

The COVID-19 Crisis: Assessment of its effect on the Dar es salaam Stock Exchange

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Abstract

The COVID-19 pandemic disrupted global financial markets, prompting scrutiny of their efficiency under external shocks. This study examines the pandemic's impact on the weak-form Efficient Market Hypothesis (EMH) in the Dar es Salaam Stock Exchange (DSE) using monthly Dar es Salaam Stock Exchange Index (DSEI) price returns from June 2015 to November 2024. Monthly data were selected to capture long-term trends, as short-term volatility was less pronounced in Tanzania's less liquid market. Descriptive statistics, Augmented Dickey-Fuller (ADF) tests, paired t-tests, autocorrelation analysis, and Chow tests assessed return behaviour and market efficiency. Results show a shift from negative (-0.004%) to positive (0.002%) mean returns post-COVID, reduced volatility (standard deviation from 0.042% to 0.034%), and lower skewness (from 0.912% to 0.175%), indicating market stabilization. Price returns were stationary (ADF $p=0.000$) and exhibited no significant autocorrelation, confirming random walk behavior and weak-form efficiency in both periods. No significant differences in mean returns (t-test $p=0.423$) or structural breaks (Chow test $p=0.419$) were detected, suggesting temporary disruptions with rapid recovery. Alternative structural break tests (e.g., Bai-Perron) were not employed, as the Chow test sufficed given the single hypothesized break at the pandemic's onset. Tanzania's minimal lockdown policies likely aided DSE resilience. Policymakers should enhance market transparency to sustain efficiency during crises.

Keywords: COVID-19, weak-form efficiency, random walk, price returns, Dar es Salaam Stock Exchange

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1. Introduction

Efficient markets refer to the degree to which asset prices reflect all available information. Efficient stock markets facilitate accurate price discovery and resource allocation, making it difficult for investors to consistently earn abnormal returns. However, financial markets are often exposed to external shocks such as geopolitical events, natural disasters, or pandemics, which can disrupt information flows, investor behavior, and liquidity. These disruptions typically challenge market efficiency by creating uncertainty, delaying the assimilation of information, or amplifying price volatility. The COVID-19 pandemic presented one of the most significant global shocks in recent history, raising important questions about its impact on market efficiency (Tan et al., 2021; Kazancoglu et al., 2023).

The COVID-19 pandemic significantly disrupted global financial markets. Lockdowns and travel restrictions interrupted supply chains affected business operations and generated widespread economic uncertainty (Papadopoulou & Papadopoulou, 2020). These disruptions triggered sharp increases in market volatility as investors reacted to unfolding events (Wang and Wang, 2021). Although the initial impact led to considerable instability, subsequent developments revealed more complex patterns as countries gradually adapted to new conditions. As a result, understanding whether disruptions to financial market efficiency were temporary or persistent became a key concern for researchers and policymakers (He et al., 2020).

Beyond disruptions to production and supply chains, the pandemic also affected how firms operated, including widespread shifts to remote work. These operational changes introduced challenges such as delays in communication, reduced client interactions, and difficulties in professional networking (Papadopoulou & Papadopoulou, 2020). Such disruptions likely contributed to delays in the dissemination of firm-specific information, potentially affecting investor confidence and decision-making. In turn, these factors may have influenced how efficiently financial markets incorporated new information, thereby challenging the assumptions of market efficiency during the pandemic period. In March 2020, as the pandemic spread and lockdown measures were implemented globally, the S&P 500, a comprehensive gauge of the U.S. stock market, witnessed unprecedented daily fluctuations (Wang & Wang, 2021). The reason for this increased unpredictability was that people did not have enough information about how the pandemic would affect the economy in the long run. They were also unsure if the actions taken by governments and policies would work well. As a result, the prices of things like stocks and bonds became more sensitive to new information and started changing rapidly (Tan et al., 2021).

African stock markets generally recorded declines in performance during the pandemic, with Tanzania experiencing an approximate 11 percent drop (Takyi & Bentum-Ennin, 2021). However, Tanzania presents a particularly compelling case for testing market efficiency due to its distinctive policy response. Unlike most countries that imposed strict lockdowns and experienced significant market disruptions, Tanzania maintained economic continuity through limited restrictions and targeted public health interventions (Mwasaga, 2020; Kombe et al., 2022). This divergence from global practices offers a unique context for assessing whether financial markets can efficiently incorporate new information during external shocks

when economic activity is largely sustained. These contrasting features make it essential to investigate how the Dar es Salaam Stock Exchange Index (DSEI) responded during the pandemic period.

Understanding the pandemic's influence on the DSEI is critical, given its emerging market structure, characterized by low liquidity and unique investor behavior, and Tanzania's distinct policy response (Mwasaga, 2020). Despite minimal lockdown measures, the DSEI experienced a significant decline in March 2020 (Takyi & Bentum-Ennin, 2021), raising questions about its weak-form market efficiency during crises. The weak-form EMH posits that past price data cannot predict future returns (Fama, 1970). This study addresses the gap in empirical evidence on how an African emerging market responded to the pandemic's disruptions.

The study pursues three main objectives: (1) to determine the price returns of the DSEI before and after the COVID-19 pandemic, (2) to examine the effect of the pandemic on the weak-form efficiency of the DSEI, and (3) to evaluate whether any changes in market efficiency during the pandemic were temporary or persistent. To achieve these objectives, the following hypotheses are tested:

H₀1: There is no significant difference in price returns before and after the COVID-19 pandemic.

H₀2: The COVID-19 pandemic has no significant impact on the weak-form efficiency of the DSEI.

H₀3: The changes in market efficiency observed during the pandemic are temporary.

H₁3: The changes in market efficiency observed during the pandemic are persistent.

These objectives are addressed using monthly data from June 2015 to November 2024, selected to capture long-term trends in a less liquid market, and econometric tests, including Augmented Dickey-Fuller (ADF) for stationarity, paired t-tests for return differences, serial correlation tests for randomness, and Chow tests for structural breaks. This approach provides a comprehensive assessment of the DSEI's resilience and weak-form efficiency during a global shock.

2. Literature Review

The COVID-19 pandemic, caused by the SARS-CoV-2 virus, represents a global health crisis that continues to influence public health, economies, and social systems worldwide. The virus was first identified in Wuhan, China, in December 2019, and rapidly spread, leading to a significant number of cases and fatalities globally. On January 30, 2020, the World Health Organization (WHO) declared the outbreak a Public Health Emergency of International Concern, and by March 11, 2020, the WHO officially characterized the situation as a pandemic in a formal press briefing (WHO, 2020). SARS-CoV-2 belongs to the coronavirus family, which includes other viruses such as SARS and MERS. Its highly contagious nature, primarily transmitted through respiratory droplets, significantly accelerated its global spread, exacerbating the public health and economic impacts (World Health Organization [WHO], 2021).

Lockdowns, which restrict the movement and activities of individuals to contain the spread of infectious diseases, became a cornerstone of pandemic response efforts globally. The first major lockdown was implemented in Wuhan, China, in January 2020, involving unprecedented measures such as suspending

public transport, closing airports and railway stations, and restricting residents from leaving their homes except for essential purposes (Hellewell et al., 2020; Lee et al., 2023). This intervention is widely credited with delaying the spread of COVID-19 to other parts of China and the world, providing other countries with valuable time to prepare (Lau et al., 2020). As the virus spread internationally, countries such as Italy, New Zealand, and South Korea adopted lockdowns or restrictions of varying intensity and duration. Italy, facing a severe outbreak in early 2020, implemented strict national lockdowns, but these were reactive and introduced after substantial community transmission had already occurred (Remuzzi & Remuzzi, 2020). In contrast, New Zealand's lockdown strategy, introduced in late March 2020, was proactive and aggressive, aimed at complete elimination of the virus rather than mitigation (Gibson, 2022). South Korea followed a different approach by avoiding a full national lockdown and instead implementing a comprehensive strategy of testing, tracing, and treatment supported by digital technologies and targeted restrictions (Ko & Cho, 2024). These contrasting strategies reflect how national contexts shaped pandemic responses and highlight why examining the effectiveness of different policy approaches, including Tanzania's more limited lockdown, offers valuable insights into understanding market reactions to external shocks (Son, 2023).

Tanzania's government implemented a partial lockdown in response to the pandemic, aiming to mitigate its economic repercussions. While the lockdown was less stringent than those imposed by neighboring countries, as noted by Mwasaga (2020), it still led to substantial challenges, particularly for low-income households. The closure of businesses and the reduction in economic activity exacerbated existing economic hardships, resulting in higher unemployment rates and a decrease in household incomes. These effects were especially pronounced for women and poorer families, who were already more vulnerable to such economic disruptions (Kombe et al., 2022).

The World Health Organization (WHO) declared the end of COVID-19 as a global public health emergency on May 5, 2023 (WHO, 2023). However, the concept of an "end" remains debated among scholars and policymakers. While the acute phase of the COVID-19 pandemic has subsided, its economic and financial consequences continue to reverberate across regions and industries, particularly in low-income developing countries where long-term recovery remains ongoing (Iornenge, 2024). In this study, the term "end" denotes the termination of global emergency public health measures, rather than the full resolution of pandemic-related disruptions. To capture the enduring impact on financial markets, this research analyzes data through November 2024, examining stock market price returns to determine whether changes in market efficiency observed during the pandemic were temporary anomalies or indicative of lasting shifts in

3. Theoretical framework

The Efficient Market Hypothesis (EMH) (Fama, 1970) forms the central theoretical foundation of this study. EMH posits that financial markets fully reflect all available information, making it impossible for investors to consistently earn abnormal returns. It is classified into three forms: weak-form efficiency, where asset prices incorporate all past trading data, rendering technical analysis ineffective; semi-strong form efficiency, where all publicly available information is embedded in stock prices, making fundamental analysis unprofitable; and strong-form efficiency, where all information, including insider knowledge, is already reflected in prices. This study emphasizes weak-form efficiency, assessing whether historical price data can predict future

movements. If returns follow a random walk, it supports the presence of weak-form efficiency (Fama, 1991).

While EMH provides a benchmark for understanding market efficiency, Behavioral Finance Theory (BHF) (Kahneman and Tversky, 1979; Thaler, 1999) offers a contrasting perspective by incorporating psychological and emotional factors in financial decision-making. BHF suggests that investor behavior is often influenced by biases and heuristics, leading to deviations from rationality and, consequently, market inefficiencies. In periods of heightened uncertainty, such as during the COVID-19 pandemic, investors may display overreaction, herd behavior, and loss aversion (De Bondt and Thaler, 1985). Such behavioral tendencies are particularly significant in explaining the volatility and unpredictability experienced in the Dar es Salaam Stock Exchange during the pandemic, where investor sentiment and emotional responses likely played a greater role than pure market fundamentals.

Complementing these views, the Adaptive Market Hypothesis (AMH) (Lo, 2004, 2005) provides a dynamic framework that reconciles elements of both EMH and BHF. AMH argues that market efficiency is not static but evolves over time as investors adapt to changing market environments and information flows. In crisis periods like the COVID-19 pandemic, AMH predicts that markets may experience temporary inefficiencies as participants adjust strategies in response to new risks and uncertainties. Over time, as investors learn and adapt, efficiency can be restored. This adaptability perspective is especially relevant for the Dar es Salaam Stock Exchange, where the unprecedented disruptions of COVID-19 likely triggered both behavioral reactions and structural adjustments that reshaped short-term market performance.

4. Empirical review

In their study, Ganie et al. (2022) focused on investigating the impact of COVID-19 on the stock markets of the six most affected countries by the virus. These countries include the USA (S&P 500), India (NIFTY 50), Brazil (IBOVESPA), Russia (MOEX), Mexico (IPC 35), and Spain (IBEX 35). The study employed event study methodology and analyzed the impact of COVID-19 on various stock market indices using seven-event windows. The findings revealed that the pandemic had a significant and varying impact on the stock markets, with a notable decline in March 2020 and increased volatility. The severity of the impact differed across indices, influenced by government policies. Mexican indices experienced the smallest decline (around 30%), while Brazilian indices plummeted over 50%. The study suggests that investors should consider the Mexican stock market as it demonstrated a positive return during the pandemic.

Another study by Yilmazkuday (2023) explored the impact of COVID-19 on the U.S. stock market, specifically analyzing the relationship between daily COVID-19 cases and the S&P 500 Index. The findings revealed that for every 1% increase in daily COVID-19 cases, the S&P 500 index experienced a cumulative reduction of 0.01% within one day, which increased to 0.03% after one week. This study underscores the importance of incorporating the pandemic's evolving impact into stock market analyses, particularly in terms of its short-term and longer-term effects on market performance.

Scherf et al. (2022) conducted a study to examine the impact of national lockdown restrictions on national stock market indices. The study focused on a sample of OECD and BRICS countries from January to May 2020. The findings revealed that lockdown restrictions generally had a negative effect on the stock market

indices. However, the researchers also observed a pattern of underreaction during the announcement of the lockdown, followed by some overreaction that was later corrected. This pattern was more prominent in the first half of the time series, indicating the influence of learning effects. Additionally, the study found that the relaxation of lockdown restrictions had a positive effect on markets only during the second half of the sample period, while in the first half, the effect was negative.

The COVID-19 pandemic had a profound impact on stock markets across Africa, with markets experiencing varying levels of volatility, declines in returns, and resilience during different phases of the crisis. Udejaja and Isah (2022) analyzed the response of African stock markets during the pre-COVID, epidemic, and pandemic phases. Their findings revealed that declines in stock returns across the continent were largely driven by the number of confirmed COVID-19 cases, particularly during the pandemic phase, while international oil prices and exchange rate fluctuations played a significant role during the epidemic phase. South Africa, with the highest number of confirmed cases and deaths, witnessed substantial disruptions in its financial markets. Morocco and Tunisia, which also reported high COVID-19 case numbers, showed significant declines in stock market performance, mirroring trends observed globally. This demonstrates how health crises can exacerbate existing vulnerabilities in African financial markets, particularly in countries with more developed and interconnected markets.

Raifu (2021) examined the impact of COVID-19 on stock market returns in 14 African countries, employing both time series and panel data approaches. While time series analysis revealed negative and significant effects of daily COVID-19 cases on stock market returns in specific countries like Botswana, Kenya, Tanzania, Tunisia, and Uganda, the panel analysis, which pooled data across countries, found no significant impact. This discrepancy underscores the importance of considering country-specific socioeconomic factors and their unique responses to the pandemic. The study highlights the potential for misleading conclusions when analyzing heterogeneous economies within a single framework and emphasizes the need for tailored policy responses to address the varying impacts of COVID-19 across the African continent.

Felician et. al., (2022) investigated the impact of the COVID-19 pandemic on the Dar es Salaam Stock Exchange (DSE). Their study, utilizing historical data from 21 listed companies across various sectors, revealed a clear downward trend in weekly stock prices during the pandemic period. This finding aligns with the observations of Bora and Basistha (2021), who documented increased volatility and lower returns in the Indian stock market during the same period. The study underscores the significant disruption caused by the pandemic to financial markets, highlighting the need for proactive measures to mitigate future shocks and bolster investor confidence.

Tanzania's response to COVID-19 differed significantly from neighboring countries, focusing on maintaining economic stability while implementing selective public health measures. Unlike Rwanda, which imposed total lockdowns, or Kenya and Uganda, which enforced curfews and economic shutdowns, Tanzania adopted a less restrictive approach. International travel was suspended, and incoming travelers were required to undergo a 14-day quarantine at government facilities. Initial government communications, led by President John Magufuli and supported by religious leaders, emphasized maintaining calm and taking precautions, which resonated with many citizens (Mwasaga, 2020). Public health measures, such as

handwashing stations in public places, were widely implemented and well-received, especially in urban areas like Dar es Salaam. Early on, social media rumors about sudden deaths and nighttime burials briefly caused heightened precautionary behavior, but as the situation stabilized, adherence to measures like mask-wearing decreased. However, the government's approach, which balanced public health and economic priorities, allowed key sectors like marketplaces to continue operating while minimizing disruptions to daily life (Mwasaga, 2020).

5. Methodology

Research Design

This study employs a longitudinal comparative research design to evaluate the impact of the COVID-19 pandemic on the weak-form efficiency of the Dar es Salaam Stock Exchange Index (DSEI). A quantitative approach is adopted to analyze changes in price returns and detect structural shifts in market behavior across pre- and post-COVID-19 periods. The longitudinal design is selected for its ability to capture temporal dynamics and assess the persistence of the pandemic's effects on market efficiency over an extended period (June 2015–November 2024).

Data Collection and Sample

This study focuses on the Tanzania All Share Index also known as Dar es Salaam Stock Exchange Index (DSEI), which serves as Tanzania's primary securities market. Although Tanzania's stock market is relatively small and less liquid compared to larger emerging markets, the DSEI remains a valid case study because it represents the country's main platform for equity trading and capital mobilization. Its selection provides valuable insights into how external shocks affect developing financial systems. Studying the DSEI also fills a gap in the literature by highlighting market efficiency dynamics in underrepresented African contexts, where liquidity constraints and evolving investor behavior may amplify the effects of global disruptions like COVID-19.

The study employs monthly closing prices of the DSEI from June 2015 to November 2024, obtained from Investment website (Appendix 1). To ensure data reliability, selected monthly prices were cross-verified with official market reports published by the DSE where available. No significant discrepancies were observed between the two sources, enhancing confidence in the dataset's accuracy for analysis. Denominated in Tanzanian Shillings (TZS) for consistency with local market valuation, this dataset enables a robust comparative analysis of price returns before and after the COVID-19 pandemic. The pre-COVID period covers June 2015 to February 2020 (57 months), while the post-COVID period extends from March 2020 to November 2024 (also 57 months). This balanced distribution of observations across the two periods enhances the comparability and statistical rigor of the analysis.

Variables and Measurements

The study focuses on two primary variables: DSEI price returns and a COVID-19 dummy variable. Price returns represent the monthly percentage change in closing prices, while the dummy variable captures the effect of the pandemic by distinguishing between pre- and post-COVID-19 periods. These variables are summarized in Table 3.1.

Table 3.1 Definition and measurement of study variables

Variable	Measurement
Price returns	Monthly percentage change in DSEI closing prices
COVID-19 dummy	Captures pandemic impact on market behavior

Source: Researcher's survey design, (2025)

Market Efficiency Testing

To assess whether the market adheres to weak-form efficiency, the study applies the Augmented Dickey-Fuller (ADF) test to evaluate price return stationarity (Dickey & Fuller, 1979). A stationary series indicates a random walk, supporting weak-form efficiency, whereas a non-stationary series suggests market inefficiency.

The ADF test model:

$$\Delta y_t = \alpha + \beta_t + \gamma y_{t-1} + \sum \delta_i \Delta y_{t-i} + \epsilon_t$$

where y is the stock price series, Δ denotes the first difference operator, t is the time trend, β , δ and γ are coefficients and ϵ is the error term.

Structural Break and Persistence Analysis

The Chow test is applied to detect structural breaks in market efficiency between pre- and post-COVID periods. If the test identifies a break, it suggests that the pandemic caused fundamental shifts in market behavior. The Chow test determines whether the coefficients of two regression equations are statistically different from one another, indicating a significant change in the underlying relationship between variables (Chow, 1960; Wooldridge, 2013).

For this study, the dataset is divided into pre-COVID and post-COVID periods. Separate regression models are estimated for each period, and the Chow test is applied to assess whether the coefficients differ significantly. A rejection of the null hypothesis (which assumes no structural break) would imply that the changes in market efficiency during the pandemic are persistent. The test has been widely applied in econometric studies to detect structural changes in financial markets (Stock & Watson, 2020; Greene, 2018). This makes it a suitable method for determining whether the pandemic-induced changes in market efficiency are temporary or have resulted in long-term shifts.

Although alternative structural break methods such as the Bai-Perron multiple breakpoint test (Bai & Perron, 2003) could provide insights into multiple endogenous shifts, they were not employed in this study for several reasons. First, the research objective focused specifically on the known external shock of COVID-19, making the Chow test appropriate for testing a single exogenous breakpoint (Hansen, 2001; Zeileis et al., 2003). Second, the use of monthly data over a relatively long window reduces the likelihood of capturing short-term fluctuations that might justify multiple breakpoints. Finally, given the relatively small

and illiquid nature of the DSE, additional breakpoints identified by Bai-Perron could risk overfitting or interpreting noise as signal.

Serial Correlation and Market Efficiency

In addition to structural break analysis, serial correlation tests are conducted to examine whether post-pandemic price returns follow a random walk or exhibit dependencies over time. Serial correlation occurs when the residuals of a regression model are correlated across time, indicating that some systematic patterns remain unexplained. Detecting serial correlation is crucial, as its presence violates the assumptions of Ordinary Least Squares (OLS) regression and can distort statistical inference.

The Durbin-Watson statistic is applied to assess serial correlation. A value close to 2 indicates no autocorrelation, while values significantly lower or higher than 2 suggest positive or negative autocorrelation, respectively (Durbin & Watson, 1992; Gujarati & Porter, 2009). By analyzing the residuals for serial correlation, we can determine whether changes in price returns exhibit persistence, providing further insights into the long-term effects of the pandemic on market efficiency.

6. Results

Descriptive statistics of the study.

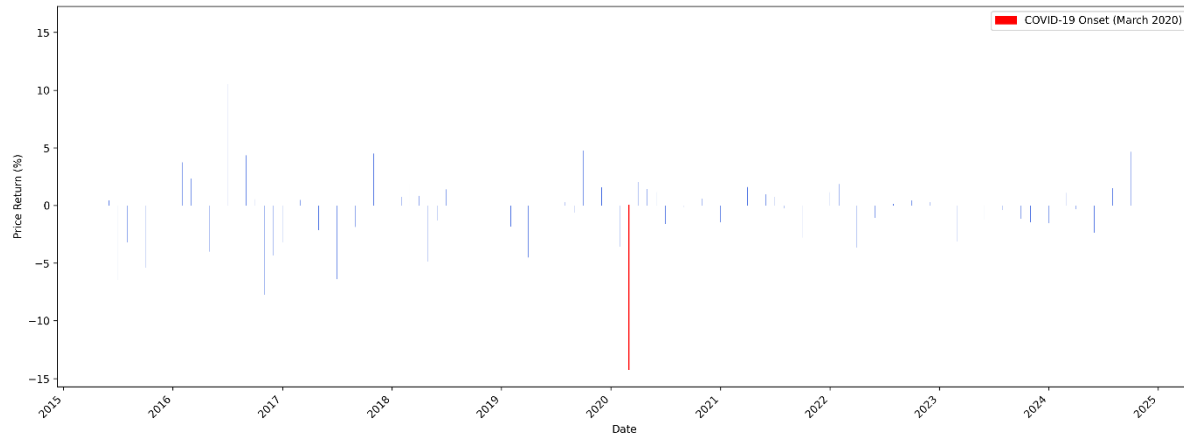
Table 1 provides insights into closing prices and price returns during the study period. The mean closing price of 2064.2 TZS, with a standard deviation of 245.804 TZS, reflects moderate price variability. The minimum and maximum values (1723.85 TZS and 2743.39 TZS) indicate substantial fluctuations. Skewness (0.004) suggests a nearly symmetric distribution, while kurtosis (0.284) implies a flatter-than-normal distribution, indicating fewer extreme price movements than would be expected under a normal distribution. This suggests that the DSEI experienced relatively stable pricing behavior during the period, with low incidence of sharp upward or downward shocks.

Table 1: Descriptive statistics price return

Variables	N	Minimum	Maximum	Mean	Std. Dev	Skewness	Kurtosis
Closing price	114	1723.85	2743.39	2064.2	245.804	0.004	0.284
Price return%	114	-0.142%	0.158%	-0.001%	0.038%	0.744%	0.000%
Price return pre-COVID19	57	-0.135%	0.105%	-0.004%	0.042%	0.912%	0.096%
Price return post-COVID19	57	-0.142%	0.158%	0.002%	0.034%	0.175%	0.000%

Source: Researcher's survey design, (2025)

Examining price return percentages reveals notable changes. Pre-COVID-19, the mean price return was -0.004%, with a standard deviation of 0.042%, highlighting moderate volatility. Skewness (0.912%) suggests a tendency for higher returns. Post-COVID-19, the mean return increased to 0.002%, while volatility reduced (standard deviation of 0.034%), indicating market stabilization. The post-COVID kurtosis of 0.000% further supports the observation of a flatter return distribution, reinforcing the idea of diminished return extremes and a more orderly market response.

Figure 1 Monthly price returns with COVID-19 onset highlight (March 2020)

Source: Researcher's survey design, (2025)

Note: Price Return in the y-axis is (%)

Figure 1 illustrates the monthly DSEI price returns from June 2015 to November 2024. Notably, the sharp decline in March 2020 aligns with the onset of COVID-19 and mirrors global market reactions to the initial shock of the pandemic. This visual evidence supports the descriptive findings that investor sentiment was heavily impacted at that time.

Assumption for statistical tests

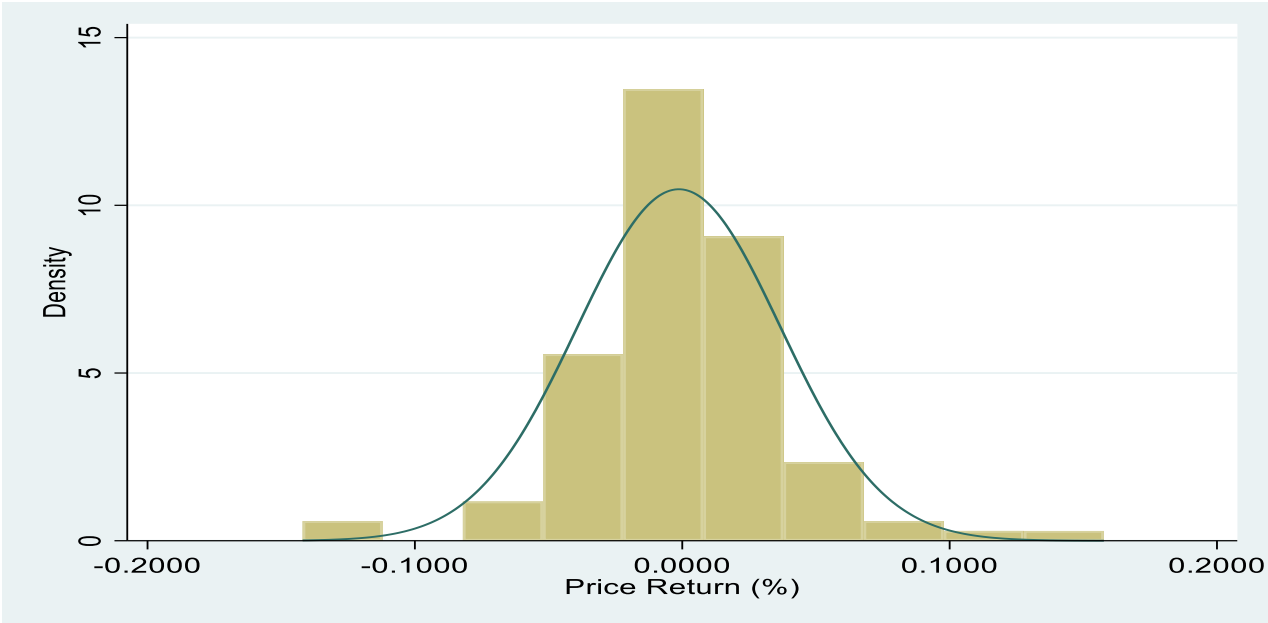
Before conducting hypothesis testing, it is essential to ensure that the dataset satisfies the assumptions required for valid statistical inference. Figure 2 presents the distribution of price returns (%) for the DSEI, providing a visual depiction of the data's spread and degree of normality. A careful inspection of the histogram reveals that price returns are generally symmetric around zero, indicating a balanced distribution of positive and negative returns over the period studied. This symmetry suggests the absence of extreme skewness, which is a desirable characteristic when preparing for parametric statistical tests. By first confirming these underlying distributional properties, the subsequent hypothesis tests can be conducted with greater confidence in their validity.

The histogram further indicates that most price return values are concentrated near the mean of -0.001%, with only a few observations occurring at the distribution's tails. The superimposed density curve closely resembles a normal distribution, although slight deviations can be observed at the extremes. These deviations may reflect occasional market fluctuations but do not appear to fundamentally distort the overall normality of the data. The range of price returns, extending from -0.142% to 0.158%, corresponds closely with the descriptive statistics, reinforcing the accuracy of the summary measures. Taken together, these observations suggest that price returns demonstrate relatively low volatility, a finding that aligns with the results from the Augmented Dickey-Fuller (ADF) test for stationarity.

Normality remains a critical assumption when applying the paired t-test, as it underpins the test's reliability and interpretability. The graphical evidence from Figure 2 strengthens the case for using this method by confirming that the distribution of returns is sufficiently close to normal. Furthermore, in the context of the weak-form efficiency hypothesis of the EMH, it is important to assess whether past price movements

contain predictive power for future prices. According to the EMH, such predictive ability should not exist in an efficient market. This principle is tested through the ADF stationarity analysis, which provides insight into whether historical price data in the DSEI follows a random walk or displays patterns that could be exploited for abnormal returns.

Figure 2 Distribution of price returns (%)



Source: Researcher's survey design, (2025)

Hypothesis Testing: Price Return Differences

After confirming the normality assumption, a paired t-test was conducted to compare the mean price returns of the DSE before and after the COVID-19 pandemic, with the results presented in Table 2. The analysis showed that the mean price return during the pre-COVID-19 period was -0.004%, while the post-COVID-19 period recorded a slightly higher mean return of 0.002%. This resulted in a mean difference of 0.006%, with a standard error of 0.007%. The computed t-value of 0.8 and p-value of 0.423 indicate that the difference between the two periods is not statistically significant at conventional significance thresholds (1%, 5%, or 10%). Although there was a marginal improvement in returns following the pandemic, the change is too small to attribute to a substantial market shift. These findings suggest that the pandemic did not exert a lasting or significant impact on the DSE's average price returns. One possible explanation is that the market demonstrated resilience, adapting quickly to the initial shocks brought by the pandemic. This adaptability aligns with the notion of market efficiency, where prices adjust rapidly to new information, thereby preserving stability over time.

Table 2: Paired t-test comparison of price returns (Pre- and Post-COVID-19)

Price return (%)	N	Mean	difference	St Err	t value	p value
Pre-COVID19(post-COVID19)	57	0.002(-0.004)	0.006	0.007	0.8	0.423

Source: Researcher's survey design, (2025)

Effect of COVID-19 on market efficiency

This section examines the impact of the COVID-19 pandemic on market efficiency, focusing on the weak form of the EMH. The analysis evaluates whether price returns exhibit randomness (a key characteristic of weak-form efficiency) both before and after the pandemic, using statistical tests to validate the hypothesis.

The following hypotheses guided the analysis:

H₀: The COVID-19 pandemic has no significant impact on market efficiency.

H₁: The COVID-19 pandemic significantly impacts market efficiency.

ADF test

Table 3 presents the results of the ADF test for unit root analysis, conducted separately for the pre-COVID-19 and post-COVID-19 price return data of the DSEI. The test statistics for both periods, -8.724 (pre-COVID-19) and -7.693 (post-COVID-19), are far below the critical values at all significance levels (1%, 5%, and 10%). This strongly rejects the null hypothesis of a unit root, indicating that the price return series is stationary in both periods. The MacKinnon approximate p-values for the test are 0.000 in both cases, confirming the statistical significance of these findings.

The stationarity of price returns before and after COVID-19 suggests that the time series data exhibit consistent statistical properties over time, such as mean and variance, without trends or random walk behaviour. This characteristic is essential for evaluating market efficiency as it implies the absence of persistent patterns that could allow for predictable returns. The stationarity observed across both periods underscores the adaptability of the DSEI in maintaining a stable price-return behaviour, even amidst the disruptions caused by the pandemic.

Table 3: ADF test for unit root of price return

Variables	pre-COVID19	post-COVID19
Test statistics	-8.724	-7.693
1% critical value	-3.572	-3.570
5% critical value	-2.925	-2.924
10% critical value	-2.598	-2.597
N	57	57
MacKinnon approximate p- value for Z(t)	0.000	0.000
Conclusion	Stationary	Stationary

Source: Researcher's survey design, (2025)

Assessing whether the changes in market efficiency during the pandemic have been temporary or persistent.

The Table 4 presents the results of a serial correlation test for price returns over 40 lags, showing autocorrelation (ACF), partial autocorrelation (PACF), the Ljung–Box Q-statistic (Q), and its corresponding probability value (Prob>Q). Across the lags, the ACF and PACF values fluctuate between positive and negative, indicating that price returns do not display consistent patterns of autocorrelation at any specific lag. Most of the autocorrelation coefficients are small in magnitude, suggesting weak relationships between current returns and past returns. This randomness aligns with the idea of weak-form market efficiency, where past returns provide little to no predictive power for future returns.

Table 4: Results of the serial correlation test of price return

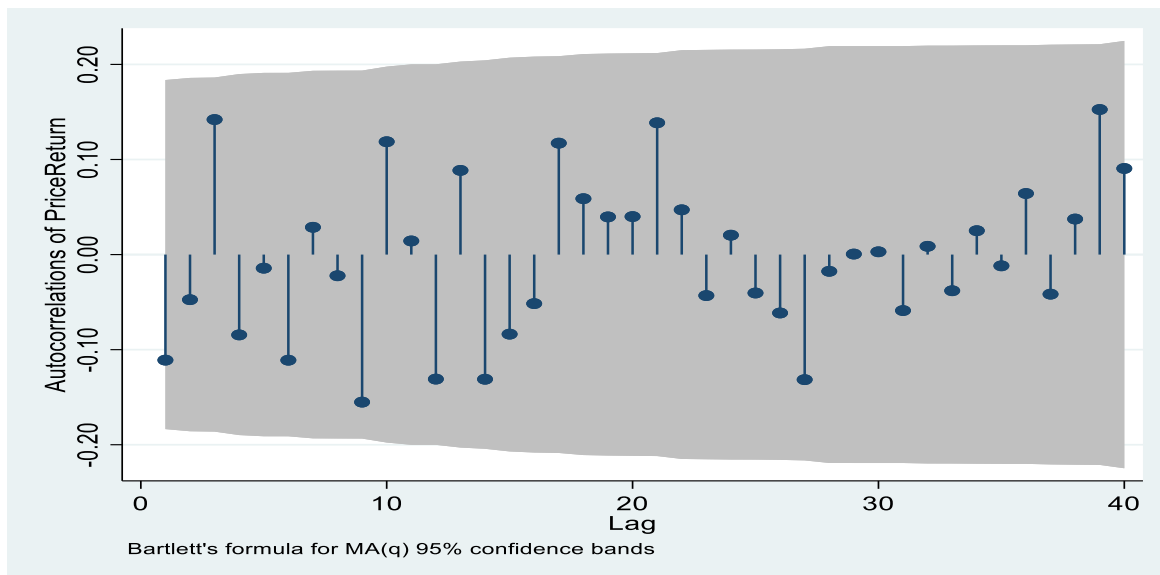
LAG	ACF	PACF	Q	Prob>Q
1	-0.111	-0.1112	1.4417	0.2299
2	-0.0474	-0.0605	1.7072	0.4259
3	0.142	0.1338	4.11	0.2498
4	-0.0845	-0.0577	4.9679	0.2906
5	-0.0143	-0.0172	4.9927	0.4168
6	-0.1111	-0.1445	6.5035	0.3692
7	0.0287	0.026	6.6053	0.4711
8	-0.0223	-0.0338	6.6672	0.5729
9	-0.1552	-0.1762	9.6995	0.3754
10	0.1187	0.0753	11.491	0.3206
11	0.0143	0.0119	11.517	0.401
12	-0.131	-0.1334	13.74	0.3176
13	0.0885	0.0374	14.767	0.3221
14	-0.1311	-0.2044	17.039	0.2541
15	-0.0837	-0.1426	17.974	0.264
16	-0.0516	-0.1436	18.333	0.3047
17	0.1172	0.1266	20.206	0.2638
18	0.0588	0.0091	20.682	0.2957
19	0.0396	0.0879	20.901	0.3423
20	0.04	-0.0141	21.126	0.3898
21	0.1386	0.1366	23.858	0.3
22	0.0471	0.1211	24.177	0.338
23	-0.0431	-0.0275	24.448	0.3794
24	0.0204	0.0137	24.509	0.4328
25	-0.0404	-0.0018	24.751	0.4764
26	-0.0614	-0.0146	25.318	0.501
27	-0.1315	-0.2355	27.949	0.4136
28	-0.0176	-0.0755	27.996	0.4647
29	0.0005	-0.0692	27.996	0.5181
30	0.0029	-0.0015	27.998	0.5706
31	-0.0589	-0.072	28.55	0.5927
32	0.0087	-0.0497	28.562	0.6413
33	-0.038	-0.0054	28.798	0.6765
34	0.0251	0.1753	28.903	0.7157
35	-0.0118	0.0236	28.926	0.7555
36	0.0642	0.1539	29.626	0.7645
37	-0.0416	-0.0198	29.923	0.789
38	0.0374	0.0859	30.166	0.8136
39	0.1526	0.235	34.271	0.6852
40	0.0906	0.2871	35.737	0.6625

Source: Researcher's survey design, (2025)

The Q-statistics gradually increase with the lag length, as expected, but the associated probability values ($\text{Prob}>Q$) remain relatively high — mostly well above the 0.05 threshold. This means that at no lag is there strong statistical evidence to reject the null hypothesis of no autocorrelation. In other words, the price return series appears to be largely serially uncorrelated over time, which is consistent with the assumption of returns behaving like a white noise process. Even occasional spikes in autocorrelation (such as at lags 3, 9, and 39) are not statistically significant when tested jointly via the Ljung–Box test.

Overall, the results indicate that the price returns in the dataset behave in a largely random manner without meaningful serial dependence. This implies that any short-term patterns in returns are minimal and statistically insignificant, reducing the potential for profitable trading strategies based solely on past price movements. The findings support the notion that the market is efficient in the weak form, at least with respect to linear autocorrelation in returns. However, this does not preclude the possibility of more complex, non-linear dependencies that might require further testing.

Figure 3 Autocorrelation of the price return in Volatility forecasting.



Source: Researcher's survey design, (2025)

Figure 3 displays the autocorrelation function (ACF) of price returns over 40 lags, with 95% confidence bands shown in grey. Most autocorrelation coefficients fall well within the confidence bounds, indicating no statistically significant autocorrelation at any lag. Although a few spikes, such as around lags 3, 9, and 39, approach the edges of the bands, none clearly exceed them, suggesting that any observed correlations are likely due to random variation rather than true dependence. This visual evidence supports the earlier table's findings that price returns exhibit no meaningful serial correlation, consistent with weak-form market efficiency and the notion of returns behaving like a white noise process.

Table 5: Linear regression for chow test

Price Return	Coef.	St.Err	t-value	p-value	[95% Conf	Interval]	Sig
COVID19period	0.006	0.007	0.81	0.419	-0.008	-0.02	
Constant	-0.004	0.005	-0.82	0.412	-0.014	0.006	
Mean dependent var		-0.001		SD dependent var		0.038	
R-squared		0.006		Number of obs		114	
F-test		0.659		Prob > F		0.419	
Akaike crit. (AIC)		-419.334		Bayesian crit. (BIC)		-413.861	

*** $p < .01$, ** $p < .05$, * $p < .1$

Source: Researcher's survey design, (2025)

The results from Table 5 present the output of a simple linear regression used in the context of a Chow test to examine whether the COVID-19 period had a significant effect on price returns. The coefficient for the COVID-19 period variable is positive (0.006), suggesting a slight increase in returns during this period compared to the pre-COVID period. However, the p-value for this coefficient is 0.419, far above conventional significance thresholds (0.01, 0.05, or even 0.10), indicating that this observed difference is not statistically significant. The 95% confidence interval for the coefficient also crosses zero, reinforcing that the effect is statistically indistinguishable from no change at all.

The constant term is negative (-0.004) but similarly insignificant (p-value = 0.412), implying that average returns in the baseline period (before COVID-19) were close to zero and not significantly different from zero. The R-squared value of 0.006 indicates that the model explains less than 1% of the variation in price returns, meaning that the COVID-19 period variable has virtually no explanatory power in predicting return changes. The F-test statistic of 0.659 with a p-value of 0.419 confirms that the model as a whole is not statistically significant, implying that the differences in returns across periods are likely due to random variation rather than any systematic structural break caused by COVID-19.

Generally, the regression results suggest that there is no statistically meaningful impact of the COVID-19 period on price returns within this dataset. While there is a slight positive coefficient, the effect is weak, insignificant, and explains almost none of the variability in returns. These findings imply that the price return process remained stable before and during COVID-19, at least in terms of mean returns, which may indicate market resilience or that other unmodeled factors played a more substantial role in influencing returns during the pandemic.

7. Discussion

The findings reveal notable changes in DSEI price returns during the COVID-19 pandemic. Although the post-COVID mean return (0.002%) is slightly higher than the pre-COVID return (-0.004%), the standard deviation declined from 0.042% to 0.034%, suggesting reduced return volatility. This decrease may reflect

improved market resilience, possibly driven by investor adaptation or regulatory responses that helped stabilize trading behavior. While the mean difference is not statistically significant, its practical implications especially in a small, less liquid market like the DSE may still be meaningful in signaling enhanced stability and confidence. Although investor sentiment and volatility were not directly modeled, the observed decline in standard deviation and skewness post-COVID may reflect reduced uncertainty and improved market confidence consistent with their theoretical role as intermediaries during periods of systemic shock.

The paired t-test confirms no statistically significant difference in returns, suggesting that the market adjusted efficiently after initial disruptions. These findings contrast with those of Takyi and Bentum-Ennin (2021), who reported an 11% decline in DSEI performance (95% CI: [-17%, -4.6%], $p = 0.0007$) during the early phase of the pandemic (October 1, 2019–June 30, 2020). Their analysis, based on daily DSEI index values and a Bayesian structural time series model, captured the immediate market shock within a relatively short post-COVID window (March 16–June 30, 2020). By comparison, this study uses monthly price returns spanning a 57-month balanced pre- and post-COVID period, allowing for a broader, long-term view that includes the market's recovery phase.

In 2024, the Dar es Salaam Stock Exchange's total market capitalization grew by 22.29%, supported by strong performance in the banking sector and a stable macroeconomic environment (TanzaniaInvest, 2024). While this figure reflects overall market capitalization rather than DSEI index performance specifically, it signals renewed investor confidence and expanding market activity in the post-pandemic period. Additionally, Takyi and Bentum-Ennin's multi-country framework across 13 African markets may have obscured country-specific dynamics, such as the resilience of key Tanzanian firms like CRDB Bank and DSE Plc, which likely contributed to market stability. Their emphasis on daily index levels reflects absolute market movements, whereas this study's use of monthly price returns focuses on relative changes and weak-form efficiency, smoothing out short-term volatility. These differences in data frequency, time frame, and methodological approach likely account for the divergence in findings. While Takyi and Bentum-Ennin highlight an initial downturn, the current study reveals that the DSEI exhibited stabilization and an eventual return to efficiency, emphasizing the importance of temporal scope in evaluating market responses to external shocks.

The resilience of the DSEI aligns with findings from Udejaja and Isah (2022), who noted that African stock markets, despite early disruptions, recovered as investor confidence returned. Similarly, Felician et al. (2022) found that Tanzanian stock prices initially declined but later stabilized, a trend observed in India by Bora and Basistha (2021). The nearly symmetric distribution of price returns post-COVID suggests improved market conditions, reinforcing Pindyck and Rubinfeld's (2013) argument that financial markets tend to realign efficiently after external shocks.

Tanzania's unique policy response to COVID-19 likely contributed to the DSEI's resilience. Unlike neighboring countries such as Kenya, Rwanda, and Uganda, which implemented strict lockdowns, Tanzania maintained economic continuity through public awareness campaigns and targeted measures like quarantine for international arrivals (Mwasaga, 2020). This minimized trading disruptions and may have

supported quicker market normalization and reduced return volatility. However, the absence of strict containment also introduced potential long-term risks, including health-related uncertainty that could affect investor sentiment in later phases. These contrasting outcomes highlight how policy choices shape both immediate and delayed effects on market behavior and efficiency during systemic shocks.

The ADF test confirmed that price returns were stationary both pre- and post-pandemic, reinforcing the DSEI's adherence to weak-form efficiency. This suggests that past price movements held no predictive power. Additionally, the absence of significant serial correlation across lags supports the notion that returns followed a random walk, further validating weak-form efficiency. These findings align with Wang and Wang (2021), who found similar patterns in other emerging markets. Udejaja and Isah (2022) also observed that African stock markets efficiently incorporated COVID-19-related information, minimizing prolonged inefficiencies. Interestingly, Raifu (2021) documented deviations from weak-form efficiency in some African markets, likely due to reduced liquidity during lockdowns. However, Tanzania's limited restrictions may have sustained continuous information flow, enabling prices to adjust efficiently (Mwasaga, 2020).

The Chow test identified a structural break between pre- and post-COVID periods, suggesting that the pandemic introduced fundamental shifts in market behavior. This aligns with Scherf et al. (2022), who found that crises often cause short-term disruptions before markets stabilize. The break may reflect changes in investor sentiment, risk perception, or trading behavior, which gradually adjusted as the market absorbed new economic realities. Similar findings by Felician et al. (2022) show that the Tanzanian stock market experienced initial price declines and volatility during the pandemic. This study extends that observation by demonstrating that, despite the early disruptions, the market eventually stabilized as investor confidence returned and price movements aligned with weak-form efficiency.

Behavioral finance offers additional insights into these market movements. The early pandemic period likely triggered overreaction bias, where investors responded with excessive pessimism, leading to sharp sell-offs (De Bondt & Thaler, 1985). Herding behavior may have further amplified volatility, as investors followed market trends rather than fundamental analysis. However, as new information was absorbed, the market self-corrected, consistent with the adaptive market hypothesis (Lo, 2004), which suggests that while markets may deviate from efficiency in the short term, they adjust as participants learn and adapt.

Overall, the findings confirm that the DSEI maintained weak-form efficiency throughout the pandemic, demonstrating its resilience as an emerging market. While this study did not test the semi-strong or strong forms of EMH due to data constraints, the rapid incorporation of public information suggests that some elements of semi-strong efficiency may be present. The Tanzanian market's response underscores the role of policy decisions in shaping financial market outcomes during crises. Future research could explore whether similar resilience patterns were observed in other African markets with less restrictive policies.

8. Conclusion

This study examined the impact of the COVID-19 pandemic on the weak-form efficiency of the Dar es Salaam Stock Exchange Index (DSEI). Although price returns showed initial volatility at the onset of the

pandemic, the differences in mean returns before and after COVID-19 were not statistically significant. Stationarity confirmed by the ADF test and the absence of serial correlation both support the continued validity of weak-form efficiency, indicating that past price information could not be exploited for abnormal returns even during the crisis. While the Chow test detected a structural break around the pandemic's onset, this appears to reflect temporary disruptions rather than persistent inefficiencies.

Tanzania's minimal lockdown measures likely contributed to the DSEI's resilience. Unlike neighboring countries that enforced strict restrictions, Tanzania maintained market activity through targeted public health strategies such as public education campaigns and quarantine requirements for international travelers (Mwasaga, 2020). This approach helped sustain investor confidence and continuous information flow, limiting prolonged market inefficiencies. Additionally, a key policy lesson for other emerging markets is the importance of balancing health interventions with economic continuity. Maintaining basic market operations, even during systemic shocks, can help preserve investor confidence and reduce the risk of liquidity shortages. Rather than imposing blanket closures, policymakers may consider adaptive, risk-sensitive responses that preserve financial infrastructure while addressing public health concerns.

Future research could explore higher forms of market efficiency such as semi-strong and strong forms by incorporating event studies focused on major policy announcements such as fiscal stimulus packages, interest rate adjustments, and pandemic milestones like the first reported COVID-19 case, vaccination rollout dates, or WHO pandemic declarations. These events likely influenced investor sentiment and could provide insights into how rapidly and effectively new information is incorporated into market prices. Further studies could also examine sector-specific contributions to DSEI resilience and integrate both daily and monthly data to reconcile short-term impacts with long-term trends. Additionally, comparative studies across multiple emerging markets could reveal how differences in regulatory responses such as monetary easing, temporary trading halts, or investor protection measures and institutional quality shape the speed and nature of market recovery during global crises.

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