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# EFFICACY OF MONETARY POLICY INSTRUMENTS ON ECONOMIC GROWTH: EVIDENCE FROM NIGERIA

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## ABSTRACT

The inability of monetary policies to efficiently and effectively exploit its policy objective could be a function of the pitfall of policy instruments adopted which seems to restrict its contributions to economic advancement in Nigeria. It is on this premise that this study investigated the efficacy of monetary policy instruments in Nigeria using monthly data from year 2000 to 2016. The study adopted the Johansen Multivariate Cointegration approach and Vector Error Correction (VECM). The Cointegration test established existence of long-term relationship between monetary policy instruments and economic growth. The study also revealed that there was monthly speed of adjustment of the variables towards their long-run equilibrium path to about 27 percent. The key discovery emanated from this study indicated that Consumer Price Index (CPI), Real Exchange Rate (RER), Money Supply (M2) and Interest Rate (INT) were significant monetary policy instruments that propelled economic growth in Nigeria during the period under review. Consequently, the study concluded by recommending Nominal GDP targeting as the framework to be adopted by the monetary authority in Nigeria in their monetary policy making process especially in the face of the new economic paradigm which is expected to be more plausible in improving and sustaining the stated Nigerian macro-economic objectives.

**Contribution/ Originality:** This study differs from others in examining the subject matter with high frequency data as against traditional annual data which has proved to be more efficient and captures more the effect of time, and the very first with such logical conclusion and recommendation for policy makers.

## 1. INTRODUCTION

The Central Bank of Nigeria began operation in 1959 and since then the apex bank has continuously discharged its roles as enshrined in the Act establishing it. The major role of the Bank is to effectively control the money stock in the circulation in order to ensure price stability for advancement of economic development. This function encompasses the use of monetary policy mechanism towards reaching the specified macroeconomic objective including rapid economic progress, full employment, stability of price and external balance. Over the years, especially in the last decade, the two later objectives occupied the forefront of monetary policy objectives of the Bank as the primary goals. The assumption that exchange rate policy and inflation targeting are crucial

instruments for attaining macroeconomic stability has made the two objectives major forces in the monetary policy calculations in the recent past (Ajayi, 1999).

Monetary policy has been described as the deployment of various monetary tools by the monetary authorities with the intention of regulating the supply, volume and cost of money in the circulation in order to achieve the expected economic objectives. The attainment of sustainable development, full employment, balance of payment equilibrium and price stability remains the primary monetary policy objective in many countries as opined in Folawewo and Osinubi (2006).

Since 1980s, evidence abounds in Nigeria that considerable level of relationship exists between the Nigerian stock of money and economic progress. Variation in the stock of money has over the years been the main policy measure employed by the monetary authorities to regulate the Nigerian economy. Nigerian government made drastic efforts to mitigate the consequences of the fall in the oil price in 1981 and deficit balance of payment (BOP) witnessed during that critical period which prompted the employment of stabilization measure alternating from monetary to fiscal policy. Ojo (1989) discovered that only the huge borrowers who were predominantly farmers benefited from the fixed interest rates during the period. Appraising the impact of the Structural Adjustment Program (SAP), Ikhide and Alawode (2001) established that Gross National Product would diminish if money stock is reduced through the decrease in interest rate. Thus, the Nigerian economy is not excluded from the notion that the economic activities in the circulation is a function of variation in money stock (Laidler, 1985).

In third world nations, tradable economic activities are essential and countries in this regard are kept poor because the economic activities suffer excessively from the institutional and market failure. To alleviate the economic cost of these distortions, enduring real exchange rate depreciation that raises the relative benefit of investing in the act of second best fashion and tradable activities are to be encouraged. This is the main reason why higher economic growth is strongly associated with the devaluation of currency (China experience). There exist a unique affiliation between economic growth and the rate of interest because the rate of interest is a crucial determining factor of economic progress. Meanwhile, if those other factors as highlighted by Guseh and Oritsejafor (2007) which negatively affect the rate of investment in Nigeria are not adequately analyzed and attended to, then the interest rate deregulation in Nigeria may fail to attain its stated goals optimally.

The high inflation rate, low investment, and increasing unemployment rate are the major challenges faced by the Nigerian economy and these factors over time have slowed the pace of Nigerian economic progress. The problem highlighted above can better be managed or tackled via contractionary and expansionary measures by the Central Bank of Nigeria (CBN) as the monetary mechanism to manipulate the fluctuations experienced over time in the economy. On this note, there arise the need to examine the potency of monetary policy on the Nigerian pursuit of economic stability and growth.

Since the birth of CBN in 1959, the institution has been saddled with the responsibility of manipulating the monetary policy tools to attaining the policy objective of government. But unfortunately, over time, this has not been too effective or elusive.

The impact of monetary policy on growth process in Nigeria has been well researched (Nnanna, 2001; Balogun, 2007; Onyeiwu, 2012; Okoro, 2013) with nearly all of them using annual data that may not adequately address the high volatility of time series macroeconomic variables being employed.

The motivation for this work is therefore to examine the effectiveness of monetary policy instruments on the Nigerian economic growth over the years with monthly data as against the traditional annual data engaged by most researchers and the use of oil revenue as proxy for GDP. The study adopted the use of high frequency data and oil revenue as a proxy for GDP. High frequency data is considered more effective and efficient because time series data often exhibit strong seasonality pattern and volatility. Therefore, higher frequency series like monthly data tend to be more accurate and reliable as it captures more effectively the impact of time than the usual annual data.

This research work is carried out using time series analysis from year 2000 to 2016. Because of the seasonality nature of time series data, it is therefore important that we examine the unit root behavior of the series to ascertain the stationarity of all the variables under review. Having established the stationarity status of the variables, Johansen Cointegration is deployed to confirm the long term affiliation among the parameters. The study also adopted Vector Error Correction Model (VECM) to ascertain the adjustment speed from the possible short-run disequilibrium value to a long-term equilibrium path.

The remaining parts of the study are as follows; section two captures the review of related literature. Section three provides methodology while section four dwell on the empirical findings and the conclusion and policy issues is in section five.

## 2. LITERATURE REVIEW

The stabilization of the rate of exchange, domestic price and the foreign exchange reserve remains the primary objective of the Nigerian monetary policy based on its core role of advancing economic growth and external sector efficiency (Sanusi, 2002). Sanusi highlighted some factors including the legal framework, institutional structure, and conducive political environment which according to him are essential requirements for Central Bank of Nigeria to pursue a dynamic monetary policy in a modern and fast integrated financial market environment.

However, evidence from different countries indicates inconsistencies with theoretical expectations which is what economists always tagged "puzzle". The three puzzles identified in most literature are the price, liquidity, and exchange rate. The price puzzle shows that contractionary monetary policy via positive innovations in the rate of interest result to rise (rather than fall) in price. While the liquidity puzzle indicates that a rise in monetary aggregate goes with an increase (rather than decline) in the rate of interest. Exchange rate remains the most common puzzle where a rise in the rate of interest is associated with depreciation (instead of appreciation) of the domestic currency. In recent investigations, researchers have come up with better ways of dealing with these three puzzles and most of which is fashioned after the framework set by Lucas (1972) where rational expectation approach to the monetary policy study was recommended. Recent studies that have adopted the same approach include (Cochrane, 1998; Kahn *et al*., 2002; Zhang, 2009; Hsing, 2014; Aguir *et al*., 2015; Edeme and Obiayo, 2017; Adjei, 2018; Taguchi and Wanasilp, 2018) to mention but a few.

In developed economies like the United States (U.S), Canada, Australia, UK other developed nations, vast evidence exist on the impact of monetary policy innovations on macroeconomic parameters (Christiano *et al*., 1999; Mishkin, 2002; Rafiq and Mallick, 2008). But the scenario is full of puzzles as well as weak proof in developing countries like Nigeria. For instance, a study was conducted to examine the impact of monetary policy in Nigeria using simultaneous equation models, the findings revealed that, rather than for monetary policy to advance economic growth, it resulted in stagnation and unabated inflation (Balogun, 2007). With the same model, studies also showed that Gambia, Ghana, and Serra Leone, which are neighboring West African countries recorded similar evidence.

In their joint investigations of the relative influence of monetary and fiscal policy on economic progress in Nigeria, Ajisafe and Folorunso (2002) deployed cointegration and error correction modeling approach and annual time series data from 1970 to 2008. They found that monetary policy rather than fiscal measure exerts more effect on economic activities in Nigeria and submitted that much distortion has emanated in the economy as a result of fiscal tool by the government of Nigeria.Chimobi and Uche (2010) evaluated the correlation between money, output, and inflation in Nigeria. Using cointegration and Granger causality approach, the outcome did not establish any long-run relationship among the variables. In this case, supply of money Granger caused both inflation and level of output. They concluded that price stability remained a function of well-tailored monetary policy since the supply of money is a product of changes in the price level and that inflation remained a monetary phenomenon. In the same spirit (Adefeso and Mobolaji, 2010) employed error correction mechanism and cointegration method between 1970

and 2007 to dissect the capacity of fiscal and monetary policy on economic growth in Nigeria. They found that the monetary policy exerted more influence on growth in Nigeria than fiscal policy and that the conclusion was never affected by leaving out the degree of openness. Amassoma *et al.* (2011) used a simplified ordinary least squared method to explore the impact of monetary policy on macroeconomic parameters between 1986 and 2009 in Nigeria. The approach found positive impact on exchange rate and money supply, but it recorded no significant influence on price instability. Onyeiwu (2012) adopted the same econometric technique as Amassoma *et al.* (2011) to evaluate the power of monetary policy on the Nigerian economic activities from 1981 to 2008. The outcome showed that monetary policy proxy by the supply of money has a positive effect on economic growth and balance of payment. The work also indicated a negative influence on the inflation rate. The result of this investigation corroborates the money –price –output hypothesis for the Nigerian economy. Usman and Adejare (2014) examined the impact of monetary policy on industrial growth in Nigeria from 1970 to 2010 with multiple regression. The result demonstrated a significant effects on industrial growth in Nigeria in the year under review with adjusted $R^2$ of 0.8156 (81.2%). Imoughele and Ismaila (2014) examined the extent to which monetary policy affects the manufacturing sector between 1986 and 2012. They found that individual parameter: manufacturing sector's output was boosted by exchange rate, inflation rate, and external reserve. But the supply of broad money (M2) and interest rate failed statistical significance on the output of the industry and manufacturing sector did not significantly add to economic growth, they submitted. The study conducted outside Nigeria indicated that inflation rate and the rate of interest were inversely proportional and provided more evidence on how the economies are affected by the variations in monetary policy (Okoro, 2013).

Veronica (2011) in her study employed ordinary least squared, co-integration and error correction model (ECM) with time series data from 1970 to 2010 to appraise the impact of monetary policy on price stability in Nigeria .The result established a positive long-run relationship between monetary policy and general price level. And the short-run scenario was negative but has a significant correlation. The interest rate was revealed to have had a positive impact on the rate of inflation in the year under review. The study concluded by instituting a clear link between monetary policy instruments and inflation control in Nigeria where a rise in money supply results in an increase in savings, and therefore inflation declines. Thus, the controversial natural rate of the monetarists failed to hold. It was then apparent from the empirical evidence that Treasury bills, interest rate, and gross domestic product (GDP) were not active determinants of the rate of inflation in Nigeria. In his paper, Nnanna (2001) investigated the past few decades in the monetary policy evolution in Nigeria. The Author stated that the level of success recorded so far was as a result of financial sector reform dominated by indirect rather than direct monetary policy tools and this has almost been wiped off by visible fiscal influence, political interference and legal framework where Central Bank operates. Busari *et al.* (2002) in their investigation affirmed that monetary policy stabilized the economy better in the regime of floating exchange rate than administered exchange rate system and also advanced growth more under flexible exchange rate but with depreciation capable of destabilizing the economy. It means that the monetary policy would be more efficient when targeting inflation than using it to stimulate economic growth directly, they concluded. Adegoriola (2018) empirically examined the effectiveness of monetary and fiscal policy instruments in stabilizing Nigerian economy from 1981 – 2015 with Johansen cointegration and Error Correction Model (ECM) .The findings indicate a long run equilibrium relationship between monetary and fiscal policy instruments and economic growth in Nigeria. ECM has the expected negative sign between the accepted regions of less than unity. This is confirmed by the positive relationship between money supply, government expenditure and revenue while interest rate and budget deficit have negative relationship with economic growth during the year under review. Oluseyi *et al.* (2017) explored the long and short-run affiliations between broad money supply and real aggregate output (GDP) between 1981 and 2015 in Nigeria. The study combined both annual and quarterly time series data using an unrestricted version of Mixed Data Sampling (U-MIDAS) technique and Autoregressive Distributed Lag (ARDL) technique approach. The results affirm the existence of a long and

short-run relationship between annual real GDP and quarterly broad money supply at different season while the ARDL result indicates that money supply impacted significantly on real GDP in the long run only. The close of the investigations revealed that the disequilibrium correction terms from the two analytical approaches showed the evidence that there is a tendency for growth targeting in Nigeria which is one of the major objectives of Nigeria economy though at a slower rate.

In the same spirit, Sun (2017) investigated the impact of monetary policy on the economic development of Lao People's Democratic Republic from 1989-2016 with error correction model (VECM). The results show that money supply, interest rate and inflation rate have a negative effect on the real GDP per capita in the long run and only the real exchange rate has a positive sign. The outcome of error correction model demonstrates the existence of short run causality between money supply, real exchange rate and real GDP per capita. Ogbonna and Uma (2017) in their study examined the influence of monetary policy tools on economic growth of Nigeria from 1980 to 2016 with annual data series. They employed Johansen cointegration test and Vector Error correction model. From the results, VECM showed a low speed but a significant adjustment back to equilibrium. The findings also revealed that narrow money supply, exchange rate, interest rate and inflation rate at a certain time frame significantly impact on real gross domestic product. Broad money supply and reserve requirement have inverse relationship with real gross domestic product in the reviewed period. Anowor and Okorie (2016) empirically reassessed the effect of monetary policy on economic growth of Nigeria using the Error Correction Model Method with time series annual data from 1982 to 2013. The result showed that a unit increase in Cash Reserve Ratio (CRR) led to approximately seven units increase in economic growth in Nigeria. The result was in consonance with economic literature as monetary policy among other objectives is geared towards achieving the macroeconomic objectives of sustained economic growth and price stability. Ahmad *et al.* (2016) analyzed the importance of monetary measures in promoting economic growth of Pakistan with annual time-series data covering the range of 1973 to 2014. The study employed Autoregressive Distribution Lag (ARDL) Cointegration approach. The findings show a long-run affiliation between the money supply and exchange rate which has positive influence on economic growth. While Inflation has a positive sign but insignificance, interest rate on the other hand has negative effect on economic growth during the review period. Ezeaku *et al.* (2018) assess the effects of monetary policy transmission channels on industrial growth in Nigeria within the period 1981-2014. The study adopted Johansen cointegration and the error correction model (ECM). The results reveal that the private sector credit, interest rate, and exchange rate channels have negative effects on real output growth, both in the long run and in the short run. The outcomes further show that, relatively, the degrees of the established effects are higher in the long run than in the short run. The result of the Johansen cointegration also show that, in the Nigerian case, monetary policy transmission channels jointly have a long-run relationship with real output growth of the industrial sector, and disequilibrium in the system is corrected at the speed of 72.2% annually. Ifeakachukwu and Alao (2018) explored the extent to which monetary policy has influenced export diversification in Nigeria for the period 1962 to 2014. The study employed descriptive and ordinary least squares techniques. The descriptive analysis revealed that the diversification exercise in Nigeria can only be expressed as average. The regression estimate showed that monetary policy was insignificant in influencing export diversification in Nigeria. The major lesson from the work shows that monetary policy has not played a fundamental role in enhancing export diversification in Nigeria as expected. Ufoeze (2018) investigated the effect of monetary policy on economic growth in Nigeria with a time series data from 1986 to 2016. The study adopted an Ordinary Least Squared technique and also conducted the unit root and co-integration tests. The results suggest the existence of a long run relationship among the variables. In addition, the core findings of the study showed that monetary policy rate, interest rate, and investment have insignificant positive effect on economic growth in Nigeria. Money supply however has significant positive effect on growth while Exchange rate also has significant negative effect on GDP. Money supply and investment granger cause economic growth, while economic growth granger causes interest rate in Nigeria. Overall, monetary policy explains 98% of the changes in economic

growth in the year under review. Hussain and Haque (2017) explored the assessment of the impact of correlation between Money Supply and Per Capita GDP Growth Rate in Bangladesh over the period 1972-2014 with a VECM model. The model is specified with three variables, namely, the percentage of Broad Money to GDP (BMGDP), the Real Interest Rate (RIR) and the Annual per Capital GDP Growth Rate (GRGDP). Findings suggest that steady BMGDP is associated with GRGDP and money supply has important impact on the growth rate of output in the long run.

## 3. ECONOMETRICS PROCEDURE

### 3.1. Data

What this study seeks to pursue is the efficacy of monetary policy instruments on economic growth in Nigeria between 2000 and 2016. Oil revenue (proxy for GDP), money supply (M2), real exchange rate (RER), interest rate (INT) and consumer price index (CPI) were examined with the aid of monthly data series. Data were sourced from Economist Intelligence Unit and International Financial Statistics. All the parameters were transformed into their natural logarithm to capture the impact of growth and to reduce the variance of the dataset and for more meaningful econometric analysis. High frequency data is considered more effective and efficient because most time series data exhibit strong seasonality pattern and volatility. Therefore, higher frequency like monthly data tends to be more accurate and reliable because it captures more the effect of time than quarterly or annual. This is the motivation behind these findings among other things.

### 3.2. Empirical Model

Theoretical and empirical studies abound on the efficacy of monetary policy on the economic growth in Nigeria via the application of various econometric measures. It is the suggestion of the present study that the Interest rate, Money supply (M2), real exchange rate, and Consumer Price Index (CPI) as monetary policy instruments would command influence on the economic growth in the case of Nigeria. Oil revenue was adopted as a proxy for Gross Domestic Product (GDP).

**Oil Revenue**: The choice of oil revenue is as a result of the unavailability of monthly data on GDP. Oil revenue is a product of crude oil production and the prevailing international oil price of crude oil. In Nigeria, oil revenue accounts for almost 90% of the Nigerian export earnings and over 70% of Nigerian national revenue according to 2016 figure of National Bureau of Statistics (NBS). Therefore, the oil sector activities determine to a large extent the behavior of the Nigerian GDP, i.e. whatever affects the oil sector also affects the GDP directly.

**Consumer Price Index:** It measures changes in the price level of a market basket of goods and services purchased by households. Inflation measure changes in the level of retail prices paid by consumers and the retail prices are captured by the consumer price index.

**Real Exchange Rate**: Adjusted for inflation by appropriate foreign price level and deflate by domestic or home country's price level. Real exchange rates are nothing but the nominal exchange rates multiplied by the price indices of the two countries.

**Interest Rate (lending)**: The amount charged and expressed as a percentage of principal by lenders to a borrower for the use of assets typically noted on annual basis.

**Money Supply:** Broad money supply (M2) which measures the supply of money including cash, checking deposit (M1) as well as near money. Near money, in this case, is a product of M2 comprising money market mutual fund and saving deposit and other time deposit that are less liquid in nature.

Based on this background, the following econometric equation represented an expression of the functional relationship between economic growth and monetary policy for the purpose of this work and this we did in accordance with the work of Ajisafe and Folorunso (2002) and Imoughele and Ismaila (2014); Okulegu *et al.* (2013).

$Rev_t = f(M2_t, RER_t, INT_t, CPI_t)$

Where:

*Rev* = Oil Revenue (used as proxy for GDP)

*M2* = Money Supply

*RER* = Real Exchange Rate

*INT* = Lending Rate

*CPI* = Consumer Price Index.

*t* = Time Series.

The equation can be explicitly transformed into the following log-linear specification as stated earlier to capture the growth effects.

$$InRevt = \beta o + \beta_1 InM2t + \beta_2 InRERt + \beta_3 InINTt + \beta_4 InCPIt + \in_t$$

With all the parameters defined earlier, *In* represents natural logarithm and the stochastic error term is $\in_t$.

apriori criteria , oil revenue proxy for GDP is expected to relate positively to money supply (*M2)* while negative affiliation is projected between the oil revenue and consumer price index, interest rate and real exchange rate.

$\beta_1, \beta_2, \beta_3, \beta_4$ are the coefficients that represent the elasticity of all the explanatory variables in the long–term period. Monthly data were collected between the 2000 and 2016.

### 3.2.1. Unit Root Test

Gujarati (2009) affirmed that often, data on time series do possess unit root. Stationarity in the series is defined if its joint distribution is time invariant. It means that the mean, variance and covariance that are cross-sectional moment's distribution do not rely on time and that relationship across time does not vary. Data on time series that contain unit root in an econometric analysis often translates to a misleading and spurious estimate of the relationship between variables. So, it is critical to consider the property dynamism of parameters and the data that measures them prior to evaluation. Diebold and Kilian (2000) stated that ascertaining the stationarity of variables is good for forecasting prior to modeling. It also affords us the opportunity to ensure the order of integration of both dependent and independent parameters converge to the same level. The testing procedures for the unit root which are common and more acceptable are the Augmented (Dickey and Fuller, 1981) test, Phillips and Perron (1988) tests and as well as Kwiatkowski *et al.* (1992) test to validate both ADF and PP test results respectively as represented below in general form .

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta Y_{t-i} + \in_t \text{ SS}$$

### 3.2.2. Cointegration Test

A strong seasonality patterns are often displayed by most time series data such as data on inflation, unemployment, gross domestic product (GDP) with the tendency of a unit root. There exists therefore the need via Johansen Cointegration to ascertain the long term relationship between the variable in the model after the order of integration of the parameters must have been proven. The co-integration procedure defines the long-run relationships among series according to Granger (1981); Engle and Granger (1987); (Engle *et al.*, 1993). In Johansen and Juselius (1990) also demonstrated how trace statistics could be used to establish integrating vector among several parameters. At least one co-integrating vector is required to guarantee cointegration among the variables. In cointegration test, Johansen trace test has the merit of more reliability than the maximum Eigenvalue.

The Johansen and Juselius approach can be formulated with the following VAR model.

$$\Delta Y_t = \Gamma_1 \Delta X_{t-1} + \ldots + \Gamma_{K-1} \Delta X_{t-K+1} + \Pi X_{t-K} + \mu + \in_t$$

Where:

Cointegrating rank number of the vector (i.e. r) is represented by $\prod$. It is calculated by simply evaluate if the Eigen value ($\Pi_1$) is statistically different from zero. Johansen (1988) and Johansen and Juselius (1990) postulate that the estimation of trace statistic can be determined with the aid of eigenvalue.

The trace statistic can be calculated with the following approach:

$$\lambda_{trace} = -T \sum Ln(1 - \lambda_i)$$

The null hypothesis is rejected if the absolute value of the trace statistic is greater than the critical value Osterwald-Lenum (1992). And we can then conclude a co-integrating series and the vice versa.

### 3.2.3. Vector Error Correction Model (VECM)

This approach represents a dynamic pattern with special characteristics that present state of changes from its long-term relationship and possess inbuilt mechanism to adjust with time into its short-term position. Meanwhile, the same level of co-integration is needed to guarantee a long-run association between variables. Error Correction term (ECT) must be statistically different from zero and at the same time negative under this approach. It demonstrates the adjustment speed of how the parameters re-unite towards their long-term values. The ECM equation is given as follows:

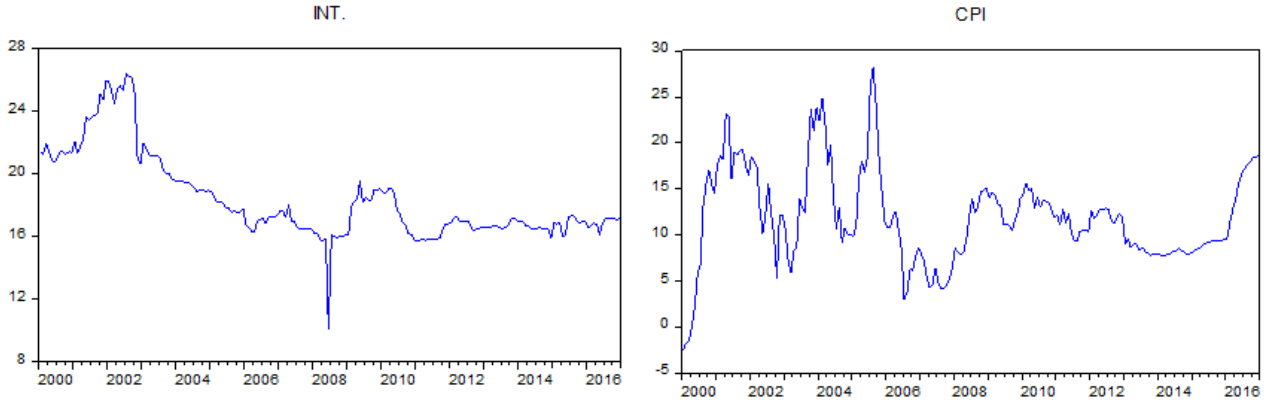
$$\Delta Y_t = \delta(\Delta X_t) + \tau(Y_{t-1} - \theta X_{t-1}) + \varepsilon_t$$

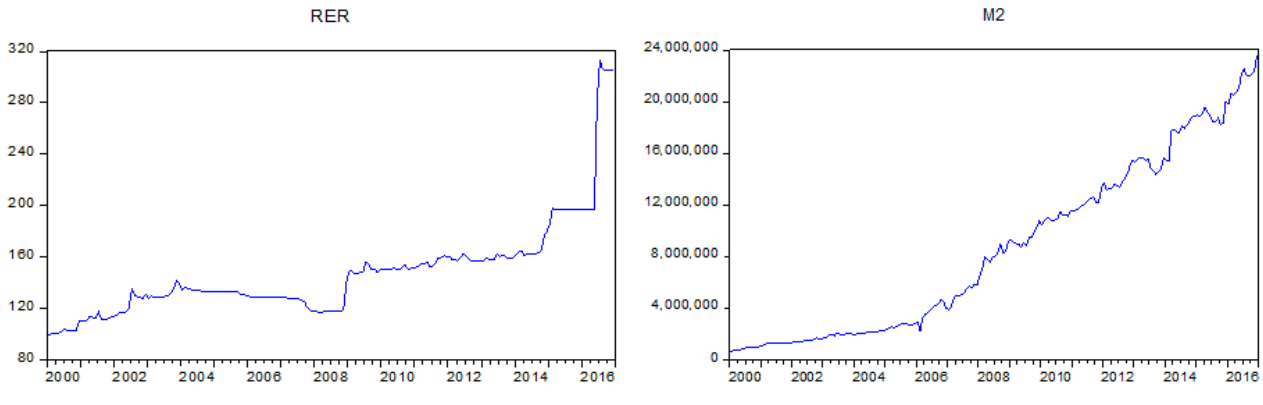
The instability of $Y_t$ close to its long run trend as triggered by, or connected to variation in $X_t$ around its long run trend. The ECT$\approx$ ($Y_T$ - $\theta X_{t-1}$ ) is represented above.

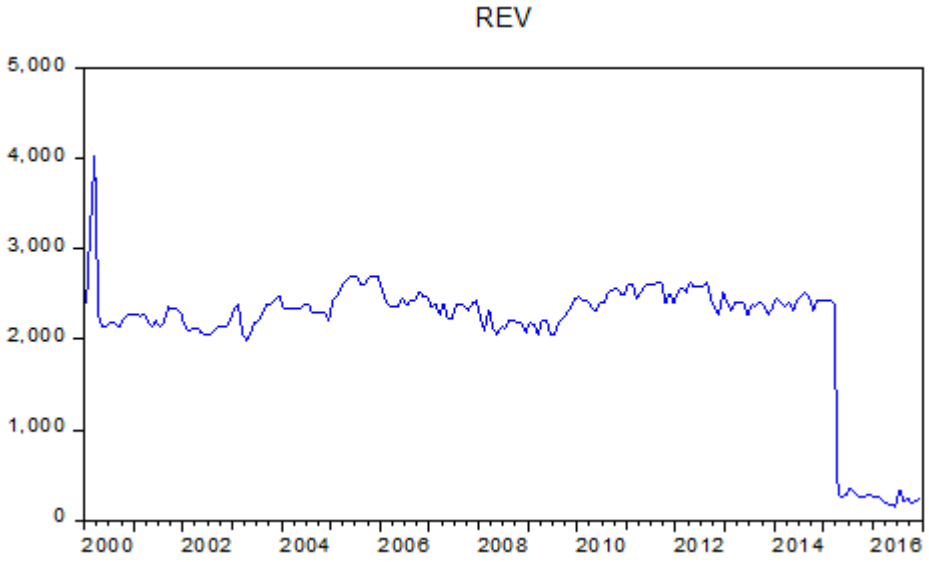
## 4. EMPIRICAL RESULTS

### 4.1. Graphical Analysis

The graphical picture depicts the visual preview of the series under evaluation. This is what is popularly known in time series analysis as eyes ball test. The visual plot is an informal test that gives a glimpse of the behavior of the variables.






**Source:** Authors' computation, 2018

The graphical representations above show that the variables contain trend and volatile and it's a pointer to the need to conduct further test in order to ascertain the stationarity status of the parameters for valid and reasonable econometric analysis.

Table 1. Descriptive Analysis

**Table-1.** Summary Statistics

| | LREV | LRER | LM2 | LINT | LCPI |
|---|---|---|---|---|---|
| Mean | 20.343 | 4.922 | 15.422 | 2.253 | 4.368 |
| Median | 20.471 | 4.913 | 15.563 | 2.380 | 4.354 |
| Maximum | 21.938 | 5.310 | 16.767 | 3.199 | 5.111 |
| Minimum | 18.235 | 4.584 | 13.602 | 0.039 | 3.454 |
| Std. Dev. | 1.135 | 0.194 | 0.956 | 0.593 | 0.482 |
| Skewness | -0.157 | 0.239 | -0.216 | -1.277 | -0.168 |
| Kurtosis | 1.572 | 2.101 | 1.537 | 4.591 | 1.878 |
| Jarque-Bera | 16.028 | 7.767 | 17.454 | 67.898 | 10.280 |
| Probability | 0.000 | 0.021 | 0.000 | 0.000 | 0.006 |
| Sum | 3661.727 | 886.018 | 2775.899 | 405.451 | 786.232 |
| Sum Sq. Dev. | 230.721 | 6.766 | 163.680 | 62.879 | 41.643 |
| Observations | 180 | 180 | 180 | 180 | 180 |

**Source:** Authors'computation,2018

As the table 1 above demonstrates, Oil Revenue proxy for the GDP recorded the highest figure on the average as compared to other parameters. All the series also indicate significant deviation from their mean value as revealed

by the command of standard deviation. Meanwhile, asides the Real Exchange Rate (RER), all other series are negatively skewed. The result as well discovered uneven normal distribution.

### 4.2. Unit Root Test

As earlier discussed that the nature of the stationarity of all the parameters would be verified with the aid of widely used stationary test mechanism of Augmented Dickey-Fuller, Phillips-Perron test. Also Kwiatkowski Phillips Schmidt and Shins test to consolidate both ADF and PP test as demonstrated in the table 2.

**Table-2.** Unit Root Test for ADF, PP and KPSS

| Statistics (Level) | LREV | lag | LM2 | lag | LINT | lag | LRER | Lag | LCPI | lag |
|---|---|---|---|---|---|---|---|---|---|---|
| $\tau_T$ (ADF) | -1.462 | (0) | -1.258 | (0) | -3.135 | (1) | -2.680 | (1) | -2.256 | (0) |
| $\tau_\mu$ (ADF) | -1.665 | (0) | -1.864 | (0) | -3.027 | (1) | -1.677 | (1) | -1.522 | (0) |
| $\tau$ (ADF) | 5.558 | (0) | 5.260 | (0) | -0.887 | (1) | 1.644 | (1) | 7.758 | (0) |
| $\tau_T$ (PP) | -1.475 | (1) | -1.123 | (3) | -2.816 | (3) | -2.349 | (4) | -2.288 | (6) |
| $\tau_\mu$ (PP) | 1.676 | (4) | -2.002 | (5) | -2.736 | (3) | -1.495 | (3) | -1.901 | (10) |
| $\tau$ (PP) | 5.533 | (2) | 5.562 | (2) | -0.827 | (2) | 1.892 | (4) | 7.596 | (6) |
| $\tau_T$ (KPSS) | 0235 | (10) | 0.268 | (10) | 0.268 | (10) | 0.110 | (10) | 0.255 | (10) |
| $\tau_\mu$ (KPSS) | 1.733 | (10) | 1.723 | (10) | 0.531 | (10) | 1.387 | (10) | 1.727 | (10) |
| Statistics (First Difference) | LREV | lag | LM2 | lag | LINT | lag | LRER | lag | LCPI | lag |
| $\tau_T$ (ADF) | -13.495*** | (0) | -14.369*** | (0) | -9.835*** | (2) | -9.517*** | (0) | -12.329*** | (0) |
| $\tau_\mu$ (ADF) | -13.467*** | (0) | -14.239*** | (0) | -9.857*** | (2) | -9.531*** | (0) | -12.201*** | (0) |
| $\tau$ (ADF) | -11.624*** | (0) | -12.366*** | (0) | -9.883*** | (2) | -9.331*** | (0) | -9.383*** | (0) |
| $\tau_T$ (PP) | -13.497*** | (4) | -14.447*** | (4) | -9.857*** | (4) | -9.471*** | (2) | -12.976*** | (11) |
| $\tau_\mu$ (PP) | -13.420*** | (3) | -14.265*** | (2) | -9.879*** | (4) | -9.485*** | (2) | -12.289*** | (9) |
| $\tau$ (PP) | -12.089*** | (6) | -12.739*** | (6) | -9.905*** | (4) | -9.331*** | (0) | -10.024*** | (6) |
| $\tau_T$ (KPSS) | 0.066*** | (4) | 0.085*** | (6) | 0.030*** | (2) | 0.080*** | (3) | 0.046*** | (10) |
| $\tau_\mu$ (KPSS) | 0.245*** | (3) | 0.375** | (3) | 0.041*** | (2) | 0.092*** | (3) | 0.237*** | (8) |

**Source:** Authors' computation, 2018

**Note:** LREV: Oil Revenue; LM2: Money Supply; LINT: Interest Rate; LRER: Real Exchange Rate; LCPI: Consumer Price Index. While the entire series are in logarithm form, $\tau_T$ stands for drift and trend that attracts more attention; $\tau_\mu$ is only a drift without trend, and $\tau$ represents no drift and trend with less attention. Lag lengths are contained in the bracket. Trend and intercept are removed from the upper most general to the minimal definite model in both ADF and PP unit root evaluation. Stars *, ** and ***

### 4.3. Cointegration Test Results

After the stationarity of all the variables were integrated in similar order 1(1). Cointegration test was then put to use to establish the possible long –term affiliation between the parameters.

**Table-3.** Johansen Cointegration Test

| Hypothesized No of CE(s) | Eigenvalue | Trace Statistic | 5% Critical Value | 1% Critical Value |
|---|---|---|---|---|
| r=0 | 0.2622 | 99.606 | 76.07 | 84.45** |
| r≤ 1 | 0.996 | 46.391 | 53.12 | 60.16 |
| r≤ 2 | 0.819 | 28.028 | 34.91 | 41.07 |
| r≤ 3 | 0.549 | 13.077 | 19.96 | 24.60 |
| r≤ 4 | 0.0180 | 3.194 | 9.24 | 12.97 |

**Source:** Authors' computation, 2018

**Note:** Trace test indicates 1 cointegrating vector at both 1% and 5% level respectively. (**) the symbol represents rejection of the hypothesis at both 1% and 5% level.

From the above, at both 5 and 1 percent level individually, the result of the cointegration test indicates 1 cointegrating equation. Consequently, we reject the null hypothesis of no cointegrating vector and conclude on a cointegrating equation (s) of the alternative as revealed by the none trace statistic which is greater than the critical value at both 1 and 5 % respectively. This shows therefore that the conclusion can be drawn that a long-term relationship do exist between economic growth proxy by oil revenue as dependent variable and the Nigerian monetary policy instruments of money supply (M2), real exchange rate, consumer price index (CPI) and the interest

rate as explanatory parameters. Afterward, we can proceed to test for Vector Error Correction Model with the establishment of 1 Cointegrating vector.

### 4.4. Vector Error Correction Model (VECM)

Based on the cointegration results, long-term vectors were revealed between economic growth and monetary policy. This therefore necessitates the need to evaluate and ascertain the short-long-run equilibrium adjustment path with the aid of Vector Error Correction Model. The technique measures the possible speed with which the variables under study converge towards their long-run equilibrium. Error Correction Term must be statistically different from zero and negative indicating a long-term evidence of equilibrium and efficiency of Error Correction tool.

**Table-4.** Estimation of Vector Error Correction Model (VECM)

| **Short-Run Causality** | **Coefficient** | **Std. Error** | **t-statistic** |
|---|---|---|---|
| LREV (-1) | 0.184989 | 0.12651 | 1.46228 |
| LRER (-1) | -0.278637 | 0.123576 | -1.18189 |
| LCPI (1-) | -0.207511 | 0.28699 | -0.272305 |
| LINT (-1) | -0.005527 | 0.01981 | -0.27898 |
| LM2 (-1) | -0.278170 | 0.14836 | -1.87500 |
| **ECT -0267612** | | | |
| Long-Run Causality | Coefficient | Std. Error | t-statistic |
| LRER | 0.600695 | 0.20172 | 2.977792 |
| LCPI | -0.577517 | 0.15763 | -3.66373 |
| LINT | -0.577517 | 0.02173 | -3.06913 |
| LM2 | -0.965586 | 0.6889 | -14.0154 |

**Source:** Authors' computation, 2018

In the short run as shown above, all the variables are statistically insignificant. A 1% increase in consumer price index (CPI) will reduce the GDP by 0.207511% while GPD goes down by about 0.278637% with a percentage increase in the real exchange rate. If the interest rate increases by 1%, GDP will fall by 0.005527%, GDP will also diminish by 0.278170% with a percent increase in money supply. While the interest rate, real exchange rate, and consumer price index conform to apriori expectations, money supply fail to comply as it turned negative instead of positive expectation.

Long-term coefficients are significant statistically at all levels according to table 4 above. It shows that a 1% rise in money supply (M2) will reduce the GDP by 0.965586% while GDP goes down also by 0.066707% with a percent increase in interest rate. If the real exchange rate increases by 1%, GDP will increase by 0.600695% and GDP reduces by 0.577517% with a 1% rise in consumer price index (CPI). Again money supply fails apriori criteria test in the long run, and the real exchange rate though significant but positive in defiance of the expected sign, interest rate and consumer price index are negative as expected and statistically different from zero.

The figure of Error Correction Term (ECT) according to the result stood at -0.267612, approximately 27%. Based on the error correction principle, the figure is significant and negative which provides further evidence for the earlier assertion that the GDP indeed cointegrated with the explanatory variables. The results indicate that if there is deviation from the initial equilibrium, only 27% speed of adjustment is corrected monthly as the variables move towards restoring equilibrium.

In monetary policy transmitting mechanism, the supply of money plays a pivotal role especially in developing countries like Nigeria where a strong monetary base is often advised by the stakeholders so as to allow for smooth transmitting adjustment within the system.

However, despite the significance of money supply in the monetary policy transmitting channels, there are still some empirical papers that actually disregarded supply of money to find out the reaction of GDP with different econometric techniques (Akujuobi, 2010), (Abaenewe and Ndugbu, 2012). Though they reached no compromise in

terms of their findings but all concluded on the important role of money supply in the channels of transmitting mechanism.

In this study, we also experimented the model with monthly data frequency mainly to find out if the outcome would be an improvement on our results if money supply (M2) was excluded from our model (see appendix A). Though the result showed one (1) cointegrating equation at both 5 and 1 % respectively but the short-run coefficients of (interest rates, consumer price index and real exchange rate) were not statistically significant. While the real exchange rate and the consumer price index were statistically significant in the long-run, interest rates also failed the significant test. The Vector Error Correction term (ECT) though negative, but it is not significant in compliance with Vector Error Correction Principle.

We also went a step further to exclude the rate of interest from the model to actually ascertain if that will lead to a substantial improvement on our results or will leave it unchanged (see appendix B). The outcome demonstrated that with or without the interest rate the results remain the same. Like we have with the full model, the removal of interest rate still leave the long-run coefficients statistically significant with one (1) cointegrating equation at both 1 and 5% respectively. The Error Correction Term is also significantly different from zero with the right sign (negative) in compliance with Error Correction principle.

The outcome of both scenarios have demonstrated the place and the crucial role of money supply in the transmitting mechanism channels especially in a developing economy like Nigeria where stakeholders often push for a strong monetary base to facilitate economic growth and stability.

## 5. CONCLUSION, KEY POLICY ISSUES AND RECOMMENDATIONS

The main objective of this study is to establish the efficacy of monetary policy instruments on growth process in Nigeria. The outcome demonstrates that the long-term coefficients are all statistically different from zero at all levels. The significant coefficients of consumer price index (CPI), real exchange rate, interest rate as well as money supply in the long-run signified the efficacy of the parameters as crucial impulse transmitting mechanism of monetary policy to the Nigerian growth process. While the coefficient of the supply of money is negative, Real Exchange Rate maintains positive relationship with GDP as against the apriori expectations. The possible reason for the fall or negative sign in the supply of money could be a ploy by the CBN to deliberately curb inflationary pressure within the economy (i.e. tight monetary policy). The positive association recorded between exchange rate and economic growth could also be linked to the negative growth of the GDP in 2016 which coincided with the recession period as the relationship supposed to be inverse.

This research work has further proven that monetary policy instruments have the capacity to command a strong influence on economic growth subject to policy combination adopted by the monetary policy authority in Nigeria. The study affirmed that implementing monetary policy in less developed economy like Nigeria attracts extra challenges that are not common to developed countries such as threat of currency substitution, fiscal dominance and political interference.

Having established the veracity of the monetary policy to stimulate economic growth in Nigeria, we also found out that in reality the policy has been in and out in terms of its impact being felt as expected. And the following factors have been identified as the reasons why the monetary policy seems to be a puzzle in Nigeria.

- **Threat of Currency Substitution**: This practice of holding as store of value or medium of exchange the currency of another country in addition to the home country typically exacerbate the volatility of the currencies of the exchange rate and affect the stabilizing monetary policies intervention of the Central Bank.
- **Fiscal Dominance**: With a large government budget deficit and debt stock arising from fiscal inefficiency, prevention of government from bankruptcy becomes the monetary policy targets rather than economic objective such as economic growth, employment and inflation.

- **Poor Financial System**. The emerging report by the Price water Cooper PwC recently indicated that the inclusive and sustainable economic growth is being held back in Nigeria as result of lack of an efficient and resilient financial system.
- **Political Interference**: Only by fostering a formidable and autonomous institutions capable of reinforcing our economy and the rule of law unrestricted from political influence that we can attain the desired growth and development in Nigeria.

In view of the above highlighted factors, we would have recommended inflation targeting framework to further boost growth. Meanwhile, with the prevailing economic dispensation in Nigeria and other part of the world, such economic model may not be suitable to address our foreign reserves problem, exchange rate variability, economic growth and employment objective of the Nigerian economy. The last global financial and economic crisis has put a serious dent on the inflation targeting policy where low inflation and interest rate failed to achieve the desired economic growth in US and other advanced counties.

Consequent upon this, we therefore recommend Nominal GDP Targeting Policy Approach in the face of the new economic paradigm tagged the new normal which has expanded the CBN mandate beyond the price stability objective. This approach which is in tandem with Keynesian advocacy for low interest rate in an economy like ours suffering from huge output gap and financial market imperfection seems more plausible and would further strengthen the relative economic growth being experienced at the moment. It would also boost foreign reserves, more stable exchange rate and engender low inflation rate. Additionally, following the exit of Nigeria from recession in second quarter of 2017 under the new economic model, hanging Nigeria's faith to only the inflation target framework may be sub-optimal to counter Nigerian humongous macroeconomic issues facing the economy. Though, inflation targeting remains a relevant policy approach but may be too weak if deployed alone to address our financial and economic crisis and by extension to support the Economic Recovery and Growth Plan (ERGP) of the Nigerian Government.

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## APPENDICES

**Appendix A.** (Removal of Money supply from the model)

| Hypothesized | | Trace | 5 Percent | 1 Percent |
|---|---|---|---|---|
| No. of CE(s) | Eigenvalue | Statistic | Critical Value | Critical Value |
| None ** | 0.221938 | 73.74737 | 53.12 | 60.16 |
| At most 1 | 0.074188 | 29.83126 | 34.91 | 41.07 |
| At most 2 | 0.061277 | 16.34152 | 19.96 | 24.60 |
| At most 3 | 0.029696 | 5.275468 | 9.24 | 12.97 |

Trace test indicates 1 cointegrating equation(s) at both 5% and 1% levels
*(**) denotes rejection of the hypothesis at the 5%(1%) level

**Vector Error Correction Model ( VECM)**

| Cointegrating Eq: | CointEq1 | | | |
|---|---|---|---|---|
| LREV(-1) | 1.000000 | | | |
| LRER(-1) | 4.378198 | | | |
| | (1.16711) | | | |
| | [ 3.75133] | | | |
| LINT(-1) | -0.131241 | | | |
| | (0.12918) | | | |
| | [-1.01598] | | | |
| LCPI(-1) | -3.525572 | | | |
| | (0.32117) | | | |
| | [-10.9773] | | | |
| C | -26.40123 | | | |
| Error Correction: | D(LREV) | D(LRER) | D(LINT) | D(LCPI) |
| CointEq1 | -0.020340 | -0.003107 | 0.069840 | 0.009614 |
| | (0.01512) | (0.00472) | (0.05782) | (0.00371) |
| | [-1.34492] | [-0.65887] | [ 1.20795] | [ 2.59072] |
| D(LREV(-1)) | 0.002660 | -0.016167 | -0.204497 | -0.038937 |
| | (0.07788) | (0.02428) | (0.29773) | (0.01911) |
| | [ 0.03416] | [-0.66584] | [-0.68685] | [-2.03753] |
| D(LREV(-2)) | -0.003297 | -0.065463 | -0.475844 | 0.082725 |
| | (0.07717) | (0.02406) | (0.29504) | (0.01894) |
| | [-0.04273] | [-2.72059] | [-1.61280] | [ 4.36842] |
| D(LRER(-1)) | -0.259435 | 0.344688 | 0.529095 | 0.025480 |
| | (0.24511) | (0.07642) | (0.93706) | (0.06014) |
| | [-1.05845] | [ 4.51034] | [ 0.56463] | [ 0.42365] |
| D(LRER(-2)) | -0.004417 | -0.126317 | -0.454044 | -0.060996 |
| | (0.24884) | (0.07759) | (0.95133) | (0.06106) |
| | [-0.01775] | [-1.62811] | [-0.47727] | [-0.99894] |
| D(LINT(-1)) | 0.000641 | -0.010247 | 0.280685 | -0.006959 |
| | (0.02055) | (0.00641) | (0.07858) | (0.00504) |
| | [ 0.03116] | [-1.59899] | [ 3.57218] | [-1.37992] |
| D(LINT(-2)) | -0.003610 | -0.006580 | 0.015072 | 0.001943 |
| | (0.02072) | (0.00646) | (0.07920) | (0.00508) |
| | [-0.17426] | [-1.01875] | [ 0.19030] | [ 0.38225] |
| D(LCPI(-1)) | -0.103285 | -0.128483 | 0.104856 | 0.056807 |
| | (0.29674) | (0.09252) | (1.13444) | (0.07281) |

| | | | | |
|---|---|---|---|---|
| | [-0.34807] | [-1.38873] | [ 0.09243] | [ 0.78017] |
| D(LCPI(-2)) | -0.029740 | 0.047734 | 0.895677 | -0.097532 |
| | (0.29453) | (0.09183) | (1.12599) | (0.07227) |
| | [-0.10098] | [ 0.51981] | [ 0.79546] | [-1.34954] |
| C | 0.022083 | 0.004648 | 0.002256 | 0.008945 |
| | (0.00598) | (0.00186) | (0.02287) | (0.00147) |
| | [ 3.69187] | [ 2.49234] | [ 0.09864] | [ 6.09457] |
| R-squared | 0.026239 | 0.180026 | 0.112498 | 0.177547 |
| Adj. R-squared | -0.026239 | 0.135836 | 0.064669 | 0.133224 |
| Sum sq. resids | 0.395356 | 0.038433 | 5.778405 | 0.023805 |
| S.E. equation | 0.048656 | 0.015170 | 0.186014 | 0.011939 |
| F-statistic | 0.499992 | 4.073890 | 2.352073 | 4.005690 |
| Log likelihood | 289.0624 | 495.3443 | 51.69682 | 537.7379 |
| Akaike AIC | -3.153248 | -5.484116 | -0.471151 | -5.963140 |
| Schwarz SC | -2.973804 | -5.304673 | -0.291707 | -5.783697 |
| Mean dependent | 0.020034 | 0.002886 | -0.002752 | 0.009398 |
| S.D. dependent | 0.048030 | 0.016319 | 0.192337 | 0.012824 |
| Determinant resid covariance (dof adj.) | | 2.47E-12 | | |
| Determinant resid covariance | | 1.96E-12 | | |
| Log likelihood | | 1381.357 | | |
| Akaike information criterion | | -15.11137 | | |
| Schwarz criterion | | -14.32182 | | |

**Appendix-B.** (Removal of Interest Rate from the model)

| **Hypothesized** | | **Trace** | **5 Percent** | **1 Percent** |
|---|---|---|---|---|
| No. of CE(s) | Eigenvalue | Statistic | Critical Value | Critical Value |
| None ** | 0.255288 | 81.15075 | 53.12 | 60.16 |
| At most 1 | 0.088337 | 29.56819 | 34.91 | 41.07 |
| At most 2 | 0.053463 | 13.38325 | 19.96 | 24.60 |
| At most 3 | 0.021301 | 3.767900 | 9.24 | 12.97 |

Trace test indicates 1 cointegrating equation(s) at both 5% and 1% levels
*(**) denotes rejection of the hypothesis at the 5%(1%) level

**Vector Error Correction Model ( VECM)**

| **Cointegrating Eq:** | **CointEq1** | | | |
|---|---|---|---|---|
| LREV(-1) | 1.000000 | | | |
| LRER(-1) | 0.571893 | | | |
| | (0.22286) | | | |
| | [ 2.56621] | | | |
| LM2(-1) | -0.895712 | | | |
| | (0.07200) | | | |
| | [-12.4408] | | | |
| LCPI(-1) | -0.666477 | | | |
| | (0.16974) | | | |
| | [-3.92635] | | | |
| C | -6.479153 | | | |
| Error Correction: | D(LREV) | D(LRER) | D(LM2) | D(LCPI) |
| CointEq1 | -0.267272 | 0.019905 | -0.155782 | -0.019179 |
| | (0.06542) | (0.01923) | (0.05905) | (0.01647) |
| | [-4.08573] | [ 1.03525] | [-2.63803] | [-1.16465] |
| D(LREV(-1)) | 0.186041 | -0.018152 | 0.052725 | -0.025739 |
| | (0.12597) | (0.03702) | (0.11371) | (0.03171) |
| | [ 1.47691] | [-0.49026] | [ 0.46367] | [-0.81168] |
| D(LREV(-2)) | 0.130820 | -0.274108 | 0.197639 | 0.196861 |
| | (0.13485) | (0.03964) | (0.12173) | (0.03395) |
| | [ 0.97009] | [-6.91549] | [ 1.62353] | [ 5.79895] |
| D(LRER(-1)) | -0.273453 | 0.329169 | -0.075645 | 0.078583 |
| | (0.23153) | (0.06805) | (0.20901) | (0.05829) |
| | [-1.18107] | [ 4.83697] | [-0.36193] | [ 1.34825] |
| D(LRER(-2)) | -0.004823 | -0.091611 | -0.028455 | -0.051107 |

| | | | | |
|---|---|---|---|---|
| | (0.23342) | (0.06861) | (0.21072) | (0.05876) |
| | [-0.02066] | [-1.33525] | [-0.13504] | [-0.86974] |
| D(LM2(-1)) | -0.265167 | 0.013725 | -0.157232 | -0.013075 |
| | (0.14697) | (0.04320) | (0.13268) | (0.03700) |
| | [-1.80417] | [ 0.31771] | [-1.18507] | [-0.35338] |
| D(LM2(-2)) | -0.186786 | 0.307806 | -0.275880 | -0.155603 |
| | (0.16057) | (0.04720) | (0.14495) | (0.04042) |
| | [-1.16324] | [ 6.52170] | [-1.90323] | [-3.84938] |
| D(LCPI(-1)) | -0.215339 | -0.066747 | -0.350925 | 0.068067 |
| | (0.27941) | (0.08212) | (0.25223) | (0.07034) |
| | [-0.77070] | [-0.81275] | [-1.39131] | [ 0.96772] |
| | | | | |
| D(LCPI(-2)) | -0.164687 | 0.019399 | -0.235043 | -0.072407 |
| | (0.28179) | (0.08283) | (0.25438) | (0.07094) |
| | [-0.58442] | [ 0.23421] | [-0.92398] | [-1.02070] |
| C | 0.025784 | 0.003196 | 0.024771 | 0.008677 |
| | (0.00562) | (0.00165) | (0.00507) | (0.00141) |
| | [ 4.58938] | [ 1.93522] | [ 4.88412] | [ 6.13519] |
| R-squared | 0.107755 | 0.332279 | 0.066749 | 0.206831 |
| Adj. R-squared | 0.059670 | 0.296294 | 0.016454 | 0.164085 |
| Sum sq. resids | 0.362259 | 0.031297 | 0.295208 | 0.022957 |
| S.E. equation | 0.046575 | 0.013690 | 0.042044 | 0.011725 |
| F-statistic | 2.240932 | 9.233840 | 1.327159 | 4.838633 |
| Log likelihood | 296.7996 | 513.5224 | 314.9138 | 540.9464 |
| Akaike AIC | -3.240674 | -5.689519 | -3.445354 | -5.999394 |
| Schwarz SC | -3.061230 | -5.510076 | -3.265910 | -5.819951 |
| Mean dependent | 0.020034 | 0.002886 | 0.016614 | 0.009398 |
| S.D. dependent | 0.048030 | 0.016319 | 0.042394 | 0.012824 |
| Determinant resid covariance (dof adj.) | | 3.38E-14 | | |
| Determinant resid covariance | | 2.68E-14 | | |
| Log likelihood | | 1760.990 | | |
| Akaike information criterion | | -19.40101 | | |
| Schwarz criterion | | -18.61146 | | |