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The impact of COVID-19 on stock market performance in Africa: A Bayesian structural time series approach

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ABSTRACT

This paper evaluates and quantifies the short-term impact of the coronavirus disease of 2019 (COVID-19) on stock market performance in thirteen (13) African countries, using daily time series stock market data spanning 1st October 2019 to 30th June 2020. We employ a novel Bayesian structural time series approach (a state-space model) to estimate the relative effects of the COVID-19 pandemic on stock market performance in those countries. Generally, our Bayesian posterior estimates show that, in relative terms, stock market performances in Africa have significantly reduced during and after the occurrence of the COVID-19, usually between -2.7 % and -21 %. At the heterogeneous level, we find that 10 countries have their stock markets significantly and adversely affected by the COVID-19, whereas the remaining 3 countries see no significant impact (or a rather short-lived negative significant impact) of the COVID-19 pandemic on their stock markets. We find that, within our sample period, there is almost no chance that the COVID-19 pandemic would have positive effects on the stock market performance in Africa. Our findings contribute to the discussion and research on the economic impact of the COVID-19 pandemic by providing empirical evidence that the pandemic has restrictive effects on stock market performance in African economies.

1. Introduction

The world is experiencing an unprecedented health shock as the novel coronavirus disease of 2019 (COVID-19) sweeps across the massive population around the world. The first case of the virus was recorded in China's Wuhan during December 2019 and has since spread to various parts of the world including Africa. The World Health Organization (WHO) issued its first global alert of the COVID-19 on 30th January 2020 (WHO, 2020a). As the number of confirmed cases soared throughout the world, the WHO announced the COVID-19 as a pandemic on 11th March 2020 (WHO, 2020b). Globally, as of 23rd July 2020, over 15 million confirmed cases with more than 619,000 deaths have been reported (WHO, 2020c). At the same time, Africa recorded over 642,000 cases with more than 10,000 related deaths (WHO, 2020c). In order to curb the spread of the virus, various governments around the world, including those in Africa, continue to institute and adopt several preventive and public health policy measures such as travel restrictions, school closures, physical or social distancing, wearing of face masks, and regular hands washing.

While the full socio-economic costs associated with the COVID-19 pandemic remain uncertain, the devastating effects of the pandemic are evident, although only indicative, around the world. Going forward, the COVID-19 pandemic poses a great threat to the

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economic growth and development of many economies. In particular, developing economies, where there are weak health care systems, limited resources and fiscal space, less developed financial sectors, among others, stand at a greater disadvantage to the pandemic. That is, the effects of the COVID-19 pandemic on the welfare of households, financial and non-financial markets performance, and economic growth and development of national economies are likely to be greater in developing countries, with countries in Africa not exceptions. For example, the World Bank predicts a steady decline in economic growth from about 2.4 % in 2019 to -2.1 % and -5.9 % in 2020 in sub-Saharan Africa. Also, the loss in economic output is projected to be between US\$7 billion and US\$79 billion dollars with welfare loss to see a decrease between 7% and 10 % (World Bank, 2020 as cited in (Balde, Boly, & Avenyo, 2020)). Additionally, the United Nations Economic Commission for Africa (UNECA) projects Africa's economic growth in 2020 to slow to 1.8 % in the best-case scenario or to see a contraction of 2.6 % in the worst case, which has the potential to push 29 million people into extreme poverty (UNECA, 2020).

As with the 2007–2009 Global financial crises, one of the major concerns of financial economists and investors is the impact that the COVID-19 pandemic would have on the financial and the stock markets. A pandemic such as COVID-19, which could be described as a “Black Swan event”, could cause shock, fear, and panic among both domestic and international investors and could result in a sharp panic-selling response (He, Liu, Wang, & Yu, 2020). As the WHO and other public health officials communicate the number of confirmed cases as well as the risk of the COVID-19 outbreak to the general public, investors would shape their sentiments towards the disease, which could significantly influence the stock market. For example, when the stock market trends upwards and there is a less perceived risk then investors would behave more optimistically. On the other hand, when the stock market trends downwards and there is a high perceived risk then investors sentiments would become relatively pessimistic and as a result, they would tend to wait to enter the market until a revival begins (Burns, Peters, & Slovic, 2012; Liu, Manzoor, Wang, Zhang, & Manzoor, 2020; Lu & Lai, 2012). Such situations would lead to short-term investor overreaction and would make the stock market to be pricing in fear. As a result, many investors would resort to holding other assets which are regarded as “safe-haven investment” to reduce risk during these uncertain economic periods (He et al., 2020). The consequences of such actions by investors could reduce stock market prices, leading to lower performance of the market.

By recognizing the above potential economic effects of the pandemic and to respond to the global call to unearth the economic costs of the coronavirus, many recent empirical studies have attempted to examine the impact of the COVID-19 pandemic on stock market performance in different countries, using different econometric techniques. For example, He et al. (2020) explored the direct and spill-over effect of COVID-19 on stock markets in the People's Republic of China, Italy, South Korea, France, Spain, Germany, Japan, and the United States of America (USA). Using conventional t-tests and nonparametric Mann–Whitney tests, they found that [1] the COVID-19 pandemic has a negative but short-term impact on stock markets of those countries; and [2] the impact of COVID-19 on stock markets has bidirectional spill-over effects between Asian countries and European and American countries. Similarly, Liu et al. (2020) evaluated the short-term impact of the COVID-19 outbreak on 21 leading stock market indices in Japan, Korea, Singapore, the USA, Germany, Italy, and the United Kingdom (UK). They used an event study method and found that the stock markets in these countries fell quickly after the virus outbreak. They also documented that countries in Asia experienced more negative abnormal returns as compared to other countries.

In addition, Yan, Tu, Stuart, and Zhang (2020) analyzed the potential effects that the COVID-19 would have on the stock market and then proposed possible ways that an individual could profit off a market affected by a global viral outbreak. They examined past pandemics or outbreaks and concluded, that often, stock markets reacted adversely to such outbreaks in the short run but in the long run, markets eventually corrected themselves and increased. In order to profit off such a market, they proposed industries that are immediately affected by the virus to be shortened in the short run and then eventually buying back into those industries after their prices have significantly dropped. Also, Baker et al. (2020) used text-based methods to examine the unprecedented stock market impact of COVID-19 in the USA. They found that whereas previous pandemics, including the Spanish Flu, left only mild traces on the US stock market, the COVID-19 pandemic has forcefully impacted the stock market in the USA. Adenomon, Majumaa, and John (2020) examined the effects of the COVID-19 pandemic on Nigerian's stock exchange performance by employing Generalized Autoregressive Conditional Heteroskedasticity (GARCH) Models. They found that COVID-19 has negative effects on the stock market returns in Nigeria.

Furthermore, Yilmazkuday (2020) explored the effects of COVID-19 cases on S&P 500 Index in the U.S by employing structural vector autoregressive (SVAR) model. He found that a 1% cumulative increase in daily COVID-19 cases in the U.S. resulted in about 0.01 % of a cumulative decline in the S&P 500 Index after one day and about 0.03 % of a cumulative reduction after one month. Similarly, Ahundjanov, Akhundjanov, and Okhunjanov (2020) investigated the relationship between Google search queries related to COVID-19 and the performance of major financial indices in developed and developing countries. They employed Bayesian inference of a SVAR model and found that Google search queries related to the COVID-19 significantly reduced financial indices. In particular, their estimation results show that a one unit increase in global Google search interest of COVID-19 resulted in about 0.38 % to 0.069 % of a cumulative decline in global financial indices after one day and 0.054 % to 0.150 % of a cumulative decrease after a week. Also, Papadamou, Fassas, Kenourgios, and Dimitriou (2020) examined the effects of the COVID-19 pandemic on implied stock market volatility across countries in Europe, Asia, USA and Australia by employing panel VAR model. Their empirical results suggest that there is a causal positive direct relationship between Google trend metrics for COVID-19 and stock market implied volatility. Amstad, Cornelli, Gambacorta, and Xia (2020) analyzed the effects of investors' risk attitudes as approximated by internet searches on global stock market using ordinary least squares (OLS) estimation technique. Their results suggest that global stock markets are sensitive to changes in risk attitude index, especially in more financially developed economies.

Despite the growing literature on the impact of the COVID-19 pandemic on stock market performance, the discussion and empirical evidence from developing countries in Africa are largely non-existent. This study fills the gap in the literature and thus contributes to

the discussion and research on the economic impact of the COVID-19 pandemic on stock market performance in Africa. To that end, it employs a novel Bayesian structural time series approach to evaluate and quantify the potential impact of the pandemic on stock markets in thirteen (13) African countries: Ghana, Nigeria, South Africa, Kenya, Tanzania, Tunisia, Mauritius, Morocco, Zambia, Namibia, Botswana, Cote D'Ivoire, and Uganda. Specifically, we estimate a local level state-space model with seasonality using daily time series stock market data to analyze the impacts of the COVID-19 pandemic on stock markets in those countries.

Anticipating our results, we find that the COVID-19 pandemic has significant negative impacts on the stock markets of ten (10) countries. However, the remaining three (3) countries see no significant impact of the COVID-19 on their stock markets, although the impacts are negative. At the individual-country level, we find that Mauritius and Morocco have their stock market performance largely and significantly contracted by the COVID-19, about -21 % in relative terms, followed by Namibia (-17 %), Kenya (-15 %), Nigeria (-13 %), Tanzania (-11 %), Tunisia (-9.1 %), Ghana (-6.5 %), and Zambia (-3.6 %) with the least being Botswana (-2.7 %). Finally, we find that there is almost no chance that the COVID-19 pandemic would have positive effects on the stock market performance in all the countries considered in this study.

The rest of the paper is organized as follows: Section two describes the data used and the methodology employed. Section three presents in detail the empirical econometric model. Section four discusses the results, and section five concludes.

2. Data

The data used in this study are historical daily stock market major indices (time series data) from 1st October 2019 to 30th June 2020 for thirteen (13) African countries. These thirteen countries, chosen based on data availability, include Ghana, Nigeria, South Africa, Kenya, Tanzania, Tunisia, Mauritius, Morocco, Zambia, Namibia, Botswana, Cote D'Ivoire, and Uganda. Table 1 shows the various stock market indices, used as a proxy for stock market performance, for each of those countries. We use the GSE Composite Index (GSE-CI) for Ghana, the NSE All-Share Index (NGSEINDEX) for Nigeria, the FTSE/JSE Top 40 Index (JTOPI) for South Africa, and Tanzania All-Share Index (DSEI) for Tanzania, Tunindex (TUNINDEX) for Tunisia, Semdex (MDEx) for Mauritius, Moroccan All-Shares Index (MASI) for Morocco, LSE All-Share (LASILZ) for Zambia, FTSE NSX Overall (FTN098) for Namibia, BSE Domestic Company (DCIBT) for Botswana, BRVM Composite Index (BRVMCI) for Cote D'Ivoire, and Uganda All-Share (ALSIUG) for Uganda to measure stock market performance. The data for each of the above indices from 1st October 2019 to 30th June 2020 are collected from the web portals “www.investing.com” and “<https://gse.com.gh/>”.

We create pre-COVID-19 and post-COVID-19 periods for each of the countries using the first day (date) the country recorded or confirmed its first coronavirus infection(s) or case(s). Table 2 displays the date for each country's first coronavirus confirmed case, pre-COVID-19, and post-COVID-19 periods for all the countries. For instance, Ghana recorded its coronavirus infection on 12th March 2020 and so, its pre-COVID-19 period starts from 1st October 2019 to 11th March 2020, while the post-COVID-19 period starts from 12th March 2020 to 30th June 2020. Similarly, the first case of COVID-19 was identified in Nigeria on 27th February 2020 and therefore, from 1st October 2019 to 26th February 2020 forms its pre-COVID-19 period, while from 27th February 2020 to 30th June forms its post-COVID-19 period. Also, the first coronavirus was recorded in South Africa on 5th March 2020. Therefore, in South Africa, the pre-COVID-19 period starts from 1st October 2019 to 4th March 2020, while the post-COVID-19 period starts from 5th March 2020 to 30th June 2020. Similar patterns of analysis follow for the rest of the countries.

3. Empirical econometric model

To examine the potential causal impact of COVID-19 on stock market performance, we employ a Bayesian structural time series model, which is a state-space model for time series data, following Droste, Becker, Ring, and Santos (2018), Brodersen, Gallusser, Koehler, Remy, and Scott (2015), and Scott and Varian (2014). Specifically, we estimate the following simplified local level model with seasonality to evaluate and quantify the impact of the COVID-19 on the stock market's performance:

$$y_t = \mu_t + \tau_t + \varepsilon_t \quad (1)$$

$$\mu_{t+1} = \mu_t + w_t \quad (2)$$

$$\tau_{t+1} = - \sum_{s=0}^{S-2} \tau_{t-s} + v_t \quad (3)$$

where y_t is the stock market index for each country at a time (day) t ; $\varepsilon_t \sim N(0, \sigma_\varepsilon^2)$, $w_t \sim N(0, \sigma_w^2)$, and $v_t \sim N(0, \sigma_v^2)$ are *iid* normal errors. Also, μ_t is the level or the mean which changes with time and τ_t is the seasonal component with S being the number of seasons.

The above equations (Causal Impact)¹ estimates the post-COVID-19 occurrence difference between the observed time series of the response variable (stock market index) and a simulated (synthetic or forecasted) time series that would have occurred without the COVID-19 (Droste et al., 2018). The posterior causal inference works in the following fashion: First, the model is estimated² using only the pre-COVID-19 period data. Second, using the estimated model, the forecasts (predictions) of y_t for the post-COVID-19 period are

¹ We use the CausalImpact package within R software for the estimation.

² In our case, the model is estimated using 10,000 Markov chain Monte Carlo (MCMC) samples with $S = 120$

Table 1
Major stock market indices.

Country	Index
Ghana	GSE Composite Index (GSE-CI)
Nigeria	NSE All Share Index (NGSEINDEX)
South Africa	FTSE/JSE Top 40 Index (JTOPI)
Kenya	Kenya NSE 20 Index (NSE20)
Tanzania	Tanzania All Share Index (DSEI)
Tunisia	Tunindex (TUNINDEX)
Mauritius	Semdex (MDEX)
Morocco	Moroccan All Shares Index (MASI)
Zambia	LSE All Share (LASILZ)
Namibia	FTSE NSX Overall (FTN098)
Botswana	BSE Domestic Company (DCIBT)
Cote D'Ivoire	BRVM Composite Index (BRVMCI)
Uganda	Uganda All Share (ALSIUG)

Source: Authors' construction using information from www.investing.com and <https://gse.com.gh/>.

Table 2
Pre- and Post-COVID-19 periods.

Country	First confirmed case	pre-COVID-19	post-COVID-19
Ghana	12/03/2020	1/10/2019 to 11/03/2020	12/03/2020 to 30/06/2020
Nigeria	27/02/2020	1/10/2019 to 26/02/2020	27/02/2020 to 30/06/2020
South Africa	05/03/2020	1/10/2019 to 04/03/2020	05/03/2020 to 30/06/2020
Kenya	13/03/2020	1/10/2019 to 12/03/2020	13/03/2020 to 30/06/2020
Tanzania	16/03/2020	1/10/2019 to 15/03/2020	16/03/2020 to 30/06/2020
Tunisia	02/03/2020	1/10/2019 to 01/03/2020	02/03/2020 to 30/06/2020
Mauritius	19/03/2020	1/10/2019 to 18/03/2020	19/03/2020 to 30/06/2020
Morocco	02/03/2020	1/10/2019 to 01/03/2020	02/03/2020 to 30/06/2020
Zambia	18/03/2020	1/10/2019 to 17/03/2020	18/03/2020 to 30/06/2020
Namibia	14/03/2020	1/10/2019 to 13/03/2020	14/03/2020 to 30/06/2020
Botswana	30/03/2020	1/10/2019 to 29/03/2020	30/03/2020 to 30/06/2020
Cote D'Ivoire	11/03/2020	1/10/2019 to 10/03/2020	11/03/2020 to 30/06/2020
Uganda	22/03/2020	1/10/2019 to 21/03/2020	22/03/2020 to 30/06/2020

Source: Authors' construction

obtained. Finally, the difference between the forecasted (predicted) values and the actual data (observed values) of y_t during the post-COVID-19 period is interpreted as the causal impact of the occurrence of the COVID-19 pandemic on stock market performance.

4. Results and discussion

In this section, we discuss the results of both the Bayesian posterior estimates and the Bayesian posterior distribution graphs for the causal impact of the COVID-19 pandemic on stock markets performance for each of the thirteen (13) countries. For the posterior estimates, we discuss only the average effects but report the cumulative effects in Appendix A.

4.1. Bayesian posterior estimates

The results obtained for the posterior estimates of the impact of the COVID-19 pandemic for each country are shown in Table 3. Each column of Table 3 shows the average values. Column 1 shows the mean value of the actual data, column 2 shows the average value of the forecasted (predicted) data, column 3 shows the absolute effect, and column 4 shows the relative impact of the COVID-19. In what follows, we discuss in detail the results for each country under Panel A and B of Table 3.

In Ghana, during the post-COVID-19, the stock market performance had an average value of about 2053. However, in the absence of the occurrence of the pandemic, we would have expected an average value of 2196 with a 46 standard deviation and a 95 % confidence interval of this counterfactual prediction being [2104, 2284]. By subtracting this predicted average value from that of observed value yields an estimate of the causal effect the COVID-9 had on the stock market performance in Ghana. In absolute terms, this effect is -143 with a 95 % confidence interval of [-231, -51]. In relative terms, the stock market performance in Ghana showed a decrease of about 7% with the 95 % confidence interval of this percentage being [-11 %, -2%]. This means that the negative effect observed during the COVID-19 period is statistically significant at 5 percent level of significance. Also, the posterior tail-area probability value of 0.003 indicates that there is only 0.3 % chance that the COVID-19 would have a positive effect on stock market performance in Ghana, which re-enforces the above finding that the negative causal effect is statistically significant.

Similarly, during the post-COVID-19, the stock market performance had an average value of about 23745 in Nigeria. On the other

Table 3

Results of posterior estimates (inference) of the causal impact of COVID-19 on stock market performance.

	Average			
	Actual (1)	Prediction (2)	Absolute Effect (3)	Relative Effect (4)
Panel A				
Ghana	2053	2196 (46) [2104, 2284]	-143 (46) [-231, -51]	-6.5%** (2.1 %)[-11 %, -2.3 %] p = 0.003
Nigeria	23745	27284 (1396) [24444, 30024]	-3539 (1396) [-6280, -699]	-13%** (5.1 %)[-23 %, -2.6 %] p = 0.009
Kenya	1982	2345 (138) [2065, 2613]	-363 (138) [-631, -83]	-15%** (5.9 %)[-27 %, -3.5 %] p = 0.008
Tanzania	1806	2035 (64) [1900, 2159]	-229 (64) [-353, -94]	-11%** (3.2 %)[-17 %, -4.6 %] p = 0.0007
Tunisia	6498	7152 (98) [6962, 7352]	-654 (98) [-854, -464]	-9.1%** (1.4 %)[-12 %, -6.5 %] p = 0.0001
Morocco	9859	12325 (325) [11682, 12980]	-2467 (325) [-3121, -1823]	-20%** (2.6 %)[-25 %, -15 %] p = 0.0001
Zambia	4095	4247 (40) [4167, 4324]	-152 (40) [-229, -72]	-3.6%** (0.94 %)[-5.4 %, -1.7 %] p = 0.0007
Botswana	7389	7596 (44) [7509, 7685]	-207 (44) [-296, -120]	-2.7%** (0.58 %)[-3.9 %, -1.6 %] p = 0.0001
Panel B				
South Africa	45118	47923 (2215) [43379, 52155]	-2804 (2215) [-7036, 1739]	-5.9% (4.6 %)[-15 %, 3.6 %]
Mauritius	1639	1879 (126) [1622, 2112]	-240 (126) [-473, 17]	-13% (6.7 %)[-25 %, 0.9 %]
Namibia	967	1088 (79) [921, 1235]	-121 (79) [-268, 46]	-11% (7.3 %)[-25 %, 4.3 %]
Cote D'Ivoire	136	146 (5.9) [134, 158]	-9.8 (5.9) [-21, 2.1]	-6.7% (4%)[-15 %, 1.4 %]
Uganda	1356	1562 (115) [1325, 1782]	-206 (115) [-425, 32]	-13% (7.4 %)[-27 %, 2%]

Note: The values in the brackets show 95 % confidence interval, while those in the parentheses are standard deviations. ** represent 5% significance level and p stands for Posterior tail-area probability.

hand, in the absence of the occurrence of the pandemic, we would have expected an average response of 27284 with a standard deviation of 1396. The 95 % confidence interval associated with this counterfactual prediction is [24444, 30024]. Thus, in absolute terms, the COVID-19 has reduced the stock market performance in Nigeria by about 3539. Relatively, this reduction is about 13 % with the 95 % confidence interval being [-23 %, -2.6 %], suggesting that the negative impact of the COVID-19 is statistically significant at 5 percent level of significance. Again, the posterior tail-area probability value is 0.009, which indicates that there is only 0.9 % likelihood that the COVID-19 would have a positive effect on the stock market performance in Nigeria. This finding is consistent with what [Adenomon et al. \(2020\)](#) found for Nigeria.

Furthermore, in Kenya, the mean values of the actual and predicted stock market performance during the post-COVID-19 period stood at 1982 and 2345. This indicates that in absolute terms, the occurrence of the COVID-19 has seen the stock market performance in Kenya reduced by about 363 with a 95 % confidence interval values of [-631, -83]. Quantifying this reduction in relative terms and with a 95 % confidence interval of [-27 %, -3.5 %], it can be seen, that the stock market performance in Kenya has significantly reduced by 15 %. Also, the posterior tail-area probability value indicates that there is only about 0.8 % probability that the COVID-19 would have a positive effect on the stock market performance in the country.

Moreover, in Tanzania, the stock market performance had an average value of about 1806 during the post-COVID-19 period. By contrast, in the absence of the occurrence of the COVID-19, the average value would have been 2035 with a standard deviation value of 46. The 95 % confidence interval of this counterfactual prediction is [1900, 2159]. By subtracting the predicted average value from the actual mean value leads to a significant reduction in the stock market performance by approximately 229. In relative terms, the stock market performance in Tanzania saw a decrease of about 11 % with the 95 % confidence interval of this percentage being [-17 %, -4.6 %]. This suggests that the reduction is statistically significant at 5 percent level of significance. Evidently, the posterior tail-area probability value of 0.0007 shows that there is absolutely no chance that the COVID-19 would impact the stock market performance positively in Tanzania.

In addition, during the post-COVID-19, the stock market performance in Tunisia had an average value of about 6498. On the

contrary, without the COVID-19, an average value of 7152 and a standard deviation value of 98 would have been registered. Therefore, in absolute terms and with the occurrence of the COVID-19, the stock market performance in Tunisia has seen a reduction of about 654. Relatively, with a 95 % confidence interval $[-23\%, -2.6\%]$, this negative impact approximates -9.1% . It can be seen that the negative impact is statistically significant at 5 percent level of significance. Again, with a posterior tail-area probability value of 0.0001, there is almost no likelihood that COVID-19 would have a positive impact on the stock market performance in Tunisia.

Also, the stock market in Morocco had its share of the adverse effect of the pandemic. It can be seen that the average values of the actual and forecasted stock market performance during the post-COVID-19 recorded 9859 and 12325 respectively, suggesting a significant reduction in the stock market performance. Quantitatively, and in absolute terms, the reduction is about -2467 with the 95 % confidence interval being $[-3121, -1823]$. In relative terms, the stock market performance in Morocco saw a significant reduction of about 20 % (the largest among all the countries). Again, as with the case in Tunisia, the posterior tail-area probability value of 0.0001 shows the COVID-19 could barely have a positive impact on the stock market performance in Morocco.

With regards to Zambia and Botswana, which have their stock market performances relatively less affected by the COVID-19, the absolute impact of the pandemic is about -152 in Zambia and -207 in Botswana. In relative terms, Zambia experienced a significant reduction of its stock market performance by about 3.6 %, whereas Botswana's stock market performance reduced by approximately 2.7 % (the smallest among all the countries). These negative impacts of the COVID-19 on the stock markets in both countries are statistically significant at 5% level of significance as evidenced by the 95 % confidence intervals of $[-5.4\%, -1.7\%]$ and $[-3.9\%, -1.6\%]$ for Zambia and Botswana, respectively. Also, the values of the posterior tail-area probability obtained for both countries indicate that there are only 0.07 % and 0.01 % chances that the pandemic could have a positive impact on the stock market performances in Zambia and Botswana, respectively.

However, the results under Panel B of Table 3 show that five countries including South Africa, Mauritius, Namibia, Cote D'Ivoire, and Uganda had their stock market performances not significantly affected by the COVID-19, although both the absolute and the relative effects are negative in all of these countries. That is, although it may look as though the occurrence of the COVID-19 has exerted a negative effect on the stock market performances in those countries when considering the post-COVID-19 periods as a whole, these effects are not statistically significant, and so cannot be meaningfully interpreted. One of the reasons for these insignificant effects could be as a result of the resilience of the stock markets in those countries to the COVID-19 or other individual country-level policy interventions, which are beyond the scope of this paper.

Comparatively, Morocco has its stock market performance largely and significantly affected by the COVID-19, about -20 % in relative terms, followed by Kenya (-15 %), Nigeria (-13 %), Tanzania (-11 %), Tunisia (-9.1 %), Ghana (-6.5 %), and Zambia (-3.6 %) with the least being Botswana (-2.7 %). However, the stock market performances in South Africa, Mauritius, Namibia, Cote D'Ivoire, and Uganda were not significantly affected by the COVID-19 pandemic within our sample period.

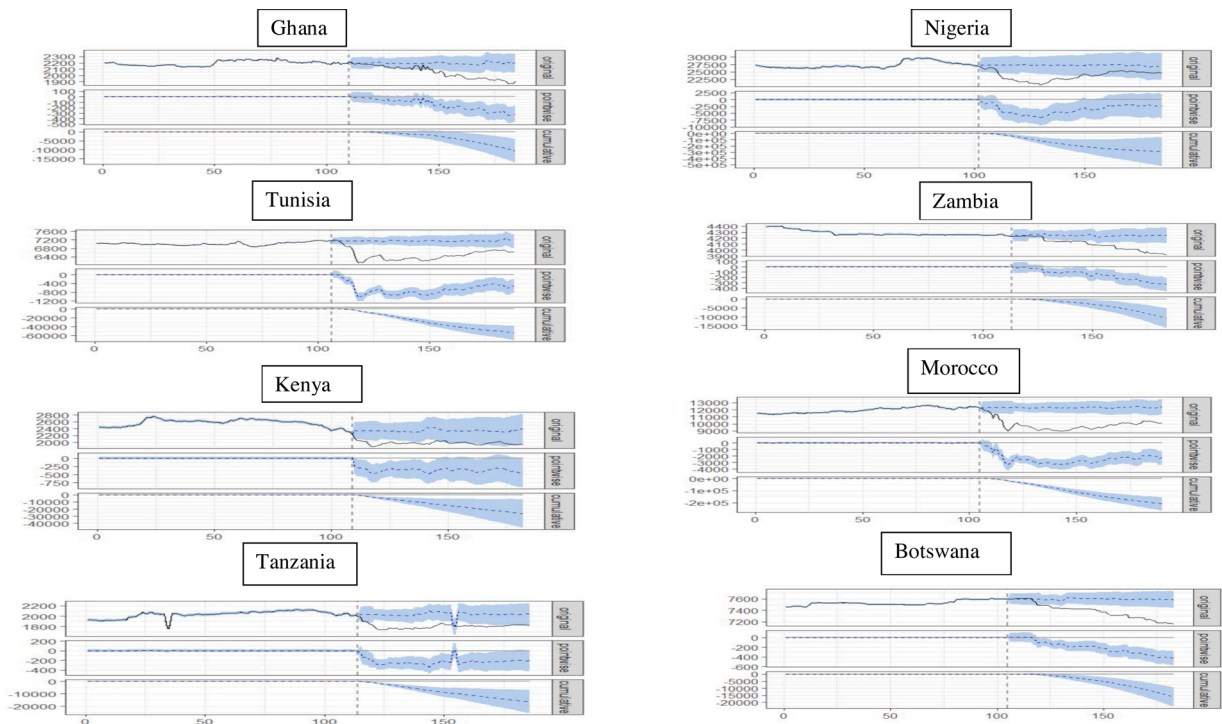


Fig. 1. Bayesian posterior distribution graphs for the causal effect of COVID-19: Pane A.

Note: On the original panel, the blue-dotted and the black solid lines horizontal indicate the time path of predicted series and actual series, respectively.

Overall, the results obtained above are consistent with what has been found at the international front. In particular, the results are in line with [He et al. \(2020\)](#) who found that the COVID-19 has negative but short-term impacts on stock markets of the People's Republic of China, Italy, South Korea, France, Spain, Germany, Japan, and the USA. Also, they are consistent with [Liu et al. \(2020\)](#) who documented that the occurrence of the COVID-19 leads to negative abnormal stock market returns in Japan, Korea, Singapore, the USA, Germany, Italy, and the UK.

4.2. Bayesian posterior distribution graphs

In this section, we discuss the impact of the COVID-19 on stock market performances by looking at the posterior distribution graphs. Here, we assess the time path of the effect of the pandemic on the stock markets in Africa. The posterior distribution graphs for the countries are shown in [Figs. 1 and 2](#). Whereas [Fig. 1](#) shows the graphs for those countries which saw a significant negative impact of the COVID-19 on their stock markets, [Fig. 2](#) shows that of the countries which experienced no significant impact of the pandemic. It is to be noted that, in each graph, the blue-dotted lines indicate the time path of the predicted values, whereas the black lines indicate the time path of the actual values. The difference between these two lines (i.e., the original panel) measures the average impact of the COVID-19 (i.e., the pointwise panel) with the cumulative panel measuring the cumulative impact. Also, the blue areas indicate 95 % confidence band or intervals.

From [Fig. 1](#) (and using the pointwise and cumulative panels), it can be seen that the negative impact of the COVID-19 on stock market performance is statistically significant for countries: Morocco, Kenya, Nigeria, Tanzania, Tunisia, Ghana, Zambia, and Botswana. This is because the blues lines within the 95 % confidence band are all below zero after the post-COVID-19 periods, confirming our quantitative results discussed above.

Nevertheless, the significant impact of the COVID-19 pandemic changes across time for the remaining 5 countries. For example, from [Fig. 2](#), it can be seen that few days after the occurrence of the COVID-19, the pandemic had a significant negative impact on stock market performance in South Africa, Mauritius, Namibia, and Uganda with the exception of Cote D'Ivoire. However, after those few days, the impact became insignificant for these countries because the confidence band includes zero for those periods. These results suggest that the stock markets in those countries have seen a recovery after being adversely affected by the COVID1-19.

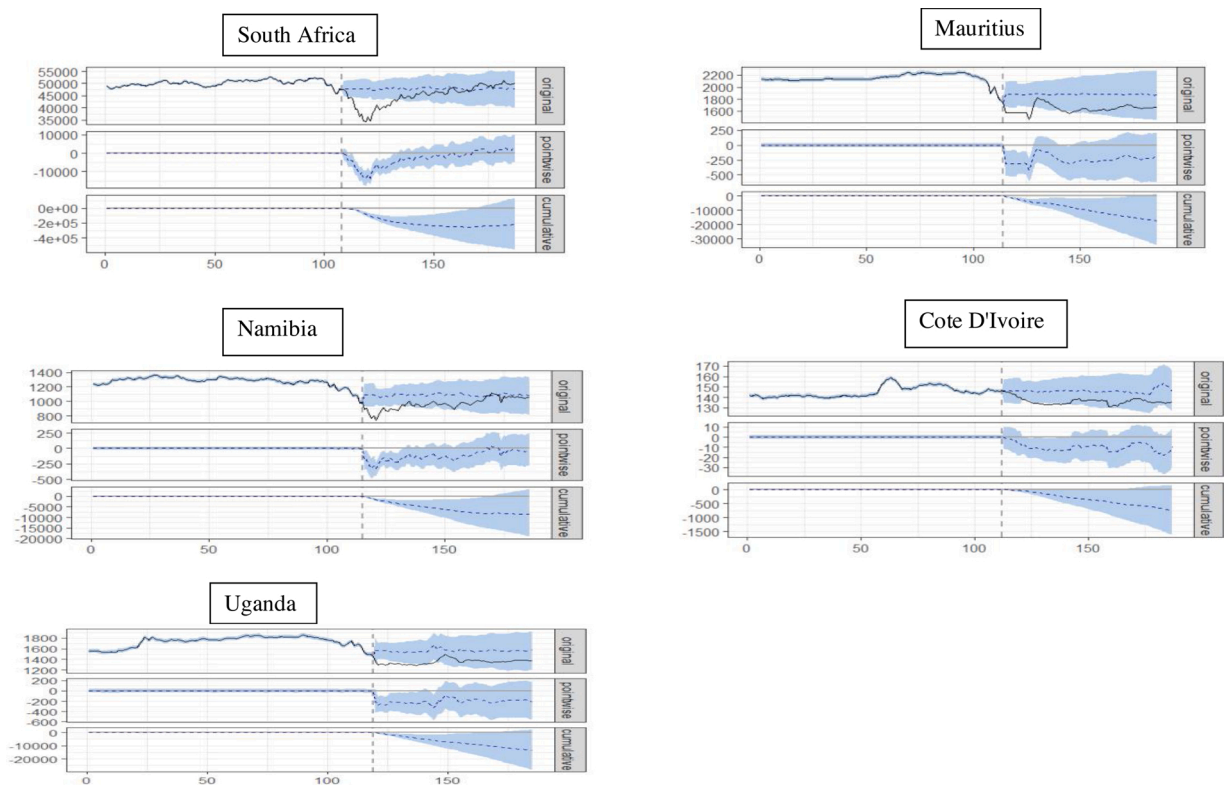


Fig. 2. Bayesian posterior distribution graphs for the causal effect of COVID-19: Panel B.

Note: On the original panel, the blue-dotted and the black solid lines horizontal indicate the time path of predicted series and actual series, respectively.

5. Robustness checks

In the following, we perform robustness checks to the analysis above to examine potential dynamic causal impact of COVID-19 on stock market performance. We do that by augmenting Eq. (1) to include volatility index (VIX) as a determinant of stock market performance. Specifically, we estimate the following equations:

$$y_t = \mu_t + \tau_t + \beta VIX_t + \varepsilon_t \quad (4)$$

$$\mu_{t+1} = \mu_t + w_t \quad (5)$$

$$\tau_{t+1} = - \sum_{s=0}^{S-2} \tau_{t-s} + v_t \quad (6)$$

Note that the definitions of all the variables and the parameters in Eqs. (4)–(6) are the same as those in Eqs. (1)–(3) with introduction of additional explanatory variable (VIX) and parameter, β .

Table 4 displays the results obtained after estimating the above equations. It can be seen that the absolute and the relative impact of the COVID-19 pandemic in all the countries are similar to the ones we have analyzed above, confirming the robustness of our results. However, by controlling for VIX, the impact of COVID-19 on stock market performance in Mauritius and Namibia become statistically significant. In particular, the absolute impact of the pandemic is about -423 in Mauritius and -191 in Namibia. In relative terms, Mauritius saw a significant reduction of its stock market performance by about 21 %, whereas Namibia's stock market performance reduced by approximately 17 %. As evidenced by the 95 % confidence intervals of [-26 %, -15 %] and [-20 %, -13 %] for Mauritius and Namibia respectively, those negative impacts of the COVID-9 on the stock markets in both countries are statistically significant at 5% level of significance.

Table 4

Robustness checks results of posterior estimates of the causal impact of COVID-19 on stock market performance.

	Average			
	Actual (1)	Prediction (2)	Absolute Effect (3)	Relative Effect (4)
Panel A				
Ghana	2053	2196 (46) [2105, 2288]	-143 (46) [-235, -52]	-6.5%** (2.1 %)[-11 %, -2.4 %] p = 0.00152
Nigeria	23745	27232 (1447) [24343, 30048]	-3487 (1447) [-6304, -599]	-13%** (5.3 %)[-23 %, -2.2 %] p = 0.00983
Kenya	1982	2382(115) [2137, 2603]	-400 (115) [-626, -115]	-17%** (4.8 %)[-26 %, -6.5 %] p = 0.00123
Tanzania	1806	2038 (62) [1909, 2156]	-231 (62) [-350, -103]	-11%** (3.1 %)[-17 %, -5.1 %] p = 0.00043
Tunisia	6498	7160 (98) [6971, 7357]	-663 (98) [-859, -473]	-9.3%** (1.4 %)[-12 %, -6.6 %] p = 0.00011
Morocco	9859	12326 (330) [11677, 12985]	-2467 (330) [-3126, -1818]	-20%** (2.7 %)[-25 %, -15 %] p = 0.0001
Zambia	4095	4250 (40) [4169, 4328]	-155 (40) [-234, -75]	-3.6%** (0.95 %)[-5.5 %, -1.8 %] p = 0.00061
Botswana	7389	7597 (44) [7509, 7686]	-208 (44) [-297, -120]	-2.7%** (0.58 %)[-3.9 %, -1.6 %] p = 0.0001
Mauritius	1639	2062 (55) [1943, 2167]	-423 (55) [-528, -305]	-21%** (2.7 %)[-26 %, -15 %] p = 0.0001
Namibia	967	1159 (18) [1123, 1195]	-191 (18) [-228, -156]	-17%** (1.6 %)[-20 %, -13 %] p = 0.0001
Panel B				
South Africa	45118	46622 (1161) [44319, 48961]	-1503 (1161) [-3843, 800]	-3.2% (2.5 %)[-8.2 %, 1.7 %] p = 0.0001
Cote D'Ivoire	136	146 (5.9) [134, 158]	9.8 (5.9) [-21, 2.2]	-6.7% (4.1 %)[-15 %, 1.5 %] p = 0.0001
Uganda	1356	1590 (115) [1346, 1802]	-233 (115) [-446, 9.9]	-15% (7.3 %)[-28 %, 0.62 %] p = 0.0001

Note: The values in the parentheses show 95 % confidence interval while those in the brackets are standard deviations. ** represent 5% significance level and p stands for Posterior tail-area probability.

6. Conclusion

In this paper, we investigate the potential impact of the COVID-19, which began in Wuhan, China and have spread to various parts of the continent including Africa, on stock market performance in thirteen (13) African countries namely: Ghana, Nigeria, South Africa, Kenya, Tanzania, Tunisia, Mauritius, Morocco, Zambia, Namibia, Botswana, Cote D'Ivoire, and Uganda. We use major daily time series stock market index data, as a proxy for stock market performance in each country and employ a novel Bayesian structural time series model (a state-space model) to evaluate and quantify the absolute and the relative impact of the COVID-19 on stock markets performance in each country. The following findings and conclusions are drawn from the study.

Evidence from the selected countries suggests that the COVID-19 pandemic has a significant negative impact on the stock markets of eight countries. However, the remaining five countries see no significant impact of the COVID-19 on their stock markets. In particular, our results show that, in relative terms, Mauritius has its stock market performance largely and significantly reduced by the COVID-19, a reduction of about 21 %, followed by Morocco (17 %), Kenya (15 %), Nigeria (13 %), Tanzania (11 %), Tunisia (9.1 %), Ghana (6.5 %), and Zambia (3.6 %) with the least being Botswana (2.7 %). However, we find that the stock market performances in South Africa, Cote D'Ivoire, and Uganda see no significant impact of the COVID-19, although the impacts are negative. The Bayesian posterior distribution graphs show that the significant negative impacts of the COVID-19 on the stock markets of these countries are rather short-lived. This suggests that the stock markets in South Africa, Cote D'Ivoire, and Uganda have seen a recovery after being adversely affected by the COVID-19.

Finally, we find that, within our sample period, there is almost no chance that the COVID-19 pandemic would have positive effects on the stock market performance in all the countries considered in this study. The findings from our study contribute to the research on the economic impact of the COVID-19 by empirically providing evidence that the COVID-19 pandemic has restrictive effects on stock market performance in African economies.

Declaration of Competing Interest

The authors report no declarations of interest.

Appendix A. Results of posterior estimates (inference) of the causal impact of COVID-19 on stock market performance

	Cumulative		Absolute Effect (3)	Relative Effect (4)
	Actual (1)	Prediction (2)		
Panel A				
Ghana	151917	162495 (3372) [155680, 168999]	-10578 (3372) [-17082, -3763]	-6.5%** (2.1 %)[-11 %, -2.3 %] p = 0.003
Nigeria	1970801	2264545 (115889) [2028830, 2492022]	-293744 (115889) [-521221, -58029]	-13%** (5.1 %)[-23 %, -2.6 %] p = 0.009
Kenya	144709	171172 (10100) [150774, 190753]	-26463 (10100) [-46043, -6064]	-15%** (5.9 %)[-27 %, -3.5 %] p = 0.008
Tanzania	130037	146533 (4642) [136831, 155446]	-16496 (4642) [-25409, -6794]	-11%** (3.2 %)[-17 %, -4.6 %] p = 0.0007
Tunisia	532801	586446 (8029) [570886, 602837]	-53645 (8029) [-70036, -38085]	-9.1%** (1.4 %)[-12 %, -6.5 %] p = 0.0001
Morocco	838008	1047662 (27630) [993000, 1103296]	-209654 (27630) [-265288, -154993]	-20%** (2.6 %)[-25 %, -15 %] p = 0.0001
Zambia	290730	301553 (2834) [295854, 307021]	-10823 (2834) [-16291, -5124]	-3.6%** (0.94 %)[-5.4 %, -1.7 %] p = 0.0007
Botswana	576322	592469 (3424) [585669, 599412]	-16147 (3424) [-23090, -9347]	-2.7%** (0.58 %)[-3.9 %, -1.6 %] p = 0.0001
Panel B				
South Africa	3564352	3785880 (174948) [3426968, 4120212]	-221528 (174948) [-555859, 137384]	-5.9% (4.6 %)[-15 %, 3.6 %]
Mauritius	118004	135295 (9049) [116789, 152070]	-17291 (9049) [-34066, 1215]	-13% (6.7 %)[-25 %, 0.9 %]
Namibia	68668	77249 (5632) [65367, 87665]	-8582 (5632) [-18997, 3301]	-11% (7.3 %)[-25 %, 4.3 %]
Cote D'Ivoire	10230	10968 (441.2) [10075, 11842]	-737.6 (441.2) [-1612, 155.0]	

(continued on next page)

(continued)

	Cumulative			
	Actual (1)	Prediction (2)	Absolute Effect (3)	Relative Effect (4)
Uganda	89520	103083 (7577) [87434, 117588]	-13563 (7577) [-28069, 2086]	-6.7% (4%)[-15 %, 1.4 %] -13% (7.4 %)[-27 %, 2%]

Note: The values in the parentheses show 95 % confidence interval, while those in the brackets are standard deviations. ** represent 5% significance level and p stands for Posterior tail-area probability.

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