



Pre, During and Post Covid-19 Stock Returns and Volatility Comparison: Empirical Investigation from Pakistan

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Abstract

This study aims to study the pre-, during, and post-COVID-19 stock returns and volatility associated with Pakistan. This study is based on daily prices and their returns from 2018 to 2023. The data was divided into categories like Category A: Before the COVID-19 pandemic, Category B: during the COVID-19 pandemic, and Category C: Post-COVID-19 pandemic. The findings of this research are that there is no stationarity issue in all the returns' series, and the average return for Pre (Category A) and Post Covid periods (Category C) is positive; however, it is negative During the Covid period (Category B) which shows the bearish trend in Pakistan Stock Exchange market (PSX) due to the Covid-19 outbreak. Moreover, the coefficient of variation (CV) is computed, which shows that pre-COVID tenure has the highest relative dispersion (CV = 44.43), followed by during COVID (CV = 40.76), and post-COVID tenure has the most negligible coefficient of relative dispersion (CV = 23.1) which refers to the least volatile phenomenon. The findings also suggest no statistically significant difference among all average returns, and all are equal. The results from the econometric model show that the highest mean reversion value was 0.969991 During the COVID period. Post-COVID has a value of 0.449377, which indicates the quick mean reversion compared to the other two.

1 Introduction

Till the 21st Century, around five pandemics were experienced. The SARS coronavirus, which causes severe acute respiratory syndrome, was first identified in Wuhan, China, in 2002. Coronavirus is classified as a member of the family Coronaviridae. The virus is a single-stranded RNA-enveloped virus. This virus affects many organs and the organ system (Peiris & Poon, 2008). In 2019, bird flu, also called avian flu, was reported in California. In 2012, a 60-year-old male patient was diagnosed with Middle East Respiratory Syndrome

(MERS) having symptoms: fever, cough and Dyspnea in Saudi Arabia. The patient was dyed after being hospitalized for 11 days (Rasmussen et al., 2016).

WHO confirmed Covid-19 as a worldwide pandemic on the 11th of March, 2020. Around 162,956 people lost their lives, and around 2,397,216 confirmed cases were reported globally on the 21st of April, 2020. The worldwide financial markets were stunned because of covid-19. The research finds that around 29 to 33% of market indices of the S&P 500 and Dow Jones Industrial Average fell from the 31st of December 2019 to the 20th of March 2020. This was when first confirmed case of COVID-19 was reported (Babar, Ahmad, & Yousaf, 2023)

The Health Ministry of Pakistan reported the first case of Coronavirus on 26th February 2020 in Karachi. The Federal Ministry of Health reported a second case on the same day in Islamabad. Till the end of April, the total cases were 16,473. It was reported that on the 9th of May, 2020, there were about 28,736 confirmed cases, including 636 deaths with 7,809 recoveries. The recovery rate was higher in Punjab, followed by other provinces of Pakistan. Around 20,291 positive cases were reported, 2.2% of the total death rate in Pakistan. However, the recovery rate will be 27.2% till 9 May 2020 (Achakzai, et al., 2020).

Pakistan's economy was weakening, as observed in the PSX 100 index. From 26th February 2020 to 25th March, the economy considerably declined from 38,858.45 to 28,109.57 because of the COVID-19 outburst. This unusual situation leads to an irregular situation in the market (Shahzad et al., 2022).

Returns are computed to gauge the stock market performance. Return is defined as the fluctuation in the value of a stock or asset for a certain period. A return is denoted in terms of percentage change. A positive return shows a profit. However, a negative return represents a loss (Hayes, 2023). Volatility is directly proportional to the spread of security's value. It means the higher the volatility, the greater the security value spread. So, the price of security intensively changes in a short period. However, lower volatility does not lead to dramatic changes in the price of security. The higher volatility makes the security riskier. Volatility can be measured via standard deviation. Volatility causes big fluctuations in any direction. For instance, the market is volatile if the stock market increases or drops by more than one percent over a certain period. As per American-based worldwide market research

platform information, Pakistan's stock market has been ranked as the fourth outstanding performer of the 2020 year internationally and in Asia despite the tumultuous time of COVID-19 (Ghani et al., 2022).

The latest report from the World Bank states that countries experienced around 90 per cent downfalls in their financial role by 2020. The worldwide economy contracted by about 3 per cent. However, the degree of poverty rises. Pakistan's condition is similar to other developing countries as the financial performance of these countries is already pathetic, demonstrated by their macroeconomic factors along with their weak agreement with the International Monetary Fund (IMF). So, the coronavirus epidemic worsened the condition, which affected the GDP in 2020. COVID outburst negatively affected several sectors, including the manufacturing industry, and caused the country's export downfall (Mazhar, 2023). COVID-19 outbursts cause financial demolition on a large and extraordinary level. Around \$2.2 trillion bailout packages were observed against \$750 billion in the United States during the worldwide economic disaster (Goodell, 2020). Several studies on the pre and post-COVID period are available. However, this study focuses on the pre-, during, and post-COVID periods, which is the novelty of this research. This study covers the pre-, during, and post-COVID periods of stock returns and volatility associated with Pakistan. This research aims to follow a common theoretical framework of pre-, during, and post-COVID-19 stock return and volatility associated with Pakistan, followed by showing the GARCH and ARCH effects. Furthermore, whether these are following mean reversion or not. If it is, then study the speed of mean reversion to forecast future return and volatility.

1.1 Statement of the Problem

This study compares and measures pre-, during, and post-COVID-19 volatility stock and returns in Pakistan. The research is also performed to determine the Return and Volatility relationship with the help of a stochastic framework.

1.2 Research Questions

RQ1: Are the average returns of the pre, during, and post-COVID periods equal?

RQ2: Are there ARCH and GARCH effects in the pre, during, and post-COVID periods?

2 Literature Review

Much literature is available on macroeconomic variables' relationship with stock returns. However, particular focus is needed to search the stock return and volatility in the pre-, during and post-COVID-19 pandemic period. The world is facing calamity in the name of COVID-19. Due to this catastrophe, lockdowns were imposed, traveling bans, and social distancing that led to economic and financial distress. Research by Saeed et al (2021) states the coronavirus relationship with the Pakistan Stock Exchange stock returns. Daily stock prices from PSX have been taken for the study from 1 January 2011 to 30 April 2021. The data was collected from the websites of the PSX, SBP, and the NIH. Using the GARCH & ARCH models, the results show a positive relationship exists between COVID-19 and the volatility of the PSX-100 index but a negative one with mean returns.

In order to study the effect of the pandemic on the performance of the Pakistani stock market, data pertaining to the closing prices of the PSX 100 for the initial period of 2020, COVID-19 positive cases, death rates, recoveries, and recoveries were collected. The results indicate that recoveries are positively correlated with PSX performance. Death rates and the performance of PSX are negatively correlated with the number of positive COVID-19 cases (Ahmed, 2020).

Shah et al, (2023) Studied the COVID-19 effect on the capitalization of PSX. Results through the ugh Regression model suggest a negative effect of COVID-19 on the capitalisation of the Pakistan Stock Exchange Market during the start of 2020. Pakistan's government's financial aid and relief packages and global aid manage the economy. Moreover, during the COVID period, a number of foreign investors withdrew their portfolios due to financial distress and unexpected downfall in the stock market. It collapsed because Pakistan's government closed the Iran border on 23rd February 2020, the first case was confirmed on 26th February 2020. Pakistan's economy almost trailed by 33 percent, equal to 1.23 trillion (Pakistani rupees). The PSX-100 was at 27,229 points on 25th March 2020. However, the IMF's grant of \$1.40 billion, funding from the World Bank, and the relaxation in debt payment from international creditors helped Pakistan's stock market.

Research by Lee et al. (2021), examines the relationship of the COVID-19 epidemic with variations in macroeconomic variables and stock return. For the study, data from China from 13th January to 11th May 2020 was taken. The findings indicate that stock returns and macroeconomic variables are both substantially disrupted by the COVID-19 pandemic. A pandemic has had a minor impact on the stock market and stock return, while it has had a positive influence on exchange rates.

Syed and Fatima (2021) investigated the effect of the coronavirus pandemic on the stock market volatility in Pakistan while monitoring macroeconomic variables, including exchange rate, interest rate, and direct or indirect interventions to fight the pandemic. For this study, the Vector Autoregressive Model was used. The data was collected from the 25th of February 2020 to the 7th of December 2020. The results show a direct relationship between the daily coronavirus total cases and stock market volatility.

Rasool et al. (2023) studied the effect on the monthly stock returns of China, Pakistan, and India in the pre-, and post-COVID-19 period. The dataset was from May 2017 to May 2020. It is reported through empirical evidence that in Pakistan, the pre-COVID period has the highest return observed in November. However, the lowest return was observed in February. China has the highest return in January and the lowest in October. Moreover, India and Pakistan's stock returns seem more volatile in October. However, China was observed to be more volatile in February. In the COVID period, it has been observed that Pakistan and China had high returns in September, and the lowest return was observed in March for India and Pakistan. Nevertheless, India had the highest returns in November, and China had the lowest in December.

Research by Iqbal et al. (2021) examining the impact of Coronavirus on the stock market volatility of South Asian countries, namely Pakistan and India. The time series data was collected from the period of 25th of February 2020 to 12th of June 2020. Regression, GARCH, and ARCH models were used for the study. Two variables were selected for the study. Positive cases and mortality rate as an independent variable and stock volatility as a dependent variable. The findings showed that independent variables significantly affect dependent variables between the selected countries.

Research by Shair et al. (2021) studied the impact of the COVID-19 epidemic and death rates on the return and volatility of stock markets in Pakistan. The daily data of reported cases recovered and deaths was taken. The data was gathered from Worldometers from 26th of February 2020 to the 4th of September 2020. The GARCH model was used on data. The findings show the non-significant effect of pandemic news and fatalities on stock returns. Further findings showed that Pakistan's stock market was unstable during the pandemic period. Suitable management may stabilise the position of the marketplace and offer enhanced opportunities to investors for diversification of risk.

A study by Shehzad et al. (2022) examines the nonlinear behavior of the Pakistani stock market (PSX-100) and the Chinese stock market (SSEC) before and during the COVID-19 outbreak. For this study, the Vector Auto Regression framework (VAR) and the DCC-MEGARCH model were used in order to define the return and volatility of the selected stock markets before and throughout COVID-19. The findings confirmed that before the COVID-19 outbreak, returns that were produced in the economic market of Pakistan regulated the return activities of SSEC, but the returns that were generated in the financial market of China remained insignificant to the return activities of PSX-100. The result also shows that before COVID-19, the volatility spillover was insignificant between PSX-100 and SSEC but significantly increased during the epidemic. The study also evaluated that to diversify the financial risk, Pakistani investors have the best option in terms of SSEC.

Internationally, stock markets have been compromised due to Coronavirus. Different countries have made policies to restrict public activities like travelling abroad and sports-related activities and have instructed the public to stay at home, which also compromises financial activities. According to research, coronavirus will lead to business downfalls in the long term. The volatility in the financial market has risen just because of Coronavirus. The smashes and variability in stock returns during the Coronavirus negatively affected investments abroad. So, this dynamic situation in stock returns causes real disturbance for economists and investors globally.

The impact of pre- and during the COVID-19 period on the volatility of Indian stock indices. By using the GARCH model, it has been found that the Covid period has more

returns on the stock indices than during COVID-19. However, during COVID-19, the stock market was seen as more volatile as compared to the pre-pandemic period.

A study by a prior researcher investigates the US stock market performance throughout the outburst. Findings showed positive stock returns in Methane gas, foodstuff, health protection and applications. However, market capitalisation in fuel, real estate, and entertainment sectors dropped by more than 70 per cent. Failure stocks seemed to be more volatile and related negatively to stock returns.

Ali et al. (2022) compare the PSX-100 index (traditional) and the KMI-30 index (Islamic) in an investigation into the impact of the COVID-19 pandemic. In order to conduct the study, daily total reported cases and fatalities were collected. From February 25th, 2020, to May 26th, 2021, the data was gathered. The researchers employed wavelet coherence transform (WCT), continuous wavelet transform (CWT), and partial wavelet transform (PCT) methods. According to the results of the study, the Pakistan Stock Exchange and KMI-30 are significantly impacted by the pandemic. The outbursts influence both indexes.

The Pakistan stock market displayed records that showed serious losses fronting the last six-year intraday rate. It resulted in a decline of about 28 percent this year. The government of Pakistan permitted a package of 1.2 trillion rupees and an additional endowment of Rs.100 billion to reduce the impact of a pandemic. The State Bank of Pakistan also tried to withstand the damages caused by the pandemic. The efforts include decreasing the policy rate by 625 basis points, delaying the reimbursement of foreign debts, and numerous sponsored finance schemes (Shah et al., 2021).

With certain limitations on imports and an immense devaluation, Pakistan somewhat managed to decrease 70 per cent of the country's current account deficit during the first and second quarters of the financial year 2019-20. Nonetheless, this was the outcome in exchange for the growth of an economy that reduced from 5.6 per cent in 2018 to 3.3 per cent in 2019. However, Pakistan seeks to gain an advantage from the situation and get debt relief, allowances and aid from the International Monetary Fund (IMF). The country sought aid from Saudi Arabia and China (Sareen, 2020).

There seems to be a great change in financial markets worldwide after COVID-19. Due to this, the investor's decision-making is also affected in numerous ways. Now,

conventional investments, including the purchase of prize bonds and gold bars and keeping money in banks, seem to be outdated. Now, investors are making wise investment decisions by investing in the stock markets, which were disrupted during the pandemic, and taking advantage of high stock returns instantly while markets are attaining thrust (Rahim et al., 2020).

A study was done by Apergis (2022) on China's stock market. The researcher used the GARCHX model for the study. Daily confirmed COVID-19 cases from China were chosen for the study. These confirmed COVID-19 cases include total daily deaths and cases. The findings suggest that these cases have a negative impact on China's stock returns. This negative effect of COVID-19 became more noticeable when the overall deaths substituted the overall effect of this outburst. On talking volatility, the results showed the positive influence of Covid-19 on the volatility.

Al-Awadhi et al. (2020) reported a substantial decrease in overall stock prices due to adverse financial apprehensions associated with COVID-19. Upon examining the performance of stocks in both the Hang Seng Index and Shanghai Stock Exchange Composite Index during the Covid-19 outbreak in China, it was observed that there was a detrimental correlation between the pandemic and stock market returns.

Another investigation was done by Onali (2020) on the relationship between COVID-19 cases and death rates with stock return and volatility. It was an empirical study of the US stock market. The results suggest the negative impact of COVID-19 on market returns and predict the statistically significant positive influence of COVID-19 in Italy and France.

Dharani et al. (2023) examine whether the Covid-19 outbreak had a uniform or varied impact on stock returns in India. The data was gathered from a total of 1,318 companies that are officially listed on the National Stock Exchange of India Limited. The findings indicate an inverse correlation between the daily increase in COVID-19 cases and mortality rates, and the returns on India's stock market. Moreover, it was observed that throughout the second lockdown in Covid-19, the average stock return was considered significant and positive. However, the average stock return during the 3rd and 4th lockdowns is negative. Furthermore, it was observed that industries including food and beverages, technology and

chemicals make higher returns than other industries. So, the study concludes that in Indian Stock markets, the COVID-19 outburst caused heterogeneous effects.

Narayan et al. (2021) empirically studied the impact of the government's response of the Group of Seven (G7) Countries against the novel COVID-19 on stock market returns. For this study, the times series data has been used. The study concludes with the hypothesis that government response, including economic packages, lockdowns, bans on transport, etc, had a significant positive impact on the stock markets of G7 countries. Furthermore, the result found that the implementation of lockdowns during the pandemic proved to be effective in order to mitigate the COVID-19 effect.

A study was done by Albulescu (2021) to examine the impact of authorised announcements against novel cases and the death rate of COVID-19 on the volatility of the United States market. For the empirical study of global COVID-19 cases, along with figures from the United States, the findings indicated that the increase in novel coronavirus cases led to an increase in volatility. The findings of this study were said to be robust to various model specifications. The results suggested that the perpetuation of the coronavirus can cause financial volatility.

2.1 Theories

Markowitz's Modern Portfolio theory enlightens the relationship between different classes of assets for the optimisation of a portfolio. The purpose of this theory is to associate the assets which have greater risk with a risk-free asset. The logic behind this is the diversification of risk (Markowitz et al., 1959). For instance, at times of disruption, the stock markets display higher volatility. So, portfolio managers are always looking for better opportunities. It means the investors are looking for assets with a weak and negative correlation against the stock market, like the commodity exchange market. Hence, an in-depth investigation is required to recognise different opportunities for diversifying a risky portfolio at a time of disruption like the novel coronavirus and the Russian-Ukrainian war.

Another theory is CAPM, which shows the relationship between the risk-free rate of return, beta value and the expected rate of return on the return market minus the risk-free rate of return. It is a model used to gauge the expected rate of return for an investment. William Sharpe, Jan Mosin, Treynor and Linter in the 1960s put forward this financial

model. The CAPM model assumes that macro factors are not involved, mostly investors having the same belief; investors might divide the investments into multiple sizes. Many of the CAPM assumptions might seem unrealistic (Kenton, 2023).

Due to criticism of the CAPM model, another theory was formulated by Stephen A. Ross in 1976, named Arbitrage Pricing Theory (APT). Sjahrial Benefactor explained this theory. This theory also does not seem to cover all the deficits in the CAPM. However, this is the first alternative model that was carried out to reduce the insufficiencies of the CAP Model.

According to the Risk-Return trade-off, return is directly proportional to risk. As the potential return increases, the risk increases. However, the decrease in potential returns leads to a decrease in risk. This principle also states that if the investor wants to attain higher profit, he has to take more risk. It means higher risk leads to higher profit. To determine the Risk-Return trade-off, there are a number of factors that investors must foresee, including the tolerance of an investor to bear risk, years of retirement of investors, and the ability to swap those lost funds. While making investment decisions, investors must contemplate the Risk-Return trade-off on portfolios and individual investments. For investors to choose a portfolio with suitable risk and return, time is a great factor. For instance, if an investor is used to investing in a long-term frame, then the investor has more time to recover from the risk factor. However, if investors invest in the short term, the same portfolios have greater risk intention (Chen, 2023)

2.2 Hypotheses

H1: The average returns of pre, during, and post-COVID are equal.

H2: There is a GARCH effect in pre-COVID.

H3: There is an ARCH effect in pre-COVID.

H4: There is a GARCH effect during COVID.

H5: There is an ARCH effect during COVID.

H6: There is a GARCH effect in post-COVID.

H7: There is an ARCH effect in post-COVID.

3 Methodology

This study examines the daily stock prices of the Pakistan Stock Exchange (PSX-100) in order to depict the stock market trends of the selected country. Our research is rooted in financial data collected daily from 2018 to 2023, which we have segmented into three distinct categories: Category A, representing the time before the COVID-19 pandemic, Category B, covering the period during the pandemic, and Category C, pertaining to the time after the pandemic. For this study, Unit Root Test, GARCH & ARCH models, charts, graphs, and different tables were used by using E-views, Microsoft Excel, and SPSS software. This research is based on daily prices and their returns.

3.1 Data and Variables

The study was conducted using secondary data. The dataset comprises daily stock prices of PSX for the periods before, during, and after the COVID-19 pandemic. The data was obtained from the website <https://www.investing.com/> for the PSX 100 index regarding stock prices. The index period spans from 1 January 2018 to 25 February 2020, before the onset of the Covid-19 pandemic. The Ministry of Health in Pakistan officially announced the initial occurrence of the Coronavirus on February 26th, 2020, specifically in Karachi (Achakzai, et al., 2020). During the COVID-19 period, the data spans from February 26, 2020, to December 31, 2021. For the post-COVID-19 period, the data covers the period from March 1, 2022, to May 8, 2023. The Covid period has 508 observations, while the previous period has 459 and 333 observations, respectively. The focal variable in this investigation is the performance of stocks, commonly referred to as Stock Returns.

Statistical Models

The models used for this study are the Descriptive Model and the Econometric Model.

3.2 Descriptive Analysis

To examine the characteristics of the data set, Descriptive Statistics have been applied including Mean, Skewness, Kurtosis and Standard Deviation. Moreover, the Jarque Bera test was also applied to ascertain the distribution of returns in the stock market.

3.3 Returns

For the empirical analysis, stock returns for the stock market indices were calculated by taking the natural log. The formula for log return is:

$$R_t = \ln \left(\frac{P_t}{P_{t-1}} \right) \dots \dots \dots \text{Equation: 01}$$

In equation 1, R_t Denotes the stock returns at time period “t”, \ln shows the natural log function, P_t represents the price of stock at the current time “t” and P_{t-1} shows the price of the stock at a previous time.

3.4 Unit Root Test

The Unit Root Test can be applied to ensure the stationarity or non-stationarity of the data series. The basic test for identifying the unit root test is the Augmented Dickey Fuller (ADF) test. The time series data is said to be stationary if the form of time series distribution is not affected by shifts in time. Moreover, if the series is stationary, the mean and variance will remain static over a certain period. The equation for the Augmented Dickey Fuller test is,

$$\Delta Y_t = Y_t - Y_{t-1} = \alpha + \beta t + \rho Y_{t-1} + e_t \dots \dots \dots \text{Equation: 02}$$

3.5 Standard Deviation

The square root of variance defines the concept of standard deviation. It represents the average deviation between observed values and the mean. Variance is less commonly used compared to standard deviation. It is utilized to assess the extent to which the data set can be dispersed. A low standard deviation is observed when the data points are in close

proximity to the mean value. Nevertheless, when the data is distributed across a wide range of values, it is considered to have a high standard deviation. Unlike variance, standard deviation is measured in the same units as the data.

$$S = \sqrt{\frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n-1}} \dots\dots\dots \text{Equation: 03}$$

In the above equation, “s” indicates the Sample standard deviation, “n” indicates the number of observations, x_i = Ith observation and \bar{x} shows the Sample average. Moreover, the standard deviation is used to calculate the dispersion around the mean for the data of every stock market in a certain period of time. This dispersion is mostly called volatility and CV. The coefficient of variation (CV), a relative dispersion measurement, is computed and used to compare risk per unit of average return. The equation can compute the coefficient of variation (CV):

$$CV = \frac{\delta}{\bar{X}} * 100 \dots\dots\dots \text{Equation 04}$$

Where,

CV = Coefficient of variation (relative measure of dispersion)

δ = Standard Deviation (risk factor)

\bar{X} = Mean (average returns)

3.6 GARCH Model

The Autoregressive Conditional Heteroskedastic model was first introduced by Engle (1982), but later on, another model named GARCH (General Autoregressive Conditional Heteroskedastic) was put forward by Bollerslev in 1986. It is a model that measures the volatility in the financial market. It is used to forecast the volatility in economic time series (Giorgi et al., 2023). Many economists and financial experts widely use the GARCH model to forecast the prices in financial markets. The reason is that this model provides a more realistic framework if it is compared with other models (Ramya & Sumathy, 2022).

The GARCH model helps observe the instabilities among historical and implicit volatility. These instabilities lead to inconsistent trading in the market. The GARCH model also examines and forecasts variance study. It is a statistical model through which investors in the market gauge the inconsistency in the stocks. Through these evaluations, bankers learn about the stocks with more income. NGARCH correlation, along with IGARCH, is the variation of GARCH. These variations control the volatility parameter (Ahmad & Sara, 2012).

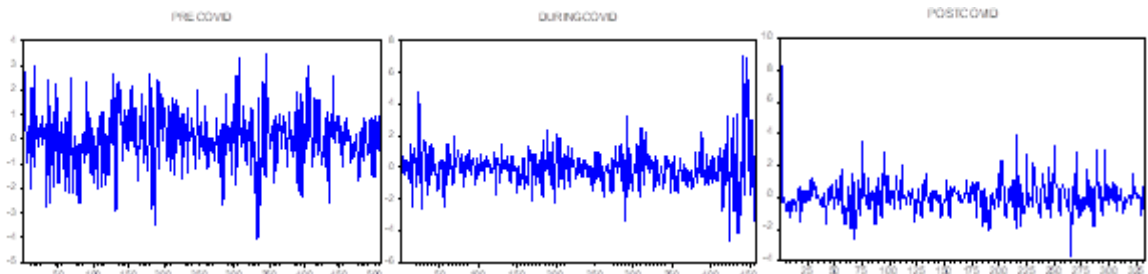
$$\sigma_i^2 = \omega + \sum_{i=1}^q \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^q \beta_j \sigma_{t-j}^2 \dots\dots\dots \text{Equation 05}$$

In the above equation, ω , α and β are termed as Coefficients, ε_{t-i}^2 indicates 1st lag of square error (ARCH (1)), σ_{t-j}^2 indicates trailing variance (GARCH (1))

4 Results and Discussion

Figure 1 shows the returns of PSX indices for pre, during and post-COVID-19 periods.

Figure 1 Graphical Analysis



In Figure 1, all three graphs show the returns of Pakistan’s Stock Market indices for pre, during and post-COVID-19 periods. The indices period is from 1st January 2018 to 25th February 2020 for pre-COVID-19, 26th February 2020 to 31st December 2021 for COVID-19, and from 1st March 2022 to 8th May 2023 for the post-COVID-19 period. In the above graphs, the x-axis shows the time, and the y-axis shows the returns. A series could be either mean stationary, variance stationary or trend stationary. Here, all the series observed equal mean, equal variance and no trend. Therefore, there is no stationarity issue in all three graphs; hence, the data sets are non-stationary.

4.1 Unit Root Test

The ADF test formally investigates stationarity (unit root) in the time series. The presence of unit root refers to stationarity in the series. The ADF test statistics for all the periods are more negative than the critical values, followed by the probability values, which are less than 0.001. We can empirically conclude that there is no unit root, i.e., no stationarity issue in all the returns' series.

Table 1 shows the Augmented Dickey-Fuller (ADF) test

Null Hypothesis: Series has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on SIC, maxlag=18)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			
Pre COVID		-19.18321	0.0000
During COVID		-19.07221	0.0000
Post COVID		-19.46073	0.0000
Test critical values:	1% level	-3.443021	
	5% level	-2.867021	
	10% level	-2.569751	

*MacKinnon (1996) one-sided p-values.

4.2 Descriptive Analysis

Table 2 shows the descriptive statistics of daily stock returns of PSX for pre-COVID-19, during COVID-19, and post-COVID-19 tenures. It can be found that the average return for the pre-and post-COVID-19 periods is positive; however, it is negative for the period during COVID-19, which shows a bearish trend in the Pakistan Stock Exchange market due to the COVID-19 outbreak. Moreover, the coefficient of variation (CV), a relative dispersion measurement, is computed and used to compare risk per unit of average return. Pre-COVID tenure has the highest relative dispersion (CV = 44.43) followed by during-COVID (CV = 40.76), and post-COVID tenure has the least coefficient of relative dispersion (CV = 23.1), which refers to the least volatile phenomenon.

Table 2 shows the Descriptive Statistics

	PRECOVID	DURINGCOVID	POSTCOVID
Mean	0.025601	-0.031269	0.047354
Median	0.061000	-0.0814	-0.0593
Maximum	3.444300	7.102400	9.398600
Minimum	-4.0434	-4.684	-3.7545
Std. Dev.	1.137563	1.274529	1.094199
Skewness	-0.116348	1.177159	2.170048
Kurtosis	3.602662	9.979981	19.26863
Jarque-Bera	8.833874	1037.779	3933.628
Probability	0.012071	0.000000	0.000000
Sum	13.00540	-14.3523	15.76900
Sum Sq. Dev.	656.0834	743.9864	397.4944
CV	44.4343	40.76	23.10
Observations	508	459	333

4.3 Average Return Comparison

Since the research considers three time periods, i.e., pre, during, and post-COVID. It is important to compare such periods for average returns. The ANOVA output has an F-stat = 0.49, which is less than the benchmark (F=4), followed by the sig value of 0.61, which is not less than the benchmark (sig<0.05), which suggests that there is no statistically significant difference among all average returns and all are equal.

Table 3 shows the Average Return Comparison

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.369	2	.684	.494	.610
Within Groups	1797.566	1297	1.386		
Total	1798.934	1299			

4.4 Econometric Analysis

The Table 4 shows the ARCH (α) and GARCH (β) results for all three periods: pre-, during, and after COVID-19. In the post-COVID period, the ARCH effect is significant at 10%, whereas for the rest, both ARCH and GARCH effects are significant at 1%. $\alpha + \beta$

shows the sum of ARCH and GARCH coefficients, which depicts the speed of Mean reversion. When the mean reversion coefficient is closer to 1, it refers to the higher volatility (slow mean reversion) and vice versa. As the sum of $\alpha + \beta$ is less than 1, it is necessary to have a process of mean reversion. The results show that the highest mean reversion value was 0.969991 During the COVID period. Post-COVID has a value of 0.449377, which indicates the quick mean reversion compared to the other two.

Table 4 GARCH and ARCH results Pre, during and Post-Covid19

Variables	α	B	$\alpha + \beta$
Pre COVID	0.135046***	0.788028***	0.923074
During COVID	0.153507***	0.816484***	0.969991
Post COVID	0.087802*	0.361575***	0.449377

4.5 Discussion

The findings of this research are related to the prior studies. For instance, according to Saeed et al. (2021), there is a positive relationship between COVID-19 and the volatility of the PSX-100 index but a negative with mean returns. A study by Ahmed (2020) shows a positive relationship between recoveries and the performance of PSX and a negative relationship between positive cases of COVID-19 and death rates with the performance of PSX. Another study was done by Ali et al. (2022) that examines the COVID-19 effect on the PSX-100 index (traditional) with the KMI-30 index (Islamic). Results showed that the outburst significantly affected the Pakistan Stock Exchange and KMI-30. The outbursts influence both indexes. Determined that a novel epidemic affected the stock markets globally, causing stock prices to decline and rise in stock price volatility.

A previous study emphasises the effect of the Coronavirus pandemic on Pakistan's stock market. The findings show that the results are the same as those of previous studies. It means COVID-19 has had an adverse effect on the stock markets that were developed. As stated in the report of the Asian Development Bank (ABD), the economy of Pakistan dropped by almost \$16.387 million to \$4.95 billion, which is a drop in Gross Domestic Product of almost 0.01 per cent to 1.57 per cent. The Pakistan Stock Exchange faced a recession period due to COVID-19. A study by Syed and Fatima (2021) shows a direct relationship between

the daily coronavirus total cases and stock market volatility using the Vector Autoregressive Model.

Another study by Khan (2020) examined the financial suffering of the firms listed at PSX in the pre and post-COVID periods. The research findings observe the same as other studies that the pandemic increased financial suffering that negatively affected the firms listed at PSX (Rasool et al., 2023). The dataset from May 2017 to May 2020 was used. It was reported through empirical evidence that the Pakistan Stock Exchange had high mean returns in November and lowest in February in a pre-COVID period. However, in the epidemic period, a high return was observed in September and the lowest in March.

The results are consistent with the study by Mushafiq (2021), which found that COVID-19 has a negative effect on the industries listed on the Pakistan Stock Exchange. The most affected sectors include insurance companies, real estate, textile firms, and banking. However, food and medical centres had positive effects. Khan (2020) examines the impact of Covid-19 on Pakistan's stock indices. Empirical evidence found that Covid-19 significantly negatively impacts Pakistan's returns. The results of Syed and Fatima (2021) relate to the study. They investigate the impact of COVID-19 on Pakistan's stock market and exchange rates by using the vector autoregressive (VAR) model. It was found that a positive relationship exists between daily COVID-19 cases, the stock market, and exchange rates.

Findings by Bhutto et al. (2022) state that a negative relationship exists between COVID-19 and the returns of Islamic and Conventional stocks. The approach used for this study was panel regression. According to Fraz (2020), the COVID-19 outburst has caused serious distractions in business operations in Pakistan. Due to the lockdown, the demand for oil has decreased. It has seen a record loss in the Pakistan Stock Exchange because the outburst has created fear in investors. The global stock markets became volatile due to COVID-19 (Ellahi et al., 2021) Empirically investigate the COVID-19 impact on Pakistan's stock market. The study used the panel Regression model by using Stata. The results stated that the outburst negatively impacted Pakistan's daily stock market returns and liquidity. The stock market was volatile, and the liquidity of the market declined. The fall in liquidity leads to a decrease in stock market returns. Covid-19 has drastically affected the stock

markets of all over the world. Due to its widespread nature, investors became fearful, leading to a quick economic loss (Ganie et al., 2022) Investigate the COVID-19 effect on the stock indices of the six most affected economies. The study results show that COVID-19 has caused abnormal returns and a significant rise in the volatility of stock indices. It has been found that Brazil's stock market was more volatile. Furthermore, the United States and Indian stock markets quickly recovered from the pandemic.

However, the stock market of Spain was the one that recovered the slightest. A study by Basuony et al. (2021) examines the effect of the pandemic on international stock markets. Using the GARCH model, it has been found that the stock markets of China, the UK, India, Japan, the US, Brazil, Russia, Italy and Spain are volatile. Another study by Tan et al. (2022), states that the Covid outbreak has significantly negatively affected the worldwide stock markets. For the study, a sample from G7 countries was chosen, and the data was treated by applying the Vector Autoregressive Model. The research findings suggest a negative relationship between the pandemic and stock returns. Time, precautionary measures, and timely policies have played an important role in stock returns.

5 Conclusion

This study examines Pakistan's pre-, during and post-COVID-19 Stock Returns and Volatility. Daily financial data from 2018 to 2023 was taken from the website, and the dataset was treated on MS Excel, E-Views and SPSS software. The results of this study show that there is no stationarity issue in all return series. Hence, the data sets are non-stationary. The findings from the descriptive analysis show that the average return for Pre and Post Covid periods is positive (Pre: 0.025601, Post: 0.047354). However, it is negative (-0.031269) During the Covid period, which shows the bearish trend in the Pakistan Stock Exchange market due to the Covid-19 outbreak. The results from ANOVA output show no statistically significant difference among all average returns, and all are equal. F-stat = 0.49, which is less than the benchmark (F=4), followed by the sig value of 0.61, which is not less than the benchmark (sig<0.05).

Moreover, the coefficient of variation (CV) is computed that COVID tenure has the highest relative dispersion (CV = 44.43) followed by during COVID (CV = 40.76), and post-COVID tenure has the least coefficient of relative dispersion (CV = 23.1) which refers to the least volatile phenomenon. The Econometric model results show that the highest mean

reversion value was 0.969991 During the COVID period. Post-COVID has a value of 0.449377, which indicates the quick mean reversion (low volatility) compared to the other two.

5.1 Limitations

The purpose of the study was to examine the impact of a pandemic on the pre-, during and post-stock returns of PSX. There were certain limitations. The study was limited to the Pakistan Stock Exchange (PSX) returns and volatility. However, other neighbouring economies, namely China, India, and Bangladesh, could have been included. The second is that the study is limited in methodology, as only some specific terms of the GARCH model are used to calculate the volatility of returns.

5.2 Future Research Direction

The study suggests that during the pandemic, there were issues that affected the economy. However, the pandemic has positive average returns that increase investors' confidence in investing in portfolios that benefit the financial sector. It has been observed that PSX has positively reacted to the pandemic, so the crucial response and the execution of anti-pandemic strategies shortly will avoid the smash of the Pakistan stock market. It will compensate for the negative stock returns. Furthermore, a study on different sectors of Pakistan, including the earning and expenditure ability of the companies listed in Pakistan and others, is recommended. Moreover, research can be done by considering variables like financial growth, inflation, and interest rates together with COVID-19-related variables internationally. Future research may also consider other econometric models, including Models from the GARCH family IGARCH, TGARCH, EGARCH, and GJR-GARCH, etc, Exponential models, and machine learning to determine the volatility.

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