Stock market reactions to COVID-19 shocks: do financial market interventions walk the talk?

Mutaju Isaack Marobhe
Department of Finance and Accounting, Tanzania Institute of Accountancy, Dar es Salaam, United Republic of Tanzania and SSM-ESAMI Research Center, Swiss School of Management, Bellinzona, Switzerland, and
Jonathan Mukiza Peter Kansheba
Department of Business Studies, Ardhi University, Dar es Salaam, United Republic of Tanzania and Department of Management, Universitetet i Agder, Kristiansand, Norway

Received 27 January 2022
Revised 24 March 2022
Accepted 27 April 2022

Abstract

Purpose – Following the COVID-19 outbreak, various economies imposed different financial interventions as part of initiatives to cushion their stock markets from deteriorating performance. Our article examines the effectiveness of these interventions in protecting stock markets during the pandemic.

Design/methodology/approach – The authors employ Panel Vector Autoregression to model the magnitude and timing of shocks from COVID-19 to stock markets. The fixed effects regression is then utilized to assess the role of financial interventions in protecting stock markets during COVID-19. The study uses daily stock index returns as well COVID-19 containment measures stringency index data from 39 countries ranging from 2nd January 2020 to 30th September 2021.

Findings – Our findings firstly reveal a significant positive stock market reaction to country-level containment measures stringency but only during the first wave of COVID-19. We secondly show that stock market functioning interventions that include short selling bans and circuit breakers amplify the positive effects of COVID-19 containment measures stringency on stock market performance.

Research limitations/implications – The authors stress the need for policymakers and regulators to timely intervene in protecting economies and stock markets during crises such as COVID-19 in order to reduce panic among investors. Moreover, investors should adjust their portfolios by investing in stocks from countries that have proper financial market interventions in place.

Originality/value – Despite growing body of literature on COVID-19 and stock market performance, there is limited evidence on the role of financial sector interventions to cushion stock markets during tumultuous conditions caused by the pandemic.

Keywords Stock market performance, COVID-19 pandemic, Financial market interventions

Paper type Research paper

1. Introduction

Stock markets across the globe have experienced increasing volatility and significant negative returns since the outbreak of COVID-19 (Zhao *et al.*, 2022; Uddin *et al.*, 2021; Ashraf, 2020; Zhang *et al.*, 2020; Baek *et al.*, 2020; Marobhe, 2022). Some major stock indices such as Dow Jones Industrial Average, Nikkei, FTSE 100 and Shanghai Composite index have exhibited a downward trend with average drops ranging between 24 and 33% from late December 2019 to late March 2020 (Hui and Chan, 2022). This may be attributed to the unprecedented levels of uncertainties due to lockdowns and other social distancing measures (Baig *et al.*, 2021). These conditions make forecasting of asset prices during COVID-19 difficult (Ashraf, 2021).

China Finance Review International
Vol. 12 No. 4, 2022
pp. 623-645

2044-1398
DOI 10.1108/CFRI-01-2022-0011

Despite rising volatility in global stock markets during COVID-19, the effect has been unparallel among regions. The major Asian stock markets have shown more resilience than any other markets while those in Latin American being hit the hardest (Szczygielski *et al.*, 2021). These disparities can be explicated by variations in financial market interventions by respective countries' governments to restore confidence and stability in the financial system during crisis (The World Bank, 2021). These interventions were also used in the global financial crisis (2008) (Yacine *et al.*, 2009). They include market functioning interventions in the form of bans on short selling of securities, extension of the deadlines for disclosure of financial statements of investment companies and cancellation of listing tariffs on corporate bonds (The World Bank, 2021). Moreover, the interventions also include public debt management (PDM) which can take the form of issuing special anti-pandemic government bonds, relaxing conditions for issuance of Treasury bills and injecting funds to support wholesale funding markets used by small lenders (The World Bank, 2021). We draw the motivation for this study to inform policymakers, investors and regulators on the effectiveness of financial market interventions in cushioning stock markets against adversity caused by COVID-19. Stock markets' volatility during major crises rises as a result of panic selling among investors as well as continuance of short-selling (Taleb, 2007; Ho, 2021). So it is vital to understand whether interventions such as bans on short selling by regulators and injection of liquidity may reduce deteriorating stock market performance during crises by restoring investors' confidence.

Our paper intends to contribute to the existing knowledge on three folds. Firstly, we use Panel Vector Autoregression (PVAR) to examine the timing and magnitude of shocks from COVID-19 to stock market returns. This provides further evidence to supplement results from previous studies (Marobhe, 2021; Ashraf, 2020; Marobhe and Dickson, 2022). Secondly, we use individual countries' COVID-19 containment measures stringency index to examine COVID-19's impact on stock markets (Ashraf, 2021). This index is instrumental in measuring daily stringency of COVID-19 containment measures such as extent of lockdowns and other social distancing measures (Hale *et al.*, 2021). Thirdly, we contribute to the current literature by showing the extent at which financial market interventions have helped to reduce rising stock markets volatilities during COVID-19 (The World Bank, 2021).

The article proceeds as follows. Section 2 presents the discussion on stock market performance in times of crisis. It also discusses the moderation effects of different financial market interventions. The section also provides for hypotheses development. Section 3 provides for the employed methods while section 4 presents the findings and discussion. Section 5 presents the implications and avenues for future research and section 6 covers conclusions.

2. Literature review and hypotheses development

2.1 Stock market reactions in the past pandemics

The mechanics of stock market performance during crisis can be sourced from the famous Black Swan Theory (Taleb, 2007). The theory posits that the occurrence of unexpected events such as financial crises pandemics, accidents, natural disasters, terrorism may positively or negatively impact stock market (Spelta *et al.*, 2019; Valizadeh *et al.*, 2017; Memdani and Shenoy, 2019; Scholtens and Boersen, 2011). The impact that these events have on stock markets is usually severe as explicated by their unpredictability (Del Giudice and Paltrinieri, 2017). With reference to past health crises, Chen *et al.* (2018) portray that shocks caused by SARS-CoV took a chunk of stock values in China and spilled over to other South East Asian stock markets which supports findings of earlier studies such as (Bhuyan *et al.*, 2010; Nippani and Washer, 2004; De Lisle. 2003).

Similarly, the fear created by the Ebola virus in West Africa negatively impacted investors' sentiments resulting into plummeting stock prices for US companies and mutual

equity funds operating in the region (Ichev and Marinc, 2018; Del Giudice and Paltrinieri, 2017). This impact resembles that brought by influenza outbreak in United States resulting into dwindling trading volume and higher bid-ask spreads (Mc Tier *et al.*, 2013). Further evidence seems to suggest that stock markets in major Latin America economies were adversely affected by the outbreak of Zika virus with Brazil suffering a relatively larger impact (Macciocchi *et al.*, 2016). However, unlike SARS-CoV, Ebola and MERS-CoV which had regional effects, the current COVID-19 pandemic has impacted all regions around the globe which makes its impact more severe (The World Bank, 2020a).

2.2 Stock markets during the COVID-19 pandemic

2.2.1 Stock market performance disparities between regions. Literature on stock markets reactions during the current COVID-19 has put forward evidence to indicate increasing volatility during the pandemic (Ashraf, 2021; Zhang *et al.*, 2020; Baek *et al.*, 2020). However, evidence points toward disparities in stock market performance among countries during the prevailing pandemic. Zhao *et al.* (2022) depict that stock markets in developed countries have suffered immensely as opposed to those from developing countries due to supply reduction, demand reduction and economic instability. Moreover, investors in developed and emerging economies reacted differently to COVID-19 in both the pre-April 2020 period (rising infections) and post April 2020 period (stabilizing) (Harjoto *et al.*, 2021). Liu *et al.* (2020a) narrate that stock indices in South East Asian economies were hit the hardest during the first outbreak of COVID-19. However, later evidence showed that Asian stock markets recovered and remained resilient to further COVID-19 shocks (Szczygielski *et al.*, 2021). This is supported by recent studies such as (Hui and Chan, 2022) that show how stock markets in Europe have been more volatile than those in South East Asia during the pandemic. Given disparities among studies pertaining to stock market performance dynamics in different regions we hypothesize that

H1. There are significant differences in stock market performance between regions during COVID-19

2.2.2 Stock market performance and COVID-19 containment measures stringency. The literature on how different government containment measures such as lockdowns, closure of schools affect stock markets has been gradually growing. This has created two opposing schools of thought on the subject with each group advocating for either improving or deteriorating stock market performance (Deng *et al.*, 2021). The advocates for improved stock market as a result of COVID-19 containment measures imposition argue that growing number of cases and deaths causes panic among investors resulting into panic selling (Aggarwal *et al.*, 2021; Haroon and Rizvi, 2020 Deng *et al.*, 2021). Therefore imposition of measures such as lockdowns and cancellation of public events is instrumental in slowing down the spread of COVID-19 and eventually reduce fatalities (Haroon and Rizvi, 2020). This helps to reduce panic among investors which inhibits their propensity to engage in panic selling of stocks thus improving stock market performance (Aggarwal *et al.*, 2021). On the other hand, imposition of containment measures has the potential to cause economic slowdown which may eventually drive the economy into recessions (Bauer and Weber, 2021; Baig *et al.*, 2021). Deteriorating economic conditions can thus create fear and panic among investors with the potential to increase stock market volatility. Due to the economic recessions experienced during COVID-19 and disruptions in activities of key economic sectors such as manufacturing and transportation we develop the following hypotheses;

H2. There are significant differences in COVID-19 containment measures stringency between regions.

H3. COVID-19 measures stringency has negative effect on stock market performance.

2.3 The moderation role of financial market interventions during COVID-19

The financial sector is the key organ to assist countries repel the adverse effects of crisis on the economy hence accelerate recovery (The World Bank, 2020a). Since COVID-19 was declared as a pandemic, governments worldwide have intervened by creating financial policies intended to mitigate the adverse effects of the pandemic on the economy (International Monetary Fund, 2020). These particular policies have been imposed during crises to restore economic stability through crucial economic drivers such as the financial sector (Cho, 2010). Since COVID-19 has run roughshod over economies, financial policy interventions have been enacted to provide liquidity to financial institutions and help maintain financial markets stability hence restoring investors' confidence (The World Bank, 2020a).

One particular type of these interventions is the financial market interventions. These are put in implemented by governments to restore confidence in the financial markets by stabilizing them during crisis (IMF, 2020). There are two main groups of financial market interventions that have been done by governments during COVID-19 namely, marketing functioning interventions and PDM (The World Bank, 2021).

2.3.1 Market functioning interventions. These interventions intend to change various financial market regulations amid crisis in order to reduce panic thus restore confidence in the market. Some of the commonly used one during COVID-19 includes bans on short selling of securities. Evidence suggests that short selling trading strategy can increase securities price volatility even during normal market conditions making the ban amid COVID-19 necessary (Ho, 2021). The other intervention is extension of the deadlines for disclosure of audited financial statements of investment companies. This is due to the uncertainties surrounding COVID-19 which may inhibit these companies from timely preparing materially correct financial statements for disclosure to investors (IOSCO, 2020). Thus deadline extension provides time for investment companies to assess the conditions amid COVID-19 provide investors with informed disclosures on business continuity. Furthermore, other governments cancelled tariffs on issuance of corporate bonds to encourage companies to raise finance and stay afloat during the pandemic. We therefore hypothesize that;

H4. Market functioning interventional strategy has a positive moderating effect on the relationship between COVID-19 measures stringency and stock market performance.

2.3.2 Public debt management interventions. These firstly include injection of funds to support wholesale funding markets used by smaller lenders, including non-bank lenders. The second form of these interventions involves strengthening liquidity in currencies by extending groups of institutions with access to auctions and to the liquidity window of the Central Bank. This is by extending access to public debt instruments by including pension and severance fund organizations. The other intervention is establishing temporary financing facilities for commercial banks that will be guaranteed by credits to corporations that issue bonds. These finances are intended to be channeled to micro, small- and medium-size enterprises (SMEs) to assist them during the pandemic (The World Bank, 2021). We therefore hypothesize that;

H5. PDM interventional strategy has a positive moderating effect on the relationship between COVID-19 measures stringency and stock market performance.

3. Methods

3.1 Data

Our study employed a global dataset from 2nd January 2020 to 30th September 2021 of 39 economies distributed across six regions namely: Africa, Asia, Europe, South America, North

America and Oceania. Our sample covered 39 countries alone because these had complete stock market and financial market interventions data for the selected timeframe. All countries with gaps in their data were dropped from the dataset to ensure robust analyses. The selection of the timeframe from 2nd January 2020 to 30th September 2021 was done to capture the effects of the first and second wave of COVID-19. Our timeframe ended at 30th September 2021 as this was the last date that the World Bank reported on financial market interventions by individual countries (The World Bank, 2021) thus making the extension to 31st December 2021 impractical.

We explore two main sub-periods; the first is the period from 2nd January 2020 to 31st November 2020 which marks the first wave of COVID-19 caused by the Alpha variant. This includes the period of rapid surge in cases from January to June 2020 and the period from July 2020 to November during which infections were falling. The second period ranges from 1st December 2020 to 30th September 2021 which marks the second wave of COVID-19. In December another more contagious variant of COVID-19 namely Delta was discovered in India and managed to spread across the globe causing a sudden surge in infections and deaths especially in March 2021.

The descriptive statistics for the variables incorporated in our dataset are presented in Table 1. The results show that the stock market performance during the studied timeframe averaged at about 0.04%. The average COVID-19 containment measures stringency has been reported to be 58.4% indicating that several countries implemented some degree of containment measures such as lockdown and social distancing. The results also indicate significant disparities among countries in terms of COVID-19 deaths and cases as revealed by the high standard deviation for the two variables. This may be caused by containment measures stringency differences between different countries. Regarding the financial market interventional strategies, the results show that market functioning strategy was employed on about 1% of the studied observations (periods) while PDM being employed on about 1.5% of the studied observations.

The average GDP growth was negative indicating decreasing output in most economies since the outbreak of the virus as elucidated by disruption in main economic activities. The mean interest rate was below 5 despite some countries reporting double digit inflation rates during COVID-19 as shown by the maximum value for the variable.

Variable	Obs	Mean	Std. dev.	Min	Max
Stock returns	16,310	0.044	1.7938	−98.997	13.909
COVID-19 measures stringency	16,310	58.427	19.417	0	100
Market functioning	16,310	0.007	0.083	0	1
Public debt management	16,310	0.001	0.035	0	1
N. culture	16,310	57.277	24.353	8	100
I. freedom	16,310	68.909	17.308	20	90
Lag. returns	16,310	0.044	1.794	−98.997	13.909
COVID-19 cases	16,310	1,680,154	4,819,559	0	43,500,000
COVID-19 deaths	16,310	37,062	90,633	0	699,634
Inflation	16,310	3.029	7.493	−2.570	48
Interest	16,310	2.946	6.630	−0.810	38
GDP growth	16,310	−0.209	5.740	−11.250	18.300
Number of countries	39				

Source(s): Own compilation (2022)

Table 1.
Descriptive statistics

3.2 Variables

3.2.1 Dependent variable. Stock market Performance: This is measured by daily stock returns of respective stock market indices. This variable and its respective measurement have also been used by recent studies such as (Baek *et al.*, 2020; Al Awadh *et al.*, 2020). The returns are computed as follows:

$$Return\ on\ Day_{one} = (Return\ on\ Day_{one} - Return\ on\ Day_0)/Return\ on\ Day_0$$

3.2.2 Independent variables. COVID-19 measures stringency: this variable is compiled by the Oxford Corona Virus Government Response Tracker (OxCGRT). It is a composite measure that incorporates nine of the response metrics. These are school closures, workplace closures, cancellation of public events, restrictions on public gatherings, closures of public transport, stay-at-home requirements, public information campaigns, restrictions on internal movements and international travel controls. The index is computed on daily basis as an average score of the nine metrics with each ranked between 0 and 100. The highest score of 100 indicates a strictest policy on a particular day.

3.2.3 Moderating variables. We employ two moderating variables representing financial market specific interventions: (1) *Market functioning* and (2) *PDM.* The country's financial market interventions to stabilize the financial system can steer/deter the effects of COVID-19 containment measures on stock market performance through restoring investors' confidence (The World Bank, 2021).

3.2.4 Control variables. To ensure results robustness we controlled for COVID-19 outbreak effects using the number of COVID-19 cases and deaths reported for respective countries. Recent studies such as (Ashraf, 2020: Liu *et al.*, 2020a) have studied the impact of the mentioned variables on investors' behavior. We further control the effects of the following variables on stock market performance: *National Culture* (Ashraf, 2021), *Lag of stock returns* (Irshad, 2017), *Real GDP growth* (Ramraika, 2015), *Interest* (Martinez *et al.*, 2020), *Inflation rate* (Otieno *et al.*, 2019) and *Investment Freedom* (Ashraf, 2021). The descriptions of each variable are presented in Table 2.

3.3 The empirical models

3.3.1 Panel vector autoregression (PVAR) model. We firstly employed the Panel Granger non-causality test to evaluate the potential of COVID-19 variables namely number of cases, number of deaths and policy stringency to cause stock returns. This test is part of VAR models that is instrumental in examining the power of one variable to forecast the other. The Granger causality (Dumitrescu and Hurlin, 2012) approach that is designed to deal with heterogeneous panel data was utilized in this particular case. Secondly, we utilized the PVAR model to examine the impact of shocks from countries' number of cases, number of deaths and policy stringency on stock returns using impulse response functions (IRFs). IRFs are paramount to panel VAR as they visualize the magnitude and timing of shocks from one variable to the other. The IRFs are generated using Cholesky decomposition of the variance–covariance with orthogonalized shocks (Holtz–Eakin *et al.*, 1988). Panel VAR is well suited to handle high-frequency data similar to the ones used in this study as well as treating variables endogenously by accounting for unobserved individual heterogeneity (Love and Zicchino, 2006). The magnitudes of cases, deaths and containment measures stringency since the first outbreak of COVID-19 have been changing over time. PVAR through IRFs is better suited to analyze and visualize the differences in shocks transmission from each COVID-19 variable to stock returns in different time periods. This is unlike other methods such as regressions which only analyze the significance and direction of relationships between variables without considering the changes in the magnitude and direction of the relationship in different time periods. Therefore PVAR captures both static and dynamic interdependencies between

Variables	Description	Sources
Stock market performance (returns)	Daily closing stock returns from 2nd January 2020 to 30th September 2021	https://www.investing.com
COVID-19 measures stringency (CoMS)	0 if the country has the leniest policy and 100 if the country has the strictest policy	https://ourworldindata.org/covid-stringency-index
Market functioning (MFN)	1 if the country employed market functioning strategy, 0 otherwise	https://datacatalog.worldbank.org/dataset/COVID-19-finance-sector-related-policy-responses
Public debt management (PDM)	1 if the country employed market PDM strategy, 0 otherwise	https://datacatalog.worldbank.org/dataset/COVID-19-finance-sector-related-policy-responses
National culture (N. culture)	Measured by country's uncertainty avoidance index ranging from 0 to 100. The higher the score, the more the panic and discomfort people have with uncertainties	https://www.hofstede-insights.com/product/compare-countries/
Investment freedom (I. freedom)	An index that ranges between 0 and 100. It measures stock market liberalization including the extent of foreign investors' participation in local stock market	https://www.heritage.org/index/download
Lag. returns	The lag of the stock returns	https://www.investing.com
COVID-19 cases (cases)	New daily COVID-19 cases per million people	https://ourworldindata.org/covid-deaths
COVID-19 deaths (deaths)	New daily COVID-19 deaths per million people	https://ourworldindata.org/covid-cases
Inflation	Quarterly inflation rate	https://tradingeconomics.com/country-list/inflation-rate
Interest rate	Quarterly interest rate	https://tradingeconomics.com/country-list/interest-rate
GDP growth	Quarterly GDP growth rate	https://tradingeconomics.com//country-list/gdp

Source(s): Own compilation (2022)

Table 2.
Variable descriptions

variables across time (Canova and Ciccarelli, 2013) thus provide robust analyses given the changing nature of COVID-19 pandemic. We specify the following Panel VAR model as postulated by Love and Zicchino (2006);

$$Sr_{it} = \Gamma_0 + \Gamma_1 sr_{i,t-1} + v_i + \varepsilon_{it}$$

$$i\varepsilon\{1, 2, \ldots, N\}, t\varepsilon\{1, 2, \ldots, T\}$$

where

(1) $Sr_{it=}$Vector of the variables COVID-19 cases, deaths, containment policy stringency and stock market returns;

(2) Γ_0 and Γ_1 = the matrix of our parameters;

(3) the vectors of country-specific panel fixed effects;

(4) ε_{it} = the error term which is assumed to be independently and identically distributed with constant variance and zero mean.

3.3.2 Fixed effects regression model. We specify the following fixed effects regression model for empirical analyses;

$$Y_{c,d} = \alpha_c + \beta_1(COVID-19MS_{c,d} \times Market\ Functioning_c) + \beta_2(COVID-19MS_{c,d} \times Public\ Debt\ Management_c) + \beta_3(COVID-19MS_{c,d}) + \beta_4(Market\ Functioning_c) + \beta_5(Public\ Debt\ Management_c) + \sum_{k=0}^{k} \beta_k X_c^k + \dot{\varepsilon}_{c,d}$$

where

Y = The dependent variable in this case stock market performance; c = Country; d = Time in days; αc = A constant term; β = Coefficient of independent/moderating variables; COVID-19MS$_{c,d}$ = COVID-19 measures stringency for a given country in a given day; COVID-19MS$_{c,\ d}$ × Market Functioning$_c$ = the first interaction term which means the effects of country's COVID-19 measures stringency on stock market performance is contingent upon the imposition of the market functioning financial market interventions; COVID-19MS$_{c,\ d}$ × Public Debt Management$_c$ = the second interaction means which means the effects of country's COVID-19 measures stringency on stock market performance is contingent upon the imposition of the public debt management financial market interventions; X_c^k = a set of country level control variables that include national culture, investment freedom, inflation rate, interest rate and real GDP growth rate; $\dot{\varepsilon}_{c,d}$ = Error term.

3.4 Pre-estimation diagnostics

3.4.1 Panel VAR diagnostics. We carried out the panel unit root test to check for stationarity of the variables. We employed the Fisher unit root test based on Augmented Dickey–Fuller (ADF) for panel data using the four methods put forward by Choi (2001). This test works well with unbalanced panel data such as stock return data in our case which usually contain gaps, e.g. due to presence of non-trading days. The results from Table 3 indicate that all the variables do not contain the unit root as illustrated by their *p*-values of less than 0.05 for each of the four methods.

3.4.2 Regression model goodness-of-fit and estimation. We mainly postulate that the COVID-19 measurement stringency negatively affects the stock markets' performance in terms of their returns. However, we further hypothesize the moderation role of financial market-specific interventional strategies namely market functioning and PDM as in securing the financial systems. The panel regression model was employed to examine the stated

Variable	Inverse Chi-squared (78)	Inverse normal	Inverse logit (199)	Modified inv. Chi-squared
Returns	2805.60*	−49.91*	−106.97*	204.85*
CoMS	372.90*	−11.00*	−12.65*	20.57*
MFN	2055.13*	−41.27*	−78.35*	148.00*
PDM	573.39*	−17.49*	−21.56*	35.75*
N. Culture	346.25*	−9.56	−10.23	18.96
I. Freedom	396.17*	12.75*	14.15*	21.87*
Lag. Returns	134.49*	−7.57*	−9.59*	3.96*
Cases	168.24*	−3.71*	−3.51*	5.06*
Deaths	156.00*	−3.64*	−3.38*	4.14*
Inflation	532.71*	−15.08*	−19.72*	32.67*
Interest	948.38*	−23.65*	−35.71*	64.16*
GDP growth	146.79*	−3.12*	−2.98*	3.44*

Note(s): *Significant at 0.05

Table 3.
Panel Fisher-type unit root test based on ADF results

relationships (Bell *et al.*, 2019). The Hausman test results suggested the fixed effects (FE) estimator to be appropriate over the random effects (RE) estimator (Lensink *et al.*, 2017).

Prior further analyses we ensured for goodness-of-fit of the model by testing several regression assumptions (Kansheba and Marobhe, 2021). Appendix 1 provides for the summary of tested assumptions gauging the goodness-of-fit of the model. The Breusch–Pagan test results show the *p*-value of 0.0647 greater than the cutoff point of 0.05 indicating the absence of heteroskedasticity problem (Hausman and Taylor, 1981). The Pearson–wise correlation matrix (see Appendix 1) shows that all independent variables have the value below the cut-off point of 5, suggesting the absence of serious multicollinearity problem (Kansheba, 2020). Additionally, the variance inflation factor-(VIF) test was performed and confirmed the absence of multicollinearity problem where explanatory variables have lower VIF value below the cut-off point of 5 (Studenmund, 2011). However, the variables cases, deaths, inflation and interest rate were excluded from the analyses due to high VIF above the cut-off point.

The link test for model specification results shows the *p*-value of 0.766 greater than 0.05 suggesting that the model is correctly specified (Lensink *et al.*, 2017). The explanatory variables explain about 38% (*R*-squared-within) of the variation in the outcome variables.

4. Results

4.1 Pairwise correlations results

We commenced our analyses by analyzing correlations between our variables as shown in Table 4. The results reveal significant correlation between containment policy stringency and stock returns. The number of cases and deaths were not significantly correlated with stock returns during COVID-19. The number of cases, deaths and CoMS are also significantly correlated with each other given their inherent interdependent nature.

The results further reveal strong correlation between COVID-19 containment policy stringency and number of deaths and cases. This may provide some evidence to indicate the fact that the number of cases and deaths is influenced by strictness of individual countries' COVID-19 containment measures.

4.2 ANOVA and post hoc ANOVA results

We conducted the ANOVA and post hoc ANOVA to examine disparities among regions in terms of returns and containment measures stringency in both waves of COVID-19. The results are presented in Table 5 and they present evidence of non-significant differences in stock market performance during the first and second wave of COVID-19. However, the results reveal significant differences between regions in terms of containment measures stringency (CoMS) in both waves. Therefore, we present evidence to reject hypothesis 1 (H1) and accept hypothesis 2 (H2).

We then proceeded to carry out post hoc ANOVA to reveal inter-regional differences in containment measures stringency since the overall differences were significant in both waves of COVID-19. During the first wave, Asian and European containment measures were stricter than those in Africa and Latin America. Furthermore, Oceania and North America containment measures stringency differed from Latin America. During the second wave of COVID-19, containment measures in Asia, Europe, Latin America and North America were stricter than those in Africa. Disparities were also observed between Latin America, North America and containment measures in Asia and Oceania.

4.3 Panel Granger causality results

We commenced our Panel VAR modeling by firstly examining causality between stock returns and each of the three COVID-19 variables which are containment measures

Table 4.
Pairwise correlation results

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) Returns	1.00											
(2) Cases	0.01	1.00										
(3) Deaths	0.01	0.94*	1.00									
(4) CoMS	0.10*	0.06*	0.06*	1.00								
(5) Inflation	0.01	0.07*	0.07*	0.15*	1.00							
(6) Interest	0.01	0.03*	0.03*	0.15*	0.97*	1.00						
(7) GDP growth	0.01	0.32*	0.29*	0.05*	0.02*	−0.03*	1.00					
(8) MFN	−0.01	−0.02	−0.02*	0.05*	0.04*	0.05*	−0.08*	1.00				
(9) PDM	−0.01	−0.01	−0.01	0.04*	−0.03	0.01	−0.01	0.04*	1.00			
(10) Lag. Returns	0.03*	0.01	0.01	0.10*	0.01	0.01	0.01	−0.02*	0.02*	1.00		
(11) N. culture	−0.02	0.03*	0.09*	0.08*	0.22*	0.25*	−0.16*	0.03*	−0.02*	−0.02	1.00	
(12) I. freedom	−0.03	−0.05	−0.02*	−0.12*	−0.26*	−0.32*	−0.11*	−0.03*	−0.05*	−0.02	−0.19*	1.00

Note(s): *Significant at 0.05

ANOVA	Returns *F*-stat	Returns *p*-value	CoMS *F*-stat	CoMS *p*-value
Region (1st Wave)	0.190	0.967	25.54	0.000*
Region (2nd Wave)	0.596	0.703	48.6	0.000*
Post Hoc ANOVA	**Containment measures stringency**			
	First wave		Second wave	
Regions	Contrast	*p*-value	Contrast	*p*-value
Asia–Africa	−6.723	0.000*	9.628	0.000*
Europe–Africa	−6.851	0.000*	9.034	0.000*
Latin America-Africa	2.326	0.577	13.576	0.000*
North America–Africa	−4.053	0.095	13.549	0.000*
Oceania-Africa	−3.709	0.363	9.663	0.000*
Europe–Asia	−0.128	1.000	−0.594	0.648
Latin America-Asia	9.049	0.000*	3.949	0.000*
North America–Asia	2.671	0.199	3.922	0.000*
Oceania-Asia	3.014	0.401	0.036	1.000
Latin America-Europe	9.177	0.000*	4.543	0.000*
North America–Europe	2.799	0.135	4.516	0.000*
Oceania-Europe	3.143	0.336	0.630	0.992
North America-Latin	−6.378	0.000*	2.719	1.000
Oceania-Latin America	−6.034	0.008*	−3.913	0.017*
Oceania-North America	0.344	1.000	−3.886	0.031*

Note(s): *Significant at 0.05

Table 5.
ANOVA and post hoc ANOVA

stringency, number of cases and number of deaths. The Panel Granger non-causality test using the (Dumitrescu and Hurlin, 2012) approach results are presented in Table 6.

The results reveal that number of COVID-19 cases and deaths do not ranger cause stock returns. Containment measures stringency however appears to Granger cause stock returns during COVID-19 which provides evidence to demonstrate the importance of this variable in forecasting stock returns. These results are supported by preliminary evidence of significant correlation between policy stringency and stock returns.

4.4 Panel VAR modeling results

Our panel VAR modeling commenced with the selection of the lag length. The results presented in Table 7 show a lag length of one day for all the three models and moments selection criteria (MMSC) namely: Bayesian Information Criterion (BIC), Akaike Information Criterion (AIC) and Hannah and Quinn Information Criterion (HQIC). We then continued to carry out an important stability test prior to panel VAR modeling. The results are visualized in Figure 1 and signify satisfaction of the stability conditions for the postulated relationships in our Panel VAR model. This can be explained by the Eigen values which are all within the unit circles.

Returns	*W*-bar	*Z*-bar	*Z*-bar tilde
Cases	0.5849	−0.0566	−0.0646
Deaths	0.5468	−0.2117	−0.2169
CoMS	5.5354	21.7993*	19.7548*

Note(s): *Significant at 0.05

Table 6.
Panel Granger non-causality test results

After selecting the lag length and satisfying the stability condition, we conducted Panel VAR modeling. The results are presented in Figure 2 and they reveal variations among COVID-19 containment policy stringency, number of cases and deaths in causing stock returns shocks.

Figure 2 specifically present orthogonalized IRFs of stock returns resulting from shocks originating from COVID-19 containment policy stringency with 95% confidence interval. The timeframe for IRFs is divided into seven main quarters starting from January 2020 ending on September 2021. The results firstly reveal a linear but negative response of stock returns to a shock from COVID-19 deaths. Secondly, shocks from COVID-19 cases also appear to have a linear negative impact on stock returns during the entire timeframe. On the other hand, COVID-19 containment measures stringency shocks caused positive linear shocks in returns as opposed to cases and deaths. These results provide early evidence to indicate rejection of hypothesis 3 (H2) which postulates a negative impact of COVID-19 containment measures on stock market performance.

4.5 Fixed effects regression results

We lastly conducted the fixed effects (FE) regression to examine the moderation role of the financial market interventions on the relationship between COVID-19 measures stringency and stock market performance during both waves of COVID-19. Model 1 in each analysis is the base line model comprised of independent variables (CoMS), control variables and the dependent variable returns. Under model 2, the moderating variable, i.e. market functioning (MFN) or PDM, is added to the regression model. Lastly, the interaction variables namely (CoMS × MF and CoMS × PDM) are each added to its respective model for final analysis.

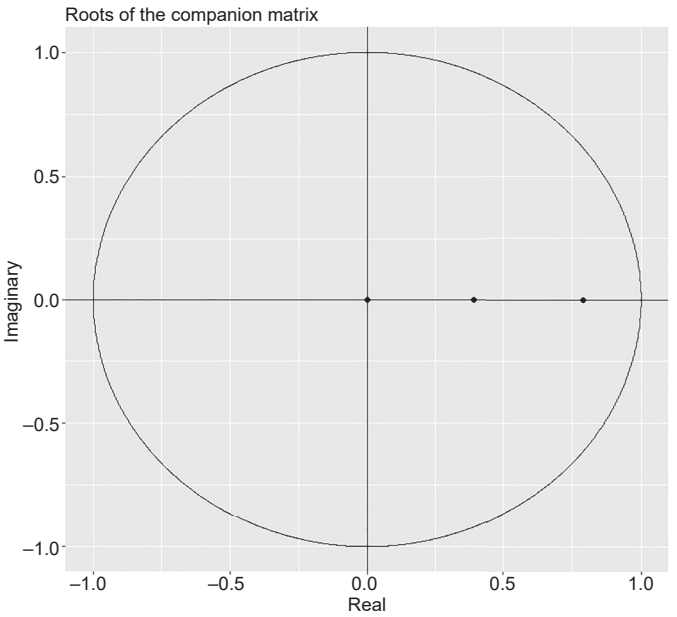
Table 8 presents FE results for the moderation role of market functioning interventions on the relationship between COVID-19 containment measures stringency and stock market performance. The results firstly reveal a statistically significant positive impact of COVID-19 containment measures stringency on stock returns in both waves of COVID-19 as shown in models 1. We thus reject hypothesis 3 (H3) which postulates the negative relationship between the two variables. In models 2 and 3 for both the first and second wave of COVID-19, we introduce the moderating role of market functioning interventions. We observed a statistically significant positive moderation role of market functioning interventions on the relationship between COVID-19 containment measures and returns during the first wave of COVID-19 alone. This signifies the fact that imposition of market functioning interventions amplifies the positive effects of COVID-19 containment measures on stock market performance. We therefore do not reject hypothesis 4 (H4) for the first wave alone while we reject H4 for the second wave of COVID-19.

We then examined the moderation role of PDM interventions on the relationship between COVID-19 containment measures stringency and stock market performance. The FE results are presented in Table 9 and they reveal a non-significant moderation role of PDM in both the first and second wave of COVID-19. We thus reject hypothesis 5 (H5) that postulates a significant moderation role of PDM on the relationship between containment measures stringency and stock market performance.

Table 7.
Lag length selection results

Lag	CD	*J*	BIC	AIC	HQIC
1	0.9782	−14742.85	−13107.23*	−28987.29*	−67238.67*

Note(s): *Lag length selection based on the three (3) criteria



Note(s): The PVAR model is stable when all three (3) dots lie within the circle

Figure 1.
PVAR stability test results

5. Discussions

In this article, we examine the effects of the novel COVID-19 on stock market performance and the role that different financial market interventions play in protecting stock markets. We firstly do not find evidence of significant differences between regions in terms of stock market performance during both waves of COVID-19 as opposed to (Hui and Chan, 2022; Szczygielski *et al.*, 2021; Harjoto *et al.*, 2021). We also provide evidence to demonstrate the positive impact of COVID-19 containment measures stringency on stock market performance during the first wave of COVID-19 only. Our results support those by Aggarwal *et al.* (2021), Haroon and Rizvi (2020), Deng *et al.* (2021) that depict positive stock market reaction to COVID-19 containment measures. These results signify the fact that investors view containment measures as necessary steps toward slowing down the virus and therefore help economies to bounce back from COVID-19-induced recessions. We also demonstrate a significant and positive moderation role of market functioning interventions in further amplifying the positive role of COVID-19 containment measures stringency on stock market performance. However, this was observed during the first wave of COVID-19 as prolonged containment measures can slowly diminish investors' hopes of economic recovery in the long run, i.e. during the second wave (Bouri *et al.*, 2021).

Evidence suggests that market functioning interventions enable investors to reduce fear and panic amid bullish conditions which reduces their propensity to engage in panic selling of stocks (Chen *et al.*, 2005). This is by being able to receive and absorb news which improves their inclination toward making more informed trading decisions. On the other hand, effects of countries' PDM interventions on stock market performance were observed to be weak during COVID-19. PDM strategies may influence stock market performance but not as direct and instantaneously as market functioning strategies. This is attributed to

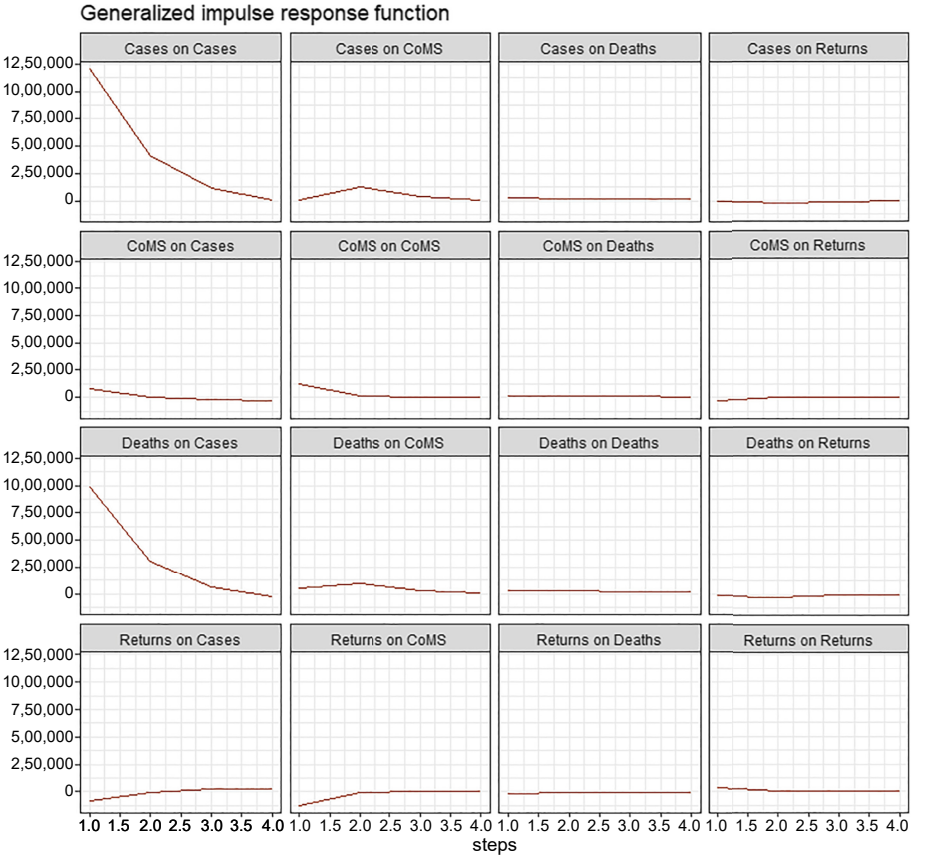


Figure 2.
Panel VAR impulse response functions results

Returns	COVID-19 (first wave)			COVID-19 (second wave)		
Variables	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Containment measures stringency	0.014*	0.015*	0.014*	0.002*	0.002*	0.002**
Market functioning	–	−0.315	−1.453*	–	0.191	0.638
Containment measures stringency × market functioning interventions	–	–	0.017*	–	–	−0.006
Investment freedom	0.002	0.002	0.002	−0.000	−0.000	−0.000
National culture	−0.001	−0.001	−0.001	0.000	0.000	0.000
GDP growth	0.008	0.007	0.008	−0.008*	−0.008*	−0.008*
Lag of returns	−0.044*	−0.044*	−0.044*	−0.0459*	−0.046*	−0.046*
Constant	−0.835*	−0.835*	−0.829*	0.026	0.027	0.027
R-squared	0.19	0.19	0.38	0.13	0.14	0.14
No. of observations	8,086	8,086	8,086	8,220	8,220	8,220

Note(s): *Significant at 0.05

Table 8.
FE estimates for the linkage between COVID-19 containment measures stringency, market functioning interventions and stock market performance: FE estimates

the fact that they are imposed to inject liquidity in the overall financial systems predominantly through financial institutions (The World Bank, 2021). However, market functioning strategies such as bans on short selling are imposed specifically to instantly alter securities trading in the markets thus leading to immediate changes in volatility (Zhang *et al.*, 2015).

Our findings appear to be in contrast to those of (Beber and Pagano, 2013; Bohl *et al.*, 2012) which showed the insignificancy of market functioning interventions such as short selling bans to reduce stock volatilities during the GFC of 2008. Boehmer and Wu (2009) depict that interventions of this sort causes deterioration in market liquidity and inhibit price discovery as investors exit from the market. Other studies such as (Eom *et al.*, 2021) have revealed that these interventions neither increased volatility nor reduced liquidity during the GFC of 2008 which questions their relevance. However the GFC of 2008 was foreseen as the US economy had already exhibited structural problems leading to the crisis (Li *et al.*, 2021). On the other hand, COVID-19 pandemic could not be predicted and its economic effects have been far devastating than that of the GFC of 2008. This can possibly explain disparities between our findings and those of previous studies that covered the GFC of 2008.

A crucial caveat for understanding our findings is based on the premise that COVID-19 has caused deterioration in stock market indices around the world which is a common occurrence during crises. However, the adverse effects are less pronounced in those countries with stricter containment measures and higher magnitude of market functioning interventions. Our findings are profound in relation to those of past studies (Zhang *et al.*, 2020; Baek *et al.*, 2020; Szczygielski *et al.*, 2021) that depict a direct relationship between COVID-19 cases, fatalities or government measures and stock market performance. We provide robust evidence to support findings by Uddin *et al.* (2021); Ashraf (2021), who have also postulated the influence of other factors/moderators for instance economic strength and national culture on the strength and direction of relationship between COVID-19 and stock market performance.

6. Conclusions, implications and avenues for future research

6.1 Conclusions

In this article, we investigate the impact of daily country-level COVID-19 containment measures stringency on performance of stock markets from 39 economies across the globe. We moderate this relationship using specific financial market interventions imposed by

Returns	COVID-19 (first wave)			COVID-19 (second wave)		
Variables	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Containment measures stringency	0.014*	0.014*	0.014*	0.002*	0.002*	0.002*
Public debt management	–	−0.275	4.676	–	2.902	2.815
Containment measures stringency × public debt management	–	–	−0.063	–	–	0.037
Investment freedom	0.002	0.002	0.002	−0.000	−0.000	−0.000
National culture	−0.001	−0.001	−0.001	0.000	0.000	0.000
GDP growth	0.008	0.008	0.008	−0.008*	−0.007*	−0.007*
Lag of returns	−0.044*	−0.044*	−0.044	−0.046*	−0.044*	−0.044*
Constant	−0.835*	−0.830*	−0.829	0.026	0.024	0.023
R-squared	0.19	0.21	0.21	0.13	0.13	0.13
No. of observations	8,086	8,086	8,086	8,220	8,220	8,220

Note(s): *Significant at 0.05

Table 9. FE estimates for the linkage between COVID-19 containment measures stringency, public debt management interventions and stock market performance

countries to reduce volatility of stock prices which suffered immensely during COVID-19. Unlike previous studies, we use COVID-19 stringency index as a proxy for COVID-19 measure because the economic effects of COVID-19 are a result of measures imposed by governments for instance lockdowns and social distancing measures. Thus, we opine that the pandemic's impact on stock markets is well understood by focusing on stringency of country's COVID-19 containment measures. Our findings firstly portray a significant positive impact of COVID-19 measures stringency on stock market performance. We further show that the improvement in stock market performance due to changes in COVID-19 measures stringency is stronger in countries with higher magnitude of market functioning interventions.

6.2 Theoretical implications

Over recent decades different regions have been rocked with pandemics such as SARS-COV, MERS-COV and Ebola which have had social and economic repercussions. The current COVID-19 pandemic is different from the past health crisis as explained by the magnitude of spread and severity of its economic repercussions on the global economy. These events have had adverse effects on stock markets around the globe due to elevated panic and fear among market participants. Our findings have enormous theoretical implications as they firstly provide evidence to support the Black Swan theory (Taleb, 2007). The theory provides a depiction of how occurrence of major events such as financial crises, pandemics, natural disasters leads into rising stock market volatility due to panic trading. However, imposition of policies that help to curb the problem is instrumental in reducing investors' panic despite the fact that these policies may lead to short-run recessions as seen in the case of COVID-19. Nevertheless, these policies diminish in significance in the long run as the problem continues to persist. Furthermore, we show that panic during major crisis is reduced further by interventions made by regulators to protect stock markets.

6.3 Practical implications

The empirical results presented in our article have tremendous practical implications. Firstly, we urge policymakers to timely intervene during crisis to protect the economy and stock markets. Bad news has the potential to cause panic among stock market investors as observed during COVID-19. However timely imposition of containment measures to contain the crisis is vital in building confidence among investors which inhibits their propensity to engage in panic selling which can cause deterioration in stock market performance. Secondly, stock market regulators should make interventions specifically focused on the functioning of stock markets during crises. Some practices such as short selling have been found to induce market volatility even in non-crisis periods. Prohibition of practices like this during crises is crucial for protecting stock markets from further deterioration. Moreover, relaxation of regulations such as removal of tariffs for issue of corporate bonds during major crises is crucial in keeping the market active and liquid. Thirdly, portfolio managers, institutional and individual investors need to take initiatives to prepare for the adverse effects of crises such as COVID-19. This is by diversifying their portfolios in countries that show better initiatives to protect stock markets through proper market functioning interventions as observed during COVID-19.

6.4 Avenue for future research

The one inherent limitation of our findings is the treatment of financial market interventions as a group despite having different strategies. The financial markets interventions data compiled by The World Bank, 2021 present different types of data for individual financial

market interventions imposed on particular dates along the timeframe. The number of these interventions was large and diverse which made it impractical to capture the interruption effects of each individual of these such as circuit breaks, ban on short selling and delays in disclosure of audited financial statements by listed companies. Thus for analysis purposes, all market functioning and PDM strategies were treated as a group and not a specific individual strategy. Due to the multiplicity of market functioning strategies, further studies should focus on the most common ones such as ban on short selling and proceed to examine their moderation role on stock market performance of individual countries during COVID-19. The findings imply that buying stocks from markets in countries with higher magnitude of market functioning interventions during major crises may be safer for investors.

Future research direction should also be directed toward studying the role of other financial sector interventions during COVID-19 in protecting stock markets during these times of economic turmoil. These include firstly, liquidity/funding interventions that comprise of policy rate, asset purchases and providing liquidity in foreign exchange (FX). Secondly, the banking sector interventions that involve support borrowers, operational continuity, cash management, integrity and prudential-based policy intervention which entails temporary relaxations of major regulatory and supervisory requirements Thirdly, payment systems interventions that include consumer protection and encouragement of digital payments to mitigate the shocks in remittance flows by waiving fees and charges and digital identification procedures.

References

Aggarwal, S., Nawn, S. and Dugar, A. (2021), "What caused global stock market meltdown during the COVID pandemic–Lockdown stringency or investor panic?", *Finance Research Letters*, Vol. 38, 101827.

Al-Awadhi, A., Ahmad, A. and Alhammadic, A. (2020), "Death and contagious infectious diseases: impact of the COVID-19 virus on stock market returns", *Journal of Behavioral and Experimental Finance*, No. 27, pp. 1-5, doi: 10.1016/j.jbef.2020.100326.

Ashraf, B. (2020), "Economic impact of government interventions during the COVID-19 pandemic: international evidence from financial markets", *Journal of Behavioral and Experimental Finance*, No. 27, pp. 1-9, doi: 10.1016/j.jbef.2020.100371.

Ashraf, B. (2021), "Stock markets' reaction to Covid-19: moderating role of national culture", *Finance Research Letters*, Vol. 41, pp. 1-9, doi: 10.1016/j.frl.2020.101857.

Baek, S., Mohanty and Glambosky, M. (2020), "COVID-19 and stock market volatility: an industry level analysis", *Finance Research Letters*, Vol. 37, pp. 1-9, doi: 10.1016/j.frl.2020.101748.

Baig, A., Butt, H., Haroon, O. and Rizvi, S. (2021), "Deaths, panic, lockdowns and us equity markets: the case of covid-19 pandemic", *Finance Research Letters*, Vol. 38, pp. 1-9, doi: 10.1016/j.frl.2020.101701.

Bauer, A. and Weber, E. (2021), "COVID-19: how much unemployment was caused by the shutdown in Germany?", *Applied Economics Letters*, Vol. 28 No. 12, pp. 1053-1058.

Beber, A. and Pagano, M. (2013), "Short selling banks around the world: evidence from the 2007-9 crisis", *Journal of Finance*, Vol. 68, February, pp. 343-381.

Bell, A., Fairbrother, M. and Jones, K. (2019), "Fixed and random effects models: making an informed choice", *Quality and Quantity*, No. 53, pp. 1051-1074, doi: 10.1007/s11135-018-0802-x.

Bohl, M., Essid, B. and Siklos, P. (2012), "Do short selling restrictions destabilize stock markets? Lessons from Taiwan", *The Quarterly Review of Economics and Finance*, Vol. 52, May, pp. 1981-20655.

Bhuyan, R., Lin, E. and Ricci, P. (2010), "Asian stock markets and the severe acute respiratory syndrome (SARS) epidemic: implications for health risk management", *International*

Journal of Environment and Health, Vol. 4 No. 1, pp. 40-56, doi: 10.1504/IJENVH.2010.033033.

Boehmer, E. and Wu, J. (2009), "Short selling and the informational efficiency of prices", Texas A & M working paper.

Bouri, E., Naeem, M.A., Nor, S.M., Mbarki, I. and Saeed, T. (2021), "Government responses to Covid-19 and industry stock returns", *Economic Research-EkonomskaIstraživanja*, Vol. ahead of print, pp. 1-24, doi: 10.1080/1331677X.2021.1929374.

Canova, F. and Ciccarelli, M. (2013). "Panel vector autoregressive models a survey", Working Paper SerieS NO 1507/January 2013.

Chen, G., Rui, O. and Wang, S. (2005), "The effectiveness of price limits and stock characteristics: evidence from the Shanghai and Shenzhen stock exchanges", *Review of Quantitative Finance and Accounting*, Vol. 25 No. 2005, pp. 159-182, doi: 10.1007/s11156-005-4247-7.

Chen, M., Lee, C., Chen, W. and Lin, Y. (2018), "Did the S.A.R.S. Epidemic weaken the integration of Asian stock markets? Evidence from smooth time-varying co-integration analysis", *Economic Research*, Vol. 31 No. 1, pp. 908-926, doi: 10.1080/1331677X.2018.1456354.

Cho, Y. (2010). "The role of state intervention in the financial sector: crisis prevention, containment, and resolution", ADBI Working Paper Series, No. 196, pp. 1-33, available at: https://www.adb.org/publications/role-state-intervention-financial-sector-crisis-prevention-containment-and-resolution, (accessed 21 September 2020).

Choi, I. (2001), "Unit root tests for panel data", *Journal of International Money and Finance*, Vol. 20, pp. 249-272, doi: 10.1016/S0261-5606(00)00048-6.

De Lisle, J. (2003), "SARS, greater China, and the pathologies of globalization and transition", *Orbis*, Vol. 47, pp. 587-604.

Del Giudice, A. and Paltrinieri, A. (2017), "The impact of the Arab spring and the Ebola outbreak on African equity mutual fund investor decisions", *Research in International Business and Finance*, Vol. 41, pp. 600-612, doi: 10.1016/j.ribaf.2017.05.004.

Deng, T., Xu, T. and Lee, Y. (2021), "Policy responses to COVID-19 and stock market reactions - an international evidence", *Journal of Economics and Business*, Vol. 119, pp. 1-12, doi: 10.1016/j.jeconbus.2021.106043.

Dumitrescu, E. and Hurlin, C. (2012), "Testing for granger non-causality in heterogeneous panels", *Economic Modelling*, Vol. 29 No. 4, pp. 1450-1460, doi: 10.1016/j.econmod.2012.02.014.

Eom, Y., Hahn, J. and Sohn, W. (2021), "Short sales restrictions and market quality: evidence from Korea", *Journal of Behavioral and Experimental Finance*, Vol. 30, 100504, doi: 10.1016/j.jbef.2021.100504.

Hale, T., Angrist, N., Goldszmidt, R., Kira, B., Petherick, A., Phillips, T., Webster, S., Cameron-Blake, E., Hallas, L., Majumdar, S. and Tatlow, H. (2021), "A global panel database of pandemic policies (Oxford COVID-19 government response tracker)", *Nature Human Behaviour*, Vol. 5, pp. 529-538, doi: 10.1038/s41562-021-01079-8.

Harjoto, M., Rossi, F., Lee, R. and Sergi, B. (2021), "How do equity markets react to COVID-19? Evidence from emerging and developed countries", *Journal of Economics and Business*, Vol. 115, 105966, doi: 10.1016/j.jeconbus.2020.

Haroon, O. and Rizvi, S.A.R. (2020), "Flatten the curve and stock market liquidity–an inquiry into emerging economies", *Emerging Markets Finance and Trade*, Vol. 56 No. 10, pp. 2151-2161.

Hausman, J. and Taylor, W. (1981), "Panel data and unobservable individual effects", *Econometrica*, Vol. 49 No. 6, pp. 1377-1398.

Ho, G. (2021), "The effect of short selling on volatility and jumps", *Australian Journal of Management*, Vol. 47 No. 1, pp. 34-52, doi: 10.1177/0312896221996416.

Holtz-Eakin, D., Newey, W. and Rosen, H. (1988), "Estimating vector autoregressions with panel data", *Econometrica*, Vol. 56 No. 6, pp. 1371-1395.

Hui, E. and Chan, K. (2022), "How does Covid-19 affect global equity markets?", *Financial Innovation*, Vol. 8 No. 25, pp. 1-19, doi: 10.1186/s40854-021-00330-5.

Ichev, R. and Marinč, M. (2018), "Stock prices and geographic proximity of information: evidence from the Ebola outbreak", *International Review of Financial Analysis*, Vol. 56, pp. 153-166, doi: 10.1016/j.irfa.2017.12.004.

International Monetary Fund (2020), *Policy Responses to COVID-19*, available at: https://www.imf.org/en/topics/imf-and-covid19/Policy-Responses-to-COVID-19 (accessed 21 August 2021).

International Organization of Securities Commissions (2020), IOSCO Statement on Importance of Disclosure about COVID-19, available at: https://www.iosco.org/library/pubdocs/pdf/IOSCOPD655.pdf (accesed 7 August 2021).

Irshad, H. (2017), "Relationship among political instability, stock market returns and stock market volatility", *Studies in Business and Economics*, Vol. 12 No. 2, pp. 103-121, doi: 10.1515/sbe-2017-0023.

Kansheba, J.M.P. (2020), "Small business and entrepreneurship in Africa: the nexus of entrepreneurial ecosystems and productive entrepreneurship", *Small Enterprise Research*, Vol. 27 No. 2, pp. 110-124, doi: 10.1080/13215906.2020.1761869.

Kansheba, J.M.P. and Marobhe, M. (2022), "Institutional quality and resource-based economic sustainability: the mediation effects of resource governance", *SN Business and Economics*, Vol. 2, p. 1-19, doi: 10.1007/s43546-021-00195-x.

Lensink, R., Mersland, R., Vu, N.T.H. and Zamore, S. (2017), "Do microfinance institutions benefit from integrating financial and nonfinancial services?", *Applied Economics*, Vol. 50 No. 21, pp. 2386-2401.

Li, Z., Farmanesh, P., Kirikkaleli, D. and Itani, R. (2021), "A comparative analysis of COVID-19 and global financial crises: evidence from US economy", *Economic Research-Ekonomska Istraživanja*, pp. 1-16, doi: 10.1080/1331677X.2021.1952640.

Liu, H., Manzoor, A., Wang, C., Zhang, L. and Manzoor, Z. (2020a), "The COVID-19 outbreak and affected countries stock markets response", *International Journal of Environmental Research & Public Health*, Vol. 17, pp. 2-19, doi: 10.3390/ijerph17082800.

Love, I. and Zicchino, L. (2006), "Financial development and dynamic investment behavior: evidence from panel VAR", *Quarterly Review of Economics and Finance*, Vol. 46 No. 2, pp. 190-210.

Macciocchi, D., Lanini, S., Vairo, F., Zumla, A., Figueiredo, L., Lauria, F., Strada, G., Brouqui, P., Puro, V. and Krishna, S. (2016), "Short-term economic impact of the Zika virus outbreak", *News Microbiology*, Vol. 39, pp. 287-289.

Marobhe, M.I. (2022), "Cryptocurrency as a safe haven for investment portfolios amid COVID-19 panic cases of Bitcoin, Ethereum and Litecoin", *China Finance Review International*, Vol. 12 No. 1, pp. 51-68, doi: 10.1108/CFRI-09-2021-0187.

Marobhe, M.I. (2021), "Investors' reactions to COVID-19 related announcements: evidence from the cargo shipping industry", *Review of Behavioral Finance*, pp. 1-22, Vol. ahead-of-print No. ahead-of-print, pp. 1-21, doi: 10.1108/RBF-04-2021-0071.

Marobhe, M. and Dickson, P. (2022), "Bearish conditions and volatility persistence during COVID-19: can microchip stocks weather the storm?", *Review of Behavioral Finance*, pp. 1-23, doi: 10.1108/RBF-11-2021-0235.

Martinez, P., Lapena, R. and Escribano-Sotos, F. (2020), "Interest rate changes and stock returns in Spain: a wavelet analysis", *Business Research Quarterly*, Vol. 18 No. 2, pp. 95-110, doi: 10.1016/j.brq.2014.07.004.

McTier, B., Tse, Y. and Wald, J. (2013), "Do stock markets catch the Flu?", *Journal of Financial and Quantitative Analysis*, Vol. 48 No. 3, pp. 979-1000, doi: 10.1017/S0022109013000239.

Memdani, L. and Shenoy, G. (2019), "Impact of terrorism on stock markets across the world and stock returns: an event study of Taj attack in India", *Journal of Financial Crime*, Vol. 26 No. 3, pp. 793-807, doi: 10.1108/JFC-09-2018-0093.

Nippani, S. and Washer, K. (2004), "SARS: a non-event for affected countries' stock markets?", *Applied Financial Economics*, Vol. 14, pp. 1105-1110.

Otieno, D., Ngugi, R. and Muriu, P. (2019), "The impact of inflation rate on stock market returns: evidence from Kenya", *Journal of Economics and Finance*, Vol. 43, pp. 73-90, doi: 10.1007/s12197-018-9430-5.

Ramraika, B. (2015), "Stock market returns the GDP growth rate myth", *SSRN Electronic Journal*. doi: 10.2139/ssrn.2671739.

Scholtens, B. and Boersen, A. (2011), "Stocks and energy shocks: the impact of energy accidents on stock market value", *Energy*, Vol. 36 No. 3, pp. 1698-1702, doi: 10.1016/j.energy.2010.12.059.

Spelta, A., Flori, A., Pecora, N. and Pammolli, F. (2019), "Financial crises: uncovering self-organized patterns and predicting stock markets instability", *Journal of Business Research*, Vol. 129, pp. 736-756, doi: 10.1016/j.jbusres.2019.10.043.

Studenmund, A.H. (2011), *Using Econometrics: A Practical Guide*, 6th International ed., Pearson Education, Upper Saddle River.

Szczygielski, J., Bwanya, P., Charteris, A. and Brzeszczyński, J. (2021), "The only certainty is uncertainty: an analysis of the impact of COVID-19 uncertainty on regional stock markets", *Finance Research Letters*, Vol. 43, pp. 1-12, doi: 10.1016/j.frl.2021.101945.

Taleb, N. (2007), *The Black Swan: the Impact of the Highly Improbable*, Random House Publishers, pp. 40-128, ISBN 978-1400063512.

The World Bank (2020a), "Patterns and some implications of COVID-19 financial sector policy interventions", available at: https://blogs.worldbank.org/psd/patterns-and-some-implications-COVID-19-financial-sector-policy-interventions (accessed 12 August 2021).

The World Bank (2021), "COVID-19-finance-sector-related-policy-responses", available at: https://datacatalog.worldbank.org/dataset/COVID-19-finance-sector-related-policy-responses (accessed 10 August 2021).

Uddin, M., Chowdhury, A., Anderson, K. and Chaudhuri, K. (2021), "The effect of COVID – 19 pandemic on global stock market volatility: can economic strength help to manage the uncertainty?", *Journal of Business Research*, Vol. 128, pp. 31-44, doi: 10.1016/j.jbusres.2021.01.061.

Valizadeh, P., Karali, B. and Ferreira, S. (2017), "Ripple effects of the 2011 Japan earthquake on international stock markets", *Research in International Business and Finance*, Vol. 41, pp. 556-576, doi: 10.1016/j.ribaf.2017.05.002.

Yacine, A., Andritzky, J., Jobst, A., Nowak, S. and Tamirisa, N. (2009), "How to stop a herd of running bears? Market response to policy initiatives during the global financial crisis", IMF Working Paper 09/204.

Zhang, Y., Liu, K., Shen, D. and Zhang, W. (2015), "Short selling and intraday volatility: evidence from the Chinese market", *SpringerPlus*, Vol. 4, p. 797, doi: 10.1186/s40064-015-1591-5.

Zhang, D., Hu, M. and Ji, Q. (2020), "Financial markets under the global pandemic of COVID-19", *Finance Research Letters*, Vol. 36, 101528, doi: 10.1016/j.frl.2020.101528.

Zhao, L., Rasoulinezhad, E., Sarker, T. and Taghizadeh-Hesary, F. (2022), "Effects of COVID-19 on global financial markets: evidence from qualitative research for developed and developing economies", *The European Journal of Development Research*, No. 2022, doi: 10.1057/s41287-021-00494-x.

Further reading

Brown, M. and Smith, R. (2008), "The economic impact of SARS: how does the reality match the predictions?", *Health Policy*, Vol. 88 No. 1, p. 110 120, doi: 10.1016/j.healthpol.2008.03.003.

Farooq, H., Davies, E., Ahmad, S., Machin, N., Hesketh, L., Guiver, M. and Turner, A. (2020), "Middle East respiratory syndrome coronavirus (MERS-CoV) - surveillance and testing in North

England from 2012 to 2019", *International Journal of Infectious Diseases*, Vol. 93, pp. 239-248, doi: 10.1016/j.ijid.2020.01.043.

Karlsson, M., Therese, M. and Pichler, S. (2014), "The impact of the 1918 Spanish Flu epidemic on economic performance in Sweden", *Journal of Health Economics*, Vol. 36, pp. 432-444, doi: 10.1016/j.jhealeco.2014.03.005.

Kimura, H., Tsukagoshi, H., Ryo, A., Oda, Y., Kawabata, T., Majima, T., Kozawa, K. and Shimojima, M. (2015), "Ebola virus disease: a literature review", *Journal of Coastal Life Medicine*, Vol. 3, pp. 86-89, doi: 10.12980/JCLM.3.201514J93.

Liu, M., Ning, Y., Cao, D., Zhang, D. and Wang, J. and Chen, M.(2020b). "Modelling the evolution trajectory of COVID-19 in Wuhan, China: experience and suggestions", *Public Health*, Vol. 183, pp. 76-80, doi: 10.1016/j.puhe.2020.05.001.

Sarstedt, M. and Mooi, E. (2014), *A Concise Guide to Market Research: The Process, Data, and Methods Using IBM SPSS Statistics*, Springer, Heidelberg, New York.

World Health Organization (2021), "WHO coronavirus disease (COVID-19)", Dashboard, available at: https://covid19.who.int/?gclid=CjwKCAjwzIH7BRAbEiwAoDxxTp0vB4gFQLw30RQ728DrRiQ_2lo_imViyTLk1SfYFEYQxRrMbZQDdBoC5acQAvD_BwE (accessed 2 August 2021).

Zraick, K. and Garcia, S. (2020), "Canceled because of corona virus: a brief list", *New York Times*, available at: https://www.nytimes.com/article/cancelled-events-coronavirus.html (accessed 16 August 2021).

Appendix 1

S/N	Regression assumptions	Test(s)	We seek values
1	No heteroskedasticity problem	*Breusch–Pagan test* $Chi^2(1)$: 2.083 *p*-value: 0.0647	>0.05
2	No multicollinearity problem	*VIF (See Appendix 1)*	<5.00
3	No specification problem	*Link test* t: 0.766 *p*-value: 0.444	>0.05
4	No influential observations	*Cook's distance* no distance is above the cut-off	<1.00

Table A1. Regression model assumptions

Appendix 2

Table A2.
Selected countries and their respective stock indices

No.	Country	Region	Stock market	Index
1	South Africa	Africa	Johannesburg Stock Exchange	FTSE JSE
2	Nigeria	Africa	Nigeria Stock Exchange	NSE 30
3	India	Asia	Bombay Stock Exchange	BSE SENSEX 50
4	Malaysia	Asia	Bursa Malaysia	FTSE Bursa
5	Singapore	Asia	Singapore Exchange	FTSE Straits Times
6	Hong Kong	Asia	Hong Kong Exchange	Hang Seng
7	Indonesia	Asia	Indonesia Stock Exchange	Jakarta Composite
8	South Korea	Asia	Korea Stock Exchange	KOSPI Composite
9	Qatar	Asia	Qatar Stock Exchange	MSCI Qatar
10	Japan	Asia	Tokyo Stock Exchange	Nikkei 225
11	Philippines	Asia	Philippine Stock Exchange	PSEI
12	China	Asia	Shenzhen Stock Exchange	Shenzhen Composite
13	Thailand	Asia	Stock Exchange of Thailand	SETI
14	Taiwan	Asia	Taiwan Stock Exchange	TSEC Weighted
15	Austria	Europe	Vienna Stock Exchange	ATX
16	Ireland	Europe	Irish Stock Exchange	ISEQ
17	Estonia	Europe	Tallinn Stock Exchange	OMXTGI
18	Netherlands	Europe	The Amsterdam Stock Exchange	AEX
19	Greece	Europe	Athens Stock Exchange	Athex Composite
20	Belgium	Europe	Brussels Stock Exchange	BEL 20 BFX
21	Turkey	Europe	Borsa Istanbul	BIST 100
22	France	Europe	Paris Stock Exchange	CAC 40
23	Great Britain	Europe	London Stock Exchange	FTSE 100
24	Italy	Europe	Borsa Italiana	FTSE MIB
25	Germany	Europe	Frankfurt Stock Exchange	GDAXI
26	Russia	Europe	Moscow Exchange	MOEX
27	Denmark	Europe	Copenhagen Stock Exchange	OMX Copenhagen 20
28	Finland	Europe	Helsinki Stock Exchange	OMX Helsinki
29	Sweden	Europe	Stockholm Stock Exchange	OMX Stockholm All Share
30	Norway	Europe	Oslo Stock Exchange	Oslo Bors All Share
31	Portugal	Europe	Portugal Stock market	PSI 20
32	Israel	Europe	Tel Aviv Stock Exchange	Tel Aviv 35
33	Spain	Europe	The Madrid Stock Exchange	IBEX 35
34	Argentina	Latin America	Buenos Aires Stock Exchange	MERV
35	Brazil	Latin America	Sao Paulo Stock Exchange	IBOVESPA
36	Mexico	Latin America	The Mexican Stock Exchange	IPC
37	USA	North America	New York Stock Exchange	NYSE composite
38	Canada	North America	Toronto Stock Exchange	TSX Composite
39	Australia	Oceania	Australian Securities Exchange	ASX 200

About the authors
Mutaju Isaack Marobhe. He is a currently a PhD research fellow at Swiss School of Management in Switzerland. He works as a lecturer in the Finance and Accounting Department at Tanzania Institute of Accountancy. He completed his Master of Business Administration at University of Dar es Salaam. He also finished his Bachelor of Business Administration at University of Iringa formerly Tumaini University-Iringa University College. He is a Certified Public Accountant (CPA-T). His research activities are focused on the areas of behavioral finance, economics and entrepreneurship. Mutaju Isaack Marobhe is the corresponding author and can be contacted at: mutaju.marobhe@tia.ac.tz

Jonathan Mukiza Peter Kansheba. Recently a PhD research fellow at the department of management in the School of Business and Law of the University of Agder (Norway). He completed his Master's degree in Finance and Accounting in oil and gas at the University of Dar Es Salaam Business School (Tanzania). He gained his Bachelor's degree in accounting and Finance at Ardhi University (Tanzania). Mr. Kansheba works as an assistant lecturer in the department of business studies at Ardhi university majoring in Accounting, Finance, Entrepreneurship and Innovation courses. He is CPA(T) holder (Certified Public Accountant), the professional certificate offered by the Tanzania National Board of Accountants and Auditors (NBAA).His research interest focuses on entrepreneurship and innovation ecosystems, business models and strategies, entrepreneurial finance, organizational leadership and strategies, quantitative research techniques, bibliometric and meta-analytics.