Vector Autoregressive Modeling of the Impact of Monetary Policy on Macroeconomic Variables in Nigeria (1996-2020)

Iwunze, Kelechi Chizoba & Ette H. Etuk
Department of Mathematics, Rivers State University,
Port Harcourt, Rivers State

ABSTRACT

The impact of monetary policy on macroeconomic variables has been a cause of concern. Therefore, the study was carried out to do vector autoregressive modeling of the impact of monetary policy on macroeconomic variables in Nigeria (1996-2020). The purpose of the study includes; to investigate the co-integrating relationship between exchange rate, interest rate, and crude oil price and inflation rate, establish the causality of exchange rate on crude oil price and inflation rate, find out the effects of exchange rate on crude oil price and inflation rate in Nigeria and find out the effects of interest rate on crude oil price and inflation rate in Nigeria. The design for the study was an ex post facto research design. The data used for this study were the Exchange rate(Naira/dollar), Interest Rate (Naira), Nigerian Crude oil Price, and Inflation Rate, and these were extracted from the website of the Central Bank of Nigeria (CBN) www.cbn.gov.ng and the data used spanned from 1st January 1996 to 31st December, 2020. The statistical software used for data analysis was Eview Software Version 10. The results of the analysis show that long run relationship did not exist between the variables under investigation; It was also found that the exchange rate has positive effect on crude oil price, inflation rate, and their past innovation in Nigeria and that interest rate has a positive effect on crude oil price and its past innovation in Nigeria, while interest rate has negative effect on the inflation rate in Nigeria. On the issue of granger causality, it was found that exchange rate granger caused crude oil prices and inflation. This indicates significant influence and uni-directional effect from exchange rates to crude oil prices and inflation rates. It was recommended that there should be intensive monetary policy development measures that will capture both short-run and long-run relationship between macroeconomic variables, as well as structural reforms to address issues related to shocks and variations in the economy and the past innovation in the exchange rate, is useful in determining the future values of crude oil price and inflation. Therefore, there is a need to strengthen monetary policy such that it will capture the effect of an unprecedented shock to the economy following the shrink in oil revenue and inflation rate caused by fluctuations in the exchange rate.

***Key Words**: Monetary, Policy, Macroeconomic, Variables*

INTRODUCTION

1.1 Background to the Study

One of the major problems Nigeria as a country has been facing is the issue of oil and being an import-dependent economy even in the face of stagnated growth, unstable business cycles, economic volatility, and wrong adoptions of monetary policy. These are some of the causes of unemployment, inflation and balance of payment disequilibrium. It is well noted when there is no relationship between monetary policy and macroeconomic variables that there is a tendency for instability in the economy. This is because the instability will lead to a high level of inflation, unemployment, lack of balance of trade, etc since money does not hold its value for a long time. According to Lucas, (2003) a high rate of inflation, unemployment, lack of balance of trade are some of the serious macroeconomic problems that are capable of creating complications in terms of economic measurement. Lucas, (2003) further explained that this brings uncertainty when we try to project into the future.

Sometime in the early 1980s Nigeria experienced economic problems and there was a downturn in the economy. According to Mustafa (2013), the downturn in the economy, attributed to declining experience in the banking sector, was a major issue as the inability to moderate boom time with consumption habits in line with the realities of the depressed economy was the order of the day. Thus, the financial condition of an individual; businessmen and women, individual companies, and government were all at their worse level, making them unable to value and respect contractual obligations on loan repayment to banks. Sanusi,(2002), further explained that this economic downturn coupled with other factors such as corruption, mismanagement, liquidity, and under-capitalization adversely affected macroeconomic variables such as GDP, Inflation, Unemployment, etc.

In 1998, about 50 percent of the money supply in the country was outside the banking system. Soludo (2007) noted that over 373.1billion naira was outside the banking system due to the failure of banks to mobilize savings by offering reasonable interest rate to small depositors, and partly due to the dwindling confidence in the banking sector, resulting from distress in the banking sector. All these, coupled with a large informal sector that undermined the monetary policy, further weakened the effects of monetary policy on macroeconomic performance in Nigeria. It, therefore, becomes necessary to tackle this problem on an adequate scale. It is also necessary to identify some of the obstacles that hinder the implementation of monetary policy to bring about more economic performance. It may be reiterated that, in principle, the effects of monetary policy depend on the structure of the economy under analysis, the approach being adopted, the choice of variables used, and the identifying restrictions imposed on the models (Chuku, 2009). Appropriate measurement of the effects of monetary policy on policy targets is therefore essential for effective policy-making and for choosing among alternative macroeconomic frameworks. The effects of monetary policy on macroeconomic variables had been studied by several scholars, such as Starr (2005); Cortis and Kong (2007), Olorunfemi and Faloye, (2008).

To measure the effects of monetary policy on economic performance, they use one monetary policy target variable, domestic growth (GDP) as an indicator for the measurement of economic

performance. Furthermore, several empirical studies assess the effects of monetary policy on economic performance using two monetary policy targets variable, domestic output (GDP) and consumer's price index (CPI) as indicators for the measurement of economic performance such as Gamber and Hakes (2005), Hsing and Hsieh (2004, 2009) Adebiyi (2007), Saizar and Chalk (2008), Barakchian and Crowe (2010) and Mugume (2011).

Sequel to coverage of the previous studies on the impact of monetary policy on macroeconomic variables, provision was made for the scope to include a balance of payments equilibrium. This study improves on previous studies by employing three monetary policy targets variables, as indicators for the measurement of macroeconomic variables. In addition to domestic output (GDP) and consumer price index (CPI) used by previous studies, this study includes exchange rate and interest rate to the monetary policy target variables as indicators for the measurement of macroeconomic variables performance to assess the effects of monetary policy on the economy. The inclusion is based on the objective of monetary policy in Nigeria which is to maintain a healthy balance of payments position. It is also the objective of macroeconomic policies to maintain a satisfactory balance of payments such that exports equal to imports over the long run. Also, the monetary approach to the balance of payments views the balance of payments as purely monetary phenomena (Barakchian and Crowe (2010) and Mugume, 2011).

To distinguish this study from other previous studies, the study will do a comparison of the impulse response results from VAR to linear equation results which gives innovation in methodology. No empirical studies have compared impulse response results from VAR to linear equation results. Among the studies that have investigated the effects of monetary policy on macroeconomic performance in Nigeria, many have focused on the traditional VAR methodology. Others used the structural VAR to measure the effects of monetary policy innovations in Nigeria but did not specify structural VAR model specification. Others used structural VAR in their methodology with quarterly data. It is against the background that this study intends to examine structural Vector Autoregressive modeling of the impact of monetary policy on macroeconomic variables in Nigeria to draw policy inferential statements based on the results of the co-integrating relationship between the exchange rate, interest rate, crude oil price, and inflation rate. Also, the causality of exchange rate on crude oil price and inflation rate

METHODOLOGY

3.1 Model Specification

In line with the objectives for this study, the model adopted is the Vector Auto-Regressive Model (VAR) and for the purpose of analysis the data using the Eviews software, the model is specified as:

$$InExcr_t = C(1,1)InExcr_{t-1} + C(1,2)InExcr_{t-2} + C(1,3)In\,\text{int}\,rate_{t-1} + C(1,4)In\,\text{int}\,rate_{t-2} + C(1,5)Incop_{t-1} + C(1,6)Incop_{t-2} + C(1,7)In\,\text{inf}\,tn_{t-1} + C(1,8)In\,\text{inf}\,tn_{t-2} + C(1,9) \quad (3.1)$$

$$In\,\text{int}\,rate_t = C(2,1)In\,\text{int}\,rate_{t-1} + C(2,2)In\,\text{int}\,rate_{t-2} + C(2,3)InExcr_{t-1} + C(2,4)InExcr_{t-2} + C(2,5)Incop_{t-1} + C(2,6)Incop_{t-2} + C(2,7)In\,\text{inf}\,tn_{t-1} + C(2,8)In\,\text{inf}\,tn_{t-2} + C(2,9) \quad (3.2)$$

$$Incop_t = C(3,1)Incop_{t-1} + C(3,2)Incop_{t-2} + C(3,3)In\,\text{int}\,rate_{t-1} + C(3,4)In\,\text{int}\,rate_{t-2} + C(3,5)InExcr_{t-1} + C(3,6)InExcr_{t-2} + C(3,7)In\,\text{inf}\,tn_{t-1} + C(3,8)In\,\text{inf}\,tn_{t-2} + C \quad (3.3)$$

$$Inftn_t = +C(4,1)In\,\text{inf}\,tn_{t-1} + C(4,2)In\,\text{inf}\,tn_{t-2} + C(4,3)Incop_{t-1} + C(4,4)Incop_{t-2} + C(4,5)In\,\text{int}\,rate_{t-1} + C(4,6)In\,\text{int}\,rate_{t-2} + C(4,7)InExcr_{t-1} + C(4,8)InExcr_{t-2} + C(4,9) \quad (3.4)$$

Where $InExcr_t$, $In\,\text{int}\,rate_t$, $Inftn_t$ and $Incop_t$ represents natural logarithms of exchange rate, interest rate, inflation and crude oil price. And the C(i,j) represent stochastic error terms often referred to as impulse, or innovations or shocks. Also, the C(i,j)'s > 0 , for the equations to exist. They are the coefficients to be estimated. According to Sayed (2008), the basic assumption of ordinary least square (OLS) satisfies the casual VAR model. He further explained that these assumptions include homoscedasticity or the residuals form of the model, no serial correlation, normality or the residuals, appropriate significance of the variables and Variable Inflation Factor (VIF) should be less than three (3) etc.

3.2 Source of Data for this Study

The data for this study was sourced from the Central Bank of Nigeria (CBN) statistical bulletin spanning from 1996-2020, while the software used for data analysis is Eviews software version ten (10). The data used for analysis include; Exchange rate, Crude oil Price, Inflation, and interest rate.

RESULTS

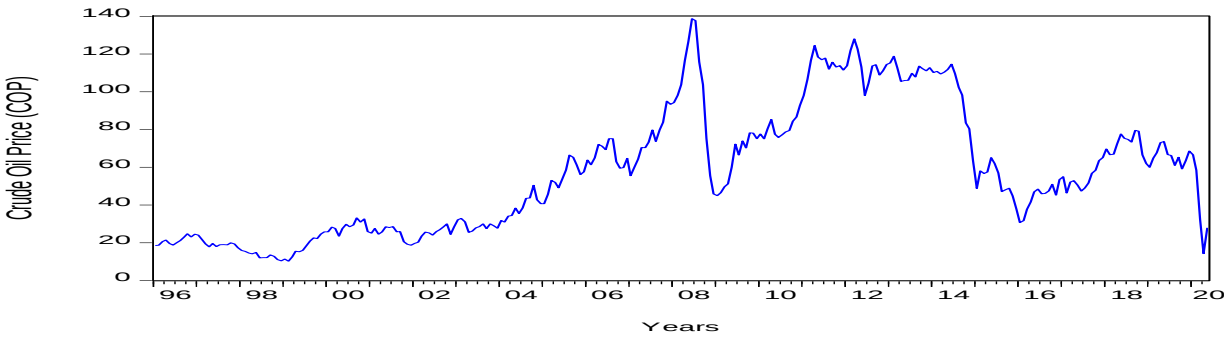

Figure 4.1: Time Plot on Crude Oil Price (Dollar/Barrel)

Figure 4.1 to 4.4 are plots of the raw data with Time (years) on the horizontal axis and Crude Oil Price (Dollar/Barrel),

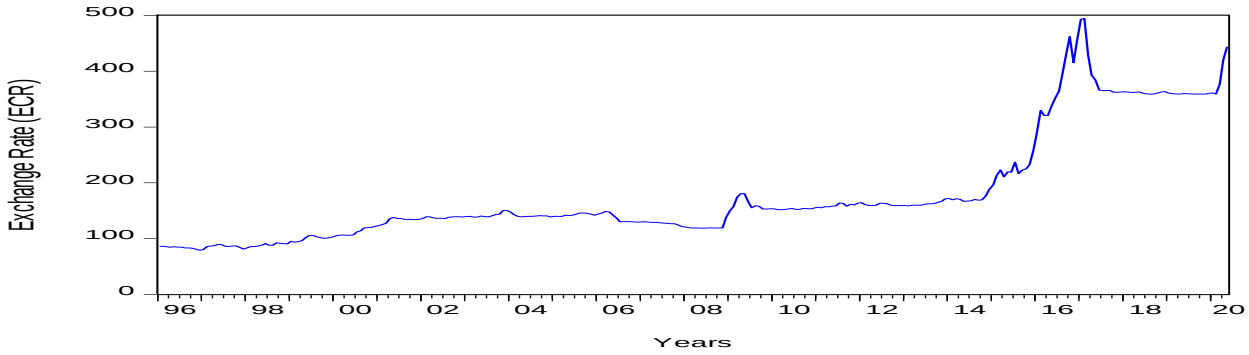

Figure 4.2: Time Plot on Exchange Rate (Naira/Dollar)

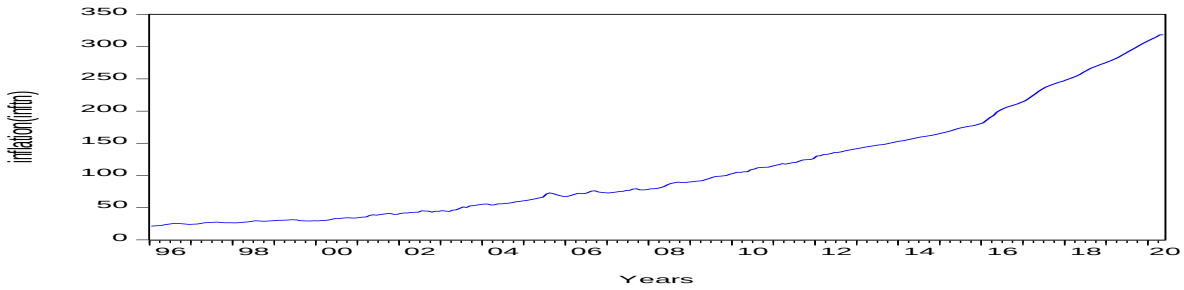

Figure 4.3: Time Plot on Inflation rate

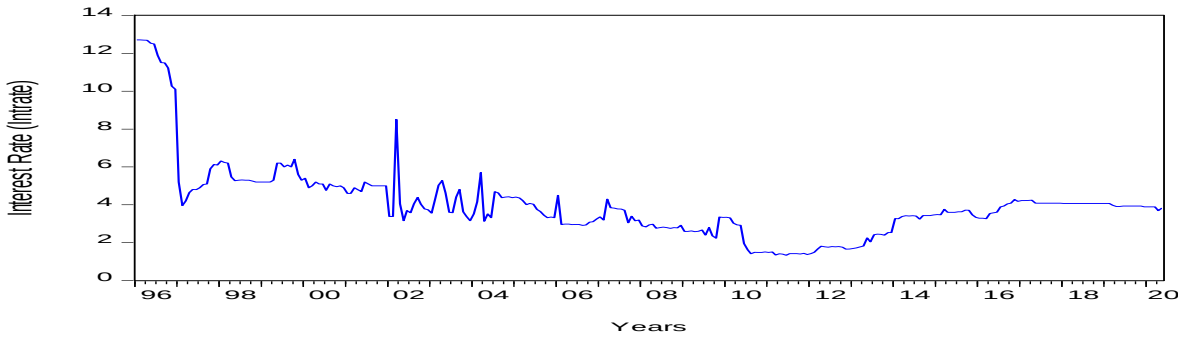

Figure 4.4: Time Plot on Interest Rate

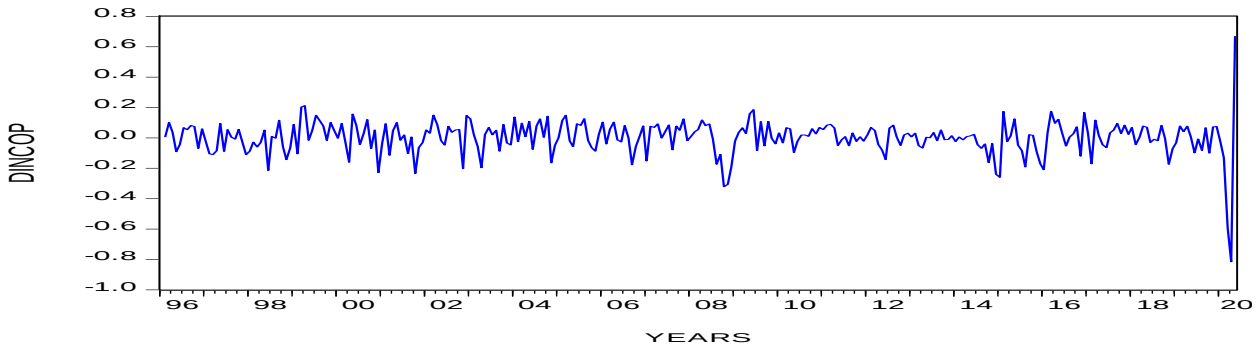

Figure 4.5: Time Plot on the Difference of InCrude Oil Price

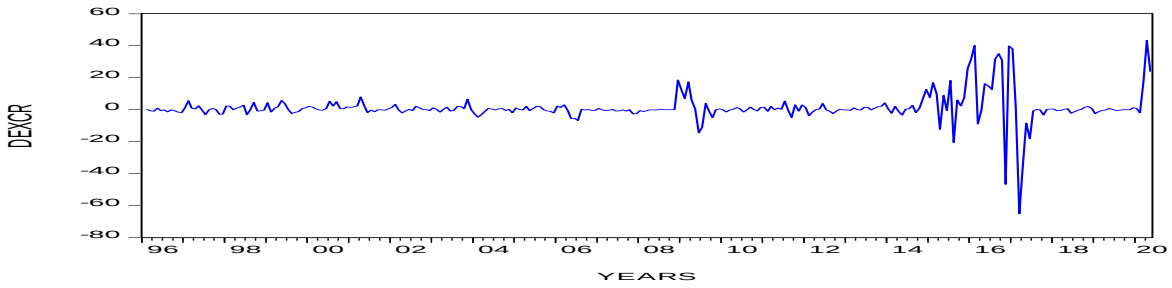

Figure 4.6: Time Plot on the Difference of InExchange Rate

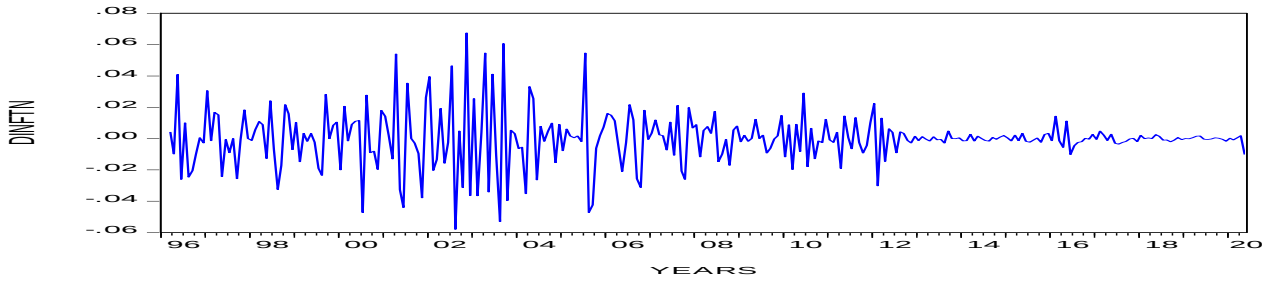

Figure 4.7: Time Plot on the Difference of LnInflation Rate

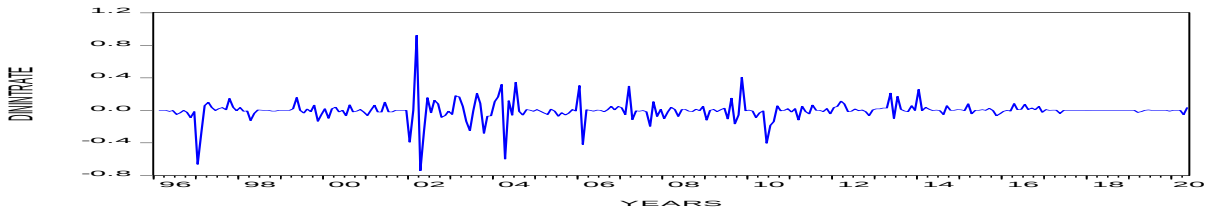

Figure 4.8: Time Plot on the Difference of InInterest Rate

Table 4.1: Descriptive Statistic for the Log Transformed Variables

Variable	Mean	Median	Max	Min	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	P-value
INCOP	3.859	3.987	4.933	2.324	0.656	-0.345	2.069	16.387	0.000
INEXCR	5.077	4.970	6.204	4.371	0.458	0.792	2.806	31.079	0.000
INIFLTN	4.415	4.381	5.763	3.054	0.779	-0.014	1.808	17.367	0.000

ININTRATE	4.035	3.820	12.710	1.330	2.022	2.324	10.425	936.817	0.000

The results were all tested at 1%, 5% and 10% level of Significance respectively

Table 4.2: Unit Test

	Augmented Dickey Fuller				Phillip Perron Test			
Variable	**(1(0))**	**Variable**	**(1(1))**		**Variables**	**(1(0))**	**Variables**	**1(1(1))**
ADF - Fisher Chi-square	8.55318	ADF - Fisher Chi-square	443.557***		PP - Fisher Chi-square	0.0154***	PP - Fisher Chi-square	449.374***
ADF - Choi Z-stat	0.68052	ADF - Choi Z-stat	-20.3997***		PP - Choi Z-stat	0.4117	PP - Choi Z-stat	-20.5108***
INCOP	0.4150	D(INCOP)	0.0000		INCOP	0.3794	D(INCOP)	0.0000
INEXCR	0.9694	D(INEXCR)	0.0000		INEXCR	0.9713	D(INEXCR)	0.0000
INIFLTN	0.9319	D(INIFLTN)	0.0000		ININFTN	0.9284	D(ININFTN)	0.0000
ININTRATE	0.0371	D(ININTRATE)	0.0000		INTRATE	0.0002	D(INTRATE)	0.0000

*, ** and *** represents *1%, 5% and 10% level of Significance respectively.*

Table 4.3: Johansen Co-integration Test Result

Hypothesized	**Unrestricted Cointegration Rank Test (Trace)**				**Unrestricted Cointegration Rank Test (Maximum Eigenvalue)**		
No. of CE(s)	Eigenvalue	Statistics	Critical value	prob	Statistics	Critical value	Prob
None	0.065147	23.33039	29.79707	0.2302	19.53623	21.13162	0.0823
At most 1	0.012111	3.794157	15.49471	0.9194	3.533552	14.26460	0.9050

At most 2	0.000898	0.260604	3.841466	0.6097	0.260604	3.841466	0.6097

Max-eigen value test and Trace test indicates no co-integration at the 0.05 level

Table 4.4: VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-351.4276	NA	0.002414	2.487211	2.525659	2.502624
1	1635.408	3917.899	2.26e-09	-11.39233	-11.23854	-11.33068
2	1662.942	53.71678	1.99e-09*	-11.52240*	-11.25327*	-11.41451*
3	1669.512	12.67781	2.02e-09	-11.50534	-11.12087	-11.35122
4	1671.641	4.064858	2.12e-09	-11.45713	-10.95732	-11.25677
5	1681.032	17.72737	2.12e-09	-11.45987	-10.84472	-11.21327
6	1687.911	12.84036	2.15e-09	-11.44499	-10.71449	-11.15215
7	1697.034	16.83741	2.15e-09	-11.44585	-10.60001	-11.10678
8	1715.364	33.44416*	2.01e-09	-11.51132	-10.55014	-11.12601

*stands for the lag of the model with its corresponding information criteria.

The Estimated Result for the Coefficients VAR Model

$$InExcr_t = 1.237\Delta InExcr_{t-1} - 0.284\Delta InExcr_{t-2} - 0.018\Delta In\,\text{int}\,rate_{t-1} + 0.017\Delta In\,\text{int}\,rate_{t-2} - 0.054\Delta Incop_{t-1} + 0.031\Delta Incop_{t-2} + 0.031\Delta In\,\text{inf}\,tn_{t-1} + 0.009\Delta In\,\text{inf}\,tn_{t-2} + 0.160 \quad (4.1)$$

$$In\,\text{int}\,rate_t = 0.003\Delta InExcr_{t-1} + 0.119\Delta InExcr_{t-2} + 0.832\Delta In\,\text{int}\,rate_{t-1} + 0.076\Delta In\,\text{int}\,rate_{t-2} - 0.021\Delta Incop_{t-1} - 0..009\Delta Incop_{t-2} + 0.333\Delta In\,\text{inf}\,tn_{t-1} - 0.350\Delta In\,\text{inf}\,tn_{t-2} + 0.179 \quad (4.2)$$

$$Incop_t = 0.201\Delta InExcr_{t-1} + 0.211\Delta InExcr_{t-2} - 0.016\Delta In\,\text{int}\,rate_{t-1} - 0.048\Delta In\,\text{int}\,rate_{t-2} + 1.134\Delta Incop_{t-1} - 0.197\Delta Incop_{t-2} + 0.813\Delta In\,\text{inf}\,tn_{t-1} - 0.809\Delta In\,\text{inf}\,tn_{t-2} + 0.240 \quad (4.3)$$

$$In\,\text{inf}\,tn_t = 0.028\Delta InExcr_{t-1} - 0.015\Delta InExcr_{t-2} + 0.002\Delta In\,\text{int}\,rate_{t-1} - 0.002\Delta In\,\text{int}\,rate_{t-2} + 0.001\Delta Incop_{t-1} + 0.004\Delta Incop_{t-2} + 1.251\Delta In\,\text{inf}\,tn_{t-1} - 0.261\Delta In\,\text{inf}\,tn_{t-2} - 0.031 \quad (4.4)$$

The estimates of the coefficients of multiple determinations (R^2) and its corresponding adjusted R-square ($\overline{R}^2$) of the models were: For Log on Exchange Rate (InExcrt) $R^2 = 0.996$ $\overline{R}^2 = 0.996$,For Log on Interest Rate (InIntrate) $R^2 = 0.921$, $\overline{R}^2 = 0.920$, For Log on Crude Oil Price (InCOPt) $R^2 = 0.969$ $\overline{R}^2 = 0.969$, and For Log on inflation Rate (Inftnt) $R^2 = 1.000$ $\overline{R}^2 = 1.000$

respectively

Diagnostic Test

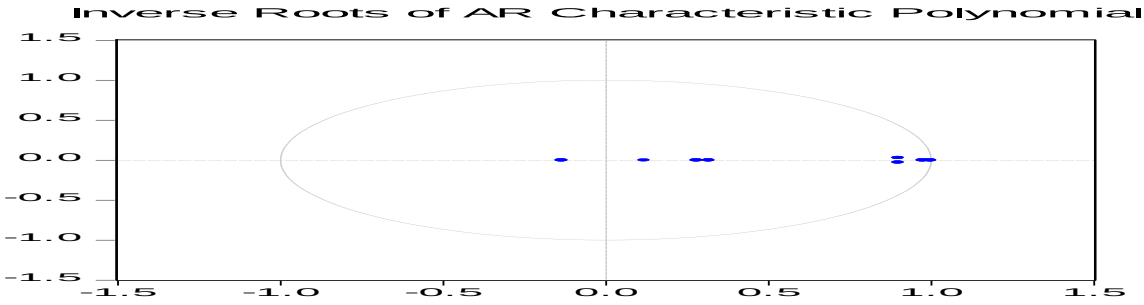

Fig. 4.9: VAR Model Stability Test: Inverse Root of AR Characteristic Polynomial

According to Halkos and Tsilika, (2012), the necessary and sufficient condition for VAR stability is that all characteristic roots lie inside the unit circle

Table 4.5: VAR Model Stability Test: Inverse Root of AR Characteristic Polynomial (Endogenous Variables: InEXCr, Incop, Inintrate, IFR. Exogenous Variables: C)

Root	Modulus
1.001429	0.001429
0.976603	0.976603
0.900970 - 0.028842i	0.901431
0.900970 + 0.028842i	0.901431
0.320153	0.320153
0.281491	0.281491
-0.134034	0.134034
0.119935	0.119935

No root lies outside the unit circle.

VAR satisfies the stability condition

Table 4.6: Granger Causality Test Statistics

Dependent Variables	Independent Variables				
	INEXCR	**ININTRATE**	**INCOP**	**ININFTN**	**All**
INEXCR		0.406(0.816)	1.604(0.448)	4.541(0.1033)	33.159(0.000)
ININTRATE	1.702(0.427)		6.156(0.046)	0.281(0.8688)	8.110(0.030)
INCOP	26.108(0.000)	3.546(0.170)		2.075(0.3543)	9.912(0.128)
INIFLTN	15.009(0.000)	0.418197(0.811)	2.915(0.233)		5.206(0.518)

Note: The parenthesized "()" values represent the probability values or p-values of the estimates

Table 4.7: Diagnostic Test

Diagnostic Test	Test Statistics	(Prob. Value)	Remarks
Serial Correlation	*Edgeworth expansion corrected likelihood ratio statistic.	1.443(0.166)	No Serial Correlation
VAR Residual Normality Tests	Orthogonalization: Cholesky (Lutkepohl)	1.871687(0.171)	Multivariate Residuals is Normal
Var Residual Heteroschedasticity	Chi-square	274.9547(0.154)	Homoschedastic

Note: The parenthesized "()" values represent the probability values of the estimates

DISCUSSION

5.1 Time Plots

The time plots are shown in Figure 4.1 to 4.4. These are plots of the raw data with Time (years) on the horizontal axis and Crude Oil Price (Dollar/Barrel), Exchange Rate (Naira/Dollar), Inflation, and Interest Rate on the vertical axis and this portrays the direction and movement trend of the variable under investigation. There is an indication that all variables showed fluctuations within the period of the study, no variable followed a steady trend. Figure 4.5 to 4.8 are plots of the differenced natural logarithm data with time (years) on the vertical axis and natural logarithm transformation of the data on Crude Oil Price (Dollar/Barrel), Exchange Rate (Naira/Dollar), Inflation, and Interest Rate on the vertical axis. There is an indication that all

variables showed fluctuations around the mean zero showing that it is stationary and evidence of clustering volatility.

Table 4.1 which contain the results for descriptive statistics for the natural logarithm transformation of the data on crude oil price (Dollar/Barrel), Exchange Rate (Naira/Dollar), Inflation and Interest Rate. This is carried out to know whether the data obey the normality assumption. The results show that the skewness statistics include ; INCOP (-0.345), INEXCR (0.792), INIFLTN (-0.014) and ININTRATE (2.324) respectively with their corresponding kurtosis listed as thus: 2.069, 2.806, 1.808 and 10.425 respectively. Also, the skewness statistics are all positive except returns on crude oil prices and inflation which have negative signs. This signifies that the series is skewed to the left (extreme loss) than right tail (extreme gain). A situation whereby an indicator is skewed to the left is one of the common characteristic of financial data series (Deebom and Essi, 2018).The Jarque-Bera (J-B) test statistics are 16.387,31.079, 17.367, and 936.817 respectively and they are all statistically significant indicating that the distribution for these indicators are not normally distributed. The causes of this could be attributed to the presence of extreme observations. Hence, the null hypothesis of normality is rejected while the alternative hypothesis that these indicators are not normally distributed is accepted.

Table 4.2 shows the results of the unit root tests; the results showed that at levels, all variables had unit root (p-values > 0.05), however, all variables do not contain unit root at levels. There was the need for further differencing and from the results obtained at the second differencing, the null hypothesis of a unit root was accepted in favor of stationarity using both grouped augmented dickey fuller and Phillip Perron test.

Table 4.3 contains the results for co-integration using trace and maximum-eigenvalue of the Johansen Co-integration Test. According to Johansen, co-integration exists if two variables have a long run relationship between them. The results obtained from the λ trace and λmax statistics respectively indicate no co-integration at the 0.05 level. Therefore, the hypothesis of no co-integration is accepted as the calculated probability of trace and maximum-Eigenvalues was not significant. It was further confirmed that the long run combination of stationary processes can be non-stationary. However, trace statistic is said to be more robust to both skewed and excess kurtosis in residuals than the maximum-eigenvalue test, the Johansen maximum likelihood approach was more useful compared to the other methods as a result of its properties. The question asks whether there exists a cointegrating relationship between exchange rate, interest rate, crude oil price, and inflation rate in Nigeria, the response is; that long-run or equilibrium; the relationship between them did not exist.

Table 4.4 contains the VAR Lag Order Selection Criteria for the model specification. The result shows that the lag length selection criteria indicated two lags based on Akaike and Schwarz information criteria.

5.7 Vector Autoregressive Model Results and Inverse Roots of AR Characteristic Polynomial

The model in equation 4.1 to 4.4 in chapter four represents the estimate of coefficients of the VAR model while their multiple determinations (R2) of the models were given as 0.996, 0.921, 0.969, and 1.00 respectively. This indicates the relationship between dependent and independent variables and shows that at 99.6 percent, 92.1 percent, 96.9percent,, and 1.00 percent respectively is the relationship that exist between them. The VAR estimates indicate that exchange rates, crude oil prices, inflation rates, and interest rates are positively and significantly affected by their past innovations. Also, from the result of the Wald test, it was found that the history of each variable was jointly significant in affecting itself. Fig. 4.9 shows the Inverse roots of a characteristic polynomial, while table 4.5 contains characteristic polynomial of the endogenous variables (InEXCr, Incop, Inintrate, IFR. exogenous variables: C). The Inverse roots of a characteristic polynomial satisfy the stability condition that no root lied outside the unit root circle as shown in the graph and table 4.5. Also, the questions of whether the exchange rate has any effect on crude oil price and inflation rate in Nigeria and, whether interest rate has any effect on crude oil price and inflation rate in Nigeria. From the result obtained it was found that;

ii Exchange rate has a positive effect on crude oil price, inflation rate, and their past innovation in Nigeria

iii Interest rate has a positive effect on crude oil price and its past innovation in Nigeria and also, the interest rate has negative effect on inflation rate in Nigeria

5.8 Granger Causality Test Statistics

Table 4.6 contains the results of the granger causality test statistics. This was conducted to confirm the sources of a shock to the system. The summary of the result is that each variable significantly affected itself and it also showed that exchange rate granger caused crude oil price and inflation (INCOP (Chi-square =26.108, PV= 0.000)), ININFTN(Chi-square=15.009, PV= 0.000)) respectively. It was found that exchange rate granger caused crude oil prices and inflation.

5.9 Diagnostic Test

Table 4.7 contains the results of the diagnostic test. The diagnostic test carried out as shown in Table 4.7 is the summary result of post-analysis done on the residual multivariate variables. The results contain the test for normality, serial correlation, and heteroscedastic of the residual series. The results confirmed the absence of serial correlation and heteroscedastic in the residual series and it was also found that the residual is normally distributed.

6.1 Conclusion

The study aimed to carry out Vector Autoregressive Modeling of the Impact of Monetary Policy on Macroeconomic Variables in Nigeria, the data used for analysis include; Exchange rate, Crude oil Price, Inflation, and interest rate. The results showed that there is no co-integrating relationship between the exchange rate, interest rate, crude oil price, and inflation rate in Nigeria. It was found that the exchange rate has a positive effect on crude oil price, inflation rate and their past innovation in Nigeria and interest rate has a positive effect on crude oil price and its past innovation in Nigeria and also, the interest rate has negative effect on the inflation rate in

Nigeria. It was further revealed that the exchange rate granger caused crude oil prices and inflation. This simply means that there is significant influence of monetary policy (exchange rate) on macroeconomic variable and this is the uni-directional effect from exchange rate to crude oil.

6.2 Recommendations

1. From the results, it was found that there is no co-integrating relationship between exchange rate, interest rate, crude oil price, and inflation rate, it is therefore recommended that there should be intensive monetary policy development measures that will capture both short-run and long-run relationship between macroeconomic variables as well as structural reforms to address issues related to shocks and variations in the economy.
2. From the result, it was established that there is causality of exchange rate on crude oil price and inflation rate, it is therefore recommended that since the history of the exchange rate is useful to forecast the future values of crude oil price and inflation, there is a need to .strengthen monetary policy such that it will capture the effect of an unprecedented shock to the economy following the shrink in oil revenue and inflation rate caused by fluctuations in exchange rate
3. There is a need for fiscal policymakers to formulate an appropriate exchange rate policy that will stabilize crude oil price and inflation rate since it did not respond to shocks in oil price nor exchange rate
4 There is a need for fiscal policymakers to formulate appropriate interest rate policies which will stabilize crude oil price and inflation rate since it did not respond to shocks in oil price nor inflation rate

REFERENCES

Abeng, M. O. (2006). Financial Sector Reform Outcomes in Nigeria: A quantitative Evaluation. CBN Bullion, 30(2), 53-69.

Adebiyi, M. A. (2007), Financial Sector Reforms and the Transmission Mechanism of Monetary Policy in Nigeria: A Vector Auto-regression Mechanism. In the National Economic Empowerment and Development Strategy: (NEEDS). Familoni, Section 1V, (18)314-239

Anyanwu, J .C. (2003). *Monetary economics: Theory, policy and institution*. Onitsha: Hybrid Publishers Ltd.

Barakchian, K. & Crowe, K, (2010). Monetary Policy Matters: New Evidence Based on a New Shock Measure. IMF Working Paper WP /10/230

Black, J. (2002). Oxford Dictionary of Economics, (2nd Edition), New York, Published in the United States by Oxford University Press Inc

Campbell, J. A, Lo & MacKinlay, C. (1997). The Econometrics of Financial Markets. Princeton University Press, New Jersey

Central Bank of Nigeria (CBN) (1997)

Central Bank of Nigeria (2006)

Chinyere, S. E. Dikko, H. G & Isah, A. (2015). Modeling the Impact of Crude Oil Price Shocks on Some macro-economic Variables in Nigeria Using GARCH and VAR. American Journal of Theoretical and Applied Statistics, Published Online August 17, 2015, from http: www.Science.publishinggroup. com/j/ajtas

Chuku, A. C., (2009). "Measuring the effects of monetary policy innovations in Nigeria," *Africa Journal of Accounting, Economics, Finance and Banking Research,* 5(5),):112-129.

Cortes, T. & Kong, H. (2007). Regional Effects of Chinese Monetary Policy Studies. *The International Journal of Economic Policy Studies*.(2)2.

Culbertson, K. (1996). Quantitative Financial Economics: Stocks, Bonds and Foreign Exchange. John Wiley and Sons, Chichester.

Deebom, Z. D & Essi, I.D (2017). Modelling price Volatility of Nigeria Crude Oil Markets using GARCH Model: 1987 – 2017.*International Journal of Applied Science & Mathematical Theory*, 4(3) 23.

Dimitrios, A. G & Stephen, H. (2011). Applied Econometrics. 3rd Edition, London, Red Globe Press.

Gamber, B. & Hakes, N. (2005). Is Monetary Policy Important for Forecasting Real Growth and Inflation? *Journal of Policy Modeling*,27(177-187).

Halkos, G. & Tsilika, K. (2012). Stability analysis in economic dynamics: A computational approach: Online athttps://mpra.ub.uni-muenchen.de/41371/MPRA Paper No. 41371, posted 17 Sep 2012 13:31 UT

Hamilton, J.D. (1994).Time Series Analysis. Princeton, Princeton University Press.

Hsing, Y. & Hsieh, W. J (2004). Impact of Monetary Fiscal and Exchange Rate Policies on Output in china: A VAR Approach. *Economics of Planning*. 37(125-139).

Hsing,Y. & Hsieh, W.J(2009). Application of the Monetary Policy Function to Output Fluctuations in Bangladesh. *Economics Bulletin,* 29(3), 2119-2128

Imoisi, A. I, Moses, O.V, Godstime, I. O, & Olatunji, L. M (2014). Monetary Policy and Its Impact on Selected Macroeconomic Variables in the Nigerian Economy; 1970 – 2012 *International Research Journal of Finance and Economics.1450-2887*

Jhingan, M. L. (2005). *International Economics*, 5th Edition, Delhi, Vrinda Publications (P) Limited.

Jhingan, M. L. (2000), Monetary and Banking International Trade, Delhi, Vrinda Publications (P) Ltd.

Kenneth, B. (2011). Linear regression models with logarithmic transformations. Methodology Institute London School of Economics

Lawrence, O, U, Odimgbe S. O, Ezeabalisi V. N., & Udoka B. A (2018). Effect of Monetary Policy on Economic Growth In Nigeria: An Empirical Investigation. Annals SpiruHaret University, *Economics Series*

Lawrence, O. U, Odimgbe S. O., Ezeabalisi V. N. (2018). Effect of Monetary Policy on Economic Growth in Nigeria: An Empirical Investigation. *Pakistan Journal of Social Sciences*, 7(2).

Levine, A. L(2005). "The Notion of Equilibrium in Microeconomic Theory," Working Paper Series 99-05, Department of Economics, The University of New Brunswick, Fredericton, Canada.

Lucas, R. E., Jr (2003). 'Macroeconomic priorities,' American Economic Review, 93(1): 1–14

Lutkepohl, H. (1999). "Vector Autoregressions," unpublished manuscript, Institut f¨urStatistik and ¨Okonometrie, Humboldt-Universit¨at zu Berlin.

McKinnon, R. (1999). Money and Capital in Economic Development, Washington. D.C. Brookings Institution

Michael, B. & Ebibai, T. S (2014). Monetary Policy and Economic Growth in Nigeria (1980-2011).*Asian Economic and Financial Review*, 4(1): 20-32

Mills, T.C.(1999).The Econometric Modeling of Financial Time Series, Second Edition. Cambridge University Press, Cambridge.

Mugume, A. (2011). "Monetary Transmission Mechanism in Uganda", Final Report, *AERC Working Paper,* Nairobi, Kenya, JEL Classification Numbers: O53, E4, E5

Mustafa, I. (2013). Effects of monetary policy on macro economic performance: the case of Nigeria.

Nigeria Deposit Insurance Corporation (*NDIC*) (2000)

Nwankwo, G. O. (1993). The Structure of the Nigerian Economy and the Nigerian Banking Environment" in National Economic Recovery. Papers and Proceedings of the Bank Directors' Seminar, FITC, Lagos, Nigeria, 24.

Nwoko, N. M., Ihemeje, J. C. & Anumadu, E. (2016). The Impact of Monetary Policy on the Economic Growth of Nigeria. An International Multi-disciplinary Journal, Ethiopia.10(3),.42: 192-206

Nwoko, Nnenna M., Ihemeje, J. C &Anumadu, E., (2016). The impact of monetary policy on the economic growth of Nigeria. *An International Multi-disciplinary Journal, Ethiopia . 10(3),* 42.

Ogunjimi, S. O.(1997). *Public Finance: For Polytechnics ICAN Students.* Bida: Lekem Productions.

Olorunfemi, S. & F. O. Dotun (2008). Stationarity Analysis of the Impact of Monetary Policy on the Economic Performance of Nigeria. *Pakistan Journal of Social Sciences*, (5)6.(562-56).

Ridhwan, M. M, DeGroot, H. L. F., Nijkamp, P and Rietveld, P. (2010), impact of Monetary Policy on Economic Activity – Evidence from a Meta-Analysis, Timbergen Institute Discussion paper 10043/3

Saheed, A. M. (2018). Determinants of Listed Deposit Money Banks' Profitability in Nigeria *International Journal of Finance and Banking Research*

Saizar, K. & Chalk, T. (2008). Is Monetary Policy Effective when Credit is Low? *International Monetary Fund Working Paper*

Sanusi, J. O., (2002). Central bank and the macroeconomic environment in Nigeria. Being a lecture delivered to participants of the senior executive course No. 24 of the national institute for policy and strategic studies (NIPSS), Kuru on 19th august

Sayed, A. (2008). Country Heterogeneity and Long-Run Determinants of Inflation in the Gulf Arab States. *Munich Personal RePEc Archive*

Soludo, C. (2007). "The Road to Global Banking. The News Magazine Vol.29 No. 7; 27 August

Starr, M., (2005). Does Money matter in the CIS? Effects of Monetary Policy on output and Prices. *Journal of Comparative Economics*.33 (441-461).

Sundararajan,V. & Balino, J. T.(1991). Issues in Recent Banking Crisis: Cases and Issues. Washington, D.C. IMF

Tsay, R. (2001). Analysis of Financial Time Series. New York, John Wiley &Sons.

Tuaneh, G. (2018). Vector Autoregressive Modelling of the Interaction among Macroeconomic Stability Indicators in Nigeria (1981-2016).*Asian Journal of Economics, Business and Accounting*, 9(4): 1-17.

Waggoner, D. F. & Zha, T. (1999). "Conditional Forecasts in Dynamic Multivariate Models" *Review of Economics and Statistics*, 81(4), 639-651

Wali, G. I (2002). Educational Research, A functional Approach Port Harcourt, Harey publications

Watson, M. (1994). "Vector Autoregressions and Cointegration," in Handbook of Econometrics, Volume IV. R.F. Engle and D. McFadden(eds.). Elsevier Science Ltd., Amsterdam.