# RETURN SPILLOVER EFFECTS BETWEEN OIL PRICES AND SECTORAL STOCKS IN NIGERIA: A DISAGGRETED APPROACH

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## ABSTRACT
This study examined the return spillover effects between oil prices and sector specific stock returns on the eleven sectors listed on the Nigeria exchange group whose main objective is to uncover return spillover effects between oil and stock returns. The study utilized the constant conditional correlation – CC – VARMA-GARCH methodology where findings indicate that returns in both markets reveal both short term predictability in prices and bi-directional spillover effects between oil sectoral stock returns. The study recommends among others for investors, portfolio managers, policy makers and other market participants to continuously monitor returns in both markets and factor same in their decision making process.

**Keywords:** Returns, Spillover, GARCH, Stocks, Volatility.
JEL C22, C23, G11, G12, G15

## 1. INTRODUCTION
It is common knowledge that the integration of financial markets have significantly helped in promoting economic development and growth. However, such developments are characterized by high level of uncertainty shock and volatility especially in less developed economies, such as ours. Consequent upon these, prices of securities and commodities have now become prone to different types and levels of shocks.

Oil price stocks and uncertainty has at different times been used to evaluate economic occurrences which include, but not limited to investment decision making, unemployment relations, demand for money and, stock market returns. However, the bulk of the evaluation has been devoted to oil price - stock return nexus (Abeng, 2017). This is due to the fact that oil, as a source of energy, plays a strategic role in the performance or otherwise of the global economy as it affects the consumption and investment decision of households and business firms at various times. An important discourse in the financial economics literature of recent is the understanding of the complex dynamics that explain the volatility of oil prices over time as it is critical for the growth and development of any economy. It is pertinent to note that almost all issues of production had to do with oil (Malik and Rashid. 2017). Oil is said to occupy an important place in the world economy since it is considered as the most important source of

energy in the world, not just as fuel and source of energy for heating, but also as raw material in the production process (Al-Quduh. 2015). Any fluctuation in the price of oil has over bearing influence on other economic activities of a nation.

The stock market has been viewed worldwide as a market where elements that feed into the development of a nation's economy is said to operate. In both developed and underdeveloped economies, stock markets, which are part of the financial system plays a pivotal role in the development process. A well-functioning economy is one which is hinged on a sound financial system of which the stock market is a major player. The Stock market is often seen as a place for accessing long term securities comprising both the primary and secondary market for the issue of new securities and trading of existing share respectively. Stock markets, as posited by Adenuga (2010) support resource allocation and spur growth by reducing transaction costs, affecting the average productivity of capital mobilizing savings and altering the rate of investment, promoting and improving resource allocation among others leading to investment in critical infrastructure that give rise to increase in national income and subsequently, economic growth.

In Nigeria, the stock exchange is said to have recorded tremendous success over the years leading to its consideration as a frontier market (Kumeka, Adeniyi and Orekoya, 2017). Stock markets provide means of risk driven factor, acquisition of information on firms, efficient, funds allocation. There is a clear evidence that financial markets have been constrained, overstretched by shocks emanating from sources outside its control especially the oil price shocks, Shobande (2017). An empirical in-depth examination of the return spillover intensity offers more insight into constructing forecasts of the return of both oil and stock markets in Nigeria.

The link in the co-movements between crude oil and stock nexus hinges on the fact that oil is regarded as an important input in the production process over time Abdala (2014). Additionally, it influences the level, volume and magnitude in the returns across sectors Rashid and Malik (2017). The main goal of investors in the Nigerian Stock Market is to earn high returns on investment. However, this goal is not fully achieved due to the volatile nature of the market occasioned by the speed and nature at which information is transmitted to it from oil price shocks. There is need for portfolio managers to have adequate information for asset allocation and valuation, portfolio diversification, etc. The study seek to find out if the returns in both oil and sectoral stocks respond to their own lagged returns and or cross returns from each other.

The objective of this paper therefore, is to examine the return spillover effects between oil prices and the eleven industrial sectors listed of the Nigerian Exchange Limited (ngx). Following this introduction, is section two which is focused on literature, section three on methodology, section four on analysis and discussion of findings, while section five concludes.

## 2. LITERATURE REVIEW

### 2.1 THEORETICAL LITERATURE

The following theories are reviewed in this work as follows.

#### 2.1.1 Capital Assets Pricing Model (CAPM)

The capital assets pricing model was propounded by Sharpe (1964). The CAPM as a single factor model, quantifies the expected rate of return of an asset with the level of market systematic risk. It assumes among others that (i) financial markets are competitive (ii) There are no discretionary taxes or transaction costs (iii) all investors like portfolio reward (return) and dislike portfolio risk (variance of returns).

It is presented as:

$$R = Rfr + \beta(Rm - Rfr)$$

Where R is return on asset, Rfr is risk free return, Rm is expected return on portfolio, m is market portfolio and β is the value indicating measures of risk for individual assets/portfolio.

### 2.1.2 The Arbitrary Price Theory (APT)

The APT was introduced first by Ross (1976) and improved upon by Fama and French (1992). It allows researchers to add additional macroeconomic factors of interest as risk factor. The theory assumes that (i) security specific risks are diversifiable, (ii) markets do not allow for prolonged arbitrage, (iii) returns on assets are generated by a factor model.

A multifactor APT model is expressed as:

$$R_{it} = \lambda_{it} + \beta_{it} F_{1t} + \beta_{2t} F_{2t} + \beta_{3t} F_{3t} + - - - \varepsilon_t.$$

Where $R_{it}$ is return on asset I at time t, λ is risk free rate, β is security of the factors while $F_i$ are the risk factors.

## 2.2 Empirical Review

Chen, Li and Jin (2018), examined the effect of return and volatility spillover between crude oil prices and stock price in China using daily data from 2010 to 2017. The paper employed the Constant Conditional Correlation – Multivariate Generalized Autoregressive Conditional Heterescedasticity (CCC-MGARCH) model where results indicate un-directional return spillover from crude oil to firms in the Chinese stock market. However, no formal pretests for model selection were conducted. The study ought to have conducted the Engle-Sheppards CCC test. Abioglu (2021), examined the return and volatility correlation between oil prices and stock sectors in Turkey using weekly data from 2002 to 2020. Findings from the Dynamic Cocditional Correlation (DCC) model indicate significant return spillovers from oil to market to the 12 sectoral indices on the Turkish Exchange. The study did not disclose how the DCC model was chosen. Also, the study quoted oil price in the local currency instead of dollars.

Hongsakulvasa, Khewugandee and Liammukda (2020) investigated the effect of oil market risk and return on Thailands sectoral indices in the presence of Covid-19. Using daily data from 2016 – 2019, utilizing the DCC-GARCH-in-mean model, findings show significant return spillover from oil to services, constructions and property financial and products sectors. Notwithstanding, not all the industrial sectors were used. Stationarity properties of the variables were not done. The nexus between oil prices and stock market in South Asia was also examined by Alamgir and Bin Amin (2021) using the NARDL model using data from 1997 – 2018. Results indicate significant positive effects of oil prices on the economies selected. Findings further show that high oil prices stimulate stock prices. The study ought to have used the Panel-non-linear autoregressive distributed large model as it covers more than one entity.

Umm and Wenlong (2020), investigated the dynamics of volatility spillover between oil prices and stock market returns at the sector level in Pakistan using data from January 2003 to December 2017, using the VARMA – GARCH framework, findings indicate negative return spillover effects from oil market to agriculture, energy, machinery sectors, while the return spillover effects from stock to oil market were not significant. The study captured adequately, the return and volatility services at daily frequency using all the sectors, however, it chose the CCC variant arbitrarily.

Fasanya, Oyewole and Agbatogun (2019) measured the return and volatility spillover among sectoral stocks in Nigeria using monthly data from 2007 – 2016. Results indicate evidence of interdependence among sectors. The study covered only 9 sectors, which does not give an accurate picture of the entire market.

Writing on oil price stocks and stock returns nexus for Malaysia, Al-Hajj, Al-Mulali, and Solarin (2018) sought to examine the asymmetric effect of oil prices on stock returns in Malaysia. Apart from oil prices, the study used other variables such as exchange rate, industrial production and inflations, possible such as exchange rate, industrial production and inflations, possibly as control variables form 2000 to 2016 about nine (9) economic sectors. The study utilized the non-linear autoregressive distributed lag model for analysis. Findings from the study implied that oil price stocks have an adverse impact on the stock market returns in most of the sectors in respective of whether oil price stocks are asymmetric or symmetric. However, the use of monthly data may not have yielded efficient result because of the volatile nature of financial series.

Kumeka, Adenyi and Orekaya (2018) analyzed the effects of oil shocks-stock return relationships using selected sectors for Nigeria including banking and oil/gas sectors from January, 2000 to December, 2015. The study focused on oil prices, and individual. Stock returns on banking sector and oil and sector. It used the VAR-GACH methodology as a tool analysis. Results from the study indicate that returns on stock market are affected by their own past values. Past oil shocks drive volatility for the firms in the banking sector. The study nonetheless had limited focus as it only covered two (2) sectors.

Oyinlola and Oloko (2018) investigated the link between exchange rate dynamics and, stock market performance in Nigeria. The main objective of the paper was to investigate asymmetry in the impact of exchange rate on the Nigeria stock market using non-linear ARDL framework. The study made use of exchange rate and stock prices as variables from 1985 to 2017 on monthly basis. The result from the study indicates the existence of long run, but not short run, asymmetry effect between exchange rate and the Nigeria stock market for the period of study. Inspite of this, the study used one variable to represent the overall stock market which may not be a reflection of the market.

Modeling the impact of oil price shocks on energy sector stock returns in Nigeria was examined by Ebechidi and Nduka (2017). The study used oil prices and stock returns of energy related firms using monthly data from January 2000 to December 2015. Using the generalized autoregressive conditional heterescedastity (GARCH) modeling approach, the results indicate the existence of negative effect between oil prices shocks and energy sector stock returns by over 74%. Also, an increase in oil prices leads to a margin increase in stock return. The variance equation which measures volatility indicates that oil price shocks and energy stock returns are negatively related at least on the short run. The study used only one sector, also the asymmetric effect of shocks were ignored.

Malik and Rasid (2017) examined the return and volatility spillover between sectoral stock and oil price in Pakistan. The study used oil price and sectoral stock returns on eight different sectors on the Pakistan Stock exchange as variables of interest from January 2001 to December 31$^{st}$ 2015. Using the VAR-GARCH modeling technique, the results indicate no short run price transmission between world oil prices and stock sectors of the PSE. However, past shocks in world oil prices have significant effect on volatility individual sectors of the PSE.

Okekwu, Njoku, Ajeniweni, Aliyu, Onyibo and Adejoh (2022) examined impact of capital market on economic growth in Nigeria using time series data from 1986 – 2021. The study used ARDL to carry out empirical investigation, where results indicate that capital market positively affect the growth of the Nigerian economy. Ahmad and Usman (2022) investigated whether oil prices influences economic growth in Nigeria. The study used data on oil price, oil production and Nigeria GDP from 1989 – 2020. Using the ARDL model, the results indicate positive and significant effect of oil prices on economic activities in Nigeria both in the short and long run.

Adejola, Obiakor, Onakoya, Okwu and Olalekan (2022) examined the nexus between oil price and exchange rate in Nigeria using monthly data from 1980 to 2020. Data was sourced on exchange rate and oil prices and was estimated and analyzed using the wavelength trend analysis. Results show evidence of lead-lag effects of oil prices on exchange rate indicating that oil price is a key determinant of exchange rate in both short and medium run in Nigeria.

Escribano, Koczar, Janero and Esparcia (2023) examined effect of shock transmission between crude oil prices and selected stock markets using weekly data from 2000-2023 from oil importing and exporting economies. The study used the Dynamic conditional correlation (DCC) GARCH model where results indicate significant correlation between brent crude price and major oil exporting and importing countries including Nigeria. Garcia and Rambaud (2023) examined volatility spillover effects between oil and financial markets during economic and financial crisis using monthly, data from 2000-2021. The study utilized the GARCH model where results indicate significant return spillover effects between oil prices and stock returns.

Kendoza, Borab, Dervis and Atharid, (2023) tested the volatility spillover between oil prices and the volatility spillover stock market returns using data from 2006-2016. Data was sourced on S&P 500 and WTI crude oil and was estimated using the multivariate GARCH model. Results indicate significant return spillover effects from oil prices to S&P 500 stock returns. Massadikov (2021) examined return volatility spillover between oil prices and stock returns in developing countries using monthly data from 2010-2019. The study utilized the bivariate VAR-GARCH model to estimate the parameters. Results show that the lagged value of oil returns has positive effect on stock market of India and Turkey, including significant volatility spillovers.

## 3. METHODOLOGY

### 3.1 Theoretical Framework

The Arbitrate Pricing Theory (APT) propounded by Ross (1976) is used to validate the effect of shocks and other risk factors on stock market volatility. The theory assumes that returns can be describe by a factor model, there are no arbitrate opportunities, and that there are a large number of securities such that it is possible to form portfolios that diversify risk. The theory assumes that the asset (stock) returns are generated by the following equation as outlined in Salisu and Isah (2017).

$R_i = \lambda_i + \beta_i\psi + e_i$

Where;

$R_i$ is the return on asset (stock) i

$\lambda$is the unconditional expected return

$\psi$ is a vector of different risk factors

$\beta_i$is a vector measuring the influence that each risk factor has on return on asset i

$e_i$- is the error term for the residual effect of the returns series in question.

Therefore, for the purpose of this study, we isolate only the effect of oil price shocks among other risk factors. Therefore a 'reduced form' version of the APT presented above is rewritten as:

$R_i = \lambda_i + \beta_i Op + e$

Where;

$R_i$ and $\lambda_i$ are as previously defined

### 3.2 The Model

In other to realize set objective, and following Yaya et al 2017, Malik and Rashid 2017, the CC-VARMA GARCH model for the mean (return) and variance equation as specified as follows:-

**Mean Equation**

$$\begin{matrix} R_{oil_t} \\ R_{s_t} \end{matrix} = \begin{pmatrix} \gamma_{oil} \\ \gamma_s \end{pmatrix} + \begin{pmatrix} \varphi_{oil} \varphi_{oil,s} \\ \varphi_{s,oil} \ \varphi_s \end{pmatrix} \begin{pmatrix} R_{oil_{t-1}} \\ R_{s_{t-1}} \end{pmatrix} + \begin{pmatrix} \varepsilon_{oil_t} \\ \varepsilon_{s_t} \end{pmatrix} \quad 3.1$$

**Where**

$R_{oil_t}$ and $R_{s_t}$ are the daily return of sector specific stock index and oil prices respectively, $\varphi_s$ and $\varphi_{oil}$ are the coefficients of own past lag effect of sector stock returns and oil price returns respectively. $\varphi_{s,oil}$ and $\varphi_{oil,s}$ both measure the return spillover effect of oil on the stock returns and stock on oil returns respectively.

**The Conditional Variance Equation**

The conditional variance equation for the oil stock series for objective three and four is specified as follows:

$$\begin{pmatrix} \delta^2{}_{oil,t} \\ \delta^2{}_{s,t} \end{pmatrix} = \begin{pmatrix} \omega_{oil} \\ \omega_s \end{pmatrix} + \begin{pmatrix} \lambda_{oil} & \lambda_{oil,s} \\ \lambda_{s,oil} & \lambda_s \end{pmatrix} \begin{pmatrix} \varepsilon^2{}_{oil\,t-1} \\ \varepsilon^2{}_{s\,t-1} \end{pmatrix} + \begin{pmatrix} \beta_{oil} & \beta_{oil,s} \\ \beta_{s,oil} & \beta_s \end{pmatrix} \begin{pmatrix} \delta^2{}_{oil,t-1} \\ \delta^2{}_{s,t-1} \end{pmatrix} \quad \mathbf{3.2}$$

Where:

$\delta^2{}_{oil}$ and $\delta^2{}_s$ are the variance of the two series. $\omega_{oil}$ and $\omega_s$ are the non-negative constants of the model, $\lambda_{oil}$ and $\lambda_s$ measure the short run persistence or ARCH effects of the past shocks of both oil and sector stock return respectively at time $t-1$ on the present conditional variance series capturing the impact of direct transmitted shocks. $\varepsilon^2{}_{oil\,t-1}$ and $\varepsilon^2{}_{s\,t-1}$

$\beta_{oil}$ and $\beta_s$ measures the long run persistence or GARCH effects of past shocks of oil and stock return at $t-1$ respectively, on the transmitted conditional volatility series capturing the direct impact of the effects of the transmitted conditional volatility series $\delta^2{}_{oil,t-1}$ and $\delta^2{}_{s,t-1}$.

$\lambda_{oil,s}$ and $\lambda_{s,oil}$ measures the cross value of the error terms $\varepsilon^2{}_{s\,t-1}$ and $\varepsilon^2{}_{oil\,t-1}$ on current conditional variance series for oil and sector stock respectively. Thus, these parameters and shock spillover or volatility spillovers coefficients that measure the effects of volatility shocks between oil and stock markets such that $\lambda_{oil,s}$ measure the impact of sector stock shocks (volatility) on oil market, whereas $\lambda_{s,oil}$ measure the impact of oil market volatility shocks on sector stock volatility.

In the same vein, volatility spillover between oil price and sector stock returns are measured by $\beta_{oil,s}$ and $\beta_{s,oil}$, i.e $\beta_{oil,s}$ measures the impact of volatility spillover from stock to oil market while $\beta_{s,oil}$ measures the impact of volatility spillover from oil to sector stock market returns.

### 3.3 Data Analysis

Time series was sourced from the United States Energy Information Administration in the case for oil prices and for the stock prices, data on the eleven sectoral prices was sourced from the Nigerian Exchange Group NXG. The daily data range is from 4th January, 2011 to October 29th 2021 for the 12 series consisting of about 2,680 data points for each variable.

#### 3.3.1 Descriptive Statistics

The descriptive statistics for the table is presented below:

**Table 3.1: Descriptive Statistics (Return Series)**

| Variable | Mean | Median | Max | Min. | Std. Dev. | Skewness | Kurtosis | JB |
|---|---|---|---|---|---|---|---|---|
| *Oil Price* | -1.67R-2 | 0.000351 | 0.0828 | -0.1214 | 0.0100 | -0.971 | 23.665 | 48099.14 |
| *Agriculture* | 0.000341 | 0.00001 | 0.03974 | -0.2257 | 0.008092 | -7.8870 | 231.71 | 586889 |
| *Conglomerates* | -0.000197 | 0.0000 | 0.064729 | -0.07296 | 0.00764 | -0.1490 | 10.552 | 6379.55 |
| *Constr. Real Estate* | -8.50E-02 | 0.0000 | 0.04986 | 0.106934 | 0.00322 | -120377 | 487.87 | 2631814 |
| *Consumer goods* | 0.00152 | 1.60E-05 | 0.03650 | 0.03949 | 0.005302 | 0.09624 | 141.173 | 13944.9 |
| *Financial Services* | 1.32E.05 | -1.66E-05 | 0.088896 | -0.08028 | 0.00326 | 2.0971 | 419.892 | 1940956 |
| *Health Care* | 8.91E-05 | 0.0000 | 0.04537 | -0.08499 | 0.00606 | 1.31093 | 31.018 | 88431.28 |
| *ICT* | 0.000609 | 0.00011 | 0.8778 | -0.0677 | 0.02039 | 36.2494 | 1448.64 | $2.34E^{0}8$ |
| *Industrial Goods* | 0.000226 | 0.00010 | 0.063031 | -0.04017 | 0.00534 | 1.85925 | 24.589 | 53591.8 |
| *Natural Resources* | 1.26E-05 | 0.0000 | 0.07185 | 0.07947 | 0.00374 | 088076 | 177.7732 | 3409703 |
| *Oil & Gas* | 0.000156 | $-4.57E^{0}2$ | 0.28383 | -0.05557 | 0.00824 | 15.28319 | 529.080 | 31009284 |
| *Services* | 7.52E-05 | 0.0000 | 0.062088 | 0.03127 | 0.003318 | 6.0850 | 118.590 | 1508526 |

Looking at the return series on table 3.1, we can observe that the return mean on oil during the study period is 1.67E.0.5, while that of agriculture, consumer goods, financial services, industrial goods, Natural resources, oil and gas and ICT were all positive while that of the other remaining sectors reported negative values.

The highest returns for the series are that on financial services about 4.32E-05. The maximum return on investment in oil market is about 8.28%.Looking at the stock market, the highest return of investment is on ICT, followed by oil and gas sector. The standard deviation, which reveals the volatility of the series indicate that the volatility of oil return is 0.0100, which is far from the mean, indicating that oil returns are highly volatile. A look at the stock returns reveal that the ICT sector with a standard deviation of 0.020390 is the most volatile, while the construction sector seem to be the least volatile. The standard deviation values indicate the preference for GARCH model. The kurtosis of the returns are high, i.e they are leptokurtic for most series, while the Jarque Bera value indicate that all the variables are non-normal just like the price values thus, necessitating the use of our models. The non-normality of data and high value of kurtosis (peaked) provides justification for the use of GARCH models as evidenced by Tule *et al* (2018), Uzonwanne (2021).

#### 3.1.2 Stationarity Tests:

Though the study uses return series, which are already stationary nonetheless, unit root tests are conducted on the price data just for confirmatory reasons. The result is presented as follows.

**Table 3.2 Unit Root Test**

| Variable | ADF Stat | Prob | Decision |
|---|---|---|---|
| Oil Price | 63.59203 | 0.0001 | 1(1) |
| Agriculture | 47.24475 | 0.0001 | 1(1) |
| Conglomerates | 46.85522 | 0.0001 | 1(1) |
| Consumer goods | 47.14081 | 0.0001 | 1(1) |
| Construction/Real Estate | 50.17499 | 0.0001 | 1(1) |
| ICT | 39.03502 | 0.0000 | 1(1) |
| Industrial Goods | -50.27804 | 0.0001 | 1(1) |
| Health care | -32.60718 | 0.0000 | 1(1) |

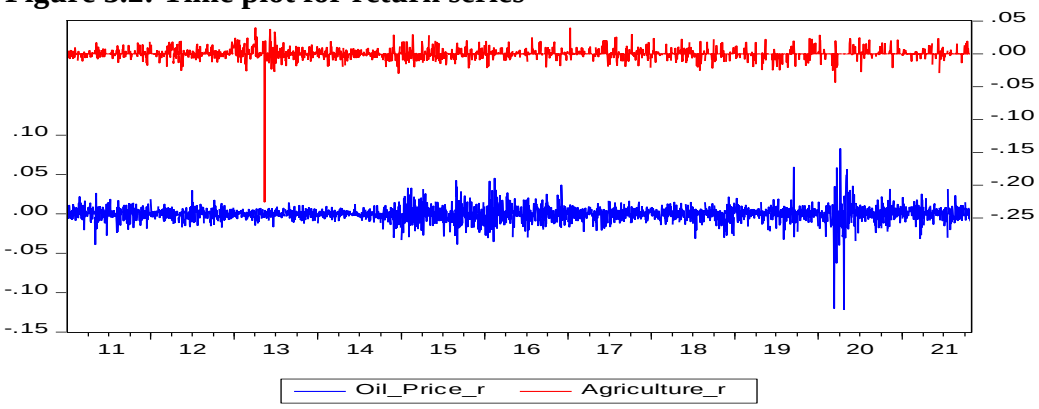
| | | | |
|---|---|---|---|
| Natural Resources | -33.31252 | 0.0000 | 1(1) |
| Oil and Gas | -48.36656 | 0.0001 | 1(1) |
| Financial Services | -45.98963 | 0.0001 | 1(1) |
| Services | -49.47295 | 0.0001 | 1(1) |

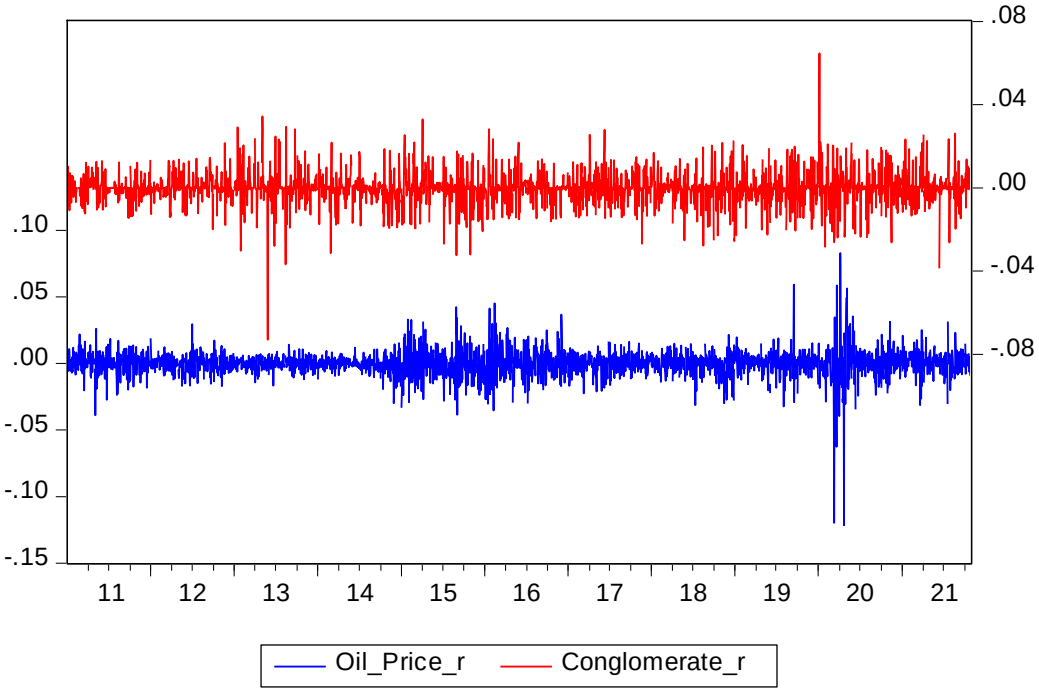
As we can see from the unit root test above, all the series are stationary after been differenced once. Consequently, the series are adequate for analysis using appropriate volatility models.

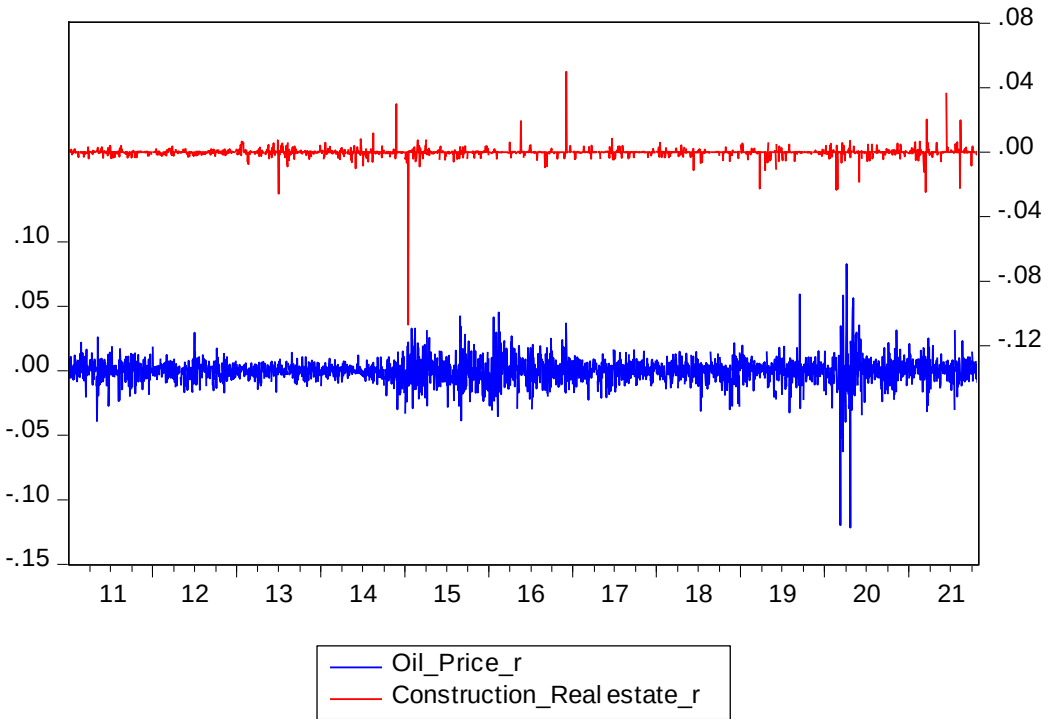
### 3.1.3 Time Plots for Return Series

The time plots of the return series are presented on figure 3.2 as follows:

**Figure 3.2: Time plot for return series**

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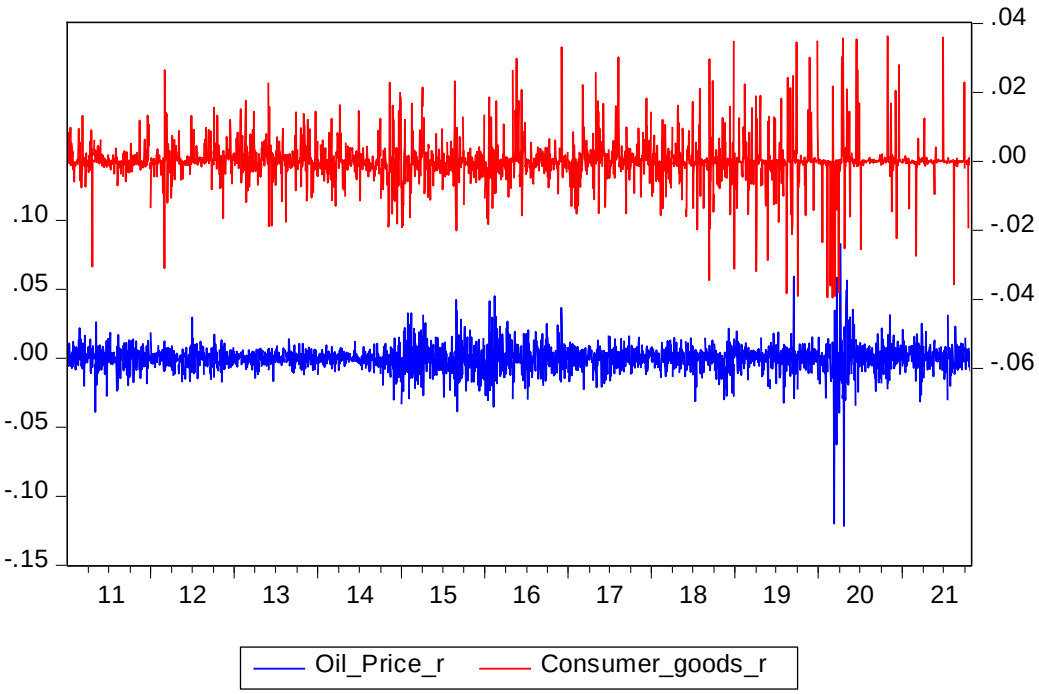
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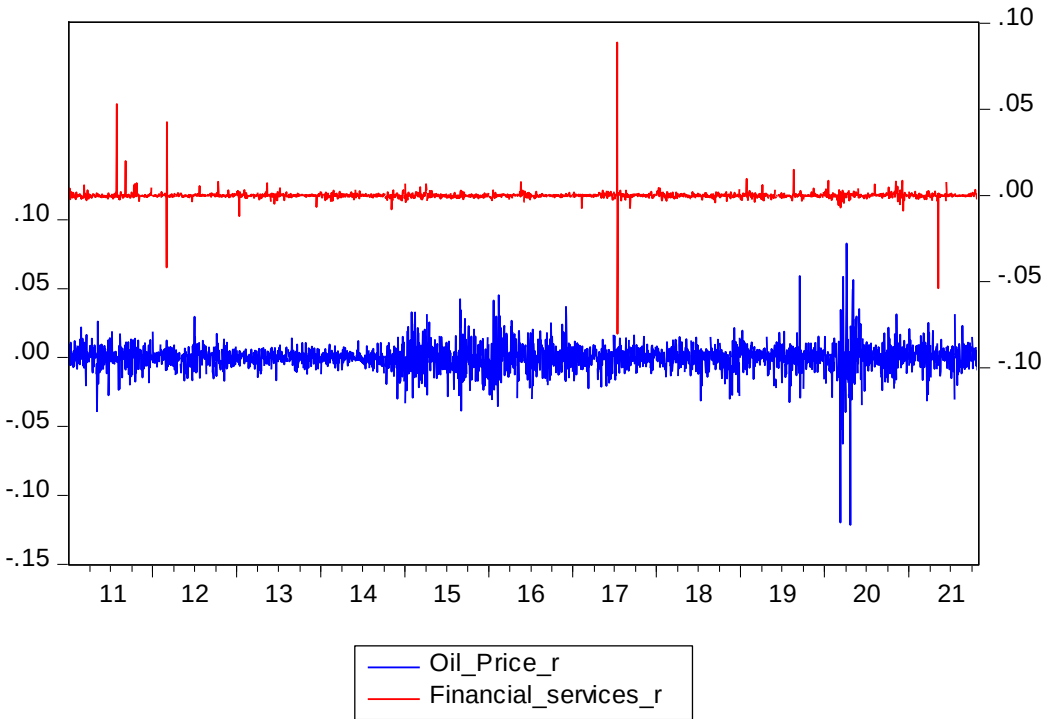
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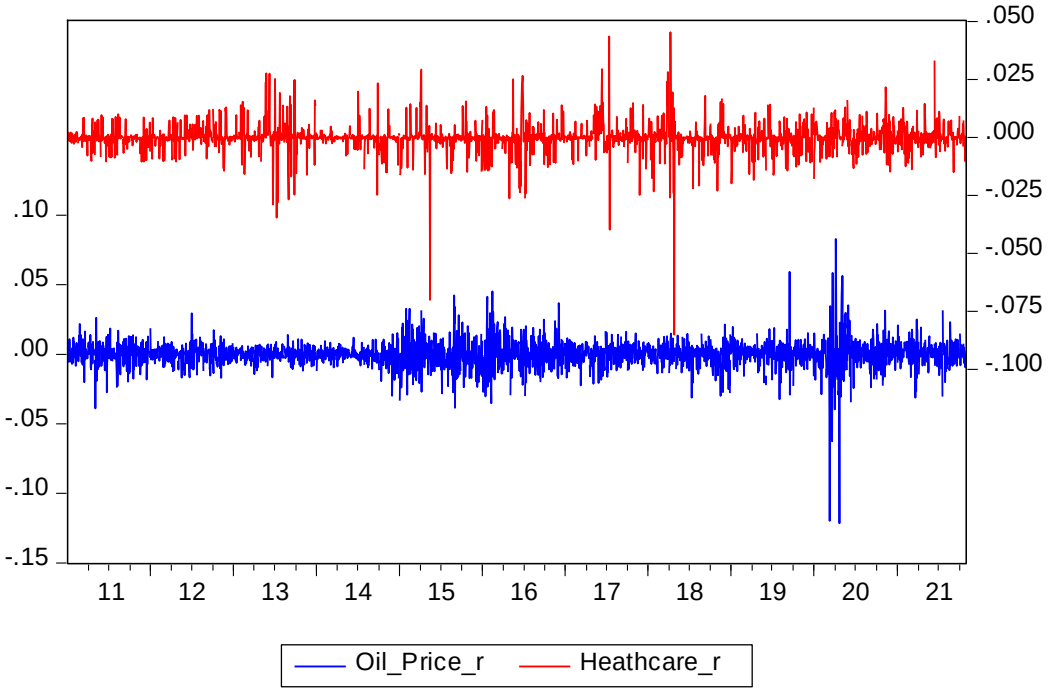
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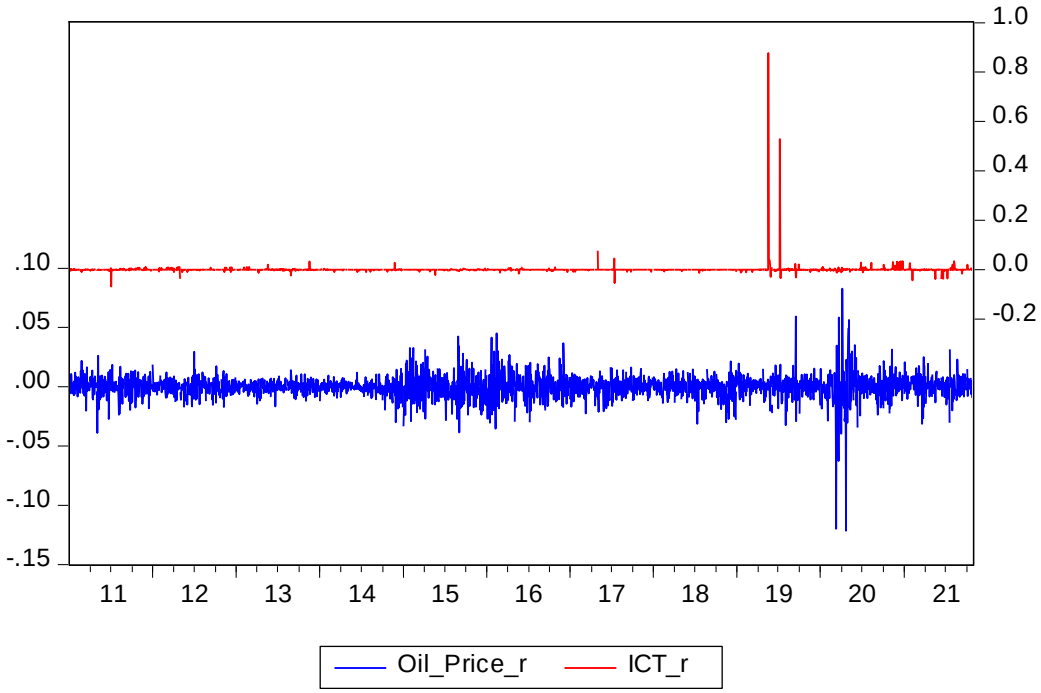
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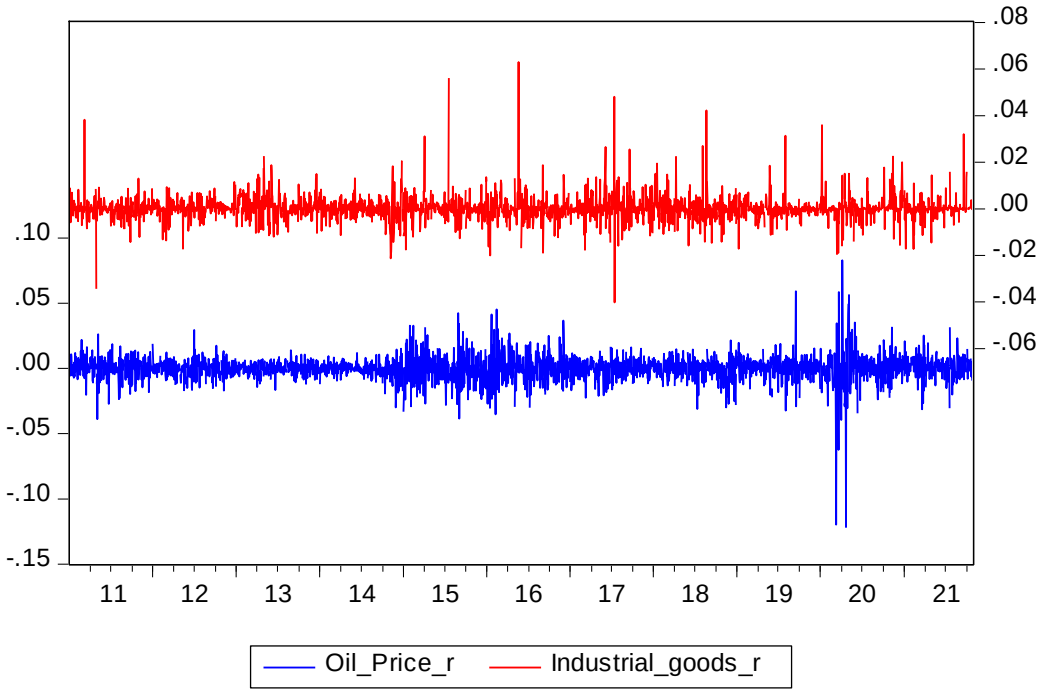
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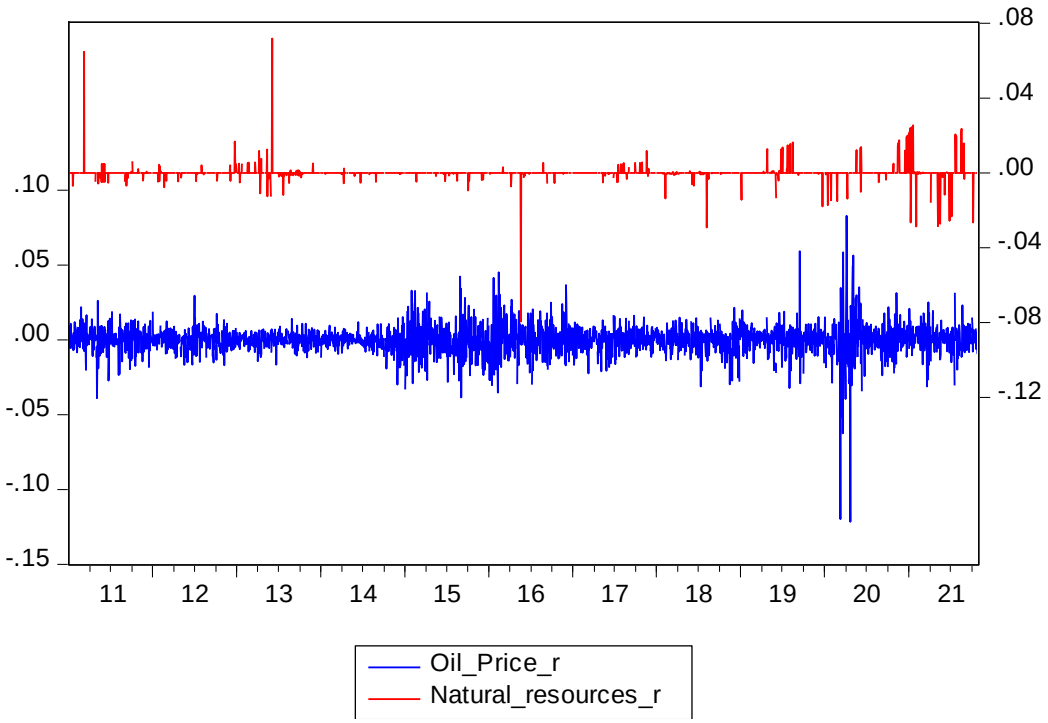
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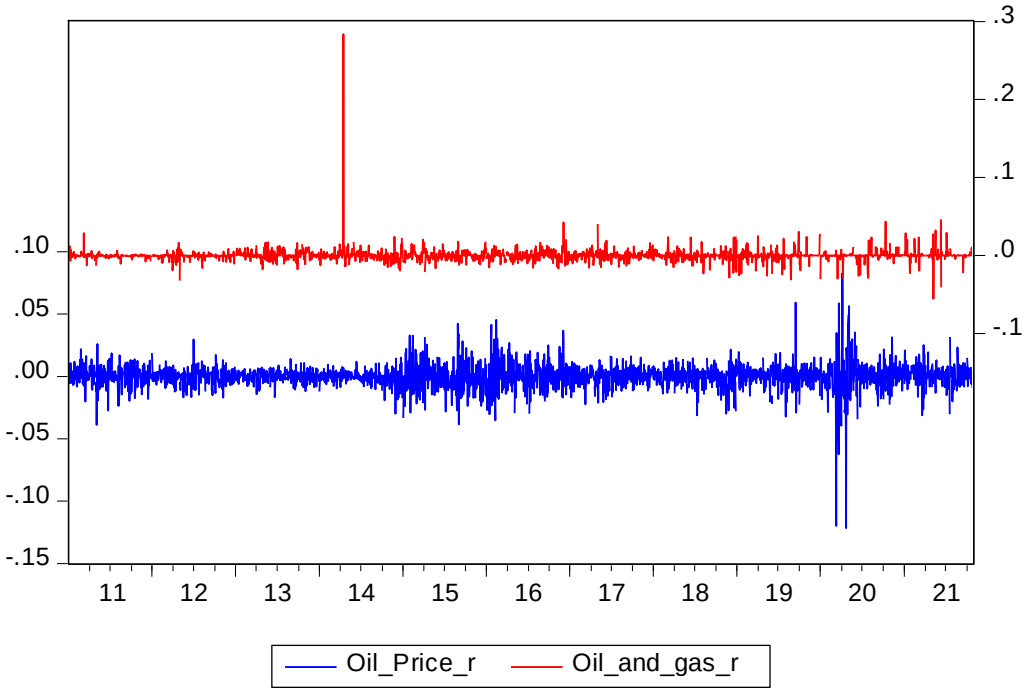
Oil_Price_r
Natural_resources_r


.3
.2
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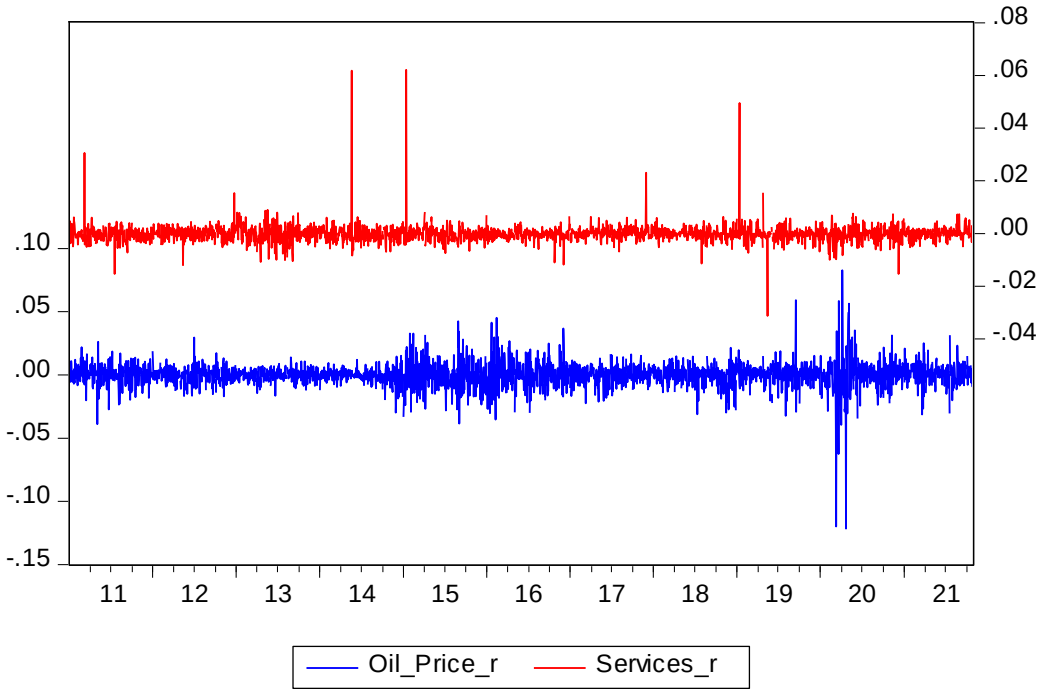
21
Oil_Price_r
Oil_and_gas_r




The time plots of oil and the eleven sectoral indices are as presented above. For the agriculture xxx we observe spikes in oil return around late 2012, while return on agriculture sector was stable between 2011 to 2014. However, as observed by 2020, there was a sharp spike in returns perhaps due to the COVID 19 Pandemic. We can also observe that all the return series exhibit volatility clustering given rise to excess kurtosis with very high values as evidence in the table 4.1 on descriptive statistics. Volatility clustering indicates that large positive changes in volatility are likely to be followed by negative changes in volatility. Thus scenario suggests the positivity of return and volatility spillover effects between the series which makes GARCH based models ideal for estimation. Also, the series appear to be stationary at some point and zero mean elsewhere, exhibits high degree of volatility at various points. Additionally, there appears to be high degree of volatility clustering over time, Edeh Iloka, R. Nnamani (2017), Fracq and Zakoian (2010), cited by Abdala (2014).

### 3.1.4 ARCH and Serial Correlation Tests

Evidence from the unit root test, Jarque-Bera and Kurtasis support the adoption of GARCH model however, the ARCH test serial correlation test were conducted. The Engle (1982) ARCH tests were conducted where results reveal existence of ARCH effects and serial correlation in the series as follows.

**Table 3.3 ARCH & Correlation Test.**

| Variable | ARCH LM | Jarque Bera |
|---|---|---|
| Oil Price | **6.7606** | **38.873** |
| Agriculture | **3.646** | **49.495** |
| Conglomerates | **4.3863** | **30.820** |
| Consumer goods | **2.8613** | **7.5563** |
| Construction/Real Estate | **32.5634** | **47.084** |
| ICT | **590.3996** | **221.37** |
| Industrial Goods | **19.6183** | **63.979** |

| | | |
|---|---|---|
| Health care | **2.7309** | **8.7091** |
| Natural Resources | **28.559** | **20.075** |
| Oil and Gas | **3.9690** | **67.689** |
| Financial Services | **6.0223** | **31.634** |
| Services | **2.4601** | **4.776** |

**Significant figures in bold.**

**3.1.5** Engle-Sheppard CC-$\chi^2$ test

In order to choose between the CCC and DCC model, a formal test was conducted. The result of the Engle-Sheppard test is as presented below

**Table 3.4: Engle-Sheppard** CC-$\chi^2$ test

| **Variable** | **Test Result** |
|---|---|
| *Agriculture* | 1.530652 (0.465182) |
| *Conglomerates* | 1.453491 (0.48348) |
| *Construction/Real Estate* | 2.293520 (0.029352) |
| *Consumer Goods* | 0.87052 (0.64709) |
| *Financial Services* | 5.993539 (0.05990) |
| *Health Care* | 1.650715 (0.438078) |
| *ICT* | 0.029403 (0.998648) |
| *Industrial Goods* | 0.037844 (0.981255) |
| *Natural Resources* | 0.22862 (0.891979) |
| *Oil and Gas* | 0.088905 (0.956520) |
| *Services* | 8.369742 (0.0582417) |

**Note:** the p-values are in brackets

As can be seen from table 4.4, all the probability values for the series are greater than 0.05 which suggest that the constant conditional correlation (CCC) model is preferred over the DCC model.

## 4. RESULTS AND DISCUSSION OF FINDINGS

### 4.1 Results[1]

The results of the VARMA GARCH Model is presented below:

**Table 4.1: Model Results**

**Return (Mean) Equation**

| *Parameters→* *Variables↓* | $\boldsymbol{\varphi_{oil}}$ | $\boldsymbol{\varphi_{s}}$ | $\boldsymbol{\varphi_{oil^s}}$ | $\boldsymbol{\varphi_{s^{oil}}}$ |
|---|---|---|---|---|
| *Oil-Agriculture* | **0.043742** | 0.09198 | **0.022915** | **0.113544** |
| *Oil-Conglomerates* | 0.289007 | 0.008525 | 0.002402 | 0.06598 |
| *Oil-Construction/Real Estate* | **0.05742** | **-0.01789** | **-0.01156** | **0.148099** |
| *Oil-Consumer Goods* | 0.027082 | 0.022263 | **0.034066** | **0.150102** |
| *Oil-Financial Services* | **-0.021258** | 0.317823 | **0.013350** | **0.272896** |
| *Oil-Health Care* | 0.02910 | -0.0209 | 9.14E-03 | **0.04920** |

| | | | | |
|---|---|---|---|---|
| *Oil-ICT* | **0.03510** | **5.9235E-03** | **5.235E-03** | **4.1464E-03** |
| *Oil-Industrial Goods* | -0.037261 | 0.044964 | **0.007294** | 0.040802 |
| *Oil-Natural Resources* | **-5.382E-05** | **0.04650** | **0.01270** | **-0.07490** |
| *Oil-Oil and Gas* | 0.03293 | -0.004397 | **0.038049** | **0.043547** |
| *Oil-Services* | **-0.014767** | **0.050332** | **0.028680** | **0.070118** |

**Note:** The bivariate VARMA CC-GARCH model is estimated for each of the oil stock pairs. The optimal lag order for the model is determined based on AIC/SBC. Significant parameters are in bold

[1] Given that the objective of the paper is to examine return spillover effects between oil prices and sectoral stocks in Nigeria, the results of the variance equation is suppressed but available

## 4.2 Findings

Evidence from the mean (return) equation from table 4.1 and show that own lagged returns are included in the conditional mean equation, the purpose and reason for which is to remove serial correlation and to ensure that spillover effects are not mistaken for serial dependence. This is in line with Tule et al (2019), Uzonwanne (2021), among others. It is observed that own lagged returns are statistically significance and positive for most of the sector stocks except few. For instance, the lagged return for the pair of agricultures, conglomerates, consumer goods, health care, natural resources and services were positive, but not significant while that of Construction and real Estate, financial services ICT, Industrial goods, Oil and Gas were all statistically significant indicating evidence of short term predictability in prices for these sectors. Own lagged returns for oil in the oil-stock pain was statistically significant for the sectors except oil-conglomerates, oil consumer goods and oil Health care.

Turning to the return cross effects, we observe positive and significant return spillover from some stock sectors to oil. For example, the return spillover from agriculture sector to oil is significant at 0.022915; Construction and real estate significant at 0.01156, Consumer goods (0.34066) Financial services (0.0133809) ICT (5.235E-03) Natural Resources (0.0127) oil and gas (0.0380) and services at 0.028680.

Results from the return (mean) equation also reveal significant return spillovers from the oil to stock sectors except conglomerates whose return is positive, though not significant. For instance, the return spillover from oil market to agriculture sector -0.1135, Construction and real estate at 0.148099. We can infer from the result that the highest return spillover is from the oil market of 0.272896 is to financial services sector, while the lease (lowest) return spillover from oil of 4.146E-03 is to information and communication technology; ICT sector.

## 4.3 Discussion of Findings

Following is the discussion of findings from the results. From the return (mean) equation results, the parameters of interest are $\varphi oil^{s}$, and $\varphi_{s}^{oil}$ the return spillover effects between oil market and the sector returns, nonetheless, as is conventional with financial times series of high frequency dimension, we include own lagged returns $\varphi oil$, and $\varphi_{s}$in the conditional return (mean) equations to make sure that spillover effects are not mistaken or confused for serial dependence. Salisu (2019) Yaya et al (2016), Tule et al (2018).

Results from table 4.1 show that own lagged oil returns for the oil stick pairs are statistically significant for oil-agric, oil-construction, oil-financial services, oil-ict, oil-natural resources, and oil-services pairs. This indicates that investors take into consideration the immediate past information of individual market in their investment decision making process. However, the

own lagged oil returns is statistically nor significantly for the remaining oil-stock pairs for oil-conglomerates, oil-consumer goods, oil-healthcare, oil-industrial goods and oil-oil/gas pairs. Turning to the industrial sectors, we observe significant effect of own lagged returns on current returns in construction/real estate, financial services, Ict, industrial goods, and oil and gas sectors indicating that the present returns on these sectors can be predicted based on their past returns. This is in line with Abdalla (2014) and Abeng (2017). This also means that returns are predicted from past realizations and thus are not informationally efficient according to the weak-form efficient market hypothesis as evidenced in the works of Elder and Serlites (2008) and Arouri et al, (2011)

However, the own past returns on the remaining sectors are not statistically significant, going by their probability valves. The results of the main equation also indicate evidence of short term price predictability in sector price changes which is consistent with existing literature; Arouri and Nguyen 2010, Arouri et al (2012) and Malik and Rashid (2017).

Regarding to return spillover effects, we observe significant returns spillover from each of the sector indices to oil market for agriculture, construction, consumer goods, financial services, ICT, natural resources, oil and gas and the services sector. This means that the returns in the oil market is influenced by the returns in these sectors, though magnitudes of the estimated parameters are very low suggesting very weak spillovers. The return spillover from conglomerates Health care, Industrial goods however, does not have any significant effect on oil market returns going by the respective probability values. These findings suggest that a bubble in the Nigerian stock market may lead to increase in return in the oil market. This also gives a signal to investors, to plan their investment decisions.

In the same vein, the return spillover from oil market to the sector stock indices indicates significant results. This means that the return on oil significantly affect the returns on the sector on the Nigerian stock market. Very significant values are for specific sectors such as agriculture, consumer goods, financial services and construction and real estate. For instance, a one unit change in return of in the oil market, will cause the financial service sector return to rise by about 27%, while that of the consumer gods is 15%. This result is not however surprising due to the reliance of the stock market on oil related companies Also, sector stock returns can be predicted by looking at the returns in the oil market going by the results we have seen.

## 5.1 CONCLUSIONS

This paper examined the return spillover effects between oil prices and sectoral stocks in Nigeria using daily data on oil price and the eleven industrial sectors on the Nigerian exchange limited (ngx) from January 4$^{th}$ 2011 to November 29$^{th}$ 2021. We employ the bivariate CC-VARMA GARCH model developed by Ling and McAleer (2003) that allows for spillover effects for the returns series.

Overall, our results show evidence of short term predictably in stock returns for most of the sectors including agriculture, conglomerates consumer goods, healthcare, natural resources and services. Same arguments hold for the oil-stock pairs, thus, we conclude that for most of these series, their returns are not informationally efficient.

Additionally, findings from the spillover effect reveal significant return spillovers from oil market to each of the industrial sectors indicating that returns on the stock market are influenced by that of the oil market. We also observe significant, though weak return spillover effects from the stock market to the oil market except for three industrial sectors.

## 5.2 RECOMMENDATIONS

From the findings and conclusions of this study, we therefore recommend as follows that: investors, fund managers, portfolio managers should build accurate asset pricing models and accurate forecasts of the return of both oil and sectoral stock prices. Policy makers should adjust their actions to avoid risks in the event of market crisis. Investors, policy makers, should continuously monitor returns in both markets in order to predict and forecast prices in the short term so as to minimize the effect of risks and shocks.

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