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RISK-RETURN RELATIONSHIP IN THE NIGERIAN STOCK MARKET DURING PANDEMIC COVID-19: SECTORAL PANEL GARCH APPROACH

Keywords: COVID-19, risk-return, news, GARCH.

J E L Classification: D81.

Abstract: This study examines how the Nigerian Stock Exchange (NSE) is responding to the COVID-19 pandemic in the form of risk-return relationship and volatility. Panel data analyses of GARCH-in-mean and Threshold GARCH were estimated on three error distributional assumptions. All Share Index (ASI) from January 2020 to December 2020 for ten stock market indices on the NSE. Findings indicate that the cross-section return of the ten stock market indices returns exhibit a positive risk-return relationship during COVID-19 and the impact of bad news was found to have no significant impact on return volatility on the NSE. This indicates that the policy response during the pandemic is adequate to cushion the negative impact of COVID-19, which should be sustained.

Introduction

Risk-return has a positive correlation whereas investors are risk-averse is the postulation of the fundamental studies of finance irrespective of analysis con-

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ducted at industry, firm and national level (Mahmood & Shah, 2015). On the contrary, behavioural finance explained that the risk-return relationship is sensitive to the investor's target or situation. According to prospect theory, investors exhibit a risk-averse attitude in the gain domain and exhibit a risk-seeking attitude in the loss domain, calculated relative to a reference point. This implies that the risk-return relationship is negatively correlated. Ghysels, Plazzi and Valkanov (2016) find fundamental change in the traditional risk-return relationship during financial crises and separation between the traditional risk-return relationship and financial crises due to flight to safety (when investors sell assets perceived to be highly risky to invest in safer assets like gold).

Various studies (Fisher & Hall, 1969; Neumann, Bobel & Haid, 1979; Glosten, Jagannathan & Runkle, 1993; Brandt & Kang, 2004; Guo & Whitelaw, 2006; Ludvigson & Ng, 2007) had been conducted at firm, industry and national levels and the controversy between risk-return relationship lingers on in the literature.

Corona Virus Disease (COVID) first identified in December 2019 in Wuhan, China, generally known as COVID-19, has spread to over 200 countries worldwide and on every continent.

It is an acute respiratory disease, caused by a novel coronavirus (previously known as SARS-CoV-2, and 2019-nCoV) named COVID-19. COVID-19 is the third highly pathogenic and large-scale epidemic coronavirus after the Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV) of 2002 and the Middle East Respiratory Syndrome Coronavirus (MERS-CoV) of 2012 in the human population in the twenty-first century (Hu, Guo, Zhou & Shi, 2020; Guo, Cao, Hong, Tan, Chen, Jin, Tan, Wang & Yan, 2020). World Health Organisation (WHO) declared COVID-19 as a pandemic in March 2020 and became the first coronavirus to be characterised as such. At the time of the declaration, there were 118,000 cases in 114 countries and 4,291 deaths but at the end of June 2020, there were over 10.5 million cases reported in 210 countries, over 514,000 deaths and more than 5.9 million infected people have recovered.

When the virus was declared a global pandemic, stock markets globally experienced a cumulative loss of 12.35% and over $9 trillion loss between January and May 2020 and the global market exhibit increased volatility. For example, the stock prices in the United States declined by 32%, in the United Kingdom declined by 27.9%, and in some emerging stock markets like Brazil reduced by 40.5%, Russia 24.2% and China by 10.1% (Salisu, Ebuh & Usman, 2020). There exist different sentiments and analysts have divergence opinions

on the impact of COVID-19, the fall in stock prices was attributed to investors' panic, as many investors sold out of fear. Another view is that COVID-19 could cause the re-emergence of another global financial crisis and analysts also understand that COVID-19 impact could be worse than the combination of Severe Acute Respiratory Syndrome (SARS) outbreak of 2003, the global financial crisis and World War II (International Monetary Fund (IMF), 2020a; International Monetary Fund (IMF), 2020b; Khan, Zhao, Zhang, Yang, Shah & Jahanger, 2020).

Therefore, as a result of the foregoing problem, it becomes imperative to examine how the NSE is responding to the COVID-19 pandemic in the form of risk-return relationship and volatility (responding to good and bad news). The findings of the study will add to existing literature especially on the study of COVID-19 and stock market performance in the presence of policy response and implications. The subsequent parts of this paper contain a literature review in section two. Section three presents the methodology. Results and discussion are presented in section four and section five provides the conclusion and recommendations of the study.

Literature Review

This section appraises relevant pieces of literature including the theoretical background and the empirical reviews.

Theoretical Background

The relationship between risk and return is one fundamental concept and practice in the field of financial economics. The risk-return relationship indicates that an investment with higher risk should attract a higher expected return proportional to the risk-free return. Merton (1973) posits that the expected excess equity market return is positively related to its conditional variance:

$$E(R_i) = R_f + \beta_i(E(R_m) - R_f) \quad (1)$$

Where $E(R_i)$ represents the expected return on the asset; R_f represents the risk-free rate such as coupons from government bonds; β_i represents the sensitivity of the expected excess return on the asset to the expected excess market returns, can be estimated through, $\beta_i = \frac{Cov(R_i, R_m)}{Var(R_m)}$; $E(R_m)$ represents the ex-

pected return of the market; $E(R_m) - R_f$ represents the market premium. When the rate of returns is independent and equally dispersed, the expected risk-return relationship is positive given the risk aversion of investors. When returns are not independent and equally dispersed, the risk-return relationship will include additional terms to recognise the hedging behaviour of investors (Merton, 1973). Empirical viewpoint has been found in both positive and negative relationships between return and risk (Guo & Whitelaw, 2006; Leon, Nave & Rubio, 2007; Lettau & Ludvigson, 2003; Nelson, 1991; Raputsoane, 2009).

Empirical Review

The risk-return relationship on stock returns has been a major area of research and studies had been conducted such as Nageri (2019a), Coffie (2015), Alade, Adeusi and Alade (2020), Ashraf (2020), Salisu and Vo (2020), Azimli (2020), among others. Ashraf (2020) examined the stock markets' response to the COVID-19 pandemic in 64 countries between the period January 22, 2020, to April 17, 2020, employed panel data regression analysis technique and the finding suggests a strong negative market reaction throughout the early days of confirmed cases of COVID-19 and later between 40 to 60 days after the initial confirmed cases of COVID-19.

Salisu and Vo (2020) evaluate the relevance of health news on the predictability of stock returns, using a panel data regression model with data of 20 top-worst-hit countries in terms of reported COVID-19 cases and deaths. The result shows that health news is significant when predicting stock return during COVID-19 pandemic. Azimli (2020) examines the impact of COVID-19 on risk-return dependence in the United States of America. The quantile regression result indicates that sectoral returns have an asymmetric dependence structure with the market portfolio.

Alade et al. (2020) investigates the connection between COVID-19 confirmed cases and Nigerian stock market capitalization used the Vector regression model and finds that confirmed cases of COVID-19 have a mixed association, which is a negative but statistically insignificant relationship to the Nigerian stock market equity capitalization. Nageri (2019a) evaluates positive and negative news on the Nigerian stock market before and after the 2018/19 financial meltdown, employed GARCH variant models of TGARCH, EGARCH and PGARCH. The study reveals that good news influence stock return more signifi-

cantly than bad news of similar extent before the meltdown, but bad news have a more insignificant impact on stock return than the good of similar extent after the meltdown.

Zhang, Hu and Ji (2020) studied the financial markets of the top 10 countries on the list of confirmed COVID-19 pandemic cases as of 27 march, 2020 (the United States, Italy, China, Spain, Germany, France, the United Kingdom, Switzerland, South Korea and the Netherlands). The study used the quantile regression methodology for the daily S&P500 (SP) returns and findings reveal global financial market risks significantly increased during the COVID-19 pandemic period of the study.

Therefore, from the pieces of literature reviewed, it is obvious that a result of the uncertainties due to COVID-19 in the stock market globally, making the stock market as a major point of call indicating the effect of COVID-19 on economies. As such, it is an important contribution to the literature and the economic rebound of the Nigerian economy to embark on a study of the risk-return relationship of stock on the NSE to provide an initial estimate for policy direction and guide concerning past policies and future decisions.

Data and Methodology

The discussion in this section includes the method that was used for the analysis, mainly the theoretical framework, model specifications, sources and estimation procedure.

Data

The data are secondary, sourced from the Nigerian Stock Exchange using the daily selected sectoral All Share Index return of different sectors (see table 1) from January 1st till June 30th, 2020. The return series was generated by the following for 123 observations for each sector:

$$ASI_{rt} = \frac{(ASI_t - ASI_{t-1})}{ASI_{t-1}} \tag{2}$$

Where ASI_{rt} is All Share Index return at a particular day, ASI_t is the All-share Index of a particular day, ASI_{t-1} is the previous day All-Share Index. Table 1 con-

sists of the sectoral index used in the study, the description and the source of the data used as a proxy for each sector index.

Table 1. Description of Selected Stock Market Indices

Variables	Description	Source
NSE30	It is the price index that tracks the top thirty listed companies with fully paid--up common shares in terms of market capitalisation and liquidity on the Nigerian Stock Exchange.	NSE
NSE5O	It is the price index of the top fifty listed companies with fully paid-up common shares. It is weighted by adjusted market capitalisation multiplied by closing prices of the companies, multiply by a capping factor.	NSE
NSEBAN	It is the price index that tracks the performance of listed banks with the most capitalisation and liquidity performance.	NSE
NSECON	It is the price index that tracks the performance of listed companies in the consumer goods sector (food, beverages and tobacco) based on the market capitalisation method.	NSE
NSEIND	It is the price index based on market capitalisation and method that captures the performance of listed companies in the industrial sector.	NSE
NSEINS	It is the price index that captures the performance of listed insurance companies with the most capitalisation and liquidity.	NSE
NSEISL	It is the price index based on the requirements of the Shari'ah Advisory Board that captures the performance of fifteen Shari'ah-compliant listed companies.	NSE
NSEOIL	It is the price index based on market capitalisation methodology that captures the performance of listed companies in the oil and gas sector	NSE
NSEPEN	It is the price index that captures the top forty listed companies in terms of adjusted (free float factor) market capitalisation and liquidity	NSE
NSEPRE	It is the price index that tracks the performance of fully paid up ordinary shares of companies listed on the premium board	NSE
NSEALL	It is the cross-section of the ten price indexes listed above	Computed

S o u r c e : Nigerian Stock Exchange (NSE).

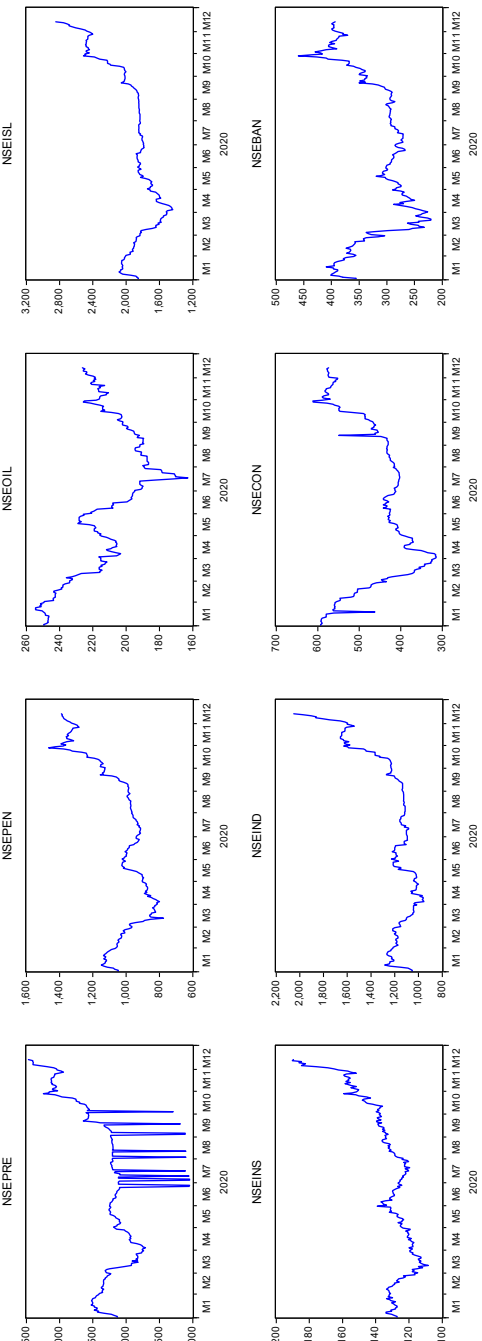

Figure 1. Graphical Presentation of the Selected Sectoral Share Index on the Nigerian Stock Exchange

Source: NSE, 2020.

The sectoral index, as shown in figure 1, indicates that the sectors respond similarly during the early months of the year and at the inception of COVID-19 cases in Nigeria between January (M1) and April (M4). The sectorial indexes were increasing in January (M1) but experienced a decline afterwards till around March (M3) and April (M4). This was the period when COVID-19 was first reported and various forms of lockdown were also announced in Nigeria. During this period of lockdowns and decline, various policy responses by different economic agencies were announced and implemented to cushion the negative effect of the pandemic in the country. NSEINS started to recover as early as March (M3) while other sectors started recovering toward April (M4), afterwards the policy responses, except for NSEOIL that indicates a second decline around May (M5) towards June (M6). The indexes indicate different magnitude because the index value of the sectors varies, the NSEPRE has the highest index followed by NSEISL while the lowest index is shown by NSEINS.

Theoretical Framework

Stock returns exhibit stochastic volatility and jumps (Nageri, 2019b) indicating the risk associated with deviation in returns (Campbell, Lettau, Malkiel & Xu, 2001; Pastor & Veronesi, 2006). Volatility models should capture error term's heteroscedasticity and stylised fact in stock returns (Engle, 1982). The general form of the conditional variance equation incorporates the ARCH processes with (p) lagged as follows:

$$\sigma_t^2 = \omega + \alpha_1 \varepsilon_{t-1}^2 + \ldots\ldots\ldots\ldots + \alpha_n \varepsilon_{t-p}^2 \quad (3)$$

Equation 3, ARCH (1) model shows that next period's variance of return which was the residuals of the mean equation (σ_t^2), depends on squared residuals of the past period from period 1 till p period (ε_{t-p}^2) known as the ARCH term, α_1 is the parameter of the ARCH term and ω is the constant. An extension is the Generalised ARCH or GARCH model which adds the lags of the variance, σ_{t-i}^2 to the standard ARCH. GARCH model has one lag of the regression model's squared residual (ε_{t-i}^2) known as the ARCH term and one lag of the variance itself (σ_{t-i}^2) known as the GARCH term (Bollerslev, 1986).

$$\sigma_t^2 = \omega + \sum_{i=1}^{k} \alpha \varepsilon_{t-i}^2 + \sum_{i=1}^{q} \beta \sigma_{t-i}^2 \quad (4)$$

Equation 4 is the GARCH model developed by Bollerslev (1986). α, $\beta > 0$ and $(\alpha + \beta) < 1$ to avoid negative conditional variance and it indicates that present period's return variance (σ_t^2) is determined by a constant (ω), estimates of the previous period's squared residual of the mean return equation ($\sum_{i=1}^{k} \alpha \varepsilon_{t-i}^2$) and estimates of the previous period's return variance ($\sum_{i=1}^{q} \beta \sigma_{t-i}^2$).

Model Specification

This study examined the risk-return relationship of returns and evaluates good and bad news during COVID-19. Variant Auto-Regressive Conditional Heteroscedasticity (ARCH) models were used to achieve the purpose of the study under three (3) distributional assumptions. The following is the general form of the panel GARCH model used in this research:

$$ASI_{rit} = C + \alpha_{it} ASI_{rit_{-1}} + \varepsilon_{1it} \quad \text{Cross-section mean return equation for } ASI_{rit} \quad (7)$$

$$\sigma_{it}^2 = \omega + \alpha \varepsilon_{it-1}^2 + \beta \sigma_{it-1}^2 \quad \text{Cross-section variance of return equation} \quad (8)$$

Where σ_{it}^2 represents the cross-section return variance (error term from the mean return equation) is determined by ω representing the constant, ε_{it-1}^2 representing the ARCH term showing the past period's cross-section squared error term derived from the mean return equation and σ_{it-1}^2 representing the GARCH term showing the past period's cross-section variance of the return.

Risk-Return during COVID-19

The panel GARCH-in-Mean (GARCH-M) model used to measure the risk-return relationship was as follows:

$$\sigma_{it}^2 = \omega + \theta_{it} g(\sigma_{it}) + \varepsilon_{1it} \quad (9)$$

Where $g(.)$ is the arbitrary volatility function of σ_{it}, the cross-section GARCH-M was specified with cross-section GARCH conditional variance specification and the function $g(\sigma_{it})$ is the standard deviation in mean (θ_{it}). Positive θ_{it} indicates higher risk leading to higher average return and vice versa. The a priori expectation of GARCH-in-Mean is $0 > \theta_{it} > 0$, indicating that the risk-return relationship can be positive or negative.

Good and Bad News during COVID-19

Threshold GARCH (TGARCH/TARCH) permits asymmetric effect between positive and negative news on cross-section stock returns with general description stated below: $\sigma_{it}^2 = \omega +$

$$\sum_{i=1}^{k} \alpha_{it}\, \varepsilon_{it-i}^2 + \sum_{i=1}^{n} \gamma_{it}\, \varepsilon_{it-i}^2 d_{it-i} + \sum_{j=1}^{q} \beta_{it}\, \sigma_{it-i}^2 \tag{10}$$

Where $d_{it-i} = \begin{cases} 1 & if\ \varepsilon_{it-i} < 0 \\ 0, & if\ \varepsilon_{it-i} \geq 0 \end{cases}$

When ε_{it-i} indicates positive news, the effect would be given as $\gamma_{it}\varepsilon_{it-i}^2$, when ε_{it-i} indicates negative news, the effects would be given as $(\sigma+\gamma_{it})\varepsilon_{t-1}^2$. γ_{it} is expected to be positive so that bad news would impact volatility. TGARCH/TARCH cross-section means return equation and cross-section return variance is stated as:

$$ASI_{rit} = C + \alpha_{it} ASI_{rit_{-1}} + \varepsilon_{1it} \quad \text{Cross-section mean return equation of } ASI_{rit} \tag{11}$$

$$\sigma_{it}^2 = \omega + \alpha_{it}\varepsilon_{it-1}^2 + \gamma_{it}\varepsilon_{it-1}^2 d_{it-1} + \beta_{it}\sigma_{it-1}^2$$

Cross-section return variance equation (12)

Where $d_{it-1} = 1$ if $\varepsilon_{it-1}^2 < 0$ and $d_{it-1} = 0$ if $\varepsilon_{it-1}^2 > 0$.

The a priori expectation of TGARCH specifies $\gamma_{it} < 0$ as a measure of the impact of negative news on return volatility persistence.

Three (3) conditional error distributions that are: Gaussian distribution, student's-t distribution and the Generalised Error Distribution (GED) were used to estimate the parameters of the consistent residuals of the models.

Estimation Procedure

The estimation procedure involves the estimation of the descriptive statistics of each sectoral return series, the univariate and panel data unit-root pre-testing of the series to establish the absence of unit root were conducted. The effect of sectoral-specific was tested with the use of least squares dummy variable estimator for heteroscedasticity and autocorrelation and the Wald test statistic was employed to test the null hypothesis of the data pool ability These are done to satisfy the requirements for the use of the GARCH model in a panel data environment according to Cermeño and Grier (2001).

Results and Discussion

In this section, the analysis is carried out and results are presented and interpreted.

Table 2. Descriptive Statistics of Selected Sectoral Share Index Return on the Nigerian Stock Exchange

Stat / Variable	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	J.Bera	Prob
NSE30	0.001417	0.000421	0.060937	-0.055389	0.013190	0.407018	7.958619	261.9745	0.0000
NSE50	0.001051	0.000251	0.199894	-0.116283	0.021080	2.683139	37.44343	12759.04	0.0000
NSEBAN	0.000743	0.000000	0.079884	-0.127868	0.026560	-0.595542	6.472291	139.8081	0.0000
NSECON	0.000288	-0.000017	0.225520	-0.174956	0.029467	1.863450	34.07173	10160.68	0.0000
NSEIND	0.002787	0.000036	0.086508	-0.075006	0.019561	0.630845	7.282481	206.7894	0.0000
NSEINS	0.001771	0.002363	0.061560	-0.056696	0.015838	-0.006462	4.693598	29.76007	0.0000
NSEISL	0.001849	0.000381	0.054492	-0.044845	0.013018	0.507936	6.914825	169.7127	0.0000
NSEOIL	-0.000512	0.000000	0.052420	**-0.056970**	0.013119	-0.827499	9.643415	486.3175	0.0000
NSEPEN	0.001234	0.000000	0.096402	-0.089618	0.015971	0.453358	13.09519	1065.876	0.0000

Table 2. Descriptive...

Stat / Variable	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	J.Bera	Prob
NSEPRE	0.020182	0.000161	1.036042	-0.502876	0.212936	3.041523	17.78441	2651.665	0.0000
NSEALL	0.003081	0.000028	1.023604	-0.502876	0.069947	9.227151	160.4829	2608424	0.0000

S o u r c e : authors computation, 2020.

Table 2 indicates that the mean return of the sectoral indices is positive except for the mean return of NSEOIL while the median return of NSECON is negative and all other sectoral median returns are positive. All the series exhibit positive maximum returns with all showing negative minimum returns during the COVID-19 year. The standard deviations of all the return series are low at a maximum of 3% except for NSEPRE with the Jarque-Bera P-values are all statistically significant at 5% indicating a normal distribution of the return series. The pooled series (NSEALL) has a positive mean and median return, positive maximum return and negative minimum return with 6% standard deviation and a Jarque-Bera P-value of less than 5% significant level indicating a normal distribution of the NSEALL series.

Table 3. Unit Root Test Result of Selected NSE Indices Series

Variable	Method	Stat	Prob.	Method	Stat	Prob.
NSE30R	ADF Test Stat	-7.403898	0.0000	PP Test Stat	-11.34105	0.0000
NSE50R	ADF Test Stat	-16.47200	0.0000	PP Test Stat	-16.46769	0.0000
NSEBANR	ADF Test Stat	-13.07916	0.0000	PP Test Stat	-12.99907	0.0000
NSECONR	ADF Test Stat	-19.04778	0.0000	PP Test Stat	-19.08406	0.0000
NSEINDR	ADF Test Stat	-13.22865	0.0000	PP Test Stat	-13.53596	0.0000
NSEINSR	ADF Test Stat	-18.09120	0.0000	PP Test Stat	-17.97058	0.0000
NSEISLR	ADF Test Stat	-7.747417	0.0000	PP Test Stat	-12.10292	0.0000
NSEOILR	ADF Test Stat	-13.96485	0.0000	PP Test Stat	-13.98646	0.0000
NSEPENR	ADF Test Stat	-13.71659	0.0000	PP Test Stat	-13.80775	0.0000
NSEPRER	ADF Test Stat	-16.46982	0.0001	PP Test Stat	-21.72942	0.0000

S o u r c e : authors computation, 2020.

Table 4. Panel Unit Root Test Result of NSEALL

Variable	Methods	Stat	Prob.
NSEALL	Levin, Lin and Chu	-9.76184	0.0000
	Im, Pesaran and Shin	-19.2477	0.0000
	ADF	388.829	0.0000
	PP	1122.30	0.0000

Source: authors computation, 2020.

Table 3 and 4 are the unit root test results for the series, the ADF and PP unit root test result for the individual ASI sectorial returns indicates no unit root while the cross-section NSEALL unit root result also indicates stationarity. Therefore, the data is suitable for econometrics analysis.

Cross-section regression requires the establishment of the pool-ability of the data to know if there exists no sectorial specific effect in the data and applicability of single intercept. To test for homogeneity (common intercept), the Least Square Dummy Variable (LSDV) according to Cermeño and Grier (2001) was used, the Auto-Regressive Conditional Heteroscedasticity (ARCH) effect test was used to test for ARCH effect and serial correlation was tested using the Ljung–Box Q-statistics and partial correlations tests for the residuals and squared residuals of the mean and variance equations.

Table 5 presents the Wald test F-statistics with Chi-Square values of the LSDV cross-section mean equation were 0.289782 and 1.876113 respectively and they are not statistically significant, indicating that there exists homogeneity (common intercept) within the sectorial return series. The F-statistics and the observed R-square values of the ARCH test from the pooled returns indicate that the null hypothesis of no ARCH effect is rejected indicating the presence of ARCH effect in the residuals of the pooled mean equation.

Table 5. Wald Test (Mean Equation) and ARCH Test (Pooled Regression)

Wald Test (Mean Equation)	Value	Prob	Heteroscedasticity Test (Pooled Regression)	Value	Prob
F-statistics	0.289782	0.8914	F-statistics	132.8361	0.0000
Obs*R-square	1.876113	0.8914	Obs*R-square	126.1997	0.0000

Source: authors computation, 2020.

Table 6. Autocorrelation Result

Residual	PAC	Q-Stat	Prob	Squared Residual	PAC	Q-Stat	Prob
	-0.008	0.0216	0.002		0.225	126.40	0.0000
	0.108	14.334	0.001		0.158	188.77	0.0000
	0.035	17.747	0.002		0.112	219.80	0.0000
	-0.083	16.680	0.002		0.081	236.30	0.0000

S o u r c e : authors computation, 2020.

Table 6 shows the autocorrelation result of the pooled regression for the residual and the squared residuals from the mean equation and it indicates that there is no serial correlation in the residuals. The result of no serial correlations and the presence of the ARCH effect indicates the application of the GARCH model. Lastly, the cross-section variance equation was tested for individual effect in the NSE sectoral series using the Maximum log-likelihood estimate (MLE) as suggested by Cermeño and Grier (2001) and the MLE is statistically significant at 5% which shows that the sectorial return variance is not consistent between the market. Therefore, the GARCH model applies to the panel data for analysis.

Table 7. Cross-Section GARCH-in-Mean Result for Sectorial Return in COVID-19

Parameters	Gaussian Distribution		Student's-t Distribution		Generalised Error Distribution	
	Estimates	P-Value	Estimates	P-Value	Estimates	P-Value
C	-0.007504	0.0000	-0.006850	0.4835	-0.056134	0.1859
ϑ_{it}	0.423549	0.0000	0.113079	0.4835	0.964359	0.1860
ω	0.000079	0.0000	0.005454	0.5914	0.001733	0.0000
α_{it}	0.164938	0.0000	-0.004056	0.6061	0.000017	0.0015
β_{it}	0.739167	0.0000	-0.263666	0.0382	0.488494	0.0000
AIC	-4.667309		-5.528884		-5.658158	
SC	-4.653280		-5.512517		-5.641791	
HQ	-4.662214		-5.522941		-5.652215	

S o u r c e : authors computation, 2020.

Table 7 shows the GARCH-in-Mean cross-section return indicating positive θ_{it} (standard deviation) of 0.423549, 0.113079 and 0.964359 under the three error distributional assumptions respectively with P-values of 0.0000, 0.4835 and 0.1860 respectively indicating statistical significance at 5% under Gaussian distribution estimates but statistically insignificant under the Student's-t distribution and the Generalised Error Distributions (GED).

This implies a positive risk-return relationship in the cross-section return on the Nigerian Stock Exchange sectors during COVID-19. Higher risk leads to higher return and vice versa. The Akaike Information Criterion (AIC), Schwarz Criterion (SC) and the Hannan-Quinn Criterion show that the GED value is the lowest indicating its superior predictive ability of GARCH-in-Mean model estimate of cross-section risk-return relationship during COVID-19. This implies that the risk-return premium of the stock on the selected sectoral stocks is not risky to hold during COVID-19.

The variance equation indicates α_{it} and β_{it} representing the ARCH term (past day's return squared residual) and the GARCH term (past day's variance of return) respectively with ω as the constant is positive and significant at 5% under Gaussian and GED distributions. This indicates that past day return and risk (variance) are significant and positive under the Gaussian and GED distributional assumptions. The past day's return squared residual is negative and statistically insignificant under the Student's-t distribution while the past day's variance of return and the constant are negative and statistically significant under the Student's-t distribution.

Table 8. ARCH Effect and Autocorrelation Result of GED GARCH-in-Mean Model

Heteroscedasticity Test (Pooled Regression)	Value	Prob	Squared Residual	PAC	Q-Stat	Prob
F-statistics	0.100427	0.8178		-0.148	54.105	0.918
Obs*R-square	0.100444	0.8177		-0.103	80.888	0.499
				-0.100	105.17	0.547
				-0.052	112.24	0.691

Source: authors computation, 2020.

The ARCH effect and autocorrelation result in table 8 is the diagnostic result of the GED estimate suggested by the criterion as the best estimate. The result

shows that the null hypothesis of no ARCH effect and no serial correlation cannot be rejected, which confirms that the model is good and desirable for policy consideration and implementation.

Table 9. Cross-Section TGARCH/TARCH Result for Sectorial Return in COVID-19

Parameters	Gaussian Distribution		Student-t Distribution		Generalised Error Distribution	
	Estimates	P-Value	Estimates	P-Value	Estimates	P-Value
ω	0.000063	0.0000	0.104493	0.0070	0.000085	0.0000
α_{it}	0.072421	0.0000	1455.982	0.0094	1.058086	0.0000
γ_{it}	0.147225	0.0000	-383.8023	0.1403	0.140300	0.6700
β_{it}	0.785788	0.0000	0.131148	0.0000	0.514905	0.0000
AIC	-4.680251		-5.662720		-5.767163	
SC	-4.666223		-5.646353		-5.750796	
HQ	-4.675157		-5.656777		-5.761220	

S o u r c e : authors computation, 2020.

The TGARCH results of the cross-section return on the Nigerian Stock Exchange during the COVID-19 half-year is shown in table 9. The value of γ_{it} under the Gaussian Distribution is positive and significant while γ_{it} is negative and insignificant under Student's-t while γ_{it} is positive and insignificant under GED distributional assumptions. The TGARCH model specifies the estimates of $\gamma_{it} < 0$ and significant to show that bad news has more impact on return volatility than the good news of the same extent. Therefore, the cross-section volatility of return reacted more to good news than to bad news of equal extent on the Nigerian Stock Exchange during COVID-19 as shown by all the distributional assumptions.

The variance equation indicates that α_{it} and β_{it} representing the ARCH term (past day's squared residual return) and the GARCH term (past day's variance of the return) respectively and ω as the constant, are positive and significant at 1% as shown by all the distributional assumptions.

The best-fitted estimates according to the estimates of the AIC, SIC and HQ selection criteria indicate that the GED value is the lowest indicating its supe-

rior predictive ability of TGARCH estimate of news impact on cross-section returns during COVID-19. This is in agreement with the finding of Nageri (2019b).

Table 10. ARCH Effect and Autocorrelation Result of GED TGARCH/TARCH Model

Heteroscedasticity Test (Pooled Regression)	Value	Prob	Squared Residual	PAC	Q-Stat	Prob
F-statistics	0.005834	0.9391		-0.002	0.0058	0.939
Obs*R-square	0.005839	0.9391		0.004	2.0487	0.976
				-0.002	3.0607	0.996
				-0.002	0.0727	0.999

S o u r c e : authors computation, 2020.

Table 10 is the diagnostic result of the ARCH effect and autocorrelation result of the GED suggested by the criterion as the best estimate. The result specifies that the null hypothesis of no ARCH effect and no serial correlation cannot be rejected, which shows that the model is good and desirable for policy consideration and implementation.

Conclusion and Recommendations

The study examined the risk-return relationship during COVID-19 on the Nigerian Stock Exchange (NSE) using panel data of ten (10) sector index returns. Panel GARCH methodology of GARCH-in-Mean and the TGARCH models were used for the analysis. The mean and variance equations were developed in a panel form as suggested by Cermeño and Grier (2001).

Findings indicate that the return of selected ten sectorial returns exhibits a positive risk-return relationship during the period under consideration, showing that the assets are not too risky to hold. This is in agreement with the conventional view that the higher the return, the higher the risk. On the other hand, stock returns respond to good news more than they do to the bad news of a similar extent on the Nigerian Stock Exchange during COVID-19 and current-day returns respond to past returns during the period. This indicates that the Nigerian stock market is resilient and was able to resist the impact of COVID-19 contrary to findings in the advanced stock market. The reason for this may be connected to the various policy responses of the financial sector regulatory

authorities such as the Central Bank of Nigeria (CBN) and Securities and Exchange Commission (SEC) to cushion the effects of the pandemic. The top fifty listed companies, listed banks, listed insurance companies and the top forty listed have remained more attractive to investors. The performance of the other sectors (consumer goods, industrial sector, shari'ah compliant companies, companies listed on the premium board and the top thirty listed companies) can be attributed to high inflation, loss of income and growing unemployment. The oil and gas sector can be attributed to the high volatility in the price of oil throughout the world.

Finally, the study suggests that policymakers should be more sincere, ingenuine and pay more attention to the Nigerian stock market for opportunities abound in the market for post-COVID-19 economic recovery and to leverage on the ability of the market to resist the pandemic to encourage more listing on the stock market.

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