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CORONAVIRUS AND STOCK PRICES IN NIGERIA: A VECTOR AUTOREGRESSIVE MULTIVARIATE TIME SERIES ANALYSIS

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ABSTRACT: *Stock market is said to be information-driven. Thus, information on health pandemic such as the novel coronavirus disease (COVID – 19) is perceived to impact stock market indicators such as the stock price index. In view of this, this study explored the effects of positive, discharged and fatal cases of COVID – 19 on stock prices in the Nigerian Stock Exchange (NSE). This study adopts event study research design and employed Granger causality and Vector Autoregression (VAR) techniques in analyzing the weekly time series data sourced from the websites of NSE and the Nigeria Centre for Disease Control. This research covered a period of 30 weeks, beginning from Monday, March 2, 2020 and ending Friday September 25, 2020. Empirical findings suggest no evidence of causality between coronavirus and stock prices in Nigeria. Furthermore, the study found that COVID-19 discharged and fatal cases have positive effects on stock prices in Nigeria while the effect of the confirmed cases is negative. None of the measures of coronavirus was statistically significant in explaining stock prices in Nigeria. It can therefore be concluded that coronavirus does not constitute a significant determinant of stock price movement in Nigeria in the study period. It is suggested that future studies should interact coronavirus measures with other variables and examine their effects on stock market performance.*

KEYWORDS: Coronavirus, COVID-19, Discharged Cases; Confirmed Cases, Fatal cases, All-share index, Stock Prices, Stock market.

INTRODUCTION

The stock market is a segment of the financial market where long term funds packaged in the form of securities, such as shares, stocks bonds, debentures, loan stocks, and derivatives, are traded. The market is information driven, thus its indicators such as price index, returns, volatility, market capitalization, etc., are believed to be potentially influenced by the availability of information in the market.

Since the outbreak of coronavirus disease (COVID-19) in China late December 2019, and the subsequent spread to other countries, up to 216 including Nigeria, no affected nation has been left the same. Ibrahim S.G. (2020) argues COVID-19 to be one of the deadliest viruses that affect the entire humanity in all spheres of life. In that light, Ali (2020) notes that the disease is not a mere public health issue but a crisis that touches every sector. It has effects on every aspects of human life including mental and psychosocial well-being (Ibrahim A., 2020; Macapagal, 2020), political and social aspect of human race (Ibrahim S.G., 2020), as well as economic life of people (AC-Ogbona, 2020; Kajo et al., 2020; Ozili, 2020), to mention but a few.

Expatiating the economic effects of the virus, Ibrahim S.G. (2020) reiterated the effects of the pandemic on employment, productivity, supply chains, imports, exports and other trading activities, thus leading to a decline in gross domestic product. According to He et al. (2020), coronavirus caused China's stock market to fluctuate resulting in spill-over effects on other stock markets due to the breadth and depth of interdependence among contemporary economies. The Nigerian stock market also has not been left badly untouched by the virus (Kajo et al., 2020). Of particular interest in this study is the effect of the virus on the general price movement in the stock market. According to Suharsono, et al. (2017), stock price index indicates the current stock price movement, market trends and conditions at a time, whether the market is active or lethargic. This indicator is very important in determining the overall performance of the market, for instance in the areas of returns, volatility. Stock market as a barometer of the health of an economy, has been established in empirical literature to spur economic growth of countries, such as Nigeria (Abina & Lemea, 2019; Acha & Akpan, 2019; Atoyebi, et al., 2013; Edame & Okoro, 2013; Ologunwa & Sadibo, 2016). This study is timely and germane as it seeks to evaluate how coronavirus information affect the overall movement in the prices of stocks in Nigeria.

Stylized Facts on Coronavirus Disease (COVID-19)

According to the Nigeria Centre for Disease Control [NCDC] (2020), the coronavirus disease has the origin of its outbreak in Wuhan, Hubei Province, China in late December 2019 but the first confirmed case was reported from the country in January 2020. On 27th February, 2020, a 44-year old Italian citizen was diagnosed of COVID-19 in Lagos State, Nigeria. The case is the first to be reported in Nigeria since the first confirmed case was reported from China. According to NCDC (2020), the case arrived the Murtala Muhammed International Airport, Lagos at 10pm on 24th February 2020 aboard Turkish airline from Milan, Italy and traveled to his company site in Ogun state on 25th February 2020. From this importation, the virus has continued to spread like wildfire to different parts of Nigeria, including all the 36 states and the Federal Capital Territory (FCT).

As at 25th September, 2020, all 36 states and the FCT in Nigeria, have reported a confirmed case of COVID-19. On the same date, there were 213 new confirmed cases from 17 states in Nigeria. 508 discharges were reported in ten states with only two deaths. On the same date, there was a total confirmed cases of 58,062 and total discharged cases standing at 49,606. Nigeria had a total fatal cases of 1103 which ultimately left the total active cases to be 7353. Out of the total confirmed cases, 64% (36933) are males while female gender constitutes the remaining 36% (21,129). Based on the provenance statistics, 984(1.7%) of the cases have travel history, contacts-oriented cases are 15,500 (26.7%) and the unknown exposure takes 71.6% (41, 578) share of the total confirmed cases (NCDC, 2020). Furthermore, the COVID-19 situation report shows that globally, on 25th September, 2020, 216 countries and territories of the world including Nigeria, were infected with the virus. On this date, there was a total of 32,110,656 confirmed cases in the world, with total 980,031 deaths.

Figure 1 shows the distribution of the coronavirus across the 36 states and FCT, Nigeria as at 25th September, 2020. In ranking according to prevalence, Lagos state had the highest number of confirmed cases (19174) and followed by FCT (5,644), Plateau State (3,373) and Oyo State (3,248) in that order. The state with the least number of confirmed cases was Kogi State (5), followed by Yobe State (75) and Zamfara State (78) in that order.

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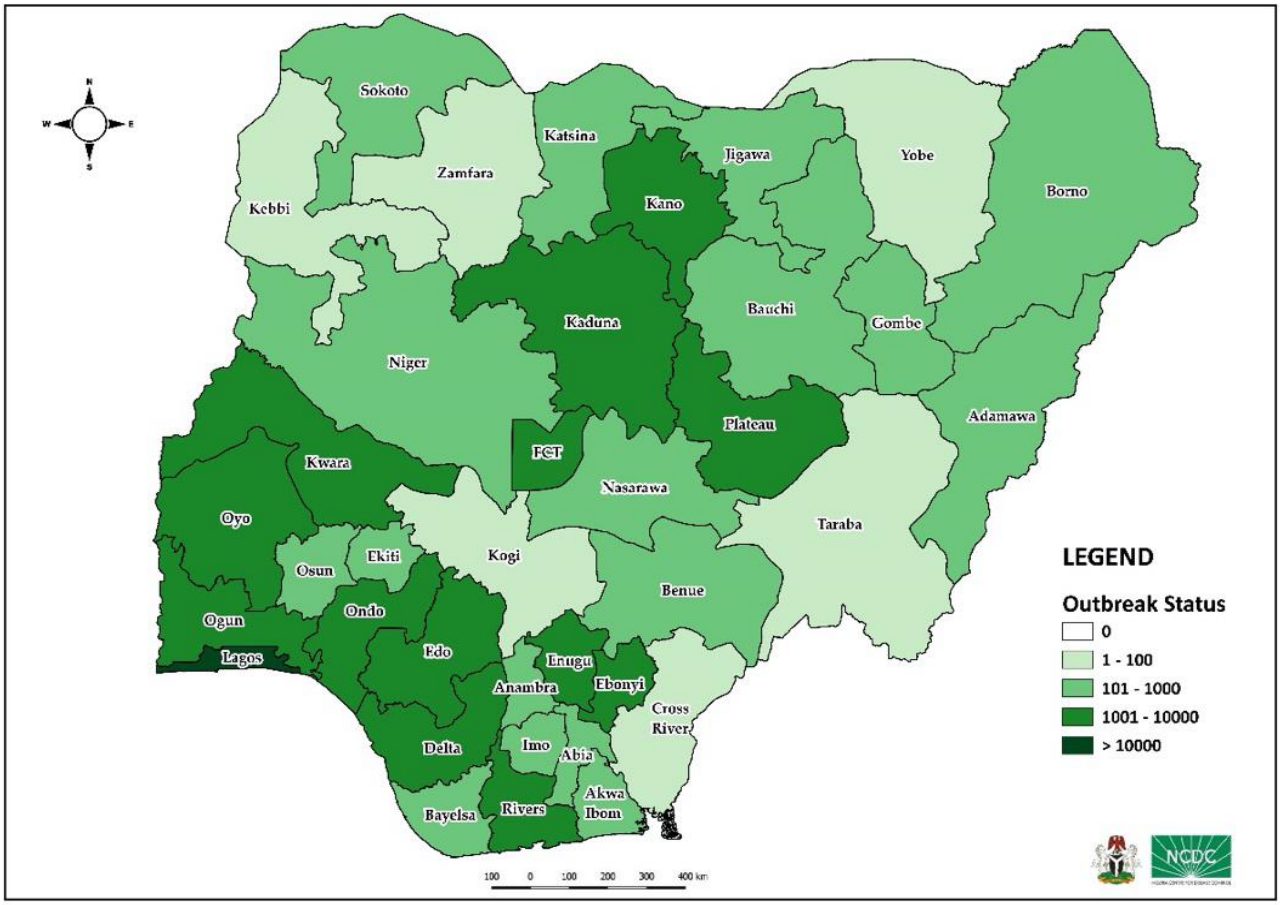

Figure 1: Map of Nigeria Showing 36 States and FCT Affected by COVID-19 as at Midnight 25th September, 2020

Source: NCDC (2020)'s COVID-19 Situation Report.

Objectives of the Study

The central aim of this study is to investigate the effect of coronavirus on stock prices in Nigeria by applying the Vector Autoregressive (VAR) model. Specifically, this study aims to determine the effect of new confirmed, discharged and fatal cases of COVID-19 on stock prices in the Nigerian capital market.

This paper is organized as follows. The first section contains the introduction as well as stylized facts on coronavirus disease. Section two focuses on reviewing empirical literature on coronavirus and stock market nexus. This is followed by the methodology of the study. The penultimate section of this paper presents and discusses data analyses. The last section contains the conclusion of the study.

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EMPIRICAL LITERATURE REVIEW

Coronavirus disease is a current burning issue of empirical significance. This section reviews some empirical literature on the link between the virus and stock market performance in both developed and developing countries. For instance, in Pakistan, Ahmed (2020), explored the effect of COVID-19 related positive cases, fatalities, and recovered cases on the closing prices of Pakistani stock exchange in the first half of 2020. The study found that only COVID-19 recoveries have significant influence on the performance of the index while daily positive cases and fatalities are insignificantly related to the performance. In a related study, Waheed, et al. (2020) concluded that confirmed cases has positive effect on returns listed on the Karachi stock exchange.

In another study carried out by Chaouachi and Chaouachi (2020) on the impact of covid-19 on Saudi stock market. The authors showed an evidence of a negative impact of COVID-19 on stock market only in the long-run with a unidirectional causality flowing from the former to the latter. In a related study, Ngwakwe (2020) examined the differential effect of coronavirus epidemic on selected global stock markets (China, Europe and USA). The study showed that only the Chinese Composite Index showed resilience to the pandemic while USA and Europe indices were negatively affected by the virus.

Furthermore, He et al. (2020) explored the effect of coronavirus on stock markets in China, Italy, South Korea, France, Spain, Germany, Japan and the USA. The study showed that coronavirus had a negative but short-term impact on stock markets of affected countries with bidirectional spill-over effects between Asian countries and European and American countries. In a study based on event study methodology, Liu et al. (2020) evaluated the short-term impact of the coronavirus outbreak on 21 leading stock market indices in major affected countries including Japan, Korea, Singapore, the USA, Germany, Italy, and the UK etc. The study indicated that coronavirus had a significant negative effect on stock market returns across all affected countries and areas.

In Nigeria, Alade et al. (2020) applied the VAR model to the investigation of the connection between COVID-19 confirmed cases and the stock market capitalization. The study submited that the announcement of global and Africa confirmed cases of COVID-19 had negative but non-significant effect on stock market capitalization in Nigeria while the effect of Nigerian cases on market capitalization are mixed but still statistically non-significant. In a study on effect of Covid-19 100thday information on health firms' stock returns in Nigeria, Ikwuagwu et al. (2020) showed an evidence of a positive abnormal return for health firms in the period.

In summary, the existing literature on the nexus between stock market and COVID-19 is basically scanty in developing country like Nigeria. This current contributes to the relatively few existing study on the subject matter in Nigeria. This study makes contribution by using a more recent and extensive observations, spanning a period of 30 weeks. The study also applies VAR method, a multivariate time series analytic technique that is not restricted by economic theory. Direction of causality between coronavirus and stock prices is also another unique contribution of this study to existing literature.

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METHODOLOGY

Research Design and Data

This study adopts event study approach with ex-post facto design. Event study approach is considered suitable because specific event, in this case, the coronavirus outbreak, is examined in line with its effect on subject of interest, such as the stock price. In the same vein, past data on coronavirus, which cannot be manipulated, were examined vis-a-vis historical data on stock prices in order to establish relationship and causality between coronavirus and general price movement in the Nigerian stock market. The secondary data on weekly basis, on stock prices were obtained from the Nigerian Stock Exchange (NSE)'s website while data on coronavirus, were obtained from the NCDC's website. This study covers a period of 30 weeks, beginning from Monday, March 2, 2020 and ending penultimate week of September 2020 (that is, Friday September, 25, 2020).

Estimation Technique and Procedure

The estimation technique of the study is the Vector Autoregression (VAR) model. In additional to being used for data description, estimation and forecasting, VAR is also adjudged (Suharsono, 2017) to be flexible and simple model for multivariate time series data which is autoregressive in nature. It can also be used to measure short-term changes in variables and also has stronger forecasting capacity (Cuvak & Kalinauskas, 2009). In VAR model, all variables are regarded endogenous. Hence, each variable is expressed as dependent upon its lag value and the lagged value of other variables in the model.

Just like most other models, in VAR model, stationarity of data is key (Garcıa-Ascanio & Mate, 2010; Suharsono et al., 2017). However, if the time series are found to be non-stationary, the order of integration is ascertained and the stationary form of the variable is added to the VAR model (Garcıa-Ascanio & Mate, 2010). In addition to need for stationarity of variables, the error terms are required to be normal and independent in VAR modelling **(**Suharsono et al., 2017).

In the estimation procedure, generally, the six-stage estimation procedure for VAR as suggested by Suharsono et al. (2017) is adapted in this study. According to the scholars, the steps to perform a VAR are: test of stationarity of data and degree of integration; determination of lag length; granger causality test; VAR model estimation; variance decomposition; and forecasting.

In this study, after descriptive analysis, via summary statistics and trend analysis using line graph, test of stationarity of each variable was carried out based on augmented Dickey-Fuller (ADF) test. This same test indicates the order of integration. Testing the independence of errors is made via of graph of residual plot. According to Suharsono, et al. (2017), if the residual point in the plot there is a clear pattern, it can be said that the error term is independent. Optimum lag length was determined using VAR lag selection criteria. Granger causality test was also carried out within the VAR framework. This is to further buttress the eventual output of the VAR estimation. Then comes the VAR estimation proper. While the complete result of the VAR is included in the Appendix, only variable of interest is reported in the body of the work (see Table 7). Thereafter, Variance Decompositions (VD) and Impulse Response Function (IRF) were reported.

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Model Specification

Following the model of Ahmed (2020), this study specified the functional relationship between coronavirus (measured as confirmed, discharged and fatal cases) and stock prices, measured as the weekly NSE All-share index. This study is different from Ahmed (2020)'s in terms of geography (Nigeria as against his Pakistan) and frequency of data set (weekly as against his daily data sets). Furthermore, his study was based on OLS, but this current study employs the multivariate Vector Autoregressive method (VAR). The VAR models for this study are specified in equations (1) to (4) below.

$$ASI_t = ASI_{t-1} + CNNCC_{t-1} + CNNDC_{t-1} + CNNFC_{t-1} + u_{t1} \quad (1)$$

$$CNNCC_t = CNNCC_{t-1} + ASI_{t-1} + CNNDC_{t-1} + CNNFC_{t-1} + u_{t2} \quad (2)$$

$$CNNDC_t = CNNDC_{t-1} + ASI_{t-1} + CNNCC_{t-1} + CNNFC_{t-1} + u_{t3} \quad (3)$$

$$CNNFC_t = CNNFC_{t-1} + ASI_{t-1} + CNNNC_{t-1} + CNNDC_{t-1} + u_{t4} \quad (4)$$

Where;

ASI_t indicates the weekly closing prices of stocks at the Nigerian Stock Exchange,

$CNNCC_t$ denotes the weekly new number of confirmed cases of COVID-19 in Nigeria,

$CNNDC_t$ represents the weekly new number of COVID-19 discharged cases in Nigeria,

$CNNFC_t$ signifies the new number of weekly COVID-19 fatal cases and u_{t1-4} denote the error terms.

RESULTS AND DISCUSSION

Descriptive Analysis

The statistical behaviour of the variables presented in Table 1 shows that the average weekly price of shares in the Nigerian Stock Exchange (ASI) stands at 24275.06 points during the 30 weeks of study. With a minimum of 21094.62, ASI hikes to a maximum of 26319.34 points in the period while its standard deviation is 1417.226. The share price is however negatively skewed (-0.767266), though has its kurtosis roughly 2. The Jarque-Bera (3.156307) with a probability value (0.206356) higher than the ideal p-values (1%, 5% and 10%), then the prices are said to be normally distributed. This normality is also corroborated by the its kurtosis (2.587379) of around 3.

Table 1 further indicates the average number of new confirmed (positive) cases of coronavirus in Nigeria (CNNCC) to be 1944, the average number of discharged (recover) cases (CNNDC) stands at 1660 and the average fatalities are 37 on weekly basis. The confirmed cases ranges between a minimum and maximum of 1 and 4593 respectively. This is unlike the fatalities and recoveries that have a minimum of 0 case each but their respective maximum remains 100 and 13633 persons respectively.

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Unlike the share prices (ASI) that is negatively skewed, the three indicators of coronavirus in this study (CNNCC, CNNDC and CNNFC) are positively skewed. However, while other measures (CNNCC and CNNFC) are roughly 0, only CNNDC has its skewness coefficient to be 3.626173.

With kurtosis of less than 1, both CNNCC and CNNFC are said to be platykurtic while CNNDC (kurtosis=17.64146) is said to be leptokurtic in nature. Based on their respective J-B statistic, both CNNCC and CNNFC are said to pass normality test. This is unlike CNNDC considered to be normally distributed, considering its J-B's p-value (0.0000) of less than 1%. Generally, with each average value less than their respective standard deviation value, all the variables of study are regarded as relatively stable over the 30-week study period.

Table 1: Descriptive Statistics

	Mean	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Prob.	N
ASI	24275.06	26319.34	21094.62	1417.226	-0.767266	2.587379	3.156307	0.206356	30
CNNCC	1944.133	4593.000	1.000000	1501.699	0.229660	1.806083	2.045515	0.359602	30
CNNDC	1659.833	13633.00	0.000000	2543.087	3.626173	17.64146	333.7111	0.000000	30
CNNFC	36.90000	100.0000	0.000000	28.80894	0.322662	1.972143	1.841169	0.398286	30

Source: Author's estimation using Eviews version 10, (2020).

Trend Analysis

The trend analysis share prices (ASI) in the Nigeria between first week in March and penultimate week in September is depicted in Figure 1. The line graph shows that at beginning of the public declaration of the coronavirus in Nigeria, stock prices were initially high but began declining drastically from the second week in March 2020 until it reaches its minimum so far in the 30-week period in the 5th week. It however picked up as from the 6th week and rose steadily up to the 12th week and also declined marginally until the 20th week. It then began to rise again from 21st week and this marginal rise trend continues till the 30 week of the study. This believed to be sustained in the future too, *ceteris paribus*.

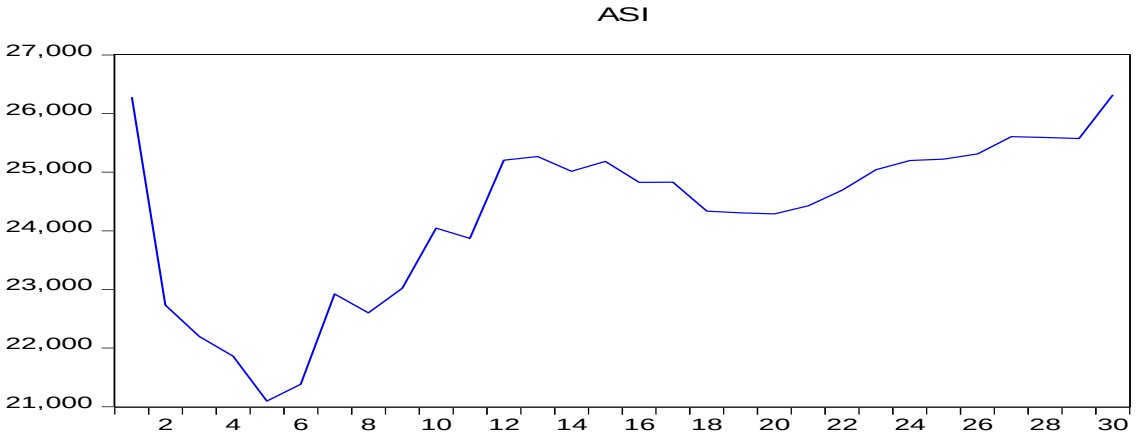

Figure 1: Trend of All-share index in the Nigerian Stock Exchange (W1:02:2020-W3:09:2020)

Source: Author's design using Eviews version 10, (2020).

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Furthermore, the trend analysis of the confirmed, discharged and fatal cases of coronavirus in Nigeria over the 30-week study period is reported in Figure 2. The near flat plot of the coronavirus new fatal cases for the weeks implies the low level of fatalities compared with the confirmed (positive) cases in Nigeria. The trend of the new confirmed cases was very low at the beginning but from the 7th week it commenced to rise steadily until its peak in around the 17th week. The rate of recovery which began only after the 6th week was very slow. However, more discharged cases were recorded as time went by. There was a great recovery recorded from the 22nd through 24th week of the study. The implication of this is that by the surge in discharged cases, the active cases will reduce substantially. As can be seen there is decline in both confirmed cases as well as the fatalities as from the 23rd week of this study.

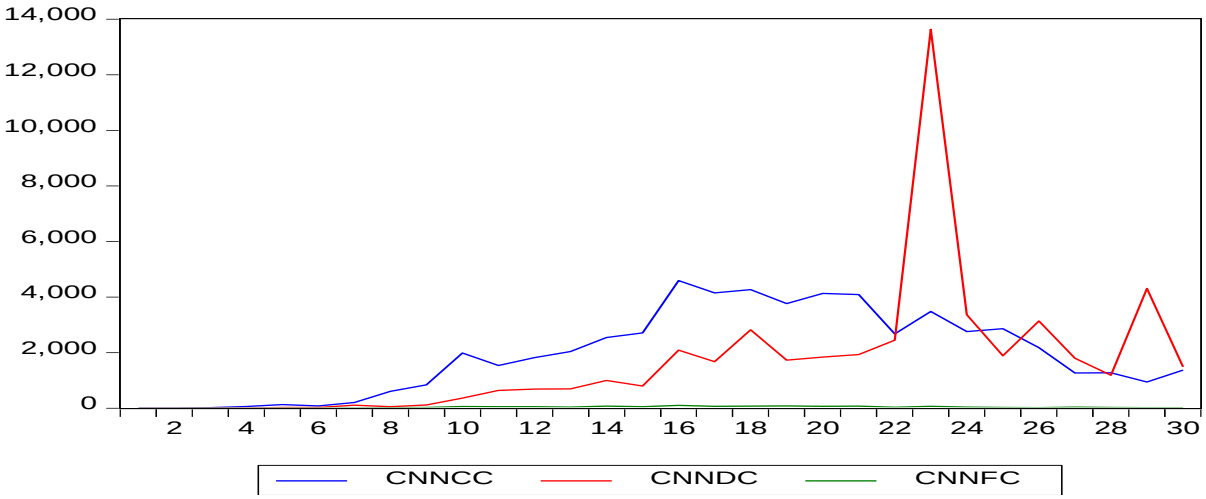

Figure 2: Trend of Confirmed, Discharged and Fatal cases of coronavirus in Nigeria (W1:02:2020-W3:09:2020)

Source: Author's design using Eviews version 10, (2020).

Stationarity Analysis

In additional to be test of stationarity, the augmented Dickey-Fuller (ADF) test was also employed to determine the order of integration of the variables. The result as reported in Table 2 shows that only two out of the four variables (ASI and CNNDC) are stationary (in levels) while the two (CNNCC and CNNFC) are not but became stationary at first difference.

Table 2: Augmented Dickey-Fuller (ADF) Test

Null Hypothesis: ASI, CNNCC, CNNDC, CNNFC has a unit root							
		t-Statistic	**1%**	**5%**	**10%**	**Prob.***	**I(d)**
ADF test statistic:	ASI	-3.153723	-3.711457	-2.981038	-2.629906	0.0348**	I(0)
ADF test statistic:	CNNCC	-6.208534	-3.689194	-2.971853	-2.625121	0.0000***	I(1)
ADF test statistic:	CNNDC	-3.838107	-3.679322	-2.967767	-2.622989	0.0068***	I(0)
ADF test statistic:	CNNFC	-9.308471	-3.689194	-2.971853	-2.625121	0.0000***	I(1)

Source: Author's estimation using Eviews version 10, (2020).

Note: ***, ** and * rejection of the hypothesis of presence of unit root at 1%, 5% and 10% levels respectively, when the p-value is less than 1%, 5% and 10%.

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Optimum Lag Selection

The optimum lag for estimating the model, results of which is presented in Table 3 shows that all criteria unanimously suggests lag order 1 as the optimum lag for model estimation in this study. This is based on the fact that information criterion with the smallest value constitutes the optimum.

Table 3: VAR Lag Order Selection Criteria

Endogenous variables: ASI D(CNNCC) CNNDC D(CNNFC)						
Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	-804.4269	NA	1.19e+21	59.88347	60.07545	59.94056
1	-766.8277	61.27269*	2.45e+20*	58.28353*	59.24341*	58.56896*
2	-759.3997	9.904037	5.06e+20	58.91849	60.64628	59.43226
* indicates lag order selected by the criterion						

Source: Author's estimation using Eviews version 10, (2020).

Note: LR: sequential modified LR test statistic (each test at 5% level); FPE: Final prediction error; AIC: Akaike information criterion; SC: Schwarz information criterion; HQ: Hannan-Quinn information criterion

Granger Causality Analysis

The VAR Granger causality/block exogeneity Wald tests is presented in Table 4. The result of the causality shows no evidence of causality between coronavirus and stock prices in Nigeria. This is based on the fact that the Wald test statistics report p-value higher than even 0.10 level of significance. This led to non-rejection of no causality between coronavirus and stock prices. However, there was a unidirectional causality, flowing from coronavirus fatal cases (CNNFC) to coronavirus discharged cases (CNNDC). This is based on The Wald test statistics with p-value (0.0713) lower than 10% which leads to rejection of the null hypothesis of no causality between CNNF and CNNDC.

Table 4: VAR Granger Causality/Block Exogeneity Wald Tests

Dependent variable: ASI				
Excluded	**Chi-sq**	**Df**	**Prob.**	**Decision**
D(CNNCC)	1.061075	1	0.3030	$CNNCC \nRightarrow ASI$
CNNDC	0.233729	1	0.6288	$CNNDC \nRightarrow ASI$
D(CNNFC)	0.409822	1	0.5221	$CNNFC \nRightarrow ASI$
Dependent variable: D(CNNCC)				
Excluded	**Chi-sq**	**Df**	**Prob.**	**Decision**
ASI	0.000391	1	0.9842	$ASI \nRightarrow CNNCC$
CNNDC	1.515954	1	0.2182	$CNNDC \nRightarrow CNNCC$
D(CNNFC)	1.159914	1	0.2815	$CNNFC \nRightarrow CNNCC$
Dependent variable: CNNDC				
Excluded	**Chi-sq**	**Df**	**Prob.**	**Decision**
ASI	1.386014	1	0.2391	$ASI \nRightarrow CNNDC$
D(CNNCC)	0.426164	1	0.5139	$CNNCC \nRightarrow CNNDC$
D(CNNFC)	3.253434	1	0.0713*	$CNNFC \Rightarrow CNNDC$

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Dependent variable: D(CNNFC)				
Excluded	**Chi-sq**	**Df**	**Prob.**	**Decision**
ASI	0.328848	1	0.5663	$ASI \nRightarrow CNNFC$
D(CNNCC)	0.249477	1	0.6174	$CNNCC \nRightarrow CNNFC$
CNNDC	0.563496	1	0.4529	$CNNDC \nRightarrow CNNFC$

Source: Author's estimation using Eviews version 10, (2020).

Note: $\nRightarrow$ denotes no causality; $\Rightarrow$ signifies unidirectional causality

Vector Autoregression Analysis

Traditionally, the VAR model is applicable when the series are of the same order of integration but not mixed order. Thus, this study differenced the two non-stationary variables (CNNCC and CNNFC) to make them stationary, thus bringing all the four variables on the level of stationarity. This is in line with the postulate of Garcıa-Ascanio and Mate (2010). The result of the VAR model of the effects of coronavirus' new confirmed cases (CNNCC), new discharged cases (CNNDC) and new confirmed cases (CNNCC), on stock prices in the Nigeria are shown in Table 5.

The Table (5) indicates that lag 1 of stock price (ASI(-1) has positive and significant effect on its itself in original(level) form. This implies the autoregressive nature of stock prices in the market. In order words, the past prices tend to dictate the current prices of stocks in Nigeria. Lag 1 of the differenced confirmed cases of coronavirus [D(CNNCC(-1)] has negative (-0.233695) and non-significant (p-value=0.3057) effect on stock prices in Nigeria. This suggests that information on positive cases of coronavirus is negatively associated with share prices but this association is not statistically significant. However, both discharged cases and fatalities resulting from coronavirus are positively related with share prices though neither of them is statistically significant. The one week lagged coronavirus discharged cases (CNNDC(-1)) with a coefficient of 0.022365 and an associated p-value (0.6299) higher than ideal p-values (1%, 5% and 10%), suggests that coronavirus discharged cases has the potential to increase share prices in Nigeria but this is not found to be statistically significant. With a coefficient (4.586094) and p-value (0.5237) exceeding even 10%, the lagged fatal cases of coronavirus in its differenced [D(CNNFC(-1)], has positive effect on All-share index in Nigeria but its impact is not statistically significant over the study period.

In summary, the non-statistical significance of the two measures of coronavirus suggest that, though potentially encouraging, discharged and fatal cases of coronavirus are not significant determinants of stock prices in Nigeria. In the same vein, though potentially discouraging, confirmed cases of coronavirus, like the fatal and discharged cases, are not determinants of changes in the prices of shares in the Nigerian stock market. The overall result shows goodness of fit of the VAR model with R squared of 0.866402 and statistically significant at 0.01 level. This indicates that systemic variation in endogenous variables are explained by its own lag and the lag of other endogenous variables. At the same time the magnitude of R squared adjusted is 0.843167 after adjusting for the degrees of freedom.

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Table 5: Vector Autoregression Estimates

Variables	Coefficient	Standard Error	t-statistic	p-value	Result
ASI(-1)	0.925753	0.08801	10.5183	0.0000	Positive, significant at 1%
D(CNNCC(-1))	-0.233695	0.22687	-1.03008	0.3057	Negative, non-significant
CNNDC(-1)	0.022365	0.04626	0.48346	0.6299	Positive, non-significant
D(CNNFC(-1))	4.586094	7.16383	0.64017	0.5237	Positive, non-significant
Constant	1885.987	2092.24	0.90142	0.3697	Positive, non-significant
R-squared	0.866402				
Adj. R-squared	0.843167				
F-statistic	37.28943				

Source: Author's estimation using Eviews version 10, (2020).

Post-Estimation Diagnostics

The post-estimation diagnostic tests results are reported in Table 6 and Fig. 3. As shown in Table 6, by the VAR residual heteroscedasticity's Chi-square statistic (72.25366) and associated high p-value (0.7191), the hypothesis of absence of residual heteroscedasticity is not rejected. This suggests that the model is homoscedastic. In the same vein, the VAR residual serial correlation LM test statistics (LRE=10.07854 and Rao F-stat= 0.604160) and an associated p-value for each t-statistic (0.8652), also means that the hypothesis of no serial correlation cannot be rejected. This means that the VAR model does not suffer serial correlation problem. This absence of serial correlation of the residuals is further buttressed by the VAR residuals plotted in Figure 3 which indicates a clear pattern. The VAR residual normality test has a J-B value of 144.3386 and an associated p-value (0.0000) of less than 1% significance level. This implies that the null hypothesis of normality of the model is rejected at 1% level. Lütkepohl (2006) argues that non-normality does not invalidate many of the statistical procedures in VAR models, improvement in the model is however possible. Despite the lack of normality of the model, its estimates are not invalid.

Table 6: Post Estimation Diagnostic Tests

Diagnostic Tests of:	Test statistics	P-value
VAR Residual Heteroscedasticity	Chi-sq: 72.25366	0.7191
VAR Residual Serial Correlation LM	LRE stat : 10.07854	0.8625
	Rao F-stat : 0.604160	0.8652
VAR Residual Normality	J-B: 144.3386	0.0000

Source: Author's estimation using Eviews version 10, (2020).

Since the residuals (error term) of the variables in the VAR shows a clear pattern in the plots in Figure 3, it can be said that the error terms are independent (that is, they are serially correlated).

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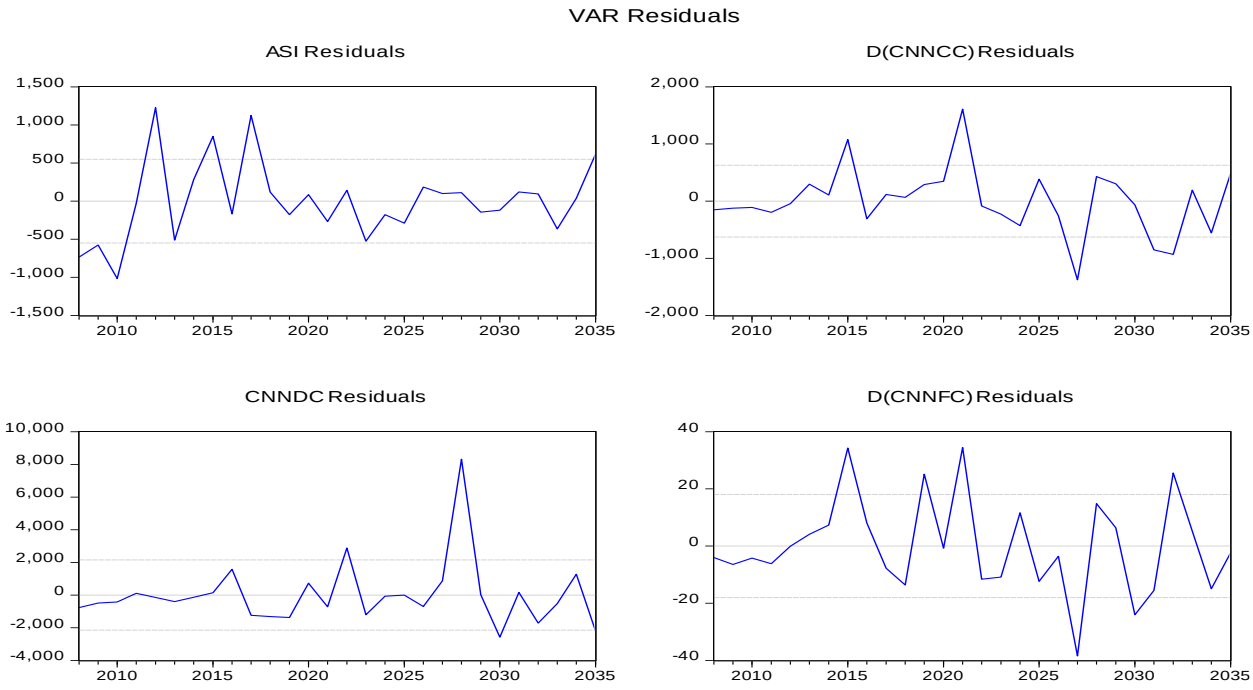

Figure 3: Plot of VAR Residuals

Source: Author's estimation using Eviews version 10, (2020)

Variance Decomposition Output

The Variance Decomposition (VD) is used for forecasting. Hence, the output of the VD for ASI is presented in Table 7 below. According to the VD, in the ninth period, all-share index(ASI) contributes 92% to own variation. Among the three explanatory variables, COVID-19 new confirmed cases (CNNCC) impacts stock prices the most, with 4%. In the same period (ninth period), the variable that accounts for the next most significant changes in stock prices (ASI), is COVID-19 new discharged cases (CNNDC). This has a contribution of about 3%. The variable with least contribution of roughly 1%, to variation in stock prices is COVID-19 new fatal cases (CNNFC). Generally, all the three measures of coronavirus (CNNDC, CNNCC and CNNFC) contribute positively to the variation in stock prices (ASI).

Furthermore, by extrapolation using VD, this study forecasts the behavior of stock prices in Nigeria up till the 60th period, which is around early April, 2021. This positive trend is likely to be sustained for a very long period even beyond the current study period. Specifically, in the 60th week, ASI contributes 90% to own shock while shock to CNNCC impacts stock prices positively of about 5% in its variation. Shock to CNNDC contributes 4% of variation in stock price while 1% variation in stock prices is attributed to shocks in CNNFC. Both short run evidence and long run forecasts of stock prices in Nigeria based on VD technique agree that rather than negative, coronavirus is likely to bring about a rise in stock prices in the country. By this, it is projected that a positive increase will continue in respect of stock prices in the Nigerian stock market.

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Table 7: Variance Decomposition Output for Stock Prices (ASI)

Period	S.E.	ASI	D(CNNCC)	CNNDC	D(CNNFC)
1	548.7678	100.0000	0.000000	0.000000	0.000000
2	755.2524	97.10739	1.630655	0.488043	0.773909
3	898.1423	95.54251	2.576059	1.181716	0.699714
4	1009.349	94.41834	3.156414	1.742338	0.682908
5	1099.156	93.63299	3.580958	2.139178	0.646875
6	1173.639	93.07780	3.862777	2.430575	0.628849
7	1236.322	92.67136	4.075371	2.642150	0.611118
8	1289.721	92.36699	4.230331	2.802826	0.599856
9	1335.570	92.13215	4.351769	2.926066	0.590012
10	1375.206	91.94743	4.446167	3.023558	0.582848
20	1580.219	91.20123	4.829245	3.416699	0.552823
30	1640.537	91.03306	4.915542	3.505324	0.546074
40	1659.412	90.98416	4.940633	3.531092	0.544111
50	1665.419	90.96895	4.948440	3.539109	0.543501
60	1667.340	90.96412	4.950919	3.541655	0.543307
Cholesky Ordering: ASI D(CNNCC) CNNDC D(CNNFC)					

Source: Author's estimation using Eviews version 10, (2020).

Impulse Response Function

The Impulse Response Function (IRF) of share prices in Figure 4 indicates that share prices reacts positively to shocks in itself over the study period. However, any shock to COVID-19 new confirmed cases (CNNCC) sends a negative signal to stock prices in Nigeria. Just ASI own shock reaction, the IRF reveals that stock prices respond positively to shocks from COVID-19 new discharged cases (CNNDC) and COVID-19 new fatal cases (CNNFC). This implies that shocks to COVID-19 fatalities and recoveries exert the same positive influence on stock prices in Nigeria over the study period.

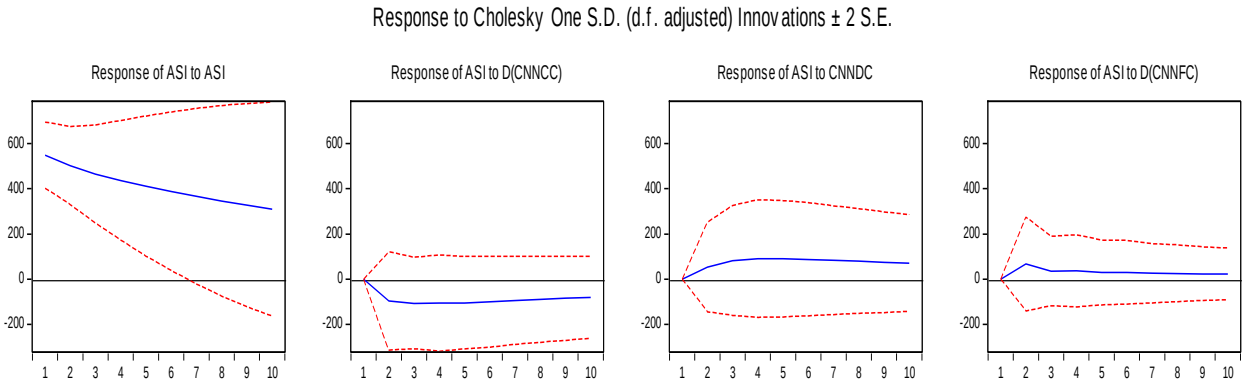

Figure 4: Impulse Response Function of Share Prices in Nigeria

Source: Author's estimation using Eviews version 10, (2020).

CONCLUSION

In a 30-week event study, this study investigated the number of fatal, positive and recovered cases of coronavirus in Nigeria and their effects on stock prices. Evidence from the Granger causality analysis suggests no evidence of causality between coronavirus and share prices in Nigeria. The VAR results indicate that confirmed cases of coronavirus have negative and non-significant effect on stock prices in Nigeria. This implies that information on positive cases of coronavirus is negatively associated with share prices but this association is not statistically significant. However, coronavirus' discharged and fatal cases have positive effect on stock prices, though neither of them is significant statistically. This study therefore concludes that coronavirus (positives, fatalities and recoveries) are not significant determinants of changes in the prices of stocks in the Nigerian stock market. The study projects via variance decomposition technique a positive increase in the share prices in Nigeria if the current tempo is improved upon or continues till the 60th week which is around early April, 2021. This is a good sign for investors to invest in the market as the market bounces back on a track of bullish tendency.

Further studies can be carried out on stock market and coronavirus nexus, by incorporating macroeconomic variables.

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APPENDIX

Vector Autoregression Estimates				
Date: 10/08/20 Time: 12:03				
Sample (adjusted): 3/01/2008 3/01/2035				
Included observations: 28 after adjustments				
Standard errors in ( ) & t-statistics in [ ]				
	ASI	D(CNNCC)	CNNDC	D(CNNFC)
ASI(-1)	0.925753	-0.001990	0.406395	-0.001662
	(0.08801)	(0.10069)	(0.34519)	(0.00290)
	[10.5183]	[-0.01977]	[1.17729]	[-0.57345]
D(CNNCC(-1))	-0.233695	0.009932	-0.580870	0.003732
	(0.22687)	(0.25954)	(0.88980)	(0.00747)
	[-1.03008]	[0.03827]	[-0.65281]	[0.49948]
CNNDC(-1)	0.022365	-0.065163	0.284706	-0.001144
	(0.04626)	(0.05292)	(0.18144)	(0.00152)
	[0.48346]	[-1.23124]	[1.56913]	[-0.75066]
D(CNNFC(-1))	4.586094	-8.826572	-50.67944	-0.600545
	(7.16383)	(8.19557)	(28.0971)	(0.23595)
	[0.64017]	[-1.07699]	[-1.80373]	[-2.54525]
C	1885.987	214.6100	-8467.238	42.84697
	(2092.24)	(2393.56)	(8205.89)	(68.9097)
	[0.90142]	[0.08966]	[-1.03185]	[0.62178]
R-squared	0.866402	0.177426	0.413449	0.346478
Adj. R-squared	0.843167	0.034370	0.311440	0.232823
Sum sq. resids	6926360.	9065096.	1.07E+08	7513.537
S.E. equation	548.7678	627.8014	2152.306	18.07417
F-statistic	37.28943	1.240254	4.053074	3.048485
Log likelihood	-213.5912	-217.3586	-251.8566	-118.0219
Akaike AIC	15.61366	15.88276	18.34690	8.787277
Schwarz SC	15.85155	16.12065	18.58479	9.025171
Mean dependent	24258.53	48.82143	1778.393	0.500000
S.D. dependent	1385.702	638.8764	2593.780	20.63528
Determinant resid covariance (dof adj.)		1.14E+20		
Determinant resid covariance		5.20E+19		
Log likelihood		-794.5027		
Akaike information criterion		58.17876		
Schwarz criterion		59.13034		
Number of coefficients		20		