

## Behavioral Pattern of Monetary Policy Variables and Effects on Economic Growth: An Econometric Investigation of Nigeria.

Ebiringa, Oforegbunam Thaddeus<sup>\*1</sup>; Onuorah Anastasia Chi-Chi<sup>2</sup> and Obi, Henry Kenedunium<sup>3</sup>

1. Department of Management Technology, Federal University of Technology, Owerri, P.M.B. 1526 Owerri, Nigeria.
2. Department of Accounting, Banking and Finance, Delta State University, Asaba Campus, Nigeria.
3. EcoBank Nigeria Plc, Orlu Imo State Nigeria  
\*otebiringa@yahoo.com

### ABSTRACT

This paper established that interest rate, inflation, and money supply had negative effects on Nigeria's economic growth in the short run, while in the long run; exchange rate had significant positive effects. A combination of Breusch-Godfrey Serial Correlation, White Heteroskedasticity, Ramsey Reset, Dickey-Fuller unit root was used for preliminary analysis. Ordinary Least Square (OLS) was used for short run estimate, while a combination of Johansen Co-Integration, Granger Causality Tests and impulse response analysis were used for long run estimation. Our model shows that the four monetary policy variables have 88% joint probability of affecting level economic growth as well as explained 84% of economic growth Nigeria experience for the period 1980-2012. The paper concludes that for sustainable economic growth to be achieved, monetary authority must devise short term strategies to manage periodic volatility in interest rate, money supply and inflation, while medium and long term strategies must be adopted to stabilize the value of the domestic currency.

**Keywords:** *Economic growth, monetary policy, interest rate, inflation, money supply, exchange rate.*

### 1.0 Introduction

Monetary policies implemented in recent years in Nigeria have been aimed at fast tracking economic reform programmes with the objective of providing enabling financial system infrastructure and environment to support sustainable economic growth. The Central Bank of Nigeria (CBN) at different times has used direct and indirect approaches to address key problems of instability in interest rate, exchange rate regimes which are believed will have direct effects on money supply and inflation and productivity in the short run and in the long run will affect rate of economic growth (Chimobi and Uche, 2010). It must be noted that the effectiveness of a monetary institution like the CBN can only be measured from the perspective stability in interest rate, exchange rate, money supply, inflation in the short term and rate of economic growth in the long run.

Ajie and Nenbee (2010) posit that monetary policy - the act of controlling the supply or price of money - may exert a powerful influence over the economy. Ajisafe and Folorunso (2002) believe that macroeconomic policies in developing countries, Nigeria inclusive, are designed to stabilize the economy, stimulate growth and reduce poverty. Monetary policy formulation is based on the duo of money supply and credit availability in the economy. In ensuring monetary stability, the CBN implements policies that guarantee the orderly development of the economy through appropriate changes in variables that influence money supply using such instruments as the cash reserve requirement, liquidity ratio, open market operations to influence credit operations of banks and movement of reserves (Masha et al., 2004).

One may be tempted to conclude that the use of monetary policy variables in Nigeria seems not to have led to the desired level of economic growth given the dismal performance of the economy in recent years. Little wonder Donli (2004) insist that the last two decades witnessed series of reforms aimed at the revitalization of the Nigerian economy owing to series of crises that had negative effects on the growth of the economy. Some have seen the problems low growth rate of Nigerian economy as a direct derivative of structural imbalances in the monetary system. Donli (2004) contends that these structural defects consisted of undiversified monolithic and monoculture production base and public revenue sources (undue reliance on agricultural products from 1960s and a total shift to exclusive reliance on petroleum since 1973). The outcome of these events as it relates to Nigeria has been that economic growth has relied more on external drivers than on internal factors. The objective of this paper therefore is to diagnose the behavioral pattern of selected monetary aggregates as it relates to their use as critical monetary policy drivers for economic growth.

This paper significant given that monetary policy has remained a critical vehicle used by government to implement Nigeria's economic transformation programme. In 1980 (austerity measures) was introduced which metamorphosed into Structural Adjustment Programme (SAP) of 1985 and Vision 2000 of 1996 and the most recent being Vision 20-2020 and FSS 20-2020, whose objective is to put Nigeria on the path of being one of the twenty leading economies of the world come year 2020. Findings made in this paper provides the much needed

empirical insights for appraising the performance of monetary authorities as well using dynamic econometric models developed in having proper understanding behavioral patterns of critical drivers of monetary policy for achieving sustainable economic growth.

## **2.0 Theoretical Foundation**

The objective of using Monetary policy instruments to regulate the quality and quantity of money supply in the economy hinge on the theoretical foundations as laid by Irving Fisher (1976), Friedman (1968), Modigliani (1963) and Keynes (1930). The theory of monetary policy as fundamental to the management of economy got its root from the works of Irving Fisher (1976), who laid the foundation of the quantity theory of money through his equation of exchange. In his proposition, money has no effect on economic aggregates but price. However, the role of money in an economy got further elucidation from Keynes (1930) and other Cambridge economists who proposed that money has indirect effect on other economic variables by influencing the interest rate which affects investment and cash holding of economic agents. The position of Keynes is that unemployment arises from inadequate aggregate demand which can be increased by increase in money supply which generates increase spending, increase employment and economic growth. However, he recommends a proper blend of monetary and fiscal policies as at some occasions, monetary policy could fail to achieve its objective. The role of monetary policy which is of course influencing the volume, cost and direction of money supply was effectively conversed by Friedman (1968), whose position is that inflation is always and everywhere a monetary phenomenon while recognizing in the short run that increase in money supply can reduce unemployment but can also create inflation and so the monetary authorities should increase money supply with caution.

Different transmission channels through which monetary policy affects economic activities exist and these channels of transmissions have been broadly examined under the monetarist and Keynesian schools of thought. The monetarist postulates that change in the money supply leads directly to a change in the real magnitude of money. Describing this transmission mechanism, Friedman and Schwartz (1963) say an expansive open market operations by the Central Bank, increases stock of money, which also leads to an increase in Commercial Bank reserves and ability to create credit and hence increase money supply through the multiplier effect. In order to reduce the quantity of money in their portfolios, the bank and non-bank organizations purchase securities with characteristics of the type sold by the Central Bank, thus stimulating activities in the real sector. This view is supported by Tobin (1978) who examines transmission effect in terms of assets portfolio choice in that monetary policy triggers asset switching between equity, bonds, commercial paper and bank deposits. He says that tight monetary policy affects liquidity and banks' ability to lend, which therefore restricts loan to prime borrowers and business firms to the exclusion of consumption spending thereby contracting effective demand and investment. Conversely, the Keynesians posit that change in money stock facilitates activities in the financial market affecting interest rate, investment, output and employment. Modigliani (1963) supports this view but introduced the concept of capital rationing and said willingness of banks to lend affects monetary policy transmission. In their analysis of use of bank and non-bank funds in response to tight monetary policy, Oliner and Rudebush (1995) observe that there is no significant change in the use of either but rather larger firms crowd out small firms in such times and in like manner Gertler and Gilchrist (1991) supports the view that small businesses experience decline in loan facilities during tight monetary policy and they are affected more adversely by changes in bank related aggregates like broad money supply. Further investigation by Borio (1995) who investigated the structure of credit to non-government borrowers in fourteen industrialized countries observe that it has been influenced by factors such as terms of loan as interest rates, collateral requirement and willingness to lend.

Monetarists like Friedman (1963) emphasized money supply as the key factor affecting the wellbeing of the economy. Thus, in order to promote steady growth rate, they insist that money supply should grow at a fixed rate, instead of being regulated and altered by the monetary authority. Keynes on the other hand, maintained that monetary policy alone is ineffective in stimulating economic activity because it works through indirect interest rate mechanism. Friedman equally argued that since money supply is substitutive not just for bonds but also for many goods and services, changes in money supply will therefore have both direct and indirect effects on spending and investment respectively. Dagmara and Łukasz (2013) referencing Brunner and Meltzer spending model insist that the demand for money will depend upon the relative rates of return available or different competing assets in which wealth can be.

## **2.1 Empirical Review**

Hameed, et al (2012) presented a review on how the decisions of monetary authorities influence the macroeconomic variables like gross domestic product (GDP), money supply, interest rates, exchange rates and inflation. The using ordinary least square (OLS) they explained the relationship between the variables under study and came to a conclusion that tight monetary policy with balanced adjustments money supply, interest

rates, exchange rates and inflation shows a positive relationship with GDP. Ajisafe and Folorunso (2002) had earlier assessed the relative effectiveness of monetary and fiscal policy on economic activity in Nigeria using co-integration and error correction modeling techniques using time series data for the period 1970-1998. The result of their analysis shows that monetary rather than fiscal policy exerts a great impact on economic growth in Nigeria. They found that emphasis on fiscal action of the government has led to greater distortion in the Nigerian economy. Ajisafe and Folorunso (2002) are, however, of the opinion that both monetary and fiscal policies should be complementary. Ghosh and Saibal (2006) developed an empirical model to explore the role that bank characteristics play in influencing the monetary transmission process, employing data on Indian commercial banks for the period 1992-2004. Their findings indicate that for banks classified according to size and capitalization, a monetary contraction lowers bank lending, although large and well-capitalized banks are able to shield their loan portfolio from monetary shocks.

Dagmara and Łukasz (2013) examines the actual degree of Polish monetary policy independence in the context of joining the Euro zone. It is frequently argued that the main cost of the participation in any other common currency area, is the loss of monetary policy independence. In contrast, the paper raises the question of the actual possibility of such a policy in a small open economy operating within highly liberalized capital flows and highly integrated financial markets like Poland. Vector Error-Correction Mechanism model and several parametric hypotheses concerning the speed and asymmetry of adjustment was used.

### 3.0 Methodology

In order to realize the objective of this paper an econometric diagnostic procedure is adopted to understand the behavior of the time series data before suitable model can be developed. The operationalization and analytical procedure is based on the following relationship model:

$$GDP = f(INT, INF, EXR, MSP) \quad (1)$$

Where:  $GDP$  = Gross Domestic product,  $INT$  = Interest Rate,  $INF$  = Inflation Rate,  $MSP$  = Money Supply and  $EXR$  = Exchange Rate.

### 3.1 Model Specification

A functional model is specified for the time series data to determine the relationship between Economic growth and Monetary Policy variables as follows:

$$\Delta GDP_t = \beta_1 + \beta_2 \sum_{i=1}^n INT_{t-1} + \beta_3 \sum_{i=1}^n INF_{t-1} + \beta_4 \sum_{i=1}^n EXR_{t-1} + \beta_5 \sum_{i=1}^n MSP_{t-1} + \delta_1 VAR(-1) + \varepsilon_t \quad (2)$$

where  $VAR(-1)$  is VAR term and  $\varepsilon_t$  is Error term. The presumptive sign or the a priori expectation for model in equation 1 and 2 is:  $\forall \beta_2, \beta_3 > 0$  and  $\forall \beta_4, \beta_5 < 0$ . The notations imply that an increase in interest and inflation may result in Gross domestic product increase while Money supply and exchange rate decrease gross domestic product.

The Long run effects are captured through the individual coefficients of the log-transformed terms. That is  $\beta_i$  captures the impact while the coefficient of the VAR variable contains information about whether the past values of variables affect the current values of the variables under study. The size and statistical significance of the coefficient of the residual correction term measures the tendency of each variable to return to the equilibrium (Lutkepohl, 2005).

### 3.2 Estimation Procedure

This paper adopts technique to test for presence of stationarity at level order using time series properties of the variables subjected to Augmented Dickey Fuller Test statistic and performance co integration to examine long run convergences of the variable equations. VAR model for multivariate analysis of the identify variables (INT, INF, MSP and EXR) on GDP is used to determine their relationship and also test the significance level of each variable on GDP. The Causal effect and significant relationship among INT, INF, MSP, EXR and GDP is determined by the Granger Causality Test procedure (Chari, Kehoe and Mc Grattan, 2008; Johansen 1995; Granger and Jin-Lung Lin 1994). In addition, ten periods and residual pattern of growth rate and exchange rate is investigated over the years of study.

### 4.0 Results & Discussion

A combination of preliminary analysis, short run and long run models were generated in this investigation.

#### 4.1 Diagnostic Test

The diagnostic test of the time data set properties results are shown on Figure 1

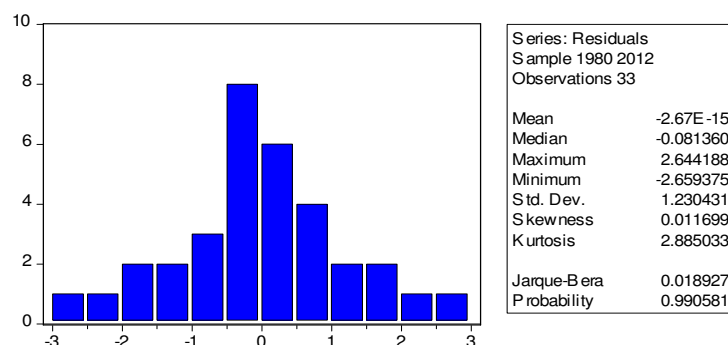


Figure 1: Normality Test

Table 1: Preliminary Analysis

##### Breusch-Godfrey Serial Correlation LM Test:

F-statistic	17.21237	Probability	0.000017
Obs*R-squared	18.80052	Probability	0.000083

##### White Heteroskedasticity Test:

F-statistic	2.607443	Probability	0.033017
Obs*R-squared	15.34489	Probability	0.052776

##### Ramsey RESET Test:

F-statistic	2.480830	Probability	0.061559
Log likelihood ratio	14.23405	Probability	0.014189

Figure 1 and Table 1 show that the pattern of the time series variables are normally distributed as the associated probability of JB-statistics is greater than 0.05 and the probability values are less than the critical value at 5%. The null hypothesis is rejected in favour of the alternative that the variables are homoscedasticity in pattern, not serially correlated and stable for prediction.

Table 2 reveal that there is no unit root in the time series properties when the variables. GDP is stationary at order 2 while INT, INF, MSP and EXR are stationary at order 1 when subjected to ADF-test at 5% critical level. This is because the calculated values of the ADF test are greater than the critical values at 5% irrespective of sign difference hence the variables are stationary. The result suggests evidence of co integration and possible VAR model application of VAR for model estimation and long run relationship.

**Table 2: Summary of Unit Root Test**

GDP at Order 2				
ADF Test Statistic	-4.307248	1% Critical Value*		-3.6852
		5% Critical Value		-2.9705
		10% Critical Value		-2.6242
INT at Order 1				
ADF Test Statistic	-3.120902	1% Critical Value*		-3.6752
		5% Critical Value		-2.9665
		10% Critical Value		-2.6220
INF at Order 1				
ADF Test Statistic	-4.393282	1% Critical Value*		-3.6752
		5% Critical Value		-2.9665
		10% Critical Value		-2.6220
MSP at Order 2				
ADF Test Statistic	-4.393820	1% Critical Value*		-3.6852
		5% Critical Value		-2.9705
		10% Critical Value		-2.6242
EXR at Order 1				
ADF Test Statistic	-4.996505	1% Critical Value*		-3.6752
		5% Critical Value		-2.9665
		10% Critical Value		-2.6220

\*MacKinnon critical values for rejection of hypothesis of a unit root.

#### 4.2 Short run Effect of Monetary Policy Variables on Economic Growth

The short run analysis and discussions are based on equation 3 developed from Table 3 parameter estimates:

$$GDP = -0.548*INT - 0.085*INF - 0.014*MSP - 0.079*EXR + 16.04965346 \quad (3)$$

Equation 3 shows that the estimate of INT, INF, MSP, EXR are negatively related to GDP, that means they have inverse relationship to the GDP, implying that any unit change in INT, INF, MSP and EXR accounts for 54.8%, 8.5%, 14%, and 7.9% decrease in GDP correspondently in the short run.

**Table 3: Ordinary Least Square Estimate**

Dependent Variable: GDP  
 Method: Least Squares  
 Sample: 1980 2012  
 Included observations: 33

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INT	-0.548552	0.101264	-5.417043	0.0000***
INF	-0.085117	0.033788	-2.519128	0.0178**
MSP	-0.014050	0.002788	-5.039079	0.0000***
EXR	-0.079705	0.026278	-3.033144	0.0052***
C	16.04965	1.615069	9.937441	0.0000***
R-squared	0.607573	Mean dependent var		6.810000
Adjusted R-squared	0.551512	S.D. dependent var		1.964165
S.E. of regression	1.315387	Akaike info criterion		3.524865
Sum squared resid	48.44677	Schwarz criterion		3.751609
Log likelihood	-53.16028	F-statistic		10.83771
Durbin-Watson stat	0.667643	Prob(F-statistic)		0.000020

Also interest rate, Inflation rate, Money supply and Exchange rate have significant relationship with the Gross Domestic Product indicating that the probability values associated with the t-calculated values of the monetary policy variables are less than the critical values at 1% level. This suggests that there is sufficient evidence that each of the explanatory variables have significant effect on the economic growth. The overall model as shown on equation 3 is statistically significant as the probability value of F-statistics is 0.00002 which is less than 1%. The Durbin Watson statistic value falls outside (2.0 and 4.0) standard scale; that is 0.665 which confirms the presence of first order series autocorrelation. The coefficient of determination ( $R^2$ ) value of 0.607 and adjusted R-squares of 0.55 indicates that INT, INF, MSP and EXR can explain economic growth positively by 55% while about 45% of economic growth cannot be explained as a result of some exogenous factors.

### 4.3 Long run Effect of Monetary Policy Variables on Economic Growth

Table 4 shows that the trace statistic and likelihood function values are greater than critical value at 1% and 5% suggesting that there is co-integration at most 1 with an implication of at least 2 co integrating equations among the variables which were rejected in favour of the alternative hypotheses at 1 and 5 per cent critical level as their values exceed the critical values at the 0.01 and 0.05 which implies that a long-run relationship existing among the variables (INT, INF, MSP, EXR and GDP).

**Table 4: Johansen Co-Integration Test**

Sample: 1980 2012

Included observations: 32 Test assumption: Linear deterministic trend in the data

Series: GDP INT INF MSP EXR

Lags interval: No lags

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.823299	112.2401	68.52	76.07	None **
0.658847	56.77467	47.21	54.46	At most 1 **
0.427169	22.36105	29.68	35.65	At most 2
0.127331	4.531801	15.41	20.04	At most 3
0.005405	0.173431	3.76	6.65	At most 4

\*(\*\*) denotes rejection of the hypothesis at 5 % ( 1%) significance level L.R. test indicates 5 cointegrating equation(s) at 5% significance level

The Johansen co integration shows that there is no presence of full rank given that subtraction of the number of co integrating equations and the variables under study is not equal to zero, therefore implying that the model is good and is in functional form. There is no presence of multi co linearity as the value of the log likelihood is positive. Based on this vector autoregressive (VAR) is performed to estimate the parameters of the model (Johansen 1995; Granger and Jin-Lung Lin, 1994).

$$GDP = 0.99GDP_{t-1} - 0.13GDP_{t-2} + 0.02EXR_{t-1} + 0.04EXR_{t-2} - 0.045INT - 0.051INF - 0.003MSP + 2.157717 \quad (4)$$

The vector autoregressive model (equation 4) extracted from Table 5 shows that previous year (t-1) economic growth rate is positively significant to current year GDP growth rate as the probability of the t-ratios (4.6972) is greater than the rule of thumb of 2.0 points.



**Table 5: VAR Model**

Sample(adjusted): 1982 2012  
 Included observations: 31 after adjusting  
 Endpoints  
 Standard errors & t-statistics in parentheses

	GDP
GDP(-1)	0.978415 (0.20830) (4.69722)**
GDP(-2)	-0.116277 (0.20318) (-0.57229)
EXR(-1)	0.019139 (0.02108) (0.90784)
EXR(-2)	0.039824 (0.01667) (2.38901)**
C	2.157717 (1.78636) (1.20788)
INT	-0.044986 (0.07389) (-0.60879)
INF	-0.050696 (0.02720) (-1.86418)
MSP	-0.002832 (0.00229) (-1.23862)
R-squared	0.883833
Adj. R-squared	0.848478
Sum sq. resids	14.11356
S.E. equation	0.783347
F-statistic	24.99876
Log likelihood	-31.79090
Akaike AIC	2.567155
Schwarz SC	2.937216
Mean dependent	6.867419
S.D. dependent	2.012411
Determinant Residual Covariance	18.30588
Log Likelihood	-133.0361
Akaike Information Criteria	9.615234
Schwarz Criteria	10.35536

The VAR model estimates imply that inverse relationship exist between INT, INF and MSP and economic growth in current periods. A unit increase in interest rate, inflation and money supply in a particular year leads to about 4.4%, 5.1% and 0.2% decrease in GDP within the same year. On the other hand the coefficients of exchange rate at one year lag (t-1) and two years lag (t-2) is all positive, implying that a positive long run relationship exists between exchange rate and economic growth.

#### 4.4 Casual Effects

The causality effect of exogenous variables on economic growth as shown on Table 6 reveals that INT causes the

GDP but GDP does not granger cause INT.

**Table 6: Pairwise Granger Causality Tests**

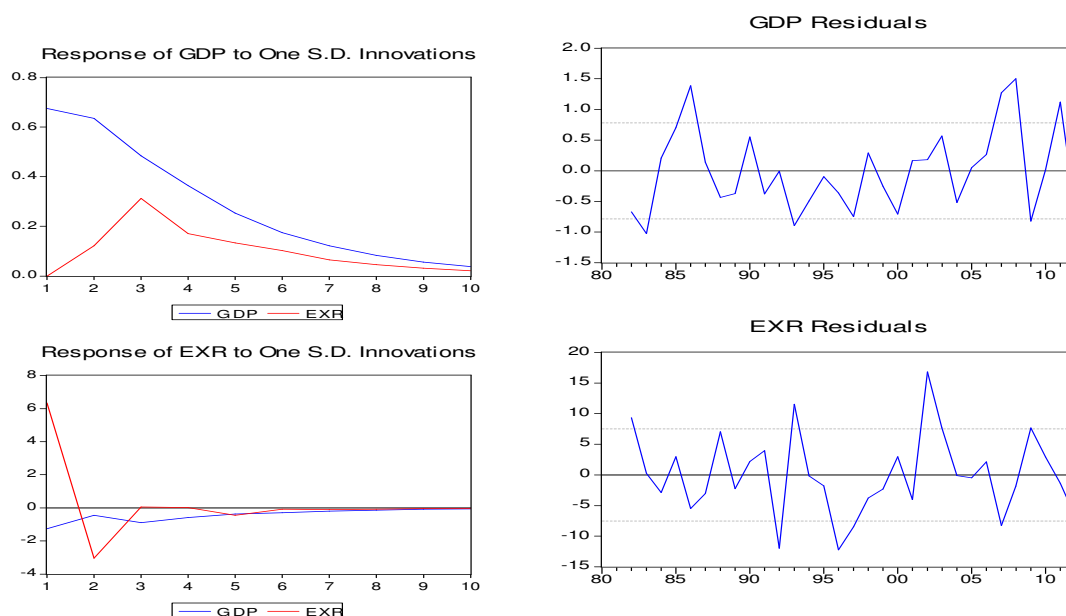
Sample: 1980 2012  
 Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
INT does not Granger Cause GDP	31	5.39812	0.01094
GDP does not Granger Cause INT		0.21856	0.80513
INF does not Granger Cause GDP	31	1.16251	0.32843
GDP does not Granger Cause INF		2.46933	0.10426
MSP does not Granger Cause GDP	31	1.54709	0.23183
GDP does not Granger Cause MSP		0.54332	0.58727
EXR does not Granger Cause GDP	31	4.02435	0.03002
GDP does not Granger Cause EXR		0.17260	0.84243

MSP and INF have no significant cause on GDP. However, EXR does granger cause GDP and not vice versa. Therefore, the exogenous variables significantly cause economic growth in Nigeria are Interest and Exchange rate whereas interest rate impact negatively in the short run, exchange rate has positive long run impact on economic growth.

#### 4.5 Impulse-Response Analysis

Figure 2 shows the patterns of one standard deviation impulse response of GDP to EXR, which indicate growth between the time period of 1 to 3 and begins to decrease significantly from the period 4 to 8 and relatively became stable with the EXR in 9 and 10 periods. Figure 2a suggested that between 1980 to 2012, the GDP experienced upward growth (1 to 3 periods) and downward growth (4 to 8) and stable within the 9 to 10 period of impulse response.



**Figure 2: Response Profiles**

In case of the behavior pattern of EXR to GDP, impulse response analysis shows that EXR only experienced exponential growth rate in the first period and suddenly decline exponentially in period 2 with negative value of -3. EXR impulse response steadily rises from that period and became stable at period 3 (0) while the GDP was negatively unstable between time period of 1 to 6 and become stably absorbed with the EXR. The Residual graphs of GDP and EXR rate in Graph 2b describe in terms of year the behaviour pattern of GDP and EXR, the



GDP was negative in 1983 rise to 1.5 in 1986. GDP maintain stability between the years 1987 to 2007 and began to rise in 2008 fall in 2009 rise in 2011. Incredibly become negative in 2012. The EXR takes a different pattern of rise to 10 in 1983 and become stable between 1984 through to 1993 and began to fall in 1994 and 1999 and rise in 2000 and fell in 2001. EXR rate increased steadily in 2001 to 2004 and fall to minor stability in 2005 and 2006 then fell in 2007 and picked up in 2008 and decreased in 2009 till 2012. This makes the performance of the GDP and EXR rate becomes very unstable within the period of study.

## 5.0 Conclusion & Recommendation

Based on results of empirical analysis, the VAR model (equation 4) is a better estimator than the OLS (equation 3) to estimate the effect of monetary policy factors on economic growth in Nigeria because the values of the AIC and SIC are smaller. Generally, the smaller the AIC, the better the model selection. However, interest rate, money supply and inflation seem to have short run effects on economic growth, while exchange rate seems to have long run effect. This may not be unconnected with the high dependence of the Nigerian economy on crude oil export with the attendant vagaries of foreign shocks and volatility. The finding shows that the four variables can significantly predict 55.15% of short run variation in GDP, while in the long run they predict economic growth to the level of 84%. We therefore recommend that for monetary policy to lead to sustainable economic growth efforts must be made to manage periodic volatility in interest rate, money supply and inflation, while in the long run the stability the value of the domestic currency must be assure through effective exchange rate management regime.

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**Ebiringa, Oforegbunam Thaddeus** is an Associate Professor of Finance and Entrepreneurship at Federal University of Technology, Owerri Nigeria. He holds Doctor of Philosophy in Financial Management from Federal University of Technology Owerri Nigeria. He is a Fellow of the Chartered Institute of Finance and Control of Nigeria as well as the Faculty Advisor of Enactus team at Federal University of Technology, Owerri Nigeria, a platform he uses to provide mentorship to undergraduates student entrepreneurs and assist them assess grants for startups. He is a World Bank and United Nations Development Programme (UNDP) accredited consultant and community-based project impact assessor as well as a Central Bank of Nigeria (CBN) certified Microfinance Trainer and consultant. A co-founder of Fisher Foundation for Sustainable Development in Africa, an NGO that engages in programmes and projects that empowers young Africans with critical skills that enables them become critical agents of socioeconomic change. His current research interest is on financial systems engineering that enables entrepreneurial actions for sustainable economic growth and human development.

**Onuorah Anastasia Chi-Chi** is a Lecturer at Delta State University, Asaba Campus Nigeria. She holds a Masters of Business Administration (MBA) in Finance and Banking from the University of Port Harcourt Nigeria and a Masters of Science Degree in Financial Management from Federal University of Technology, Owerri Nigeria. She is currently a Doctor of Philosophy (PhD) research candidate at the Federal University of Technology, Owerri Nigeria. Her research interest is on critical determinants of monetary policy regimes for economic growth and development.

Obi, Henry Kenedunium is a banker and currently works as a branch manager of one of the leading commercial bank in west and central African region (EcoBank International). He holds a Bachelor of Science (B. Sc) degree in Accounting from Delta State University Abraka Nigeria, a Master of Science (M.Sc) in Financial Management from Federal University of Technology, Owerri Nigeria. He is currently a Doctor of Philosophy (PhD) research candidate at the Federal University of Technology, Owerri Nigeria. His research interest is on determinants of bank performance in sub-Saharan Africa.