The Effect of Oil Price Fluctuation on the Economy of Nigeria

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ABSTRACT

The aim of the study is to find the empirical analyses of the impact of oil price fluctuation on the monetary instrument in Nigeria, by looking at their relationships. Specifically, we analyzed the role of Exchange rate, Inflation, Interest rate and how they respond to shocks in oil price. We explored the frequently used Toda–Yamamoto model (TY), by adopting the TY modified Wald (MWALD) test approach to causality, forecast error variance decomposition (FEVD) and impulse response functions (IRFs). The study covered the period Q1 1995-Q4 2018, and our findings from MWALD test indicated that there is a uni-directional causality at 5% level of significance a response of lnintr due to positive change in lnoilpr and next, and the combination of variables with lnintr as a dependent variable contributed to it changes. This also corroborates with our findings in FEVD, of lnintr, contributing to its future error variation of 97.41%, 60.94% and 54.34% for the 1st, 9th and 10th year, and followed by lnoilpr, contributing 24.86% and 31.12% in the 9th and 10th year, also lnexcr contributes 10.35%, 10.80% and 10.19% in 4th, 5th and 6th year into the future, this indicates also a strong causal relationship into the future. The IRFs also complement our findings, where we observed that the relationship between lnoilpr independent variable and lnintr as the dependent variable is an inverse relationship, while other independent variables are positive.

Keywords: Oil Price, Exchange Rate, Inflation, Interest Rate, Toda–Yamamoto
JEL Classifications: Q1, Q3, Q41, Q47

1. INTRODUCTION

Crude petroleum is one of the fundamental sources of energy in the world and plays an important role in economic growth and development of many economies. Because of the need for this product, the oil market is subjected to the market forces of demand and supply, which do lead to the fluctuation in the pricing. Hamilton (2009), Blanchard and Gali (2007), viewed, changes in the price of oil as an imperative source of economic fluctuations, in which the resultant effect led to global shock, capable of affecting many economic activities instantaneously. This shock is perceived generally to have a similar impact due to events like fall in growth rate, high unemployment rate, and high inflation rate, while the magnitude and the causes of the effect of these shocks may differ. For import-based economy, hike in the oil price will lead to shock in the economy, vice versa for the export-based economy (Boheman and Maxén, 2015; Hamilton 2009).

According to (Adedokun, 2018), (NNPC, 2016), the economy of Nigeria was affected by the decline in the revenue due to a fall in the price of crude oil alongside production. they cited that in about 20 months, the oil price has nosedived rapidly from as high as about one hundred and thirty dollars per barrel to as low as twenty-eight dollars and quantity also dropped from 2.15 Mbpd to 1.81 Mbpd in the earlier months of 2016, this resulted to a recession.

The crude petroleum industry is among the largest contributors to the economic growth, prior to the recession experienced by the country, in 2016 the growth rate shrank by −13.65%, a more substantial decline than that in 2015 of −5.45%. This reduced the oil sectors share of real GDP to 8.42% in 2016, compared to 9.61% in 2015, (NBS, Q4 2016). Aside from the contribution to the growth rate, the industry has an effect on monetary variable and high unemployment rate (Blanchard and Gali, 2007). According to Nweze and Edame (2016) as quoted by Adedokun (2018), CBN (2019) opined that on average, 75% of government revenues

and on average 93% of foreign earnings from trade in goods and services, in the last 10 years come from oil export, which informs part of the major sources used in financing the country's imports.

2. LITERATURE REVIEW

The fluctuate in the price of natural resources is a term more related to the oil shock, because the majority of the problems encountered with respect to recession is aggravated by a change in oil price. Hamilton (2009), in his abstract, he opined that historical oil price shocks were principally caused by physical disruptions of supply, the price hiked of 2007-2008 was caused by supply not meeting the excessive world demand. The consequences of recession are very similar with significant effects on consumption. According to Hamilton (1983) as cited by Sabiu (2014), opined that ten out of eleven economic recessions were preceded by a sharp increase in oil prices in the United States.

Oil price shock differs with different economies, the import base economies of oil, rise in the price of world oil could lead to inflation, underproduction, and hence recession (Hamilton, 2009). While to exporters, prolong fall in the price may lead to recession. This is more with the oil-producing developing economies and Dutch disease syndrome (Corden and Neary, 1982) and the consequences of externalities of import of basic goods (Katz, 1973).

Crude oil exportation contributes 93% of our foreign exchange as iterated in our introduction, use in financing import, oil shock reduced the amount of foreign exchange needed by the economy. And this had limited the monetary authority powers of regulations on the foreign exchange, consequently depreciation of the domestic currency and hence inflation (Adedokun, 2018; Gylych et al., 2016). The foreign exchange market in the wake of the recession was subjected to the market forces of demand and supply by adopting managed float exchange rate (Emefiele, 2016), to monitor trade competitiveness and to avoid inflation or deflation (Central Bank of Nigeria, 2016; (Bernanke, 2004).

Monetary policy on inflation always been informed by the general price level. Prior to the recession, the inflation rate was at a single digit of 8.0% and 9.55% for 2014 and 2015 (NBS, 2018). During the recession, the inflation rate was about 18.55% that is in 2016 and as expected, the monetary authority introduced a tight monetary policy by raising the cost of borrowing, the interest rate was steady at 14% from July 2017 to the first quarter of 2018 against 2016 which was 200 points higher. This is against the backdrop of relative improvement in the global economy (CBN, 2017; 2016).

Saban et al. (2019) Investigated the responses of monetary policy variables of select emerging markets to oil market shocks. Using conventional and Fourier Toda Yamamoto methods. In their findings, the oil prices are sensitive to structural shifts and, the causality approach with gradual/smooth shifts indicates oil price shocks influencing the currencies of Indonesia and South Africa, interest rates in Brazil and India, and inflation in South Africa and Turkey.

Also in the summaries of Santos and Chris (2013), used Johansen (1992) co-integration approach and the Toda and Yamamoto (1995) causality testing procedure. Applying Wald coefficient test, the nominal interest rates, and expected inflation co-move together, in the long run, there is a uni-directional causality from expected inflation to nominal interest rates as suggested by the Fisher hypothesis in the closed economy context. While in the open economy context, the result showed that the expected inflation and international variables do not contain information that predicts the nominal interest rate.

In the empirical findings of Mohammed and Jauhari (2016), they employed asymmetric causality test based on Toda and Yamamoto (1995) causality approach to further the causal relationship between exchange rate and inflation differentials in Brunei, Malaysia, and Singapore. The results show the existence of Granger causality running from positive cumulative exchange rate shocks to shocks in inflation differentials for Brunei and Malaysia. Also, the asymmetric causality for Singapore runs from both positive and negative cumulative domestic inflation shocks to positive and negative exchange rate shocks respectively.

Chibvalo et al. (2017) in their submissions, they employed the Toda-Yamamoto approach to Granger causality to test for a causal relationship between inflation and trade openness in Zambia. They established a bi-directional causality between inflation and trade openness. Further, there exists a positive relationship between inflation and trade openness in Zambia.

3. METHODOLOGY AND MODEL SPECIFICATION

3.1. Methodology
This analysis aims at investigating the effect and the interrelations existing between the impact of oil price fluctuation on the monetary instrument (exchange rate, inflation, interest rate). The data were sourced from the Central Bank of Nigeria (CBN), National Bureau of Statistics (NBS) and Nigeria National Petroleum Corporation (NNPC). The data cover a period of 1995-2018 and the data is on a monthly basis. All our variables are in local currency. Therefore we used oil price, the interbank exchange rate as a proxy for exchange rate data, while the prime lending rate was used as a proxy for data on the interest rate and we used consumer price index for all commodity as a proxy for inflation.

A Toda and Yamamoto model (1995) was adopted in estimating the modified WALD granger non-causality test (MWALD), forecast error variance decomposition (FEVD) and impulse response function (IRF).

3.2. The Model
The model used in this research work borrowed a leave from the Toda and Yamamoto model (1995) as iterated in the work of Saban et al. (2019), their model was adopted in this paper, to finding the inter-relationship between oil price and monetary variables. While they consider granger non-causality and structural shift, in our model we considered granger non-causality test, and substitute

structural shift with impulse response function (IRFs) and forecast error variance decomposition (FEVD).

3.2.1. Toda and Yamamoto model (1995) and the modified Wald test statistic (MWALD)

According to Salisu (2015), (Sims, 2011) and Toda and Yamamoto, (1995), vector auto-regressions (VARs) are one of the widely used classes of models in applied econometrics, used as tools both for prediction and for model building and evaluation. It success lied on its flexibility and ease of application when dealing with the analysis of multivariate time series.

Practitioners have recently shown that the conventional asymptotic theory is not applicable to hypothesis testing in levels VAR's if the variables are integrated or co-integrated (Sims, 2011; Toda and Yamamoto, 1995). And one of the deficiencies of the VAR application is the inability to ascertain the a priori expectation of the variables whether the variables are integrated, co-integrated, or (trend) stationary. This necessitates pretesting(s) for a unit root(s) and co-integration in the economic time series, as a requisite for estimating the VAR model, and also when the intentions are prioritized towards the estimation of cointegration and vector error correction model (Yakubu and Abdul Jalil, 2016).

Conversely, the powers of the unit and also simulation experiments of Johansen tests for co-integrating are very sensitive to the values of the nuisance parameters in finite samples and hence not very reliable for sample sizes that are typical for economic time series (Baum and Otero, 2017; Duasa, 2007; Toda and Yamamoto, 1995).

To alleviate these problems, Toda and Yamamoto (1995) and Dolado and Lutkepohl (1996) as quoted by Shakya (2019), Giles (2019) proposes the augmented VAR modeling, that is the modified Wald test statistic (MWALD), which is more superiority to the ordinary GRANGER - causality tests, the method is flexibility and easy to of apply, since one can test linear or nonlinear restrictions on the coefficients by estimating a levels VAR and applying the Wald criterion, paying little attention or circumventing the integration and cointegration properties of the time series data (Salisu, 2015; Yakubu and Abdul Jalil, 2016). However, the model is not a substitute for the conventional pre-testing in time series analysis, but as a complementary to the conventional VAR (Debnath and Mazumder, 2016).

In estimating the MWALD test for granger causality, it is prerequisite to determine the maximum possible order of the integration of the basic variables (d_{max}). Although, the variables could be a mixture of I (0), I (1), and I (2), in such condition, $d_{max} = 2$. The determination of the optimal lag length (k) is very important, to avoid overstating or understating the true value of lag, so as to evade biased estimates of accepting the null hypothesis when it should be rejected, vice versa. By identifying d_{max} and k, a level VAR model of order ($k + d_{max}$) is estimated and zero restrictions test is conducted on lagged coefficients of the regressors up to lag k. This process certifies that the Wald test statistics have an asymptotical chi-square (χ^2) distribution whose critical values can be used to draw a valid inference and conclusion (Yakubu and Abdul Jalil, 2016; Toda and Yamamoto, 1995).

3.2.2. VAR modified Wald test (MWALD)

The aim of the models is to establish the interrelationship that exist amongst the variables; i.e., Oil price (lnoilpr), and monetary policy variable i.e., exchange rate (lnexcr), interest rates (lnintr), and inflation (lncpi). The specification considers each variable expressed as independent in the model as a function of its lag and the lag of other variable in the model. Here the exogenous error terms $\varepsilon_{1t}, \varepsilon_{2t}, \varepsilon_{3t}, \varepsilon_{4t}$ are independent and are interpreted as structural innovations. The realization of each structural innovation is known as capturing unexpected shocks to its dependent variable (respectively), which are uncorrelated with the other unexpected shocks (ε_t). Equations for the modified Warld test model are presented as follows;

$$lnoilpr = \alpha_1 + \sum_{i=1}^{k+dm} \beta_{1i} lnoilpr_{t-1} + \sum_{i=1}^{k+dm} \gamma_{1i} lnexcr_{t-1} + \sum_{i=1}^{k+dm} \delta_{1i} lnicp_{t-1} + \sum_{i=1}^{k+dm} \theta_{1i} \ lnintr_{t-1} + \varepsilon_{1t} \quad (1)$$

$$lnoilpr = \alpha_2 + \sum_{i=1}^{k+dm} \beta_{2i} lnoilpr_{t-1} + \sum_{i=1}^{k+dm} \gamma_{2i} lnexcr_{t-1} + \sum_{i=1}^{k+dm} \delta_{2i} lnicp_{t-1} + \sum_{i=1}^{k+dm} \theta_{2i} \ lnintr_{t-1} + \varepsilon_{2t} \quad (2)$$

$$lnoilpr = \alpha_3 + \sum_{i=1}^{k+dm} \beta_{3i} lnoilpr_{t-1} + \sum_{i=1}^{k+dm} \gamma_{3i} lnexcr_{t-1} + \sum_{i=1}^{k+dm} \delta_{3i} lnicp_{t-1} + \sum_{i=1}^{k+dm} \theta_{3i} \ lnintr_{t-1} + \varepsilon_{3t} \quad (3)$$

$$lnoilpr = \alpha_4 + \sum_{i=1}^{k+dm} \beta_{4i} lnoilpr_{t-1} + \sum_{i=1}^{k+dm} \gamma_{4i} lnexcr_{t-1} + \sum_{i=1}^{k+dm} \delta_{4i} lnicp_{t-1} + \sum_{i=1}^{k+dm} \theta_{4i} \ lnintr_{t-1} + \varepsilon_{4t} \quad (4)$$

4. EMPIRICAL RESULTS AND ANALYSIS

4.1. Stationarity Tests

Although, the Todo-Yamamoto model, the MWALD test was introduced for ease of estimation by circumventing the presence of unit roots pre-testing problem, nevertheless, there is need to determine the maximum order of integration of the variables, which is necessary for estimation of The MWALD test for Granger causality by Toda and Yamamoto (1995). Therefore, we ran the test for the Augmented Dickey-Fuller (ADF) test, Phillips – Perron (PP) test of Phillips & Perron and Kwiatkowski, Phillips, Schmidt, and Shin (KPSS), and Elliott-Rothenberg-Stock test statistic, to ascertain the reliability of the stationarity result (Baum and Otero, 2017; Dickey and Fuller, 2012; Hadri and Larsson, 2005; Hobijn, 1998; Schwarz, 1978; Muller and Elliot, 2003). From Table 1, the unit roots tests confirmed all our process to be considered integrated at first difference and at 1% level of significance using Augmented Dickey-Fuller (ADF) test, Phillips – Perron (PP) and Kwiatkowski, Phillips, Schmidt, and Shin (KPSS). This corroborates with the work of Yakubu and Abdul Jalil in their test of stationarity. These test of stationarity are in contrast when Dickey and Fuller, Elliott-Rothenberg-Stock test statistic and Ng-Perron test statistics are applied to test for the stationarity on the same variable. So we stick to ADF, PP, and KPSS, and agree that $d_{max} = 1$.

4.2. Modified Wald (MWALD) Test for Granger Causality

The modified Wald (MWALD) Test for Granger Causality requires the determination of optimal lag which is presented in Table 2. By default, we use LR: Sequentially modified LR test statistic, FPE: Final prediction error, AIC; Akaike information criterion, SBC: Schwarz information criterion and Hannan-Quinn information criterion to determine the optimal lag for the estimation of VAR system. The SC and HQ minimize its value at lag 2 while LR and FPE minimizes at lag 3. According to Liew (2004), Asghar and Abid (2019) Estimating the lag length of the autoregressive process for a time series is imperative in econometrics. The selection is done with the aim of minimize the chance of underestimation while at the same time maximizing the chance of recovering the true lag length. Another important aspect of the lag selection criteria is to overcome the structural break. Though, studies indicated that HQC is found to surpass the rest by correctly identifying the true lag length. In contrast, AIC and FPE is a better choice for a smaller sample. In Table 2 out of the two criteria, we suggesting three (3) as the optimal lag.

4.3. Test for Normality of VAR Residuals

Table 3 shows the result of the Jarque-Bera test for normality of the residuals. The Jarque-Bera is a test statistics for testing whether the series is normally distributed. From our analysis, it is apparent that we failed to reject the null hypothesis of normality of residuals of each equation as well as all the equations combined at 5% level of significance (Zombe et al., 2017).

4.4. VAR Residual Serial Order Correlation LM Tests

Prior to the estimation of the causality test, forecast error variance decomposition (FEVD) and impulse response functions (IRFs). The VAR residual serial correlation test is needed to verify the reliability of the estimates of the multivariate model chosen, it is applied to test a set restrictions on a model that is unrestricted, and it is based on the restricted maximum likelihood test (ML) (Salisu, 2015; Asterious and Stephen, 2007; Judge et al., 1994). From the TY estimation output for the residual serial correlation test in Table 4, the null hypothesis for the test is that there is no serial correlation. The result submits that there is no evidence of serial correlation. Which indicate the reliability of the model used.

4.5. Granger Causality Test WALD Test

From Table 5 we have the log oil of price (lnoilpr) as the dependent variable, at 5% level of significance, there is no any causality between, the log of exchange (lnexcr), the log of cpi (lncpi) and log of interest rate (lnintr) on the dependent variable. Also, the combination of all the independent variables does not cause any changes in the dependent variable.

From Table 6 we have the log of exchange (lnexcr) as the dependent variable, at 5% level of significance, there is no any causality between, log oil of price (lnoilpr), the log of cpi (lncpi) and log of interest rate (lnintr) on the dependent variable. Also, the combination of all the independent variables do not Granger cause changes in the dependent variable.

Also from Table 7 we have the log of cpi (lncpi) as the dependent variable, at 5% level of significance, there is no any causality between, log oil of price (lnoilpr) log of exchange (lnexcr) and log of interest rate (lnintr) shows no relationship on the dependent variable. Also, the combination of all the independent variables do not granger cause changes in the dependent variable.

In Table 8 we have the log of interest rate (lnintr) as the dependent variable, at 5% level of significance, there is a causality, which is a uni-directional relation from log oil of price (lnoilpr), log of exchange (lnexcr) to the endogenous variable, while there is no

Table 1: Stationarity tests

Series	ADF		PP		KPSS		DF		Elliott-Rothenberg	
	Constant	Constant and trend	Constant	Constant and trend	Constant	Constant and trend	Constant	Constant and trend	Constant	Constant and trend
LNOILPR	−14.321**	−14.303**	−14.349**	−14.331**	−0.063**	0.0352**	−4.821**	−12.621**	50.093*	5.802**
LNEXCR	−11.644**	−11.678**	−9.8973**	−9.887**	0.198**	0.077**	2.222*	−4.404**	132.684*	14.194*
LNCPI	−13.318**	−5.328**	−13.294**	−5.562**	0.118**	0.1034**	4.706*	−6.515***	1876.140*	32.383*
LNINTR	−6.7156**	−6.703**	−16.261**	−16.231**	0.0463**	0.046**	−6.303**	−6.401**	5.140*	6.729***

Just like the ADF, the DF, the PP and Elliott-Rothenberg unit root test has the null hypothesis of "not stationary" against the alternative, which is "stationary," and in contrast, KPSS unit root test has the null hypothesis of "stationarity" against the alternative, "not stationary." Also ***, **, * represent I(2), I(1) and I(0) respectively

Table 2: VAR lag order selection criteria

Endogenous variables: LNOILPR LNEXCR LNCPI LNINTR						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	79.95715	NA	6.83e-06	−0.542551	−0.490625	−0.521724
1	2323.262	4406.491	8.42e-13	−16.45187	−16.19224	−16.34773
2	2371.092	92.58541	6.71e-13	−16.67923	−16.21190*	−16.49178*
3	2391.456	38.83762*	6.50e-13*	−16.71040*	−16.03537	−16.43964
4	2403.259	22.17237	6.70e-13	−16.68042	−15.79769	−16.32635
5	2410.052	12.56809	7.16e-13	−16.61466	−15.52422	−16.17728
6	2420.858	19.68162	7.44e-13	−16.57756	−15.27942	−16.05687
7	2426.973	10.96335	7.99e-13	−16.50695	−15.00111	−15.90296
8	2437.157	17.96778	8.34e-13	−16.46541	−14.75187	−15.77810

*indicates lag order selected by the criterion

Table 3: Jarque-Bera normality test result

Component	Jarque-Bera	df	Prob.
1	15.36714	2	0.0005
2	4572.449	2	0.0000
3	389.0131	2	0.0000
4	382.0722	2	0.0000
Joint	5358.902	8	0.0000

Sources: From the author

Table 4: VAR residual serial order correlation LM tests

Included observations: 284		
Lags	LM-stat.	Prob.
1	13.85744	0.6093
2	8.875657	0.9184
3	15.67327	0.4760
4	12.71378	0.6936
5	17.43719	0.3579
6	13.75120	0.6172
7	15.36275	0.4982
8	22.59562	0.1250
9	21.86582	0.1476
10	12.38694	0.7169
Probs. from Chi-square with 16 df		

Sources: From the author

Table 5: Granger causality test WALD test for equation (1)

Dependent variable: LNOILPR			
Excluded	Chi-sq.	df	Prob.
LNEXCR	0.297326	3	0.9605
LNCPI	2.517571	3	0.4721
LNINTR	2.072927	3	0.5574
All	5.503884	9	0.7884

Sources: From the author

Table 6: Granger causality test WALD test for equation (2)

Dependent variable: LNEXCR			
Excluded	Chi-sq.	df	Prob.
LNOILPR	6.426225	3	0.0926
LNCPI	2.889761	3	0.4089
LNINTR	1.567570	3	0.6668
All	11.29767	9	0.2559

Sources: From the author

any causality with the log of cpi (lncpi) on the dependent variable. Also the combination of all the independent variables Granger cause changes in the dependent variable.

4.6. Residual Correlation Matrix
The results from FEVD and IRFs may be sensitive to the variables' ordering, except if the error terms contemporaneous correlations are low, The ordering of variables suggested by Sims (1980) as iterated in the work of Yakubu and Abdul Jalil (2016), Duasa (2007), is to start with the most exogenous variables in the system and ended by the most endogenous variable.

Table 9 shows the residual correlation matrix, the result shows that there is no instantaneous correlation between the variables because the variables are evidently not significantly different from

Table 7: Granger causality test WALD test for equation (3)

Dependent variable: LNCPI			
Excluded	Chi-sq.	df	Prob.
LNOILPR	1.151935	3	0.7646
LNEXCR	6.824049	3	0.0777
LNINTR	7.771454	3	0.0510
All	14.75625	9	0.0979

Sources: from the author

Table 8: Granger causality test WALD test for equation (4)

Dependent variable: LNINTR			
Excluded	Chi-sq.	df	Prob.
LNOILPR	14.66233	3	0.0021
LNEXCR	10.44319	3	0.0152
LNCPI	3.488718	3	0.3222
All	31.49615	9	0.0002

Sources: From the author

Table 9: Residual correlation matrix

	LNOILPR	LNEXCR	LNCPI	LNINTR
LNOILPR	1.000000	0.156275	0.025236	0.052056
LNEXCR	0.156275	1.000000	0.038583	0.144681
LNCPI	0.025236	0.038583	1.000000	-0.057944
LNINTR	0.052056	0.144681	-0.057944	1.000000

Sources: From the author

zero (at a 5% level of significance) Lutkepohl and Kratzig, 2004), since there is no strong correlation among the variable we assume the arrangement of our variables are in other.

4.7. Forecast Error Variance Decomposition (FEVD) and Impulse Response Function (IRF)
From the estimated TY VAR, we compute forecast error variance decompositions (FEVD and impulse response functions (IRF), which serve as means for evaluating the dynamics of the interrelationship, interactions, and strength of causal relations amongst the variables in the system. The impulse response functions trace the effects of a shock to one endogenous variable on to the other variables in the VAR, variance decomposition separates the variation in an endogenous variable into the component shocks to the VAR (Gylych et al., 2016; and Duasa, 2007).

In simulating FEVD and IFRs, the VAR innovations can be contemporaneously correlated. That is a shock in one variable can work through the contemporaneous correlation with innovations in other variables. The responses of a variable to innovations in another variable of interest cannot be adequately represented in isolation, due to the facts that shock to individual variables cannot be separately identified due to contemporaneous correlation (Duasa 2007; Lutkepohl, 1991).

In our analyses we applied Cholesky approach which uses the inverse of the Cholesky factor of the residual covariance matrix to orthogonalize impulses (innovations) as recommended by Sims (1980) as quoted by Duasa (2007) and (Breitung et al., 2004) to solve this identification problem. The strategy requires a pre-specified causal ordering of the variables, which we estimated in

Tables 4-9. The results of FEVD and IRFs are displayed in Tables 10-13 and Figure 1, respectively.

We explored the Cholesky factorization in the E-Views software and forecast the interrelationship of the variables up to 10 years. Table 10 shows the 10 years forecast of the oil price. In forecasting a variable, shocks in the residual of the forecasted variable contribute more to the variance than the shocks in other variables. The shocks in oil price-output contribute more to its variance, from 100% in the 1st year down to 98.75% in the last year of the forecast. This shows that the contemporaneous relationship between the oil price as the endogenous variable and predictors in our model are very insignificant. This is an indication that it will take a longer time into the future, for other variables to determine oil prices.

Table 10: Variance decomposition of LNOILPR

Period	S.E.	LNOILPR	LNEXCR	LNCPI	LNINTR
1	0.090453	100.0000	0.000000	0.000000	0.000000
2	0.137389	99.56602	0.007555	0.357862	0.068566
3	0.171281	99.31622	0.077847	0.518729	0.087200
4	0.200876	99.17720	0.135794	0.615055	0.071949
5	0.229614	99.16728	0.123200	0.650960	0.058563
6	0.258540	99.16645	0.102858	0.650544	0.080151
7	0.287991	99.12753	0.094086	0.633670	0.144711
8	0.317830	99.03625	0.098931	0.617071	0.247745
9	0.347871	98.90556	0.107085	0.607825	0.379528
10	0.378131	98.74832	0.110467	0.607212	0.534006

Sources: From the author

Table 11, is the Variance decomposition of LNEXCR with 95.56 % in the 1st year, to about 94.67% in the 10th year into the future. This becomes apparent that apart from shocks in itself, none of the other variables contributes sufficiently to its forecasting error variance. We only have oil price which contributes 2.44% and 2.51% in the 1st and 10th year, which are very insignificant. The error variance in forecasting lnexcr is generally minimal, hence, shocks in the residuals of other variables do not have much effect in determining the exchange rate.

Table 12 is forecast error variance decomposition of LNCPI as the predictant, the predictant contributes 99.81%, 74.84% and 67.99% in the 1st, 9th and 10th years. lnexcr contributes more to the error variance in forecasting lncpi, contributing about 23.76% up to 30.42% in the 9th and 10th years. This has brought a clearer picture of the interdependency of LNCPI, where MWALD test fails to show.

Table 13 illustrated the forecast error variance decomposition of lnintr, contributing to its future error variation of 97.41%, 60.94% and 54.34% for the 1st, 9th and 10th year, and followed by lnoilpr, contributing 24.86% and 31.12% in the 9th and 10th year, also lnexcr contributes 10.35%, 10.80% and 10.19% in 5th, 5th and 6th year, this indicates also a strong relationship into the future. The forecast error variance decomposition of the variables estimates also coincides with the result we obtained in the estimates we derived in Table 8, which also indicates that our estimates are good to go for the estimation of future policy implementations.
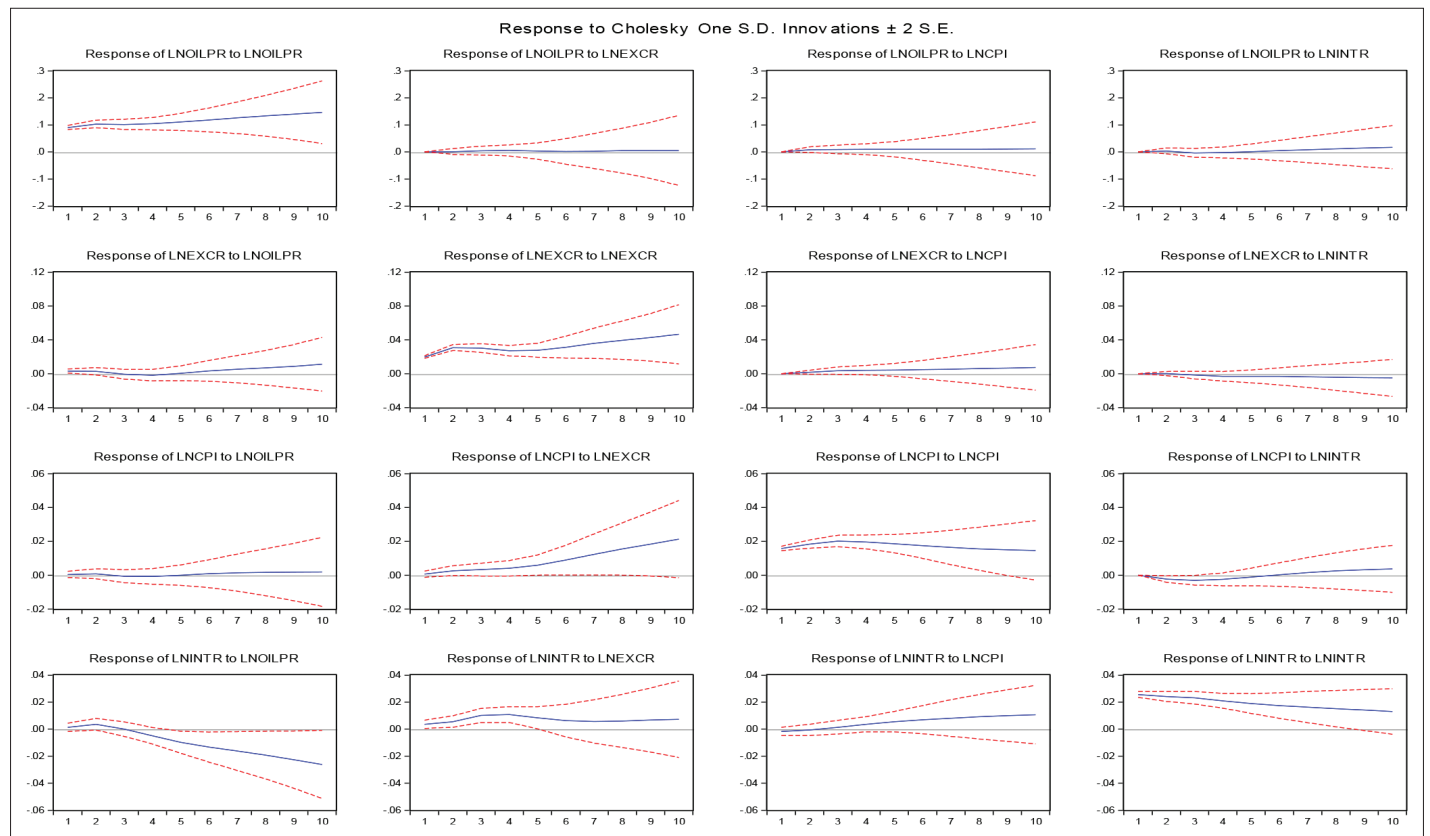
Figure 1: Impulse responses

Table 11: Variance decomposition of LNEXCR

Period	S.E.	LNOILPR	LNEXCR	LNCPI	LNINTR
1	0.019957	2.442191	97.55781	0.000000	0.000000
2	0.036882	1.303029	98.47056	0.226099	0.000307
3	0.047819	0.793908	98.43015	0.646775	0.129165
4	0.055286	0.693289	97.87271	1.034284	0.399717
5	0.062080	0.553215	97.54321	1.309243	0.594331
6	0.069867	0.647208	97.17916	1.485892	0.687736
7	0.078942	0.957948	96.68523	1.612729	0.744094
8	0.088880	1.356380	96.11710	1.725014	0.801501
9	0.099431	1.853764	95.46031	1.827727	0.858202
10	0.110732	2.513290	94.67350	1.913166	0.900043

Sources: From the author

Table 12: Variance decomposition of LNCPI

Period	S.E.	LNOILPR	LNEXCR	LNCPI	LNINTR
1	0.015757	0.063687	0.122994	99.81332	0.000000
2	0.024441	0.111687	1.169617	97.78015	0.938541
3	0.032010	0.104867	1.709240	96.72400	1.461890
4	0.037846	0.118843	2.348794	96.05369	1.478675
5	0.042585	0.094052	3.766938	94.89832	1.240691
6	0.046854	0.110542	6.716716	92.14406	1.028684
7	0.051162	0.168941	11.38883	87.49152	0.950702
8	0.055743	0.228618	17.28356	81.49007	0.997754
9	0.060688	0.275583	23.76403	74.84026	1.120127
10	0.066084	0.315101	30.42335	67.99453	1.267029

Sources: From the author

Table 13: Variance decomposition of LNINTR

Period	S.E.	LNOILPR	LNEXCR	LNCPI	LNINTR
1	0.026014	0.270981	1.911153	0.411721	97.40614
2	0.036110	1.162856	3.384292	0.236829	95.21602
3	0.044126	0.778732	7.551086	0.251113	91.41907
4	0.050352	1.545252	10.35243	0.690563	87.41175
5	0.055601	4.317860	10.80310	1.548061	83.33098
6	0.060508	8.517769	10.19189	2.639437	78.65090
7	0.065483	13.44304	9.438508	3.801150	73.31731
8	0.070781	18.89792	8.813197	4.921515	67.36737
9	0.076594	24.85681	8.298437	5.907154	60.93760
10	0.083021	31.12913	7.831438	6.686060	54.35338
Cholesky Ordering: LNOILPR LNEXCR LNCPI LNINTR					

Sources: From the author

In Figure 1, from the first row, the oil price (lnoilp) responded contemporaneously by the change in its own shocks, while the response of oil price (oilpr) to change Exchange (lnexcr), Inflation (lncpi), and Interest rate (lnintr) are insignificant. In the second row, there is a slightly positive response of exchange (lnexcr) to change Oil price (lnoilpr) in the sixth lag period, also Exchange (lnexcr) responded instantaneously, a positive response, to change in its self. In the third row, the response of inflation (lncpi) to change in price of oil (lnoilpr) and Interest rate (lnintr) is insignificant, while there is a positive response in inflation (lncpi) to change in exchange rate (lnexcr), that is from the second lag period up to the tenth lag period in an increasing order, while there is an instantaneous response of inflation (lncpi) to change in inflation (lncpi) in a high positive level, with a slight drop towards the 10th year. In the fourth row, there is an inverse response of interest rate (lnintr) to change oil (lnoilpr) from the

second lag period in an increasing order up to the 10th year, also an instantaneous positive response of interest rate (lnintr) to change in exchange rate (lnexcr), in the 3rd and 4th year, before it drops. Also, interest rate (lnintr) responds contemporaneously to change in Inflation (lncpi), with a positive increase from the 4th year and finally, inflation (lncpi) responded significantly to change Inflation (lncpi). The impulse response functions further complement the forecast error variance decomposition by given a picture of the direction of the relationship.

5. CONCLUSION AND RECOMMENDATION

In this research work, we explored the Toda-Yamamoto modified wald test (MWALD) to examine the impact of oil price fluctuation on the monetary instrument in Nigeria, by looking at their causal relationships. The study covered the period 1995:Q1-2018Q4, so as to establish the relationships between these macroeconomic indicators. Among other analyses are the FEVD and IRFs.

The review showed the direction of causality and FEVD into the future for 10 years, between oil price, exchange rate, inflation, and interest rate. From the analyses of Toda-Yamamoto granger causality WALD test, the review showed that there is a unidirectional causality between lncpi due to change in lnexcr and lnintr. This is consistency with the result we obtained in the estimation forecast error variance decomposition of LNCPI as the predictant, where the predictant contributes 99.81%, 74.84% and 67.99% in the 1st, 9th and 10th years. Lnexcr contributes more to the error variance in forecasting lncpi, contributing about 23.76% up to 30.42%, while lninr contributes 1.12% and 1.27% in the 9th and 10th years into the future. This also confirmed in our estimation of the impulse response function.

Also in the estimation of granger causality WALD Test for lnintr, it responded positively to change in lnoilpr and lnexcr. This is also in agreement with estimation of forecast error variance decomposition of LNINTR, contributing to its future error variation of 97.41%, 60.94% and 54.34% for the 1st, 9th and 10th year, and followed by lnoilp, contributing 24.86% and 31.12% in the 9th and 10th year, also lnexcr contributes 10.35%, 10.80% and 10.19 in 4th, 5th and 6th year, this indicates also a strong relationship into the future. This also conforms to the outcome of the IRF, which specified further that the relation between lnintr and lnoilpr is an inverse relationship, while others are positive.

Although our a priori expectation was negated, trying to establish a direct link between oil price and exchange rate, for the facts that Nigeria is an oil producing economy and at the same time also an import based economy. The major sources of financing the import come from oil revenue. One can still establish that relationship. As an oil-producing economy, there are tendencies of having Dutch disease syndrome (Corden and Neary, 1982; Katz, 1973). Theoretically, considering the results, there is causality in the interest rate and inflation due to change in the exchange rate, and oil price plays a vital role in determining the exchange rate, invariably, oil price determine the cost of borrowing and inflation too.

Therefore, in implementation of monetary policy by the policymakers, attention should be drawn to price level of import from the external market, that is by concurrently monitoring the domestic market and the economy of the country's trading partners. On a general note, there should be diversification of the economy from oil to non-oil economy to avoid the Dutch disease syndrome.

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