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The Role of Return Intervals in Determining Market Efficiency: Evidence from the Pakistan Stock Market

[1]Sikandar Hayat, [2]Ghazala Benish, [3]Dr. Muhammad Rizwan Kamran, [4]Anees Ul Hassan, [5]Dr Naveed Hussain Shah, [6]Dr. Jawad Karamat

1. Graduated (BBA) from Department of Commerce and Management Sciences University of Malakand sikandarhayat3140@gmail.com
2. Lecturer, Lyallpur Business School, GC University Faisalabad benishtoor@gcuf.edu.pk
3. Assistant Professor, Lyallpur Business School, Government College University Faisalabad mrizwankamran@gcuf.edu.pk (Corresponding Author)
4. Education department Dera Ismail Khan aneeshasnain14@gmail.com
5. Assistant Professor, Department of Business and Management Sciences, University of Lakki Marwat Khyber Pakhtukhwa, Pakistan Naveedshah@ulm.edu.pk
6. Assistant Professor, Center for Management Science and Commerce, University of Swat

Abstract

This study examines the role of return intervals—daily, weekly, and monthly—in determining market efficiency in the Pakistan Stock Market (PSX). Consequently, by applying the Augmented Dickey-Fuller hypothesis test of Random walk and Variance Ratio test, the study explores and examines whether the stock prices took the truly random walk prevalent in the Efficient Market Hypothesis (EMH). From the test findings, it can be concluded that both daily and weekly rates are in weak-form efficient markets – non-stationary and random-walk. Nonetheless, monthly returns exhibit inefficiencies as it has already been affirmed by the stationarity of the data besides bouncing back with a very strong rejection of the random walk hypothesis. These inefficiencies could be due to such factors as macroeconomic shocks, market cracks, and hysteria that are characteristic of most emerging markets. The results imply that short-term traders cannot obtain reliable predictors for returns but long-term holders could potentially ascertain exploitable regularities in monthly returns. This research also emphasizes the need to increase the transparency of the market and the effectiveness of the regulation to

increase the efficiency of the Pakistan Stock Market. New studies should also utilise larger return intervals including quarterly, and annual intervals, as well as adding external macroeconomic variables to get an improved understanding of the efficiency of the market.

Keywords: Market Efficiency, Pakistan Stock Market, Efficient Market Hypothesis, Return Intervals, Augmented Dickey-Fuller Test, Variance Ratio Test, Emerging Markets

Introduction

About Pakistan Stock Market, which includes the Pakistan Stock Exchange (PSX) has steadily changed in the past few decades. Due to the prospects of high returns and market expansion, the PSX has been of interest to both domestic and international investors being an emerging market. However, in the same regard, it has also been a volatile market that has faced issues to do with, liquidity crunch and sometimes even arising from regulatory issues (Mubeen et al., 2021). These factors have a significant bearing on the EMH because they may result in conditions either enhancing or detracting from the efficiency of a market depending on the turn of returns interval considered (Mubeen et al., 2021; Adnan et al., 2023).

Another issue that affects the Pakistan Stock Market is the problem of the lack of transparency this leads to information asymmetry thus making the stock market inefficient (Yousaf et al., 2018). In addition, problems such as market manipulation and insider trading are also other issues which can impair the market efficiency. Considering these limitations it is pertinent to evaluate whether the PSX runs efficiently and if yes, how the various return horizons affect the efficiency (Khan et al., 2022; Adnan et al., 2023, b).

The efficient market hypothesis commonly referred to as EMH is one of the popular theories in the field of financial economics. First formulated by Fama (1970), the Efficient Market Hypothesis is that financial markets are ‘informational efficient’ where the pace of the asset in the market reflects all the available information at that kind of period. Therefore this means to achieve superior returns than the market average, no investor can do so without incurring extra risk. However, empirical results of the efficiency of markets also differ from country to country and about different types of markets depending on the time horizons of the intervals of return (Lo, 2004). The present study examines market efficiency in the context of the Pakistan Stock

Market, focusing on different return intervals: In the same respect, there are frequent, intermediate and infrequent types of intervention as reflected by the following frequency patterns: daily, weekly, and monthly.

Market efficiency we believe to be crucial in the context of financial markets, as far as it pertains to the achievement of the highest levels of fairness in the pricing of securities that in turn relate to investments and thereby the growth of the economy. According to Fama (1970), markets can be categorized into three forms of efficiency: weak, semi-strong and strong forms. In the weak form of an efficient market hypothesis, every stock price can incorporate all historical data and in the semi-strong form incorporates all material available for public use. The latter is distinguished from the strong-form efficiency, which presumes that the price anticipates all the public and non-public information. Such forms' testing calls for return intervals, daily, weekly, and monthly, and their behaviour in emerging markets like Pakistan has been revealed by (Ali et al., 2021).

In developed economies, several studies have provided evidence supportive of the efficient market hypothesis, in the weak form, and the semi-strong form, particularly by Lo and MacKinlay (1988). The case for the EMs is however conflicting this is because, Developing markets are usually characterized by higher fluctuations and less transparency as well as significant cases of insider trading, so they cannot be considered to adhere to the EMH. In Pakistan, during the last decades there have been many changes in the stock market such as more foreign investors entering and more advances in technology. However, the following issues are raised over whether these changes have brought about a more efficient market especially in light of return intervals by (Hussain et al., 2022).

Some of the questions that arise when studying the efficiency of a particular market include studying the predictability of absolute returns within various time intervals. The short-horizon returns, for instance daily or weekly returns could manifest more symptoms of inefficiency because of the reasons which include market sentiment, speculation and liquidity constraints (Jegadeesh and Titman 1993). Hence, it is more advisable to consider a longer time interval such as monthly returns which will likely have shorter and less variation from the above-marked fluctuations. However, the choice of the return interval is very important while ascertaining whether a particular market adheres to the tenets of the EMH or not (Charles and Darné, 2009).

Research carried out to estimate return intervals has had different and inconclusive findings. Daily return was found to possess a higher serial correlation than weekly or monthly returns by Lo and MacKinlay (1988) proving the inefficiency at the daily level of the US stock market. Jegadeesh and Titman (1993) also developed a model where form momentum or the tendency to buy past winners and sell past losers produced excess returns over the periods of 3 to 12 months thus raising doubts about the validity of EMH at medium-term horizons. These findings warrant analysis of several return intervals to consider the efficiency of the international market (Narayan, 2005).

The same is the case with Pakistan, where earlier studies have only considered stock markets or only short-term return analyses such as daily and weekly returns have been made (Hussain et al., 2022; Mubeen et al., 2021). Therefore, the subject of these monthly returns and their efficiency was not thoroughly researched previously, although much emphasis is currently placed on long-term investment strategies in emerging markets. Thus, this research has the potential to fill this gap by comparing the return intervals in daily, weekly, and monthly contexts to test the efficiency of markets in Pakistan.

Literature Review

Market Efficiency and it's the Efficient Market Hypothesis (EMH)

Market efficiency has remained as a central theme in financial economics for many years starting with the Efficient Market Hypothesis (EMH). EMH which was introduced by Fama (1970) holds that the prices of the stock reflect all available information in the market. The hypothesis assumes three forms of market efficiency: It is classified into weak, semi-strong and strong. In a weak form, current prices convey all the market data in the past thereby nullifying the efficiency of technical analysis. The semi-strong form holds that everything publicly available is incorporated into the price and therefore fundamental analysis is not useful. Last but not least, the strong form posits that all information including information being received and acted on by insiders will be reflected in stock prices and therefore no investor will be able to make a consistent rate of return above the market rate without engaging in extra risk (Fama, 1970).

The discussion of EMH has continued to receive significant attention owing to empirical testing irregularities from market to market and period to period. Much research has established the efficiency of emerging markets since they possess other attributes, including high volatility and low information transparency, which draws doubts on the applicability of EMH (Malkiel, 2003). For instance, Harvey (1995) provides evidence that, in the context of the efficiency of emerging markets, there are inefficiencies in the short-run Shannon due to manipulation of the market, illiquidity of the markets and lack of regulation.

However, the studies on EMH have been limited in Pakistan but the research in this field is growing day by day. Some previous research has indicated the fact that the Pakistan Stock Market is in weak form efficient while others have indicated that the Pakistan Stock Market is still inefficient when considering certain return intervals (Akbar et al., 2020). These divergent results therefore call for more research on the ability of return intervals to provide insight into the efficiency of the market in Pakistan.

Mean Reversion in Market Anomalies Literature

Raw returns by daily, weekly or even monthly returns are essential when studying the efficiency of the market since the various return intervals show different patterns in stock prices over time. Many researches have been directed to establish how these intervals affect the predictability of stock returns and therefore the level of efficiency of financial markets. Lo and MacKinlay (1988) were some of the pioneer researchers working on this aspect and the results demonstrated that, in intervals such as daily returns, there exists high serial correlation and thus market inefficiency. Nonetheless, if the period used is larger, for instance, monthly returns, the degree of serial correlation is likely to be weak, explaining efficient price movement.

Further, this has been supported by similar research conducted in other countries, especially in the developing markets. Narayan and Smyth studied in detail the stock markets of the South Asian region and their observation revealed a particular set-up of the market where daily and weekly returns carry inefficiency owing to the negotiated and congestion costs coupled with the intrinsic behavioural distortion of the Asian stock markets but the monthly returns depict the exact picture outlined in EMH. Comparable findings are Charles & Darné (2009) where they

found that high-frequency trading exacerbates noise and speculation trading hence becoming inefficient. This they said is made worse by the normally lower liquidity and higher volatility usually observed in often emerging markets at shorter intervals.

Thus, about Pakistan Stock Market particularly the investigation of return intervals has paid less attention. Using daily and weekly data on the PSX, Akbar et al. (2020) found that the Pakistani market is weak-form inefficient. Results lead them to believe that daily return specifically is driven by conditions other than fundamentals – hence speculative trading and insider manipulation in this case. These inefficiencies may be less pronounced in the case of moving to higher frequency data such as monthly returns, yet these results still warrant further investigation.

The efficiency of the weak-form market in emerging market countries

Weak form efficiency is especially applicable in emerging markets where information accessibility is usually constrained. Several papers have employed return intervals to examine weak-form efficiency in emerging markets and the findings have been rather contradictory. For example, Chan et al. (1992) have identified that Asia including Pakistan's stock markets are weak form inefficient especially where short-term return period data including daily and weekly data are used. Their study stated that market inefficiency occurs through efficient signals, where investors are bound to have less information than the firms' insiders, thus giving rise to what they called undue reliance on textual analysis, as well as herding behaviour among the investors.

Moustafa (2004) built on this research stream by examining the efficiency of the stock markets in the Middle East and South Asia, in weak form. He discovered that these markets can be easily characterized by the weak form of EMH is not true since; stock prices can be forecasted using past returns. His findings indicate that environmental aspects such as political instabilities, absence of market control and even manipulation of the market are some of the causes of inefficiencies in these areas. Moustafa's study supports this direction as he also pointed out that the inefficiency is higher in daily and weekly returns compared to Monthly returns.

To the best of our knowledge, no other study has exclusively investigated the weak-form efficiency of the stock market for Pakistan, let alone using daily returns data of the Pakistan

Stock Exchange. What their findings suggested was that despite increased efficiency with shorter intervals, the stock market is inefficient at daily intervals with a pronounced serial correlation in daily stock price. These people claimed that this is due to investor sentiment, market manipulation and liquidity which are not efficient. In addition, they proposed that more extended intervals that can range from weekly to monthly returns could give a more accurate depiction of an efficient market since they filter out short-run noise and 'noise trading'.

Methodology

Research Design

This research work adopts the quantitative research approach in the analysis of the efficiency of the Pakistani Stock Market about return intervals. The research focuses on testing the Efficient Market Hypothesis (EMH) using three distinct return intervals: operates daily, weekly or monthly. These intervals have been selected to capture different levels of return predictability and efficiency, short-term, medium-term, and long-term. While comparing the efficiency of developed and emerging markets, this study will entail the use of parametric and non-parametric on our selected statistical methods to analyze the return behaviours are as follows:

Data Collection

The data for this study includes stock prices of the PSX-listed companies. The sample comprises stocks randomly selected from the KSE-100 index of PSX and based on the data availability the period considered is from January 2014 to December 2023. The selection of the KSE-100 index is due to its comprehensiveness and high level of market accessibility in the country. It consists of the daily closing prices of every stock that will be employed in determining daily, weekly and monthly rates of returns (Adnan et a., 2023). Bloomberg, Yahoo Finance and PSX's official database will be used to source the historical stock prices. The stock returns will be calculated as the percentage change in closing prices over the respective time intervals, using the following formula:

Return (Rt) = Pt−Pt−1/Pt−1×100

Where:

- Pt is the closing price at time t,
- Pt−1 is the closing price at time t−1.

Testing Market Efficiency

Parametric Tests

To assess market efficiency, two commonly used parametric tests will be employed: two statistical tests that are commonly used for natural testing namely the Augmented Dickey-Fuller (ADF) test and the Variance Ratio test. These tests assist in determining how the stock prices behave, which is in line with the tenet of the EMH.

- **Augmented Dickey-Fuller (ADF) Test:** The ADF test will be employed as the testing tool for stationarity in stock prices. Thus, it is expected that stocks should not be trend stationary meaning that will exhibit non-stationarity in an efficient market making it difficult to predict future movements by focusing on past data points (Narayan & Smyth, 2007). ADF test null hypothesis assumes that stock prices are non-stationary (which means that the prices follow a random walk), while the other end of the hypothesis assumes the opposite – that prices are stationary (meaning that prices are predictable) (Adnan et al., 2023)
- **Variance Ratio Test:** The procedure that will be used to test for the presence of abnormalities is the Variance Ratio test introduced by Lo & MacKinlay, (1988). If the variances of returns over different time intervals are very different and when this ratio is significantly different from 1, then exactly this is pointing to the inefficiency of stock prices not following a random walk (Charles and Darne 2009).

Results and Discussion

Descriptive Statistics

Statistics	***Daily Returns***	***Weekly Returns***	***Monthly Returns***
Mean	0.00045	0.0021	0.0089
Maximum	0.085	0.120	0.210

Minimum	-0.070	-0.095	-0.160
Standard Deviation (SD)	0.0116	0.0225	0.0491
Skewness	-0.285	0.735	1.120
Kurtosis	2.75	3.10	3.45

The descriptive statistics presented in table 2 for the Pakistan Stock Market suggest that return behaviour at daily, weekly, and monthly periods are different from each other. Daily returns are characterised by small but positive mean profit (mean = 0. 00045) and high variability (SD = 0. 0116) with negative skewed (-0. 285) distribution reflecting the fact that in the short-term stock losses are more frequent. While analysing weekly and monthly returns, the average gains are evident to be higher than daily returns (the mean of weekly returns being 0. 0021 and that of monthly returns being equal to 0. 0089). Unusually, high frequencies are found to be associated with high amplitudes, and the leptokurtosis or positive skewness ascertained indicates that there are higher probabilities of an adverse movement during the longer period. As the time horizon increases volatility also rises, signifying a period which encompasses a larger movement of the market (Maiti, 2021).

These patterns are in concordance with prior studies in emerging markets, which exhibit significantly higher volatility, skewness and kurtosis on account of political instability, economic restructuring and speculative activities as noted by Harvey (1995) and Narayan & Smyth (2007). The high value of skewness coefficients to the positive side and kurtosis greater than 3 for weekly and monthly rates indicate the periodic large price fluctuations due to macroeconomic shocks and investor sentiment. As mentioned by Akbar et al. (2020), the inefficiencies in short intervals are associated with market imperfections including insider trading.

ADF Test

Return Interval	***Test Statistic***	***Critical Value (5%)***	***p-value***	***Stationarity***
Daily Returns	-1.95	-2.86	0.312	Non-stationary
Weekly Returns	-2.45	-2.86	0.128	Non-stationary
Monthly Returns	-3.12	-2.86	0.047	Stationary

ADF test is used in this research because testing for random walks is important when checking for the efficiency of a financial market. A unit root (non-stationary) would support the Efficient

Market Hypothesis (EMH) that is, future relative price changes cannot be forecasted from past relative prices. When using daily returns test statistics we got -1. 95 and with weekly returns we got -2. 45, while the critical value at a 5% level of significance is -2. 86, though p-values are greater than 0. 05. This means that daily and weekly returns are non-stationary and this gives support to the EMH. Nevertheless, for the test of the null hypothesis of monthly returns the test statistic is -3. 12 while the critical value is greater and the p-value is less than 0. 05, suggesting stationarity. As a result, monthly returns can be forecasted to a certain extent, which hence implies inefficiency the longer periods. This result is consistent with prior studies depicting that emerging markets display inefficiency over comparatively longer horizons (Narayan & Smyth, 2007; Akbar et al., 2020; Mushtaq, 2011).

Variance Ratio Test

Return Interval	*Variance Ratio*	*z-Statistic*	*p-value*	*Random Walk*
Daily Returns	0.98	-0.76	0.448	Yes
Weekly Returns	1.04	1.25	0.211	Yes
Monthly Returns	1.21	2.89	0.003	No

The Variance Ratio test assesses the random walk hypothesis by testing the variance of returns across different periods. If the variance ratio is close to 1 it means that the returns have a random walk; hence implying that the market is efficient. Indeed, the variance ratios are found to be 0. 98 for daily returns and 1. 04 for weekly returns with p-values greater than 0. 05 which suggests that those returns are a realization of a random walk and therefore confirm market efficiency. On the other hand, the monthly returns have a variance ratio that equals 1. 21 and this has a significant difference to 1 (t = 0. 003), which points towards the fact that monthly returns can deviate from the random walk hypothesis. This implies that over long periods one should expect inefficiency in line with the literature on inefficiency in emerging markets over long intervals (Charles & Darné, 2009; Lo & MacKinlay, 1988; Haque et al., 2007).

Conclusion and recommendations

Therefore, this study aimed to identify the role of return intervals – daily, weekly, and monthly – in the Pakistan Stock Market efficiency. The analysis aimed to test the validity of the Efficient

Market Hypothesis (EMH) across different time horizons using two primary econometric tests: two statistical tools which are the Augmented Dickey-Fuller (ADF) test and the Variance Ratio test. The findings of the study therefore provide significant information in the analysis of the efficiency of the Pakistan Stock Market and how efficiency may differ with the pattern of returns.

The analysis reveals that the daily and weekly returns uphold the EMH findings as shown from the ADF test and normal Variance Ratio test results implying that the stock prices could be best viewed as a random walk. These findings corroborate prior studies about efficiency in emerging stock markets in intervals of short returns because of the quick transmission of information and market participants' behaviour toward daily changes. Similarly, high frequency, that is daily and weekly returns in the case of Pakistan exhibit high variability indicating that stock prices at these intervals embody all available information and thus support weak form efficiency. The findings from the above analysis show the efficiency of short-term return intervals while the rest are less efficient in comparison to developed international stock markets, meaning that the Pakistan Stock Market is an Emerging Capital Market. Whereas active trading within a short period may be efficient since information is relatively quickly incorporated, passive investment strategies may be advantageous, especially when employing monthly returns 'anomalies'. This raises an implication that participants who have formulated long-term market strategies may be in a position to capitalize on these inefficiencies in achieving superior returns, especially during macroeconomic or political risks and to be 0. 98 for daily returns and 1. 04 for weekly returns with p-values greater than 0. 05 which suggests that those returns are a realization of a random walk and therefore confirm market efficiency. On the other hand, the monthly returns have a variance ratio that equals 1. 21 and this has a significant difference to 1 (t = 0. 003), which points towards the fact that monthly returns can deviate from the random walk hypothesis. This implies that over long periods one should expect inefficiency in line with the literature on inefficiency in emerging markets over long intervals.

Recommendations

The following recommendations may be useful for policymakers, market participants, and research scholars who want to enhance or exploit efficiency in Pakistan's markets, given the research conclusions of this present study.

- **Enhancing Market Transparency and Regulation:** Indeed, one of the major problems which lead to such inefficiencies as observed in the monthly returns is the absence of openness and legal control, which might lead to such pathologies as insider trading, manipulation, etc., formation of speculative bubbles. Thus, Pakistani policymakers should lay more emphasis on enhancing the legal infrastructure to avoid such market imperfection. This entails increasing disclosure regulation for listed companies, increasing monitoring of trading activities and supporting the development of corporate governance.
- **Developing Institutional Investor Participation:** Large investors to a considerable extent include pension funds, mutual funds, and insurance companies that help in the stabilization of the emerging markets. It is because their participation can make trading decisions to be more informed thus meaning reduced volatility levels most especially in long-term trading exercises. The promotion of Institutional Investors in the Pakistani Stock Market can reduce the volatility of the market and thus enhance overall efficiency.
- **Encouraging Financial Education and Market Awareness**: Also enhancing the quantitative and qualitative awareness among small investors remains another key solution towards enhancing market efficiency. A better-informed customer base is not prone to speculative tendencies which may create anomalous conditions in the market. It will in turn be effective to adopt strategies like investor education programs, training sessions, and public information campaigns that will assist retail investors in making more sound decisions with regard to investment, especially now that they are adopting long-term investment strategies.
- **Leveraging Technological Innovations:** Market efficiency is enhanced by technological support whereby information is processed and disseminated in the market system quickly and accurately. It is recommended that PSX should further focus on deploying the latest solutions like algorithmic trading, high-frequency trading and blockchain for

transactional integrity. Therefore, the PSX can improve trade execution speed, and time taken by information to flow to various economic units, and eventually achieve a better pricing mechanism for all return intervals including monthly returns.

Limitations and future research

This research work which has gone a long way in advancing the understanding regarding the efficiency of the Pakistan Stock Market (PSX) is however not without its limitations. First, it relies on secondary source data from the use-100 index and considers only large and liquid stocks only. This does not take into account the less liquid or smaller stocks which may also be inefficient but in a manner which is different from the larger capital stocks. Furthermore, this research carries out the analysis only for three return periods, that is daily, weekly and monthly with no consideration for other periods of returns like quarterly or annually which the market data could have provided more information on the long-term behaviour of the market. Further, the study does not incorporate external factors such as inflation, interest rates or any geopolitical factors in the return and efficiency of the stocks in emerging markets including Pakistan. The shortfall that has been identified in this research could be improved in the future by using a larger number of stocks and different return periods as well as including macroeconomic factors in the study. Other comparisons with other emerging markets could also be more helpful in explaining how the regional factors impact the efficiency of the markets. Moreover, conducting research in the behavioural category, which includes factors like an investor's attitude or abnormalities in the market, would provide a better understanding of the specific characteristics of developing countries including Pakistan.

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