Fuel Subsidy Removal, Oil Price Shocks and Stock Market Performance in Nigeria: Evidence from a Threshold GARCH Model

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Abstract
This study investigates the effects of fuel subsidy removal and oil price shocks on stock market returns and volatility in Nigeria within the TGARCH framework using weekly data from 25/11/2012 to 21/04/2024. More specifically, the study, using a simple TGARCH model that incorporates conditional standard deviation in the mean equation with a generalized error distribution, investigates two market-wide indices: namely, All-share index and NSE 30 index as well as three industry-specific indices: namely, banking, oil and gas, food, beverages and tobacco. We find that although weekly market returns are generally persistent and can be predicted from their immediate history, they are insensitive to changes in conditional variance, and hence do not exhibit a risk premium effect, which contradicts the capital asset pricing model. Additionally, we find that fuel subsidy removal has no effect on weekly returns of all major indices in the Nigerian stock exchange. However, while it decreases the volatility of two industry-specific indices: namely, oil and gas and FBT, it does not affect the volatility of All share index, NSE 30 index and banking index. Finally, our empirical results provide evidence that oil price shocks significantly affect the performance of both the banking and oil and gas sectors but not their volatility. On the contrary, oil price shocks have a significant impact on the volatility of three indices: namely, All-share index, NSE 30 index, and FBT index and again not their returns.

Key words*: Oil price shocks, fuel subsidy removal, market returns, market volatility, TGARCH*

1. Introduction

There is increasing interest in the relationship between oil price shocks and stock market performance among scholars and policy makers. Theoretically, oil price shocks can affect stock market performance either directly or indirectly through various channels such as interest rate, aggregate output as well as government revenues and subsidies. However, there is no consensus in the empirical literature regarding both the extent and the direction of the impact of oil price shocks on stock market performance.

Debate on fuel subsidy or its removal is on-going and has attracted considerable scholarly attention globally (Diegiannakis, et al; 2014). Fuel subsidies are among the widely used fiscal policy tools to influence real economic variables towards price stability and growth in output (Ginn, 2024). Fuel subsidies, which are deliberate government actions to keep fuel prices lower than their production or supply costs, are present in one hundred and seventy-six (176) countries, accounting for about 6.5% of the global Gross Domestic Product (GDP) in 2015 (Ginn, 2024) and estimated at $1 trillion in 2022 (Oyasipe & Olukoya, 2024). They are intended to cushion the effects of global oil price shocks on real economic variables and to improve both accessibility and affordability of petroleum products for low-income earners. However, despite the several associated economic benefits, there is growing concern regarding the sustainability of fuel subsides, particularly owing to the substantial economic and environmental costs they impose on society (li et al., 2024; Omotosho, 2019; Usman et al., 2023). According to Kojima (2016), there is sufficient evidence suggesting that fuel subsidies are inefficient and inequitable as they lead to illegal diversion of petroleum products and different forms of commercial malpractices. Also, as highlighted by Li and Sun (2018), fuel subsidies effectively promote wasteful energy consumption, delay the transition towards renewable energy, discourage the advancement of green technological innovations and thereby impede the global fight against carbon emission and climate change.

In Nigeria, successive governments have attempted to remove fuel subsidy either partially or completely. Although, both diesel and kerosene subsidies were completely removed in 2003 and 2016 respectively, the total removal of petrol subsidy was announced by President Bola Tinubu on May 29, 2023 during the inauguration of the current administration. This announcement is generally perceived as a direct response to the several and persistent calls by both local and international stakeholders for the introduction of a market-based pricing mechanism that will help to save the scarce public resources needed for capital investment in public infrastructure such as roads, education, rail and health towards job creation and economic growth. It is also argued that fuel subsidy removal will help Nigeria meet its Nationally Determined Contribution (NDC) in line with the global zero carbon emission target set by the United Nations Framework Convention on Climate Change (UNFCCC). However, historical accounts show that fuel subsidy removal has been characterized by controversies and social crises, with severe macroeconomic consequences. For example, the announcement of a partial subsidy removal that led to a sharp increase in the pump price of petrol from ₦65 to ₦141 in January 2012 was followed by a nation-wide protest tagged "Occupy Nigeria", which forced the Federal Government of Nigeria to reduce the pump price to ₦97.

Several empirical studies such as Adekunle and Oseni (2021), Babalola and Salau (2020), Gidigbi and Bello (2020), Musa et al. (2014) and Omotosho (2020)) have examined the impact of fuel study removal in Nigeria. These studies have related fuel subsidy removal to several macroeconomic variables such as consumer price index, gross domestic product, poverty rate and carbon emissions, interest rate, exchange rate and inflation. However, empirical findings emerging from these studies suggest that subsidy removal or its retention has a significant impact on macroeconomic performance. Besides, to the best of our knowledge, none of the existing studies consider the impact of subsidy removal on measures of stock market performance. There is therefore good reason to evaluate the extent to which the current subsidy regime has impacted various indicators of stock market performance in terms of returns and volatility. So this study is a major attempt to seek to provide dependable empirical evidence on the impact of fuel subsidy removal and oil price shocks on both return and volatility dimensions of stock market performance in Nigeria using the TGARCH model. The study employs weekly time series data covering the period from 25/11/2012 to 21/04/2024.

In the next section, some recent empirical studies on the impact of fuel subsidy removal and oil price shocks are reviewed. It is followed by section three which discusses the research methodology in terms of data and sample, measurement and empirical strategy. The fourth section contains the empirical analysis and results, while the study is summarized and concluded in section five.

2.0. Literature Review

2.1. Studies on Impact of Subsidy Removal

Several studies have investigated the impact of fuel subsidy or its removal in Nigeria and other jurisdictions but the following ones seem to be outstanding among others.

Musa et al. (2014) employs the error correction model (ECM) to study both the short-run and the long-run implications of fuel subsidy removal on socio-economic development in Nigeria. They measure socio-economic wellbeing in terms of GDP per capita and their dataset includes yearly time series observations covering between 1981 and 2012. They find that fuel subsidy removal has a highly significant positive impact on GDP per capita in the long run. However, the evidence does not indicate any significant impact of fuel subsidy removal in the short run.

Babalola and Salau (2020) seek to determine the impact of fuel subsidy removal on consumer prices in Nigeria using the pooled mean group/ARDL framework. They consider three fuel pump prices: namely, petrol, diesel and kerosene in the analyses with their impact on consumer price index using monthly data spanning between 2000 to 2019. They find that all fuel pump prices have a significant short-run impact on consumer price index. However, while the pump price of kerosene exerts a significant long run impact on consumer index, there is no evidence suggesting that in the long run both petrol and diesel pump prices have a significant impact on consumer price index.

Gidigbi and Bello (2020) evaluate the choice between subsidy retention and subsidy removal in the context of petrol prices in Nigeria using the vector autoregressive model (VAR). Based on time series data collected at yearly frequency and focusing on period from 1981 to 2016, they find no significant difference between subsidy retention and subsidy removal in terms of their impacts on poverty incidence. However, their results appear to support the view that subsidy retention produces more macroeconomic benefits than subsidy removal.

Omotosho (2020) examines the impacts of fuel subsidy regime and oil price shocks on several macroeconomic variables using a New-Keynesian DSGE model. Using quarterly data covering from 2000Q2 to 2018Q2, they find that oil price shocks are significant and persistent in influencing prices, interest rate and output. It is documented that a negative oil price shock is associated with a reduction in aggregate output and explains an increase in both non-oil GDP and headline inflation as well as a depreciation of Naira in the foreign exchange market. However, subsidy removal moderates the contraction effect of negative oil price shocks, reduces inflation, but causes exchange rate to depreciate further. Overall, the study notes that fuel subsidy retention is more appealing in the context of macroeconomic stability than fuel subsidy removal.

Adekunle and Oseni (2021) study the influence of fuel subsidy removal on carbon emission in Nigeria using a non-linear Autoregressive Distributive Lag(ARDL) model. Using time series data from 1980 to 2013, they find that fuel subsidy removal has a significant negative impact on carbon emission in both the short run and long run.

2.2.Studies on the Impact of Oil Price Shocks

Al-hajj et al. (2017) investigate the impact of oil price shocks on stock market returns in Malaysia using the ARDL and vector error correction frameworks. Based on time series data covering from January 1991 to December 2016, they find that oil prices have a negative impact on stock market returns. They also find that the relationship between stock market return is cointegrated with oil prices along with inflation, exchange rate, interest rate and industrial production.

Köse and Ünal (2020) use a structural vector autoregression model to analyze the significance of oil price shocks in the stock markets of Russia, Iran and Kazakhstan using monthly data. Their empirical model incorporates industrial production, inflation and exchange rates. Focusing on the period from 2005M03 to 2018M08, they find the presence of asymmetric effect on the relationship between oil price shocks and stock market performance. Their findings further indicate that negative oil price shocks exert stronger and highly significant effects in the three stock markets than positive oil price shocks.

Lu et al. (2021) analyze the US stock market volatility in relation to oil shocks using a hybrid model that integrates the Markov regime-switching model with the least absolute shrinking and selection operator (i.e., MS – LASSO). Their findings consistently show that oil shocks performance is time varying and the hybrid model improves forecasting with accuracy of volatility in line with economic activities.

Rahman (2022) examines the asymmetric response of real stock returns to crude oil price changes in U.S.A. using both bivariate GARCH model and nonlinear structural VAR model. It is reported that there is asymmetric effect on the response of aggregate returns to positive and negative oil price shocks, with oil price volatility playing a significant role in the asymmetric response process by having a negative effect on stock returns. This finding, which is based on monthly data covering the period from 1973M01 to 2020M12, holds for both aggregate returns and disaggregated data from different industries.

3.0.Methodology

3.1.Data and Sample

Our data comprises weekly closing prices on brent crude oil futures and five major stock market indices: namely, All-share index, NSE 30 index, Banking index, Oil and Gas index and Consumer Goods (Food, Beverage and Tobacco) index. The sample covers the period from 25/11/2012 to 21/04/2024. All data are obtained from www.investing.com and are analyzed in EViews. The indices are described as follows:

All-Share Index (NGX ASI): This is a benchmark index that measures the general market performance. The index includes all listed companies on the Nigerian stock exchange regardless of capitalization.

NSE 30 Index (NGX 30): This is a capitalization weighted price index that serves a benchmark for measuring the performance of the 30 largest and most liquid companies traded on the floor of the Nigerian stock exchange and includes only fully paid-up common shares.

Banking Index (NGX Banking): This is a benchmark index that measures the performance of the banking sector. It is based on capitalization methodology and includes the most capitalized and liquid banking companies. Currently, 10 banks are included in the index.

Consumer Goods Index (NGX CG): This index measures the performance of companies in the consumer goods sector. It is a benchmark index based on capitalization methodology and includes the most capitalized and liquid food, beverage and tobacco(FBT) companies in the Nigerian stock exchange. Currently, 15 companies are included in the index.

Oil and Gas Index (NGX OG): This index measures the performance of the oil and gas sector. It is a benchmark index based on capitalization methodology and includes the most capitalized and liquid oil and gas marketing companies. Currently five companies are included in the index.

Measurement

Weekly return

To obtain weekly continuously compounded returns, we transform the data as follows:

$$\mathrm{R_t} = \ln\left(\frac{\mathrm{P_t}}{\mathrm{P_{t-1}}}\right) \tag{1}$$

Where $\mathrm{R_t}$ = current weekly return, $\mathrm{P_t}$ = current weekly price, $\mathrm{P_{t-1}}$ = previous weekly price, ln = natural logarithm.

Oil Price Shock

Consistent with the literature, we define oil price shock in terms of the difference in current price and previous price as follows:

$$DOILP = P_t - P_{t-1} \tag{2}$$

Where = $DOILP$ = difference in oil price or oil price shock, P_t = current oil price, P_{t-1} = previous oil price.

Fuel Subsidy

We measure fuel subsidy in terms of dummy variable (SUB), with 0 representing the period from 25/11/2012 to 28/05/2023 when the recent subsidy removal has not been announced, or 1 representing the period from 04/06/2023 to 21/04/2024 when the new subsidy regime is in force.

3.2.Empirical Strategy

To analyze the impact of oil price shocks and fuel subsidy removal on stock market performance, we employ the Threshold Generalized Autoregressive Conditional Heteroscedasticity (TGARCH) model suggested by Zakoian (1994). This model is attractive as it allows us to capture the time-varying features of stock volatility such as persistence and asymmetric effects while estimating the relationships of interest. Hence, both oil price shocks and fuel subsidy dummy are incorporated in both the mean and variance equations of the TGARCH model to examine their impacts on return and volatility.

Mean Equation

Consistent with the capital asset pricing model and following Engle et al. (1993), we incorporate one period lagped return and conditional standard deviation in the mean equation as follows:

$$R_t = \lambda + \theta \mathrm{R}_{\mathrm{t}-1} + \phi\sigma_t + \psi_1 DOILP_t + \psi_2 \mathrm{SUB} + \epsilon_t \qquad (3)$$

Where R_t = continuously compounded return; λ is the model intercept representing average return when other right-hand-side variables are jointly zero; θ is the persistence term representing the effect of lagged return on current return; ϕ is the coefficient on conditional variance which captures the risk-premium effect on current return, ψ_1 captures the effect of oil price shocks on market return; ψ_2 captures the effect of fuel subsidy removal on market return, ϵ_t is the error term or regression residual.

Variance Equation

We specify our variance model as follows:

$$\sigma_t^2 = \alpha_0 + \alpha_1\epsilon_{t-1}^2 + \beta\sigma_{t-1}^2 + \gamma\epsilon_{t-1}^2\Gamma_{t-1} + \varphi_1 SUB + \varphi_2 DOILP_t \qquad (4)$$

Where σ_t^2 = conditional variance, α_0 = unconditional volatility, α_1 = ARCH parameter, β = GARCH parameter, γ = asymmetric volatility parameter, φ_1 = coefficient on fuel subsidy removal, while φ_2 = coefficient on oil price shocks. Further, there is evidence of leverage effect if γ is positive, implying that negative news will increase volatility more than positive news of equal magnitude. On the other hand, if γ is negative, then positive news will increase volatility more than negative news of equal size. There is no asymmetric effect if γ is zero, implying that both positive news and negative news affect volatility equally irrespective of size and that the TGARCH model is not different from the Bollerslev's (1986) standard GARCH model.

4.0.Analysis and Results of the Study

4.1.Descriptive Statistics

Table 1: Descriptive Statistics for Weekly Prices

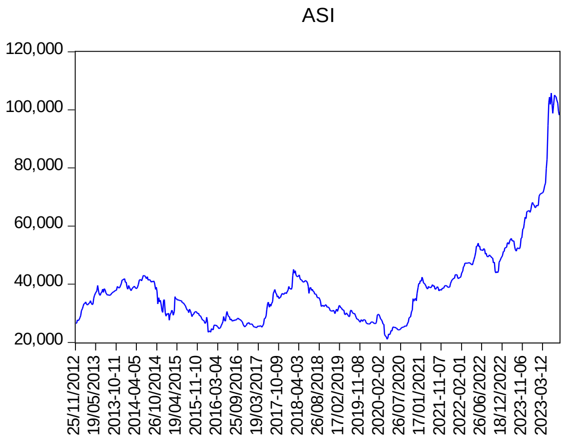
Statistic	ASI	NSE30	BANK	CG	OG	OILP
Mean	38763.95	1626.88	408.06	774.38	380.49	72.80
Maximum	105722.80	3984.18	1040.02	1673.33	1312.22	122.01
Minimum	21094.62	892.44	207.66	314.16	152.30	21.44
Std. Dev.	14773.53	498.53	135.77	236.21	219.61	23.20
CV	38.11	30.64	33.27	30.50	57.72	31.87
Skewness	2.32	2.23	2.23	0.98	2.51	0.27
Kurtosis	9.75	10.42	9.39	4.54	9.61	2.09
Jarque-Bera	1665.49	1860.91	1508.90	153.93	1713.03	28.14
Probability	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

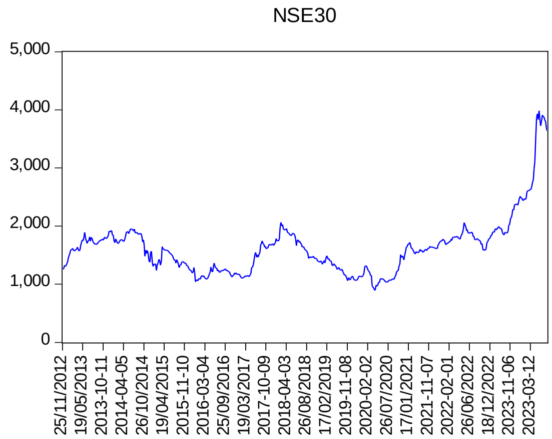
Table 2: Descriptive Statistics for Weekly Returns

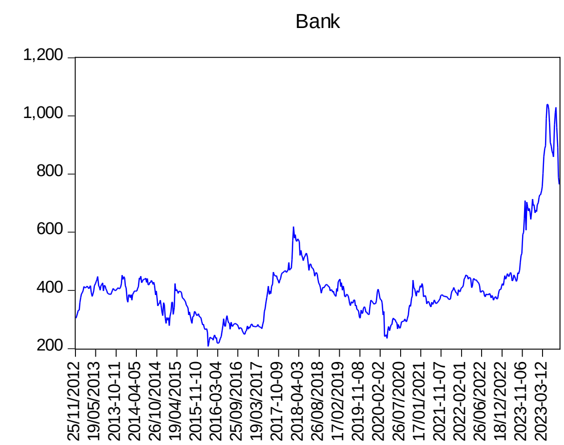
Statistic	R_ASI	R_NSE	R_BANK	R_CG	R_OG
Mean	0.0022	0.0018	0.0015	0.0012	0.0035
Maximum	0.1562	0.1648	0.2149	0.1447	0.1580
Minimum	-0.1449	-0.1639	-0.3032	-0.1600	-0.1592
Std. Dev.	0.0285	0.0299	0.0427	0.0336	0.0391
CV	1295.96	1676.09	2764.60	2898.71	1106.77
Skewness	0.1777	0.0443	-0.4845	0.2071	0.5264
Kurtosis	9.4157	9.1399	9.7164	6.3655	5.0119
Jarque-Bera	1023.59	934.80	1141.62	285.06	127.83
Probability	0.0000	0.0000	0.0000	0.0000	0.0000

Table 3: Correlation Matrix for Weekly Prices

R	ASI	NSE30	BANK	CG	OG	OILP
ASI	1					
NSE30	0.97	1				
BANK	0.91	0.93	1			
CG	0.62	0.76	0.72	1		
OG	0.92	0.87	0.83	0.56	1	
OILP	0.44	0.50	0.37	0.48	0.23	1


ASI
120,000
100,000
80,000
60,000
40,000
20,000
25/11/2012
19/05/2013
2013-10-11
2014-04-05
26/10/2014
19/04/2015
2015-11-10
2016-03-04
25/09/2016
19/03/2017
2017-10-09
2018-04-03
26/08/2018
17/02/2019
2019-11-08
2020-02-02
26/07/2020
17/01/2021
2021-11-07
2022-02-01
26/06/2022
18/12/2022
2023-11-06
2023-03-12


NSE30
5,000
4,000
3,000
2,000
1,000
0
25/11/2012
19/05/2013
2013-10-11
2014-04-05
26/10/2014
19/04/2015
2015-11-10
2016-03-04
25/09/2016
19/03/2017
2017-10-09
2018-04-03
26/08/2018
17/02/2019
2019-11-08
2020-02-02
26/07/2020
17/01/2021
2021-11-07
2022-02-01
26/06/2022
18/12/2022
2023-11-06
2023-03-12


Bank
1,200
1,000
800
600
400
200
25/11/2012
19/05/2013
2013-10-11
2014-04-05
26/10/2014
19/04/2015
2015-11-10
2016-03-04
25/09/2016
19/03/2017
2017-10-09
2018-04-03
26/08/2018
17/02/2019
2019-11-08
2020-02-02
26/07/2020
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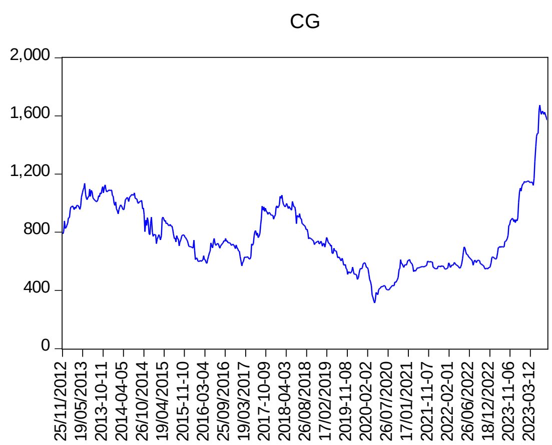
2023-11-06
2023-03-12


CG
2,000
1,600
1,200
800
400
0
25/11/2012
19/05/2013
2013-10-11
2014-04-05
26/10/2014
19/04/2015
2015-11-10
2016-03-04
25/09/2016
19/03/2017
2017-10-09
2018-04-03
26/08/2018
17/02/2019
2019-11-08
2020-02-02
26/07/2020
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2021-11-07
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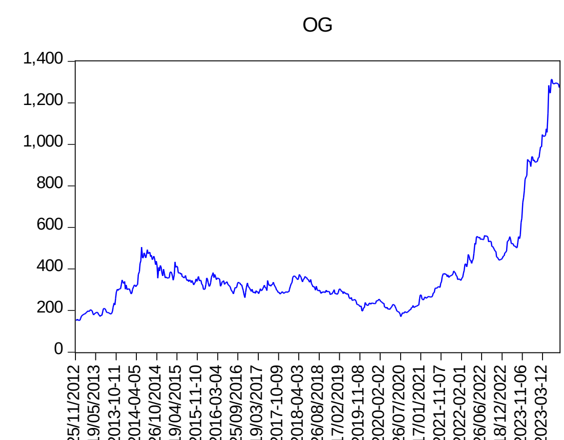
26/06/2022
18/12/2022
2023-11-06
2023-03-12


OG
1,400
1,200
1,000
800
600
400
200
0
25/11/2012
19/05/2013
2013-10-11
2014-04-05
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19/04/2015
2015-11-10
2016-03-04
25/09/2016
19/03/2017
2017-10-09
2018-04-03
26/08/2018
17/02/2019
2019-11-08
2020-02-02
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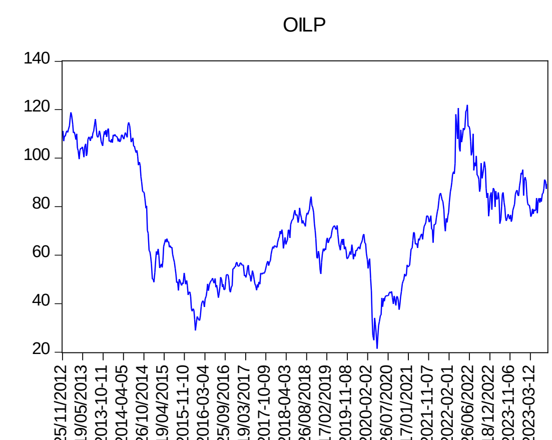
2023-11-06
2023-03-12


OILP
140
120
100
80
60
40
20
25/11/2012
19/05/2013
2013-10-11
2014-04-05
26/10/2014
19/04/2015
2015-11-10
2016-03-04
25/09/2016
19/03/2017
2017-10-09
2018-04-03
26/08/2018
17/02/2019
2019-11-08
2020-02-02
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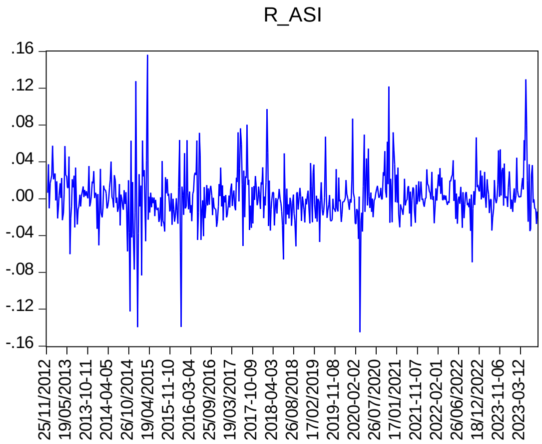
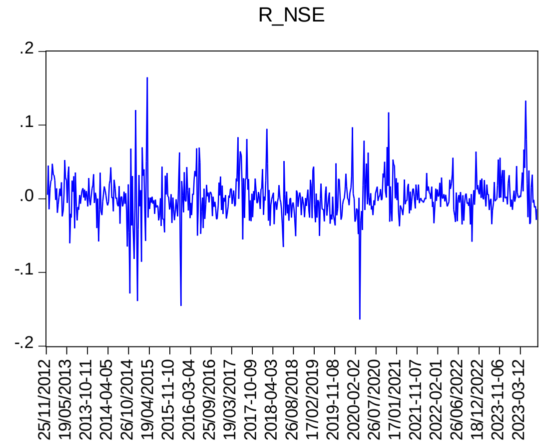
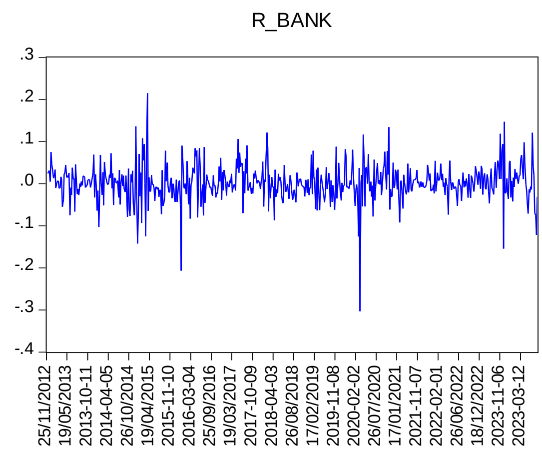
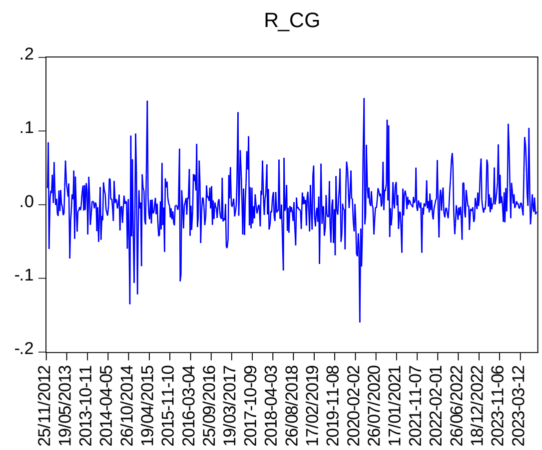
2023-11-06
2023-03-12


R_ASI
.16
.12
.08
.04
.00
-.04
-.08
-.12
-.16


R_NSE
.2
.1
.0
-.1
-.2


R_BANK
.3
.2
.1
.0
-.1
-.2
-.3
-.4


R_CG
.2
.1
.0
-.1
-.2

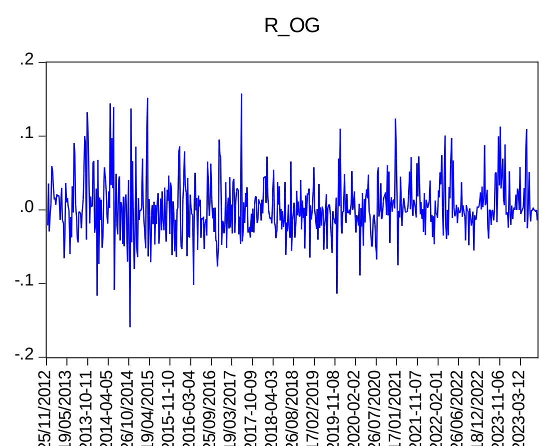

R_OG
.2
.1
.0
-.1
-.2

Table 1 displays the basic statistics that describe the distributional properties of our weekly price data. Table 2 displays the basic statistics that describe the distributional properties of our weekly returns data and in table 3, the correlation matrix for weekly prices is shown.

From Table 1, weekly brent crude oil price which averaged $72.80 per barrel over the period under investigation, has been highly volatile, as indicated by the high standard deviation as well as the large difference between the maximum and minimum values. For the stock market indices, the coefficient of variation (CV) shows that oil and gas index is the most volatile index, followed by All-share index, and then by Banking index, while NSE 30 index is the least volatile. Besides, all variables have a positively skewed and leptokurtic distribution with Jarque Bera statistic clearly rejecting the null hypothesis of normal distribution in all cases.

From Table 2, oil and gas index has the highest weekly mean return, followed by All-share index, while consumer goods index has the lowest mean return. However, according to the coefficient of variation, consumer goods index has the highest return volatility, while oil and gas index has the lowest return volatility. Further, the skewness and kurtosis coefficients indicate a positively skewed and leptokurtic distribution of weekly return for all indices, while the Jarque Bera statistic shows and confirms that none of the indices have a normally distributed return series.

From Table 3, we can see that oil prices are positively correlated with all the main indices in Nigeria with the correlation coefficient ranging between 0.23 and 0.50. This shows that rising oil prices is followed by a bullish trend in the stock market, while falling oil prices is followed by a bearish stock market trend. However, whereas oil prices are moderately correlated with NSE 30 index, CG index and ASI are less correlated with both OG and banking indices.

4.2. Empirical Analysis

Test of ARCH Effect

Table 4: ARCH Effect Test

Series	TR^2 statistic (5)	P-value	ARCH Effect
R_AS I	37.725	0.0000	Yes
R_NSE	36.003	0.0000	Yes
R_BANK	25.344	0.0001	Yes
R_CG	43.212	0.0000	Yes
R_OG	37.365	0.0000	Yes

Table 4 shows the results of the Langrage Multiplier (LM) test which is conducted to see if there is possible ARCH effect. As expected, the results reveal that ARCH effect is a strong feature of daily market returns for all selected market indices. The LM test statistic at lag 5 is highly statistically significant for all series and thereby rejects the null hypothesis of no ARCH effects. This has confirmed that ARCH/GARCH framework can adequately capture most of the stylized facts that characterize our weekly returns data.

Estimation of TGARCH Model

To estimate the TGARCH model, we employ the generalized error distribution (GED) method to control the positive skewness and large excess kurtosis that characterize our data as reported in the descriptive statistics.

Table 5: TGARCH Results: p-values in parenthesis

PARAMATER	R_ASI(1)	R_NSE	R_BANK	R_OG5	R_CG
Mean Equation					
GARCH (ϕ)	0.0035 (0.9808)	0.0915 (0.7613)	0.1708 (0.1622)	0.1574 (0.4424)	-0.0309 (0.7721)
Intercpet (λ)	0.0009 (0.8212)	-0.0025 (0.7715)	-0.0060 (0.1467)	-0.0058 (0.4397)	-0.0003 (0.9263)
R_{t-1} (θ)	0.0636 (0.0254)	0.0840 (0.0068)	0.0741 (0.0791)	-0.0033 (0.9361)	0.0708 (0.0257)
DOILP (ψ_1)	-0.0001 (0.5376)	-8.02E-05 (0.7883)	0.0005 (0.0984)	0.0007 (0.0483)	9.46E-05 (0.6934)
SUB (ψ_2)	0.0009 (0.6612)	0.0010 (0.7134))	0.0064 (0.3738)	0.0029 (0.5306)	0.0008 (0.7134)
Variance Equation					
Constant (α_0)	0.0003 (0.0706)	0.0003 (0.0776)	0.0002 (0.0019)	0.0005 (0.0026)	0.0003 (0.0003)
ARCH (α_1)	0.1273 (0.1570)	0.0136 (0.6902)	0.3292 (0.0088)	0.2796 (0.0224)	0.1658 (0.0430)
ASYMMETRY (γ)	0.0006 (0.9965)	0.1014 (0.3489)	0.0780 (0.6097)	-0.1281 (0.3569)	0.1804 (0.2101)
GARCH (β)	0.5730 (0.0048)	0.5494 (0.0156)	0.4938 (0.0000)	0.4600 (0.0013)	0.5511 (0.0000)
SUB (φ_1)	-8.77E-05 (0.4764)	2.00E-05 (0.8759)	0.0006 (0.1964)	-0.0003 (0.0090)	-0.0002 (0.0016)
DOILP (φ_2)	-3.31E-05	-3.49E-05	-1.40E-05	-4.24E-06	4.29E-05

	(0.0567)	(0.0009)	(0.4171)	(0.8612)	(0.0014)
Persistence ($\alpha_1 + \beta$)	0.7003	0.5630	0.8230	0.7396	0.7169
HLV	1.95	1.20	3.55	2.29	2.08
Diagnostics					
GED (r)	0.8220 (0.0000)	0.9093 (0.0000)	1.1092 (0.0000)	1.0665 (0.0000)	0.8808 (0.0000)
ARCH LM	0.1091 (0.7411)	4.1402 (0.1419)	1.7740 (0.1829)	0.8945 (0.9706)	1.4222 (0.2330)
Q-stat	38.140 (0.1190)	25.184 (0.1200)	0.1286 (0.7200)	0.0210 (0.4570)	18.442 (0.1030)

Table 5 reports the results obtained from the estimated TGARCH model for all major market indices. We use the generalized error distribution (GED) for the conditional errors to capture the fat-tailed feature of our weekly market returns data. Both volatility persistence and half-life volatility are self-computed from the results.

Model Diagnostics

As expected, the estimated GED tail parameter is significant and less than 2 for all indices, thereby validating our estimation assumption that conditional errors distribution is fat-tailed. Further, both Q-statistic and ARCH LM statistic are not statistically significant in all cases, showing that both serial correlation and ARCH effects are not present in the fitted model. Hence, the fitted TGARCH model is well-specified and our empirical results are valid.

Mean Equation

From the mean equation, the coefficient on R_{t-1} is significant for most of the indices, except oil and gas index, indicating that in general, market return is persistent and predictable based on its immediate history. For the oil and gas index, previous return is not a significant determinant of current return as return shocks disappear almost instantaneously. However, the GARCH parameter, ϕ, is not significant for all indices, showing that volatility changes do not contemporaneously affect market returns. Hence, contrary to the capital asset price model (CAPM), our weekly data do not provide evidence of a GARCH-in-mean or risk-premium effect in the Nigerian stock market. Also, the estimated subsidy dummy (ψ_2) is marginal and not statistically significant in all cases, hence, the recent subsidy removal has no impact on market returns both statistically and economically. Further, the coefficient on OILP is not significant for most of the indices, except banking and oil and gas indices. This shows that oil price shocks (unexpected oil price changes) affect only few industries and do not drive the return performance of the entire market. For both banking and oil and gas industries, oil prices and market return move in similar direction, and unexpected increase or decrease in oil price is followed by an increase or decrease in market return respectively.

Variance Equation

From the variance equation, while the ARCH parameter, α_1, is significant for the three industry-specific indices namely, banking, oil and gas, and food and beverages, it is not significant for the two market-wide indices - All-share index and NSE 30 index. However, the GARCH parameter, β, is significant for all indices. Further, the persistence parameter, $\alpha_1 + \beta$, is less than one in all cases, which is what one would expect if volatility shocks do not persist indefinitely or if volatility is mean reverting. However, the degree of volatility persistence varies significantly across indices, with market-wide indices having the least volatility persistence, compared to industry-specific indices. According to the estimated Half-Life Volatility (HLV), the banking sector has the highest volatility persistence; it takes more than 3 weeks for its volatility to return half-way back to its initial level after suffering a significant shock. The estimated HLV is 2.29 weeks for oil and gas index, and 2 .08 weeks for food and beverages index, while the estimated HLV is 1.20 weeks and 1.95 weeks for NSE 30 index and All-share index respectively.

Surprisingly, for all indices, the asymmetric coefficient, γ, is not statistically significant, indicating that volatility does not exhibit significant asymmetric effect in the Nigerian stock market. This shows that in the Nigerian stock market, there is tendency for volatility to respond symmetrically to both good news and bad news irrespective of the magnitude of the shock. The implication is that the volatility dynamics in the Nigerian stock market may be well described by a standard GARCH model, which is not significantly different from the estimated TGARCH model.

Turning to the main relationships of interest, the coefficient of SUB (φ_1) is negative for three indices: namely, ASI, OG and CG; while it is positive for both NSE 30 and banking indices. This shows that subsidy removal tends to increase the volatility of NSE 30 and banking indices but tends to decrease the volatility of All-share index, oil and gas index, and food and beverages index. However, as indicated by the p-values, the effect of subsidy removal is significant only for two indices: namely, oil and gas and food and beverages indices. Generally, our evidence suggests that fuel subsidy removal decreases the volatility of weekly returns in the Nigerian stock market. Further, our results show that oil price shocks exert a significant effect on All-share index, NSE 30 index and CG index, but do not significantly affect both banking and oil and gas indices. For the two market-wide indices, oil price shocks exert a negative volatility effect, while for CG index, oil price shocks exert a positive volatility effect.

5. Summary and Conclusion

It is well-established in theory that shocks to macroeconomic variables affect the performance of stock markets in terms of returns and volatility, either symmetrically or asymmetrically. However, there is little empirical investigation of the impact of oil price shocks and fuel subsidy removal on the volatility of Nigerian stock market returns and volatility. This study investigates the effects of oil price shocks and the recent fuel subsidy removal on stock market returns and volatility in

Nigeria within the TGARCH framework using weekly data from 25/11/2012 to 21/04/2024. More specifically, the study, using a simple TGARCH model incorporates conditional standard deviation in the mean equation with a generalized error distribution to investigate two market-wide indices: namely, All-share index and NSE 30 index as well as three industry-specific indices: namely, banking, oil and gas, and food, beverages and tobacco.

There is evidence that although weekly market returns are generally persistent and can be predicted from their previous ones, they are insensitive to changes in conditional variance and hence do not exhibit a risk premium effect, which contradicts the capital asset pricing model.

There is evidence that fuel subsidy removal has no effect on weekly return on all major indices in the Nigerian stock exchange. However, while it decreases the volatility of two industry-specific indices: namely, oil and gas and CG indices, it does not affect the volatility of All share index, NSE 30 index and banking index. Further, our empirical results provide evidence that oil price shocks significantly affect the performance of both banking and oil and gas sectors but do not affect their volatility. On the contrary, oil price shocks have a significant impact on the volatility of three indices: namely, All-share index, NSE 30 index and CG index but do not affect their performance.

References

Adekunle, I. A., & Oseni, I. O. (2021). Fuel subsidies and carbon emission: evidence from asymmetric modelling. *Environmental science and pollution research*, *28*(18), 22729-22741.

Al-Hajj, E., Al-Mulali, U., & Adebola, S. S. (2017). The influence of oil price shocks on stock market returns: Fresh evidence from Malaysia. *International Journal of Energy Economics and Policy*, *7*(5), 235-244.

Babalola, A., & Salau, T. J. (2020). Petroleum pump price and consumer price index in Nigeria: A case for or against total subsidy removal–panel dynamic analysis. *Timisoara Journal of Economics and Business*, *13*(2), 107-128.

Degiannakis, S., Filis, G., & Kizys, R. (2014). The effects of oil price shocks on stock market volatility: Evidence from European data. *The Energy Journal*, *35*(1), 35-56.

Engle, R. F., Lilien, D. M., & Robins, R. P. (1987). Estimating time varying risk premia in the term structure: The ARCH-M model. *Econometrica: journal of the Econometric Society*, 391-407.

Gidigbi, M. O., & Bello, K. M. (2020). Petroleum subsidy reduction and poverty in Nigeria: A choice between maintaining the subsidy or providing infrastructural services equivalent to the deadweight loss. *Asian Development Perspectives (ADP)*, *11*(1), 70-81.

Ginn, W. (2024). The paradox of fossil fuel subsidies. https://www.researchgate.net/profile/William-Ginn-4/publication/377436251

Kojima, M. (2016). Fossil fuel subsidy and pricing policies: recent developing country experience World Bank Policy Research (WBPR) Working Paper No. 7531.

Köse, N., & Ünal, E. (2020). The impact of oil price shocks on stock exchanges in Caspian Basin countries. *Energy*, *190*, https://doi.org/10.1016/j.energy.2019.116383

Li, J., & Sun, C. (2018). Towards a low carbon economy by removing fossil fuel subsidies. *China Economic Review*, *50*, 17-33.

Li, Z., Zhao, Q., Guo, H., & Huang, R. (2024). Impact of fossil fuel subsidies on energy-saving technological change in China. *Energy*, *286*. https://doi.org/10.1016/j.energy.2023.129265

Lu, X., Ma, F., Wang, J., & Zhu, B. (2021). Oil shocks and stock market volatility: New evidence. *Energy Economics*, *103*. https://doi.org/10.1016/j.eneco.2021.105567

Musa, A. D. E. W. U. N. M. I., Hounsou, R. E. M. Y., & Adeyele, I. T. (2014). The impact of fuel subsidy removal on socio-economic development in Nigeria: An Econometric Investigation. *International Journal of Economics, Commerce and Management*, *2*(12).

Omotosho, B. S. (2020). Oil price shocks, fuel subsidies and macroeconomic (in)stability in Nigeria. *CBN Journal of Applied Statistics*, *10*(2), 1 – 38.

Oyasipe, S. A., & Olukoya, F. I. (2024). The effect of fuel subsidy removal on the profitability of entrepreneurial businesses in Lagos state, Nigeria. *FULafia International Journal of Business and Allied Studies*, *2*(1), 107-118.

Rahman, S. (2022). The asymmetric effects of oil price shocks on the US stock market. *Energy Economics*, *105*. https://doi.org/10.1016/j.eneco.2021.105694

Usman, S. U., Kura, N. U., Khalil, M. S., Mallam, I., Umar, D. U. A., & Abdulhamed, A. I. (2023). Effects of fossil fuel subsidy removal on environment and sustainable development in Nigeria. *Book of Proceedings – 2023 Environmental Management Association of Nigeria (EMAN) Annual National Conference,* (pp 199 – 213). Bayero University Kano, Nigeria.

Zakoian, J. M. (1994). Threshold heteroskedastic models. *Journal of Economic Dynamics and control*, *18*(5), 931-955.