



The Effect of Covid-19 Pandemic on the Performance of JSE-TOP40 Listed Companies

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Abstract: In this article, the effect of covid-19 pandemic on the performance of the TOP40-JSE listed companies is investigated using the two-step difference generalised method of moments (GMM) approach. JSE-Top40 listed companies' data from 24 November 2020 to 29 July 2022 was used to examine the relationship. This is motivated by desire to understand how future pandemic could be managed and help contribute to measures that could minimise the adverse effect of the pandemic. Results showed that the Covid-19 as proxied by number of new deaths positively impacted the stock return of the selected companies. The JSE-TOP40 companies offered investors a safety net during the period of a pandemic. The results show that companies were able to change their business models and strategies to counter the effects of a pandemic.

Keywords: Pandemic; generalized method of moments; covid-19; stock returns; JSE-TOP40; strategies; business models.

JEL Classification: L1; E3

1. Introduction and Background

The covid-19 pandemic exposed the developed and developing countries to downside risk because of closure of some companies which were unable to cope with the financial strain. This occurred because companies had no other options but to adhere to government restriction that were implemented at the time (Akinola, Anderu & Mbonigaba, 2021). In doing this, it led to companies retrenching their employees, decreasing salaries and wages, decreasing their dividend because they were unable to operate during the pandemic with the exclusion of companies providing essential services (Mazur, Dang & Vega, 2021; Insaideo, Arthur, Amoako

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& Andoh, 2021). This global pandemic emanated from China in Wuhan because of a leak leading to a systematic risk to economies of many nations (Mbunge, 2020). South Africa had no other options but to choose between economic growth or savings lives and therefore chose the latter.

As a result, disputing the argument made by the Efficient Market Hypothesis (EMH) that markets are efficient as it means that investors have all the information required to make investment decisions (Ball, 2009). Therefore, leading to a conclusion that the capital Asset pricing model (CAPM) is appropriate to explain the systematic risk that occurred in the TOP40-JSE during the pandemic. As it asserts that markets are supposed to generate stock returns that exceed risk-free rate. This as the risk-free rate is one of the variables that must be added to the excess return attributed to systematic risk. The argument stems from the rationale that risk adverse investors are willing to accept higher return for each level of risk when investing in the financial market (Ball, 2009). There are some empirical studies that have used noise trading theory (Mbunge, 2020), agency cost theory (Mbunge, 2020), stakeholder theory (Mbunge, 2020) and institutional theory (Harjoto & Rossi, 2019) to explain the effect of covid_19 to the performance of companies in their financial markets.

During the pandemic gold performed better and was considered a safe haven especially because period of financial instability and extreme volatility lead to herd's mentality. According to Salisu Vinhu and Lucey (2021) gold was found to be a safe haven during the pandemic. The discussion emanates from such factors because the TOP40 selected sample consist of 20 percent of companies from the precious mining sector excluding financial services companies. However, when we consider such advantages associated with adding mining companies to the final sample. It is important that we consider the challenges, successes, strength, opportunities, weaknesses, and threats posed by the pandemic. These analyses assist us with tabulating a hypothesis that will guide the subject of this topic due to previous challenges caused by a financial crisis that happened in 2008 (Akinola *et al.*, 2022).

It is important to consider such companies because of their role in the economic performance of the country. In fact, they are used as a gauge to monitor and anticipate the economic growth of South Africa. Therefore, the economic forces of this country assist these companies with economic emancipation because of the size and scope of their operations. Akinola *et al.* (2022) used capital asset pricing model, supply, and demand shocks to explain the effect of the covid-19 on the TOP20-JSE listed companies. Therefore, this study is motivated by lack of empirical studies which are scant especially due to the important role the TOP40-JSE listed companies have to the South African economy. The following sections is outlined in follows 2. Covid-19 pandemic in South Africa, 3 empirical literatures, 4. methodology, 5. discussion of results, and 6. conclusion.

2. Covid-19 Pandemic in South Africa

The total global loss of lives due to the pandemic was 6 552 803 on the 06th of October 2022 (John Hopkins University, 2022). The first case to surface in South Africa was in Kwa-Zulu Natal from an individual who contracted the disease while in Milan, Italy (Stiegler & Bouchard, 2020) with the first reported case on the 05 March 2020 and followed by rapid increase in the pandemic post the 17 March 2020 (Zhao, Li, Liu, Zhu, Ma & Wang, 2020). Thus, the government declared the state of emergency on the 26 March 2020 (Ngarava, Mushunje, Chaminuka & Zhou, 2022). The government observing that the pandemic was spiraling out of control and decided that it would be conducive to implement measures that would curtail the disease from spreading to regions in the country (Stiegler & Bouchard, 2020) as noted in figure 1. During that process, it was decided at the behest of the President of South Africa to implement strict levels to control the movement in the economy through the lockdown restriction (Mbunge, 2020). This was closely aligned to the performance of the JSE-TOP40 (J200) index that were severely impacted by the pandemic as observed through the market return in figure 2.

These restrictions were implemented through the five-point likert scale from one (1) to five (5). The upper echelon number being the most restrictive and an increase being the least restrictive (Stiegler & Bouchard, 2020). According to Mbunge (2022); Ngarava *et al.*, (2022) the South African president implemented additional measures such as restriction on the large number of gatherings, ban on the sales of alcohol and cigarettes, work at home for individuals working at the tertiary sector, campaigned, and advertised to the masses in South Africa regarding pre-cautionary measures that must be implemented during the ongoing pandemic. The strict measures on the sales of alcohol were perpetuated by the fear that the pandemic could spiral out of control as these items are non-essential and shared amongst its consumer (Ngarava *et al.*, 2022). On the 5th October 2022 there were four million and nineteen thousand three hundred and sixty-five (4 019 365) positive cases reported, recovery rate of 97.30 percent and 102 194 individuals that have succumbed to the pandemic. Gauteng was a major contributor to the overall loss of lives by twenty-one thousand and forty-six (21 046) (Department of Health, 2022). However, South Africa managed to effectively deal with other pandemic better than other countries (Zhao *et al.*, 2020).

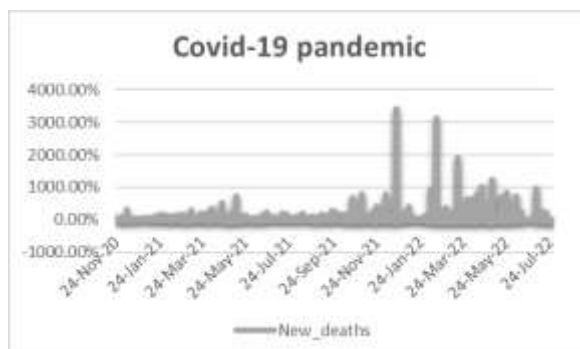


Figure 1. It shows the percentage of the new death reported daily from the 24 November 2020 to 29 July 2022. From the 24 November 2020 we see a steady increase in the number of new deaths reported till the 14 October 2021. However, on 19 October 2021, there is an unexpected increase in the number of new death percentage reported until the 22 December 2021. This is followed by a significantly unexpected decline in the percentages of new death reported on 23 December until the 04 February 2022. The performance in the number of reported new death continues to above reported case when the first reported case from 07 February 2022 to 22 July 2022.

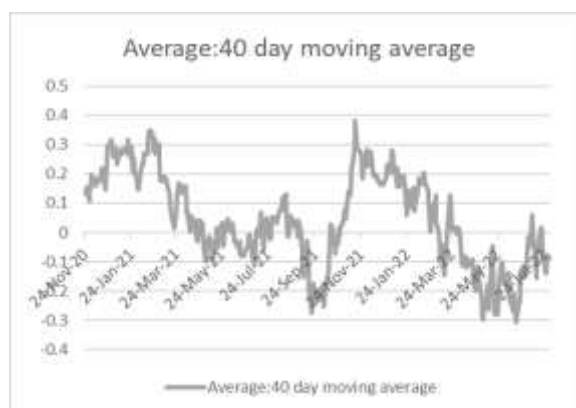


Figure 2. The return on the JSE-TOP index (J200) had an upward trajectory in the performance of the 24 February 2021. This shows that the impact of covid_19 as measured by new death reported. However, from there onwards we find that the impact of covid_19 has a significant impact on the JSE-TOP40 index till the 21 September 2021. There is lack of consistency between the covid_19 and stock performance as observed on 17 September to 17 November 2021. This might be attributed to the percentage reduction in the number of reported cases during this time. However, considering the steep decline in the performance of the 18 November 2021 onwards observe a steep decline in the performance of the stock market which is consistent with the percentage of reported covid_19 (new death) pandemic.

3. Empirical Literature Review

In any empirical study, theories are used as a basis to explain the foundation of academic reasoning. As noted by Ball (2009, p. 15), "it takes a theory to beat a theory". However, in this study we are not concerned with which theory is dominant but theories that were used in empirical studies to explain the relationship between covid-19, financial crisis (Harjoto & Rossi, 2019), corporate governance (Hu & Liao, 2022), and negative news (Maneenop & Kotcharin, 2020) with the performance of companies through-out the world before summarizing the literature review.

Hu and Liao (2022) used noise trading theory to explain the effect that covid-19 has on the performance of the stock market. They argue that negative news such covid_19 led to an increase in volatility which led to a decline in the performance of the stock returns. They further expanded their argument with the use of stakeholder and agency cost theory by incorporating the board specific variables such as board independence and CEO duality. Their argument stems from having independent board as a source of alleviating the adverse effect on the performance in their sampled companies.

There are numerous factors that must be considered when a pandemic lead to a total shutdown of countries. Hsu and Liao (2022) using data from companies listed in the New York Stock Exchange (NYSE) and National Association of Securities Dealers Automated Quotations (NASDAQ) found that the pandemic has led to decline in the performance of the stock returns. Furthermore, covid vaccines and government benefits were found to negatively affect the stock return in the companies listed in these stock markets (Hsu & Liao, 2022). This is contrary to popular believe as most of the countries in the developing and developed countries saw vaccines as a source of competitive advantage to deter the spreading of the pandemic thus lead to business risk decline.

This is consistent with Maneenop and Kotcharin (2020) who partitioned their analysis to three events before running the actual analysis using event study methodology by targeting airline industry in developing and developed countries. They partitioned their event study into three scenarios, namely: cases reported outside China from the 01 January 2020, secondly, cases reported in Italy on 21 February 2020. Lastly, total shutdown by the World Health Organisation (WHO) and banning of the 26 European nation by President Donald Trump from visiting the United States of America (USA). It was found that adverse abnormal returns occurred in the United States of America (USA), Canada, India, and Thailand (Maneenop & Kotcharin 2020).

However, South Korea managed to deter the adverse effect in their airline industry because of government interventions that were implemented in time. Whereas Mazur *et al.*, (2021) using the event study methodology for the standard & poor 1500

companies finds that companies providing essential services (e.g., natural gas, food, healthcare, and software's) returned abnormal returns when compared with companies that providing non-essential services (e.g., petroleum, real estate, entertainment, and hospitality sectors). The abnormal return generated from the firms providing essential goods and services is attributed to government initiatives implementing measures that did not lead to closure of companies providing goods and services in these sectors.

Stigler and Bouchard (2020) find challenges associated with covid-19 led to financial insecurity because companies had to close their companies. Stigler and Bouchard (2020) from the distribution of questionnaires to the upper, middle, and lower class found the government restriction to have been successfully implemented by the government. This indicate that South Africa was in a good position to successfully implement the covid-19 restriction because of their superior infrastructure relative to other African countries as they are relatively underdeveloped. According to Zhao *et al.* (2020) found that although the pandemic was extremely severe In South Africa. The government quick and prompt decision to implement the lock down were effectively managed in April of 2020 (Zhao *et al.*, 2020). This is aligned to Maneenop and Kotcharin (2020) finds that South African airline industry was severely impacted by the Covid-19 pandemic and therefore led to negative abnormal returns.

This is consistent in all the sectors in the South African economy as noted by the covid-19 pandemic having a major setback in the South African health system because of pressure arising from increased patient that contracted the pandemic (Mbusi, 2020). In addition, a total shutdown of the South African economy led to an increase in retrenchment because the economy could not operate efficiently. Therefore, the government implemented measures to curb the catastrophic issues associated with lack of provision of food during those periods before the country experience a civil unrest by offering the R350 grants to purchase essential goods and services during those periods (South African government, 2022). The citizen had to apply for these funds because the pandemic was severely affecting the countries and its citizens to generate enough funds during those periods. This were aligned to the department of health initiatives to curb the sales of alcohol and cigarettes which were cited as a major attribute to contain spread of the pandemic. Thus Ngarava *et al.*, (2022) found that as a result the share price of British American Tobacco and Distell Group limited were negatively impacted by covid-19 pandemic due to the banning of such sales items.

H1: Covid-19 pandemic led to a decline in the performance of stock returns of the JSE-TOP40 listed companies.

4. Methodology

4.1. Data Collection and Management

The covid-19 data used in this study was extracted from the World Health Organization (WHO). Whereas the share price data for the JSE-TOP40 companies excluding the financial services companies was collected from the INET BFA in the University of South Africa's (UNISA's) website from 24 November 2020 to 29 July 2022. The study did not include financial services companies because of their unique capital structure and additional macro prudential policy from the South African Reserve Bank (SARB). In addition, we are using the daily covid-19 and share price data which is converted to the rate of return for homogeneity and dealing with the issue of outliers by applying the following computation $r_r = [(\frac{r}{r_-}) \times 100]$. The use of daily data assist with accurate information when running the model in the software (Hsu & Liao, 2022). This data will then be extracted, collated, and cleaned through the Microsoft excel application for calculation.

Table 1. Variable Description and Data Sources

Variables	Definition of variables	Source	Expected	Empirical studies
Stock returns	(Current price at the end of the day/previous share price at the end of the day - 1) $\times 100$	INET BFA	positive/negative	Hu and Lia (2022); Ngavara <i>et al.</i> , (2022)
Covid_19	new death, communicative death, new cases, cumulative new cases.	World health organization	Positive/ negative	Mazur <i>et al.</i> , (2021); Harjoto & Rossi (2021)
JIBAR	12 months average JIBAR rate	South African Reserve Bank (SARB)	negative	Gyimah, Addai & Asamoah, 2021.
RM	JSE (J200) all share index	INET BFA	Negative/positive	Insaidoo <i>et al.</i> , (2021); Ashraf (2020)

4.2. Statistical Analysis

This study will use the descriptive analysis to observe the median, mode, range, and standard deviation. Descriptive statistic is used to check for outliers for selected independent and dependent variables (Gyimah, *et al.*, 2021; Salyer *et al.*, 2021). Furthermore, descriptive statistics assist with comparing the performance of similar

variables that are selected from other study by comparing their effect to the stock market and extracting information that could be expected in this study. In addition, the study will use panel data methodology because it helps in dealing with multicollinearity, serial correlation, and biasness in the study. As a result, it assists with understanding the severity of the Covid-19 pandemic as observed through the new cases, cumulative cases, new death, and cumulative death. Specifically, the system GMM model was used to investigate the relationship between COVID-19 and stock returns.

Due to its ability to use the lagged dependent variable and thus assumes that lagged dependent variables will affect the current dependent variable which control for endogeneity, “and unobservable heterogeneity and simultaneity” (Wintoki, Linck & Netter, 2012, p. 582; Arellano & Bond, 1991). Hausman test was used to choose between fixed and random models (Hausman, 1978). This differs from an ordinary least square regression (OLS) model which does not assume that the current movement in the dependent is affected by the previous movement in the dependent variable’s movements. As a result, present the problem of endogeneity and serial correlation. Lastly multicollinearity which must be solved through the variance inflation factor (VIF) (Bao & Lewellyn, 2017) and therefore lead to the wrong conclusion in the analysis of the sampled data (Wintoki *et al.*, 2012).

The empirical model for examining the nexus between COVID-19 and stock return for selected JSE TOP-40 Companies is presented as follows:

$$\Delta R_{it} = \Delta R_{it-1} + B_{1\Delta} COV_t + \Delta RM_t + \Delta IR + \Delta \mu_i + v_t + \Delta \varepsilon_{it} \quad (1)$$

The rate of return was calculated based on the share price of the JSE-TOP40 companies to measure the dependent variable as reflected by the $Return_{i,t}$. The COV symbol is used to represent the independent COVID-19 variables which are computed in the following manner $COVID_NC_{j,t-1}$ meaning new cases, $COVID_CC_{j,t-1}$ meaning cumulative cases, $COVID_ND_{j,t-1}$ meaning new deaths $COVID_CD_{j,t-1}$ meaning cumulative cases. The JSE All-share index returns is represented by RM , money market will be represented by the IR and μ_i captures the unobserved country specific impact with v_t represents the time specific impact; ε_{it} represent the unobserved regression residual.

4.3. Statistical Diagnosis

The Hausman (1978) found that fixed effect model is better than the random effect model. Whereas Breusch and Pagan (1980) found that random effects are not present nor preferred. In addition, Pesaran (2004) and Frees (1995) statistical models found that selected variables are interdependent. The statistical diagnosis reported above is concerning the new death cases (Covid_ND) because it was found to have been the

most reliable measure of covid-19 pandemic. Therefore, statistical diagnosis for the following covid-19 variables are not discussed as they are included to check for consistency or inconsistency in our statistical reporting and are available upon request. These omitted results are cumulative cases (COVID_CC), new cases (COVID_NC), cumulated death (Covid_CD).

5. Discussion of Results

Table 2. Descriptive Statistics

Variable	Mean	Median	Std Dev	Maximum	Minimum
R	-0,0374	0,0000	0,2066	7,9535	-1,0000
IR	0,0538	0,0481	0,0093	0,0664	0,0397
RM	0,0580	0,0000	0,3960	3,3833	-0,7739
COVID_CC	0,0131	0,0010	0,1800	2,8000	-0,8772
COVID_CD	0,0026	0,0011	0,0041	0,0277	0,0000
COVID_NC	0,2438	-0,0332	2,8415	58,5705	-1,0000
COVID_ND	0,7484	0,0002	2,9260	34,0000	-1,0000

Table 2: Selected data finds that returns for the JSE-TOP40 companies has a mean of -0.0374, median of 0.000, standard deviation of 0.2066, maximum return of 7.9535 and minimum return of -1.000. Considering the close relationship with the JSE-TOP40 index which has a mean of 3.3833, median of 0.000, standard deviation of 0.3960, maximum return of 0.0580 and minimum return of -0.7739. The difference between the JSE-TOP40 index and selected companies could be attributed to the omission of financial companies in the final sample of selected JSE-Top40 companies. We are using the index as it is one of the variables used to represent the market and thus used to measures systematic risk.

When we consider the covid-19 variables we find that cumulative cases had a mean of 0.0131, median of 0.0010, standard deviation of 0.1800, maximum value of 2.800 and minimum value of -0.8772.

Whereas new cases had a mean of 0.2438, median of -0.0332, standard deviation of 2.8415, maximum value of 58.5705 and minimum value of -1.000 and new death reported had a mean of 0.7484, median of 0.0002, standard deviation of 2.9260, maximum reported new death of 34,000 and minimum reported new death being -1.000.

However, we must note that the discussed variables might present the problem of outliers because of the huge difference between the median and mean (Gyimah *et al.*, 2021). With the exclusion of interest rate (IR) which has a mean of 0.0538, median of 0.0481, standard deviation of 0.009 maximum of 0.0664 and minimum interest rate of 0.0397, cumulative death with a mean of 0.0026, median of 0.0011,

standard deviation of 0.0041, maximum cumulative death of 0.0277 and minimum of 0.000.

Table 3. Correlation

Probability	R	IR	RM	COVID_CC	COVID_CD	COVID_NC	COVID_ND
R	1.000000						
IR	(0.028574) ***	1.000000					
RM	(0.031339) ***	(-0.007718)	1.000000				
COVID_CC	(0.009151)	(0.071090) ***	(0.044289) ***	1.000000			
COVID_CD	(-0.008595)	(-0.417390) ***	(-0.018153) *	(-0.022960) **	1.000000		
COVID_NC	(0.004632)	(-0.021760) **	(-0.040309) ***	(-0.003809)	-0.016419	1.000000	
COVID_ND	(0.052824) ***	(0.100941) ***	(0.008975)	(-0.016729)	(-0.038962) ***	(0.068097) ***	1.000000
*** ** represent significant at 0.05, 0.01, 0.001							

Table 3: The results indicate that new death (COVID_ND), cumulative cases (COVID_CC) had a positive relationship with the stock return (R) for the JSE-TOP40 selected companies and J200 index (RM) at the significance of interval of 0.1 percent. This could be attributed to the strict measures that were implemented by the South African government not being extreme enough to cause the covid-19 pandemic to have an adverse effect on the top40-JSE listed compared. As a result, we could attribute such result to investor irrationality as crisis are known to negatively affect the stock market. In some instances, shareholders might not have considered covid-19 measures (COVID_ND; COVID_CC) as a major problem for shareholders. This is consistent with Interest rate (IR) which has positively affected the return (R) of the selected sample; new death reported (COVID_ND). In light of the above revelation, we find that new death is positively related to the financial stock returns.

Table 4. Main results

	2-Step difference GMM	Random Effects	Fixed effects	2 Step Least Square	FGLS
	R	R	R	R	R
L.R	-0.0251*** (0.00206)	-0.0264** (0.00877)	-0.0264** (0.00879)	-0.0264** (0.00877)	-0.0264** (0.00877)
IR	0.671*** (0.0200)	0.672*** (0.187)	0.672*** (0.187)	0.672*** (0.187)	0.672*** (0.187)
RM	0.0116*** (0.00116)	0.0115** (0.00439)	0.0115** (0.00440)	0.0115** (0.00439)	0.0115** (0.00439)
COVID_ND	0.00273*** (0.0000588)	0.00274*** (0.000539)	0.00274*** (0.000539)	0.00274*** (0.000538)	0.00274*** (0.000538)
_cons		-0.0711*** (0.0101)	-0.0711*** (0.0102)	-0.0711*** (0.0101)	-0.0711*** (0.0101)
N	10447	10477	10477	10477	10477
R2			0.006	0.006	
F-Stats	-	61.60	15.36	61.63	61.63
ARI	-5.46				
AR2	-3.84				
Sargan	10175.40				
Hansen	30.00				
* ** *** represent significant at 0.05, 0.01, 0.001					

Table 4 results found that covid-19 (COVID_ND) has a positive relationship with the performance of the TOP40-JSE listed companies. This is aligned to studies by Salisu, Vo and Lecey (2021) in the United States of America (USA) targeting US gold sector. Lyke and Ho (2021) found that Guana and Tanzania outperformed during the period of market instability and are better equipped to offer diversification for shareholders. The expectation was that the pandemic would lead to financial deterioration in stock performance of these companies. As a result, aligning with empirical studies that found that companies are negatively impacted by the covid-19 pandemic in the Ghanaian stock market (Insaadoo *et al.*, 2021). This means that shareholders find it hard to generate excess return, benefit from diversification and decrease systematic risk during period of market instability.

In some instance, some emerging stock markets were less severely impacted than the small capitalization rate companies (Harjoto & Rossi, 2019). These could be attributed to policies implemented during the covid-19 pandemic by the South African government which supported companies that provided necessities. In addition, the market return has a positive relationship with the return of the selected companies and thus present less systematic risk. This is inconsistent with Harjoto

and Rossi (2019) findings that systematic risk is a major concern in the developing and developed companies.

Even though, interest rate is found to have a positive relationship with the performance of the TOP40-JSE listed companies. This could mean several things. First, investors do not consider interest rate as a problem because these companies command a significant purchasing power or selling power. Second, these companies are not heavily exposed to debts as they are value companies. Third, interest rates are not a major concern because they are multinational companies that borrows at low interest rate compared to companies with low market capitalization rate.

6. Conclusion

In this study we found that the pandemic has a positive relationship with the JSE-TOP40 listed companies. These results assisted with finding-out which companies tend to offer diversification during market instability. Therefore, giving shareholders an opportunity to identify companies that are likely to offer superior return during the financial instability (Harjoto & Rossi, 2019; Mazur *et al.*, 2020), especially as the sampled companies returned a -3.75. Whereas the JSE-TOP40 average return of 6.67 percent based on the market value which is slightly higher than the all-share market return (J203) index during the duration of the study. In such instance, offering shareholders an opportunity to generates foreign currencies in other market that dealt with the pandemic better than South Africa.

This study is beneficial to the government of South African, policy bodies, credit holders, shareholders, and investors as it informs them of the method that require better implementation during the pandemic to better deal with future pandemic. As the implementation of policy during the pandemic was found to weaken adverse market conditions (Maneenop & Kotcharin, 2020) which results in a financial assistance to medium and small firms of 26 billion (Stiegler & Bouchard, 2020). Especially as the government of South Africa implemented, “physical distancing, self-isolation, closure of non-essential services, schools, travelling restrictions and recursive national lockdowns” (Mbunge, 2020:1809). These measures led to the deteriorating market conditions, liquidation, bankruptcy and increase in unemployment (Reuter, 2022; Maneenop & Kotcharin, 2020; Mazur *et al.*, 2020; Stiegler & Bouchard 2020).

As a results, these findings will assist the companies with encouraging foreign investment, encourage banks to lessen their lending practices, freezing or decreasing dividend payment, minimizing finance charges, drafting a rescue plan, loan forgiveness program, decreasing tax rate, decreasing remuneration packages for senior executives, retaining and retrenching board executive members with poor performance and offering financial assistance (Maneenop & Kotcharin, 2020; Mazur

et al., 2020). Therefore, further studies should consider the same studies focusing on the small capitalization companies, airline industry, Southern African Development Countries (SADC) financial markets, Brazil, Russia, India, China, and South Africa (BRICS) financial markets. These must be considered because small cap companies are the future of economic growth in South Africa, SADC countries are a major hub of economic integration and BRICS because South Africa is politically aligned with these countries because of being part of its establishment.

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Appendix

Appendix 1: Diagnostic tests for COVID_ND as the dependent variable			
Test	Test Statistic	P Value	Inference
Joint validity of cross-sectional individual effects $H_0: \alpha_1 = \alpha_2 = \dots \alpha_{N-1} = 0$ $H_A: \alpha_1 \neq \alpha_2 \neq \dots \alpha_{N-1} \neq 0$	F=0.01	0.999	Cross-sectional individual effects are valid.
Breusch Pagan (1980) LM test for random effects $H_0: \delta_{\mu}^2 = 0$ $H_A: \delta_{\mu}^2 \neq 0$	LM = 0.00	0.999	Random effects are not present. Random effects model is not preferred.
Hausman (1978) specification test $H_0: E(\mu_{it} X_{it}) = 0$ $H_A: E(\mu_{it} X_{it}) \neq 0$	Chi2 = 0.00	0.999	Regressors not exogenous. Hence the Fixed effects specification is valid.
Heteroscedasticity $H_0: \delta_i^2 = \delta$ for all i $H_0: \delta_i^2 \neq \delta$ for all i	Chi2=930.71	0.0000	The variance of the error term is not constant. Heteroscedasticity is present.
Cross-sectional dependence tests $H_0: \rho_{ij} = \rho_{ji} = cor(\mu_{it}, \mu_{jt}) = 0$ $H_A: \rho_{ij} \neq \rho_{ji} = 0$ Pesaran (2004) CD test Frees (1995) CD test	 CD= 79.207 F= 6.278	 0.0000 0.0000	Cross sections are interdependent.