Oil Price and Exchange Rate Volatilities: Its Implications on the Cost of Living in OPEC Member Country - Nigeria.

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Abstract:

As the large exporter of crude oil, Nigeria heavily depends on oil earnings to fund economic activities. The country also rely heavily on imports of consumables, both oil and non oil consumables. Nigeria s vulnerability to crude oil price shock at the international oil market exposes the nation to certain negative shocks. The study investigated the dynamics of crude oil price and exchange rate volatilities and its implication on the cost of living in Nigeria. Structural Generalized Autoregressive Conditional Heteroscedasticity (S-GARCH) was employed to measure the influence of crude oil price volatility on the exchange rate fluctuation as well as their influence on the consumer price index. Oil price and exchange rate volatilities did not significantly pass-through to the consumer price index in Nigeria. However, information on previous volatilities proved a significant determinant of current volatilities. The media should be significantly utilized as a strategic tool to better predict and manage oil price and exchange rate volatilities in Nigeria. Government should further reconsider allowing the importation of certain consumable goods which are also produced in Nigeria, while boosting domestic production and export.

Keywords: cost of living, exchange rate, oil price, pass-through, volatilities

JEL Classification: E31, F13, F31, F41

1 Introduction:

In most of oil exporting countries, like Nigeria, government directly receives the financial benefits crude oil export. Government spending pattern becomes very crucial in the economy. Since the necessary funds for government expenditure come from the revenue gotten from oil export, Macroeconomic policies (fiscal and monetary policies) depend on the price of oil (Rosser and Sheehan, 1995). In such economy, oil price shock could easily be transmitted through exchange rate to cause economic instability due to the variations in oil revenue. According to Kilian (2006), when a country has favourable terms of trade, oil revenue can easily be used to efficiently finance expenditure by government, which otherwise would lead to waste as is mostly the case with fiscal

expansion and inefficient public financing. The unproductive system of inefficient public finance and fiscal expansion, over time, makes economy more open and subjected to oil price shocks, especially where the capital market has certain imperfections (Anashasy, Bradly and Joutz, 2005). However, when there is a down turn in the price of oil without a corresponding immediate downturn in the level of spending of large public sectors, the economy faces substantial deficits. This was evidenced in Nigeria between 2015 and 2017, following the drop in crude oil price plus fiscal imbalance, which plunged Nigeria into economic recession.

Nigeria has witnessed a sudden decline in oil prices from the peak of US$147 per barrel in July 2008 to US$40 per barrel in February 2009 and below US$40 between second and third quarter of 2015. Also, the economy has experienced depreciation of currency from ₦118/$1 to ₦145/$1 and ₦345/$1 (official rate) in the same period, while parallel exchange rate rose over ₦450/$1 in quarter three of 2016. Decreasing oil price also has negative implications for a major importing economy - Nigeria. An economy that imports almost all its consumables, including refined crude oil products will also have depreciating currency value, rising inflation level - cost of living and doing business and other negative macroeconomic implications. Therefore, giving the above analogy, for an oil exporting country such as Nigeria, though earning increases with rising oil price and declines as neither oil price declines, neither rising oil price nor declining oil price reduces the cost of living. In line with Ogiri, Amadi, Uddin and Dulon s (2013) opinion, the present of large price increases and decreases replicate a considerable rise in the volatility of the real oil price which creates market uncertainties that will prompt companies to defer their investment, which would have boosted the economic growth and wellbeing of the populace.

Considering the import habit of Nigerians on consumables, the rising exchange rate has caused an increase in the general price level, resulting in rising cost of living and increased level of poverty as these factors among others contributed in plunging Nigerian economy into recession. Demand for imported consumables have declined due to the depreciating currency of Nigeria and forced a massive shift from consumption of foreign goods to consumption of locally produced goods, which is in short supply to its demand, and therefore, adding to the demand pull inflation. Furthermore, while oil earnings declined due to lowering oil prices in 2015, Nigeria buys refined oil products, such as fuel, gas, and kerosene even at a higher price than the oil export price, therefore causing cost-push inflation (supply side negative effect). The pertinent questions therefore are; to what extent does oil price volatility influence exchange rate volatility in Nigeria? What is the exchange rate volatilities influence on the cost of living in Nigeria? What is the influence of oil price volatility on the consumer price index in Nigeria and how significant is the pass-through from oil price and exchange rate to the cost of living in Nigeria?

2 Literature Review

In the study of the long-linkage between real oil price and real exchange rate in OPEC members, Nikbakht (2010) investigated the long run relationship between them by using a monthly panel of seven countries of OPEC members and suggested that real oil prices may have been the major source of real exchange rate volatilities, showing from the result a long run and positive linkage between real oil prices and real exchange rates. However, Muhammad, Suleiman and Kouhy

(2011) argued otherwise. Their investigation of the oil price exchange rate nexus for Nigeria during the period 2007-2010 using daily data evidenced that a rise in oil prices leads to a depreciation of the Nigerian Naira vis-à-vis the US dollar. Shafi, Hua, Idrees, Satti and Nazeer (2015) employed Engle and Granger Cointegration technique to check the significance of exchange rate volatility and oil price fluctuation on economic growth in France. Closely related to the findings of Nikbakht (2010), they indicated a significant impact in the long run, while its error correction adjustment mechanism (ECM) in short runs was significant and followed the a priori expectation for France. This also proved contrary in the case of Nigeria as Nwanna and Eyedayi s (2016) investigation in Nigeria showed that oil price volatility does not have a positive impact on the economy but oil price itself does.

Investigating the link between real exchange rates and real oil prices in Nigeria, Egbe (2015) revealed that dynamic short run impact of oil price volatility on exchange rate does not hold due to the fact that transactions on crude oil are not primarily carried out using the naira and so the fluctuation in prices may not be easily transmitted to the naira exchange rate in the short run. Ogundipe and Ogundipe (2013) assessed external reserves, oil price and interest rate effects on the volatility of exchange rate in Nigeria using annual data from 1970 to 2011 and concluded that a proportionate change in oil price leads to a more than proportionate change in exchange rate volatility in Nigeria, implying that exchange rate responds to oil price shocks. Extending the study on the effect of oil price movements on USD-Naira exchange rate pair using 420 observations from monthly time series data for the period January 2008 to December 2014, Osuji (2015), showed that oil prices on a relative basis significantly affected exchange rate compared to imports. The study also showed evidence of unidirectional Granger causality from oil prices to exchange rate and from oil prices to foreign reserves.

Plante and Traum (2014) studied how exogenous changes in oil price uncertainty affect GDP and other macroeconomic variables. The argued that positive innovations in the index lead to increased oil price uncertainty and small but statistically significant declines in the growth rate of U.S. real GDP, and that a New Keynesian model in which oil usage is required for the utilization of both capital and durable goods also produced declines in GDP and other macroeconomic variables following an increase in real oil price uncertainty. Apere and Ijomah (2013) investigated the time-series relationship on the impact of oil price volatility on macroeconomic activity in Nigeria using exponential generalized autoregressive conditional heteroscedasticity (EGARCH), impulse response function and lag-augmented VAR (LA-VAR) models and found evidence that an unidirectional relationship exists between the interest rate, exchange rate and oil prices, with causal direction moving from oil prices to both exchange rate and the interest rate. However, they did not find significant relationship between oil prices and real GDP. Blaming domestic prices for inflation, Omojolaibi (2013) claimed that variations in oil price are caused mainly by oil shocks, arguing that shocks within the country also account for a considerable portion of the variations in oil price. Alper and Torul (2008) investigated the relationship between oil prices and manufacturing sector of Turkey reported that while the rise oil price did not substantially impact on the manufacturing sector as a whole, some sub-sectors were seriously affected.

Akinbobola (2012) provided quantitative analysis of the dynamics of money supply, exchange rate and inflation in Nigeria with empirical results confirming that in the long run, there was significant and negative effect of exchange rate and money supply on inflation, explaining that it may be due to the hiccups in the supply of domestic and foreign goods from their respective outlets, while changes In international prices of goods and real output had positive effects on inflation. In 2014, Onuoha argued that inflation is positively related to exchange rate in Nigeria, evidenced by the direct relationship between export, import and exchange rate, and inflation. The study explained that an increase in exchange rate volatility leads to increase in inflationary pressure.

Examining the consistency, persistency, and severity (degree) of exchange rate volatility of Nigerian Naira vis-a-vis the United State dollar using monthly time series data for the period of 1986 to 2008, Adeoye and Atanda (2010) indicated that overshooting volatility was present as well as the persistent volatility in the real and nominal exchange rate of naira vis-à-vis U.S dollar, proving the ineffectiveness of monetary policy in stabilizing exchange rate. Nkurunziza (2002) argued that political stability and more fundamental changes in Burundi s economy and its management is needed to ensure the success and sustainability of the foreign exchange. Obiekwe and Osabuohien (2016) discovered that exchange rate volatility has a significant direct impact on inflation in the long run. Imimole and Enoma (2011) concluded that although Naira depreciation is relevant in ensuring an improvement in the production of exportable commodities, it must not be relied upon as a potent measure for controlling inflation in Nigeria. Madesha, Chidoko and Zivamonoyo (2013) on the other hand looked into the empirical relationship between exchange rate and inflation in Zimbabwe during the period 1980 to 2007. Using Granger Causality test, they showed that both the exchange rate and inflation have long run and bi-causality relationship. While substantial literature exist on oil price volatilities and exchange rate fluctuations in Nigeria, this study seeks to examine the implications of oil price and exchange rate volatilities pass-through on the cost of living in an OPEC member Country, Nigeria.

3 Methodology

The study adopted ex-post facto research design for the analyses. The theory of long run price determination, the flow theory of exchange rate determination and the cost push theory of inflation was utilized as guide in framing the methodology. A synergy of the structural equation modeling (SEM) outlined by Jöreskog (1973), Sivo (1997), Sivo and Wilson (2000), Sivo (2001) and Kaplan (2001) and the generalized autoregressive conditional heteroscedasticity (GARCH) was designed as the main technique of analysis. The SEM was modified to integrate the GARCH, which uniquely models in its variance equation, the effects of one period lag of residual [(μ_{t-1}), measuring the autoregressive/lag effect] and squared one period lag residual [$(\mu_{t-1})^2$], measuring the effect of information of the lagged residual], in a structural Generalized Autoregressive Conditional Heteroscedasticity (S-GARCH). In order to integrate the ARCH [$(\mu_{t-1})^2$] and Generalized Autoregressive Conditional Heteroscedasticity [GARCH (μ_{t-1})], Econometric view software, version 8 was employed to determine the ARCH and GARCH variables. The ARCH and GARCH variables were treated as observed variables, rather than latent (unobserved) variables in the SEM.

Two hundred and four (204) time series monthly observations from 1996 to 2016 were collected

for all the variables specified in the models. Investigation of the sensitivity of consumer price index to exchange rate fluctuations and oil price volatility was restricted to period from January, 1996 to 2016 due to non-availability of necessary data prior to 1996 from the central bank of Nigeria (CBN) statistical bulletin, Nigerian Bureau of Statistics (NBS) annual abstract and World Bank data bank. The secondary and time-series data were collected from publications of Central Bank of Nigeria (CBN) such as Statistical Bulletin and Monthly Market Report (MOMR) of the Organization of Petroleum Countries (OPEC). Observed volatility variables, such as previous volatilities and information on previous volatilities were estimated using E-VIEWS version 8 and introduced in IBM SPSS AMOS 24, while the latent volatility variables, such as *d1*, *e1* and *f1* were estimated using IBM SPSS AMOS 24.

Furthermore, Granger causality was employed to examine the causality relationship between key variables in line with Mandizha (2014) and Madesha, Chidoko and Zivamonoyo (2013).

The structural model can be written as

$$\boldsymbol{\eta} = \mathbf{B}\boldsymbol{\eta} + \Gamma\boldsymbol{\xi} + \boldsymbol{\zeta} \qquad (1)$$

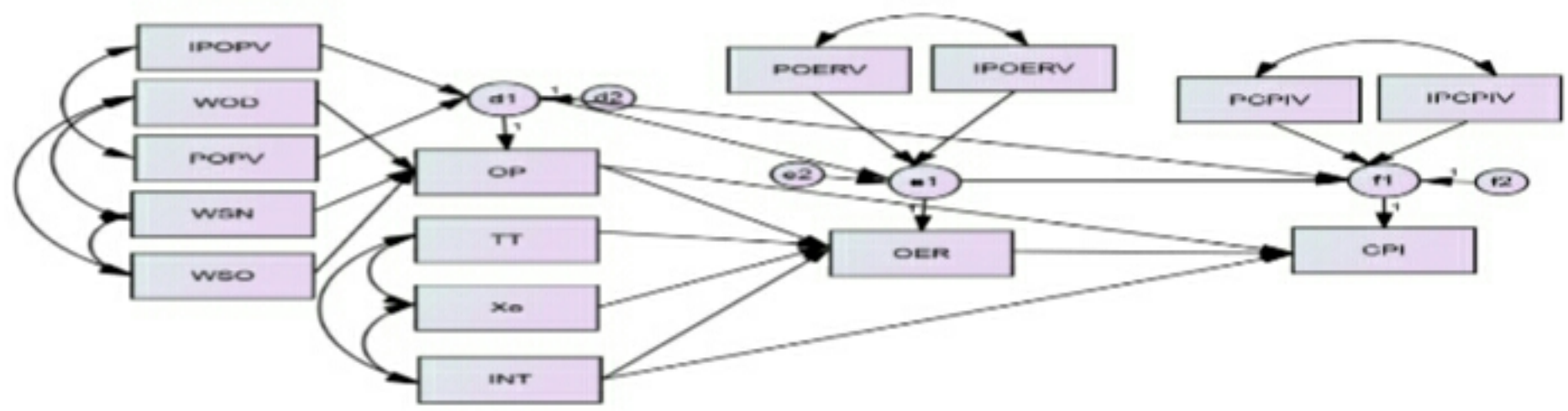
Where $\boldsymbol{\eta}$ is a vector of endogenous unobserved variables, $\boldsymbol{\xi}$ is a vector of exogenous unobserved variables, **B** is a matrix of regression coefficients relating the latent endogenous variables to each other, Γ is a matrix of regression coefficients relating endogenous variables to exogenous variables, and $\boldsymbol{\zeta}$ is a vector of disturbance terms. The latent variables are linked to observable variables via measurement equations for the endogenous variables and exogenous variables. These equations are defined as

$$\mathbf{y} = \boldsymbol{\Lambda}_y\boldsymbol{\eta} + \boldsymbol{\varepsilon} \qquad (2)$$

and

$$\mathbf{x} = \boldsymbol{\Lambda}_x\boldsymbol{\xi} + \boldsymbol{\delta} \qquad (3)$$

Where $\boldsymbol{\Lambda}_y$ and $\boldsymbol{\Lambda}_x$ are matrices of factor loadings, respectively, and $\boldsymbol{\varepsilon}$ and $\boldsymbol{\delta}$ are vectors of uniqueness, respectively. In addition, the general model specifies variances and covariances for $\boldsymbol{\xi}$, $\boldsymbol{\zeta}$, $\boldsymbol{\varepsilon}$, and $\boldsymbol{\delta}$, denoted Φ, Ψ, Θε, and Θδ, respectively. However, Structural equation model is not complete without a 'path model', usually depicted using path diagram (Sivo, 2001). Therefore, it is modeled thus;



Source: Modeled using IBM SPSS AMOS version 24

Where, ***OP*** represents oil price; ***WOS***, world OPEC oil supply; ***WSN***, world non-OPEC oil supply; ***WOD*** is world oil demand; ***Xo*** is oil export; ***TT*** stands for term of trade; ***OER***, the exchange rate; ***d1***, oil price volatility; ***e1*** is volatility of real exchange rate; ***e3***, exchange rate volatility; ***CPI***, consumer price index; ***INT***, interest rate; ***f1***, volatility of consumer price index; d2, e2 and f2 are second residuals; ***POPV*** represents previous oil price volatility [d1(-1)]; ***IPOPV***, information of previous oil price volatility [$d1(-1)^2$]; ***POERV***, previous exchange rate volatility [e1(-1)]; ***IPOERV***, information of previous exchange rate volatility [$e1(-1)^2$]; ***PCPIV*** is previous consumer price index [f1(-1)]; ***IPCPIV*** is information on previous consumer price index volatility [$f1(-1)^2$]; '→' represents direct effects; '↔' represents covariance;'□', factors variables and '○' represents the latent variable.

GARCH Model 1:

Mean Equation

$$OP_t = b_0 + b_1WOD_t + b_2WSN_t + b_3WOS_t + \mu_{OPt} \quad (4)$$

Variance Equation

$$\mu_{OPt} = \mu_{OP(t-1)} + \mu_{OP(t-1)}^2 \quad (5)$$

GARCH Model 2:

Mean Equation

$$OER_t = b_0 + b_1OP_t + b_2Xo_t + b_3TT_t + b_4INT_t + \mu_{OERt} \quad (6)$$

Variance Equation

$$\mu_{OERt} = \mu_{Opt} + \mu_{OER(t-1)} + \mu_{OER(t-1)}^2 \quad (7)$$

GARCH Model 3:

Mean Equation

$$CPI_t = b_0 + b_1OP_t + b_2OER_t + b_3INT_t + \mu_{CPIt} \quad (8)$$

Variance Equation

$$\mu_{CPIt} = \mu_{OPt} + \mu_{OERt} + \mu_{CPI(t-1)} + \mu_{CPI(t-1)}^2 \quad (9)$$

Where, μ_{OPt}, μ_{OERt} and μ_{CPIt} are the volatility/ residuals of oil price, exchange rate and consumer price index respectively. $\mu_{OP(t-1)}$, $\mu_{OER(t-1)}$ and $\mu_{CPI(t-1)}$ are previous month's volatilities of oil price, exchange rate and consumer price index respectively. $\mu_{OP(t-1)}^2$, $\mu_{OER(t-1)}^2$ and $\mu_{CPI(t-1)}^2$ represent information on previous month's volatilities of oil price, exchange rate and consumer price index respectively. Other variables are as specified in the S-GARCH.

4 Discussion

4.1 Unit Root Test

Augmented Dickey Fuller (ADF) and Philip Perron (PP) tests

Variable	ADF Statistics	Critical Values	Order of Integration	PP Statistics	Critical Values	Order of Integration
CPI	-14.55674	-3.432226	I(1)	-14.55494	-3.432226	I(1)
OP	-9.341325	-3.432226	I(1)	-9.294354	-3.432226	I(1)
WOD	-17.94064	-3.433525	I(2)	-14.67764	-3.432226	I(1)
WSN	-14.34246	-3.432226	I(1)	-15.42694	-3.432226	I(1)
WSO	-11.57219	-3.432566	I(1)	-63.88294	-3.432226	I(1)
OER	-11.31595	-3.432226	I(1)	-11.10121	-3.432226	I(1)
Xo	-9.827543	-3.433036	I(1)	-70.87770	-3.432226	I(1)
TT	-10.88356	-3.432566	I(1)	-82.21021	-3.432226	I(1)
INT	-15,00028	-3.432226	I(1)	-15.00062	-3.432226	I(1)
OPV	-6.390227	-3.433600	I(0)	-9.754051	-3.433100	I(0)
ERV	-6.552880	-3.433500	I(0)	-11.22035	-3.433000	I(0)
CPIV	-6.722448	-3.433500	I(0)	-15.28184	-3.433000	I(0)

Source: author s computation using e-view 8 software

The test of stationarity conducted on monthly data of ten (10) variables at 5% level of significance, adopting the Augmented Dickey-Fuller and Philip Perron tests, as listed in the table above showed that there was unit root in the data at level. However, at first difference, they became stationary for Philip Perron test. For the ADF test, the world oil demand was stationary at second difference,

while other variables were stationary at the first order of integration. The Augmented Dickey Fuller test statistics and Philip Perron test statistics clearly showed that there was constant unconditional mean at first order (CPI, OP, WSN, WSO, OER, Xo, TT, and INT) and second order (WOD) of integration. Utilizing differenced variables in the GARCH analysis, ADF test on the residuals showed constant unconditional variance at level for the three GARCH models (OPV, ERV and CPIV).

4.2 Confirmatory Factor Analysis Model Validation

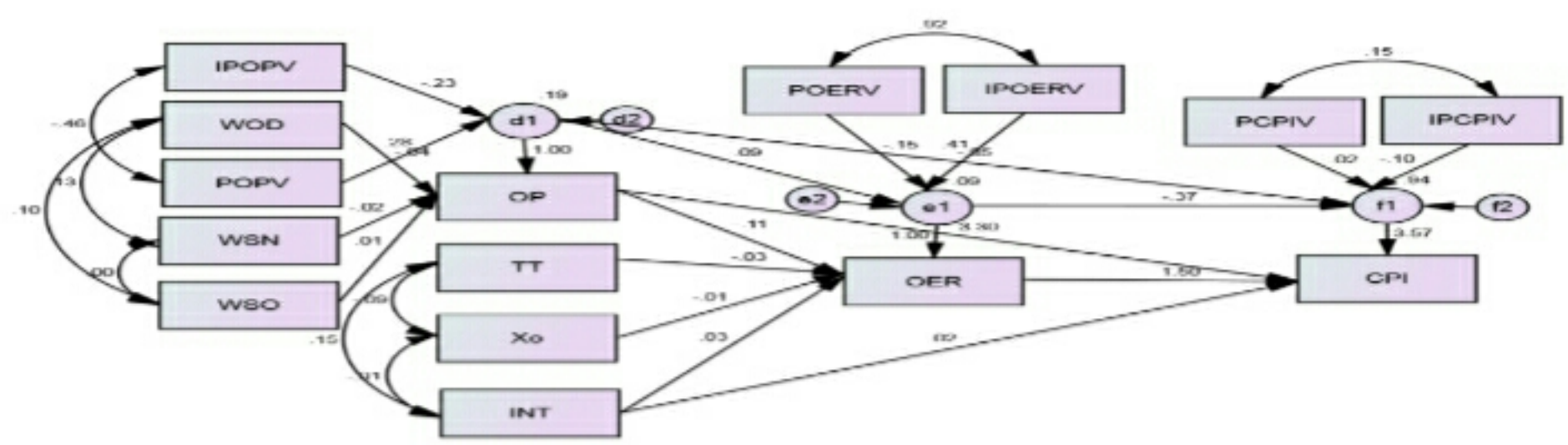
Analysing the fitness of the entire factor model, result from the confirmatory factor analysis showed that the model was very well fitted. Looking closely at the various indices of model fitness, the probability of the chi-square value is greater than 5% [i.e. 0.494 > 0.05]. The Global fit indices (GIF) and the Adjusted Global Fit indices (AGFI) were 0.953 and 0.926 respectively, implying that the model fitness indices did give up to 90% confidence on the factor model fit, supporting the chi-square result of a good model fit.

Although the Normed fit index was 0.874 < 0.90, incremental fit and comparative fit indices also suggested that the model is a good fit, as their values, 1.001 and 1.000 respectively. They were well over the 90% margin of goodness of fit.

Furthermore, the root mean square error of approximation was 0.000 < 0.05, lending credence the goodness of fit of the model used in the study. Therefore, the global fit indices (GFI) and all the relative fit indices plus the RMSEA revealed that over 90 % variations in the dependent variables could be attributed to joint variations in the factors, covariances, path coefficients, latent and observed variables (regressors).

4.3 Impact Analyses of Regressors on Dependent variables and their Volatilities.

Fig. 2 Standardized Regression Coefficients of S-GARCH



Source: author s computation using IBM SPSS AMOS version 24

4.3.1 Analyzing the Effects of World Oil Demand, World non-OPEC Oil Supply, World OPEC

Maximum Likelihood Estimates
Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
d1	<---	IPOPV	-.019	.006	-3.264	.001	
d1	<---	POPV	.279	.072	3.876	***	
OP	<---	d1	1.000				
OP	<---	WOD	.000	.000	-.714	.475	
OP	<---	WSN	.000	.000	-.565	.572	
OP	<---	WSO	.000	.000	.538	.591	

Source: author s computation using IBM SPSS AMOS version 24

Standardized Regression Weights: (Group number 1 - Default model)

			Estimate
d1	<---	IPOPV	-.233
d1	<---	POPV	.276
OP	<---	d1	.999
OP	<---	WOD	-.039
OP	<---	WSN	-.017
OP	<---	WSO	.015

Source: author s computation using IBM SPSS AMOS version 24

Evidence from the maximum likelihood and standardized regression estimates of the structural generalized autoregressive conditional heteroscedasticity conducted at 5% level of significance using AMOS 24 revealed showed that neither world oil demand nor world OPEC and non OPEC supply significantly impacted on crude oil price. The probabilities of their critical ratios were less than 5% (0.475, 0.591 and 0.572 respectively < 0.05). The standardized regression weights and maximum likelihood both showed that world oil demand and world non-OPEC supply negatively influenced oil price while world OPEC oil price showed a direct but insignificant relationship with oil price. The path coefficients/ estimates of the standardized regression weights showed that a percentage increase in the world oil demand and world non-OPEC supply will cause 0.056% decline in oil price and vice versa, while a percentage increase in world OPEC supply will lead to an increase in oil price by 0.015%.

Considering the GARCH and ARCH effect, given by previous oil price volatility (POPV) and information on previous oil price volatility (IPOPV) effect on oil price volatility, they were found to have significant impact on the volatility of oil price. IPOPV has inverse effect with oil price volatility, decreasing oil price by 0.23% per percent increase in IPOPV, while previous oil price volatility directly influences oil price volatility by 0.28% for every 1% increase. Furthermore, the S-GARCH showed that previous month s oil price volatility significantly influenced current month s oil price, increasing oil price by 0.38% for every 1% increase. Noteworthy is the significant

covariance between previous oil price volatility and information on previous oil price volatility, while WOD, WSN and WOS did no significantly covary with each other. An increase by 1% of POPV significantly reduces IPOPV by 0.46% and vice versa. This implies that the individual effect of POPV and IPOPV as well as their interrelationship significantly influences OPV. The same could not be said about the WOD, WSN and WOS, though positive, yet their correlation, as well as their individual effects did not significantly impact on the oil price.

The coefficient of multiple determination implied that variations in world oil demand and supply attributed to only about 19% of the variations in oil price volatility. Furthermore, the R-squared was 0.152%, depicting that variations in regressors explain only 15.22% of the variations in the oil price. This further shows that the specific model for determining oil price was not a good fit, however, that is within the scope of study.

4.3.2 Oil Price and Exchange Rate Volatilities

Maximum Likelihood Estimates

Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
e1	<---	POERV	-.151	.168	-.901	.367	
e1	<---	IPOERV	.006	.002	2.463	.014	
e1	<---	d1	.116	1.837	.063	.950	
OER	<---	OP	-.134	1.835	-.073	.942	
OER	<---	TT	-.009	.024	-.385	.700	
OER	<---	Xo	.000	.000	-.235	.814	
OER	<---	INT	.233	.623	.373	.709	
OER	<---	e1	1.000				

Source: author s computation using IBM SPSS AMOS version 24

Standardized Regression Weights: (Group number 1 - Default model)

			Estimate
e1	<---	POERV	-.151
e1	<---	IPOERV	.411
e1	<---	d1	.092
OER	<---	OP	-.107
OER	<---	TT	-.025
OER	<---	Xo	-.011
OER	<---	INT	.025
OER	<---	e1	1.004

Source: author s computation using IBM SPSS AMOS version 24

Observing the path from oil price volatility to exchange rate volatility, determined by oil price, oil

export, term of trade and interest rate, it is clear that the volatility of oil price does not significantly transmit to exchange rate volatility. The probability of the critical ratio is 0.95 > 0.05, implying that oil price volatility did not significantly impact on the volatility of exchange rate of naira vis-à-vis the dollar. However, the impact is positive. Therefore an increase in oil price volatility will increase exchange rate volatility by 0.092% and vice versa. Previous month s volatility of exchange rate also did not have statistically significant impact on the present volatility of the exchange rate. It further showed to have an inverse relationship with exchange rate volatility, implying that high volatile periods are followed by less volatile periods and vice versa. Therefore, one can easily forecast from the present volatility, what the succeeding period volatility might be, being determined, although not significantly by previous month s volatility, other factors being constant.

The result showed that active players respond positively and positively to information on previous period s volatility of the exchange rate. The exchange rate volatility, which is studied in this context in a deregulated regime, responds mainly to the demand and supply of relevant currencies [for exports and imports, foreign direct investments (portfolio and real investments)], and to some structural macroeconomic policies which affect exchange rate, have now in this study been revealed to also respond positively significantly to information on previous period s volatility. Therefore, the more information is circulated on previous exchange rate volatility, the more volatile current exchange rate becomes. That is, the spread of information on volatility of exchange rate by 1% will result in 0.411% increase in the volatility of the current exchange rate. Volatility depicts predictability. The more the volatility, the increasingly unpredictable exchange rate becomes. Also, the more people become informed of the volatility of exchange rate, the more volatile it becomes in the next period as a result of how key players respond to the information that received.

The coefficient of multiple determination (R-squared) for exchange rate and exchange rate volatility was 0.053 and 0.087 respectively, depicting that variations in regressors explain only 5.3% and 8.7% of the variations in the exchange rate and its volatility. This further show that the specific models for determining exchange rate and its volatility in Nigeria was not a good fit, however, that is within the scope of study.

Oil price, term of trade and oil export had negative and insignificant impact on the exchange rate, while interest rate had positive but insignificant impact on the exchange rate. This follows the a priori expectation as reduction in interest rate would allow for borrowing, expansion of money supply, boost investment and production and invariably export. As export gains over import, the domestic currency improves as exchange rate depreciates. This may not be so for capital flows and portfolio investments, however, the positive effect may be due to the fact that there are many small and medium enterprises dealing on import and export of consumption and production goods, whose effect on the exchange rate outweighs such large companies quoted on the floor of the stock exchange (Kleindl, 2000, Jagoda, 2010, and Zerenler & Sahin, 2013 as reported in Okolo and Obidigbo, 2014).

Furthermore, there is significant correlation between previous exchange rate volatility and information on previous volatility of the exchange rate, evidenced by the probability of the critical

ratio being **** < 0.05. The correlation is positive and strong (0.916; i.e. 91.6%).

4.3.3 Oil Price Volatility, Exchange Rate Volatility on Consumer Price index

Maximum Likelihood Estimates
Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
f1	<---	PCPIV	.065	.066	.980	.327	
f1	<---	IPCPIV	-.060	.011	-5.303	***	
f1	<---	e1	-.262	.822	-.319	.750	
f1	<---	d1	-.755	1.093	-.691	.490	
CPI	<---	f1	1.000				
CPI	<---	OER	.298	.822	.362	.717	
CPI	<---	INT	.028	.258	.109	.913	
CPI	<---	OP	.816	1.235	.661	.508	

Source: author s computation using IBM SPSS AMOS version 24

Standardized Regression Weights: (Group number 1 - Default model)

			Estimate
f1	<---	PCPIV	.018
f1	<---	IPCPIV	-.095
f1	<---	e1	-.372
f1	<---	d1	-.854
CPI	<---	f1	3.571
CPI	<---	OER	1.503
CPI	<---	INT	.015
CPI	<---	OP	3.302

Source: author s computation using IBM SPSS AMOS version 24

price volatility and exchange rate volatility failed to significantly impact on the consumer price index volatility in Nigeria. The volatility regressors had negative effect on the dependent variables (CPIV). Notable is the oil price volatility, which negatively influences the volatility of consumer price index by 85.4%, while exchange rate volatility negatively influences consumer price index volatility by 37.2%. Therefore, as oil price and exchange rate
become more volatile, consumer price index becomes less volatile by 85.4% ($d1$) and 37.2% ($e1$).

While the previous month s volatility of the consumer price index positively but insignificantly influenced the present volatility of consumer price index, information on previous month s volatility of consumer price index negatively and significantly influence the consumer price index volatility of the present month. For every 1% increase in the information spread about previous month s price level of consumption goods, current consumer price level volatility declines by 0.19%.

Oil price, exchange rate and interest rate did not have significant impact on the price level of consumption goods in Nigeria. However, their impact was positive. Notably, the oil price positively influenced the consumer price index more than other regressors. As oil price increases by 1%, it causes the price level of consumption goods to rise by 3.30%. Likewise, 1% increase in the exchange rate will lead to 1.50% increase in the price level. Arguably, interest rate and oil price failed the a priori expectation, as an increase in interest rate should contract money supply and invariable inflation in the country following the theory of cost push inflation. In the same vein, increase in oil price implies a gain to the country s income through oil export, which should decrease the exchange rate of Naira vis-à-vis the US dollar and in turn decrease the consumer price index.

Furthermore, there is significant correlation between previous price level volatility (PCPIV) and information on previous price level volatility (IPCPIV), evidenced by the probability of the critical ratio being 0.034 < 0.05. The correlation is positive and weak (0.150; i.e. 15%).

4.4 Pass-Through of Oil Price and Exchange rate to Consumer price index (Evaluating the Indirect Effects of the Path Coefficients)

World oil demand and world non-OPEC oil supply indirectly through oil price influenced exchange rate positively by 0.4% and 0.2% and through exchange rate influenced the price level negatively by 12.4% and 5.2% respectively, implying that for every 1% increase in world oil demand and world non-OPEC oil supply, exchange rate, on the aggregate, increases by 0.006%, while consumer price index decreases by 0.176% cumulatively. However, world OPEC oil supply indirectly, through oil price, influenced exchange rate negatively by 0.2% and through the oil price and exchange rate, positively influenced the consumer price index by 4.7%.

Oil price volatility (d1) indirectly influenced exchange rate negatively by 1.5% (i.e. 0.15% decreases in exchange rate for every 1% increase in oil price volatility). This is in agreement with the negative direct effect of oil price on exchange rate. Oil price volatility also had a negative indirect effect on the volatility of consumer price index by 3.4%. This effect is mediated by exchange rate volatility, which had a direct and negative effect of 37.2% (0.372) on the price level volatility. This indirect effect became positive on the consumer price index as it was mediated by a path through exchange rate volatility to exchange rate and to consumer price index, and mediated by exchange rate volatility through consumer price index volatility to consumer price index. Information on previous exchange rate volatility indirectly influenced exchange rate through its volatility variable by 41.3%. IPOERV further indirectly and negatively impacted volatility of the consumer price index by 15.3% through exchange rate volatility and through exchange rate to the consumer price index.

Information on the previous consumer price index volatility had and indirect and negative effect (34.1%) on the consumer price index through CPIV and to consumer price index in Nigeria. While previous oil price volatility indirectly influenced oil price by 27.6% (i.e. 0.276% for every 1% increase in POPV), it had an indirect effect on oil price volatility, causing it to decrease by 0.245% for every 1% increase in POPV. Oil export and term of trade had indirect and negative effect

(-0.016% and -0.038%) on the consumer price index through official exchange rate. Although the significance of the indirect effects were not measured, it can be deduced from the relevant direct effects, which were mainly insignificant, that their relevant indirect effects were also insignificant, except for the POPV, IPOPV, IPOERV and IPCPIV, which showed significant impacts on d1, e1 and f1 respectively.

4.5 Granger Causality

The Granger causality tests conducted at 5% significance level and 202 degree of freedom showed that consumer price index unidirectional causality with exchange rate (0.0042 < 0.05), world oil demand (0.0056 < 0.05), world OPEC oil supply (0.0011 < 0.05) and world non-OPEC oil supply (0.0004 < 0.05). Oil price granger caused term of trade (0.0169 < 0.05), world non-OPEC oil supply (0.0016 < 0.05) and world OPEC oil supply (0.0045 < 0.05). Interest rate and world OPEC oil supply showed a bi-directional causality with each other (2.E-09 and 0.0172 < 0.05). Exchange rate also showed a unidirectional causality with world OPEC oil supply, as world oil demand also granger caused Nigerian oil export (0.048 < 0.05). World oil demand further granger caused world OPEC oil supply (6.E-06 < 0.05) as world non-OPEC oil supply granger caused world OPEC oil supply, evidenced by the probability of f-statistics (0.0032 < 0.05).

5 Conclusion

The empirical analysis revealed that oil price has an inverse causal effect on the exchange rate, which follows the a priori expectation. However, the volatility of the oil price and exchange rate showed a direct causal effect, implying that as the oil price becomes one percent less predictable, exchange rate of the Naira vis-à-vis the USD also becomes 11.6% unpredictable. However, one percentage increase in oil price has 13.4% negative causal effect on the variation of exchange rate, which favours an oil exporting country such as Nigeria. However, this relationship wasn t significant. Similar relationship existed between the exchange rate, oil price and consumer price index. While oil price and exchange rate positively influenced inflation, their (oil price and exchange rate) volatilities had negative influence on the volatility of consumer price index.

The econometric results showed that volatilities of oil price and exchange rate do not significantly transmit to inflation in Nigeria. Therefore, there isn t a significant pass-through from oil price, through exchange rate to inflation in Nigeria. Other domestic factors such as the prevailing monetary policy, aggregate demand etc., may be significantly responsible for the variations in price level. Furthermore, contrary to theoretical underpinning, world oil demand and world oil supply (OPEC and non-OPEC) did not have significant impact on the oil price. Similarly, exchange rate of the Naira vis-à-vis the USD was not significantly determined by oil export, term of trade, interest rate and oil price.

Two clear conclusions which emerged from the above analysis is that information on previous period volatilities of oil price, exchange rate and inflation are significant predictor of current volatilities of oil price, exchange rate and inflation respectively. Therefore, Nigerians respond more to information on the stability or otherwise of oil price, exchange rate and inflation in

previous time than on factors determined by price theory, flow and stock theory of exchange rate determination and cost push theory of inflation, as adopted in the study to model the determinants of oil price volatility, exchange rate volatility and price level changes. The study further clarifies the lingering controversy in the literature regarding the direction of effects of oil price, exchange rate and inflation as is specific to Nigeria.

Information on previous oil price volatility has negative and significant impact on the current volatility of oil price, while having negative indirect pass-through effect on exchange rate volatility (-0.021). This implies that the more information is circulated by 1% regarding volatility of previous oil price, the less exchange rate becomes volatile by 0.021%, a desired condition for businesses, especially those directly involved in international trade. It also positively influences exchange rate by 0.003%. Therefore; the media should be utilized in predicting and managing the effect of oil price volatility in Nigeria.

Information on previous period volatility of the exchange rate significantly and positively influenced current volatility of exchange rate. At the same time, passing through its current volatility, it causes an inverse relationship with the volatility of price level in Nigeria by 15.3% (0.153), implying that boosting information on exchange rate volatility causes inflation to be more predictable as it increases. This triggers an increase in the demand for USD, forcing the exchange rate to rise by 41.1% (0.411) and invariably price level by 7.4% (0.074) due to large importations into Nigeria. The media also becomes crucial in predicting exchange rate and inflation in Nigeria. Government may have to tighten importation of certain consumable goods which are also produced in Nigeria and encourage domestic production of these goods through relaxed and favourable credit and tax policies. Government should further create international and domestic market patronage for locally produced goods, through modern outlets, such as e-commerce, m-commerce, social media etc. Since exchange rate has positive impact on price level in Nigeria, growing domestic production and consumption of made in Nigeria products would reduce importation of foreign consumables as well as boost exports, raising the value of the Naira vis-à-vis the USD.

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