



Article

Three Major Crises and Asian Emerging Market Informational Efficiency: A Case of Pakistan Stock Exchange-100 Index

Bahrawar Said ^{1,*}, Shafiq Ur Rehman ² and Muhammad Wajid Raza ³

¹ Joseph M. Katz Graduate School of Business, University of Pittsburgh, Pittsburgh, PA 15213, USA

² Department of Commerce and Management Sciences, University of Malakand, Dir Lower 18800, Pakistan

³ Department of Management Sciences, Shaheed Benazir Bhutto University Sheringal, Dir Upper 18050, Pakistan

* Correspondence: bahrawar.szabist@gmail.com

Abstract: Periods of economic turmoil distort the ability of stock prices to reflect the available information. In the last three decades, emerging markets experienced numerous crises. The major three of them are the Asian Financial Crisis (1997–1998), Global Financial Crisis (2007–2009) and Global Pandemic Crisis (2020–2022). The nature, intensity and duration of these crises differ significantly. This study investigates the impact of these varying natures of crises on the level of informational efficiency. The empirical evidence is based on the emerging stock market of Pakistan. Index-level data are collected from Pakistan Stock Exchange-100 Index for the period 1995–2022. The rebalancing is done each year to ensure that the final sample is composed of only 100 stocks with the highest market capitalization. The results based on the Variance Ratio (VR) test show that informational efficiency is time-varying. Among all the three crises, informational efficiency deters more in the COVID-19 pandemic, albeit the market efficiency recovers soon. This implies that the arbitrage opportunity is marginal in crisis periods, while investors prefer to invest in post-crisis periods. Finally, our results reveal that among all the crises, investors were more informed in the Global Financial Crisis. Investors must keep a close eye on market regimes for designing investment solutions.

Keywords: Asian Financial Crisis (AFC); Global Financial Crisis (GFC); Global Pandemic Crisis (GPC); PSX-100 Index; market efficiency

JEL Classification: G01; G11; G12; G14



Citation: Said, Bahrawar, Shafiq Ur Rehman, and Muhammad Wajid Raza. 2022. Three Major Crises and Asian Emerging Market Informational Efficiency: A Case of Pakistan Stock Exchange-100 Index.

Journal of Risk and Financial Management 15: 619. <https://doi.org/10.3390/jrfm15120619>

Academic Editor: Ruipeng Liu

Received: 24 October 2022

Accepted: 12 December 2022

Published: 19 December 2022

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Copyright: © 2022 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction of the Study

According to the Efficient Markets Hypothesis (EMH), security prices fully reflect all the available information (Samuelson 1965; Fama 1970). In efficient markets predicting stock prices using merely historical data is a cumbersome task. The EMH is a well-established concept and is widely discussed by academic literature, and its applications are evaluated globally by several studies in different time spans (see, e.g., Kim and Shamsuddin 2008; Lee 2012; Raza et al. 2022). The term market efficiency is perceived in different contexts. However, this study refers to the informational efficiency of the stock market, which is concerned with the degree of information reflected in stock prices (Raza et al. 2022).

Numerous factors, i.e., market volatility (Bae et al. 2004), exchange rate volatility (Olugbenga 2012), market microstructure and financial reforms (Arjoon 2016) and macroeconomic shocks (Ting et al. 2020) affect the level of informational efficiency of stock markets. Stock markets are prone to external shocks, and the reaction to such shocks is often time-varying, i.e., market rallies are characterized by stable returns, while crisis periods are associated with high volatility. Market turmoil has a drastic effect on different aspects of the stock market, i.e., it causes returns drag (Boudt et al. 2019a) and excessive risk (Boudt et al. 2019b). Finally, it also has a significant relationship with the level of informational efficiency (Lim et al. 2008; Raza et al. 2022).

In a crisis, the ability to reflect the available information deters. Investors' confidence is fragile, and uncertainty is at its peak. In such a situation, the level of informational efficiency reduces. The crises have provoked policymakers to reconsider their commitment to the liberalization of capital flows. Though there is widespread literature available on crises, its application to market efficiency is limited. The massive fall of stock prices in several Asian countries during the crises was often quoted, with no formal analysis, as compelling evidence against stock market efficiency. This issue was discussed recently by [Kim and Shamsuddin \(2008\)](#).

In the last three decades, emerging markets in Asia experienced many major crises. The major three of them are the Asian Financial Crisis (AFC), Global Financial Crisis (GFC) and Global Pandemic Crisis (GPC) caused by Covid-19. Several studies linked such crisis periods with the ability of markets to reflect the available information in stock prices. The case of market crisis and informational efficiency has been investigated by several studies. For example, the AFC started on 2 July 1997 and lasted till the first quarter of 1998 ([Stubbs 2014](#)). The immense devaluation of the Thailand Baht is widely considered a major reason that triggered the AFC. The bankruptcy of Thailand's largest finance company 'Finance One' and massive speculative attacks were a few major reasons for the downward shift in Thailand's currency ([Kaminsky et al. 2003](#)). The spillover effect soon extends to Philippine Peso, the Malaysian Ringgit, the Indonesian Rupiah and the Singaporean Dollar ([Pontines and Siregar 2012](#)). Finally, the De-Facto depletion of foreign reserves further fueled the crisis.

Similarly, the mortgage scandal led to the bankruptcy of two major US banks (Lehman Brothers and Bear Stearns) in 2008. It leads to a severe financial crisis in the US particularly. The spillover effect extends to the rest of the world in the shape of the Global Financial Crisis. COVID-19 was termed a global pandemic by World Health Organization (WHO) in 2020. In response to this crisis, S&P Global BMI declined by almost 30%, while the FTSE-100 Index, S&P 500 and DJIA experienced a decline of 35% approximately ([Raza et al. 2022](#)). The origin, different nature, and intensity of the above three crises make their interesting cases and give raise an important question: How does informational efficiency react to different types of crises?

We are not the first to highlight the effect of crises on informational efficiency. For example, [Gilson and Kraakman \(2014\)](#) report a negative link between AFC and informational efficiency. A similar conclusion was drawn by [Charles et al. \(2015\)](#). [Sengonul and Degirmen \(2011\)](#) extend the analysis to European markets (Bulgaria, Romania, Estonia, Lithuania and Slovenia). Literature also provides evidence related to GPC; see, for example, ([Wang and Wang 2021](#)). The study of [Li et al. \(2021\)](#) indicated an interesting finding that the effect of a current pandemic on market efficiency is more severe than the GFC. A major finding highlighted by most of the studies is the behavior of informational efficiency in the post-crisis era. As noted by [Charles et al. \(2015\)](#), the response of the stock market is completely different and shows quick recovery once the crisis period is over.

A detailed analysis of the literature reveals that the empirical evidence is rich but mostly limited to developed markets (see, e.g., [Mensi et al. \(2022\)](#) examined the impact of GFC on US future markets: Chicago Mercantile Exchange and London Metal Exchange; [Horta et al. \(2014\)](#) analyzed the impact of GFC on Belgium, France, Greece, Japan, the Netherlands, Portugal, the UK and the US). Studies conducted by ([Gulati 2022](#)) extend this debate to developing markets. For example, the study of [Gulati \(2022\)](#) investigates the case of the Indian market in GFC, while [Park et al. \(2010\)](#) focus on the Chinese market in the context of AFC. According to the best of our knowledge, there is no such study that highlights the case of the Pakistani market. Furthermore, the majority of the above studies focus on a single crisis. Most of the above-mentioned studies ignore the effect of the nature of crises on efficiency. Therefore, we reshape the previously mentioned question as follows: how informational efficiency reacts to different types of crises in an emerging market like Pakistan?

Pakistani market is in its embryonic stage of development and has gone through many structural changes in the last three decades; for example, the announcement of financial liberalization, the introduction of financial reforms and improvements in key market microstructure components. Hence, this market is an ideal setting for such an analysis. Further, empirical evidence from this market helps improve the generalizability of findings related to emerging markets.

The findings of this study based on the Variance Ratio test of [Kim \(2006\)](#) and [Kim and Shamsuddin \(2008\)](#) revealed that the informational efficiency of the Pakistan stock market is time-varying and it has a close association with market regimes. In comparison to AFC and GFC, the impact of GPC is much more severe. We further strengthen the findings of [Charles et al. \(2015\)](#) and found a strong recovery in the post-crisis period, which reduces the space for arbitrageur and improves informational efficiency.

The policymakers should pay close attention to the improvement of the trading mechanism and formulate such policies which contribute to the resilience of the market to withstand external shocks. It is important to understand the behavior of informational efficiency and market regimes. If the inefficiency problem, specifically in a crisis period, is not resolved by the concerned quarters, it could seriously limit the ability of the stock market to allocate capital resources to the most productive sectors of the economy and possibly impede its long-term growth ([Kavussanos and Dockery 2001](#)). The tendency of the market to improve in the post-crisis period is a positive signal for the individual as well as institutional investors. In light of the findings of this study, investors can design a long-only portfolio and evade implementing speculative trading strategies in periods of high volatility.

The study proceeds as follows: Section 2 discusses the literature review. Section 3 describes the methodology. Section 4 presents and discusses the major results, while Section 5 concludes this article.

2. Relevant Literature Review of the Study

The theoretical foundation of this study lies in one of the widely debated theories of the Neoclassical School of Finance, the Efficient Market Hypothesis (EMH) of [Fama \(1970\)](#). EMH has three forms: weak, semi-strong, and strong form. In a weak form of market efficiency, the stock prices can be predicted by considering only the historical information, while in a semi-strong form of efficiency, the investors have to consider both historical and public information. The rarest form of market efficiency is when all the private, public and historical information is used for predicting stock prices. In an efficient market, obtaining information is costly while the reward is very low.

Stock market efficiency has been thoroughly discussed, particularly in the developed markets ([Samuelson 1965](#); [Fama 1970](#); [Liu et al. 2020](#)). A vast strand of literature tested different forms of market efficiency in different geographical settings and time spans. For example, the study of [Worthington and Higgs \(2006\)](#) tests for efficiency in sixteen European stock markets based on daily returns using serial correlation, runs tests, ADF, PP and KPSS unit root tests and MVR tests. The results, which are in broad agreement across the approaches employed, indicate that of the developed markets, only Germany, Ireland, Portugal, Sweden and the UK conform with the efficiency criteria. [Ito and Sugiyama \(2009\)](#) investigate the time-varying efficiency based on a state space model. The study reported that the US stock market exhibits varying degrees of efficiency over the sample period of 1955–2006. The study claims that there is little literature available that examines the degree of time-varying efficiency of stock markets. [Gaio et al. \(2022\)](#) investigate the impact of the Russia-Ukraine conflict on the efficiency of six developed stock markets using the multifractal structure of the series on the basis of daily stock index data from the US, UK, Germany, France, Italy and Spain. Efficiency was analyzed in full series, COVID-19, pre-conflict and post-conflict. The results reject the market efficiency hypothesis and indicate the predictability of asset prices in times of instability and GFC. Further, using the variance ratio test, [Ozkan \(2021\)](#) investigates the impact of the GPC on the efficiency of six hard-hit

developed countries: the US, Spain, the UK, Italy, France, and Germany for the period of 29 July 2019–25 January 2021. Results revealed that all stock markets deviate from market efficiency, but the effect of the pandemic was more intense in US and UK.

Perhaps the research work in emerging economies mostly focuses on testing the weak form of market efficiency. For example, the study by [Lee \(2012\)](#) reported the inefficiency of 26 developing markets for the period of 1999–2007. [Kim and Shamsuddin \(2008\)](#) investigated weak forms of efficiency in the Hong Kong, Japan, Singapore, and Taiwan stock markets. [Chaudhuri and Wu \(2003\)](#) tested the efficiency in seventeen emerging markets by employing unit root tests. They found that only seven markets exhibit only weak efficiency. [Narayan and Smyth \(2004\)](#) found the South Korean market to be weak and efficient. [Cooray and Wickremasinghe \(2005\)](#) applied the ADF and PP test and found a weak form of efficiency in India, Sri Lanka and Pakistan, while the results were not significant for Bangladesh's stock market.

[Wright and Swidler \(2023\)](#) investigate the Jamaica Stock Exchange (JSE) and conclude that historical and newly released public information do not predict future stock price movements. Taken as a whole, the evidence suggests a violation of market efficiency and has implications for capital allocation in this emerging market. Another study by [Chang et al. \(2023\)](#) examined the market efficiency targeting 12 major Asian stock markets of Hong Kong, India, Indonesia, Japan, Malaysia, the Philippines, China, South Korea, Taiwan, Thailand, and Vietnam with the stochastic dominance method (SDM) in the pre and post-financial crisis. Results indicate that the level of market efficiency is not significantly different between these periods. However, further evidence shows that different anomaly pattern exists in these two periods. The empirical evidence provided by [Hkiri et al. \(2021\)](#) shows a departure from the weak form of market efficiency. Further, the study shows that political events adversely affect efficiency in most markets.

The study conducted by [Arjoon \(2016\)](#) revealed that informational efficiency is time-varying. Such that the ability of stock prices to reflect available information improves in times while it distorts in market downturns. It implies that in such times the equity prices reflect the firm fundamental value and are more resistant to market speculations. During the GFC, most of the markets revealed unsettled behavior and resulting in high volatility. [Lim et al. \(2008\)](#) studied the impact of the crisis on market efficiency in Asian markets. They found that the efficiency of the Hong Kong market was severely affected by the crisis, followed by the Philippines, Thailand, South Korea, Singapore, and Malaysia. The majority of these markets showed an improved level of efficiency in post-crisis periods.

On the other hand, there are studies that support evidence against the theory of EMH. For example, [Hoque et al. \(2007\)](#) found no significant effect of the Dot-Com crisis on the level of efficiency in Thailand, Singapore, Malaysia, the Philippines, and Hong Kong. However, the crisis has affected the stock market of South Korea. Another study by [Kim and Shamsuddin \(2008\)](#) did not find any link between the AFC and the market efficiency of Asian markets. However, the efficiency of Thailand and Singapore stock markets improved in the post-crisis period.

We can also trace some studies that have focused on the context of GPC. For example: The study of [Naeem et al. \(2022a\)](#) reveals that this pandemic reduced the efficiency in ESG markets, except in Europe, which sustained its efficiency during the pandemic. Against the backdrop of the recent pandemic, the study of [Naeem et al. \(2022b\)](#) examines the comparative asymmetric efficiency of dirty and clean energy markets in pre and during the Covid-19 pandemic through the A-MF-DFA technique. The results suggest superior efficiency of clean-energy markets compared to conventional energies. The results further confirm the time-varying nature of market efficiency in the energy markets, and during the pandemic, market inefficiencies in the clean and dirty energy markets soared. The study of [Umar et al. \(2021\)](#) examined the relationship between the recent spread of COVID-19 and stock prices. The findings indicate that the impact of the GPC spreads over different time periods, which points out that it can be seen as an economic crisis in the short run while more like a geopolitical risk in the long run.

Like the case of developed economies, the case of emerging economies is very interesting. Rapid globalization, coupled with the easing of economic and investment barriers and financial integration, facilitates capital flow to emerging markets but at the cost of high volatility (Guo and Huang 2010). Nonetheless, these markets seem more attractive to foreign investors with the main objective of diversification (Fernandes 2005). This has contributed to emerging markets, allowing them to have a higher degree of market efficiency (Debata et al. 2018).

Asian emerging economies are confronted with a series of crises, e.g., the Asian Financial Crisis, the Global Financial Crisis and the Global Pandemic Crisis. Such crises have generated thorough discussion on the desirability of stock market efficiency (see; Arjoon 2016; Raza et al. 2022). Crises have negatively affected market efficiency in the short run, and market development plays a vital role in an emerging market's long-term market efficiency (Arshad et al. 2016). Market efficiency in emerging markets varies over time (Hull and McGroarty 2014). Literature on the emerging Asian stock market's efficiency, on the whole, is half-done. For example, Mahmood et al. (2011) rejected the EMH for the stock markets of Indonesia and Malaysia. Another study in the same vein was conducted by Claessens et al. (1993) with an extended sample period and combined more countries with different techniques to assess the level of market efficiency. The study brings no significant evidence for market efficiency in these twenty markets.

Hoque et al. (2007) also examined the effect of AFC on the efficiency of Asian emerging markets with several approaches. Out of the total eight markets, six markets, Hong Kong, Indonesia, Malaysia, the Philippines, Singapore, and Thailand, remained inefficient even after the Asian crisis. Further, this analysis was confirmed by the study of Kim and Shamsuddin (2008), using multiple variance ratio tests based on the wild bootstrap and signs, finding no significant change in efficiency associated with the impact of the Asian Financial Crisis. One of the studies examined the impact of the crisis on market efficiency in eight Asian markets. They found that the efficiency of the Hong Kong market was severely affected by the crisis, followed by the Philippines, Thailand, Singapore and Malaysia. The majority of these markets showed an improved level of market efficiency in the post-crisis period (Lim et al. 2008).

Pakistan, an emerging economy, is also severely affected by numerous global crises. Ahmad et al. (2020) examined the impact of COVID-19 on the volatility of the Pakistan stock market. Results show a strong link between the recoveries and PSX returns, while the fatalities have a negative effect on the security prices. Reviewing literature leads to contrasting results regarding market efficiency. Particularly, the case of emerging markets is inconclusive as the majority of the studies are not leading to a single and unified conclusion. Therefore, further studies are required to highlight the behaviors of stock market indices in crisis periods and to establish a conclusive argument regarding the level of efficiency in crisis, pre-crisis and post-crisis periods. This study contributes to the existing literature by examining the impact of all three crises (AFC, GFC and GPC) on the informational efficiency of the Pakistan Stock Exchange-100 Index. Furthermore, it not only focuses on the recent crisis but also provides empirical evidence from pre-crisis and post-crisis periods.

Hypotheses of the Study

- H1.** *There is a negative effect of the Asian Financial Crisis on market informational efficiency.*
- H2.** *There is a negative effect of the Global Financial Crisis on market informational efficiency.*
- H3.** *There is a negative effect of the Global Pandemic Crisis on market informational efficiency.*

3. Research Methods and Techniques of the Study

This study considers the Pakistan Stock Exchange-100 Index as the target population. The time period of study ranges from 1995–2022. This time period is enough to cover all three major crises, e.g., AFC, GFC and GPC. PSX is composed of eleven indices. The final sample is composed of the top 100 companies with the highest market capitalization. The

final sample has companies from all eleven sectors. The informational efficiency of the PSX-100 Index is calculated with a VR test of Kim (2006). Finally, the empirical evidence not only highlights the crisis periods but also investigates the pre-crisis and post-crisis periods.

3.1. Measure of Informational Efficiency of the Stock Market

Variance Ratio Test

Literature shows different tests to investigate the informational efficiency of security prices and stock market indices, for example, Lo and MacKinlay (1988). Numerous tests like unit roots, variance ratio tests, GARCH models tests, and Data Envelopment Analysis tests are applied to investigate the efficiency of the stock market and firms. This study is concerned with the variance ratio test developed by Kim (2006) to check the random walk, while the magnitude of the static test shows the informational efficiency of the stocks. This test is basically used to test market efficiency by determining whether securities prices show autocorrelation. If there exist autocorrelations in securities, then resultantly, we can get help from the past securities prices and can predict future prices on the basis of past prices. Hence, in this case, the weak form of market efficiency can be rejected. In finance, the random walk of the securities has been thoroughly discussed and it is a broader phenomenon.

These tests rely on the underlying autocorrelation in stock returns for testing the EMH and have widespread uses, e.g., testing the martingale hypothesis in financial time series. However, for small samples, the above-mentioned tests may lead to unrealistic and ambiguous results. A financial time series typically exhibits heteroscedasticity. The key reason for using the VR test of Kim (2006) is its pervasive use in the literature and robustness in small samples of panel data (see, e.g., Kim and Shamsuddin 2008). The application of wild bootstrap enhances its robustness to size distortions and leads to a substantially higher power than other tests. This test is also applicable to the data with an unknown form of conditional and unconditional heteroscedasticity (see Davidson and Flachaire 2008). This study follows the methodology of Kim (2006) and applies the wild bootstrap to the VR test of Lo and MacKinlay (1988) $M_2(K)$ and Chow and Denning (1993) $MV_2(K_i)$ VR tests.

1. Make a bootstrap sample of T observations $X_t^* = \eta_t X_t$ ($t = 1 \dots T$) where in this equation η_t is a random sequence with $E(\eta) = 0$ and $E(\eta^2) = 1$.
2. Compute $MV^* = MV_2(X^*; k_i)$, and the $MV_2(X^*; k_i)$ statistic is developed from the bootstrap sample created in the initial phase.
3. Reprise stage (a) and stage (b) passably 'm' times to make a bootstrap distribution of the test statistic $\{MV_2(X^*; k_j; j)\}_{j=1}^m$.

4. Results and Interpretations

We initiate the research analysis by reporting the historical performance of the PSX-100 Index. In addition to the full-period analysis, we also perform a sub-period analysis of the PSX-100 Index in pre-crises, crises and post-crisis periods. For downside risk analysis, we report value at risk (VaR), maximum drawdowns (MDD) and expected shortfall (ES). This analysis presents a clear picture of the historical returns and volatility.

Let us first highlight the historical performance of the index. For this purpose, we plot the historical daily prices of the PSX-100 Index for the time period 1995–2022. Figure 1 shows that the PSX-100 Index can be categorized into growth periods and high volatility periods. The index increased from approximately 1000 points in 1995 to 46,000 points in the study period of 1995–2022. In this whole period, the high volatility periods are mostly associated with GFC i.e., GFC in the period of 2007–2008 and GPC at the start of 2020 while there is almost tranquility in the AFC period of 1997–1998. In the latter two crisis periods, the Pakistan stock market was enormously turbulent and suffered huge downside risks. Interestingly, the market reacts positively once the GFC period is over.

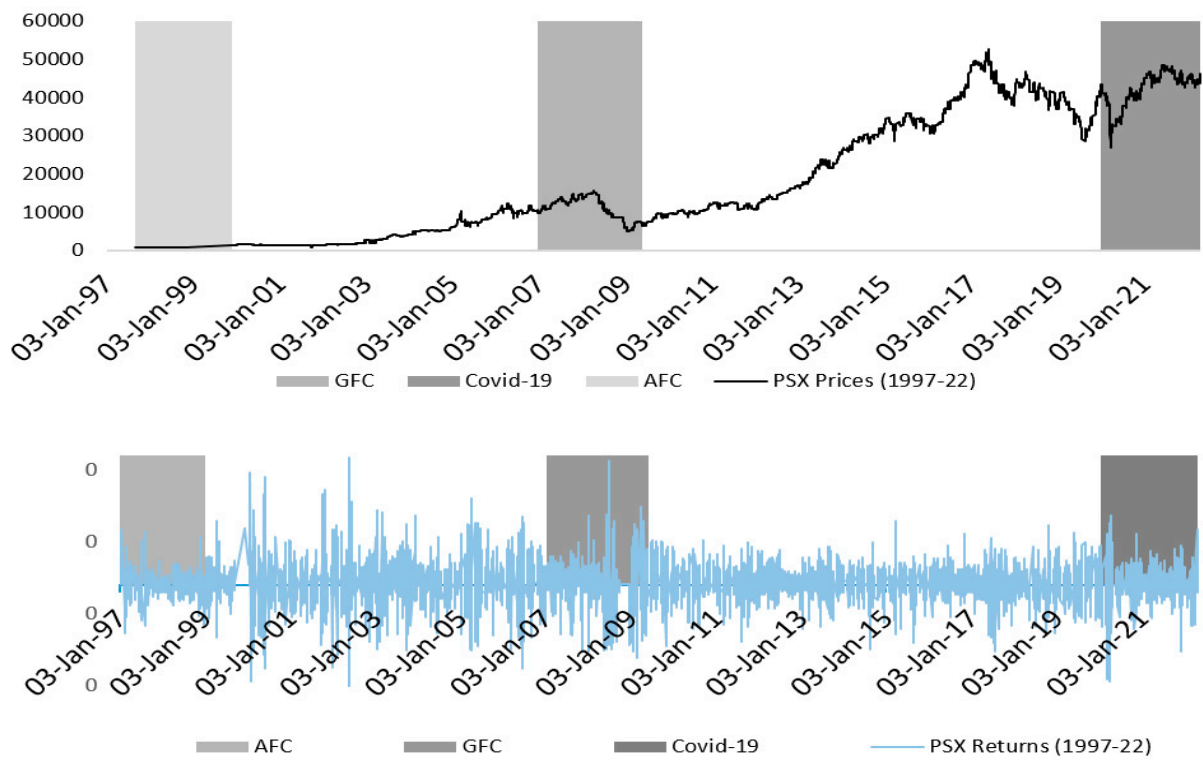


Figure 1. Stock Prices and Returns for the Period of 1995–2022.¹

Now let us highlight the average financial performance, variation and downside risk of the PSX-100 Index in Table 1.

Table 1. Effect of Market Turmoil on Financial Performance of PSX-100 Index.

	Whole Sample	AFC			GFC			COVID-19		
		Pre	AFC	Post	Pre	GFC	Post	Pre	GPC	Post
μ	17.15	26.11	−35.12	37.04	30.21	−79.40	98.12	11.80	−91.03	29.70
SD	20.01	14.16	27.00	19.10	18.70	31.00	26.32	19.00	34.00	16.18
SR	0.82	0.50	−1.15	3.73	1.60	−2.56	3.73	0.57	−2.65	1.77
MDD	69.18	09.08	27.97	10.03	15.80	70.00	13.03	30.88	37.00	12.01
VaR	−2.16	−1.90	−3.71	−2.01	−2.19	−4.10	−2.11	−2.03	−5.73	−1.51
ES	−3.29	−1.52	−2.52	−2.10	−3.13	−4.35	−3.17	−2.33	−6.73	−2.31
Skew	−0.22	−0.54	0.13	0.10	−0.81	0.34	0.15	0.15	−1.16	0.14
Kurt	3.90	2.01	1.60	0.35	3.16	2.36	0.51	0.00	1.52	3.00 ²

Table 1 μ shows annualized returns while SD is the standard deviation. SR is the Sharpe ratio which shows the risk-adjusted performance of the Index. All three major crises were identified with the help of drawdown analysis. For post and pre-crisis periods of all three events, we consider a window of 253 working days around the event date.

The results in Table 1 show that the returns and risk characteristics of the Pakistan stock market vary in nature. In the whole period, the PSX-100 Index reports 17% annualized returns with a 20% standard deviation on a yearly basis. All the crises resulted in negative annualized returns for the PSX-100 Index. It is one of the thought-provoking findings that all period returns and volatility are time-varying in nature. Non-crisis periods are associated with higher and more stable returns. In comparison, the crisis periods show extremely lower but highly volatile returns. If we compare the volatility of all the Index in AFC, GFC and GPC, we can see that the market was more volatile in GPC (34% vs. 31% and 27%). The Index experienced severe downside risk, as indicated by maximum drawdowns

and value-at-risk statistics. The drawdowns of 70% are the worst losses experienced by the Pakistan stock market in the GFC period. In comparison, the GPC has a less severe effect, and PSX experienced 37% maximum drawdowns.

One of the possible reasons for high volatility and worse VAR in the GPC is, in fact, the nature of this crisis. This global pandemic was an unexpected shock due to the policy’s failure to recognize the health emergency through containment measures, and it spread very quickly throughout the world. The current event put the whole economy into almost a hibernation stage and has resulted in serious contractions in the overall output of the economy. The effect of shocks was even sharper compared to those during the Great Depression and some other serious events. From this, we can infer that in contrast to the AFC and GFC, the present crisis has three key features. Firstly, it is truly exogenous and the result of financial imbalances. Secondly, the GPC was truly uncertain in the specific sense that the wide range of possibilities depends on unpredictable non-economic factors. Finally, the virus spread all over the world, thus making the GPC a universal matter. However, the AFC is also termed as “Global,” but in fact, many countries did not actually experience it, such as those in Asia, which was linked with the Asian Financial Crisis and Limited to Thailand, Indonesia, South Korea, Malaysia and the Philippines.

Informational Efficiency Link with Triangle Crises

Several studies (Bae et al. 2004; Arjoon 2016; Raza et al. 2022) highlight various sets of factors that cause the level of informational efficiency to fluctuate, e.g., liquidity and volatility, trading cost and market microstructure, and financial reforms and institutional ownership. This study is not concerned with the rest of the factors, but we have certain evidence concerning the Pakistan stock market volatility. Our results revealed a relatively higher value of standard deviation in all the crisis periods, which shows that the market is disturbed and indicates low efficiency in these periods. In the post-crisis period, the market responds positively, and we expect improved statistics for stock market efficiency. To achieve this objective, we examined the informational efficiency of the market in both normal and crisis periods. The results are conveyed in Table 2.

Table 2. Time-varying Informational Efficiency of PSX-100 Index.

	Whole Sample	AFC			GFC			COVID-19		
		Pre	AFC	Post	Pre	GFC	Post	Pre	GPC	Post
μ	1.89	1.00	1.02	0.91	2.10	1.43	1.81	1.09	1.78	1.09
Sigma	25.60	74.30	10.09	15.09	74.30	14.5	14.73	25.10	7.16	23.78
Skew	0.83	0.23	0.59	0.12	0.23	0.40	0.28	0.19	−1.28	1.32
Kurt	−1.20	−0.20	1.04	0.53	−0.20	−0.42	−2.40	1.76	3.74	1.66

The GFC was identified with the help of drawdown analysis, and it shows that the crisis lasted from 2008 to 2009. Similarly, the COVID-19 crisis period started in the first quarter of 2020 and lasted until the first few months of 2020. For pre and post-crisis periods, we consider a window of 253 working days.

The above analysis highlights the descriptive statistics of the PSX-100 Index in the full sample and sub-sample periods. In the next section, we highlight the informational efficiency of the PSX-100 Index for the whole time period. The higher (lower) the value, the lower (higher) will be the Informational efficiency of the index in the specified period. For this purpose, we report the VR test and plot the yearly observations in Figure 2.

The results in Figure 2 show informational efficiency calculated with the variance ratio test of Kim (2006) for the PSX-100 Index in the pre-AFC (1995–1996) and AFC period (1997–1998). In the above plot, the size of the dots/points is very important. A point at a long distance from X-axis indicates lower informational efficiency, while a shorter distance from X-axis represents higher efficiency. The figure is divided into two panels. The upper panel shows the monthly efficiency of the pre-crisis period, while the lower panel shows

the monthly efficiency of the PSX-100 Index in the crisis period. The analysis for a time period of pre-crisis (1995–1996) shows no distinct differences in the informational efficiency of the Pakistan stock market, which confirms that there is no link and spillover effect of AFC on this market.

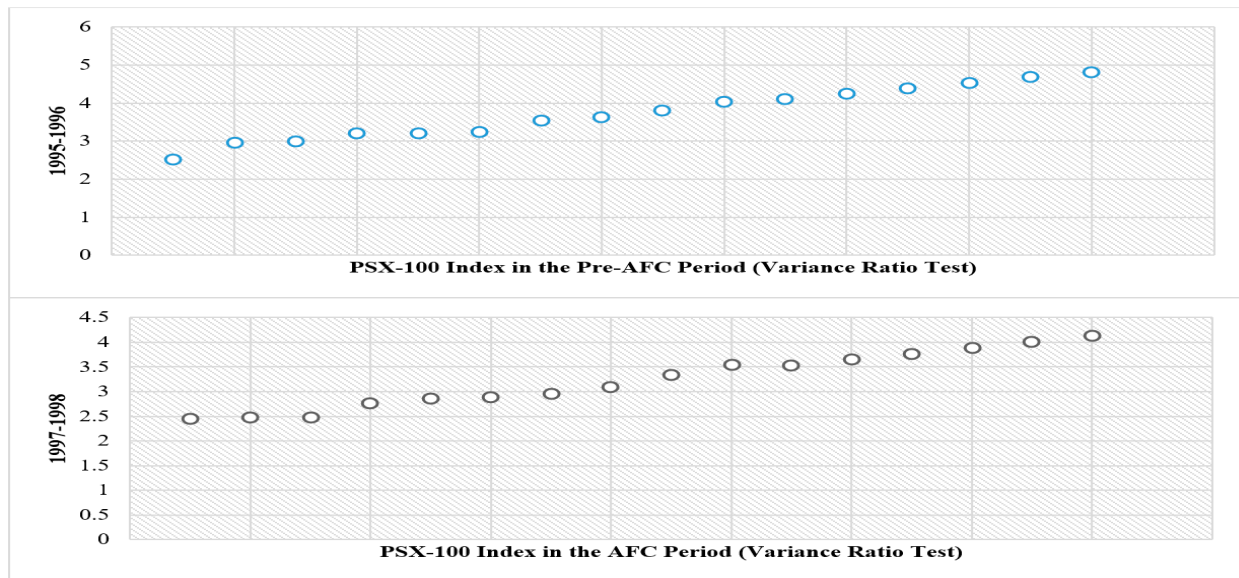


Figure 2. Informational Efficiency of PSX-100 Index in Pre-AFC (1995–1996) and AFC period (1997–1998).³

The results in Figure 3 are divided into two panels. The upper panel shows the efficiency of the pre-GFC period, while the lower panel shows the GFC period. The plot indicates that for the time period (2004–2006), the majority of the firms show higher informational efficiency. The points in the lower panel indicate a relatively higher distance from the X-axis, which is an indication of lower informational efficiency in the crisis period (2007–2009). Though, at times the length of the point’s distance from the X-axis decreased comparatively and got closer to zero which indicates improvement in efficiency after the GFC period.

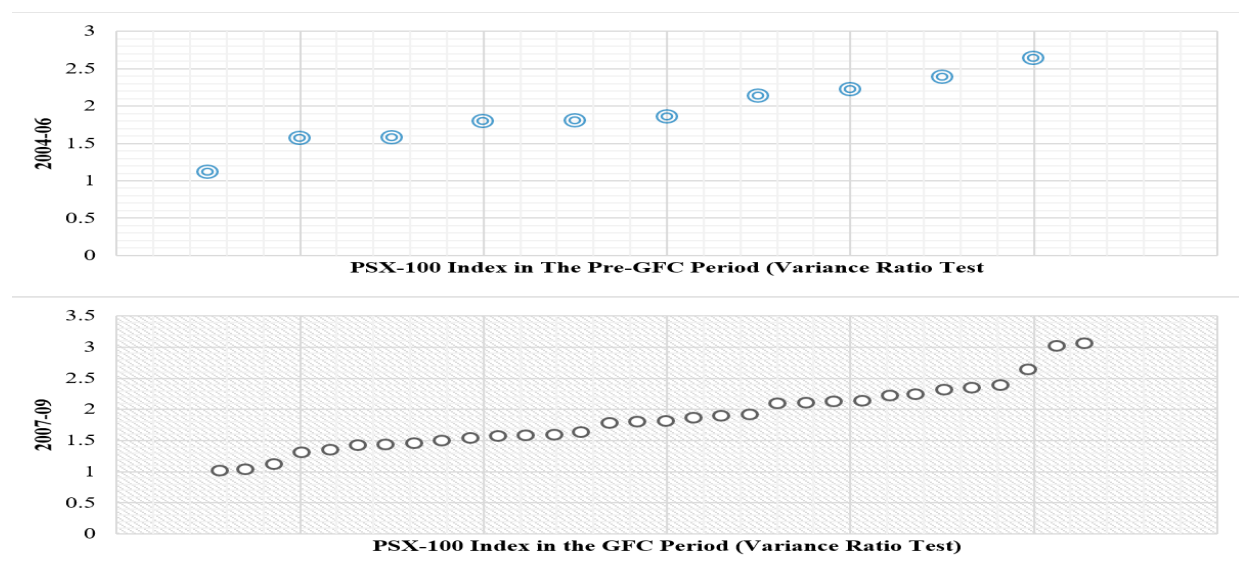


Figure 3. Informational Efficiency of PSX-100 Index in Pre-GFC (2004–2006) and GFC period (2007–2009).

In Figure 4, the study reports the same empirical analysis, but this time the study mainly focuses on the pre-crisis and crisis period caused by the recent GPC (2020–2022). If we compare the length of the dots in this figure with Figures 2 and 3, we can extract an interesting finding that the PSX-100 Index leads to be least informational efficient in this GPC period compared to AFC and GFC crises. As discussed earlier, a possible reason for such behavior may be the fact that unlike the AFC and GFC, which were mainly caused by endogenous economic, regulatory and financial irregularities, the existing pandemic is purely exogenous in nature. GPC has had far more profound and prevalent economic influences, particularly in terms of output, economic uncertainties, fiscal expenditures as well as public debt. Actually, the GFC-driven regulatory reforms and experiences learned about the cross-sectoral feedback effects and the use of numerous tools to address regulatory and institutional matters have significantly helped policymakers to survive these shocks. Unusually, financial institutions were the center of the GFC in terms of causes and its spread, but in the GPC, banks played a partial role in the solution for this issue. Moreover, the policy responses of the central banks and concerned national authorities around the world have been swift and aggressive against the current pandemic, and the scale and scope of these measures exceed the ones used to contain GFC.

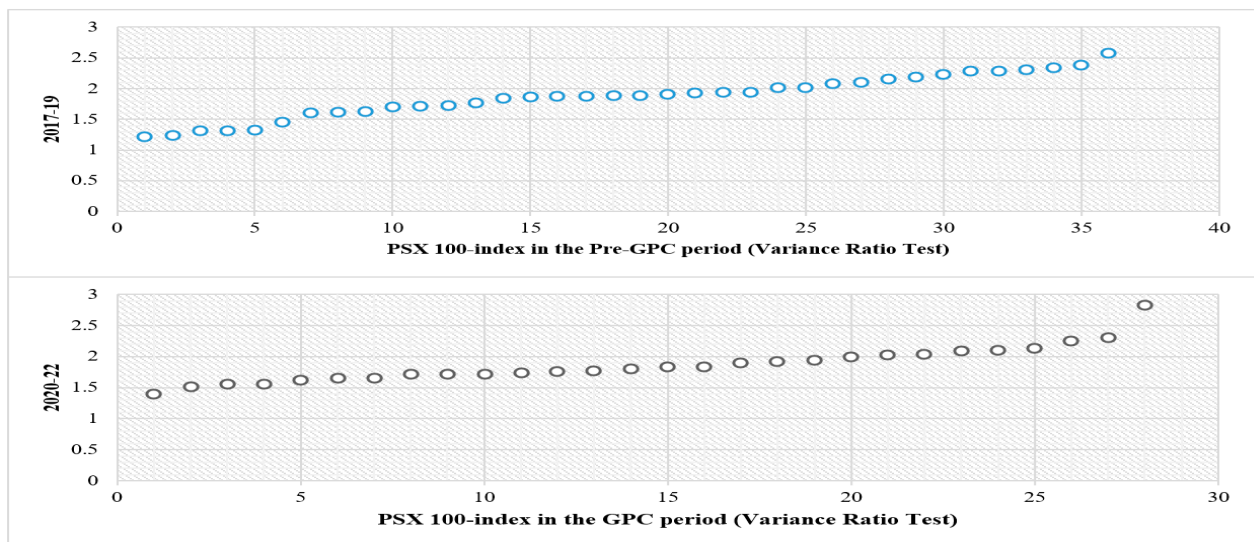


Figure 4. Informational Efficiency in the Pre-GPC period and GPC period.

5. Conclusive Remarks

Stock market informational efficiency is of prodigious importance for developing countries to achieve optimum asset allocation. This study contributes to the existing literature by providing a comparative analysis of the weak form of informational efficiency in the triangle of crises (Asian Financial Crisis, Global Financial Crisis and Global Pandemic Crisis). The empirical results of this research provide evidence of the informational efficiency of the Pakistan stock market-100 Index.

The study has made a few contributions. First, the sample period consists of an extended time period (1995–2022) which is enough to cover both the normal and crisis periods. Second, the data is collected on a monthly basis which provides in-depth information compared to the annual data, which may overwrite the real-time series changes. Third, the PSX-100 Index results can be generalizable to the whole economy of Pakistan. Fourth, the study is concerned with time-varying market informational efficiency instead of event methodology, which brings insignificant results in the long run due to lowering the specific event impact.

Descriptive statistics confirm that such crises have a detrimental effect on the financial performance of the PSX-100 Index. The estimated values of standard deviation confirm high risk in both GFC and GPC as compared to AFC. High standard deviation values show

that high turmoil periods yield high risk and confirm exposure of the PSX-100 Index to global shocks. One of the key factors may be the investors' herd behavior that results in over and underpricing of securities, consequently leading to the overall market extreme movements (Ghufran et al. 2016). These findings are consistent with the expectations insofar as the crises are vital factors causing market turbulence.

We also found that the informational efficiency is relatively lower in AFC and GPC as compared to GFC and these results are consistent with (Hoque et al. 2007; Kim and Shamsuddin 2008; Li et al. 2021). This study has confirmed that the stock market's efficiency recovers once the crisis period is over. This is true, particularly in the case of GFC. A few of the possible reasons are; in GFC the global output loss was 0.6 percent while GPC has increased to 3.3 percent. The spillover effect of GFC was slower, while the latter abruptly spread globally.

Practical Implications for Pakistan

The empirical analyses derived above have important implications. The data presented in this research open up a number of questions and suggestions for further refinement of the Asian stock markets in general while particularly in the Pakistani market. The market efficiency deteriorates significantly in a period of crisis which further reduces the capability of investors to predict the prices with the limited available information. However, the market recovered in a post-crisis period, which boosted investor confidence, and it implies that emerging markets (specifically Pakistan) are attractive avenues for investing in bull markets. The policymakers should introduce reforms that can safeguard the level of efficiency in economic turmoil, e.g., accounting standards for screening, market regulations and investment laws. Publishing pamphlets and information disclosure can also help improve the level of efficiency.

Author Contributions: All authors contributed equally. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Conflicts of Interest: The authors declare no conflict of interest.

Notes

- ¹ Figure 1 consists of two panels. The first panel shows PSX-100 Index prices for the period of 1995–2022. There are three highlighted areas starting from the light highlighted area to the dark highlighted area. The first highlighted area is the AFC period (1997–1998), the second highlighted area is the GFC period (2007–2009), and lastly, the dark highlighted area is the GPC period (2020–2022). The line graph shows high fluctuations in the GPC period (2020–2022) followed by the GFC period (2007–2009), while the AFC period (1997–1998) is the most tranquil one in the graph. The second panel shows PSX-100 Index returns for the period of 1995–2022. There are three highlighted areas starting from the light highlighted area to the dark highlighted area. The first highlighted area is the AFC period (1997–1998), the second highlighted area is the GFC period (2007–2009), and lastly, the dark highlighted area is the GPC period (2020–2022). The line graph of returns shows high negative fluctuations in the GPC period (2020–2022) followed by the GFC period (2007–2009), while the AFC period (1997–1998) shows relatively no high fluctuations in the line graph.
- ² In Table 1, ' μ ' is the annualized returns, 'SD' is the standard deviation, 'VaR' is the value at risk, 'MDD' is maximum drawdowns, 'ES' is expected shortfall, 'Skew' is skewness and 'Kurt' is kurtosis of the study.
- ³ All the dot/Point graphs of efficiency are drawn on a monthly basis for the Pre-AFC period (1995–1996) and AFC period (1997–1998), Pre-GFC period (2004–2006), GFC period (2007–2009) and the Pre-GPC period (2017–2019) and the GPC period (2020–2022). The first blue dot/point graphs exhibit Pre-AFC, Pre-GFC and Pre-Covid period for the PSX-100 Index informational efficiency, and black dot/point graphs show the AFC, GFC and the GPC of the PSX-100 Index informational efficiency.

References

- Ahmad, Ehtisham, Nicholas Stern, and Chunping Xie. 2020. *From Rescue to Recovery: Towards a Post-Pandemic Sustainable Transition for China. Towards a Post-Pandemic Sustainable Transition for China*. Beijing: China Development Forum. Available online: <https://cdrf.org.cn/jjh/pdf/> (accessed on 10 November 2021).
- Arjoon, Vaalmikki. 2016. Microstructures, financial reforms and informational efficiency in an emerging market. *Research in International Business and Finance* 36: 112–26. [[CrossRef](#)]

- Arshad, Shaista, Syed Aun R. Rizvi, Gairuzazmi Mat Ghani, and Jarita Duasa. 2016. Investigating stock market efficiency: A look at OIC member countries. *Research in International Business and Finance* 36: 402–13. [CrossRef]
- Bae, Sung C., Taek Ho Kwon, and Jong Won Park. 2004. Futures trading, spot market volatility, and market efficiency: The case of the Korean index futures markets. *Journal of Futures Markets: Futures, Options, and Other Derivative Products* 24: 1195–228. [CrossRef]
- Boudt, Kris, Muhammad Wajid Raza, and Dawood Ashraf. 2019a. Macro-financial regimes and performance of Shariah-compliant equity portfolios. *Journal of International Financial Markets, Institutions and Money* 60: 252–66. [CrossRef]
- Boudt, Kris, Muhammad Wajid Raza, and Marjan Wauters. 2019b. Evaluating the Shariah-compliance of equity portfolios: The weighting method matters. *International Review of Financial Analysis* 63: 406–17. [CrossRef]
- Chang, Haowen, Yichein Chiang, Meichu Ke, Minghui Wang, and Tienchung Nguyen. 2023. Market efficiency of Asian stock markets during the financial crisis and non-financial crisis periods. *International Review of Economics & Finance* 83: 312–29.
- Charles, Amélie, Olivier Darné, and Adrian Pop. 2015. Risk and ethical investment: Empirical evidence from Dow Jones Islamic indexes. *Research in International Business and Finance* 35: 33–56. [CrossRef]
- Chaudhuri, Kausik, and Yangru Wu. 2003. Random walk versus breaking trend in stock prices: Evidence from emerging markets. *Journal of Banking & Finance* 27: 575–92.
- Chow, K. Victor, and Karen C. Denning. 1993. A simple multiple variance ratio test. *Journal of Econometrics* 58: 385–401. [CrossRef]
- Claessens, Stijn, Susmita Dasgupta, and Jack Glen. 1993. *Stock Price Behavior in Emerging Markets*. Washington, DC: International Economics Department, Debt and International Finance Division, World Bank.
- Cooray, Arusha, and Guneratne Wickremasinghe. 2005. The Efficiency of Emerging Stock Markets: Empirical Evidence from the South Asian Region. 171–184. Available online: <https://mpra.ub.uni-muenchen.de/23626/> (accessed on 15 March 2021).
- Davidson, Russell, and Emmanuel Flachaire. 2008. The wild bootstrap, tamed at last. *Journal of Econometrics* 146: 162–69. [CrossRef]
- Debata, Byomakesh, Saumya Ranjan Dash, and Jitendra Mahakud. 2018. Investor sentiment and emerging stock market liquidity. *Finance Research Letters* 26: 15–31. [CrossRef]
- Fama, Eugene. 1970. Efficient capital markets: A review of theory and empirical work. *The Journal of Finance* 25: 383–417. [CrossRef]
- Fernandes, Nuno. 2005. Portfolio disaggregation in emerging market investments. *The Journal of Portfolio Management* 31: 41–49. [CrossRef]
- Gaio, Luiz Eduardo, Nelson Oliveira Stefanelli, Tabajara Pimenta Júnior, Carlos Alberto Grespan Bonacim, and Rafael Confetti Gatsios. 2022. The impact of the Russia-Ukraine conflict on market efficiency: Evidence for the developed stock market. *Finance Research Letters* 50: 103302. [CrossRef]
- Ghufuran, Bushra, Hayat M. Awan, Aftab Khan Khakwani, and Muhammad Azeem Qureshi. 2016. What causes stock market volatility in Pakistan? Evidence from the field. *Economics Research International* 2016: 1–9. [CrossRef]
- Gilson, Ronald, and Reinier Kraakman. 2014. Market efficiency after the financial crisis: It's still a matter of information costs. *Virginia Law Review* 100: 313. [CrossRef]
- Gulati, Rachita. 2022. Global and local banking crises and risk-adjusted efficiency of Indian banks: Are the impacts really perspective-dependent? *The Quarterly Review of Economics and Finance* 84: 23–39. [CrossRef]
- Guo, Feng, and Ying Sophie Huang. 2010. Does “hot money” drive China's real estate and stock markets? *International Review of Economics & Finance* 19: 452–66. [CrossRef]
- Hkiri, Bisma, Azza Béjaoui, Cheima Gharib, and Hashem A. AlNemer. 2021. Revisiting efficiency in MENA stock markets during political shocks: Evidence from a multi-step approach. *Heliyon* 7: e08028. [CrossRef]
- Hoque, Hafiz A. A. B., Jae H. Kim, and Chong Soo Pyun. 2007. A comparison of variance ratio tests of random walk: A case of Asian emerging stock markets. *International Review of Economics & Finance* 16: 488–502. [CrossRef]
- Horta, Paulo, Sérgio Lagoa, and Luís Martins. 2014. The impact of the 2008 and 2010 financial crises on the Hurst exponents of international stock markets: Implications for efficiency and contagion. *International Review of Financial Analysis* 35: 140–53. [CrossRef]
- Hull, Matthew, and Frank McGroarty. 2014. Do emerging markets become more efficient as they develop? Long memory persistence in equity indices. *Emerging Markets Review* 18: 45–61. [CrossRef]
- Ito, Mikio, and Shunsuke Sugiyama. 2009. Measuring the degree of time varying market inefficiency. *Economics Letters* 103: 62–64. [CrossRef]
- Kaminsky, Graciela L., Carmen M. Reinhart, and Carlos A. Vegh. 2003. The unholy trinity of financial contagion. *Journal of Economic Perspectives* 17: 51–74. [CrossRef]
- Kavussanos, Manolis, and Everton Dockery. 2001. A multivariate test for stock market efficiency: The case of ASE. *Applied Financial Economics* 11: 573–79. [CrossRef]
- Kim, Jae H. 2006. Wild bootstrapping variance ratio tests. *Economics Letters* 92: 38–43. [CrossRef]
- Kim, Jae H., and Abul Shamsuddin. 2008. Are Asian stock markets efficient? Evidence from new multiple variance ratio tests. *Journal of Empirical Finance* 15: 518–32. [CrossRef]
- Lee, Yen-Jung. 2012. The effect of quarterly report readability on information efficiency of stock prices. *Contemporary Accounting Research* 29: 1137–70. [CrossRef]
- Li, Zongyun, Panteha Farmanesh, Dervis Kirikkaleli, and Rania Itani. 2021. A comparative analysis of COVID-19 and global financial crises: Evidence from US economy. *Economic Research-Ekonomska Istraživanja* 1952640: 1–15. [CrossRef]

- Lim, Kian-Ping, Robert D. Brooks, and Jae H. Kim. 2008. Financial crisis and stock market efficiency: Empirical evidence from Asian countries. *International Review of Financial Analysis* 17: 571–91. [\[CrossRef\]](#)
- Liu, Lu, En-Ze Wang, and Chien-Chiang Lee. 2020. Impact of the COVID-19 pandemic on the crude oil and stock markets in the US: A time-varying analysis. *Energy Research Letters* 1: 13154. [\[CrossRef\]](#)
- Lo, Andrew W., and A. Craig MacKinlay. 1988. Stock market prices do not follow random walks: Evidence from a simple specification test. *The Review of Financial Studies* 1: 41–66. [\[CrossRef\]](#)
- Mahmood, Faiq, Xinping Xia, Mumtaz Ali, Muhammad Usman, and Humera Shahid. 2011. How Asian and global economic crises prevail in Chinese IPO and stock market efficiency. *International Business Research* 4: 226–37. [\[CrossRef\]](#)
- Mensi, Walid, Xuan Vinh Vo, and Sang Hoon Kang. 2022. Upward/downward multifractality and efficiency in metals futures markets: The impacts of financial and oil crises. *Resources Policy* 76: 102645. [\[CrossRef\]](#)
- Naeem, Muhammad Abubakr, Imran Yousaf, Sitara Karim, Aviral Kumar Tiwari, and Saqib Farid. 2022a. Comparing asymmetric price efficiency in regional ESG markets before and during COVID-19. *Economic Modelling* 118: 106095. [\[CrossRef\]](#)
- Naeem, Muhammad Abubakr, Sitara Karim, Saqib Farid, and Aviral Kumar Tiwari. 2022b. Comparing the asymmetric efficiency of dirty and clean energy markets pre and during COVID-19. *Economic Analysis and Policy* 75: 548–62. [\[CrossRef\]](#)
- Narayan, Paresh Kumar, and Russell Smyth. 2004. Is South Korea's stock market efficient? *Applied Economics Letters* 11: 707–10. [\[CrossRef\]](#)
- Olugbenga, Adaramola Anthony. 2012. Exchange rate volatility and stock market behaviour: The Nigerian experience. *European Journal of Business and Management* 4: 88–96.
- Ozkan, Oktay. 2021. Impact of COVID-19 on stock market efficiency: Evidence from developed countries. *Research in International Business and Finance* 58: 101445. [\[CrossRef\]](#)
- Park, Albert, Dean Yang, Xinzheng Shi, and Yuan Jiang. 2010. Exporting and firm performance: Chinese exporters and the Asian Financial Crisis. *The Review of Economics and Statistics* 92: 822–42. [\[CrossRef\]](#)
- Pontines, Victor, and Reza Y. Siregar. 2012. Fear of appreciation in East and Southeast Asia: The role of the Chinese renminbi. *Journal of Asian Economics* 23: 324–34. [\[CrossRef\]](#)
- Raza, Muhammad Wajid, Bahrawar Said, and Ahmed Elshahat. 2022. Covid-19 and Informational Efficiency in Asian Emerging Markets: A Comparative Study of Conventional and Shariah-Compliant Stocks. *International Journal of Islamic and Middle Eastern Finance and Management*. [\[CrossRef\]](#)
- Samuelson, Paul A. 1965. Proof that properly anticipated prices fluctuate randomly. *Industrial Management Review* 6: 41–49. [\[CrossRef\]](#)
- Sengonul, Ahmet, and Suleyman Degirmen. 2011. Does the recent global financial crisis affect efficiency of capital markets of EU countries and Turkey. Paper presented at the 13th International Conference on Finance and Banking, Ostrava, Czech Republic, December 10.
- Stubbs, R. 2014. ASEAN's leadership in East Asian region-building: Strength in weakness. *The Pacific Review* 27: 523–41. [\[CrossRef\]](#)
- Ting, Hiram, Jeffery Ling, and Jun Hwa Cheah. 2020. It will go away!? Pandemic crisis and business in Asia. *Asian Journal of Business Research* 10: 1–7. [\[CrossRef\]](#)
- Umar, Muhammad, Syed Kumail Abbas Rizvi, and Bushra Naqvi. 2021. Dance with the devil? The nexus of fourth industrial revolution, technological financial products and volatility spillovers in global financial system. *Technological Forecasting and Social Change* 163: 120450. [\[CrossRef\]](#)
- Wang, Jingjing, and Xiaoyang Wang. 2021. COVID-19 and financial market efficiency: Evidence from an entropy-based analysis. *Finance Research Letters* 42: 101888. [\[CrossRef\]](#)
- Worthington, Andrew, and Helen Higgs. 2006. Random walks and market efficiency in European equity markets. *The Global Journal of Finance and Economics* 1: 59–78.
- Wright, Calvin, and Steven Swidler. 2023. Abnormal trading volume, news and market efficiency: Evidence from the Jamaica Stock Exchange. *Research in International Business and Finance* 64: 101804. [\[CrossRef\]](#)