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How have COVID-19 Confirmed Cases and Deaths Affected Stock Markets? Evidence from Nigeria

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ABSTRACT

This study assesses the effect of COVID-19 proxied by the number of confirmed cases of the infection and deaths on Nigeria's stock market over the 23rd March to 11th September 2020 period using the autoregressive distributed lag (ARDL), canonical cointegrating regression (CCR), dynamic ordinary least squares (DOLS) and fully modified ordinary least squares (FMOLS) techniques. The bounds test to cointegration result reveals that a long-run relationship exists between COVID-19 and Nigeria's stock market (along with oil prices and exchange rate). The results of the various estimations demonstrate that COVID-19 (proxied by the number of confirmed cases of infection) has a negative and significant impact on stock market performance, while the number deaths has a positive and significant impact on the market in the long-run. In addition, oil prices and exchange rate have a significant and positive effect on stock market performance in the long-run. Similar results were found for sub-sectors including consumer goods and healthcare sub-sectors of the stock market. The study recommends policies to curb the spread of the virus.

KEY WORDS: COVID-19, confirmed cases, deaths, stock market, Nigeria.

JEL Classification: D53, E44, G14, I15.

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1. Introduction

Health disasters, like the coronavirus disease (COVID-19) that is ravaging countries across the world, do not only have an undesirable effect on individuals' health conditions - it can also leave negative social and economic impacts that last for years. COVID-19 which started in the city of Wuhan in China in December 2019, later declared as a pandemic on the 11th March 2020 (Williams & Kayaoglu, 2020), has continued to pose major threats to the global community with increasing number of infections and deaths both in developed and developing countries. Till date around 60 million persons have been infected by (or tested positive to) the virus with over 1,400,000 deaths reported. Although more than 40 million infected persons have been treated and recovered, the lack of a potent vaccine for the virus implies that the worst days of the pandemic might not be over.

Following the outbreak of the disease, international organizations and scholars predicted/projected job losses, reductions in trade, exports and foreign direct investment (FDI), shrinking GDP or economic contraction, decline in stock market activity and increase in the number of poor, among other things (see Hanspal et al., 2020; ILO, 2020; Maliszewska et

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al., 2020; McKibbin & Fernando, 2020; OECD, 2020; Ozili & Arun, 2020; UNCTAD, 2020). The absence of known vaccine(s) to permanently treat the disease has forced countries to take different measures to limit the spread of the virus. These measures include lockdown, social distancing, closure of institutions of learning and non-essential businesses or services, cancellation or postponement of events, elections, sporting activities, Summer Olympics, and ban on social gatherings of persons above certain numbers (see Gössling et al., 2020). Most nations have also announced fiscal stimulus to mitigate the adverse effects of COVID-19 on their respective economies, and wealthy countries and organizations are sending aid, health equipments and related items to poor countries to assist them in combating the spread of the virus including alleviating harsh economic conditions they are currently facing.

Nigeria reported her first index case of COVID-19 (an Italian) on 27th February 2020. Initially, it appeared that the country was able to contain the spread of the virus, but spikes in the number of infected persons and rising number of deaths in the weeks that followed coupled with the precarious state of the healthcare system leaves much to be desired. Available statistics from the Nigeria Centre for Disease Control (NCDC) indicate that single-digit daily infection cases were reported during the first month (27th February to 23rd March 2020) except for two days when the figures were 10 and 14 cases, respectively. The total number of confirmed cases during that period was 70. However, between 24th March and 23rd April, two-digit cases were reported and the total number of confirmed cases rose to 981. But since 28th April 2020, Nigeria has reported mostly daily confirmed infection cases of over 100 (see Figure 1). In addition, the number of deaths (or fatalities) caused by COVID-19 increased over the period (see Figure 2).

In an attempt to contain the spread of the virus, the Nigerian government took certain measures including lockdown, closing down of schools, places of worship, and non-essential businesses, restriction of movements and travel ban, social distancing, among others. Moreover, governments at both federal and state levels have introduced palliatives to ease the burden of the compulsory stay-at-home order particularly on the poor majority of who earn their living on a day-to-day basis. Also, the federal government announced plans to give stimulus to strategic sectors of the economy. These include the sum of N3.5 trillion in direct spending and US$6.9 billion in fiscal support (Ozili & Arun, 2020).

Other measures were contingency funds of N984 million to the NCDC with plan to release extra N6.5 billion; creation of N500 billion COVID-19 Crisis Intervention Fund (CCIF) to upgrade healthcare facilities across the country and intervention funds for states; Presidential approval for the employment of 774,000 persons with each Local Government Area (LGA) to be allotted 1,000 slots; a three-month repayment moratorium for all FarmerMoni, MarketMoni, and TraderMoni loans with an immediate effect; N15 billion federal government's grant to Lagos state government; conditional cash transfers to be paid to the most vulnerable at Internally Displaced Persons (IDPs) for the next two months; a reduction of petrol pump price from N145.0 to N123.50 per litre; suspension of proposed increase in electricity tariffs by distribution companies; and import duty waivers on medicines, medical equipments, protection equipments for COVID-19 treatment (PwC, 2020).

Although the number of total confirmed cases and fatality rate remain low, it is believed that these figures do not reflect the true situation in Nigeria. In addition, the low testing capacity occasioned by the country's weak healthcare system has been blamed for the low number of infections and deaths reported.

On the economic front, the Nigeria's stock market (Nigerian Stock Exchange) appeared to be one of the victims of the COVID-19 pandemic. In fact, the press/media had reported an association between large daily (stock) market movements and the COVID-19 outbreak (Baker et al., 2020a). The lockdown that was introduced by authorities in Nigeria resulted in total or partial shutdown of most firms/businesses' activity and operations. With many economic activities halted Nigeria's stock market indicators (i.e. market turnover and market capitalization) showed an unimpressive performance. These indicators which have been used to measure stock market performance or development in Nigeria (see

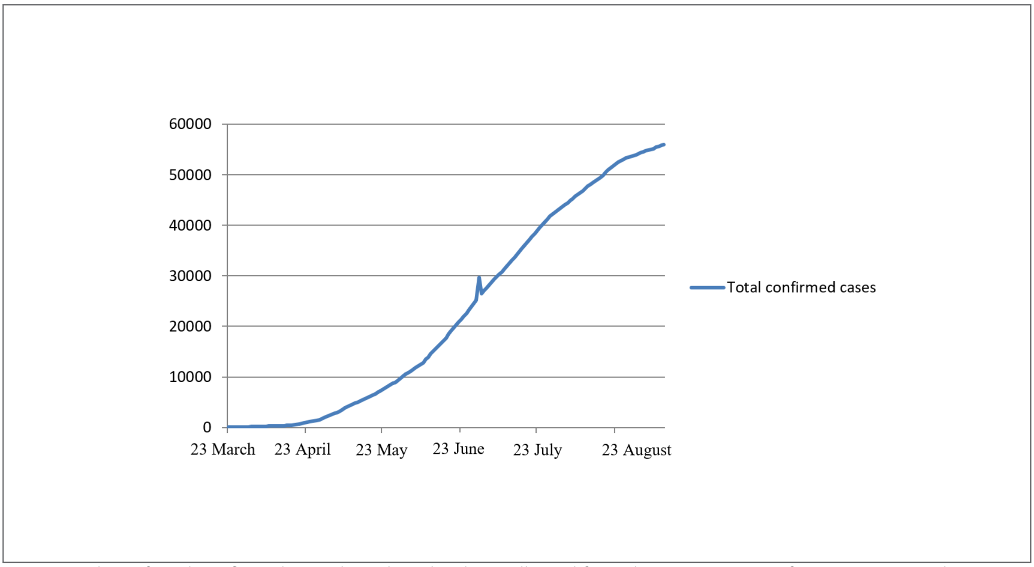

Figure 1. Plots of total confirmed cases based on the data collected from the Nigeria Centre for Disease Control.

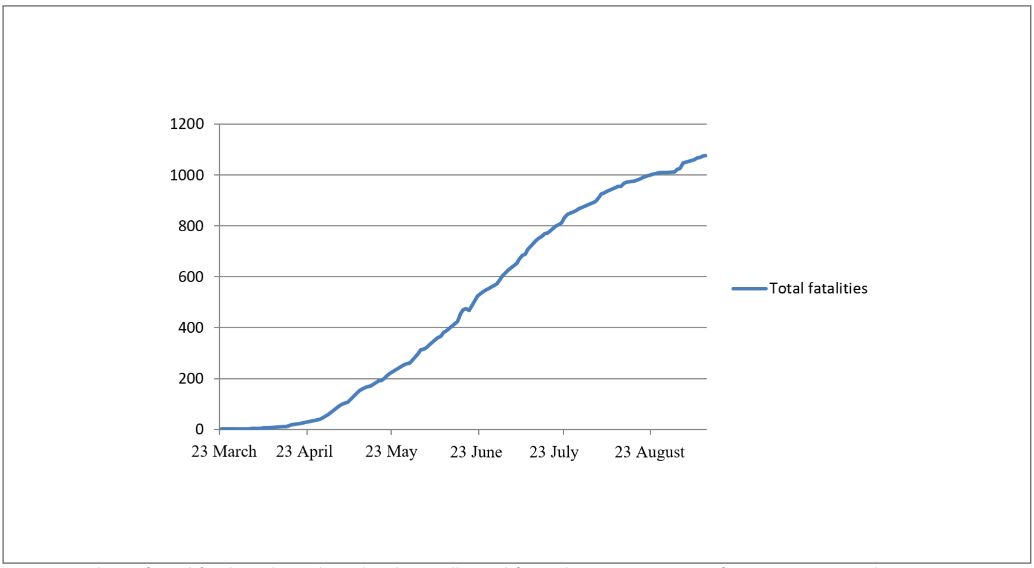

Figure 2. Plots of total fatalities based on the data collected from the Nigeria Centre for Disease Control.

Nurudeen, 2009) exhibited an unstable trend as they increased in certain days and declined in others (see Figure 3 and Figure 4).

Although stock market indicators fluctuated since March 2020 it is not clear whether the COVID-19 pandemic is responsible for this behavior. Therefore, the primary objective of this study is to investigate if the performance of Nigeria's stock market can be attributed to the virus outbreak. The remainder of this study is organized as follows. Section two is the review of relevant literature, while the third section is the theoretical framework and model specification. The fourth section is for data and methodology, and results and discussion are taken up in the fifth section. Section six concludes the study.

2. Review of Relevant Studies on COVID-19 and Stock Market Relationship

The COVID-19 pandemic was announced some months ago and research on its impact on the economy (and certain economic variables) is still emerging. Researchers have been making concerted efforts to investigate the effects of the virus on financial sector variables like stock markets.

For example, Alam et al. (2020) assessed the reaction of stocks of 31 listed firms on the Indian Bombay Stock Exchange following the COVID-19 outbreak from 24th February to 17th April, 2020. The authors discovered that the market reacted positively to the lockdown, while the reaction was negative in the pre-lockdown period. In addition, Al-Awadhi et al. (2020) examined the effect of COVID-19 deaths and confirmed cases on the stock market in China over the 10th January - 16th March 2020 period using panel data analysis. The results demonstrate that daily growth in total deaths and confirmed cases have a negative and significant effect on stock market returns in China. Moreover, Alfaro et al. (2020) found that unanticipated decrease (increase) in projected COVID-19 infections forecasts raises (reduces) overall US market value by 4% to 11%. Furthermore, Anh and Gan (2020) employed panel regression to examine the effect of daily increase in confirmed cases of COVID-19 over the pre-lockdown and lockdown period on daily returns of 723 firms listed on the Vietnamese stock market from 30th January to 30th May, 2020. The results reveal that daily increases in the number of confirmed cases has a negative impact on stock returns. Whereas pre-lockdown had a negative and significant effect on stock returns, the lockdown era had a positive and significant impact on stock returns in Vietnam.

In addition, Apergis and Apergis (2020) evaluated the impact of COVID-19 outbreak on stock market returns and their volatility in China from 22nd January to 30th April 2020 using the GARCHX model. The results illustrate that increases in total confirmed cases and deaths have a negative and significant effect on stock market returns, and the virus has a positive and significant impact on market returns volatility. On his part, Ashraf (2020) used pooled regression analysis to evaluate the impact of COVID-19 confirmed cases and deaths on stock markets in 64 countries from 22nd January to 17th April, 2020. The empirical evidence show that growth in the number of confirmed cases has a negative impact on stock markets. Also, the results suggest that the growth in the number of confirmed cases was more than the growth in the number of deaths. Moreover, Bash (2020) used the mean-adjusted returns and market model to study the impact of the first registered COVID-19 case on stock returns in 30 countries. The results demonstrate that stock market returns significantly declined in reaction to the pandemic.

Cao et al. (2020) assessed the response of 14 daily stock indices to the COVID-19 during the 21st January to 30th June 2020 period. The authors submitted that stock market indices responded negatively and significantly to the pandemic. Also, Cepoi (2020) used a panel quantile regression estimator to examine COVID-19 related news and stock returns relationship in six most affected economies by the virus from 3rd February to 17th April 2020. The results reveal that stock markets in this group of countries presented asymmetric dependencies with COVID-19. Furthermore, Chia et al. (2020) investigated the stock market returns and COVID-19 pandemic relationship in Malaysia using time series data from 2nd January to 30th

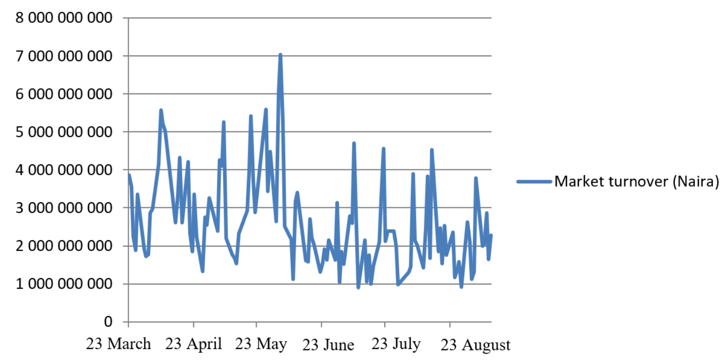

Figure 3. Plots of market turnover based on the data collected from the Nigerian Stock Exchange.

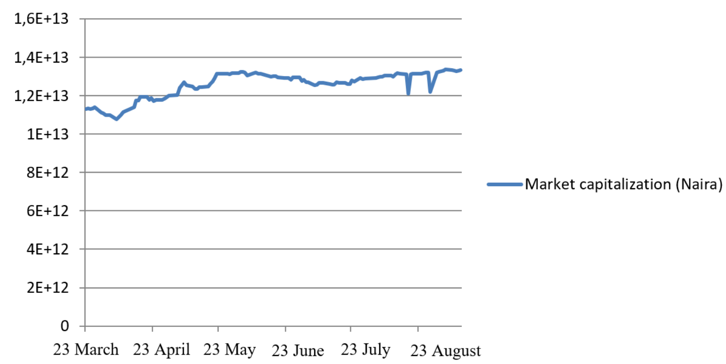

Figure 4. Plots of market capitalization based on the data collected from the Nigerian Stock Exchange.

April, 2020. Employing the ordinary least squares estimator, the authors found that new daily confirmed cases and deaths have an insignificant negative impact on stock returns. On the other hand, movement control order (MCO) was found to have a positive and significant effect on stock returns. Corbet et al. (2020) discovered that COVID-19 pandemic has a significant and positive effect on the volatility of Shanghai and Shenzhen stock markets.

Moreover, Erdem (2020) investigated the response of stock markets and freedom of countries to COVID-19 announcements across 75 nations during the January-April 2020 period. The results indicate a negative response of stock markets to the pandemic. On their part, He et al. (2020) examined the impact of COVID-19 outbreak on stock prices on the Chinese stock market from 3rd June, 2019 to 13th March, 2020 using the event study approach. The authors concluded that certain stocks have been affected negatively by the virus outbreak. In the same vein, Huo and Qiu (2020) evaluated how Chinese stock market reacted to the COVID-19 lockdown announcement. The evidence suggest poor performance of stocks in China. Similarly, Liu et al. (2020a) examined the short-term impact of the COVID-19 outbreak on Chinese stock markets using the event study technique after 20th January, 2020. The authors observed a decline in stock indices during the pandemic. In addition, Liu et al. (2020b) established that indicators of major stock markets of countries have declined sharply in response to COVID-19 outbreak. Moreover, Mazur et al. (2020) investigated the performance of the US stock market during the market crash of March 2020 caused by the COVID-19 outbreak. The authors confirmed that some stock indices declined considerably as a result of the disease outbreak.

In addition, Mishra et al. (2020) employed the Markov switching vector autoregression method to examine the effect of COVID-19 pandemic on Indian stock market returns. The authors compared the findings with implementation of the goods and services tax and demonetization policy outcomes using daily data from 3rd January, 2003 to 20th April, 2020. The results demonstrate that stock indices responded negatively during the COVID-19 outbreak unlike the goods and services tax and post-demonetization era. Furthermore, Naidenova et al. (2020) illustrated that stock markets (or market indices) have reacted negatively to COVID-19 (measured by number of confirmed cases and deaths, lockdown and movement restrictions, and social distancing). Elsewhere, Narayan et al. (2020) investigated the impacts of government responses to COVID-19 (i.e. stimulus packages, lockdowns and travel bans) on G7 stock market returns from 1st July, 2019 to 16th April, 2020. The results of the ordinary least squares estimation corrected for autocorrelation and heteroscedasticity indicate that stimulus packages, travel bans and lockdowns have a positive impact on stock markets in G7 countries. Salisu et al. (2020) evaluated the oil-stock linkage under the COVID-19 pandemic era in worse hit countries using panel VAR and panel logit models. The results reveal negative stocks and oil returns which might have been caused by panic or uncertainty in respective markets.

Moreover, Salisu and Vo (2020) examined the role of health news in predicting stock market returns during COVID-19 outbreak among top 20 worse hit or most affected economies using heterogeneous panel estimator. The authors' findings suggest that regardless of movement of health news, COVID-19 pandemic affected stock market returns negatively. In addition, Şenol and Zeren (2020) confirmed a long-run relationship between global stock markets and the pandemic between January and April 2020. Also, Topcu and Gulal (2020) examined the effect of COVID-19 on emerging stock markets over the 10th March-30th April, 2020 period by employing the pooled OLS estimator with robust standard errors. The results illustrate that the impact which has been negative has started to decline and gradually tapping off since the middle of April. In addition, emerging markets in Asia appeared to have been most affected with their counterparts in Europe least impacted. Moreover, Zhang et al. (2020) employed correlation analysis, graph theory and minimum spanning tree (MST) to evaluate the performance of financial (stock) markets across the world during the COVID-19 pandemic from February to March 2020. The authors concluded that global stocks have become more risky and highly volatile as a result of the pandemic. Furthermore, Zeren and Hizarci (2020) established that stock markets and COVID-19 (measured as total deaths) have a long run-relationship.

Looking at the literature, it is glaring that there is scarcity of empirical studies which focus on the COVID-19 outbreak and stock market relationship in Nigeria. Therefore, this study contributes to the literature by examining the relationship between the COVID-19 pandemic and Nigeria's stock market behavior.

3. Theoretical Framework and Model Specification

Although there is no theory that explains the direct relationship between a disease and financial variables such as the stock market, this study relies on the cost of illness (COI) approach to establish the link between COVID-19 and stock market performance. The approach looks at the opportunity cost of resources which are either consumed or lost due to the existence of a disease. These costs can be direct or indirect (Costa et al., 2012). The first type of cost is the direct costs, and it consist of resources used to treat or check a disease from escalating. Examples of such costs are expenditure on physicians/doctors and nurses who treat patients, procurement of drugs, and so on. The second costs consist of not only the present but also future costs arising from disability, morbidity and premature death to the economy (Brahmbhatt & Dutta, 2008). Thus, the existence of a disease can lead to a decline in labor productivity and/or death of workers, and consequently result to output losses.

In addition, economic theory suggests that pandemics such as the COVID-19 are likely to increase labor scarcity, reduce investment demand and impact on financial or stock markets (see Baker et al., 2020a; Jordà et al., 2020; Mandel & Veetil, 2020). As a disease/virus spread from one country to another, labor supply is constrained with an increased risk in operations of businesses including restrictions on movement/travel amongst other things (Mohan, 2006). The high uncertainty that accompany a pandemic/disease outbreak impacts on the survival of existing businesses, establishment of new businesses, investment in human capital and research and development, as well as factors which affect productivity in the medium-term and the long-term (Baker et al., 2020b). As production declines, firms' sales and profits reduce too. The poor performance of firms is reflected in the value of their stocks/shares as holders of these stocks/shares embark on sell-off to avoid further losses on their investment.

Also, poor health (which results from a disease/virus) reduces individuals' productivity and efficiency, and as a result lower their ability to earn substantial income. As people's incomes decline, aggregate demand for goods and services also reduce, which further lessens the need for future investment spending. The increased uncertainty in the business environment hurts the functioning of financial markets/institutions (stock markets inclusive) because it raises investors' pessimism about future returns on their investment (Liu et al. 2020a). In the same vein, high uncertainty forces stockholders to sell-off their stocks, leading to the flow of funds from capital (stock) markets to safe haven assets (AlAli, 2020; Zeren & Hizarci, 2020). Persistent stock sell-off puts downward pressure on the value/price of stocks, leading to a decline in market indices (or performance).

The discussion above suggests that the COVID-19 pandemic (COVD) might have affected the performance of Nigeria's stock market (STMKT). Thus, we specify a model in which STMKT is dependent on COVD as follows:

$$STMKT_t = \alpha_0 + \alpha_1 COVD_t + \varepsilon_t \qquad (1)$$

Recent studies have proxied COVD by the number of confirmed cases of the infection (CASE) and number of deaths or fatalities (FAT) (see Liu et al., 2020b; Naidenova et al., 2020; Şenol & Zeren, 2020; Zeren & Hizarci, 2020). Thus, the model above is re-specified as:

$$STMKT_t = \alpha_0 + \alpha_1 CASE_t + \alpha_2 FAT_t + \varepsilon_t \qquad (2)$$

Besides the variables of interest (CASE and FAT), oil prices (OILP) can also influence stock market performance or stock prices. Authors have claimed that since oil is a very important input used by most firms during production process, changes in oil prices are expected to affect firms' expected cash flows. This in turn influences firms' production costs and earnings, their dividends and as a result stock prices (see Narayan & Narayan, 2010; Rafailidis & Katrakilidis, 2014; Salisu et al., 2020; Salisu & Isah, 2017).

Also, changes in exchange rate (appreciation or depreciation) can affect stock prices or stock market performance. The traditional approach or goods market theory argues that exchange rate (EXR) depreciation raises a country's (domestic firms') competitiveness and therefore, lead to increases in export of goods and services (see Dornbusch & Fischer, 1980; Tian & Ma, 2010). In essence, local currency depreciation facilitates output expansion and exports, raising earnings of exporting firms, thus, leading to high prices of their stocks (see Abdalla & Murinde, 1997; Alagidede et al., 2011; Ashraf, 2020; Bahmani-Oskooee & Sohrabian, 1992; Megaravalli & Sampagnaro, 2018; Tian & Ma, 2010; Zarei et al., 2019). Conversely, exchange rate appreciation reduces an economy's competitiveness, exports and trade balance, leading to lower earnings of firms and stock prices.

Taking the possible impacts of OILP and EXR into cognizance, the econometric model is re-specified to include both variables as follows:

$$LSTMKT_t = \alpha_0 + \alpha_1 LCASE_t + \alpha_2 LFAT_t + \alpha_3 LOILP_t + \alpha_4 LEXR_t + \varepsilon_t \qquad (3)$$

where L denotes logarithm. Taking the logarithm of variables reduces their skewness.

4. Methodology and Data

This study uses daily data from 23rd March to 11th September 2020. COVID-19 is proxied by the number of confirmed cases of the infection (CASE) and number of deaths (FAT) as used in recent research (see Ashraf, 2020; Liu et al., 2020b; Naidenova et al., 2020; Şenol & Zeren, 2020; Zeren & Hizarci, 2020). Following Nurudeen (2009) stock market behavior/performance is captured by stock market capitalization, and the data were collected from the Nigerian Stock Exchange. The stock exchange operates five days a week (i.e. Monday to Friday), except on weekends (i.e. Saturday and Sunday) and public holidays. In all, we have 117 days (i.e observations or series). The data on the number of cases of infection and the number of deaths were gathered from the Nigeria Centre for Disease Control. The data on oil prices were collected from the Organization of Petroleum Exporting Countries and the International Energy Association, and exchange rate data were gathered from the Central Bank of Nigeria.

4.1. Unit Root Tests

Time series are required not to have a unit root or be stationary before they are used in regression analysis (İskenderoglu & Akdag, 2020). Stationarity of data is very important to guide against obtaining spurious results. The Augmented Dicker-Fuller (ADF) test by Dickey and Fuller (1979) and Philips-Perron (PP) test by Phillips and Perron (1988) were employed in ascertaining the unit root status of the series. The ADF test equation is specified as:

$$\Delta y_t = \text{a} + \rho y_{t-1} + \theta_1 \Delta y_{t-1} + \cdots + \theta_k \Delta y_{t-k} + \varepsilon_t$$

y_t is the series and ε_t the error term.

The hypotheses which are to be tested include:

H_0: $\rho = 0$ (unit root) and H_1: $\rho<0$ (series has no unit root)

The PP test is used as a complement to the ADF test. If the ADF or PP test statistic is less than the critical values at 1%, 5% or 10%, H_0 is not be rejected. But if the test statistic is higher than the critical values the H_1 is accepted.

4.2. ARDL Bounds Test to Cointegration

If it is confirmed that the series are all stationary at I(1) or a mixture I(1) and I(0), the ARDL-bounds test to cointegration (Pesaran & Shin, 1999; Pesaran et al., 2001) will be used to check the existence of cointegration (long-run relationship) among the variables. The justification for using the ARDL approach and its preference over the conventional cointegration methods such as the residual-based technique (Engle & Granger, 1987) and the maximum likelihood method (Johansen, 1988; 1991; Johansen & Juselius, 1990) has been explained by several authors (see Abu & Staniewski, 2019; Abu & Gamal, 2020). The ARDL model (p,k_1,k_2,k_3,k_4) to be estimated is specified as follows:

$$\Delta LSTMKT_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1i}\, \Delta LSTMKT_{t-i} + \sum_{i=0}^{k_1} \alpha_{2i}\, \Delta LCASE_{t-i} + \sum_{i=0}^{k_2} \alpha_{3i}\, \Delta LFAT_{t-i} + \sum_{i=0}^{k_3} \alpha_{4i}\, \Delta LOILP_{t-i} + \sum_{i=0}^{k_4} \alpha_{5i}\, \Delta LEXR_{t-i} + \delta_1 LSTMKT_{t-1} + \delta_2 LCASE_{t-1} + \delta_3 LFAT_{t-1} + \delta_4 LOILP_{t-1} + \delta_5 LEXR_{t-1} + \varepsilon_t \qquad (4)$$

The procedure of the ARDL begins with the conduct of the bounds test for the null hypothesis of no cointegration (H0) against the alternative hypothesis (H1) for individual equation stated as follows:

H_0: $\delta_1=\delta_2=\delta_3=\delta_4=\delta_5=0$ and H_1: $\delta_1\neq\delta_2\neq\delta_3\neq\delta_4\neq\delta_5\neq0$

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Next, is to decide if cointegration exists among the variables by comparing the computed F-statistic with upper and lower critical bounds values. If the computed F-statistic is higher than the upper bound, it is concluded that cointegration exists between the variables. But if the F-statistic is smaller than the lower bound, it is concluded that cointegration does not exist among them. Furthermore, if the computed F-statistic lies between the lower and upper bounds, our decision will be inconclusive. If cointegration is established among the variables, we will proceed to estimate both long-run and short-run parameters using equation 5 and equation 6 which are specified as:

$$LSTMKT_t = \Upsilon_0 + \Upsilon_1 LCASE_t + \Upsilon_2 LFAT_t + \Upsilon_3 LOILP_t + \Upsilon_4 LEXR_t + \varepsilon_t \quad (5)$$

and

$$\Delta LSTMKT_t = \beta_0 + \sum_{i=1}^{p} \beta_{1i}\, \Delta LSTMKT_{t-i} + \sum_{i=0}^{k_1} \beta_{2i}\, \Delta LCASE_{t-i} + \sum_{i=0}^{k_2} \beta_{3i}\, \Delta LFAT_{t-i} + \sum_{i=0}^{k_3} \beta_{4i}\, \Delta LOILP_{t-i} + \sum_{i=0}^{k_4} \beta_{5i}\, \Delta LEXR_{t-i} + \theta_1 ECT_{t-1} + \varepsilon_t \quad (6)$$

ECT is the error correction variable lagged by one period, and its coefficient, θ, denotes the speed of adjustment back to equilibrium in the event of any deviation from the equilibrium.

4.3. Diagnostic Tests

After the model estimation conventional diagnostic tests are performed to ascertain the reliability of the results obtained. These tests include the Breusch-Godfrey serial-correlation LM test to check for the existence of serial-correlation, and the Breusch-Pagan-Godfrey heteroscedasticity test to check if the residuals are homoscedastic or not.

4.4. Stability Tests

Stability tests are conducted to evaluate the stability status of the estimated coefficients of the regressors and model. To achieve this object, the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ) would be employed. If the plots of CUSUMSQ break in the lower or upper bound, the model and the parameters will be adjudged not to be stable (see Greene, 2003; Tang & Lean, 2007).

4.5. Alternative Estimation Techniques

Alternative cointegration estimation techniques including the canonical cointegrating regressions (CCR) by Park (1992), dynamic ordinary least squares (DOLS) by Saikkonen (1992) and Stock and Watson (1993), and fully modified ordinary least squares (FMOLS) by Hansen and Phillips (1990) are used to estimate the relationship between COVID-19 and stock market performance. These methods have advantages such as solving problems of endogeneity bias between/among regressors as well as providing results which are more efficient or robust in finite samples (see Abu & Gamal, 2020; Abu & Staniewski, 2019; Alhassan & Fiador, 2014; Montalvo, 1995; Narayan & Narayan, 2004; Singh, 2015).

The CCR technique executes the ordinary least squares estimation via transforming the variables using long-run covariance matrix of the residuals terms, and therefore, ensures that the ordinary least squares estimator is asymptotically efficient (Beard et al., 2010). On the other hand, the FMOLS procedure starts with the ordinary least squares estimation, and then makes a non-parametric correction which may emanate from the ordinary least squares residuals including endogeneity bias (Singh, 2015). The DOLS approach involves the regression of a I(1) variables on other I(1) and I(0) variables, and the leads and lags of (first difference) of I(1) variables. This corrects any simultaneity bias between the regressors. Employing these alternative estimation methods helps to ascertain the consistency and/or robustness of the results.

5. Discussion of Results

5.1. Results of Unit Root Tests

The unit root tests results reported in Table 1 demonstrate that two series namely - LCASE and LFAT have no unit root (i.e. they are stationary at level) at 1% level. However, LSTMKT, LOILP and LEXR have a unit root (i.e. non-stationary) at level. But the series turned out stationary after their first difference has been taken at 1% level.

Table 1. Results of Unit Root Tests

	ADF		PP	
Variable	Level	1st diff.	Level	1st diff.
LSTMKT	-1.6450	-14.8173***	-1.7256	-15.0676***
LCASE	-8.9241***	-	-11.8332***	-
LFAT	-7.1369***		-7.6452***	
LOILP	-1.2430	-10.7073***	-1.2971	-10.7074***
LEXR	-0.5358	-10.7238***	-0.5358	-10.7238***

Note:*** denotes statistical significance at 1%.

5.2. Result of Bounds Test to Cointegration

The bounds test to cointegration result in Table 2 reveals that the computed F-statistic (4.3702) is larger than the upper critical bound value (i.e. 4.37) at 1% level.

Therefore, the null hypothesis of no cointegration is rejected. This implies that a long-run relationship exists among the variables. This finding provides justification for using an ARDL technique to estimate the relationship between the variables.

5.3. Results of Selected ARDL Model

The results of estimation of the selected ARDL model are shown in Table 3. The optimal lag length selected by the AIC is: 2,0,1,0,0. The results demonstrate that COVID-19 proxied by the number of confirmed cases of infection (LCASE) has a negative and significant effect on stock market performance (LSTMKT) proxied by stock market capitalization in the long-run. A 1% increase in LCASE leads to a reduction in LSTMKT by a 0.11% at 1% level in the long-run. On the other hand, the number of deaths (LFAT) is positively and significantly related to LSTMKT in the long-run. A 1% increase in LFAT raises LSTMKT by a 0.12% at 1% level in the long-run.

Moreover, oil prices (LOILP) has a positive and significant impact on LSTMKT in the long-run. A 1% increase in LOILP causes LSTMKT to rise by a 0.05% at 10% level in the long-run. Furthermore, exchange rate (LEXR) has a positive and significant effect on stock market in the long-run. A 1% increase in LEXR (exchange rate depreciation) leads to a 0.68% increase in LSTMKT at 5% level in the long-run. In the short-run, COVID-19 appears not to have a significant effect on the stock market. The coefficient of the error correction term lagged by one period is correctly signed and statistically significant at 1% level.

5.4. Results of Diagnostic Tests

The diagnostic tests results are presented in Table 4. The Breusch-Godfrey serial-correlation test result demonstrates that the test statistic is 1.0579 and its probability is 0.5892. In addition, the Breusch-Pagan-Godfrey heteroscedasticity test result shows that the test statistic is 9.4072 and its probability is 0.2247. These findings suggest that the estimates are free from serial-correlation and heteroscedasticity problems.

5.5. Results of Stability Tests

The stability tests results in Figure 5 and Figure 6 indicate that the plots of CUSUM and CUSUMSQ fall within the lower and upper boundaries. These findings indicate that the coefficients of the regressors and the model are stable in the long-run.

Table 2. Result of Bounds Test to Cointegration

Critical values bounds			
F-stat. =4.3702***		I(0)	I(1)
	10%	2.2	3.09
	5%	2.56	3.49
	2.50%	2.88	3.87
	1%	3.29	4.37

Note: *** denotes statistical significance at 1%. L denotes logarithm.

Table 3. Results of ARDL model

Long-run model		Short -run model	
Regressor	Coefficient	Regressor	Coefficient
C	11.4509*** (0.8199) [13.9646]	ΔLSTMKT-1	-0.2256*** (0.0825) [-2.7339]
LCASE	-0.1119*** (0.0364) [-3.0664]	ΔLFAT	0.0117 (0.0105) [1.1141]
LFAT	0.1223*** (0.0326) [3.7436]	ECT-1	-0.2757*** (0.0526) [-5.2389]
LOILP	0.4547* (0.0240) [1.8879]		
LEXR	0.6800** (0.3327) [2.0439]		
R^2	0.9324		

Note: ***,**, and * denotes statistical significance at 1%, 5% and 10%, respectively. L denotes logarithm. Values in ( ) and [ ] are standard errors and t-statistics, respectively.

Table 4. Results of Diagnostic Tests

Test Statistic	Results
Serial Correlation: χ^2	1.0579[0.5892]
Heteroscedasticity: χ^2	9.4072[0.2247]

Note: Probability values are in parenthesis

5.6. Results of Alternative Estimation Methods (FMOLS, DOLS and CCR Models)

The results of FMOLS, DOLS and CCR estimations (Table 5) reveal that COVID-19 proxied by the number of cases of infection (LCASE) has a negative and significant effect on stock market performance (LSTMKT). A 1% increase in LCASE reduces LSTMKT by a 0.071%, 0.077% and 0.070% at 1% level in FMOLS, DOLS and CCR models, respectively. The results also indicate that a 1% increase in COVID-19 proxied by the number deaths (LFAT) raises LSTMKT by a 0.087%, 0.094% and 0.085% at 1% level in FMOLS, DOLS and CCR models, respectively.

Also, an increase in oil prices (LOILP) by a 1% raises LSTMKT by a 0.040%, 0.052% and 0.039%, at 1% level in FMOLS, DOLS and CCR models, respectively. In addition, a 1% increase in the exchange rate (exchange rate depreciation) raises stock market performance by a 0.507%, 0.552% and 0.495% at 1% level in FMOLS, DOLS and CCR models, respectively.

5.7. Results of Estimation of Stock Market Sub-sectors (Consumer Goods and Healthcare)

We extended our analysis to see how individual sub-sector of the stock market has responded to the COVID-19 pandemic. The sub-sectors are consumer goods, oil and gas, financial services, healthcare, industry, and information and communication technology. However, only the results of consumer goods and healthcare sub-sectors are reported here. Other sub-sectors (results) were left out because the coefficients were mostly insignificant and many of them showed absence of cointegration between the variables including failing diagnostic tests.

5.8. Results of Bounds Test to Cointegration (Consumers Goods and Healthcare Sub-sectors)

The bounds test to cointegration results in Table 6 reveal that the individual computed F-statistic (6.1719 for consumer goods sub-sector) and (4.6885 for healthcare sub-sector) is larger than the upper critical bound value (i.e. 4.37) at 1% level.

These indicate a rejection of the null hypothesis of no cointegration, and implies the existence of a long-run relationship between the variables both in the consumer goods sub-sector and healthcare sub-sector.

5.9. Results of ARDL Models (Consumer Goods and Healthcare Sub-sectors)

The results of estimation of the selected ARDL model (consumer goods sub-sector) are shown in Table 7. The optimal lag length selected by the AIC is: 4,2,0,0,0. The results illustrate that LCASE is negatively and significantly related to LSTMKT in the long-run. An increase in LCASE by 1% lowers LSTMKT by a 0.22% at 1% level in the long-run. On the other hand, LFAT has a positive and significant impact on LSTMKT in the long-run. An increase in LFAT by 1% raises LSTMKT by a 0.23% at 1% level in the long-run.\

In addition, LOILP is positively and significantly related to LSTMKT in the long-run. A 1% increase in LOILP leads to a 0.14% increase in LSTMKT at 5% level in the long-run. Also, LEXR has positive and significant relationship with LSTMKT in the long-run. An increase in LEXR by 1% raises LSTMKT by a 1.14% at 10% level in the long-run. The short-run results demonstrate that LCASE has a negative and significant effect on LSTMKT in the short-run. A 1% increase in LCASE leads to a reduction in LSTMKT by a 0.04% at 1% level in the short-run.

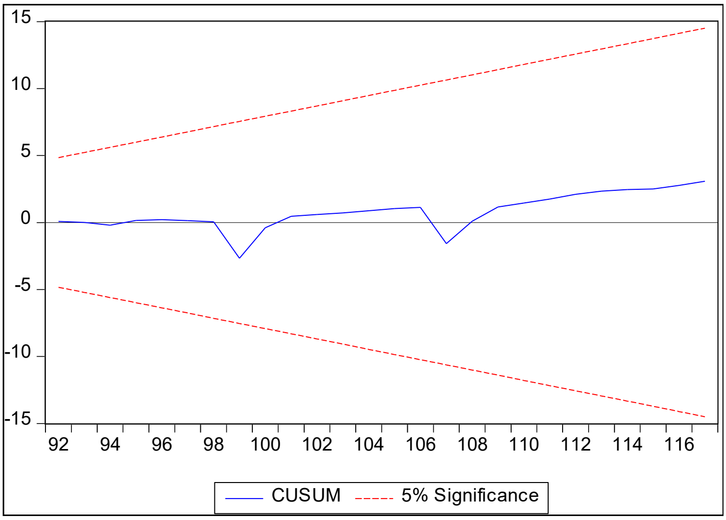

Figure 5. Plots of cumulative sum of recursive residuals.

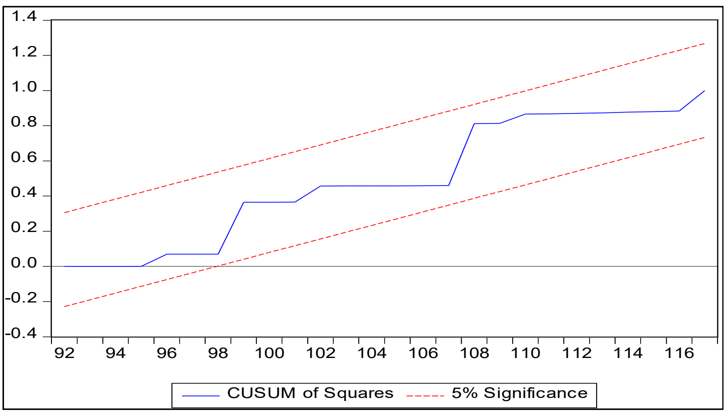

Figure 6. Plots of cumulative sum of squares of recursive residuals.

Table 5. Results of Diagnostic Tests

	FMOLS	DOLS	CCR
Regressor	Coefficient	Coefficient	Coefficient
C	11.8195*** (0.4705) [25.1165]	11.6866*** (0.5097) [22.9273]	11.8485*** (0.4616) [25.6674]
LCASE	-0.0714*** (0.0184) [-3.8765]	-0.0765*** (0.0207) [-3.6922]	-0.0691*** (0.0167) [-4.1362]
LFAT	0.0873*** (0.0167) [5.2162]	0.0937*** (0.0185) [5.0518]	0.0853*** (0.0154) [5.5081]
LOILP	0.0397*** (0.0135) [2.9236]	0.0520*** (0.0172) [2.7117]	0.0385*** (0.0125) [3.0684]
LEXR	0.5070*** (0.1893) [2.6777]	0.5521*** (0.2036) [2.7117]	0.4945*** (0.1850) [2.6718]
R2	0.8467	0.8912	0.8471

Note: *** denotes statistical significance at 1%. L denotes logarithm. Values in ( ) and [ ] are standard errors and t-statistics, respectively.

Table 6. Result of Bounds Test to Cointegration (Consumer Goods and Healthcare Sub-sectors)

Consumer goods sub-sector				Healthcare sub-sector			
	Critical values bounds				Critical values bounds		
F-stat.= 6.1719***		I(0)	I(1)	F-stat.= 4.6885***		I(0)	I(1)
	10%	2.2	3.09		10%	2.2	3.09
	5%	2.56	3.49		5%	2.56	3.49
	2.50%	2.88	3.87		2.50%	2.88	3.87
	1%	3.29	4.37		1%	3.29	4.37

Note: *** denotes statistical significance at 1%. L denotes logarithm.

Table 7. Results of ARDL Models (Consumer Goods and Healthcare Sub-sectors)

Consumer goods sub-sector		**Healthcare sub-sector**	
Long-run model		Long-run model	
Regressor	Coefficient	Regressor	Coefficient
C	9.4281***	C	3.1983
	(1.5372)		(3.6521)
	[6.1331]		[0.8757]
LCASE	-0.2230***	LCASE	-0.5067***
	(0.0704)		(0.1807)
			[-2.8031]
	[-3.1667]		
LFAT	0.2333***	LFAT	0.3871***
	(0.0608)		(0.1406)
	[3.8362]		[2.7516]
LOILP	0.1362**	LOILP	0.1826
	(0.0531)		(0,1161)
	[2.5649]		[1.5722]
LEXR	1.1403*	LEXR	3.1767**
	(0.6237)		(1.5090)
	[1.8281]		[2.1051]

Note: ***,**, and * denotes statistical significance at 1%, 5% and 10%, respectively. L denotes logarithm. Values in ( ) and [ ] are standard errors and t-statistics, respectively.

The results of estimation of the selected model (healthcare sub-sector in Table 7) show that the optimal lag length selected is: 1,0,4,0,0. The results reveal that a 1% increase in LCASE leads to a 0.51% decrease in LSTMKT at 1% level in the long-run. However, LFAT is positively and significantly related to LSTMKT in the long-run. A 1% increase in LFAT leads to a 0.39% increase in LSTMKT at 1% level in the long-run. In addition, LEXR has a positive and significant effect on LSTMKT in the long-run. An increase in LEXR by a 1% raises LSTMKT by a 3.18% at 5% level in the long-run. Furthermore, the short-run results illustrate that LFAT has a negative and significant effect on LSTMKT. A 1% increase in LFAT reduces LSTMKT by a 0.04% at 5% level in the short-run. The coefficient of ECT-1 is correctly signed and statistically significant at 1% level in all the results.

5.10. Results of Diagnostic Tests (Consumer Goods and Healthcare Sub-sectors)

The results of diagnostic tests (for consumer goods and healthcare sub-sectors) are reported in Table 8. In the case of consumer goods sub-sector, the Breusch-Godfrey serial-correlation test result illustrates that the test statistic is 2.0488 with a probability of 0.3590. Also, the Breusch-Pagan-Godfrey heteroscedasticity test result shows that the test statistic is 9.4099 with a probability of 0.4937.

For the healthcare sub-sector, the Breusch-Godfrey serial-correlation test result illustrates that the test statistic is 0.1382 with a probability of 0.9332. Also, the Breusch-Pagan-Godfrey heteroscedasticity test result shows that the test statistic is 10.6188 with a probability of 0.3027. Thus, these findings reveal that the estimates do not have serial-correlation and heteroscedasticity problems.

Table 7. Results of ARDL Models (Consumer Goods and Healthcare Sub-sectors) (Continued)

Consumer goods sub-sector Short-run model		**Healthcare sub-sector** Short-run model	
Regressor	Coefficient	Regressor	Coefficient
$\Delta LSTMKT_{-1}$	0.0679	$\Delta LFAT$	-0.0364**
	(0.0799)		(0.0166)
	[0.8499]		[-2.1844]
$\Delta LSTMKT_{-2}$	0.1615**	$\Delta LFAT_{-1}$	-0.0499**
	(0.0787)		(0.0191)
	[2.0506]		[-2.6068]
$\Delta LSTMKT_{-3}$	0.1851**	$\Delta LFAT_{-2}$	-0.0506***
	(0.0786)		(0.0179)
	[2.3558]		[-2.8254]
$\Delta LCASE$	-0.0388***	$\Delta LFAT_{-3}$	-0.0506***
	(0.0145)		(0.0183)
	[-2.6641]		[-2.7698]
$\Delta LCASE_{-1}$	0.0423***	ECT_{-1}	-0.0835***
	(0.0136)		(0.0153)
	[3.1065]		[-5.4311]
ECT_{-1}	-0.1572***		
	(0.0252)		
	[-6.2327]		
R^2	0.9790	R2	0.9738

Note: ***,**, and * denotes statistical significance at 1%, 5% and 10%, respectively. L denotes logarithm. Values in ( ) and [ ] are standard errors and t-statistics, respectively.

Table 8. Results of Diagnostic Tests (Consumer Goods and Healthcare Sub-sectors)

Consumer goods sub-sector		**Healthcare sub-sector**	
Test statistic	Results	Test statistic	Results
Serial Correlation: χ^2	2.0488[0.3590]	Serial Correlation: χ2	0.1382[0.9332]
Heteroscedasticity: χ^2	9.4099[0.4937]	Heteroscedasticity: χ2	10.6188[0.3027]

Note: Probability values are in parenthesis

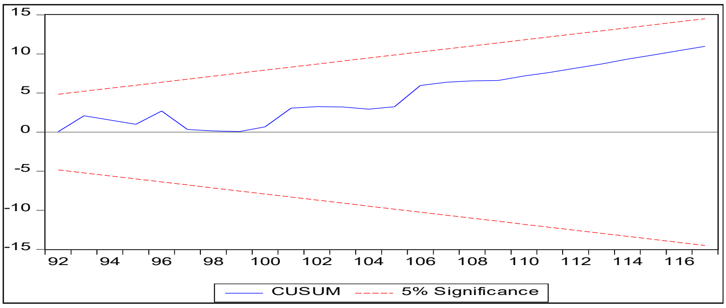

Figure 7. Plots of cumulative sum of recursive residuals (consumer goods sub-sector).

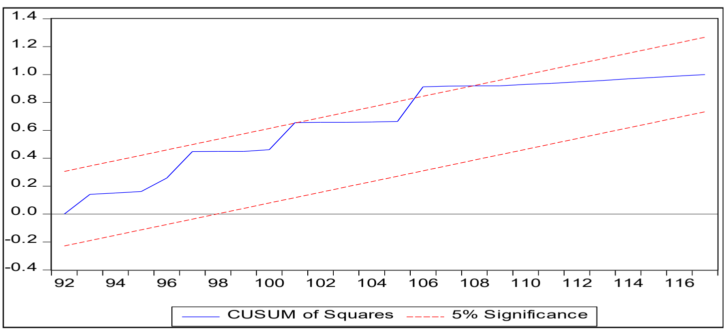

Figure 8. Plots of cumulative sum of squares of recursive residuals (consumer goods sub-sector).

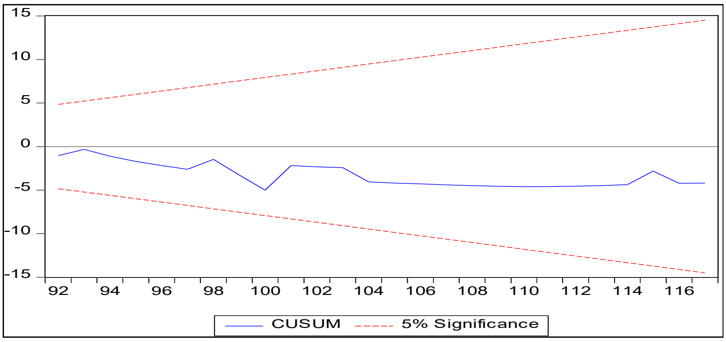

Figure 9. Plots of cumulative sum of recursive residuals (healthcare sub-sector).

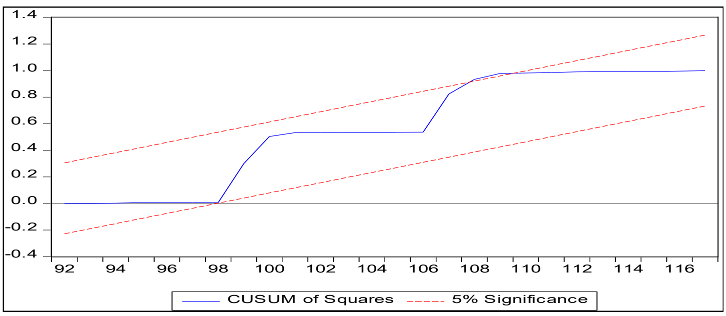

Figure 10. Plots of cumulative sum of squares of recursive residuals (healthcare sub-sector).

Table 9. Results of FMOLS, DOLS and CCR Models (Consumer Goods and Healthcare Sub-sectors)

	Consumer goods sub-sector			Healthcare sub-sector		
	FMOLS	DOLS	CCR	FMOLS	DOLS	CCR
Regressor	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient
C	11.4180*** (0.8001) [14.2700]	11.4098*** (0.9129) [12.4979]	11.4582*** (0.7778) [14.7314]	7.2524*** (2.0086) [3.6106]	6.6408*** (2.2398) [2.9649]	7.4331*** (1.9849) [3.7447]
LCASE	-0.1285*** (0.0315) [-4.0709]	-0.1342*** (0.0375) [-3.5760]	-0.1251*** (0.0280) [-4.4625]	-0.1916** (0.0792) [-2.4184]	-0.2093** (0.0921) [-2.2723]	-0.1787** (0.0737) [-2.4247]
LFAT	0.1615*** (0.0286) [5.6421]	0.1689*** (0.0335) [5.0317]	0.1586*** (0.0260) [6.0808]	0.2154*** (0.0718) [2.9973]	0.2296*** (0.0823) [2.7876]	0.2058*** (0.0684) [3.0086]
LOILP	0.0382 (0.0233) [1.6411]	0.0384 (0.0314) [1.2227]	0.0366* (0.0212) [1.7249]	0.1150* (0.0585) [1.9649]	0.1457* (0.0771) [1.8893]	0.1049* (0.0538) [1.9493]
LEXR	0.3417 (0.3219) [1.0612]	0.3464 (0.3648) [0.9495]	0.3244 (0.3117) [1.0407]	1.2662 (0.8083) [1.5664]	1.4995* (0.8950) [1.6752]	1.1902 (0.7968) [1.4936]
R2	0.8375	0.9015	0.8381	0.6910	0.7188	0.6926

Note: ***,**, and * denotes statistical significance at 1%, 5% and 10%, respectively. L denotes logarithm. Values in ( ) and [ ] are standard errors and t-statistics, respectively.

5.11. Results of Stability Tests

The stability tests results (Figures 7 and 9) indicate that the plots of CUSUM fall within the lower and upper boundaries. Although, the plots of the CUSUMSQ (Figures 8 and 10) breaks outside the boundaries briefly, it soon fall back within it.

5.12. Results of Alternative Estimation Methods (Consumer Goods and Healthcare Sub-sectors)

The results of FMOLS, DOLS and CCR for consumer goods and healthcare sub-sectors are reported in Table 9. For the consumer goods sub-sector, the results indicate that LCASE has a negative and significant impact on LSTMKT. A 1% increase in LCASE reduces LST-

MKT by a 0.128%, 0.134% and 0.125% at 1% level in FMOLS, DOLS and CCR models, respectively. Also, a 1% increase in LFAT raises LSTMKT by a 0.162%, 0.169% and 0.159% at 1% level in FMOLS, DOLS and CCR models, respectively. In addition, an increase in LOILP by a 1% raises LSTMKT by a 0.036% at 10% level in the CCR model. The results of the healthcare sub-sector show that LCASE has a significant negative impact on LSTMKT. An increase in LCASE by 1% leads to a 0.192%, 0.209% and 0.179% decrease in LSTMKT at 5% level in FMOLS, DOLS and CCR models, respectively. In addition, a 1% increase in LFAT raises LSTMKT by a 0.215%, 0.230% and 0.206% at 1% level in FMOLS, DOLS and CCR models, respectively. Also, a 1% increase in LOILP leads to a 0.115%, 0.146% and 0.105% increase in LSTMKT at 10% level in FMOLS, DOLS and CCR models, respectively.

Overall the empirical findings illustrate that COVID-19 proxied by the number of cases of infection has a long-run negative and significant impact on Nigeria's stock market, while the number of deaths is positive and significantly related to stock market performance in the long-run. The negative relationship between COVID-19 and stock market is consistent with the findings of early research (see Al-Awadhi et al., 2020; Apergis & Apergis, 2020; Chia et al., 2020; Liu et al., 2020b; Naidenova et al., 2020; Şenol & Zeren, 2020; Topcu & Gulal, 2020; Zeren & Hizarci, 2020). For example, Liu et al. (2020b) confirmed that stock markets in 21 countries declined following the outbreak of the disease. Also, Zeren and Hizarci (2020) found the number of confirmed cases of infection to have had an adverse effect on the stock markets of countries considered in their study. In the same manner, Naidenova et al. (2020) established that stock markets reacted negatively to the number of confirmed cases. Similarly, Chia et al. (2020) discovered a negative relationship between confirmed cases and stock market in Malaysia.

The negative impact of the pandemic on stock market suggests that rising number of confirmed cases in Nigeria creats high uncertainty in the economy with its consequences on business survival, investment spending, productivity and efficiency of labor, demand for goods and services, as well as overall economic activity. All of these lowered business sales, revenue and profits, and so on. The poor performance of firms is reflected in declining values of stocks/shares which forces holders to sell-off their stocks/shares to avoid further loss of their investments, leading a decline in stock market indices or performance. However, the positive relationship between COVID-19 deaths and stock market may not be unconnected with the low number of deaths relative to the number of confirmed cases. The low fatality rate might have lowered the uncertainty/risk associated with investment, leading to higher stock market performance.

The positive impact of oil prices on stock market is consistent with previous studies (see Narayan & Narayan, 2010; Narayan et al., 2020; Rafailidis & Katrakilidis, 2014; Salisu et al., 2020; Salisu & Isah, 2017; Topcu & Gulal, 2020). For example, the study by Narayan et al. (2020) suggests that oil prices do have a positive relationship with stock market. This finding implies that higher oil prices raise the earnings of oil producing and exporting firms including dividends payments, leading to higher stock prices and market performance.

Also, the positive relationship between exchange rate and stock market lends support to the outcome of prior studies (see Abdalla & Murinde, 1997; Alagidede et al., 2011; Ashraf, 2020; Bahmani-Oskooee & Sohrabian, 1992; Megaravalli & Sampagnaro, 2018; Tian & Ma, 2010; Zarei et al., 2019). Thus, exchange rate depreciation increases the competitiveness of Nigeria's firms, and raises their exports and earnings. Consequently, the prices of their stocks rise, leading to an improvement in stock market performance.

6. Conclusion

This study investigates the impact of the COVID-19 pandemic on Nigeria's stock market using daily data from 23rd March to 11th September 2020. The bounds test to cointegration results reveal that a long-run relationship exists between COVID-19 and stock market in Nigeria. The results of estimation using the ARDL, FMOLS, DOLS and CCR estimators indicate that COVID-19 (proxied by the number of confirmed cases of infection) has a negative impact on stock market, while the number of deaths is positively related to stock market performance in the long-run. The analysis was extended to the sub-sectors of the stock market, and the results suggest that the pandemic has impacted on both consumer goods sub-sector and healthcare sub-sector of the stock market.

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Based on these empirical findings, this study recommends policies to combat the spread of the virus to reduce its adverse impact on the Nigeria's stock market in the long-run. To this end, government is advised to invest more in the health sector via upgrading the healthcare facilities which are currently in poor shape. In addition, more testing kits and personal protection equipments and related items should be procured to increase the capacity of the NCDC and health workers in discharging their duties as well as containing the spread of the virus. Furthermore, salaries and allowances of frontline workers should be paid as at when due to boost their morale/confidence in fighting this deadly virus, while on the job training should be emphasized to prepare them for future disease outbreak. Moreover, government should encourage Nigeria's researchers/scientists to develop vaccine(s) so as to curb the spread of the virus via increased funding of research institutions and universities. Lastly, there should be an enlightenment or awareness campaign to educate Nigerians on the need to adhere strictly to preventive measures such associal distancing, partial lockdown or restrictions on travelling where necessary, cancellation or postponement of certain events and ban on social gatherings of persons above certain numbers.

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