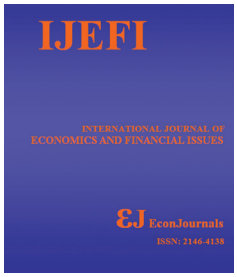

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The Effects of Earthquakes on the Stock Market: The Case of Türkiye

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ABSTRACT

It is fact that the frequency of disasters—particularly earthquakes—have increased all over the world. These events have growing significant adverse effects on both national and global economies. The economic and financial costs caused by earthquakes are often substantial. Minimizing their devastating impact on financial markets, especially stock exchanges, has become a key priority for governments for the sake of financial system. The relationship between seismic events and economic indicators is therefore of considerable importance. The aim of this study is to comparatively analyze the effects of two major earthquakes experienced in Türkiye—the 1999 Marmara Earthquake and the 2023 Kahramanmaraş Earthquake—on the stock market. Utilizing the event study methodology, stock prices were compared across three timeframes: The days of the earthquakes, the days preceding the events, and the days following them. Later, volatility dynamics were examined using the GARCH (Generalized Autoregressive Conditional Heteroskedasticity) model. The empirical findings indicate that both earthquakes caused statistically significant short-term fluctuations in stock returns. The 1999 Marmara earthquake resulted in more distinct and sharp market fluctuations, whereas the 2023 Kahramanmaraş earthquake was followed by a comparatively milder recovery trend. The empirical results of the GARCH model highlighted that while there was volatility throughout the period, it showed a declining trend on the days the earthquakes occurred. This result can be explained by temporary market closures, investor reluctance to engage in trading, and a contraction in market liquidity.

Keywords: 1999 Marmara Earthquake, 2023 Kahramanmaraş Earthquake, Stock Market, BIST
JEL Classifications: G14, Q54

1. INTRODUCTION

Natural disasters, including floods, earthquakes, hurricanes, wildfires, and pandemics, may cause severe challenges not only to human safety, physical infrastructure, houses, and harvest, but also to the stability, sustainability, and functioning of national and global economies as well as financial markets. Depending on the severity of the catastrophic event, there may be an increasing number of deaths, displacement of populations, migrations, disruption of production cycles, and damage to capital assets (Cavallo and Noy, 2011). The negative consequences of disasters can be conceptualized through direct and indirect effects. While direct effects include physical asset losses, infrastructure damage, and interruptions to trade and industrial production activities as expressed above, indirect effects lead to a reduction in productivity, loss of investor confidence, outflows of foreign capital, and increased government borrowing for reconstruction (Kellenberg and Mobarak, 2008).

Besides, as Barro (2006) pointed out, rare economic disasters such as wars, financial crises, or depressions have greater welfare costs than ordinary economic fluctuations. The author indicated that while standard business cycle volatility costs of a1.5% of GDP, the unexpected economic disasters due to wars, depressions,

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and financial crises cause a welfare loss of approximately 20% of annual GDP. Local natural disasters may impact nationwide or global financial intermediaries, as well. These financial intermediaries try to adjust their risk and control their portfolios depending on the damage of a catastrophe or expected future losses (Eickmeier and Schüler, 2024).

The fact is that the level of economic development of countries is an important parameter in combating natural disasters. There is an inverse relationship between the risk of losses from unexpected natural disasters and the level of development of countries. Indeed, the higher-income countries are able to mitigate disaster risks. On the contrary, the least developed countries need to choose one of the two goals due to limited budget. They either make an investment in disaster risk prevention program or concentrate on economic development, which is not a solution for any form of natural disaster. In addition to allocating resources to manage disaster risk, the less developed countries may have to be more proactive in creating policies to activate and raise awareness among their citizens to alleviate the natural disaster risk (Kellenberg and Mobarak, 2008). Furthermore, low income per capita and income inequality are other important economic factors that have inverse effects during disasters. The lower the income and the higher the income inequality, the higher the number of deaths during an earthquake (Anbarci et al., 2005). Particularly in emerging markets, where institutional resilience and financial buffers are limited, economic shocks due to disasters can severely destabilize macroeconomic performance and trigger long-term volatility and developmental setbacks.

Disasters such as epidemics, wars, and earthquakes, which affect macroeconomic variables, also influence the course of the stock market. Numerous studies analyze the macroeconomic consequences of wars with global impact, as well as natural disasters such as epidemics and earthquakes (Erdoğan et al., 2020; Albuquerque and Rajhi, 2019; Çakar et al., 2021; Nguyen and Chaiechi, 2021; Boungou and Yatié, 2022; Gedikli et al., 2022; Erdoğan et al., 2020; Khan et al., 2023; Ahmed et al., 2023). Although there is a broad literature on the relationship between different types of natural disasters, in this study, the relationship between earthquakes and stock markets will be analyzed.

The reverse effects of disasters on financial activities may be channeled through financial risks, growing uncertainty, and undermining of investor confidence, leading to hazardous effects on economic transactions that can persist long after the immediate physical damage of the disaster. The impact of these risks on local economies is ambiguous. For example, disasters can trigger panic selling, unexpected behavioral responses, or reallocations of portfolios because of uncertainty, volatility, or fear of loss. The responses of stock markets to natural hazard shocks are also various (Pagnattoni et al., 2022). The type of hazardous event and the location in which the event has occurred are basic factors affecting the investors' responses to the financial shocks due to natural disasters. However, most of the natural calamities induce extreme reactions in international financial markets.

Compared to the other natural disasters, earthquakes may be more significant, multifaceted, and destructive because of their unique characteristics. Their limited predictability and potential to massive infrastructure and building damages trigger a substantial fiscal burden for governments, long-term disruptions in labor markets, loss of real economic activities, trade, and business, and decline in economic output. The immediate panic in the real economy affects financial markets, and investor behaviors depending on the seismic scale of the earthquake, the area of epicenter, and its magnitude (Yamori and Asai, 2017). Every earthquake is followed by immediate recovery processes handled by both the national government and international support, including evacuation, disaster relief, and post-disaster philanthropic donations (Wang et al., 2020; Felbermayr and Gröschl, 2014; Worthington and Valadkhani, 2007). However, all these recovery processes are very long, their costs are high, and donations and grants may be limited to cover all damages. Furthermore, negative effects of these seismic events on financial markets can also be destructive. Earthquakes may have both a short-term impact on stock prices and a higher risk aversion. These results have often been found in studies on the effects of earthquakes on the financial system and stock market of Japan, one of the countries that produces the most destructive natural disasters, particularly earthquakes in the world (Yamori and Asai, 2017; Yamori et al., 2009).

Similar to Japan, Türkiye also suffers from different catastrophic natural disasters. Between 1980 and 2024, there were 49 earthquakes, 43 floods, and 12 storms recorded in Türkiye (World Bank Climate Change Knowledge Portal, 2025). The fact is that Türkiye is located on several active fault lines and is one of the most seismically active countries in the world, suffering from the devastating economic consequences of earthquakes, especially in its financial system. The 1999 Great Marmara earthquake and the more recent 2023 Kahramanmaraş earthquakes are the most destructive ones in the near past. On August 17, 1999, Türkiye experienced one of the greatest earthquakes in its history with a magnitude of 7.4. The epicenter was Kocaeli, 100 km away from Istanbul. There were almost 17.500 people lost their lives during the August 17, 1999 Great Marmara earthquake (IFRC, 2019). Destruction of physical stock was more than $10 billion. This amount represented almost 50% of the housing and enterprise sectors. The associated income losses were almost 3% of GDP. This loss is due to both the loss of output and the high cost of emergency relief (OECD, 2000).

On February 6, 2003, the twin earthquakes with magnitudes (Mw) of 7.8 and 7.5 occurred in the southeastern region of Türkiye. The epicenter was Kahramanmaraş. According to the World Bank report released on the immediate damages of the Kahramanmaraş earthquake, the twin earthquakes caused great damage in 11 provinces where 14.01 million people were affected (16.5% of the total population). In the report, it was also underlined that the direct cost of the Kahramanmaraş earthquake was estimated as $34.2 billion (4% of the GDP of 2021) (World Bank Group Global Facility for Disaster Reduction and Recovery (GFDRR), 2023). JP Morgan also declared that the estimated cost of physical destruction of the Kahramanmaraş earthquake was 2.5% of the GDP in 2023 (Reuters, 2023).

Due to its seismically active structure, there may be great earthquakes very frequently in Türkiye. This makes the country open to economic and financial instability risks. During1999 Marmara earthquake and the 2023 Kahramanmaraş earthquakes periods, the complex interaction between seismic risk and financial markets was observed. The extent of the two earthquakes' impact on the Borsa İstanbul (BIST) and the stock market were varied. For these two great earthquakes there are rising questions about market resilience, government response, and investor adaptation mechanisms. Although the BIST showed resilience in some indicators, sectoral reactions and investor panic played crucial roles in realizing market responses. Given these multidimensional impacts, understanding how earthquakes impact national stock markets and how markets recover from these shocks is a critical question not only for academicians and investors but also for policy makers to prepare disaster preparedness plans and risk management strategies.

Hence, this study aims to investigate the effects of major earthquakes on the Turkish stock market, focusing on stock performance before and after seismic events, sector-specific impacts, and investor behavior. One of the most important indicators for measuring the effects of earthquakes on economic instability is sudden changes and reactions in the stock market. Therefore, investigating the impact of earthquakes on the stock market is a key research topic for revealing the impact of earthquakes on the economy. To the best of our knowledge, there is no paper investigated the two great earthquakes hit Türkiye together. In this paper, it is aimed to compare the impacts of 1999 Marmara earthquake and 2023 Kahramanmaraş earthquake on the BIST and stock markets. Furthermore, we utilized both the event study methodology and the GARCH model. Hence, a comparative investigation of the two major earthquakes will be provided within the paper.

Also, with the growth of the financial system in Türkiye in passing 25 years, research on measuring the effects of earthquakes on such a developed financial system has become important. Since 1999, numerous regulations have been implemented regarding financial markets in Türkiye. Since then, the financial system has developed, diversified, and steps have been taken towards financial deepening, and the assets and liabilities of the financial system have increased. Financial literacy, investment diversity, and financial awareness have also improved over the past 25 years. The question of whether increasing financial literacy and awareness among investors affects the resilience of financial markets to shocks like earthquakes has also been explored in the paper.

Although the impacts of the two earthquakes were significant, the Kahramanmaraş earthquake had a much broader impact. Both the magnitude of the twin earthquakes and the area affected during the February 06, 2023, Kahramanmaraş earthquake were enormous. Thus, there will be higher long-term impacts to recover in encompassing 11 provinces after the Kahramanmaraş earthquake.

It should be noted that, there has been a significant improvement in the Turkish economy's earthquake-fighting capacity since 1999. Türkiye, with its much greater economic soundness today, requires greater investments. This resulted in a significant financial need. Funding was needed for much larger investments in infrastructure and building construction.

In short, by employing event study methodology and employing the GARCH model, this research seeks to contribute to the literature on disaster economics and financial market resilience by comparing the August 17, 1999 Great Marmara earthquake and the February 06, 2023, Kahramanmaraş earthquake through analyzing the effects of them on stock markets.

The rest of the paper includes literature survey, data and methodology, findings of the analysis and conclusion. Some policy suggestions have been also put forth at the end of the paper.

2. LITERATURE SURVEY

There is a broad literature investigating the effects of natural disasters on stock markets and indices. Most of these studies concentrated on the devastating effects of earthquakes and indicated that earthquakes have a negative impact on stock markets. On the contrary, there are few studies that proved the impact of earthquakes is statistically insignificant. Some even found positive effects on stock markets. The empirical findings of these researches also showed that sectors react to earthquakes in the different same way or different degrees. While some sectors are adversely affected, others indicated a positive response. The macroeconomic performance of the country, global economic conditions, and the structural characteristics of individual sectors are all critical factors in determining the extent and direction of the earthquake's effects on stock markets.

The findings of studies examining the effects of earthquakes on stock markets can be classified under two main categories:

1. Those that emphasize the negative financial consequences of earthquakes due to physical destruction, business interruptions, and uncertainty
2. Those that highlight potential positive effects, such as reconstruction activities, insurance payouts, and increasing government expenditures, that may stimulate certain sectors during the post-disaster period.

2.1. Studies Explaining the Negative Effects of Earthquakes on the Stock Market

Under this heading, the researches whose findings reveal that earthquakes exert negative consequences on stock markets are explained.

Caporale et al. (2025) analyzed the stochastic behavior of stock market log prices and returns in Japan for the period January 2009-February 2024, by classification of earthquakes by magnitude. Their results indicated that seismic activity generates uncertainty which spread overall market performance. Khan et al. (2024) examined the causal effects of earthquakes on the Borsa Istanbul Stock Exchange Index (BIST-100). Using daily data from January 09, 2023 to February 28, 2023, the authors found a significant negative effect of earthquakes on stock market value during the post-earthquake period. The authors emphasized the

role of uncertainty. Similarly, Pandey et al. (2024) analyzed the effects of the February 6, 2023, Kahramanmaraş earthquake, which caused devastating effects on both Türkiye and Syria, focusing on 382 firms listed on the Turkish stock market. Their analysis revealed that the earthquake had a substantial impact on stock returns. Furthermore, it was observed that firms with higher risk profiles experienced more losses, highlighting the heterogeneity in market responses in different sectors and risk categories.

Some studies have revealed that earthquakes do not exert similar effects in different sectors, nor do all earthquakes generate the same type of impact. Sector-specific characteristics play a critical role in determining these outcomes. Furthermore, while some industries are adversely affected by calamities, others may benefit from them. This finding is confirmed in Aksoy and Akyüzlü (2024)'s study. Investigating the impact of the February 6 Kahramanmaraş earthquakes on BIST index returns, the authors reported that while the insurance sector indicated a negative reaction during the day of the earthquake and the following 10-day period, the stone, soil, and cement industries exhibited a positive response.

Han and Tosun (2024) reached the similar results and indicated that not all recent earthquakes in Türkiye had identical effects. Analyzing the 2011 Van, 2020 Elazığ, and February 06, 2023, Kahramanmaraş earthquakes, they examined the impact of variables such as the volatility index, exchange rates, and oil prices on the BIST100 index. Their analysis confirmed that during the 2011 Van earthquake, increases in the volatility index and US dollar parity negatively affected the index. In the 2020 Elazığ earthquake case, only the US dollar had a negative effect, whereas during the 2023 Kahramanmaraş earthquake, increases in both the US dollar parity and oil prices positively affected the BIST100 index.

Aksoy and Yılmaz (2024) analyzed short-term price reactions of 450 firms listed on the BIST All Index on Borsa Istanbul (BIST) after the February 06, 2023, earthquake. The results indicated that on the earthquake day, most sectors experienced significantly negative abnormal returns, except for non-metallic mineral products, which showed significantly positive returns. While firms with strong sustainability performance had resilience to the earthquake in the financial sector, the telecommunications sector was the most negatively affected from the uncertainty due to the earthquake.

Lastly, by using the BIST TUM index for the period from January 01, 2000, to January 28, 2020, Güleç (2000) explored the relationship between earthquakes and the Turkish stock market. The author found no significant relationship between earthquakes that are below a certain magnitude and market movements. However, the proximity of an earthquake to the surface and its impact on urban centers were found to raise the negative effects on financial markets. These findings points the heterogeneous nature of market reactions to seismic events and highlight the necessity of considering sectoral dynamics and earthquake characteristics while assessing market vulnerabilities.

Batrancea et al. (2024) analyzed the impact of the February 6, 2023, Kahramanmaraş earthquakes on the BIST 100 Index. The empirical findings showed the importance of financial regulations and market mechanisms in maintaining stability after seismic events. Büyükoğlu et al. (2024) analyzed the effects of the February 06, 2023, Kahramanmaraş earthquakes on the BIST 100 Index, BIST Sustainability Index, and BIST Electricity Index. The empirical results showed that both the sustainability and electricity indices were adversely affected by the earthquakes. Sakariyahu et al. (2023) investigated the impact of the Kahramanmaraş earthquakes on stock market returns using daily stock data from Türkiye's 21 largest trading partners for the period February 06, 2023-February 20, 2023. The empirical findings indicated that the earthquakes had an immediate and significant negative impact on stock market returns. Yıldırım and Alola (2020) studied the shock effect of earthquakes on the stock index in Türkiye during the 2000/Q2–2017/Q4 period. The authors concluded that earthquakes had a statistically significant and negative long-term impact on the index. Scholtens and Voorhorst (2013) explored the effects of 100 earthquakes on the stock market that occurred in 21 countries between 1973 and 2011. The study confirmed that earthquakes have substantial negative consequences on stock market value.

2.2. Studies Explaining the Positive Effects of Earthquakes on the Stock Market and Studies that do not find Significant Evidence of Impact

Ferreira and Karali (2015) investigated the effects of major earthquakes on the returns and volatility of aggregate stock indices on 35 financial markets during the period of February 03, 1994-August 08, 2013. The authors suggested that global financial markets are resilient to shocks caused by earthquakes. Moreover, except for Japan, stock market volatility does not appear to be significantly affected by seismic events. Galido and Marites (2013) examined the effects of earthquakes, tropical cyclones, and volcanic eruptions on the Philippine Stock Exchange Index over the period from January 02, 1985, to December 30, 2010. The empirical findings indicated that such natural disasters had no significant impact on stock market returns.

3. DATA AND METHODOLOGY

The aim of this study is to comparatively examine the impact of the two major earthquakes in Türkiye on the stock market. Primarily, the effects of the 1999 Marmara earthquake and the 2023 Kahramanmaraş earthquake on the stock market are investigated. The event study methodology is also used to measure market recovery process. By comparing these two major earthquakes in Türkiye, short-term abnormal returns in the stock market are analyzed. Subsequently, the impact of the earthquakes is tested through volatility modeling using the GARCH model.

The event study methodology developed by MacKinlay (1997) is designed to measure stock price responses to unexpected events. This methodology is grounded in the Efficient Market Hypothesis (EMH), developed by Fama et al. (1969), which suggests that stock prices tend to adjust as a reaction to unexpected events. The theory provides the scope and nature of the event study by

confirming that if markets are efficient, new information is rapidly reflected in asset prices, resulting in market efficiency. Hence, the relationship between information flow and price movements can be observed through the event study framework developed by MacKinlay (1997). MacKinlay (1997) highlighted that both pre-event and post-event windows should be considered to understand the actual effect of an event more clearly.

The primary action is to define the event window in an event study. Umar et al. (2022) focused on abnormal behaviors and analyzed the speed at which prices adjust to certain types of new information by examining pre-event and post-event periods. The event window is defined to include not only the event date. In practice, the period of interest is often expanded to multiple days, including at least the day of the event and a few days after the event. This captures the price effects of the event that occur after the stock market closes on the event day. Thus, the periods prior to and after the event should also be of interest for the examination of periods around the event (MacKinlay, 1997).

MacKinlay (1997) also underlined that, in order to assess the impact of an event, the abnormal return must be measured. Abnormal return is calculated by subtracting the expected normal return—the period that the event not occurred—from the actual return observed during the event window. Hence, the term "normal return" refers to the return that would be expected under the assumption that the event had not taken place. For firm *i* at time *t*, the abnormal return is defined as follows:

$$AR_{it} = R_{it} - E(R_{it} \mid X_t) \tag{1}$$

Here, AR_{it} refers to the abnormal return, R_{it} represents the actual return, and $E(R_{it} \mid X_t)$ denotes the expected (normal) return. X_t symbolizes the conditioning information used in the normal return model. There are two approaches to modeling normal returns. The constant mean return model assumes that the average return of a given security remains constant over time, whereas the market model assumes a stable linear relationship between market returns and the returns of individual securities.

Following the return calculations, MacKinlay (1997) emphasized the importance of identifying the estimation window. Ideally, the period before the event window is utilized as the estimation window. Thus, the period preceding the event window is used as the estimation window.

In this study, the period from January 02, 1995, to July 31, 2025, is analyzed using BIST100 closing prices, covering the two major earthquakes in Türkiye: the August 17, 1999, Marmara earthquake and the February 6, 2023, Kahramanmaraş earthquake. As defined by MacKinlay (1997), the event window includes the days on which the impact occurs and the days of abnormal returns are observed to persist. Therefore, for the 1999 Marmara earthquake, the event date is set as August 17, 1999, and for the 2023 Kahramanmaraş earthquake, the event date is February 06, 2023. Accordingly, the event window is defined as (−5, +5) days surrounding the event date, while the estimation window is set as −30 days prior to the event window.

In the study, closing prices were selected for the BIST100 variable, and returns were calculated using the following formula:

$$R_{it} = \frac{P_{it}}{P_{it-1}} \tag{2}$$

Here, R represents the return of the BIST100 variable, P_{it} denotes the closing price at time t, and P_{it-1} refers to the closing price at time *t–1*.

Abnormal returns (AR_{it}) are calculated by subtracting the expected (normal) returns from the actual observed returns during the event window (Öztürk et al., 2024; Umar et al., 2022):

$$AR_{it} = R_{it} - R_{it} \tag{3}$$

Following this calculation, the Cumulative Abnormal Return (CAR) was calculated for each day within the event window. This step is crucial to determine whether the observed effect of the earthquakes on stock prices is statistically significant or merely coincidental (Ali et al., 2021). The corresponding equation is as follows:

$$CAR_t = \sum_{i=1}^{N} AR_t \tag{4}$$

For both earthquakes, t-tests were applied to the AR and CAR series to examine the presence of an event effect. To analyze whether the observed average AR and CAR values differ significantly from zero, the hypotheses tested using the t-test were formulated as follows:

- H_0: The mean value of AR/CAR is equal to zero (no event effect)
- H_1: The mean value of AR/CAR is significantly different from zero (there is an event effect).

The above equations enable the analysis of the impact of the respective earthquakes on each index value. The statistical significance of the AR and CAR values at the index level further clarifies this impact (Umar et al., 2022).

The fluctuation of financial markets over time and the magnitude of these fluctuations have driven the development of numerous econometric models. Engle (1982), Bollerslev (1986), Nelson (1991), and (Mazibas, 2005) had contributions to the estimation of time-varying volatility with their analysis.

In this study, volatility is estimated using the GARCH (1,1) model proposed by Bollerslev (1986). The GARCH model, developed by Bollerslev (1986), is widely used in the literature to estimate time-varying volatility of returns. The GARCH (1,1) model is formulated as follows:

$$\begin{aligned} &R_t = \mu_t + \varepsilon_t, \\ &\varepsilon_t \backslash \left(\varepsilon_{t-1}, \varepsilon_{t-2}, ..., R_{t-1}, R_{t-2}, ...\right) \\ &h_t^2 = \omega + \alpha\varepsilon_{t-1}^2 + \beta h_{t-1}^2 + \delta_1 D_G + \delta_2 D_K \end{aligned} \tag{5}$$

Here, *Rt* denotes the return series, μt represents the mean of returns, and εt denotes the error terms. D_G and D_K are dummy variables

created to measure the impact of the Marmara and Kahramanmaraş earthquakes on volatility, respectively. In the GARCH model, α indicates the impact of shocks on volatility, β reflects the persistence of volatility clustering. Bollerslev (1986) explained that the estimated coefficients in the conditional variance model cannot be negatively signed and that the condition for stationarity is $\alpha + \beta < 1$. Additionally, dummy variables were introduced for the days of the earthquakes and the subsequent five days to examine the increase in volatility during the earthquake periods.

4. EMPIRICAL FINDINGS

In order to explain the effects of the 1999 Marmara earthquake, the 5 days before and after the event were examined within the scope of the event study methodology. Empirical findings are illustrated in Table 1. According to the empirical results, the abnormal return (AR) values were not found to be statistically significant. Nevertheless, the cumulative abnormal returns (CAR) during the earthquake period were found to be statistically significant.

Table 2 illustrates the event study results for the 5 days before and 5 days after the 2023 Kahramanmaraş earthquake. Similar to the findings from the 1999 Marmara earthquake, the AR values were not found to be statistically significant, whereas the CAR (cumulative abnormal returns) were statistically significant.

Based on the findings of the event study method of the 1999 Marmara and 2023 Kahramanmaraş earthquakes, the abnormal return (AR) values for both earthquake periods were not found to be statistically significant. However, the cumulative abnormal returns (CAR) were statistically significant in both cases. This indicates that while the single-day abnormal returns were not significant, the cumulative effect over the event window was meaningful. The findings suggest that the impact on the day of the event was weak, but the effect increased for the tests within the event window.

The empirical results indicate that the two major earthquakes in Türkiye did not create a significant impact on short-term daily returns in Borsa Istanbul. However, as illustrated in Graph 1, the CAR values for the 1999 Marmara earthquake remained stable before the earthquake (−5 days) and indicated a sharp decline afterward. In the 1999 Marmara earthquake, it reached to the lowest point on the third day after the event, indicating a strong negative effect. In contrast, the 2023 Kahramanmaraş earthquake showed fluctuations even before the event, with a noticeable drop on the first day after the earthquake. Comparing the post-earthquake recovery, the 2023 Kahramanmaraş event reflects a relatively faster rebound. This quicker recovery in the 2023 earthquake can be explained by the strengthening of financial markets in recent years and the development of alternative investment opportunities, making the stock market more resilient to shocks.

The study also examines the impact of earthquakes on volatility. According to the GARCH (1,1) model results in Table 3, volatility persistence is found to be high. Additionally, the average return over the sample period is positive and statistically significant. The α coefficient is estimated at 0.079, indicating that past shocks increase volatility. Thus, sudden price changes have a significant effect on volatility throughout the period. The β coefficient,

Graph 1: Comparison of the cumulative effects of the two earthquakes, (a) 1999 Marmara earthquake, (b) 2023 Kahramanmaraş Earthquake

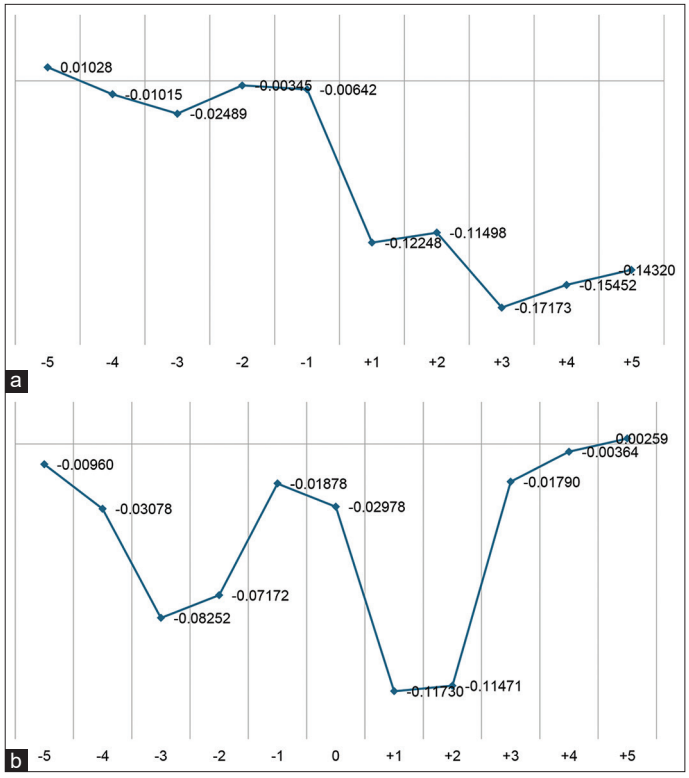

Table 1: For the 1999 Marmara earthquake AR and CAR t-test results

Variable	Sample period	Number of observations	Mean	Standard deviation	t-ist	P-value
AR (Abnormal return)	August 10, 1999 September 02, 1999	10	−0.016	0.041	−1.280	0.232
CAR (Cumulative abnormal return)	August 10, 1999 September 02, 1999	10	−0.074	0.073	−3.211	0.010

Table 2: For 2023 Kahramanmaraş earthquake AR and CAR t-test results

Variable	Sample period	Number of observations	Mean	Standard deviation	t-ist	P-value
AR (Abnormal return)	January 30, 2023 February 17, 2023	11	−0.0003	0.048	−0.023	0.981
CAR (Cumulative abnormal return)	January 30, 2023 February 17, 2023	11	−0.0449	0.043	−3.392	0.006

Table 3: 1999 Marmara Earthquake and 2023 Kahramanmaraş Earthquake GARCH model findings

Mean equation	Coefficient	Standard error	P-value
μ	0.001***	0.000176	0.000
Variance equation	**Coefficient**	**Standard error**	**P-value**
ω	4.56E-06***	8.20E-07	0.000
α	0.079***	0.006396	0.000
β	0.913***	0.006407	0.000
δ_1	−0.001088**	0.000442	0.014
δ_2	−0.000118***	0.000448	0.008
Dispersion Parameter	**Coefficient**	**Standard error**	**P-value**
t- distribution	5.927	0.380	0.000

The table presents the GARCH (1,1) model estimation results for BIST daily returns. Standard errors in the model estimations were calculated using the Student's t-distribution. The dummy variables for the 1999 and 2023 earthquakes represent the event window of−5/+5 days. *** and ** stand for coefficients that are statistically significant at the 1% and 5% levels, respectively

measured at 0.913, reflects the persistence of volatility, suggesting that the effects of fluctuations endure over a long period.

Once the dummy variable representing the 5 days before and 5 days after August 17 is included in the volatility model, it is observed that volatility decreased during the earthquake period. This decrease is statistically significant ($\delta_1 = -0.001088$). This decline can be explained by a search for safe havens and a reduction in trading volume during this period. The empirical findings suggest that market participants became risk-averse and reduced their trading activity, resulting in narrower price movements. Similarly, the dummy variable representing the 2023 Kahramanmaraş earthquake also indicates a negative and statistically significant volatility coefficient ($\delta_2 = -0.000118$). It should be noted that the short closure of markets, reduced trading volume, and cautious investor behavior following the 2023 earthquake were major factors contributing to the decline in volatility.

5. CONCLUSION

The stock market reactions before and after the event days of the Marmara and Kahramanmaraş earthquakes provide valuable insights into the financial markets' soundness. The findings indicate that following the 2023 Kahramanmaraş earthquake, financial markets exhibited a more resilient structure. This can be explained by the expansion of alternative investment options and the diversification of investors' portfolio preferences. These factors improved the market's resistance to shocks.

Different from the 1999 Marmara earthquake, the short-term closure of markets after the 2023 Kahramanmaraş earthquake resulted in a decline in trading volume. Besides, investors' cautious reactions accelerated the recovery process.

Regarding the earthquakes and volatility causality, it was observed that volatility before the earthquakes was affected by past shocks. During the selected period, sudden price changes in the stock market have affected volatility, and these effects have demonstrated persistence over time. It is evident that investors exhibited cautious behavior during the days of the earthquake within the event window. However, the abrupt price movements caused by the disaster indicate persistent uncertainty factors in the long term, even though there is no immediate reaction.

This finding suggests that market participants reacted reflexively to protect themselves from the fluctuations and uncertainty and sought safe havens after the disaster. From the perspective of the event window, the most significant factor explaining the decrease in volatility is investors' protective behavior. The financial system depends not only on overall macroeconomic performance but also on investor psychology and liquidity conditions in the face of unexpected shocks. Therefore, the resilience of the financial system is of great importance during disaster periods.

With the deepening of financial systems in Türkiye, the stock market has gained a more robust structure, which helps prevent sharp volatility in the equity markets in response to unexpected natural disasters and earthquakes. Compared to the economic conditions during the 1999 Marmara earthquake, Türkiye is now in a much stronger position, and this enhanced preparedness contributes to the stock market and stock markets being less affected by such unpredictable shocks.

In this context, prioritizing earthquake-resistant construction, implementing resilient infrastructure systems, and enhancing disaster preparedness can prevent panic in the post-earthquake period. Most importantly, reducing loss of life will significantly mitigate the adverse effects of earthquakes on the macroeconomic structure, and the financial system. Finally, there will be less volatility and more resilience in stock markets.

REFERENCES

Ahmed, S., Hasan, M.M., Kamal, M.R. (2023), Russia-Ukraine crisis: The effects on the European stock market. European Financial Management, 29(4), 1078-1118.

Aksoy, M., Akyüzlü, M.K. (2024), Depremin hisse senedi piyasasi üzerindeki etkileri: 6 şubat 2023 kahramanmaraş örneği. Anadolu Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 25(4), 213-228.

Aksoy, M., Yilmaz, M.K. (2024), Stock market response to natural disasters: Does corporate sustainability performance make difference? Journal of Cleaner Production, 454, 142294.

Albuquerque, P.H., Rajhi, W. (2019), Banking stability, natural disasters, and state fragility: Panel VAR evidence from developing countries. Research in International Business and Finance, 50, 430-443.

Ali, S.E.A., Lai, F.W., Dominic, P.D.D., Brown, N.J., Lowry, P.B.B., Ali, R.F. (2021), Stock market reactions to favorable and unfavorable information security events: A systematic literature review. Computers and Security, 110, 102451.

Anbarci, N., Escaleras, M., Register, C.A. (2005), Earthquake fatalities: The interaction of nature and political economy. Journal of Public Economics, 89(9-10),1907-1933.

Barro, R.J. (2006), Rare disasters and asset markets in the twentieth century. The Quarterly Journal of Economics, 121(3), 823-866.

Batrancea, L.M., Balcı, M.A., Akgüller, Ö., Nichita, A., Rus, M.I. (2024), Seismic shocks and financial systems: A topological perspective on Borsa Istanbul after the earthquake. Humanities and Social Sciences Communications, 11(1), 1-14.

Bollerslev, T. (1986), Generalized autoregressive conditional heteroskedasticity. Journal of Econometrics, 31, 307-327.

Boungou, W., Yatié, A. (2022), The impact of the Ukraine-Russia war on world stock market returns. Economics Letters, 215, 110516.
Büyükoğlu, B., Özpolat, A., Özsoy, F.N. (2024), The effects of natural disasters on financial markets: The empirical analysis of 2023 Earthquakes in Türkiye. Akademik Araştırmalar ve Çalışmalar Dergisi (AKAD), 16(30), 186-197.
Çakar, N.D., Gedikli, A., Erdoğan, S. (2021), The global economic hibernation: macroeconomic indicators and health management policies. Duzce Medical Journal, 23(Special Issue), 48-60.
Caporale, G.M., Gil-Alana, L.A., Muñoz, L. (2025), Earthquakes and Stock Market Performance: Evidence from Japan. CESifo Working Paper, No. 11822, CESifo GmbH, Munich.
Cavallo, E., Noy, I. (2011), Natural disasters and the economy - A survey. International Review of Environmental and Resource Economics, 5(1), 63-102.
Eickmeier, S., Schüler, J.Q.Y. (2024), Macroeconomic and Financial Effects of Natural Disasters. Deutsche Bundesbank, Discussion Paper, No: 45/2024.
Engle, R.F. (1982), Autoregressive conditional heteroscedasticity with estimates of the variance of United Kingdom ınflation. Econometrica, 50(4), 987-1007.
Erdoğan, S., Gedikli, A., Çevik, E.İ. (2020), The effects of the Covid-19 pandemic on conventional and Islamic stock markets in Turkey. Bilimname, 2020(42), 89-110.
Erdoğan, S., Yıldırım, D.Ç., Gedikli, A. (2020), Dynamics and determinants of inflation during the COVID-19 pandemic period in European countries: A spatial panel data analysis. Duzce Medical Journal, 22(Special Issue), 61-67.
Fama, E.F., Fisher, L., Jensen, M.C., Roll, R. (1969), The adjustment of stock prices to new information. International Economic Review, 10(1), 1-21.
Felbermayr, G., Gröschl, J. (2014), Naturally negative: The growth effects of natural disasters. Journal of Development Economics, 111, 92-106.
Ferreira, S., Karali, B. (2015), Do earthquakes shake stock markets? PLoS One, 10(7), 1-19.
Galido, A.P., Marites, A. (2013), Natural disasters and the Philippine stock exchange ındex: A GARCH-M analysis. DLSU Business and Economics Review, 22(2), 54-63.
Gedikli, A., Erdoğan, S., Shahbaz, M. (2022), The wealth of nations during the pandemic: The vaccine equity. Konuralp Medical Journal, 14(S1), 172-182.
Güleç, T.C. (2020), An analysis of the effects of seismic events on the Turkish stock market. İşletme Araştırmaları Dergisi, 12(4), 4043-4050.
Han A., Tosun N. (2024), The ımpact of the VIX, exchange rate, and oil prices on the BIST100 during earthquake periods: Evidence from fourier approaches. Türk Deprem Araştirma Dergisi, 6(2), 649-668.
IFRC. (2019), Marmara Earthquake: 20 Years on. Available from: https://www.ifrc.org/article/marmara-earthquake-20-years#:~:text=On%20Saturday%2017%20August%2C%20Turkey,killing%20thousands%20as%20they%20slept
Kellenberg, D., Mobarak, A.M. (2008), Does rising income increase or decrease damage risk from natural disasters? Journal of Urban Economics, 63(3), 788-802.
Khan, K., Cifuentes-Faura, J., Shahbaz, M. (2024), Do earthquakes shake the stock market? Causal inferences from Turkey's earthquake. Financial Innovation, 10(1), 145.
Khan, M.T.I., Anwar, S., Sarkodie, S.A., Yaseen, M.R., Nadeem, A.M. (2023), Do natural disasters affect economic growth? The role of human capital, foreign direct investment, and infrastructure dynamics. Heliyon, 9(1), e12911.
MacKinlay, A.C. (1997), Event studies in economics and finance. Journal of Economic Literature, 35, 13-39.
Mazibas, M. (2005), IMKB Piyasalarındaki Volatilitenin Modellenmesi ve Öngörülmesi: Asimetrik GARCH Modelleri Ile Bir Uygulama (Modeling and Forecasting Volatility in Istanbul Stock Exchange Markets: An Application with Asymmetrical GARCH Models). Available from: https://www.SSRN 3008342
Nelson, D.B. (1991), Conditional heteroskedasticity on asset retuns: A new approach. Econometrica, 59(2), 347-370.
Nguyen, T., Chaiechi, T. (2021), The effects of natural disasters on stock market return and volatility in Hong Kong. In: Economic Effects of Natural Disasters. New York: Academic Press. p11-20.
Öztürk, M.B., Çelik, M.S., Avbaz, G. (2024), Efficient market hypothesis during Covid-19 pandemic: Brics-T countries. Ömer Halisdemir Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 17(4), 1036-1049.
Pagnattoni, P., Spelta, A., Flori, A., Pammolli, P. (2022), Climate change and financial stability: Natural disaster impacts on global stock markets. Physica A: Statistical Mechanics and its Applications, 599, 127514.
Pandey, D.K., Kumar, S., Kumari, V., Alahdal, W.M. (2024), Quaking the stock market: Event study evidence on the Turkey-Syria earthquake. International Review of Economics and Finance, 93, 182-194.
Reuters. (2023), JPMorgan Estimates Turkey's Direct Quake Damage at $25 bln, Expects Rate Cut. Available from: https://www.reuters.com/world/middle-east/jpmorgan-estimates-turkey-direct-quake-damage-25-bln-expects-rate-cut-2023-02-16
Sakariyahu, R., Lawal, R., Oyekola, O., Dosumu, O.E., Adigun, R. (2023), Natural disasters, investor sentiments, and stock market reactions: Evidence from Turkey-Syria earthquakes. Economics Letters, 228, 111153.
Scholtens, B., Voorhorst, Y. (2013), The impact of earthquakes on the domestic stock market. Earthquake Spectra, 29(1), 325-337.
Umar, M., Riaz, Y., Yousaf, I. (2022), Impact of Russian-Ukraine war on clean energy, conventional energy, and metal markets: Evidence from event study approach. Resources Policy, 79, 102966.
Wang, A., Marinova, D., Wang, F., Wei, J. (2020), Corporate investor confidence in the aftermath of a mega natural disaster: An empirical study of the 2008 Wenchuan earthquake. Safety Science, 125, 104620.
World Bank Group Global Facility for Disaster Reduction and Recovery (GFDRR). (2023), Global Rapid Post-Disaster Damage Estimation (GRADE) Report, Kahramanmaraş Earthquakes Türkiye Report.
Worldbank Climate Change Knowledge Portal. (2025), Total Natural Disasters, Türkiye. Available from: https://climateknowledgeportal.worldbank.org/country/turkiye/natural-disasters-historical
Worthington, A.C., Valadkhani, A. (2004), Measuring the impact of natural disasters on capital markets: An empirical application using intervention analysis. Applied Economics, 36(19), 2177-2186.
Yamori, N., Asai, Y. (2017), Great East Japan Earthquake and Risk Management for Small and Medium-Sized Enterprises -how do Japanese SMEs Prepare against Natural Disasters? Discussion Paper Series DP2017-14, Research Institute for Economics and Business Administration, Kobe University.
Yamori, N., Okada, T., Kobayashi, T. (2009), Preparing for large natural catastrophes: The current state and challenges of earthquake insurance in Japan. International Review of Business, 10, 1-22.
Yıldırım, H., Alola, A. (2020), Do earthquakes affect stock market ındex? OPUS International Journal of Society Researches, 15(1), 4768-4780.