Abstract

Purpose – The purpose of this study is to assess the extent to which the Ghana stock market performance has been impacted by the novel COVID-19 pandemic.

Design/methodology/approach – The study used the exponential generalized autoregressive conditional heteroscedasticity (EGARCH) model, by using daily time series data from 2 January 2015 to 13 October 2020. Both pre-estimation (Augmented Dickey-Fuller and Phillips-Perron) and post-estimation tests (Jarque-Bera) were conducted to validate the results.

Findings – While the study shows a statistically insignificant negative relationship between the COVID-19 pandemic and the Ghana stock returns, the results confirm that the COVID-19 pandemic has occasioned an increase in the Ghana stock returns volatility by 8.23%. Furthermore, the study confirmed the presence of volatility clustering and asymmetric effect, with the latter implying that worthy news tends to affect volatility more than unwelcome news of equal size.

Practical implications – To dampen uncertainties that trigger stock market volatility, the government should surgically target worse affected COVID-19 pandemic businesses and households to check the drop in profits and demand. Rigidities associated with stock market operations must be addressed to make it attractive to investors even in the midst of a pandemic.

Originality/value – This paper is a pioneer attempt at assessing the extent to which a developing economy stock market has been impacted by the novel COVID-19 pandemic using the EGARCH model.

Keywords Developing economy, Stock market, COVID-19 pandemic, EGARCH model

Paper type Research paper

1. Introduction

COVID-19 has devastated the world and is predicted to be the biggest economic shock in human history. The continued spread of the pandemic and its implications on economic...
growth around the globe is a concern for policymakers. Economic activities in many countries have drastically reduced due to strict measures on human movements to contain the spread of the virus (World Bank, 2020). Consequently, growth in the global economy is expected to contract up to 5.2%, which will be the deepest recession the world has seen in decades and the pandemic will be the largest economic shock the world has witnessed in many years according to the World Bank report. The report further revealed that many governments around the globe have introduced measures to mitigate the effect of the pandemic, such as stimulus packages to assist the private sector, strengthening the health sector and providing financial help for households.

The African continent received its first share of the virus on 14 February 2020 and the virus has since spread throughout the continent. Even before it reached the continent, economic impacts emanating from the pandemic was already being felt on its shores. These were reduced demand for Africa’s commodity exports, the collapse of the tourism and air transports and depreciation of the local currencies stemming from a deteriorating current account balance. Growth in sub-Saharan Africa (SSA) is expected to shrink by 2.8% in 2020, which reflects the extent of potential damage to the continent. Undoubtedly, the persistence and continual spread of the pandemic could have a daunting effect on both human lives and the economy such as worsened poverty and inequality levels and even cause financial crises, especially in the SSA region and Ghana is no exception (UN, 2020; World Bank, 2020).

Ghana recorded its first case of the virus on 12 March 2020, which has escalated to 47,126 with 310 deaths and 347 active cases by 10th October, 2020 (Ghana Health Service, 2020a). Like many other developing countries, the gross domestic product of the country is expected to shrink from 6.8% to 2.6% in 2020 (Deliotte, 2020). This recession could affect various sectors of the economy including the stock market due to uncertainties. These uncertainties that will arise will further affect the economy through the low participation of businesses and households in economic activities and the financial market. Businesses may withhold their investments and households may cut off spending particularly on luxuries, as well as investments. Outflow of multi-national funds could also be triggered by uncertainties due to the economic upheaval caused by the pandemic. Moreover, economic disruptions arise because uncertainties tend to heighten stock market risk and its performance (Tsai, 2017).

Ghana’s stock market has experienced a downward spiral since mid-2018 but deepened since November, 2019 till date (coinciding with the period of the COVID-19 pandemic). Figures 1 and 2 depict the monthly average composite index and the monthly average market capitalization for Ghana Stock Exchange (GSE) for the period, January, 2015 to October, 2020.

![Average Monthly Index](https://gse.com.gh/market-summary-equities/)

**Figure 1.** Average monthly index

**Source:** Authors’ Construction (Data used for the construction of the graphs and the empirical estimation can be accessed at: https://gse.com.gh/market-summary-equities/)
The index experienced decline up until December, 2016 albeit, with few recoveries, then recovered with positive growth from January, 2017 to April, 2018 interlaced with few declines and subsequently have been on a downward spiral from May, 2018 to October, 2020 though with few intermittent recoveries. Figure 2 shows the monthly average Market Capitalization in million Ghana Cedis for the GSE from January, 2015 to October, 2020. Similar to the index’s trend, the market capitalization declined for the first 26 months with few intermittent recoveries, then experienced positive growth with few declines from April, 2017 to May, 2018. It then declined sharply for two months, recovered for the next three months and has plummeted though with few occasional recoveries from November, 2018 to October, 2020.

Generally, stock market returns respond to economic shocks such as natural disasters, political events and pandemics (Tavor and Teitler-Regev, 2019; Zach, 2003; Chen et al., 2007). In this regard, the impact of the COVID-19 pandemic on Ghana’s stock market may be expected. However, the magnitude and the nature of the effects on it are not clearly understood. Also, lacking in our understanding of the issue is the evidence of volatility clustering and the asymmetric effects of the COVID-19 pandemic. Gaining an in-depth insight into the magnitudes of the expected and the nuances of the pandemic in relation to the Ghana stock market is critical to design well-informed mitigating measures to abate the daunting effects. Therefore, this study seeks to provide some evidence of the extent to which the Ghana stock market has been affected by the novel COVID-19 pandemic. While the novel COVID-19 pandemic impact on the stock market performance has received some attention in recent times (Al-Awadhi et al., 2020; Phan and Narayan, 2020; Baker et al., 2020; Onali, 2020; He et al., 2020; Sharif et al., 2020; Albulescu, 2020; Cox et al., 2020; Baek et al., 2020; Erdem, 2020; Ashraf, 2020; Liu et al., 2020; Zhang et al., 2020; Papadamou et al., 2020; Narayan et al., 2020), the use of autoregressive conditional hetoscedasticity (ARCH) group of models in these empirical studies is rare. Further, the few studies on the crisis and Ghana focused on other areas. Asante and Mills (2020) looked at the socio-economic impact of COVID-19 in marketplaces in urban Ghana whilst Uppalkpajor and Uppalkpajor (2020) focused on the impact of COVID-19 on education in Ghana. The closest study by Agbloyor et al. (2020) focused on the impact of the COVID-19 crisis on the informational efficiency of the GSE. As a key contribution, this study is a pioneer attempt to assess the extent to which the Ghana stock market has been impacted by the novel COVID-19 pandemic using the exponential generalized ARCH (EGARCH) model.

The rest of the paper is presented as follows. Subsequent to the introduction, Section 2 reviews literature on the relationship between health pandemics and stock market performance. Section 3 presents the modelling framework for empirical estimation. Section 4 provides the estimation results and Section 5 concludes with some policy implications.

![Figure 2. Average monthly market capitalization](https://gse.com.gh/market-summary-equities/)

**Source:** Authors’ Construction (Data used for the construction of the graphs and the empirical estimation can be accessed at: [https://gse.com.gh/market-summary-equities/](https://gse.com.gh/market-summary-equities/))
2. Literature review

Since the onset of COVID-19 in the latter part of 2019, a lot of research and debate on the cause and effect of the virus on almost all sectors of the global economy is currently on-going. Against a backdrop that major or global scale events impact financial markets and stock exchange returns in particular (Zach, 2003), it is not surprising that studies on earlier pandemics have been conducted on how such global, regional or country specific pandemics can impact the stock market. Because of the high volatility rate of the stock markets and the interdependencies that are associated with it, such shock is likely to impact the stock market in one way or another. For example, Chen et al. (2007, 2009) asserts that the severe acute respiratory syndrome had its toll on the stock markets. Further, Ichev and Marinč (2018) revealed that the effect on stock prices of US companies, which were exposed to the origin of a different pandemic; Ebola virus outbreak, was strongest in comparison to other unexposed stock prices. Mostly, such shocks are transmitted through channels of reduced consumption, low patronage of businesses and other times, according to the magnitude or the degree of the exposure the country faces (McKibbin and Fernando, 2020). Moreover, shocks in the oil market and uncertainties also affect stock markets (Sadorsky, 1999; Papapetrou, 2001; Ciner, 2001; Cong et al., 2008). For instance, Dutta et al. (2017) investigated how the stock market volatilities was impacted by the oil market uncertainties in the African and Middle East markets. Using the extended version of the GARCH and the GARCH-jump models, the authors findings indicated that oil market uncertainties have an enormous effect on the volatility of stock markets of most of the markets that they studied. Aside, stock markets, there is some evidence of a relationship between periods of economic uncertainties and crisis on one hand and similar assets such as safe havens and cryptocurrencies on the other hand. Raza et al. (2018) confirms the positive relationship that exists between worldwide economic uncertainties and gold. The literature on co-movements of worldwide economic uncertainties and Bitcoin and related currencies is, however, replete with mixed inconclusive results. Gozgor et al. (2019) and Smales (2019) found a negative relationship while Bouri et al. (2017) and Bouoiyour and Selmi (2019) confirmed a positive relationship. Applying the wavelet method to daily data of COVID-19 deaths and Bitcoin prices from 31st December, 2019 to 29th April, 2020, Goodell and Goutte (2020) concluded that the rise in the global COVID-19 cases resulted in an increase in Bitcoin prices. This is in contrast with Conlon and McGee (2020), who found that the increase in the COVID-19 crisis led to a decline in the price of Bitcoin.

There is a gradual build up and a foundation of literature pointing to how global health pandemics can impact stock markets either at the global, region, group or country level. With the crisis originating from the city of Wuhan in China and the initial epicenter of the crisis being China with its attendant government restrictions, the economy of China including its financial market was expected to be adversely affected. Al-Awadhi et al. (2020) investigated the effect of COVID-19 on the Chinese stock market using panel testing analysis and found that the stock market returns across all companies were negatively impacted by the disease. Similarly, He et al. (2020) using the daily stock market index from the Chinese stock market and applying the event study approach found the health-care, education, information technology and manufacturing sectors to be resilient to the COVID-19 crisis. The study, however, found the electricity and heating, mining, environment and transportation sectors to have been negatively impacted by the crisis. This suggests that the Chinese Government’s responses to the crisis might have worked to some extent with respect to the performance of its financial market. Subsequent to the COVID-19 outbreak in China, the second country to experience a major outbreak was South Korea and then followed by Iran. By March, 2020, China and South Korea had the situation under control but the viral nature of the disease meant that the epicenter moved to Europe and then to the US with the latter leading globally with the total number of
confirmed cases (Zhang et al., 2020). The dire nature of the disease resulted in a series of response proposals from the US Federal Reserves to provide several trillions of dollars to support the US economy (Cox et al., 2020). Despite these policy proposals, the US economy especially the financial market was not insulated from the negative effect of the crisis. Baker et al. (2020) asserts that the COVID-19 impact is far more potent in affecting the stock exchange market than all prior health pandemics in history. Specifically, using the US stock market, it was revealed that the huge magnitude of COVID-19 seems to be weightier than all the pandemics in the 20th century because of the safety protocols such as social distancing and general restrictions vis-à-vis a service-based economy. In a similar study, Sharif et al. (2020) applying the coherence wavelet method to daily data on COVID-19 and US stock price index (Dow Jones 30 Index) among other indicators found an unprecedented sensitivity of the US stock market to the COVID-19 pandemic along with other findings. Further, Albulescu (2020) using a simple ordinary least squares (OLS) regression model to COVID-19 statistics on the global and US and the S&P Dow Jones indices found evidence that the crisis with it attendant uncertainties caused a rise in the US financial markets’ volatility. Cox et al. (2020) using the dynamic asset pricing model found significant fluctuations in the pricing of US stock market risk, which was attributed to COVID-19 induced Federal Reserve’s responses. The study concludes that due to the Reserve’s inability to provide the credit as announced, the stock market movements during the crisis boiled down to sentiment rather than substance. Likewise, Baek et al. (2020) relying on daily US stock index values, macroeconomic indicators and COVID-19 confirmed cases found among other findings, confirmed that the COVID-19 news impacted the US stock market volatility. The study concludes that both positive and negative COVID-19 news impacted the market volatility but the negative news impact was more pronounced. Evidently, the US financial market have not been spared the rippling negative effects of the pandemic culminating in the US stock market crash in March, 2020 (Mazur et al., 2020). As a public health incident of global magnitude, the impact of the COVID-19 on the global economy have been adversely intense (Njindan Iyke, 2020). Erdem (2020) used daily stock markets’ indices of 75 countries with their corresponding COVID-19 data and measuring volatility using standard deviation, found evidence that whilst the global financial market was negatively impacted by the crisis, the adverse effects were more felt in less-free countries than in freer countries. In addition, a study by Ashraf (2020) applied pooled panel OLS regression model to daily data on stock markets from 77 countries, found a direct negative effect of the COVID-19 crisis on stock markets’ returns whilst the reduction in COVID-19 cases has an indirect positive effect on stock markets’ returns. Similarly, Liu et al. (2020) used an event study method on countries including Germany, Italy, Japan, Korea among others to assess how 21 major stock exchange markets around the world were impacted in the short run by the novel COVID-19. Their findings reveal that the initial shock of the pandemic had a negative impact on stock markets mainly through pessimism from investors regarding future returns. Further, Zhang et al. (2020) using stock markets data and COVID-19 confirmed cases from the top 10 countries with confirmed COVID-19 cases concluded that the stock market risks of all countries increased substantially as a result of the COVID-19 pandemic. Equally, a study by Ali et al. (2020) uses daily prices and returns of morgan stanley capital international indices of the top nine countries with COVID-19 confirmed cases along with some regional indices and applied the EGARCH model in their empirical analysis. The results show a negative effect of the COVID-19 crisis on the returns of most of the financial securities whilst the securities became more volatile as a result of the COVID-19 deaths. Moreover, Papadamou et al. (2020) assessed how the use of google tend synthetic index regarding coronavirus affects the implied volatilities of 13 main stock markets in Europe, Asia, USA and Australia using panel data analysis. The study found that increased search queries for COVID-19 had a direct effect on volatility and the
pandemic has an indirect effect, which is channelled through stock returns due to risk-aversion with Europe recording a stronger effect. Furthermore, Gunay (2020) examined how the stock markets of the US, UK, China, Italy, Spain and Turkey have been impacted by COVID-19 using the iterative cumulative sum of squares test, dynamic conditional correlation – multivariate generalized autoregressive conditional heteroscedasticity and dynamic conditional correlation – multivariate fractionally integrated generalized autoregressive conditional heteroscedasticity models and indicated that the stock markets exhibited structural breaks in the volatility of their indexes. The structural breaks could account for the time of restrictions and the ease of restriction during the COVID-19 pandemic, as well as government interventions in the economy. Strikingly, Narayan et al. (2020) using time-series data of G7 countries and a multiple linear regression model found evidence that COVID-19 induced travel bans, economic stimulus packages and lockdowns all had a positive effect on the G7 stock markets. Undoubtedly, the global financial architecture has not been spared the rippling effects of the novel COVID-19 pandemic.

Dwelling on the captivating and informed research on how pandemics and in this case, COVID-19 can impact the stock market, this study equally attempts to examine the extent to which the Ghana stock market has been impacted by the novel COVID-19 pandemic. Because Ghana is a developing economy, results from this study can be a benchmark for consideration by other developing economies. Further, it will show how SSA’s fifth strongest stock exchange market [1] fared with the onset of the Covid-19 pandemic.

3. Modelling framework

Volatility determination has necessitated the use of the ARCH group of models in financial literature. From the initial ARCH model developed by Engle (1982), the model has gone through improvements including GARCH, GARCH-in-mean, Quadratic GARCH, Threshold GARCH models, etc. Nelson (1991) also extended the ARCH model with the development of the EGARCH, which makes it possible to combine the determination of volatility with the analysis of asymmetry information. Asymmetric effect captures the effect of news on the volatility. Specifically, it determines if positive news has a more noticeable effect on volatility than adverse news of equal size or if adverse news has a more noticeable effect on volatility than positive news of equal size. This approach is, therefore, applied to examine the extent to which the stock returns and volatility of Ghana has been impacted by the novel COVID-19 pandemic. The following provides the EGARCH model specifications:

\[ R_t = \alpha + \beta X_t + \varepsilon_t \quad (1) \]

\[ \varepsilon_t \bigg| \Omega_{t-1} \sim iid \ N(0, h_t) \quad (2) \]

\[ \log(h_t) = \vartheta + \sum_{j=1}^{q} \delta_j \log(h_{t-j}) + \sum_{i=1}^{p} \theta_i \left| \frac{\varepsilon_{t-i}}{\sqrt{h_{t-i}}} \right| + \sum_{k=1}^{r} \gamma \quad (3) \]

In equation (1), \( R_t \) represents the stock return of the Ghana Stock market, which is dependent on \( \alpha \), a drift term, \( X_t \), exogenous variable(s) and \( \varepsilon_t \) is the error term with the subscription \( t \) indicating the usage of time series data. This equation is otherwise known as the conditional mean equation. Equation (2) captures the error term mathematically expressed to show that its constant variance and the zero mean residuals of the independent distribution. Equation (3) is referred to as the conditional variance equation with the dependent variable \( h_t \) representing
Ghana’s stock market returns conditional variance depending on a number of explanatory variables. The autoregressive (AR) (p) or autoregressive moving average (ARMA) (p, q) are usually incorporated as explanatory variables of the dependent variable in the conditional mean equation of the GARCH models. A plus to the GARCH type of model is its flexibility to incorporate explanatory variable(s) and dummy variable(s) in the conditional mean, as well as the variance equations to suit the aim(s) of the study. Accordingly, this study used COVID-19 pandemic (COVID) as an explanatory variable in both the conditional and variance equations to examine the extent to which the Ghana stock returns and volatility has been impacted by the pandemic. To aid in our analysis, AR (1) is included in equation (1) with a dummy variable (COVID). The equation (3) would also be modified with the inclusion of the dummy variable (COVID). Consequently, equations (1) and (3) are modified accordingly as:

\[ R_t = \alpha + \beta AR(1) + \lambda COVID + \epsilon_t \]  
\[ \log(h_t) = \vartheta + \sum_{i=1}^{p} \frac{\mu_{t-i}}{\sqrt{h_{t-i}}} + \sum_{k=1}^{q} \gamma \frac{\mu_{t-k}}{\sqrt{h_{t-k}}} + \sum_{j=1}^{q} \delta_j \log(h_{t-1}) + \varphi COVID \]  

The conditional mean equation in equation (4) now includes an AR specification and a dummy variable (COVID) to aid in examining the extent to which the Ghana stock returns has been impacted by the novel COVID-19 pandemic. The model selection criteria including correlogram give an indication of the choice of either an only AR or ARMA representation in a model.

Furthermore, the conditional variance equation captured in equation (5) now includes the same dummy variable (COVID) to aid in determining the extent to which the Ghana stock market volatility has been impacted by the novel COVID-19 pandemic. The \( h_t \) in equation (5) is a dependent variable, which depends on a constant (\( \vartheta \)), the ARCH effect (\( \vartheta \)) shows the presence of conditional volatility of the returns, the GARCH effect (\( \delta \)) indicates volatility clustering, the asymmetric effect (\( \gamma \)) shows the effect of shocks on the volatility of returns provided the coefficient is non-zero. If the coefficient of the asymmetric effect is negative, it signifies adverse news has a more pronounced effect on the volatility than worthy news of equal size. On the other hand, if the coefficient is positive, it implies that worthy news tends to affect volatility more than adverse news of equal size. The coefficient of the dummy variable (\( \varphi \)) depicts the extent to which the Ghana stock market volatility has been impacted by the novel COVID-19 pandemic. The model is estimated using the daily stock index \([2]\) of GSE for the period 2nd January, 2015 to 13th October, 2020 and this was sourced from the GSE.

4. Estimation and results
The stock returns are calculated following Ali and Afzal (2012) and Omet et al. (2002) as:

\[ R_t = lnP_t - lnP_{t-1} \]

Where \( R_t \) depicts stock returns, \( ln \) is a natural log, \( P_t \) represents time \( t \)’s stock market index and \( P_{t-1} \) represents the previous time, \( t - 1 \)’s stock market index. To examine the extent to which the Ghana stock market has been impacted by the novel COVID-19 pandemic, a dummy variable (COVID) has been included in the model representing 1 during the period of the COVID-19 and other period represented by 0. Following the identification of COVID-19
in Wuhan, China in December, 2019 and Ghana recording its first case in 12 March, 2020 (Ghana Health Service, 2020b), this study considers the COVID-19 period in Ghana to be from 12 March, 2020 to present.

The descriptive statistics of the returns of the Ghana stock market is presented in Table 1. The mean returns value of the stock market is close to zero whilst the median returns value is zero. The non-normality of the distribution is indicated by the presence of skewness and excess kurtosis. The excess kurtosis implies that the stock market distribution is leptokurtic whilst the negative value of skewness shows that the distribution right side’s tail is smaller or shorter than the left side. The Jarque-Bera test statistics with its high significance confirms the departure of the distribution from normality. As a result of the distribution’s non-normality, the student’s t conditional distribution for errors is applied in the EGARCH model and the estimation is aptly done to achieve convergence. The behaviour of the GSE stock returns is depicted in Figure 3 where small changes in the stock market’s returns are followed by further small changes and major changes are further followed by further major changes.

4.1 Unit root test

The stationary properties of a time series data need to be satisfied for the data to be seen and behaved. Consequently, it is important to scrutinize the behaviour of the return series of the stock market because of its economic significance. The importance is borne out of the inability of non-stationary activities of a return series be credited to sudden sets of information in Ghana stock market, internal factors or external factors. To assess the stationarity or otherwise of the series, the Phillips-Perron and Augmented Dickey-Fuller tests have been performed. The report is presented in Table 2 below.

The result shows the high significance of both tests in all the three settings for the Ghana stock market series. Consequently, we accept the alternative hypothesis confirming the stationarity of the return series.

The EGARCH result on the Ghana stock returns is contained in Table 3. The first part of the result presents the conditional mean equation results whilst the variance equation results are contained in the second part. The bottom part of the result shows the results of the diagnostic tests performed on the model. The mean equation results for the Ghana stock market from the first part confirm that the current stock return is predicted by the immediate past stock return as the coefficient of one period lagged value of stock return $\beta$ (0.0663) is significant. Furthermore, the coefficient of $\lambda$ (−0.0003) suggest that the stock

<table>
<thead>
<tr>
<th>Statistic</th>
<th>GSE returns</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>−0.0001</td>
</tr>
<tr>
<td>Median</td>
<td>0.0000</td>
</tr>
<tr>
<td>Maximum</td>
<td>0.0699</td>
</tr>
<tr>
<td>Minimum</td>
<td>−0.0706</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>0.0039</td>
</tr>
<tr>
<td>Skewness</td>
<td>−0.0835</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>156.9266</td>
</tr>
<tr>
<td>Jarque-Bera</td>
<td>1,405,809</td>
</tr>
<tr>
<td>Probability</td>
<td>0.0000</td>
</tr>
<tr>
<td>No. of observations</td>
<td>1,424</td>
</tr>
</tbody>
</table>

Source: Authors' construction (Data used for the construction of the graphs and the empirical estimation can be accessed at: https://gse.com.gh/market-summary-equities/)
Figure 3.
GSE Daily Returns (January 2015–October 2020)

Source: Authors’ Construction (Data used for the construction of the graphs and the empirical estimation can be accessed at: https://gse.com.gh/market-summary-equities/)

Table 2.
Unit root test (at levels) of the GSE stock return series

<table>
<thead>
<tr>
<th>Test specification</th>
<th>Phillips-Perron</th>
<th>Probability</th>
<th>ADF</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>With intercept</td>
<td>−48.5614</td>
<td>0.0001</td>
<td>−7.9473</td>
<td>0.0000</td>
</tr>
<tr>
<td>With intercept And trend</td>
<td>−48.5310</td>
<td>0.0000</td>
<td>−7.9724</td>
<td>0.0000</td>
</tr>
<tr>
<td>Without intercept And trend</td>
<td>−48.5786</td>
<td>0.0001</td>
<td>−7.9437</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Source: Authors’ construction (Data used for the construction of the graphs and the empirical estimation can be accessed at: https://gse.com.gh/market-summary-equities/)

Table 3.
Parameter estimates of EGARCH model

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficient</th>
<th>Standard error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean equation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \alpha )</td>
<td>−0.0000</td>
<td>0.0000</td>
</tr>
<tr>
<td>( \beta )</td>
<td>0.0663***</td>
<td>0.0242</td>
</tr>
<tr>
<td>( \lambda )</td>
<td>−0.0003</td>
<td>0.0002</td>
</tr>
<tr>
<td>Variance equation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \delta )</td>
<td>−1.3187***</td>
<td>0.2419</td>
</tr>
<tr>
<td>( \theta )</td>
<td>0.8209**</td>
<td>0.3681</td>
</tr>
<tr>
<td>( \gamma )</td>
<td>0.0462</td>
<td>0.0623</td>
</tr>
<tr>
<td>( \delta )</td>
<td>0.9007***</td>
<td>0.0206</td>
</tr>
<tr>
<td>( \varphi )</td>
<td>0.0823*</td>
<td>0.0435</td>
</tr>
<tr>
<td>( ARCH LM (1) )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( F )-statistic</td>
<td>0.0476</td>
<td></td>
</tr>
<tr>
<td>( Obs*R^2 )</td>
<td>0.0477</td>
<td></td>
</tr>
<tr>
<td>( SIC )</td>
<td>−9.3129</td>
<td>Insignificant</td>
</tr>
<tr>
<td>( Q)-stats (1 lag)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: ***, ** and * are statistical significance at the 1%, 5% and 10% levels, respectively
Source: Authors’ construction (Data used for the construction of the graphs and the empirical estimation can be accessed at: https://gse.com.gh/market-summary-equities/)
returns and the novel COVID-19 pandemic are inversely related, yet there is not enough evidence to confirm that the pandemic impacted on Ghana stock returns due to the coefficient of $\lambda$ being insignificant.

In addition, the second part of the table confirms the presence of the ARCH effect with the coefficient of $\theta$ (0.8209) being significant. This implies that recent past news have affected the present period stock returns. The positive coefficient of $\gamma$ (0.0462) suggests the presence of an asymmetric effect signifying that worthy news tends to affect volatility more than unwelcome news of equal size. The GARCH effect represented by $\delta$ with a positive significant coefficient of (0.9007) confirms the presence of volatility clustering in Ghana stock market returns. This implies that major changes in the stock returns are further followed by major changes, of either sign and minor changes are also followed by further minor changes. The positive significant coefficient of $\varphi$ (0.0823) confirms that the stock market volatility has been positively impacted by the novel COVID-19 pandemic. This result corroborates the findings of Albulescu (2020), Ali et al. (2020) and Baek et al. (2020). The implication of this result is that the pandemic has occasioned an increase in the Ghana stock market returns volatility by 8.23%. The diagnostic tests performed on the model presented in the third part of the table shows the accuracy of the model specification because of the ARCH-lagrange multiplier and Observed-$R^2$ test statistics being insignificant. Additionally, the Q-Stat value for the specified lag of 1 is insignificant signifying an insulation of the model from autocorrelation.

5. Conclusion
The key object of the present study is to examine the extent to which the Ghana stock market returns and volatility has been impacted by the novel COVID-19 pandemic. The descriptive statistics depicting the basic properties of the stock returns series were performed. The EGARCH estimation was used to analyse the effects of COVID-19 on Ghana stock market. Pre-estimation tests such as the Phillips-Perron and Augmented Dick-Fuller tests were first conducted to confirm the stationarity of the stock returns series, while post estimation diagnostics tests such as the Jarque-Bera tests were performed. Daily stock index of GSE from 2nd January, 2015 to 13th October, 2020 from the GSE have been used to assess the extent to which the Ghana stock market has been impacted by the novel COVID-19 pandemic. The statistical results of the EGARCH model applied confirmed the predictability of recent stock returns by past stock returns and whilst the relationship that exist between the stock returns and COVID-19 pandemic is negative, there was not enough evidence to confirm the impact of the pandemic on Ghana stock returns. In addition, the results established the presence of volatility clustering whilst the asymmetric effect shows that worthy news tends to affect volatility more than unwelcome news of equal size. Additionally, the results show that the increase in the volatility by 8.23% of the Ghana stock returns is occasioned by the novel COVID-19 pandemic.

The severity of the COVID-19 pandemic necessitates a holistic approach to ameliorate its impacts. Because of the rapid transmission of the virus, policy measures were implemented, which resulted in supply shocks globally, particularly in the travel, tourism, manufacturing and labour-intensive sectors. To preserve lives, a number of restrictions including but not limited to lockdowns were rolled out. Though the restrictions have been eased, businesses are not operating at levels prior to COVID-19 pandemic. These restrictions reduce economic activities, which ultimately affect businesses’ profitability and households’ consumption. These challenges have resulted in staff cut backs, shut down and in some cases, demand shocks. This explains the underlying factor accounting for the panic mode of financial markets globally. Stock
prices are seen as potential future earnings by investors, as a result, negative happenings (the magnitude of COVID-19 pandemic) derail these future revenues. A rational investor would, therefore, sell the stocks before the pandemic heightens. Our findings provide critical inputs in policymaking. A holistic approach including government officials, financial regulations and the Central Bank would need to work hand-in-hand to address these challenges. Banks can support businesses that have been heavily hit especially those in the travel, tourism and manufacturing sectors by rolling over their current loans. Other struggling businesses and the pandemic induced redundant households, can be surgically targeted by the government and given some level of financial support. These would give some level of reprieve to these businesses and individuals to ensure their continuous operation and consumption, which would dampen the uncertainties that triggers stock market volatility. Phan and Narayan (2020) asserts that during crisis periods such as the COVID-19, stock market overreact to unexpected news, arguing that as more information are made available to people, which makes them to better appreciate the ramifications, the markets eventually corrects itself. The present study recommends that investors should shy away from panic activities on the stock market, which would rather exacerbate the volatile situation at hand. Furthermore, the bottlenecks associated with stock market operations in the SSA region must be addressed by the government and the stock market regulators to improve efficiency. The removal of these rigidities would improve operational efficiencies, liquidity and depth, which would make these markets attractive to investors even in pandemic periods.

Notes
1. Available at: www.africanbusinesscentral.com/2019/02/17/top-6-largest-stock-exchanges-in-sub-saharan-africa-video/
2. Data used for the construction of the graphs and the empirical estimation can be accessed at: https://gse.com.gh/market-summary-equities/

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