holding other variables constant. This variable using the FMLS method does not conform with the A priori expectation since theoretically, it ought to have a positive relationship with economic growth. For Monetary policy rate, holding other variables constant, it shows that one unit increase in MPR will decrease output by 677.9391 which does conform with a priori expectation of the model. Conversely, labour participation rate which has a P value of 0.0143 shows that, holding other variables constant, one unit increase in the variable will increase output by 765.6269.

Money supply which is statistically significant at 1% with a probability value of (0.0000) and has a positive relationship with real gross domestic product. It implies that money supply is a long run statistically significant determinant of output in Nigeria. That means one unit increase in Money supply will lead to 0.00232 unit increase in real gross domestic product ceteris paribus. The implication of this is that as money supply in the economy increases, it leads to increase the general level of purchasing power and consumption. This in turn improves the economic growth of the country.

Patent Application which is statistically significant at 1% with a probability value of (0.0093) has a positive relationship with real gross domestic product. It implies that patent application is a long run significant predictor of output in Nigeria, and thus implies that a unit increase in PA will lead to 247.6627 increase in output ceteris paribus. By implication, increases in PA means there are increases in technological innovations or inventions, which will enhance productivity. This increases the economic growth of the country and improves standard of living through job creation. There is a high coefficient of determination of 96% which is an indication that the model is goodly fitted. Thus, 96% change in output is explained by the independent variables while the remaining 4% is explained by other variables not captured in the model.

Post-estimation Tests

Post-estimation tests like Breusch-Godfrey Autocorrelation LM test, Heteroscedasticity test, CUSUM graph and normality tests were conducted to show that model estimations are error free and did not violate the conditions of classical linear regression assumptions.

Table 4.4.1a. Serial Correlation Test (Breusch-Godfrey LM Test)

Consumer Price Index Function	
F-statistics	0.098154
Probability Value	0.9070

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Table 4.4.1a. shows that the probability values of the serial correlation test for the two models are greater than 5% significance level, leading to rejection of the null hypothesis. It can therefore be concluded that the models are free from serial correlation.

Table 4.4.2b Heteroscedasticity Test (ARCH Heteroscedasticity Test)

Consumer Price Index Function	
F-statistics	2.220144
Probability value	0.0612

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4.4.2c. Breusch-Godfrey Serial Correlation LM Test:

Output Function			
F-statistic	0.810248	Prob. F(2,17)	0.4595
Obs*R-squared	0.353888	Prob. Chi-Square(2)	0.8378

Table 4.4.2c Heteroscedasticity Test (ARCH Heteroscedasticity Test)

Output Function	
F-statistics	4.358568
Probability value	0.3645

Table 4.4.4 shows that the probability values of the heteroscedasticity test of the models is greater than 5% significance level, leading to rejection of the null hypothesis. It can therefore be concluded that the models are free from heteroscedasticity.

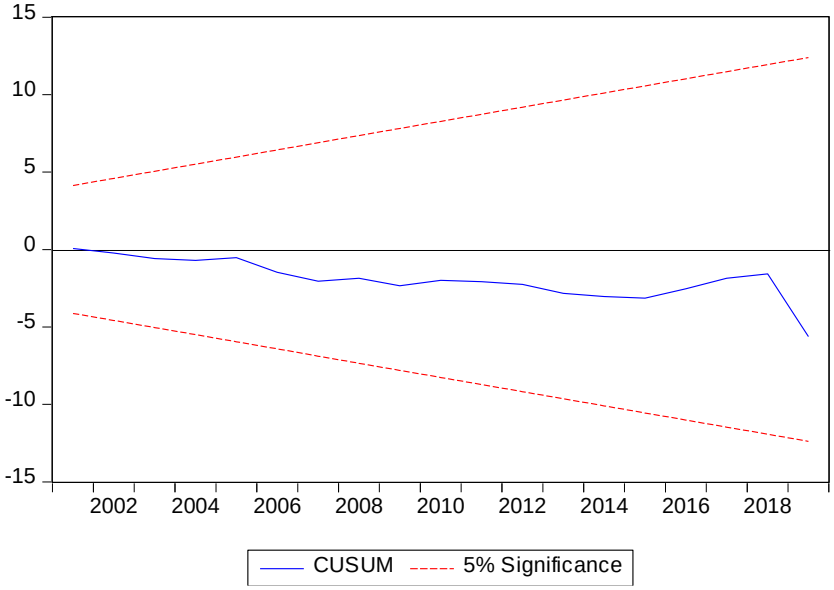

Figure 1. CUSUM Graph for Consumer Price Index Function

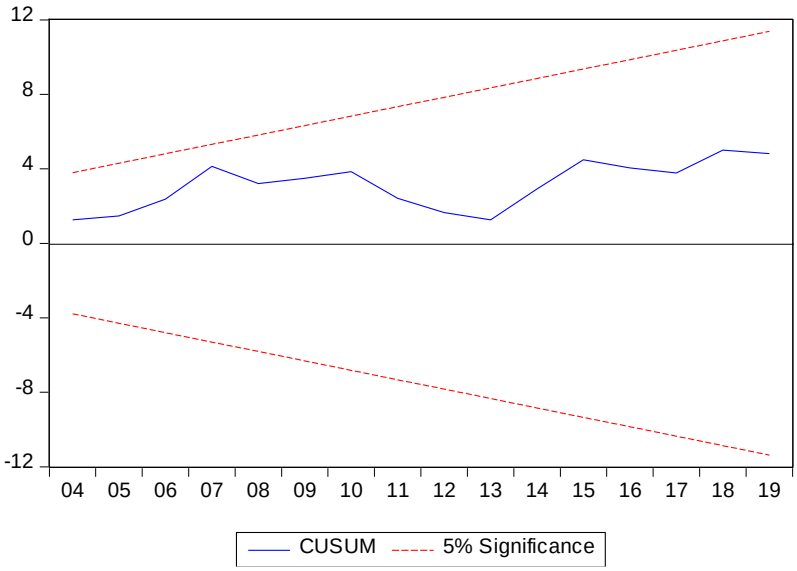

Figure 2. CUSUM Graph for Real Gross Domestic Product Function
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The CUSUM graphs in figures 1 and 2 show that the blue line is in-between the two red lines and confirms that the models are stable and free from misspecification error.

Test of Normal Distribution of Residuals of the Model

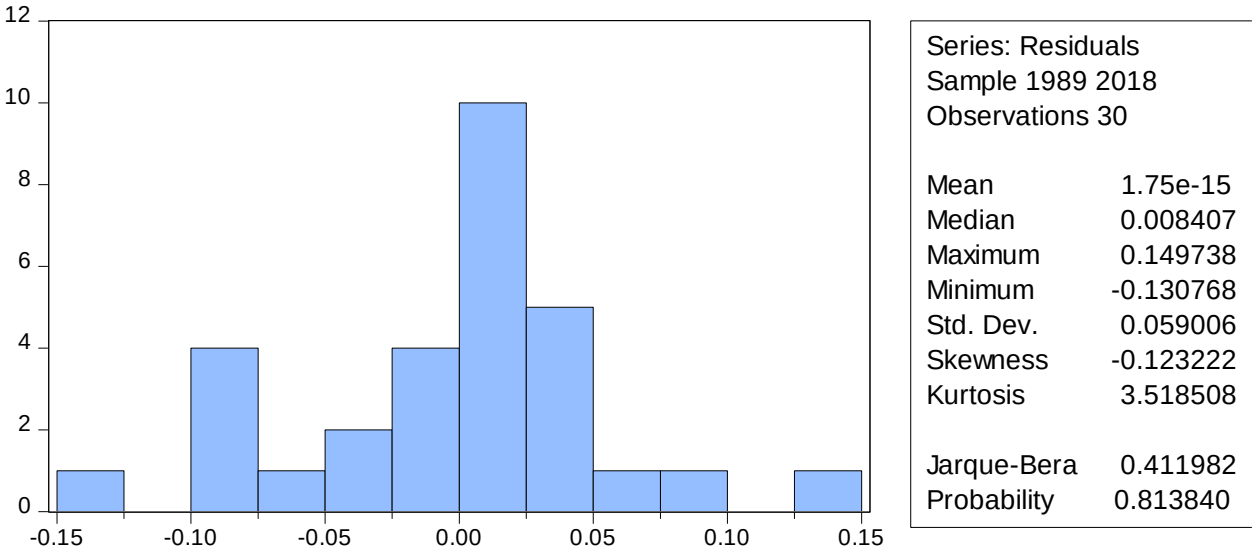

Figure 3. Normal Distribution of Residuals of Model 1

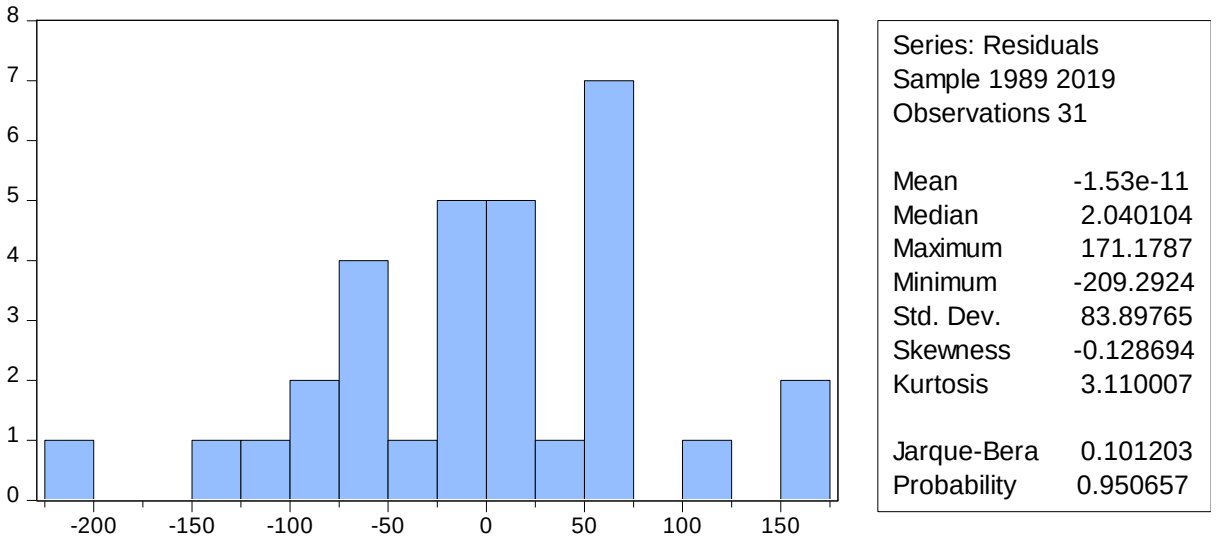

Figure 4. Normal Distribution of Residuals of Model 2

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Figure 3 and 4 show that the residuals of the models are normally distributed. This is ascertained by the fact that the probability value of the Jarque-Bera statistics is greater than 5% level of statistical significance. It therefore implies that the estimates from the model are good, consistent and reliable.

CONCLUSION AND RECOMMENDATIONS

The study examined the effect of monetary policy on prices and output in Nigeria. money supply and exchange rate were found to exert significant effect on prices proxied by the CPI while the MPR did not. Interestingly, same variables including technology proxied by patent applications was found to significantly explain changes in output within period of study. In the light of the findings, the following recommendations are made:

I. The central bank should regulate money supply to control output and maintain its positive contribution to aggregate output in Nigeria.

II. Monetary policy rate should be adjusted to address economic realities in order to increase access to investment funds. By so doing, gross capital formation can contribute significantly to output in Nigeria.

III. The central bank should also address forex scarcity through appropriate policies in order to ease access to forex for capital goods importation needed to boost output.

IV. Central bank should be independent and therefore should be able to achieve its inflation targets.

V. Central bank should not only aim at stabilizing inflation around the target but also put some weight in stabilizing the real economy thereby increasing output.

VI.

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