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Price Stability and Monetary Policy Framework in Nigeria: A Structural VAR Representation

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Abstract

This study investigated empirically the price stability and monetary policy framework in Nigeria using annual time series data spanning from 1970 to 2019. The main trust of the paper is to ascertain whether exchange rate, inflation rate and interest rate have stabilized the monetary policy outcomes in Nigeria. The data set for the paper were checked using Augmented Dickey Fuller (ADF) and Philips Perron unit root tests, which found that all series were stationary at I(1). In the unrestricted VAR model, only exchange rate was found to be statistically significant having a t-statistic of over 4.05. This showed that even in the short-run, it is only the first lagged predetermined exchange rate can influence the price stability in designing the monetary policy framework in Nigeria. In the impulse response function, the result indicated that there is a positive and significant impact of exchange rate to interest rate but insignificant to inflation rate resulting in an unparallel shock in the stability of monetary policy. Further, the result of the variance decomposition test revealed that the own shock impact on exchange rate, inflation rate and interest rate accounted for about 88 percent, 83 percent and 83 percent respectively, in their total variations across the 10 point time horizon. Therefore, to ensure price stability in the monetary policy framework in Nigeria, the CBN should adopt an improved credit allocation, strict management of expected inflation, plodding and synchronization of exchange rate and creation of enabling environment for a rapid and sustainable growth in Nigeria.

Key Words: *Price, Stability, Monetary Policy, SVAR and Nigeria.*

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I. INTRODUCTION

Until recently, there has been a controversial debate among monetary policy makers as to whether monetary policy framework should focus on a single objective of price stability in the financial system. This contest seems to be a bit clearer in various empirical works (e.g. Adeniyi, 2020; Idoko, Seyi and Rotimi, 2017; Ismail, Adegbemi and Mariam, 2013; Onuorah and Ebiringa, 2012; Omankhanlen, 2011; Berument and Nergiz, 2008 & Yue, Zhou and Shuanglong, 2007). In Nigeria, just like other developing economies, volatility of prices of foreign commodities couples with poor harvest of agricultural products results in unpredictability in price stability. To curtail this situation, the Central Bank of Nigeria (CBN) has the mandate to manage inflation rate to a single digit as this will prevent a widespread of persistent price increase over time. Thus, price stability implies that there should be interference in the supply of credits for productive purposes for both domestic and external use. In order to ensure full price stability, the CBN should focus on the creation of credits for an inclusive financial system, as this will spur stability in the financial system and sustainable growth in Nigeria.

Available records show that inflationary pressures moderated, but the rate remained above the single digit target for 2015 (CBN Annual Reports, 2016). Food and Core inflation rates declined to 11.0 and 10.8 per cent, from their respective rates of 12.7 and 15.7 per cent in December 2015 (CBN, 2016). The development was attributed to the favourable weather conditions experienced throughout the year, which contributed to good harvests for most agricultural output as well as the tight monetary policy stance adopted by the monetary authority. Hence, exogenous changes in the money stock led to equivalent percentage changes in the overall price level under conditions of stable money demand ((Dedola and Lippi, 2005; Okwu, Obiakor, Falaiye, and Owolabi, 2011).

The exchange rate of the Naira to the US dollar averaged N199.25 per US dollar at the wDAS segment of the foreign exchange market in 2014 to N289.57 in 2016, a depreciation of 45.32 per cent, compared with the level in 2014 (CBN Quarterly Reports, 2016). At the inter-bank and BDC segments, the Naira depreciated by 3.1 and 3.9 per cent to N169.13 and N199.56 per US dollar, respectively (CBN, 2015). However, due to the

pressure on the foreign exchange market and external reserves, in the fourth quarter of the year, the Bank adjusted the mid-point exchange rate band to N299.65 per US dollar in 2016 and maintained the band of +/-3.0 per cent. This was aimed at reducing arbitrage opportunities and speculative attacks.

Developments in interest rates reflected the credit and liquidity conditions in the banking system during 2015. The MPR was raised six (6) times, from 6.25 per cent in January 2014 to 12.0 percent in October 2015; Cash Reserve Requirement (CRR) was raised three (3) times from 1.0 per cent in January 2013 to 8.0 per cent in October 2014; while the Liquidity Ratio (LR) was raised once from 25.0 to 30.0 per cent in January 2015 (CBN Annual Reports, 2016). The MPC decisions signaled to the market the clear and unambiguous commitment to the attainment of the bank's key mandate of monetary and price stability. Monetary management substantially improved liquidity in the banking system. Consequently, both reserve money and broad money (M_2) were above the indicative benchmarks for fiscal year of 2016. Aggregate bank credit (net) to the domestic economy grew by 42.4 per cent, compared with 10.0 per cent at the end of the preceding year and the target of 36.6 per cent for the year. Claims on the Federal Government (net) and credit to the private sector increased by 52.7 and 31.6 per cent, compared with targets of 29.3 and 29.1 per cent, respectively (CBN, 2014).

However, the Central Bank of Nigeria (CBN) has perceived a high capacity of sustainability by providing a stable inflation and prudent financial standards, which serves as an important determinant of vulnerability to sudden stops in international capital inflows. This move can lead to a sharp contraction in investment, output and employment. Thus, the main trust of this paper is to examine price stability and monetary policy framework in Nigeria with focus on exchange rate, inflation rate and interest rate constancy. The rest of the paper is structured as follows: section II reviews some existing theoretical and empirical literature, section III outlines the methodology for the study, section IV presents the empirical results while section V concludes.

II. THEORETICAL AND EMPIRICAL BASES

This paper adopts the Radcliffe-Sayer's theory of monetary approach. The theory contradicts with the monetarists' view that there is a direct link between money supply and national income or Gross Domestic Product (GDP). The proponents of this theory such as Radcliffe (1959), as recently modified by Samson and Abass (2012) claimed that money is a close substitute for other financial assets, particularly to those issued by non-banking financial institutions. Therefore, if Central Bank wants to follow a contractionary monetary policy by selling securities in the open market, non-bank financial intermediaries will release idle demand deposits and currency. This will offset the restriction of money supply and leave aggregate demand unchanged. The decisions to spend on goods and services determine the level of total demand and is been influence by liquidity of the spender. The theory argues that spending is not limited by the amount of money in existence, but it is related to the amount of money people can get hold of, whether by receipt of income, by disposal of capital assets or by borrowing. The proponents are equally of the view that monetary authorities can only influence the level of overall liquidity and the level of aggregate expenditures through interest rate. Therefore, a rise in interest rate will reduce liquidity, and financial institutions, in turn reduce the supply of loanable fund. This reduces individuals and businesses expenditure since they cannot procure fund. On the other hand, a fall in interest rate will strengthen balance sheets and encourages lenders to seek new business. Meanwhile, the theory posits that business investment is insensitive to changes in short-tern interest rate but influenced by long-term interest rates. Therefore, it is undesirable to cause long-term interest rate to fluctuate sharply because sharp fluctuations will undermine the strength and stability of financial institutions.

However, the application of structural VAR to investigate monetary policy framework has attracted scanty debate. Only few studies relied on Nigerian environment while others are divergent across national boundaries. For instance, the recent study of Adeniyi (2020) investigated the effect of monetary policy on the real sector, by employing the structural vector autoregressive (SVAR) framework. The paper used a set of policy and non-policy macroeconomic variables based on monthly data spanning the period 2006 and 2019. The empirical results based on structural impulse response functions reveal that MPR as a policy tool provides significant results as it is effective in stabilizing price levels, increasing output marginally, and improving the nominal exchange rate conditions. Despite the innovations in the policy rate in the period covered, shocks to the nominal exchange rate have been a major challenge, it affects domestic economic activity complicating the effort of the monetary authority.

Idoko, Seyi and Rotimi (2017) examined the monetary policy in stabilizing price level in Nigeria using the Vector Autoregressive (VAR) model, with in-built differencing to take care of unit root test of the time series in order to capture the relationship between consumer price index and money supply. Their study found that money supply has no significant relationship with price level in Nigeria. This, they believe, may be due to the influence of the large informal financial sector which controls a very significant fraction of money in circulation. Thus, policy reforms that would curb the influence of the informal financial sector should be implemented in order to allow the central monetary authority to work better, and enhance the role of monetary

management in Nigeria. Ismail et al (2013) examined the impact of monetary policy on economic growth in Nigeria. The study uses time series data covering the range of 1975 – 2010. The effect of stochastic shocks of each of the endogenous variables was explored using VAR approach. The results show that long run relationship exists among the variables. Also, the core findings of this study suggest that inflation rate, exchange rate and external reserve are significant with the monetary policy instruments that drive growth in Nigeria.

Okwo, Eze and Nwoba (2012) examined the effect of monetary policy outcomes on macroeconomic stability in Nigeria using time series data spanning from 1985 to 2010 obtained from the CBN statistical bulletin. A simplified ordinary least squared technique stated in multiple forms was applied to the data after ensuring data stationarity. At 5% significant level, none of the variables were statistically significant. The insignificant statistics between monetary policy, gross domestic product, credit to the private sector, net credit to the government and inflation in Nigeria, suggest that monetary policy as a policy option may have been inactive in influencing price stability in Nigeria. Nenbee and Madume (2011) empirically investigated the impact of monetary policy on Nigeria's macroeconomic stability between 1970 - 2009. The study differs by others by viewing macroeconomic stability in terms of price stability. In order to reduce the problem of stationarity usually associated with time series data, the study adopted the SVAR methodology. The results revealed the only 47 percent of the total variation in the model are caused by the monetary policy variables – money supply, rediscount rate and treasury bill at the long run.

Chimobi and Uche (2010) applied Granger causality test to investigate the empirical relationship between money, inflation and output in Nigeria. Employing co integration technique, their findings indicated that money supply had a significant causal effect on both output and inflation and further found that there was no co integrating relationship between money, output and inflation in Nigeria. In a study Chuku (2009), using Structural Vector Autoregression (SVAR) approach to trace the effects of monetary policy shocks on output and prices in Nigeria, found evidence that monetary policy innovations have both real and nominal effects on economic parameters depending on the policy variable selected. The results suggest that price-based nominal anchors, monetary policy rate (MPR) and real exchange rate (REER) do not have a significant influence on real economic activity. However, innovations in the quantity-based nominal anchor, broad money (M2), affect economic activities modestly. Cheng (2006), in his work on a VAR Analysis of Kenya's Monetary Policy Transmission Mechanism: How Does the Central Bank's REPO Rate Affect the Economy, suggests that an exogenous increase in the short-term interest rate tends to be followed by a decline in prices and on appreciation in the nominal exchange rate, but has no significant impact on output.

In a related study by Ludvigston, steindel and Lettau (2002) on monetary policy transmission through the consumption wealth channel, using Vector Autoregression (VAR) methodology with the baseline dynamic structural model embodying five variables in logarithm form as arguments, the study concluded that the wealth channel plays a minor role in monetary policy transmission to consumption. In Japan, Fujiwara (2003) focused on output composition of the monetary policy to investigate the view that whereas in the US, the predominant driver of output change is consumption, in the euro area it is the investment channel. Applying empirically the VAR model, the author concludes that the operation of the monetary policy framework in Japan relied on short-run divergence between the expected rate of inflation and the actual inflation rate. Again, the financial market pass-through was splendidly analyzed in regard to the economy of Iceland by Petursson (2001), using a SVAR approach. Two stages were identified – the first stage was that of interest rate channel, with the second stage explaining the propagation of monetary policy from the financial markets to the real economy. The author concludes that an innovation to monetary policy by the use of the official interest rate has had a significant effect on the money market rate. Walsh and Wilcox (1995) used a monthly data-based vector autoregression (VAR) analysis in which bank loan supply shocks are identified with innovations in the prime lending rate. They show that loan supply innovations are related to changes in bank capital ratios, changes in required reserves and the imposition of credit controls. The results of the study further appear quite similar to the experiences of banks, for example in Nigeria, under its stabilization regime.

III. METHODOLOGY AND DATA SET

This study adopted the Structural Vector Autoregressive Approach (SVAR) to investigate the behaviour of stability in the monetary policy framework of Nigeria. The application of SVAR in this paper is informed by its several merits. For instance, SVAR allows modeling non-recursive structures of the economy with a parsimonious set of variables and it facilitates the interpretation of the contemporaneous correlations among disturbances (Joao and Andrea, 2006). Second, SVAR methodology proposes imposing restrictions on the contemporaneous structural parameters only so that reasonable economic structures might be derived. Unlike the simultaneous, or structural, equation models where some variables are treated as endogenous and some as exogenous or predetermined (exogenous plus lagged endogenous), in VAR models, all the variables are treated as endogenous and therefore, there is no a priori distinction between endogenous and exogenous variables (Arnoštová and Hurník, 2005). In addition to data description and forecasting, the VAR model is also

used for structural inference and policy analysis. In structural analysis, certain assumptions about the causal structure of the data under investigation are imposed, and the resulting causal impacts of unexpected shocks or innovations to specified variables on the endogenous variables in the model can be analyzed. These causal impacts are usually computed with impulse response functions and forecast error variance decompositions (Ezra, Phebian and Emeka, 2012).

In economic literature however, the linkage between the stability of monetary policy framework and its economic variables has been established (Jacobson, Vredin and Warne, 2001). By generating Nigerian economic data, the paper modeled four endogenous variables which include real gross domestic product (RGDP), real effective exchange rate (REXR), inflation rate (INF) and interest rate (INT). Thus, the log of these variables was generated and each variable is explained by a structural equation that has an error term associated with it. The error term for each equation represents a particular shock. The paper employs mostly Nigerian annual time series data spanning from 1970 to 2016. All the data were sourced from various publications of CBN, CBN statistical bulletin various years and International Financial Statistics (IFS) of International Monetary Fund (IMF).

Model Set Up

The paper opened its specification with a simple unrestricted VAR model of Dabla-Norris and Floerkemeier (2006) as,

$Y_t = \sum AiY_{t-1} + e_t$ (1)

where:

Y_t is a column vector of observation at time t on all the variance in the model, $\sum$ is the summation of exogenous variable at time t, Ai represents the matrix of polynomials in the lag operator, a_{t-1} assumes the lag of endogenous variable, and e_t remains the stochastic error term or innovation of shocks. Equation (1) can therefore be transformed into a tri-variate case of VAR (2) as specified below;

$$EXR_{1t} = C_1 + \pi^1_{11}EXR_{1t-1} + \pi^2_{11}EXR_{1t-2} + \pi^1_{12}INF_{2t-1} + \pi^2_{12}INF_{2t-2} + \pi^1_{13}INT_{3t-1} + \pi^2_{13}INT_{3t-2} + \varepsilon_{1t} \quad (2)$$

$$INF_{2t} = C_2 + \pi^1_{21}INF_{1t-1} + \pi^2_{21}INF_{1t-2} + \pi^1_{22}INT_{2t-1} + \pi^2_{22}INT_{2t-2} + \pi^1_{23}EXR_{3t-1} + \pi^2_{23}EXR_{3t-2} + \varepsilon_{2t} \quad (3)$$

$$INT_{3t} = C_3 + \pi^1_{31}INT_{1t-1} + \pi^2_{31}INT_{1t-2} + \pi^1_{32}EXR_{2t-1} + \pi^2_{32}EXR_{2t-2} + \pi^1_{33}INF_{3t-1} + \pi^2_{33}INF_{3t-2} + \varepsilon_{3t} \quad (4)$$

Where;

EXR_{1t} , INF_{2t} and INT_{3t} are the time series variables of interest each expressed as a function of its past (lagged) values and past values of other variables. Further, equations (2), (3) and (4) can be expressed in matrix form as follows;

$$\begin{pmatrix} EXR_{1t} \\ INF_{2t} \\ INT_{3t} \end{pmatrix} = \begin{pmatrix} C_1 \\ C_2 \\ C_3 \end{pmatrix} + \begin{pmatrix} \pi^1_{11} & \pi^1_{12} & \pi^1_{13} \\ \pi^1_{21} & \pi^1_{22} & \pi^1_{23} \\ \pi^1_{31} & \pi^1_{32} & \pi^1_{33} \end{pmatrix} \begin{pmatrix} EXR_{1t-1} \\ INF_{2t-1} \\ INT_{3t-1} \end{pmatrix} + \begin{pmatrix} \pi^2_{11} & \pi^2_{12} & \pi^2_{13} \\ \pi^2_{21} & \pi^2_{22} & \pi^2_{23} \\ \pi^2_{31} & \pi^2_{32} & \pi^2_{33} \end{pmatrix} \begin{pmatrix} EXR_{1t-2} \\ INF_{2t-2} \\ INT_{3t-2} \end{pmatrix} + \begin{pmatrix} \pi^3_{11} & \pi^3_{12} & \pi^3_{13} \\ \pi^3_{21} & \pi^3_{22} & \pi^3_{23} \\ \pi^3_{31} & \pi^3_{32} & \pi^3_{33} \end{pmatrix} \begin{pmatrix} EXR_{1t-3} \\ INF_{2t-3} \\ INT_{3t-3} \end{pmatrix} + \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \end{pmatrix} \quad (5)$$

Note here that the lag length is three (3). A generalized framework for the tri-variate VAR model with third lag length (that is, VAR(3)) is given below;

$$EXR_{1t} = C_1 + \sum_{i=1}^{p}\pi^i_{11}EXR_{1t-i} + \sum_{j=1}^{p}\pi^j_{12}INF_{2t-j} + \sum_{k=1}^{p}\pi^k_{13}INT_{3t-k} + \varepsilon_{1t} \quad (6)$$

$$INF_{2t} = C_2 + \sum_{I=1}^{p}\pi^i_{21}INF_{1t-i} + \sum_{j=1}^{p}\pi^j_{22}INT_{2t-j} + \sum_{k=1}^{p}\pi^k_{23}EXR_{3t-k} + \varepsilon_{2t} \quad (7)$$

$$INT_{1t} = C_1 + \sum_{i=1}^{p}\pi^i_{31}INT_{1t-i} + \sum_{j=1}^{p}\pi^j_{32}EXR_{2t-j} + \sum_{k=1}^{p}\pi^k_{33}INF_{3t-k} + \varepsilon_{3t} \quad (8)$$

Where i, j and k = 1, 2 and 3; and p = 3.

Equations (6), (7) and (8) allow for the inclusion of as many lags as possible in the VAR model. In determining the optimal lag length to be employed in the VAR model, we first consider the interpretation of parameters in equations (6), (7) and (8). It is noteworthy to mention here that the tri-variate case of VAR(*p*) is the underlying framework for the Granger causality test. Thus, we can further interpret equations (6), (7) and (8) in terms of direction of causality between EXR_{1t}, INF_{2t} and $INT_{3t.}$ Thus, the interpolar transformation of the equations into a bi-variate granger causality test remains that either EXR_{1t}, granger cause INF_{2t}, EXR_{1t} granger cause INT_{3t} or INF_{2t} granger cause INT_{3t}.

Estimation of the Bi-Variate VAR(*p*) Model

In order to estimate the bi-variate VAR model, let us consider the model in equation (7) and (8) and remodeled them to a lag length of VAR (4) as in below:

$$INF_t = C_1 + \sum_{I=1}^{p}\alpha_i INF_{t-i} + \sum_{j=1}^{p}\beta_j \log INT_{t-j} + \varepsilon_{1t} \quad (9)$$

$$\log INT_t = C_2 + \sum_{i=1}^{p}\gamma_i INF_{t-i} + \sum_{j=1}^{p}\delta_j \log INT_{t-j} + \varepsilon_{2t} \quad (10)$$

Where P is equal to 4, INF_t denotes log of inflation rate and $\log INT_t$ represents log of interest rate. As indicated, the chosen lag length here is 4. We therefore employ instructional software of Eviews 9.0 for the estimation and subsequently obtain the coefficients and relevant statistics in order to test the hypotheses as postulated below:

$$\mathbf{H_0}: \sum_{i=1}^{p}\alpha^{inf}_i + \sum_{j=1}^{p}\beta^{inf}_j = 0 \quad (11)$$

$$\mathbf{H_0}: \sum_{i=1}^{p}\gamma^{int}_i + \sum_{j=1}^{p}\delta^{int}_j = 0 \quad (12)$$

Thus, in apriori, it expected that all parameters of our interest are greater than zero.

IV: Presentation and Analysis of Results

1V.1 Descriptive Statistics

This sub section is included in order to analyze the statistical imperatives of the study. For instance, the Jarque-Bera is a statistical test that determines whether the series is normally distributed. This statistic measures the difference of the skewness and the kurtosis of the series with those from the normal distribution. The result of the descriptive statistic is in table 1 below;

Table 1: Test of Descriptive Statistic
Sample: 1970 2019

	EXR	INF	INT
Mean	60.98552	17.86021	10.96213
Median	21.88610	13.40000	11.00000
Maximum	289.5663	72.80000	26.00000
Minimum	0.546400	2.300000	3.500000
Std. Dev.	75.34779	14.89356	5.011433
Skewness	0.990029	1.996609	0.461095
Kurtosis	3.017642	6.718129	3.087343
Jarque-Bera	7.678507	58.30013	1.680373
Probability	0.021510	0.000000	0.001630
Sum	2866.320	839.4300	515.2200
Sum Sq. Dev.	261155.3	10203.63	1155.265
Observations	47	47	47

Source: E-view 9.0

From the above table, the null hypothesis is that the series is normally distributed against the alternative that it is not. From the results of the descriptive statistics as contained in table 1, the Jarque-Bera statistic rejects the null hypothesis of normal distribution for the exchange rate (EXR), inflation rate (INF) and interest rate (INT), since their probability values were less than 0.05. However, Kurtosis measures the peakedness or flatness of the distribution of the series. The statistic for Kurtosis shows that all series were normally distributed and leptokurtic, since their distributions were peaked (approximately greater than 3) relative to the normal distribution. Also, all series were found to be platykurtic, suggesting that its distribution is flat (less than 3) relative to the normal distribution. Lastly, skewness is a measure of asymmetry of the distribution of the series around its mean. The statistic for skewness shows that all the series were positively skewed implying that these distributions have long right tails and further suggested that the series under review were significant.

IV.2 Unit Root Test

In this paper, a unit root test was carried out to determine if all variables were stationary or not.To achieve this, both Augumented Dickey Fuller (ADF) and Philip Peron (PP) tests were enggaged.The variables such exchange rate, inflation rate and interest rate were linearized in order to reduce their values. The hypotheses of the tests were stated below:

H_0: observable time series are not stationary i.e. have a unit root.

H_1: observable time series are stationary i.e. do not have unit root

Table 2: Summary Result of Unit Root Tests by ADF and PP Approach

	Level		**Ist Difference**			
Variables	**ADF t-statistic**	**PP t - statistic**	**ADF t-statistic**	**PP t - statistic**	**Order**	**Prob.**
EXR	-2.496574*	-2.632553*	-4.350901**	-4.774965**	I (1)	0.000
INF	-3.732673*	-3.465244*	-7.009644**	-14.07792**	I (1)	0.000
INT	-2.316423*	-2.117503*	-7.129091**	-9.328934**	I (1)	0.000

*Not stationary at any %

**Stationary at 1%, 5% and 10%

Sources: Author's Computation from E-view 9.0, 2018

In economic literature, the decision rule will be to rejected null hypothesis if the probability is less than 0.01,0.05 or 0.1 at the conventional levels of significance,that is,1%,5% or 10% and to reject alternative hypothesis if the probability is more than 0.01, 0.05 or 0.1 at the conventional levels of significance, that is 1%,5% or 10%. From the unit root test conducted as contained in table 2 above, the study found that all series were stationary after differencing them once, that is I (1). The paper therefore, rejected the null hypothesis and concluded that the observable time series were stationary.

IV.3 Unrestricted Vector Autocorrelation

Table 3 contained the estimates of the VAR model having ascertained that the series engaged in the model were stationary at first difference (I(1)). From the estimates however, the paper revealed that only the model of exchange rate is statistically significant having a t-statistic of over 4.05. This suggested that even in the short-run, it is only the first lagged predetermined exchange rate can influence the stability of monetary policy framework in Nigeria. Conclusively, the paper maintained that there is no sufficient evidence in the predetermined values of exchange rate to explain the variations in the stability of monetary policy in their contemporaneous values. However, both the values of coefficient of determination, its adjustments and the overall regression model were satisfactory as over 96 percent of the regression model was explained by the explanatory power. See table 3 below;

Table 3: VAR Estimates

Variables	EXR		INF		INT	
	Coefficients	t-Stat	Coefficients	t-Stat	Coefficients	t-Stat
EXR(-1)	0.9097	4.0547	-0.1089	-0.6264	-0.0184	-0.4589
EXR(-2)	0.1708	0.7418 -	0.0674	0.3779	0.0145	0.3531
INR(-1)	0.0926	-0.4529	0.5489	3.4622	-0.0478	-1.3124
INF(-2)	-0.1443	-0.7286	-0.2742	-1.7864	0.0236	0.6712
INT(-1)	0.8502	0.9656 -	0.4235	0.6206	0.5961	3.7994
INT(-2)	0.1982	-0.2122	0.3449	0.4765	0.2729	1.6396
C	-0.3882	-0.0552	7.2967	1.3375	2.3852	1.9015

$R^2 = 0.96$; Adj. $R^2 = 0.95$ and F* = 145.92

Source: Author's Computation from E-view 9.0, 2018

IV.4 Lag Order Selection Criteria

The estimation of the base line model was done without any prior identification such that the ordering of all the series in the model was arbitrary. However, the lag selection provided an environment for the selection of appropriate VAR, including the VAR lag length of the estimates. Table 4 contained the Lag selection estimate;

Table 4: VAR Lag Selection
Endogenous Variables: EXR INF INT
Included observations: 43

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-550.2592	NA	30080271	25.73299	25.85586	25.77830
1	-455.9364	171.0973	569474.2 *	21.76448	22.25598 *	21.94573 *
2	-451.4003	7.595292	705909.8	21.97211	22.83223	22.28929
3	-437.8643	20.77620*	581578.9	21.76113*	22.98987	22.21425
4	-430.9969	9.582408	663443.0	21.86032	23.45769	22.44938

* indicates lag order selected by the criterion

Source: Estimate from E-view 9.0

From table 4 above, an optima lag length of three was selected for the estimate based on the proposed VAR model. Consequently, three criterions which included FPE, AIC and HQ were employed for the selection of the optimum lag for the model. Thus, the optimum lag of two was selected since HQ seems to be superior considering possible challenges that may arise from other criterions.

IV.5 VAR Granger causality Test

The VAR Granger causality test is usually conducted to determine the direction of relationship among variables included in the VAR model. It is important to note here that only the p-values of the Granger causality estimates were reported and analyses were based on them. Table 5 below reports the p-values of the Granger causality test;

Table 5: VAR Granger Causality/Block Erogeneity Wald Tests
Included observations: 45

	Dependent Variables in the regression	
Regressor	EXR	INF
INT		
EXR	0.0	0.78
0.21		
INF	0.42	0.0
0.40		
INT	0.34	0.54
0.0		
All	0.59	0.37
0.74		

Source: Author's Computation from E-view 9.0. (Only p- values were reported) Table 5 above where VAR Granger causality test was shown, it can be inferred from the p-values that the paper failed to reject the null hypothesis at 5 percent level of significant, which implied that exchange rate does not Granger cause inflation rate and vice versa. In the same way, inflation rate does not Granger cause interest rate, just like interest rate does not Granger cause exchange rate. The above empirical findings suggested that there is no directional causality among all the series engaged in this study. The above findings further implied that exchange rate, inflation rate and interest rates are not predetermined factors in the stability of monetary policy framework in Nigeria.

IV.6 Analysis of Impulse Response Function

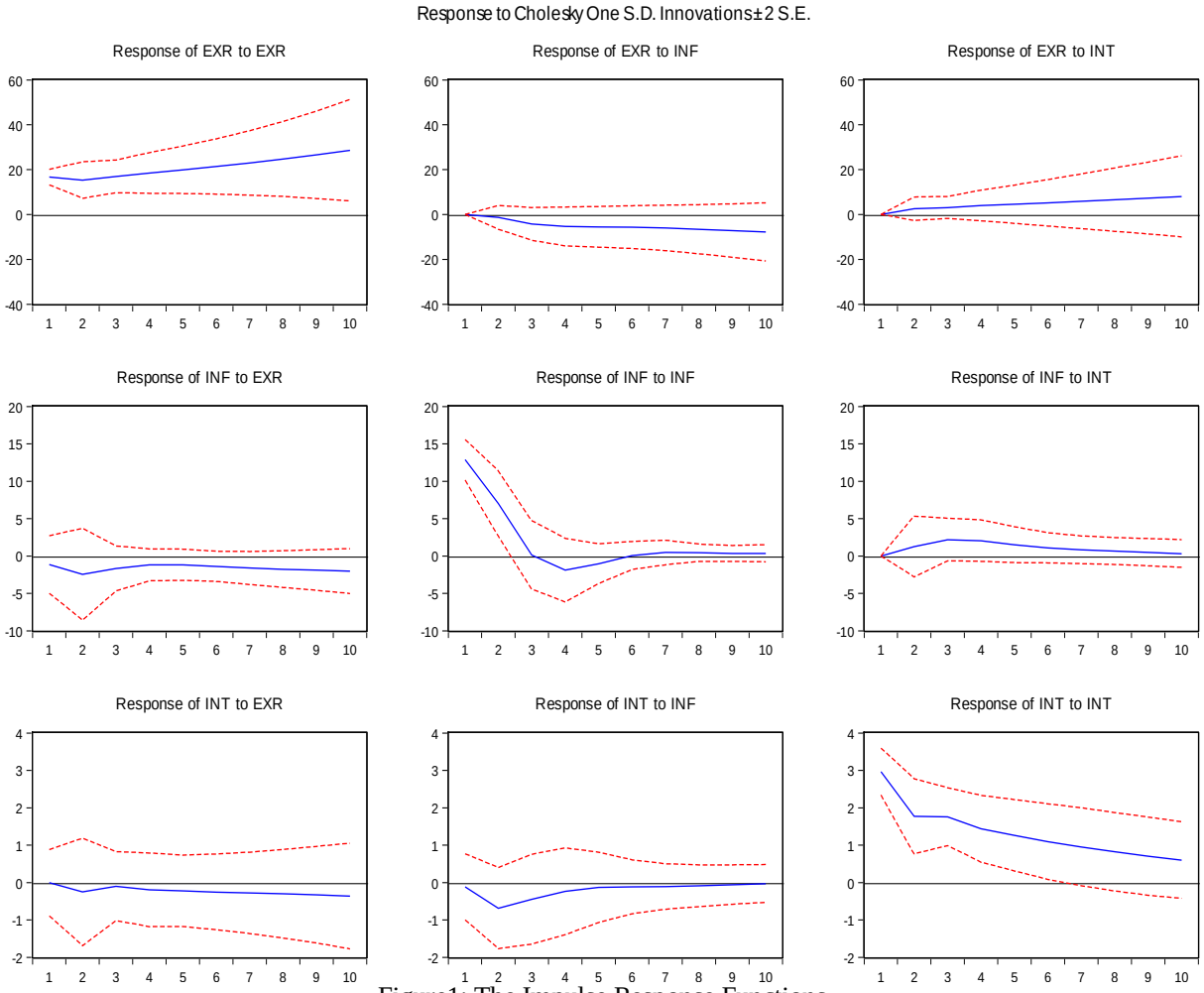

Figure1: The Impulse Response Functions

Source: E view 9.0

Figure 1 above depicted the impulse response function for exchange rate, inflation rate and interest rates in fixing monetary policy stability in Nigeria. This result indicated that there is a positive and significant impact of exchange rate to interest rate but insignificant to inflation rate resulting in unparallel shock in the stability of monetary policy in Nigeria. These responses are most likely to converge very fast since there exist a significant effect. However, inflation responded positively to interest rate but insignificant to exchange rate shock as predicted by economic theory. Further, interest rate seemed to respond negatively with inflation rate but very flat to exchange rate across the years. This finding coincided with economic apriori since interest rate and inflation rate are negatively related to each other, and tend to support the fact that either of the variables tend to stabilize monetary policy framework in Nigeria.

IV.7 Analysis of Variance Decomposition Test

The test is included in the paper to determine the variations in the decomposition of the series in the model. Quite interestingly, the result showed that the impact of own shock on the exchange rate was estimated to be above 88 percent across the 10 point horizon. This result indicated that there is a clear contemporaneous influence of exchange rate on the monetary policy framework in Nigeria. See details of the estimates as contained in table 6 below;

Table 6: Variance Decomposition Test

Variance Decomposition of EXR:				
Period	S.E.	EXR	INF	INT
1	16.66042	100.0000	0.000000	0.000000
2	22.76855	98.45059	0.322136	1.227270
3	28.84057	95.72118	2.363033	1.915785
4	34.88805	93.40837	3.964350	2.627284
5	40.79196	92.09322	4.746573	3.160210
6	46.68612	91.27361	5.089014	3.637376
7	52.70312	90.62243	5.295758	4.081808
8	58.94598	90.02859	5.471114	4.500298
9	65.47472	89.48357	5.628064	4.888365
10	72.33263	88.99547	5.760454	5.244072
Variance Decomposition of INF:				
Period	S.E.	EXR	INF	INT
1	12.91408	0.801079	99.19892	0.000000
2	14.95031	3.287931	96.00559	0.706484
3	15.20286	4.396457	92.84974	2.753807
4	15.50306	4.818207	90.79524	4.386556
5	15.65562	5.295585	89.47406	5.230354
6	15.75524	6.024521	88.34753	5.627949
7	15.86601	6.981350	87.20388	5.814771
8	15.98314	8.103977	86.00204	5.893979
9	16.10590	9.363176	84.74096	5.895867
10	16.24017	10.77046	83.39250	5.837042
Variance Decomposition of INT:				
Period	S.E.	EXR	INF	INT
1	2.969260	0.000482	0.159288	99.84023
2	3.532778	0.518591	3.883553	95.59786
3	3.972597	0.476024	4.344643	95.17933
4	4.235154	0.635539	4.131872	95.23259
5	4.426387	0.832955	3.871418	95.29563
6	4.568230	1.093767	3.697144	95.20909
7	4.675850	1.396033	3.582310	95.02166
8	4.757696	1.752918	3.494281	94.75280
9	4.820823	2.177231	3.417947	94.40482
10	4.870910	2.681646	3.351485	93.96687
Cholesky Ordering: EXR INF INT				

Source: E-view 9.0

Similarly, the result of the variance decomposition test revealed that the own shock impact on inflation rate accounted for about 83 percent of total variations in inflationary trend across the 10 point time horizon. This empirical finding is in line with the results of the VAR granger causality test, which failed to reject the null

hypothesis. Finally, the empirical evidence of variance decomposition discovered that the own shock impact of interest rate explained over 93 percent of the total variation in interest rate across the 10 point time horizon. Conclusively, the above findings suggested that exchange rate, inflation rate and interest rate are endogenously determined.

V. CONCLUSION AND RECOMMENDATIONS

This paper has demonstrated that there is price stability in the monetary policy framework in Nigeria using structural vector autoregressive approach within 1970 to 2019. The paper engaged the monetary policy variables as exchange rate, inflation rate and interest rate having confirmed that the series were stationary at I(1). In the unrestricted VAR model, only exchange rate was found to be statistically significant having a t-statistic of over 4.05. This suggested that even in the short-run, it is only the first lagged predetermined exchange rate can influence the price stability of monetary policy in Nigeria. In the impulse response function, the result indicated that there is a positive and significant impact of exchange rate to interest rate but insignificant to inflation rate resulting in an unparallel shock in the price stability of monetary policy in Nigeria.

In order to ensure price stability in the monetary policy variables, activities of Central Bank of Nigeria (CBN) should go beyond maintaining single digit inflation but should incorporate providing full employment to the teeming populace as this will ensure stability in the financial system. Furthermore, the CBN can adopt the following measures which include improvement of credit allocation, strict management of expected inflation, gradual and synchronization of exchange rate and creation of enabling environment for a rapid and sustainable growth in Nigeria.

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