Dynamic Interaction of COVID-19 Incidence and Stock Market Performance: Evidence from Nigeria

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Received: 23 November 2020 / Revised: 5 April 2022 / Accepted: 9 April 2022 / Published online: 5 May 2022
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Abstract
The incursion of COVID-19 into global space has constituted both public health emergency and economic crisis, thus there is need to investigate the transmission of inherent uncertainty associated with the pandemic on stock markets. Based on this, this study investigates the dynamic interaction of COVID-19 incidence and stock market performance in Nigeria. The study uses daily time series data between 2/4/2020 and 8/8/2020 of All Share Index (ASI), COVID-19 pandemic confirmed cases, Nigerian borrowing rate and exchange rate to conduct the analysis. Sequel to careful econometric investigation of data, vector autoregressive model was adopted for estimation due to the dynamic nature of the study. The estimation results show that the lagged value of COVID-19 infections exerts negative impact on ASI; specifically, a unit increase in COVID-19 infections causes ASI to fall by 0.066%. Similarly, the lagged value of ASI exerts negative impact on COVID-19 cases. Equally notable, a unit increase in ASI causes COVID-19 cases to fall by 0.02% though it is not statistically significant. The study concludes that COVID-19 has a negative effect on Nigerian stock market performance; therefore, apart from small and medium enterprises government may need to extend stimulus package to public quoted firms as part of the efforts to bring the economy back on track.

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Keywords  Nigeria · Pandemic · Stock performance · VAR

1 Introduction

The incursion of COVID-19 into global space has constituted both public health emergency and economic crisis. Public health emergency in the area of treatment, containment and vaccines development for the virus have been the major preoccupation of global and national health systems. Additionally, global lockdown measure adopted by government to curtail the spread of the virus has created economic crisis through supply and demand shocks. Consequently, labour market, global supply chains, consumer consumption and stock market are considered as major channels through which the lockdown will affect the global economy. This has created opportunity for several studies investigating the nexus between the virus and global economic activities. Within this space, many studies have examined the effect of COVID-19 incidence on general macroeconomics [1, 2] with some focusing on stock markets [3] while others predict its outbreak [4]. However, substantial gap still exists as it is observable that most studies focus on countries with high incidence of COVID-19. Given this, many African countries have not received appreciable empirical patronage and Nigeria is not an exception. This may not be unconnected with cultural issues [5, 6]. Another important gap is the assumption of unidirectional effect that flows from COVID-19 incidence to economic activities without feedback effect. The investigation of feedback effect is crucial as this can help to determine the incremental effect of economic activities on COVID-19 incidences. Specifically, this study will investigate the dynamic interaction of COVID-19 incidence and stock market performance in Nigeria.

Nigeria recorded its index case of COVID-19 on 27th February 2020 and this led to the activation of national emergency operations centres at level 3 which is the highest level in the country. By 6th March 2020, the second incidence of COVID-19 was reported and the country started to witness daily confirmed cases of the disease. Between 27th February and 30th March, cumulatively, the country recorded 131 confirmed cases of COVID-19 and this necessitated a non-pharmaceutical approach of total lockdown in three major cities considered as epicentres. The policy created significant economic and social disruptions with unanticipated shock in supply chain and panic buying. The situation engendered increase in the price of food items and general consumables. The subsequent nationwide lockdown and ban on interstate movement worsened the situation further. This became more evidenced in national bureau of statistics (NBS) reports for second quarter indicating inflation rate of 12.82% as against 12.34% in the previous quarter. Similarly, negative GDP growth of − 6.10% in real terms was recorded ending the three-year trend of low but positive real growth rates. By 4th May, national and sub-national governments started gradual ease of lockdown. Despite this development, the confirmed cases of COVID-19 in the country as at 9th October, 2020 was 59,841 with 51,551 recovered and 1113 deaths. Giving the total of 1,537,669 confirmed cases in Africa during the same period, the case in Nigeria could be considered moderate.
Stock markets have been generally considered as integral to any economy and their responses to activities in real sectors have been well-documented in literature. Thus, exploring how stock markets behave during this global pandemic will of immense research interest. Just like any other developing and emerging market, it has been empirically established that Nigerian stock market is vulnerable to many external shocks, especially inconsistent international capital flow [7]. However, the global pandemic of COVID-19 created an unprecedented shock to global stock market only comparable to the global financial crisis of 2007/2008. The Nigerian All Share Index fell as low as 21,300 points in March, the lowest since June 2012. Prior to this, it recorded 28,843 in January and 26,216 in February 2020. Uncertainty and fear of the pandemic and consequential lockdown of the global economy triggered a significant outflow of capital from the Nigerian economy. However, recent events in market indicate gradual sign of recovery. After the current introduction, this paper is divided into three sections. Section two focuses on extant literature review while section three addresses the data and methodology. Next is section four which concludes the study and offers policy prescriptions towards improving market resiliency in post-COVID-19 era.

2 Literature Review

This section focuses on the review of extant literature on the macroeconomic effects of COVID-19 in general and financial market in particular. Economic impacts of epidemics and pandemics has been examined in literature in forms of country-specific and global studies. Studies in this direction include [1, 6, 8]. However, COVID-19 has created an unprecedented global disruption which has necessitated several studies. Consequently, emphasis in this review will be on macroeconomic and financial market disruptions orchestrated by COVID-19 pandemic.

2.1 COVID-19 and Global Economy

At the beginning of the pandemic, a study by McKibbin and Fernando [9] provides early insight with seven scenarios of how COVID-19 might evolve in the following year using a global CGE modelling technique. The study emphasised investment in public health systems in all economies as important mitigating factor. A study by Chudik et al. [10], using threshold-augmented multi-country econometric model, gave quantitative value to the impact of the COVID-19 shock in different economic dimensions. Contrary to the submission of McKibbin and Fernando [9], the study argues that COVID-19 will create a long-lasting global economic recession regardless of huge investment in public health systems. A similar study by Gay et al. [11] explored the potential macroeconomic impacts of the COVID-19 pandemic on food demand with Aglink-Cosimo model. In line with Chudik et al. [12], the study submitted that the pandemic would cause a lasting contraction in world food demand and consequently food security. Apart from these global studies, specific studies such as Adam et al. [13] and Mueller et al. [14] have examined the macroeconomic implications of COVID-19.
in Africa and concluded that the pandemic would weaken the fiscal position of many economies in the continent.

## 2.2 COVID-19 and Financial Market

Specific empirical studies on COVID-19 and financial market are gradually emerging just as on other aspects of the economy. A study by Capelle-Blancard and Desroziers [15] explores the reactions of stock markets in 74 countries to investigate if public information about the COVID-19 and policy reaction of lockdown have been integrated into the price of stocks. The study submits that the stock markets have been less sensitive to macroeconomic fundamentals, thus failing to exhaustively incorporate public information about the COVID-19 and non-pharmaceutical policy of lockdown. However, a study by Pagano et al. [16] provides evidence of resource reallocation among industries and that firms more resilient to non-pharmaceutical measures significantly performed better than those with lower resilience to the pandemic. In a multi-country study, Ashraf [17] investigates the stock markets’ response to the pandemic in 64 countries, using a daily data of stock market returns as well as COVID-19 confirmed cases and fatality. The study provides evidence of negative reaction in stock market returns as a result of COVID-19 confirmed cases and fatality. This reinforces the stance of Pagano et al. [16] that COVID-19 confirmed cases and fatality has effect on stock market performances. A study by Topcu and Gulal [18], with focus on emerging economy employing regression based on Driscoll–Kraay procedure using data from 26 emerging stock markets, provides evidence to establish that the pandemic has negative impact on emerging stock markets. In summary, most of these multi-country studies overwhelmingly provide empirical evidences to support that the COVID-19 pandemic has a negative impact on stock market. Apart from global studies, country-specific studies such Anh and Gan [10] and Baig et al. [19] corroborate prominent position of multi-country studies that COVID-19 pandemic has a negative impact on stock market.

Notably, there are numerous studies in this area, but many of them neglect African countries with reasons that could be traced to low incidence of COVID-19 cases in the continent and perceived insignificant status of African stock markets. However, many stock markets in continent especially Nigeria are vulnerable to external shocks, thus it is necessary to investigate their response to COVID-19 pandemic, and this study is undertaken to achieve that for Nigerian stock market.

## 3 Methodology and Model Specification

The major focus of this study is to examine the dynamic interrelationships between COVID-19 pandemic, stock market performance and monetary policy instruments in Nigeria using daily time series data. Reviews have shown that very few empirical studies in this area of discourse adopted the vector autoregressive (VAR) model [20, 18]. This is because VAR model has proved especially useful for describing the dynamic behaviour of economic and financial time series as well as forecasting.
3.1 Vector Autoregressive (VAR) Model

Let \( Y_t = (Y_{1t}, Y_{2t}, \ldots, Y_{nt})^* \) denote an \((n \times 1)\) vector of time series variables. The basic P-Lag vector autoregressive (VAR(P)) model has the form:

\[
Y_t = C + \Pi_1 Y_{t-1} + \ldots + \Pi_p Y_{t-p} + \xi_t, \quad t = 1, \ldots, T \tag{3.1}
\]

where \( \Pi_i \) are \((n \times n)\) coefficient matrices and \( \xi_t \) is an \((n \times 1)\) unobservable zero mean white noise vector process (serially uncorrelated or independent) with time invariant covariance matrix and \( t = 1, \ldots, T \) refers to the time period.

The functional form of the VAR model is written as:

\[
ASI_t = F(CASES, NIBOR, EXCHR) \tag{3.2}
\]

\[
ASI_t = \varphi_{11} + \beta_{11} ASI_{t-1} + \beta_{12} CASES_{t-1} + \beta_{13} NIBOR_{t-1} + \beta_{14} EXCHR_{t-1} + \xi_{1t} \tag{3.3}
\]

\[
CASES_t = \varphi_{21} + \beta_{21} CASES_{t-1} + \beta_{22} ASI_{t-1} + \beta_{23} NIBOR_{t-1} + \beta_{24} EXCHR_{t-1} + \xi_{2t} \tag{3.4}
\]

\[
NIBOR_t = \varphi_{31} + \beta_{31} NIBOR_{t-1} + \beta_{32} ASI_{t-1} + \beta_{33} CASES_{t-1} + \beta_{34} EXCHR_{t-1} + \xi_{3t} \tag{3.5}
\]

\[
EXCHR_t = \varphi_{41} + \beta_{41} EXCHR_{t-1} + \beta_{42} ASI_{t-1} + \beta_{43} CASES_{t-1} + \beta_{44} NIBOR_{t-1} + \xi_{4t} \tag{3.6}
\]

From the equations above, ASI represents All Share Index, CASES represent COVID-19 confirmed cases, NIBOR represents Nigerian borrowing rate and EXCHR represents exchange rate.

3.2 Unit Root Test

Generally, macroeconomic time series data are stochastically trended, which is a problem that can be solved by differencing. Many tests can be used to verify the presence of unit roots in time series. This study adopts Augmented Dickey–Fuller and Phillips–Perron tests to check for the presence of unit root in the All-Share Index, COVID-19 confirmed cases, Nigerian borrowing rate and exchange rate time series data. Theoretically, unit root model is specified as:

\[
\Delta y_t = \alpha_i + \beta_i y_{t-1} + \cdots + \epsilon_t \tag{3.7}
\]
where $\Delta y_t$ represents each variable in the model, $\alpha_i$ stands for the intercept, $\beta_i$ is the coefficient and $\epsilon_t$ is the random term.

### 3.3 Cointegration Test (Johansen Cointegration)

Establishing the existence of co-integration is the sufficient condition for the adoption of the vector autoregressive (VAR) model. Here, the Johansen cointegration test is employed because the VAR is a system of equation. This is presented using the Eqs. 3.8, 3.11. The equations are of the form presented below.

\[
ASI_t = C + \sum_{i=1}^{p} \alpha_{11} EXCHR_{t-1} + \sum_{i=1}^{p} \alpha_{12} CASES_{t-2} + \sum_{i=1}^{p} \alpha_{1i} NIBOR_{t-3} + \epsilon_{1t}
\]

(3.8)

\[
CASES_t = C + \sum_{i=1}^{p} \alpha_{21} ASI_{t-1} + \sum_{i=1}^{p} \alpha_{22} NIBOR_{t-2} + \sum_{i=1}^{p} \alpha_{23} EXCHR_{t-3} + \epsilon_{2t}
\]

(3.9)

\[
NIBOR_t = C + \sum_{i=1}^{p} \alpha_{31} ASI_{t-1} + \sum_{i=1}^{p} \alpha_{32} CASES_{t-2} + \sum_{i=1}^{p} \alpha_{33} EXCHR_{t-3} + \epsilon_{3t}
\]

(3.10)

\[
EXCHR_t = C + \sum_{i=1}^{p} \alpha_{41} ASI_{t-1} + \sum_{i=1}^{p} \alpha_{42} CASES_{t-2} + \sum_{i=1}^{p} \alpha_{43} NIBOR_{t-3} + \epsilon_{4t}
\]

(3.11)

### 3.4 Empirical Analysis

Here, the study conducted series of tests and diagnostics in the following order: descriptive statistics, matrix correlation tests, unit root test (Augmented Dickey-Fuller and Phillips-Perron test), Toda-Yamamoto causality test, vector auto-regression (VAR) estimation and the impulse response function (IRF).

The descriptive statistics table shows that stock performance proxy with All Share Index (ASI) recorded an average value of 23.92 trillion naira within the study which covers from March—August, 2020 while the median, maximum and minimum values were 24.28 trillion, 26.45 trillion and 20.67 trillion respectively. Given the difference between the mean and maximum values of ASI, it can be deduced that there was relatively slow progress in stock market performance within the COVID-19 pandemic period. Comparing the mean value of ASI in the Nigerian Stock Exchange (NSE)
and New York (NY) Stock Market, and with that of the previous years, it can be perceived that the COVID-19 pandemic affected the recent progress in the NSE. The standard deviation was 1382.22 while the Kurtosis and Jarque–Bera statistics were 2.50 and 8.167. Given the p-value of 0.017, it can be concluded that the null hypothesis which poses the presence peaked and non-normality in the series should be rejected. The average value of COVID-19 cases was approximately 14,833 infections, while the median, maximum and minimum values were approximately 7139, 48,445 and 1 infections respectively. The great disparity between the maximum and minimum values within the study periods shows how spontaneously the COVID-19 infections spread across the country. This is from one (1) confirmed case in February, 2020 to over 48,445 confirmed cases in August, 2020. This allusion is supported by the huge size of the standard error (16,277.45). Similarly, the series show absence of kurtosis and non-normality since the probability value (0.001) supports the rejection of the null hypothesis.

Arguably, the mean value of exchange rate which is 383.71 shows the level of depreciation which might be accounted on the poor export values resulting from crude-oil glut in the international market. This was triggered by the country-specific measures taken to curb the spread of the virus. According to the Nwokolo et al. [18], the measures include lockdown and social distancing. All this caused the demand for crude oil, the major foreign exchange earner, in Nigeria to plummet; hence, triggering exchange rate depreciation. More so, the median, maximum and minimum values of exchange rate were 386, 392.18 and 365.46 respectively. Interestingly, the minimum value of exchange rate within the study period was greater than the exchange rate benchmark of 360 naira to one dollar. On the other hand, borrowing rate in Nigeria was relatively low within the COVID-19 period. This is tenable from the mean (7.29), median (6.23), maximum (15.45) and minimum (2.89) values. For instance, the minimum value of NIBOR was 2.84 which is relatively low. This might be arising from the need to encourage new investments to spring up and old ones to bounce back following the gradual re-opening of the economy in May, 2020; after the initial lockdown in March, 2020. Given the p-value of exchange rate (0.000) and NIBOR (0.0003), it can be confirmed that the series are free of kurtosis and non-normality (Table 1).

Following the descriptive statistics result is the matrix correlation tests in Table 2 below, which shows the degree of relationship between COVID-19 infections and stock market performance.

The correlation test result depicts perfect positive correlation between ASI and ASI. This is highly acceptable because stock market performance is expected to provide perfect explanations for itself, since the \( r = 1 \). However, COVID-19 infections scored a moderate positive correlation with All Share Index, since \( r = 0.485 \). Here, increasing number of COVID-19 cases might have caused stock market performance to increase at a decreasing rate. Further, it was observed that there was no correlation between stock market performance and exchange rate because exchange rate is determined mainly by external factors. Surprisingly, All Share Index and borrowing rate were negatively correlated. This means that as, All Share Index continues to rise, borrowing rate declines within the study period. Here, economic theory proposing negative relationship between stock market performance and borrowing rate is confirmed. The correlation between COVID-19 infections and COVID-19 infections shows perfect
Table 1 Descriptive statistics *Source: Authors’ computation, 2020*

| Variables | Mean    | Median | Maximum  | Minimum  | Std. Dev | Kurtosis | Jarque–Bera | P-value |
|-----------|---------|--------|----------|----------|----------|----------|-------------|---------|
| ASI       | 23,918.69 | 24,282.86 | 26,449.22 | 20,669.38 | 1382.215 | 2.477   | 8.167       | 0.017   |
| CASES     | 14,832.92 | 7138.5  | 48,445   | 1        | 16,277.45 | 2.095   | 14.386      | 0.001   |
| EXCHR     | 383.711  | 386    | 392.18   | 365.46   | 6.485    | 5.277   | 92.872      | 0.000   |
| NIBOR     | 7.291    | 6.23   | 15.45    | 2.89     | 2.975    | 3.033   | 16.074      | 0.0003  |
Table 2 Correlation tests Source: Authors’ computation, 2020

| Variables | ASI | CASES | EXCHR | NIBOR |
|-----------|-----|-------|-------|-------|
| ASI       | 1.000 | 0.485 | 0.0004 | −0.699 |
| CASES     | 0.485 | 1.000 | 0.464 | −0.699 |
| EXCHR     | 0.0004 | 0.464 | 1.000 | −0.403 |
| NIBOR     | −0.699 | −0.699 | −0.403 | 1.000 |

correlation since \( r = 1 \). Also, it could be perceived that the relationship between COVID-19 infections and exchange rate is positive and moderate. Here, COVID-19 infections caused exchange rate to depreciate gradually as explained through the crude-oil price pathway. Drawing from the above, a relationship exists between COVID-19 pandemic and stock market performance. Following the correlation test is the unit root test to establish the level of integration for each variable. This is presented in Table 3 below.

The unit root test presented in Table 3 reveals that the Augmented Dickey-Fuller and Phillips-Perron tests depict that the series (ASI, CASES, EXCHR and NIBOR) were integrated of order one (1) at 1% levels of significance. This is evident from their probability values which are less than 1% and, as such, is the first condition for the VAR estimation. More importantly, the second condition is that the variables must be cointegrated. It is based on this premise that the cointegration results are presented in Table 4a, b below. Notably, only 1% and 5% significant levels are considered while 10% level of significance are considered insignificant for our decisions.

Drawing from Table 4 (panels A and B), it is arguable that the variables are cointegrated in the long-run because, from the results of the trace test, it could be concluded that the three equations are cointegrated. Similarly, the maximum eigenvalue test supports the above findings of at least three cointegrating equations. This is the confirmation test for the adoption of the VAR technique as presented in Table 6. For purpose of lag order selection criteria, see Table 5.

The result in Table 5 presents lag lengths from zero to three. However, the information selection criteria only find lag length one based on the dictates of the likelihood ratios, Akaike information criterion, Schwartz criterion and Hannan–Quinn criterion. The lag length one is selected and, as such, provides information on the expected lag(s) of the variables to be included in the VAR model.

The result in Table 6 above presents the vector autoregressive (VAR) estimate which shows the dynamic interrelationships between stock market performance and COVID-19 pandemic. Observations show that the lagged value of All Share Index (ASI) has positive impact on current value of All Share Index (ASI). Here, a unit increase in lagged ASI forces current ASI to increase by 1.18 units holding other variables constant. Similarly, lagged ASI exerted positive impacts on borrowing rate and exchange rate within the study period. This might be drawn from the premise that, as stock market performance improves, borrowing rate increases since most fund would be channeled to the stock market. In the same vein, improvements in the stock market attracts more firms to invest and, as such, encourages the domestic investment which,
| Variables | Augmented Dickey–Fuller (ADF) Test | Phillips–Perron (PP) Test |
|-----------|-----------------------------------|-------------------------|
|           | I (0) t-Statistic | P-value | I (1) t-Statistic | P-value | I (0) t-Statistic | P-value | I (1) t-Statistic | P-value |
| ASI       | −2.640 | 0.088 * | −4.373 | 0.001 *** | −1.735 | 0.411 | −7.137 | 0.000 *** |
| CASES     | −0.689 | 0.844 | −1.389 | 0.005 *** | 4.505 | 1.000 | −8.704 | 0.000 *** |
| EXCHR     | −3.012 | 0.057 * | −15.147 | 0.000 *** | −3.029 | 0.055 * | −14.775 | 0.000 *** |
| NIBOR     | −1.566 | 0.496 | −10.941 | 0.000 *** | −2.453 | 0.130 | −17.561 | 0.000 *** |

*, **, *** Represent 10%, 5% and 1% respectively
Table 4 Unrestricted Cointegration Rank Test

| Hypothesised no. of CE(s) | Eigenvalue | Trace statistic | 0.05 Critical value | P-value |
|--------------------------|------------|-----------------|---------------------|--------|
| **Panel A: Trace**       |            |                 |                     |        |
| None *                   | 0.3375     | 100.62          | 47.84               | 0.000  |
| At most 1 *              | 0.284873   | 56.56879        | 29.79707            | 0      |
| At most 2 *              | 0.171244   | 20.69227        | 15.49471            | 0.0075 |
| At most 3                | 0.005541   | 0.594559        | 3.841466            | 0.4407 |
| **Panel B: Maximum Eigenvalue** |          |                 |                     |        |
| None *                   | 0.337483   | 44.05279        | 27.58434            | 0.0002 |
| At most 1 *              | 0.284873   | 35.87652        | 21.13162            | 0.0002 |
| At most 2 *              | 0.171244   | 20.09771        | 14.2646             | 0.0054 |
| At most 3                | 0.005541   | 0.594559        | 3.841466            | 0.4407 |

Source: Authors’ computation, 2020

Table 5 VAR Lag order selection criteria

| Lag | LogL | LR     | FPE     | AIC     | SC      | HQ      |
|-----|------|--------|---------|---------|---------|---------|
| 0   | -652.4372 | NA       | 1.11e+13 | 38.55513 | 38.68981 | 38.60106 |
| 1   | -551.5571 | 178.0237* | 5.02e+10* | 33.15042* | 33.68913* | 33.33413* |
| 2   | -547.0523 | 7.154698  | 6.64e+10 | 33.41484 | 34.35759 | 33.73634 |
| 3   | -540.2274 | 9.635029  | 7.82e+10 | 33.54279 | 34.88958 | 34.00208 |

*Represents that the lag 1 is significant
Source: Author’s computation, 2020

in turn, discourages import and causes exchange rate appreciation. These findings are in tandem with a priori expectations. Interestingly, the lagged value of COVID-19 infections exerts negative impact on All Share Index (ASI). This finding supports the results of the descriptive statistics which show that, as COVID-19 infections spread across the country, the measures taken to curb it, including lockdowns, causes the stock market performance to fall. Here, a unit increase in COVID-19 infections causes ASI to fall by 0.066, in line with Ashraf [17]. Similarly, COVID-19 infections have negative impact on borrowing rate. This could be pitched on the measures (quantitative easing) taken to control the looming recession as adopted by most government economic committees. Notably, COVID-19 cases had positive impact on exchange rate as confirmed from the correlation. This might be because of the exchange rate depreciation, experienced during the COVID-19 peak period, arising from the fall in exchange rate earnings. Undoubtedly, the lagged value of COVID-19 cases has positive impact on current COVID-19 cases. This could be premised on the argument that the higher the
Table 6 Vector autoregressive (VAR) estimation technique Source: Authors’ computation, 2020

|                | ΔASI       | ΔCASES     | ΔNIBOR     | ΔEXCHR     |
|----------------|-----------|------------|------------|------------|
| ΔASI (-1)      | 1.1802    | −0.0235    | 0.0004     | 0.0004     |
|                | (0.0903)  | (0.1567)   | (0.0006)   | (0.0007)   |
|                | [13.0742] | [−0.1502]  | [0.6261]   | [0.5090]   |
| ΔCASES (-1)    | −0.0661   | 0.8810     | −0.0004    | 0.0003     |
|                | (0.0575)  | (0.099)    | (0.0004)   | (0.0005)   |
|                | [−1.1494] | [8.828]    | [−1.0187]  | [0.7593]   |
| ΔNIBOR (-1)    | −20.068   | −27.020    | 0.5126     | −0.0130    |
|                | (15.566)  | (27.013)   | (0.0965)   | (0.1243)   |
|                | [−1.289]  | [−1.0003]  | [5.3108]   | [−0.1045]  |
| ΔEXCHR (-1)    | 23.9726   | 16.646     | 0.0691     | 0.5613     |
|                | (16.038)  | (20.440)   | (0.094)    | (0.094)    |
|                | [−2.1437] | [0.8144]   | [5.9687]   | [5.9687]   |
| Adj. R-Squared | 0.974     | 0.990      | 0.793      | 0.916      |
| Akaike AIC     | 13.78     | 14.88      | 3.61       | 4.12       |

lagged values of COVID-19, the more the current values of COVID-19 cases would increase. The value of the adjusted R-squared is above 0.79, confirming the goodness of fit of the models.

Lastly, the impulse response function (IRF) helps to validate and strengthen the robustness of this analysis. Here, the study utilised the IRF to examine the dynamic interaction between COVID-19 pandemic and stock market performance. Therefore, it traces the effects of one-time shock to one of the innovations on current and future values of endogenous variables. Figure 1 below presents the impulse responses to shock in stock market performance as a result COVID-19 pandemic.

From Fig. 1, it was noticed that the response of All Share Index to COVID-19 infections was negative in periods 1, 2 and 3. This might be explained by the slump in the level of economic activities as a result of the lockdown measures arising from the spread of pandemic. Also, during the period of lockdown, most firms were locked down while traders in the stock exchange were inactive [21]. However, in period 4, the response of All Share Index to COVID-19 pandemic tilted towards the line of origin which could be described as neutral. Surprisingly, the response of All Share Index to COVID-19 infections maintained its neutrality in period 5 through period 10. Here, the neutrality of the response of All Share Index to COVID-19 pandemic could be explained by the increasing activities in the stock market and economy arising from the gradual ease in lockdown, following the gradual decrease in the number of infections after the index case. This finding supports the results of the vector autoregressive (VAR) model which posed a negative interaction between All Share Index and COVID-19 infections.

Similarly, the response of borrowing rate to COVID-19 infections followed a similar pattern as observed above. Here, borrowing rate exhibited negative response to shocks in COVID-19 infections in period 1, 2, 3, 4 and 5. Drawing from this observation, it could be argued that the findings from the impulse response function (IRF) supports
the VAR results. As witnessed in the VAR results, the relationship between borrowing rate and COVID-19 infections was negative. This is explained by the deliberate effort of the Federal Economic Committee to reduce borrowing thus promote economic and stock market activities. After period 5, the response of borrowing rate to shocks in COVID-19 infections—maintained neutrality since it remained on the line of origin in periods 6, 7, 8, 9 and 10. Lastly, the response of exchange rate to shocks in COVID-19 infections was positive in periods 1 and 2; however, it became neutral in period 3. Afterwards, period 4 to period 8 exhibited positive response in exchange rate to shocks in COVID-19 infections, and maintained neutrality in periods 9 and 10. Observations from the impulse response functions show an appreciable support for the VAR results as observed in Table 6. This is built on the premise that, during the peak of COVID-19 pandemic, export earnings to Nigeria dropped drastically as a result of decline in crude-oil price which is the major earner of foreign exchange for Nigeria. Thus, in most of the periods, exchange rate depreciated and weakened the naira weaken against dollar from 360 naira to 1 dollar to over 420 naira to 1 dollar at the peak of the pandemic.

3.5 Conclusion and Policy Recommendations

The study investigates the dynamic interaction of COVID-19 incidence and stock market performance using daily time series data between 2/4/2020 and 8/8/2020 of All Share Index (ASI), COVID-19 pandemic confirmed cases, Nigeria's borrowing rate and exchange rate. It spans through the pre-lockdown, lockdown and post-lockdown periods. Based on the assumption of endogeneity, vector autoregressive (VAR) model
was employed for estimation. The result revealed that COVID-19 confirmed cases have a significant negative effect on stock market performance proxy by stock market returns. This was because measures taken to ameliorate spread of infections, including lockdown, drastically reduced productive activities as well as stock market transactions. Additionally, there is evidence of insignificant negative feedback effect from COVID-19 confirmed cases to stock market returns. This suggests that, if an economy opens up and people are COVID-19 safety-compliant, the number of confirmed cases may come down. More so, COVID-19 infections exert negative effect on borrowing rate which could be explained by government policies (quantitative easing) adopted to curb looming recession triggered by the pandemic. As a strategy to enhance rebound caused by fall in the rate of infections, the monetary policy committee could reduce monetary policy rate. Thus, the combination of these actions promotes decline in borrowing rate. Another important empirical finding is the positive effect of COVID-19 on exchange rate. This supports the huge exchange rate depreciation witnessed during the peak of the pandemic, resulting from fall in the price of oil which is the highest foreign exchange earner for Nigeria. The policy inference from this study is that apart from small and medium enterprises (SMEs), government may need to identify firms facing serious value erosion as a result of COVID-19 and extend stimulus packages to these firms as part of the efforts to prevent huge job loss and supply shocks associated with COVID-19. This will significantly boost investors’ confidence and restore the economy to its pre-COVID-19 state. Lastly, the study suggests that investors could adopt long-term investment strategies in weakened market conditions and buying stocks will be the suitable response.

**Author Contributions** Lukman O. Oyelami, Ph.d conceptualized the idea and prepared the introduction and literature review while Mahew I. Ogbuagu and Olufemi M. Saibu, Ph.D worked on the method and the results.

**Funding** Not Applicable.

**Data Availability** Not Applicable.

**Code availability** Not Applicable.

**Declarations**

**Conflict of interest** Not Applicable.

**Ethical statements** I hereby declare that this manuscript is the result of our independent creation under the reviewers’ comment. Except for the quoted contents, this manuscript does not contain research achievements that have been published or written by other individuals or groups. We are the only author of this manuscript. The legal responsibility of this statement shall be borne by us.

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