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**MARKET EFFICIENCY: THE STUDY OF PAKISTAN
STOCK EXCHANGE**



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Abstract:

Information is a set of facts or news that has a both positive and negative impact on stock markets. Globally, Unpredictable events always create an environment of uncertainties in the stock markets and strongly attacks on developing markets. The market is informationally efficient if any new information comes into market and instantly reached to every investor. The focus of this research is to empirically explore the impact of COVID-19 event on Pakistan Stock Exchange to classify it either informational efficient or inefficient. For this research data is gathered from dated (January 2019 to June 2022) of daily closing stock prices to detect the volatility in stock market and also examine the persistence of volatility in degree of long run or short run. The simple random sampling technique is specified for this research and considered 54 companies for statistical analysis from the population of KSE-100 index. The empirical finding reveals that during an event of COVID-19 there is a positive mean returns with higher magnitude of volatility. Beside it there is a mixed results of short run or long run existence of volatility in different sectors of Pakistan Stock Exchange (KSE-100). Pakistan Stock Exchange (KSE-100) is considered as an inefficient market because there is a variation in stock returns and also seem an existence of a volatility cluster in financial market. The findings of this study will be helpful for the stock market investors to healthier understanding of an event's impact on different sectors of Karachi Stock Exchange.

Key words: Volatility, Stock Return, Efficient Market Hypothesis, COVID-19 pandemic

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SECTION 1

1. INTRODUCTION:

In developing economies investors considered “Efficient Market Hypothesis” (EMH) as an essential tool for investment purpose. The level of volatility and stock returns usually seem to be high in developing economies that attract the investors toward it (Akhtar S. &, 2016). Around the globe various number of researchers evaluate the issues of stock markets regarding their efficiency. For maximizing returns on stocks, investors use the phenomenon of market efficiency to their investment models for further investments. Market efficiency is important for investors because it carries different implications about investors stock returns. Beside the historical justifications the disputable results of market efficiency make this topic a significant subject in the discussion of modern finance (Akash, 2020). It can directly affect the regulatory authorities for the reason of limited role because the stock prices are priced perfectly. In efficient markets the stocks are not either overvalued or undervalued and not offering higher or lower than expected returns (Julijana, 2018). The changes in stock price would have random walk and have not monthly design in their returns (Malkiel, 2018). The slow-moving process of flow of information towards investors leads toward market inefficiency. Therefore, scholars design researches concerning with time varying informational market efficiency (Bahrawar Said, 2021). It is to be prominent that efficiency of market is informational. The market is treated completely as an efficient if every single information is well known instantly to all investors and completely reflected in stock prices (Sophana, 2017). According to this definition, if market takes less time to flow of information towards investors and fully reflected in the current prices of the stocks then the market is interpreted as a more efficient.

Although, informational market efficiency is the most important foundation of financial theories. Numerous studies have been available at one fingertip regarding market efficiency but most of them concerned with developed markets. The focus of this time varying market efficiency study is to assess the market efficiency by examining the volatility due to any unpredicted events that effects the companies listed in Pakistan Stock Exchange (KSE-100) by utilizing the updated data ranging from January 2019 to June 2022.

Furthermore, the structure of Pakistan Stock Exchange (KSE-100) index conflicts with “Efficient Market Hypotheses” (EMH) as a consequence of mispricing, volatility in stock returns and different behavioral pattern of investors in stock market (Akash, 2020). Moreover, this type of research can be explained the relationship between the informational market efficiency, volatility and their persistence in stock return whether it is for long run or short run. Researcher have documented many times, continual anomalies that contradict the efficient market hypotheses. There are many types of market anomalies, however, three main types are: fundamental anomalies, technical anomalies and calendar anomalies. The superior conditions such as noise trading, political instability, oil prices, economic conditions, pandemics, terror and variation in exchange rate are causes of calendar anomalies that challenge the efficient market hypothesis (EMH) (Julijana, 2018). These type of instabilities and anomalies are most beneficial and provide support to speculators. The speculators purchase assets or stocks according to the condition of market tendency and make abnormal returns for the reason that nobody has a perfect information (Akash, 2020). The anomalies take place due to the lack of market information and behavior of investors toward market. Furthermore, the lack of market information originates the chances of risk and speculator takes a chance with that situation and make abnormal returns. Pakistan Stock Exchange (KSE-100) has a variation in stock returns as a consequence of mispricing and lack of perfect information. Moreover, the predictability of stock returns can be measurable, therefore, investors use systematic pattern to gain the abnormal -returns (Fraz, 2016). For make the market efficient it is necessary to be a large market and quick liquid market, the cost of transactions should be inexpensive and there are some investment strategies for profit (Julijana, 2018).

There is some difference between the developed and developing stock market because both have a different characteristic. Moreover, the spread of COVID-19 was a shock for stock market investors. Initially for the first time on 31 December 2019 the World Health Organization announced COVID-19 outbreak. At first, WHO considered it as an outbreak when the virus was only stayed in Wuhan, China. After that on 11 March 2020 World Health Organization announced COVID-19 as a pandemic due to spread in all continents.

Formerly Worldometers, is a website which gives a statistic of multiple events, according to the statistics of this organization there was more than 150 million positive registered cases of COVID-19 beside a death rate of more than 3 million at the last week of April 2021 (Budi Setiawan, 2020). In addition, the first case of the virus spread occurred in Pakistan on 26 February 2020. Information related COVID-19 event mentioned in Table given below.

Table 1. COVID-19 Related Information

First Information	First Registered Case	26-Feb-2020
Second Information	First Death	20-Mar-2020
Third Information	First lockdown	1-Apr-2020
Fourth Information	First Vaccine Consignment	17-May-2021

The first case of COVID-19 registered in Pakistan in last week of February 2020 and increases time to time. The number of cases increased in Pakistan and got to half of million on February 2021. After increasing new cases of COVID-19 the government of Pakistan chair a meeting of National Command and Operation Center (NCOC) that recommend the precautionary measures to avoid the spread of virus. The measures recommended by WHO comprise social distancing, limited travel, wearing mask, closure of educational institute and restriction on creating crowded activities (Baker, 2020). To avoid the spread of COVID-19 restrictions imposes on business activities that causes a negative impact on the economy (Chang C.-L. M.-K., 2020). The stock market variation was started by the spread of evidence about the surge in number of positive registered cases. Economically, Pakistan is listed in a group of developing countries therefore this research is doing to examine the time varying market efficiency of Pakistan Stock Exchange (KSE-100) during the event of COVID-19 pandemic. Furthermore, high risk shaped due to misinformation therefore higher the risk generates higher returns (Rana Shahid, 2020).

1.1. Background:

After 80's the concept of behavioral finance has been introduced that change the focus from standard finance to behavioral finance but the elimination of market efficiency is impossible. The investors who participate in market cannot be rational because they are humans and having different pattern of behavioral factors. Although, several academic researches have been accomplished with the evolution of Behavioral Finance. The claim of Behavioral Finance is that the rational investors who use fundamental techniques their decisions are based on optimism and pessimism (Mutlu Başaran, 2018). However, the hypothesis of efficient market is studied comprehensively for stock markets among developed and developing markets yet, despite academic literature is still growing in this area of study.

The "Efficient Market Hypotheses" explained by Fama, an American economist, in 1970. In his doctoral study "The Behavior of Stock Market Prices" Fama briefed that the prices of stocks in market are unpredictable and go along with random walked (Akash, 2020). According to the Fama dissertation market efficiency is defined as "A market where numerous numbers of rational individuals competing to maximizing the profit, trying to predict future market value of individual securities where all current information is freely available to all competitors". Market efficiency generally expressed in three levels: First one, weak form of market efficiency, second one, semi-strong and third one, is strong form of market efficiency. In week form of market efficiency, the prices of stock cannot be predictable and fully imitate historical information in their stock price (Fama, 1970). Similarly, in semi-strong form of market efficiency, the public and historical stock information is fully reflected in stock prices (Fama, 1970). Last form of market efficiency is, strong form, in which all the information related to private, public and historical information fully absorbed in stock prices (Fama, 1970). According to the arguments of Behavioral Finance, all available information in the market is not with a similar capacity for all investors although it is distributed equally but the behavioral pattern toward processing of information is different from each individual (Mutlu Başaran, 2018).

1.2. Problem Statement:

Many investors invest their money in stock markets to earn profits. According to the assumptions of efficient market hypothesis (EMH) the behavior of investors is rational in stock market. Pakistan Stock Exchange (PSX) has a conflict with Efficient Market Hypothesis as a consequence of variation of stock returns, anomalies in stock returns, lack of information and mispricing of stocks. Therefore, Calendar Anomaly is main threat to Efficient Market Hypothesis (Akash, 2020). For assessing the level of market efficiency either it is classified as efficient market or inefficient market an event study is considered for this research.

1.3. Research Gap:

Many studies have explained the concept of market efficiency by different aspects, thus far large number of the studies concerned with the developed markets. Different researchers have been used different procedures in their research to measure the efficiency of stock market. However, volatility was the key highlighted measure which is always have been measured to understand the efficiency level of market either it is classified as an efficient or inefficient This study is different from the previous literature because most of the previous studies concerned with market efficiency by examining the stock indices. In this research market efficiency is examined by different sectors instead of indices. In past years, different researches have been conducted on the topic of market efficiency by using different techniques but there is lack of evidence that the study have been accomplished to measure the persistence of volatility either it is for short term or for long term (Budi Setiawan, 2020). Therefore, this research is conducted to examine time varying market efficiency that how long term and short term the volatility persists in the stock market (KSE-100).

1.4. Research Questions:

The above objective of the research is addressed by the following questions:

1. Pakistan Stock Exchange is efficient or inefficient?
2. Persistence of volatility is for long run or short run?

1.5. Research Hypothesis:

H1: There is a volatility in sectors of Pakistan Stock Exchange (KSE-100).

H2: There is a long run and short run persistence of volatility in KSE-100 sectors.

1.6. Research Objective:

The aim of this study is to examine the volatility of stock returns that variate over the time in Pakistan Stock Exchange (KSE-100). For evaluating the level of stock market efficiency either it is classified as efficient market or inefficient market, time varying market efficiency is considered in Pakistan stock market because it contradicts with efficient market hypothesis (EMH). Many investors facing the challenge of abnormal returns due to the way of mispricing that leads inefficiency and generates abnormal returns. Beside it, Investors react differently towards new information; some time reacts with overreaction and some-times underreaction that causes the stock price overvalued or undervalued.

1.7. Research Significance:

Pakistan stock exchange has a significant role in our economy by providing a business investment opportunity. Large number of investors invest their money in different companies of Pakistan Stock Exchange that gradually generates a different way of employments and lead to economic growth. There are many numbers of crisis in the history of financial markets that disrupted the stock markets heavily such as SARS, EBOLA and MARS (Budi Setiawan, 2020). Numerous studies have been done on the topic of stock market efficiency. Different academic researchers use different tools, procedures and techniques in their studies to measure the efficiency of stock market. Moreover, volatility is the key highlighted measure which is always measured to understand the efficiency level of market either it is classified as an efficient or inefficient. Therefore, the author perspective is that to measure the volatility existence in the content of short run time period or a long run time period. However, the author noted that on the basis of previous literature there is no study conducted on the persistence of short term or long-term volatility.

Moreover, the COVID-19 event is considered to measure the persistence of volatility in Pakistan Stock Exchange (KSE-100). This event study is conducted through several phases such as estimated window that is a pre-event period, event window that is a during event period and post event window which is a after event time period. Moreover, this study will help to understand the reaction of stock market during the events and increase our financial knowledge towards financial markets.

1.8. Research Scope:

This study is conducted to measure the volatility in Pakistan Stock Exchange (KSE-100) during the event of COVID-19 pandemic. This study will help the researchers who are working on the informational efficiency of Pakistan Stock Exchange. It is also useful for investors who invest their money in stock markets specially in Pakistan because it provides a knowledge about reaction of Pakistan stock market during the event of COVID-19. Beside it, this research will helpful for the investors to timely diversification of portfolio. This research will also be accommodating to those investors who are fresh investors and want to invest their money in the stock market of Pakistan. They can easily access which sector of KSE-100 index is less volatile and which sector has a short-term persistence of volatility after fronting the shocks.

This research is basically organized in following five sections which explains the impact of volatility in Pakistan Stock Market (KSE-100): Section 1; explain the Introduction of the research including the background, Problem statement, Gap of the research, objective of the study, Research significance and scope of the research. Section 2; focus a previous literature review related to the area of research that have been already done. Section 3; elaborates the research methodology. Section 4; consist of interpretations and the empirical results of volatility existence in Pakistan Stock Exchange and Section 5; presents the conclusion of research, limitations and future suggestion for study.

SECTION 2

2. LITERATURE REVIEW:

The matter of market efficiency is observed one of the most disputed topics, but dominant for financial experts and financial markets. The idea and empirical researches on stock market efficiency are usually based on assumptions that prices of stocks comply with random walk. If the asset prices are random walked behavior, it suggests that stock prices are not predictable. This theory is known as Random walk theory and another name is Efficient Market Hypothesis. Market efficiency vary time to time because it is a natural phenomenon. Mostly, in developing markets occurrence of new information strongly affect the sustainability of market. As given below is the material of previous researches which have been already accomplished in this area of research.

The evidence from the world largest companies that has a connection to China face a negative result in stock returns (Ramelli, 2020). Beside it many of other companies that linked with natural gas, food, healthcare and software sectors in America seems a positive results in stock returns during the pandemic of COVID-19 (Mazur, 2021). The empirical study was conducted to examine the calendar anomalies in Indian stock market to identify the effect of day on week. The data frame was considered for the study is for seven years 2009 March to 2016 February. To reveal the day effect on week the method of “GARCH” and “OLS” is used for the evaluation of anomalies affect. The results show positively effect on Monday and beside it Tuesday and Thursday reveals negative effects. (Akhtar, 2017).

Another descriptive result indicates the negative impact of COVID-19 event on capital markets (Baker, 2020). Similarly, many studies explain that COVID-19 has a negative reaction on stock markets as compare to the previous events (Schell D. M., 2020). The study investigated the day effect with respect to week in “Nigerian stock exchange”. On the basis of daily stock prices data has been gathered from dated January-2009 to 2015 of December. The method was used for this study is “Ordinary least square”. Outcomes reveal the highest positive impact of Friday as compare to other corresponding days. (Onoh, 2016). The most popular indices of BRICS nations also know the determination of weekday anomaly.

The period for investigating the anomalies ranging from January 2001 to December 2014 and method used for analysis unit root testing. The results show week day effect anomaly causes only in China and India financial market. (Khanna, 2016) . The anomalies in financial markets of Istanbul also faced a weekday effect. There are many numbers of companies listed in Bosra Istanbul stock index almost 289. The data collected from the range of four years from the period of 2010 – 2014. To explore the effect of anomalies method of ANOVA approach is applied for concluding the results. Author concluded that the results indicate the Monday effect on the return of other days. Highest positive significant impact observed for Thursday and Friday (Cengiz, 2017).

The aim of research is to evaluate the “week form of efficiency” in KSE-100 index of Pakistan Stock Exchange. The methodology used to analyze unit root tests and Ljung-Box. There was a significant positive result between predictability and market inefficiency. Future prediction of prices causes the inefficiency of market (Mazhar Farid A. F., 2018). Also, on other research it is to evaluating the weak form of efficient market hypothesis in “Macedonian Stock Market”. The author utilized a technique for this study is time series, data on MBI10 extents collected from 2005 of January to 2018 of April. The methodology uses to assess the form of market, unit test root and GARCH model found that Macedonian stock is not an efficient market (Angelovska & J., 2018).

To evaluate the one-day effect on whole week the researcher considered 33 different countries and 37631 stocks that are listed in 51 different financial markets to estimate the significant results of day effect. Data is observed for this study is collected from the date of first month of 2000 to last month of 2007. Ordinary least square approach is used for this study. Findings explore the significance day effect on week. (Dicle M.F., 2014). The study is conducted in 2012 by Akrami, that consider the month of Ramadan to investigate the ratio of abnormal returns as compare to the whole year. This study has been conducted on the stock market of Tehran. The results from considerable market indicates that there is a positive Ramadan effect (Akrami, 2012). Many of the emerging markets also shows efficiency in weak form. The researcher of this study considered three different markets; developed, emerging and frontier. Results shown efficiency in all the developed markets, inefficiencies found in frontier markets and combined results for emerging markets (Su, 2015).

In 2020 Akash, conducted a study on Asian stock markets to gather the evidence of calendar abnormality. The countries included for this research was “Karachi, Bombay, Colombo, Maldives and Dhaka” stock exchange. To employed the statistical test the range of data considered for the study to the year of January 2005 to December 2014. For analysis the days effect, week effect and effect of the month the “ordinary least square” approach is used. Furthermore, methodology of “GARCH-M” is used to examine the effect of day on week and one month effect on year. Findings concludes the all types of calendar anomalies is observed in Asian stock market.(Akash, 2020).

The study conducted in five Southeast Asian stock markets to examine the technical trading techniques in different indices. The indices are “JSX- index, KLC-index, PSE-index, FTSE index and SET index” from different nations such as Singapore, Thailand, Philippines, Malaysia and Indonesia. The data range is for this study is thirteen years, since 2000 – 2013.the study explore the significant positive impact to the prediction of rules in the Thailand beside it there is a no supporting effect on the Singapore that is a developed market. the impact of rules on other three countries observed a abnormal returns (Tharavanij, 2015). Anomalies work as an instrument to examine the efficiency level of the market either it is efficient or inefficient. To evaluate the efficiency of the market, anomalies are considered to apply the methods of estimation. If the market is efficient, more it considered trustworthy and consistent for speculators even though speculators are in a continuous search for some anomaly for higher returns (Ahsan, 2013). One can see that different anomalies may emerge at the stock markets. Market anomalies can be reduced by using new techniques. There may be new tools such as “Artificial Neural Networks” to the measurement as well as predicting stock performance (Kuzu, 2017).

In this study calendar anomalies by creation classification buckets such as Week Turn Effect, Month Turn Effect, Year Turn Effect and Month Turn Effect separately, researcher focused five south Asian Stock Markets, and results discovered that in the class of Week Turn Effect cluster structures impact is found in the Sri Lankan and Bangladeshi Stock Market, there is diverse of relationships such as positive and negative suggestion with Tuesday and Friday returns. The returns on Monday are significantly negative and that on Thursday and Saturday are significantly positive (Dankar, 2019).

The study shows that the stock pattern makes the market inefficient. The data for this study was collected from KSE-100 index in which predictable behavior founded where investors have availability of information and insight capital markets (Fraz, 2016). This research explored the influence of two key disasters from the latter two eras, i.e., the globally occurrence of financial crisis and pandemic of COVID-19, the stock market return and stock market volatility of Indonesian and Hungarian stock indices. The empirical findings of the financial markets in Indonesia and Hungary reaction to the event of COVID-19 pandemic with the more negative cumulative abnormal return and experienced volatility as a comparison with the before disrupted period (Baker, 2020).

The new evidence from the multinational focused companies have involvement to China that have practiced a decrease in stock returns (Ramelli, 2020). With the other side the firms attached with the production of software, natural gas, healthcare and food sectors in America attained optimistic returns at the time of COVID-19 event (Mazur et al. 2021). Research associated to the stock market and COVID-19 clarified that financial markets of most developed nations (Japan, America, Germany, Italy, and the UK) showed rapidly negative reaction due to COVID-19 conducted by (Liu, 2020). Also, the pandemic of COVID-19 is an event that partakes the extreme negative influence on the stock market, compared to the Swine influenza, Ebola, and Zika viruses (Schell D. M., 2020).

A long-run perception of stock market volatility was focused on the infection pandemic and volatility on the US, China, UK, and Japan equity market from the period of 2005 to 2020 by implementing GARCH-MIDA. They found a permanent positive significant reaction on volatility of international stocks markets with the lag of 324 months pandemic (Bai, 2021). In this study used GARCH to examine volatility in stock indices at the time of the COVID-19 pandemic. With top ten countries data founded on the basis of GDP from the range of 2019 January to 2020 of June, the finding of this study exposed that the at the time of COVID-19 event the volatility is higher as compare to the normal period (Chaudhary, 2020). Different families of GARCH models used as an instrument to define the volatility movement of financial time series data. The E-GARCH model is utilized in this research to examine the higher volatility cluster in bank sector of Pakistan stock prices (Mohsin, 2020).

The Companies having the social trust had a significant better results with a higher return of three percent to four percent than the other businesses with a lesser intervene toward social trust (Mazumder, 2020). Investigation of stock market from the five regions, with the addition of the MSCI World Index, that discloses total number of patient of COVID-19 clarify deviations in the prices of shares in “Spain, Italy, Britain, and the United States”, nevertheless in China and world stock indices (O’Donnell, 2021). Beside it, the other study reveals the indication from the China stock market, the pandemic of COVID-19 has no effect of the lockdown decisions from the government taken to avoid the spread of virus has no negative impact on the stock market of China (Cookson, 2020).

The author Muhammad Saeed conduct a study in the year of 2022, in which they attempt to study the pandemic reaction on the financial market of Pakistan stock exchange. The data for this study is comprised from the daily share prices. To employed the different test the consideration of data is from the period of January 2011- April of 2021. In this research author used their information as a form of dummy variables which is one for the period of arrival and zero for non-existence period. In their study, they conclude that there is a significant existence of volatility during the event.

SECTION 3

3. DATA AND METHODOLOGY:

Research methodology is basically describing the techniques, procedures and direction through which researcher formulating their study. This section also explains the data gathering process and addresses the procedures employed on study to collect the results of empirical findings. The focus of this research is to explore the time varying market efficiency in different sectors of KSE-100 index. Furthermore, in this study investigated the volatility of stock returns of Pakistan Stock Exchange and examine either the market is efficient or inefficient. The quantitative research approach is used for this study by utilizing the secondary data. For assessing the results market efficiency is considered as a dependent variable beside it stock returns, COVID-19 information and volatility is considered as an independent variable.

3.1. Population and Sampling:

The population for this research is KSE-100 index. There are 54 companies, considered as a sample size from different sectors of KSE-100 index, to consideration of sample size “The Taro Yamane” method is applied to calculate the sample size. The Taro Yamane statistical formula is $(n= N/1+N(e)^2)$ where “n” is the representation of required sample, “N” represents the whole population, “e” is denoting the sampling error. The simple random sampling technique is used for this research.

3.2. Data Collection:

The secondary data is used for this research. The time frame considered for the research from January 2019 to June 2022. In this study data is collected from the different sectors listed in Pakistan Stock Exchange (KSE-100) such as Automobile Assembler, Cement, Food & Personal Care Products, Commercial Banking, Oil & Gas Marketing, Engineering, Fertilizer, Oil & Gas Exploration Companies, Power Generator and Distribution, Pharmaceutical, Refinery, Technology and Communication, and Textile Composite based on daily closing share prices. The data gathered from the website ksestocks.com.

3.3. Research Methods:

Moreover, for assessing the time varying market efficiency the event of COVID-19 pandemic is considered for this event study to investigate the level of market efficiency. To assess the market efficiency daily returns of stocks essential to be calculated that later used to run the test. Mentioned below formula is used to calculate the returns of the stock (Benninga, 2008).

$$R = \text{LN} \left(\frac{P_t}{P_{(t-1)}} \right)$$

Where” R” shows the return of the stocks

“LN” is representing natural logarithm

“Pt” represents the current stock price

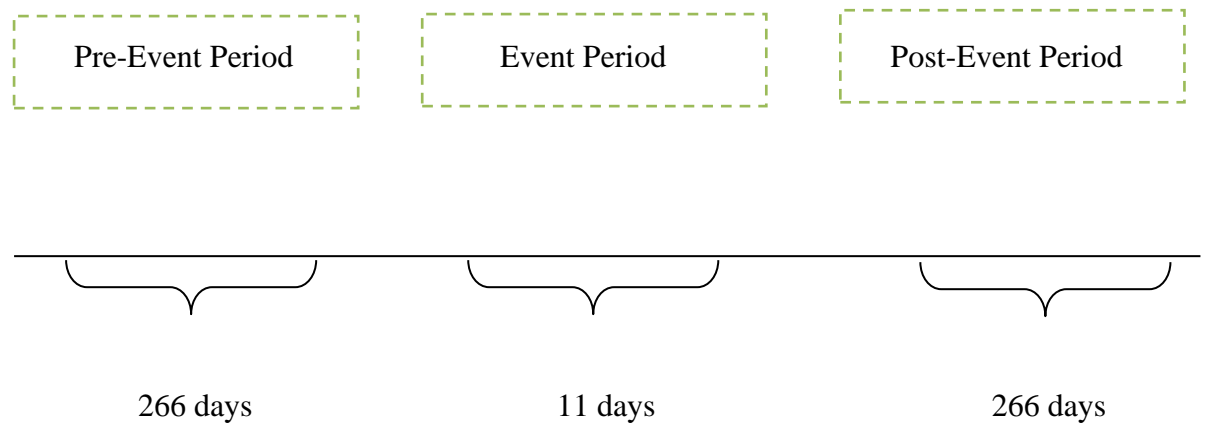
“P(t-1)” represents the previous stock price

3.3.1 Event Study Setup:

The event study approach is used to measure the informational efficiency, as represent from the Pakistan stock market (KSE-100) reaction during the event of COVID-19 pandemic. The event study approach is used to measure the stock price’s reaction during the event period (Feb 2020 to May 2021) and compared with pre-event period (Jan 2019 to Feb 2020) and post-event period (May 2021 to Jun 2022). To examine the informational efficiency the volatility in stock market is examined through all the estimated windows by implementation of “Generalization Autoregression Conditional Heteroscedasticity” (GARCH) model.

3.3.2. Event Selection Criteria:

For event study the period of estimated window could be ranged of 100 to 300 days and the period for event window range could be 2 to 150 days (Chang C.-L. S.-H., 2018). In this study 266 days considered for estimation window and 11 days for event window to estimate the specific impact of event on stock prices. The short-term period of 11 days is reliable to identify the impact of specific event on stock prices (Kothari, 2006). This study divides events into three parameters; First, event window which includes all event related COVID-19 information. Second, estimated window that is pre-event window. Third, post-event window which is after crisis period.



3.3.3. Unit Root Test:

Augmented Dickey-Fuller test is used to measure either the time series data has a characteristic of stationarity or not. Usually, time series data of stock prices are non-stationary therefore it is necessary for the reliable research to make data series stationary before estimating any relationship between the variables. Dickey and Fuller in 1979 proposed test- statistics for testing the process of unit root.

The equation given below is used to measure either data is stationary or non-stationary.

$$Y_t = c + \beta t + \alpha Y(t-1) + \phi \Delta Y(t-1) + e_t$$

In above mentioned equation the term “ Δ ” represents the first difference, “ Y_t ” indicates the variables of financial indicators such as stock prices, “ t ” is the trend term. “ e_t ” is the term of white noise. “ c ” is the constant term, “ β ” is the coefficient term of variable. “ $t-1$ ” is the lag length. “ Y_t ” is consider to be a unit root if the null hypothesis is failed to rejected. If there is consideration of acceptance of null hypothesis its mean data is non-stationarity and has a trend in their series that indicates characteristics of the random walk. On the contrast, if the consideration of null hypothesis is failed to accept it indicates there is a stationarity in data series and denial the characteristics of random walk. Stationarity means there is no regular variation in mean and variance over the time and a denial of null hypothesis determines that the series is stationary (Gujarati, 2009). In the study of previous literature, it is suggested that unit root test (ADF) is a source of “Random Walk” provided in a series. Although, in the rejection of null hypothesis indicates that share prices have a successive degree of shift and depend on each other (Haque, 2011). ADF, unit root test reveals that higher the negative value of test statistics and lower the negative critical value is the indication of fail to acceptance of unit root in data of time series, which is the confirmation of the null hypothesis to be rejected (Mazhar Farid A. F., 2018).

If value of probability is greater than 0.05 it means that acceptance of null hypothesis which shows the non-stationarity behavior in the series. Similarly, if the value of probability is less than 0.05 its mean fails to accept the null hypothesis which shows that the series is stationary. Here if the beta value of equation is greater than 1 which means that the series will be exclusive and if the value of beta is lesser to the 1 it means the lag values effect will decreased in the series and relationship between current and lag will be no more that series considered as stationary. Similarly, if the value of beta is equal to 1 it means that every lag value reflect in current value and the effect will be consistent and this type of series is said to be non-stationary. The series will have a unit root at beta equal to 1. When to run the test to explore the stationarity property in any kind of data series the test is called unit root test.

It is remembered that all the time null hypothesis concludes the existence of unit root but the value of probability should be less than 0.05 to reject the null hypothesis. Augmented Dickey-Fuller test (ADF) also known as a unit root test is performed for different sectors with the hypothesis.

Ho: Series has unit root (series is non-stationary)

3.3.4. GARCH Model:

To estimate the volatility analysis, the time frame is divided into three categories. The first category is before the COVID-19 event, second category is during the event, third category is after the COVID-19 event. These categories will provide the complete information about the stock market volatility to the response of unpredictable event from the stock market sectors. To gather the influence of volatility in multiple sectors of KSE-100 index, Generalized Auto Regressive Conditional Heteroskedastic (ARCH/GARCH) model is used. Firstly in 1982 ARCH model was introduced by R. Engle in the paper of “Auto regressive conditional heteroskedasticity with the estimate of United Kingdom inflation”.

The model was later introduced by Bollerslev in 1986 and named it “GARCH” model that is the basically extension of ARCH model. After estimating the variance, the lag values of the error squared are added and made it an ARCH/GARCH model (Akash, 2020). In ARCH model heteroskedasticity is utilized to estimate the volatility changing over time and auto regressive tool is used to measure the conditions to previous lags. Forecast use this model to compute the statistics and dynamic of mean, standard deviation and conditional variance. GARCH is considered as a most popular and most powerful tool to detect the variation in the series. To perform the volatility model, it is necessary to have the stationary data series so that first step is to estimate the stationarity is return series by using unit root test (ADF) and confirmed that the data series is stationary or non-stationary. The variance of ARCH model is depended on the past innovations. According to the GARCH model the presence of volatility cluster mean that market is inefficient. There is a variance equation in GARCH model that is mentioned below.

Variance Equation:

$$h_t = C + \alpha \varepsilon^2(t-1) + \beta \gamma^2(t-1)$$

Since h_t represents the conditional variance that is forecasted one period ahead on the basis of previous information. The above-mentioned conditional variance equation consists of three different functions where “C” is representing a constant “ α ” represents the ARCH effect and the last “ β ” represents the GARCH effect of stock returns. In GARCH model “ $\alpha \varepsilon^2(t-1)$ ” this term is represented by RESID (-1) ^2 and “ $\beta \gamma^2(t-1)$ ” this term is represented by GARCH (-1). The sum of RESID (-1) ^2 and GARCH (-1) showed the degree of volatility existence in stock return. GARCH model is most popular tool to measure the volatility cluster in stock returns therefore it is used to the measurement of volatility cluster (Brooks, 2008).

3.3.5. Vector Error Correction Model (VECM):

Vector Error Correction Model is used to measure the short term and long-term relationship between the variables. The process of cointegrated was firstly introduced by Granger in 1981 and then Engle in 1987. If two or more than two variables show a common nonlinear trend in their series then this type of combination is known to be cointegrated. For the adjustment of more than one cointegrated vectors in the series of data a preferable analysis is vector error correction model that rearrange the short-term changes appeared in variables and deviation from equilibrium.

In the results of vector error correction model a crucial part is to estimate the coefficient in term of error correction which represent the speed of adjustments towards its equilibrium point. To measure the short-term relation within the variables the effect is examined through individual coefficients of differentiated term. The size of error correction and statistically significant of error term represents the intensity of every variable moves toward equilibrium level. In vector error correction model each variable is a given series of data is a function of its own lag and helpful to interpret the equations of short term and long term. When cointegration is occurred between the two variables and after that any shock in the form of event came which creates disequilibrium in a series then the cointegration equation will drive the system of economic bounce back toward the long-term equilibrium (Nuryunianto, 2020).

The vector error correction model is utilized to estimate the degree of speed between the variables towards conditions of equilibrium (Buhaerah, 2017). The VECM model estimation provides two main outputs, First, is cointegration term for variables secondly, error correction term for the speed of adjustment towards the equilibrium position. Dummy variable of COVID-19 information is used to estimate the results of VECM in EViews. In statistical software named EViews, the value of t-statistics for testing VECM is shown in the [] square brackets for each variable.

SECTION 4

4. EMPIRICAL RESULTS

In efficient markets investors use historical data to maximize their profits and analyze the trend of market. In time varying market efficiency all the historical information reflects in current prices of stocks. Firstly, to examine the stationarity and non-stationarity in stock returns of daily closing prices is examined by applying unit root test and descriptive statistical calculations are given below in Table 2.

H0: There is a unit root (non-stationary)

H1: alternative of null hypothesis (stationarity)

Table 2. Unit Root Test

Companies	T-Statistics	Critical Value	Probability
PSO	-20.70363	-2.566	0.0000
SHEL	-19.55519	-2.566	0.0000
SNGP	-30.304	-2.566	0.0000
AKBL	-32.788	-2.566	0.0000
MCB	-31.260	-2.566	0.0000
UBL	-29.325	-2.566	0.0000
FCCL	-30.765	-2.566	0.0000
FFL	-33.031	-2.566	0.0000
MLCF	-28.970	-2.566	0.0000
ASC	-28.952	-2.566	0.0000
DCL	-30.005	-2.566	0.0000
HCAR	-20.268	-2.566	0.0000
INDU	-27.383	-2.566	0.0000
TREET	-30.481	-2.566	0.0000
PSMC	-27.529	-2.566	0.0000
ABOT	-19.6787	-2.566	0.0000
AGP	-20.0936	-2.566	0.0000
ANL	-19.3537	-2.566	0.0000
ASL	-21.5461	-2.566	0.0000
ATRL	-19.5931	-2.566	0.0000
AVN	-18.4283	-2.566	0.0000
BOP	-21.2362	-2.566	0.0000
CENERGY	-21.8901	-2.566	0.0000
COLG	-21.9882	-2.566	0.0000

ENGRO	-17.3317	-2.566	0.0000
EPCL	-21.2966	-2.566	0.0000
FATIMA	-21.5495	-2.566	0.0000
FFC	-17.9856	-2.566	0.0000
FCEPL	-19.3658	-2.566	0.0000
GATM	-18.3802	-2.566	0.0000
GLAXO	-19.3309	-2.566	0.0000
HUBC	-19.8134	-2.566	0.0000
HINOON	-19.3309	-2.566	0.0000
ICI	-20.3587	-2.566	0.0000
INIL	-18.4304	-2.566	0.0000
ISL	-17.8986	-2.566	0.0000
KAPCO	-18.1991	-2.566	0.0000
KEL	-23.6228	-2.566	0.0000
KOHC	-17.2428	-2.566	0.0000
LOTCHEM	-21.2164	-2.566	0.0000
MUGHAL	-16.9976	-2.566	0.0000
MUREB	-18.6482	-2.566	0.0000
NATF	-20.5287	-2.566	0.0000
NML	-17.5014	-2.566	0.0000
NCL	-18.2069	-2.566	0.0000
NESTLE	-23.3811	-2.566	0.0000
NRL	-17.7286	-2.566	0.0000
OGDC	-18.7077	-2.566	0.0000
POL	-19.0467	-2.566	0.0000
PPL	-19.0523	-2.566	0.0000
PTC	-23.0106	-2.566	0.0000
SYS	-18.5156	-2.566	0.0000
TRG	-19.1153	-2.566	0.0000
UNITY	-20.0013	-2.566	0.0000

The statistical values of different companies are mentioned in Table 2. The descriptive analysis of different companies show that the null hypothesis has a unit root. The value of probability is 0.0000 that is significant at level with constant, with constant and trend and without constant and trend which means the null hypothesis is fail to acceptance and stock prices obtained a stationary behavior in their series. Similarly, the empirical results show that the values of t-statistics of all the companies are less than critical values which means that there is a volatility in stock prices. According to the calculation it fails to accepts the null hypothesis which is indication of stationary behavior in stock prices.

Furthermore, after confirmation of stationarity in series of stock return GARCH model is used to estimate the volatility in stock returns, the descriptive results are shown in Table 3. given below.

Table 3. GARCH Model

Dependent Variable: Returns

Method: ML ARCH- Normal distribution (Marquardt / EViews legacy)

GARCH = C (3) + C (4) *RESID (-1) ^2 + C (5) *GARCH (-1)

	MEAN (%)	STD (%)	α	β	$\alpha + \beta$
Before Event	-0.0407	2.8110	0.1571	0.5958	0.7531
At First Info	0.27966	3.3036	0.1363	0.6796	0.8163
At Second Info	0.7667	5.6776	0.1566	0.6844	0.8415
At Third Info	0.6852	4.3241	0.1645	0.7154	0.8803
At Fourth Info	0.9303	2.0989	0.1676	0.7111	0.8788
During Event	0.1153	3.0209	0.1124	0.7891	0.9016
After Event	-0.1518	2.2736	0.1092	0.6269	0.7363

The above-mentioned results show that all the values of Alpha plus Beta are just about near to 1, demonstrate that there is a persistence of volatility in return series of selected sample. The summarized values of alpha represent the existence of certain spikes in returns with respect to its previous information and the value of beta indicates how much volatility is persist in data series. The evidence of volatility confirmed that the KSE-100 index is inefficient and contradict with efficient market hypothesis (EMH). The detailed results express that before COVID-19 pandemic on average 75% of volatility cluster exist in companies of KSE-100 index, 81% at the time of first information, 84% at second

information, 88% and 87% at the time of third and fourth information respectively. During the whole period of COVID-19 event the persistence of volatility cluster is 90%. After the pandemic the average percentage of volatility decreases to 73%.

The endorsement of time varying market efficiency show that considerable proportion of stock prices exist in companies of KSE-100 index to be mispriced either overvalued or undervalued. Instabilities and volatility in stock prices provide support to speculator to purchase stocks according to the condition of market and earn abnormal profit. After examine the volatility cluster in data series VECM model is applied to detect the long run and short run existence of volatility is stock market.

Table 4. Vector Error Correction Estimates

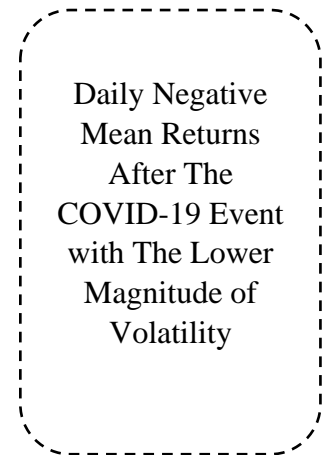
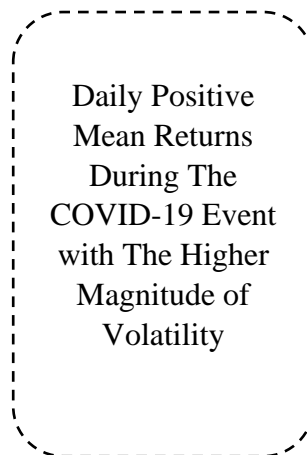
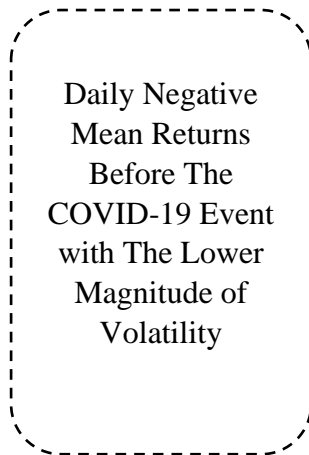
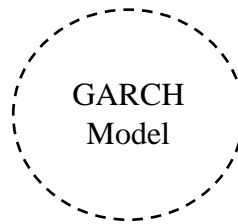
Companies	Coefficient	Correction Term	T-Statistics
AKBL	0.053613	-0.949261	-12.1533
ASC	0.048866	-0.814025	-11.1524
DCL	0.004774	-0.941923	-11.7421
FCCL	-0.071297	-0.893694	-11.1266
FFL	-0.014328	-0.9805	-12.2005
HCCR	-0.039994	-0.8086	-10.0456
INDU	0.002423	-0.750452	-10.5537
MLCF	0.044418	-0.9178	-13.9757
PSMC	0.030531	-0.8645	-10.6723
PSO	0.033522	-0.9870	-12.7463
SHEL	0.062892	-0.9521	-12.3934
NGP	0.107176	-0.9757	-11.6746
TREET	0.048926	-0.9400	-11.0798
UBL	-0.010505	-0.8404	-10.2379
ABOT	-0.059770	-0.825005	-8.90560
AGP	0.092458	-0.977129	-10.8679
ANL	-0.090196	-0.774653	-8.81511

ASL	-0.012421	-0.935993	-11.6173
ATRL	-0.053775	-0.872252	-11.0922
AVN	0.057847	-0.847150	-11.5030
BOP	-0.049931	-0.903492	-11.8449
CENERGY	-0.018928	-1.010237	-12.1654
COLG	-0.077679	-0.990679	-11.4721
ENGRO	0.182615	-0.970203	-14.8122
EPCL	0.010098	-0.821027	-12.6798
FATIMA	-0.030027	-0.896526	-11.3190
FCEPL	0.039741	-0.926821	-11.9185
FFC	-0.01368	-0.80658	-11.5638
GATM	-0.134765	-0.686273	-9.3769
GLAXO	0.089245	-0.751487	-13.0159
HINOON	0.089245	-0.851487	-13.0159
HUBC	0.069913	-0.968232	-12.3481
ICI	-0.084891	-0.862183	-10.7362
INIL	-0.142738	-0.767429	-9.97743
ISL	-0.127247	-0.747547	-9.93408
KAPCO	0.061747	-0.856282	-11.7237
KEL	0.089964	-0.889192	-14.0493
KOHC	-0.048138	-0.750442	-10.2944
LOTCHEM	-0.065187	-0.928425	-11.2131
MCB	0.060781	-0.890219	-11.7838
MUGHAL	-0.085111	-0.692731	-9.73045
MUREB	0.083530	0.692103	-13.6685
NATF	0.020115	-0.916236	-11.8726
NCL	-0.017360	-0.843355	-11.1026
NESTLE	-0.093659	-0.937602	-11.9737
NML	-0.023933	-0.756181	-10.4187
NRL	-0.071134	-0.775234	-10.3082
OGDC	0.065801	-0.896185	-11.8985

POL	-0.008025	-0.850163	-11.1367
PPL	0.050970	-0.927219	-11.8762
PTC	0.077034	-0.728870	-13.4155
SYS	-0.026471	-0.741616	-10.3381
TRG	-0.069028	-0.782892	-10.3739
UNITY	-0.044606	-0.825392	-10.8751

The above-mentioned descriptive results represent the estimation of vector error correction model. The negative sign of the coefficient indicates the strength of stocks prices to bounce back toward its equilibrium position. Beside it the positive value of coefficient indicates the movement away from the equilibrium position. All those companies having a negative coefficient value indicates that there is a short-term persistence of the volatility while positive coefficient values indicate the long-term existence of volatility. in above mentioned results 28 companies indicates that after short term dynamics they converge toward long run equilibrium. Beside it 26 companies indicate that after short dynamics they diverge from the equilibrium point that is the indication of long-term persistence of volatility. The value of correction term indicates the speed of adjustment that the model will restore its equilibrium after any disturbance. Correction error term consist of two characteristics, negative sign and numerical magnitude. Negative sign indicates the convergence toward equilibrium and numerical value indicates the speed toward equilibrium.

**ANALYSE THE IMPACT OF COVID-19 ON THE RETURN AND VOLATILITY
OF PAKISTAN STOCK EXCHANGE**



ANALYSE THE SHORT TERM AND LONG-TERM PERSISTENCE OF VOLATILITY OF PAKISTAN STOCK EXCHANGE

DURING AN EVENT
FEB 2020 – MAY 2021

VECM

During An Event
of Covid-19

26 Companies
Indicates the
Divergence from
The Mean
Position

Divergence From Mean
Position Indicates
Persistence of Long-Term
Volatility While
Convergence Toward
Mean Position Indicates
Short Term Existence of
Volatility

During An Event
of Covid-19

28 Companies
Indicates the
Convergence
Toward Mean
Position

4.1. Discussion of Results:

In above mentioned section, the empirical findings reveal the impact of COVID-19 on the volatility of stock market (KSE-100). There are three different techniques are employed in this study to exploring the effect of an event on Pakistan stock market (KSE-100) to identify the informational efficiency. In this research two hypothesis are used to gather the significant results that are shown given below.

H1: There is a volatility in sectors of Pakistan Stock Exchange (KSE-100).

H2: There is a long run and short run persistence of volatility in KSE-100 sectors.

According to the results of first hypothesis, it is proved that there is a lack of informational efficiency in Pakistan stock market. The empirically results reveal that there is a positive significant impact of an event of COVID-19 on financial market. It is to be seen that there is a variation in stock market after occurring an event. Stock market of Pakistan is a developing market that effect instantly after occurring any form of an event whether it is political, social, economic and other unpredictable event. Results of this research is also homogeneous to previous studies that have been already conducted on this area of research by (Rana Shahid, 2020). Sectors of Karachi stock exchange is highly volatile that shows continuously variation in their return series. It is to prove that there is a conflict between Fama's theory of "Efficient Market Hypothesis" and the sectors of Karachi stock exchange because there is a trend in this market that can help the investors to predict the future performance of stocks (Mazhar Farid A. F., 2018). This event study approach also denial the informational efficiency as by explained Fama because after occurring an event there is a high volatility cluster is observed in the market which mean that there is variation in stock series. To maintain the stability in stock market it is necessary to implement the affective strategies to avoid the abnormality behavior in stock returns. Empirically findings of first hypothesis clearly describe that after appearing of an event return series shows a positive mean return as well as increasing the magnitude of volatility which is the evidence of accepting previous literature available on the area of this study.

Similarly, the second hypothesis of research is also provided a significant positive result of short-term and long-term persistence of volatility in stock return series. Therefore, it is acceptable, and provide an insight understanding of time varying informational efficiency. Almost 28 companies of Krachi stock exchange bear a short-term volatility, it could be the reason of well-defined strategies that systematically controls the information that newly comes in the market. short-run existence of volatility does not mean that non-existence of volatility, it is the indication of strength that how efficiently companies endure the newly information and how instantly they stabilized after facing the events. Correspondingly, in long-term persistence of volatility is the indicator of lack of managing the newly information that occur in the market. Therefore, they lost their equilibrium point and appear in the list of most volatile companies.

At least 26 companies in this research shows disequilibrium for long period of time which mean that after approaching the latest news or information in the market they reveal a disequilibrium for long period of time. In case of long-term volatility, speculator takes advantage to earn the abnormal profit because they are interested in volatile market from which they can earn high profit returns. It is necessary to find out the space through which the companies do not sustain their stability and move away from the mean position for long period of time. For the informational efficient market, regulatory authorities should investigate the point of matter and should go toward innovative tools and techniques to make Pakistan stock market efficient.

SECTION 5

5. CONCLUSION:

This study investigates the stock market volatility of Pakistan Stock Exchange which is a developing market. The phenomenon of volatility in stock markets is common due to the positive and negative events occurred at national or international level. Various studies have been accomplished about the volatility of stock markets despite its findings have a contradicts yet. Specially in the occurrence of pandemic the volatility of stock markets is due to the disaster of health and fatalities as the virus outspread just about all over the world.

This study analyzed the impact of COVID-19 event on the volatility of Pakistan Stock Exchange sectors. The time series data is considered for this study from period January 2019 to June 2022. The implications of most popular techniques of unit root test, generalized autoregressive conditional heteroscedasticity and vector error correction model provides reliable results. The empirical findings specify that the reaction of Pakistan Stock Exchange sectors to the COVID-19 pandemic with the positive average returns beside its highest magnitude of volatility as compared to the prior event period and after event period. On the other side, out of 54 companies 28 companies indicates the short-term persistence of volatility in their return series and 26 indicate the long-term existence of volatility in their stock returns. In economic aspect the concept of demand and supply is disrupted heavily during the pandemic. It can be concluded that the weak form of informational efficiency of stock market generates an opportunity for speculators to gain excess amount of profit. It is concluded that the Pakistan Stock Exchange is not a best platform for the lower-level investors to diversification of portfolio during the event while it is a best place for speculators to diversify their portfolio during the event to gain maximum profit. The results of empirical findings suggest that the Pakistan Stock Exchange contradicts with Efficient Market Hypothesis because there is a variation between the stock returns and also a volatility cluster is existed.

For the regulatory bodies, it is necessary to assume all essential initiatives to make stock prices are correctly priced to achieve efficient market. To make an informational efficient market it also required a motivation and continuous plan of actions to sustain the stability of stock market. Sometimes investors have their own mistakes, However, they can learn from their past mistakes and moves toward changing environment. For the addition, the government should intervene toward stock market by simply promoting the potential corporations to become a public companies and reduced taxes on Foreign Direct Investments to attract the foreign investors toward Pakistan Stock Exchange. Furthermore, the regulatory authorities take initiative for financial literacy to educate people regarding financial investments to improve the stability of Pakistan Stock Exchange. It is also to be noted that innovation and competition also leads toward development of stock market which can turn the degree of informational efficiency.

5.1. Limitation And Suggestion for Future Study:

This study is analyzing the reaction of the stock market during the pandemic at the country level. In this research some companies considered randomly from the different sectors of Karachi Stock Exchange (KSE-100 index) to analyze the response of stock markets. In this study simple popular GARCH model approach is used to detect the volatility in different sectors of KSE-100 index during the pandemic. There could be considered other political, seasonal and financial events to predict the volatility. Firstly, for future study it would be focused on top sectors of Pakistan Stock Exchange to find the volatility in stock returns by utilizing a modern tools, techniques and procedures. Secondly, it could be studied comprehensively in specified sector of Pakistan stock market to obtain a sector wise better significant result. Moreover, to investigate the better performance it is necessary to implement the modern technique of GARCH model to detect the volatility such as (E-GARCH, G-GARCH). Thirdly, this research could be considered for modern techniques to carried out a better result. Fourthly, this study is required to consider a further parameter to measure the period of volatility in Pakistan stock market either it is considered for short time or for long time. Lastly, it is necessary to investigate the time period of volatility in different specified sectors of Pakistan stock market that will help to investors for their future investment decisions to check which sector is volatile for short run and which one is volatile for long run.

5.2. Recommendations:

This study is done on different sectors of Pakistan Stock Exchange to analyze the short-term and long-term persistence of volatility cluster in Pakistan Stock Exchange (KSE-100). Following are the recommendations of research that are mentioned below.

- To maintain the stability in stock market it is necessary to implement the affective strategies to avoid the abnormality behavior in stock returns.
- It is necessary to find out the space through which companies does not sustain their efficiency.
- For efficient market regulatory bodies should take continues plan of action to sustain the stability of stock market.
- The regulatory authorities should take initiative for financial literacy to educate people regarding financial investments.

SECTION 6

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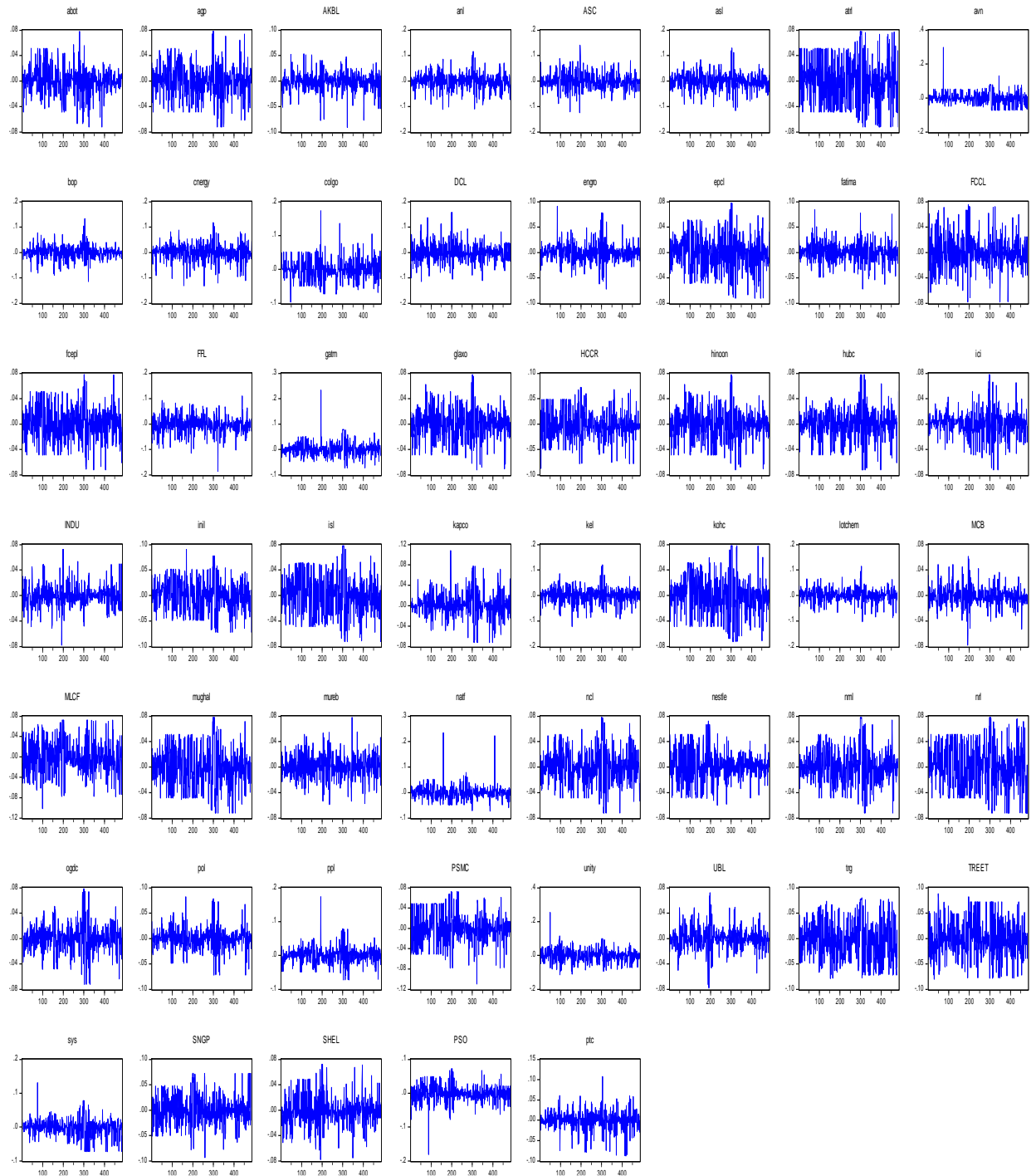
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7. APPENDIX:

CHEMICAL	
Symbol	Companies Name
COLG	Colgate Palmolive (Pakistan) Limited
EPCL	Engro Polymer and Chemicals Limited
ICI	I.C.I. Pakistan Limited
LOTCHEM	Lotte Chemical Pakistan Limited
KOHC	Kohat Cement Company Limited
DCL	Dewan Cement Limited
MLCF	Maple Leaf Cement Factory Limited
FCCL	Fauji Cement Company Limited
ENGINEERING	
ASL	Aisha Steel Mills Limited
INIL	International Industries Limited
ISL	International Steels Limited
FERTILIZER	
ENGRO	Engro Corporation Limited
FATIMA	Fatima Fertilizer Company Limited
FFC	Fauji Fertilizer Company Limited
EFERT	Engro Fertilizers Limited
FOOD & PERSONAL CARE PRODUCTS	
ASC	Al-Shaheer Corporation Limited
FFL	Fauji Foods Limited
TREET	Treet Corporation Limited
UNITY	Unity Foods Limited
NESTLE	Nestle Pakistan Limited
MUREB	Murree Brewery Company Limited
NATF	National Foods Limited
OIL & GAS EXPLORATION COMPANIES	
OGDC	Oil and Gas Development Company Limited
POL	Pakistan Oilfields Limited
PPL	Pakistan Petroleum Limited
POWER GENERATION & DISTRIBUTION	
HUBC	Hub Power Company Limited
KAPCO	Kot Addu Power Company Limited
KEL	K-Electric Limited
OIL & GAS MARKETING COMPANIES	
PSO	Pakistan State Oil Company Limited
SHEL	Shell Pakistan Limited
SNGP	Sui Northern Gas Pipelines Limited

PHARMACEUTICALS	
HINOON	Highnoon Laboratories Limited
GLAXO	GlaxoSmithKline (Pakistan) Limited
ABOT	Abbot Laboratories (Pakistan) Limited
SEARL	The Searle Company Limited
AGP	AGP Limited
REFINERY	
ATRL	Attock Refinery Limited
NRL	National Refinery Limited
CENERGY	Cnergyico PK Limited
TECHNOLOGY & COMMUNICATION	
AVN	Avanceon Limited
PTC	Pakistan Telecommunication Company Limited
SYS	Systems Limited
TRG	TRG Pakistan Limited
TEXTILE COMPOSITE	
ANL	Azgard Nine Limited
GATM	Gul Ahmed Textile Mills Limited
NCL	Nishat Chunian Limited
NML	Nishat Mills Limited
COMMERCIAL BANKS	
BOP	Bank Of Punjab Limited
MCB	MCB Bank Limited
UBL	United Bank Limited
AKBL	Askari Bank Limited
AUTOMOBILE ASSEMBLER	
HCAR	Honda Atlas Cars (Pakistan) Limited
INDU	Indus Motor Company Limited
PSMC	Pak Suzuki Motor Company Limited

Volatility Cluster



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