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Investigating the Effects of Natural Disasters on the Stock Market on a Sectoral Basis: The Case of 2023 Kahramanmaraş/Türkiye Earthquake

Doğal Afetlerin Borsaya Etkilerinin Sektörel Bazda İncelenmesi: 2023 Kahramanmaraş/Türkiye Depremi Örneği

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ABSTRACT

This study aims to examine the effects of two earthquakes in Kahramanmaraş/Türkiye on February 06, 2023 on Borsa Istanbul (BIST) stock markets on a sectoral basis. In this context, whether there is a statistically significant difference between sectoral stock returns before and after the earthquake is investigated. The study divides 18 BIST sectoral index returns into two sub-samples, pre-earthquake and post-earthquake and analyzed by the event study method. For this purpose, Paired Samples t-Test, a parametric test, and the Wilcoxon Signed Rank Test, the non-parametric equivalent of this test, are used. According to the research results, no statistically significant difference was found between the pre-and post-earthquake returns of BIST sector indices. The findings show that, in the case of investing in BIST sectoral indices, abnormal returns cannot be obtained depending on the earthquake event. Accordingly, BIST sectoral indices are an efficient market in a semi-strong form.

Anahtar Kelimeler:
Doğal Afetler,
Deprem,
BIST Sektör Endeksleri,
Eşleştirilmiş Örneklem t-Testi,
Wilcoxon İşaretli Sıralar Testi

Jel Kodları:
C12, C16, G11, G14

ÖZET

Bu çalışma, 06 Şubat 2023 tarihinde Kahramanmaraş/Türkiye'de meydana gelen iki depremin Borsa İstanbul (BİST) borsalarına etkilerini sektörel bazda incelemeyi amaçlamaktadır. Bu kapsamda deprem öncesi ve deprem sonrası sektörel hisse senedi getirileri arasında istatistiksel olarak anlamlı bir fark olup olmadığı araştırılmaktadır. Çalışma, 18 BİST sektörel endeks getirisini deprem öncesi ve deprem sonrası olmak üzere iki alt örnekleme ayırarak olay çalışması yöntemiyle analiz etmektedir. Bu amaçla parametrik bir test olan Bağımlı Örneklem t-Test ve bu testin parametrik olmayan karşılığı olan Wilcoxon İşaretli Sıra Sayıları Testi kullanılmaktadır. Araştırma sonuçlarına göre BIST sektör endekslerinin deprem öncesi ve sonrası getirileri arasında istatistiksel olarak anlamlı bir fark bulunmamıştır. Bulgular, BIST sektör endekslerine yatırım yapılması durumunda deprem olayına bağlı olarak anormal getirilerin elde edilemeyeceğini göstermektedir. Buna göre, BIST sektör endeksleri yarı güçlü formda etkin bir piyasadır.

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1. INTRODUCTION

Although disaster is defined as "destruction caused by various natural events", according to the Turkish Language Association (www.tdk.gov.tr), today, it can be said that this definition is relatively narrow. Özler (2019) mentions many factors such as natural, environmental, global, biological, meteorological, chemical, nuclear, social, political and technological in the classification of events leading to disasters.

Among the disasters, earthquake is the one that causes tremendous destruction (Akdur, 2000: 2). One of the giant earthquakes of the recent period is the earthquake that took place in Kahramanmaraş/Türkiye on 06 February 2023, which also affected Syria. Two earthquakes with magnitudes Mw7.7 (focal depth = 8.6km) and Mw7.6 (focal depth = 7km) occurred at 04:17 and 13:24, Türkiye time, with epicentres in Pazarcık and Elbistan districts of Kahramanmaraş. On February 20, 2023, at 20:04 Turkish time, an earthquake with a magnitude of Mw6.4 occurred, the epicentre of which was Hatay-Yayladağı. The earthquakes mentioned above caused great destruction in 11 provinces (Kahramanmaraş, Malatya, Gaziantep, Diyarbakır, Hatay, Şanlıurfa, Kilis, Osmaniye, Adana, Adıyaman, Elazığ). More than 14 million people were directly affected by the earthquakes, more than 50 thousand people lost their lives, more than half a million buildings were damaged, communication and energy infrastructures were damaged, and significant financial losses occurred (T.C. SBB, 2023). Because there were two earthquakes with a magnitude greater than 7 in the same region within 12 hours, the losses caused by the earthquakes to date, and the first assessment reports prepared for the earthquakes, the Kahramanmaraş earthquakes were recorded as the most significant earthquake disaster we experienced in the Turkish Republic period (Şen, 2023: 5). It is estimated that the total burden of the disaster caused by the earthquake on the Turkish economy is approximately 2 trillion TL (103.6 billion dollars). This size will reach approximately 9 per cent of the national income in 2023 (T.C. SBB, 2023).

This study aims to examine the effects of two earthquakes in Kahramanmaraş/Türkiye on February 06, 2023, on Borsa Istanbul (BIST) stock markets on a sectoral basis. Comprehensive studies on the effects of the earthquake on the stock markets are insufficient on a sectoral basis, and detailed studies on a sectoral basis have not yet been found in the case of the February 06, 2023, Kahramanmaraş/Türkiye earthquake. With this study, the effects of the earthquake on the stock markets of different sectors are revealed by determining whether abnormal returns can be obtained during the earthquake period. Studies in which many different sectors are included, as in this study, are not frequently encountered in the literature. In addition, the distribution characteristics of the variables were taken into account in the analyses. Accordingly, Paired Samples t-Test, one of the parametric tests, is used for normally distributed variables, and non-parametric Wilcoxon Signed Rank Test is used for non-normally distributed variables. The results obtained in this respect can be a guide for stock investors in their investment decisions for Turkey, which is an earthquake country, as well as for regulatory authorities to be informed about the measures to be taken regarding stock market transactions in the event of an earthquake, taking into account the said effects.

We planned the rest of the study as follows. In the second section of the study, we included the literature review on the subject, and in the third section, we explained the method of the study. In the fourth section, we presented the dataset and descriptive statistics of the study, and in the fifth section, the empirical findings and discussion. In the sixth section, we have included the results of the study and general evaluations.

2. LITERATURE REVIEW

Due to their essential consequences, natural disasters have economic, financial, social, political, and psychological effects. Many aspects of its effects are examined in the literature. In this context, there are many studies on the economic-financial effects of natural disasters, such as economic growth, exchange rates, stock market effects, Etc. However, since this study examines the economic effects of the earthquake, this section includes studies on natural disasters and especially the effects of earthquakes on the stock market.

Shelor et al. (1990) examined the effect of the October 17, 1989, California earthquake on the stock values of companies in the real estate sector. The findings showed the earthquake's statistically significant negative effect on real estate firms in the San Francisco area; in contrast, real estate firms operating in other parts of California are generally unaffected.

Worthington & Valadkhani (2004) investigated the impact of 42 natural disasters in Australia on the Australian stock market. They discovered that forest fires, hurricanes and earthquakes have a significant effect on market returns; however, severe storms and floods do not have a significant effect.

Worthington & Valadkhani (2005) investigated the impact of natural, industrial and terrorist disasters on the Australian capital market. They determined that the shocks created by natural disasters and other disasters affect the sector's returns.

Lee et al. (2007) examined whether a contagion effect occurred between 26 international stock indices and exchange rates after the Southeast Asian earthquake in 2004. As a result of the research, although there was no contagion effect between any stock markets, a contagion effect was determined for some countries in the foreign exchange markets. Another significant result of the research is that the contagion effects are more pronounced in emerging financial markets than in developed markets.

Worthington (2008) examines the impact of all severe natural events and disasters on Australian stock returns from 01.01.1980-30.06.2003. The results demonstrated that natural events and disasters do not significantly impact individual returns.

Scholtens & Voorhorst (2013) investigated the effects of 101 earthquakes on stock markets in 5 continents and 21 countries. They stated that earthquakes significantly affect the local stock market, and the losses on an annualized basis are in the range of 6-12% of the total market value of the companies traded in the relevant domestic stock exchange. However, they also found that the stock market's response to earthquakes is not different in terms of the severity of earthquakes, the income level of the relevant country or the legal systems; that is, stock market investors tend to respond to earthquakes similarly.

Takao et al. (2013) examine the effects of the Great East Japan Earthquake on the value of Japanese insurance companies, especially non-life insurance companies. They determined that the earthquake affected insurance companies' stock prices negatively in the short term; however, this negative effect was less on the stock prices of non-life insurance companies compared to life insurance companies.

Wang & Kutan (2013) examined the impact of different types of natural disasters on the insurance sector and composite stock market indices for the USA and Japan. They found that while the composite index returns of both countries are unaffected by natural disasters, the insurance sectors are affected. They also discovered that when natural disasters are evaluated regarding risk effects, all returns are affected by natural disasters, except for the Japanese composite market index.

Ruiz & Barrero (2014) investigated the effects of the 2010 Chile earthquake and tsunami on stock prices. As a result of the research, the returns are positive in the retail, real estate and banking sectors; they were found to be negative in the food, steel and forestry sectors.

Ferreira & Karali (2015) examine stock market indices' return and volatility effects in thirty-five financial markets of significant earthquakes in the last two decades. The findings showed that global financial markets resist shocks caused by earthquakes.

Bourdeau-Brien & Kryzanowski (2017) investigated the impact of different types of major natural disasters (storms, floods, extreme temperature, winter weather, hurricanes) on US stock returns and volatility in the period 1990-2014. As a result of the research, a small portion of disasters have a significant impact on returns; It was determined that conditional volatility increased after hurricanes, floods, extreme temperature periods and severe winter weather, but no change in conditional volatility was detected in other storm-like events.

Fakhry et al. (2018) analyzed the short- and long-term effects of the Japanese earthquake and tsunami (Great Tohoku or Sendai earthquake) of 11.03.2011 on the Japanese stock, debt, foreign exchange and gold market. As a result of the research, it was determined that the natural disaster affected the efficiency of the market more in the short term than the long term, and it was stated that the Japanese market could be a partially efficient market.

Tavor & Teitler-Regev (2019) examine the effects of natural disasters, artificial disasters and terrorism on the stock market. According to the findings of the research, natural disasters cause the greatest damage to the economy, and terrorism causes the least damage. In addition, natural disasters show the highest level of severity, while artificial disasters show the lowest impact.

Yıldırım & Alola (2020) investigated the relationship between BIST REIT index and earthquakes in Türkiye between 02.2000-02.2017, the USD exchange rate and global economic policy (GEPU). In the results of working; Statistically significant and negative effects of these variables on BIST REIT were determined in the long term, but the effect of the earthquake on the relevant stock market index was not found in the short term.

Hamurcu (2022) examined the effect of the Izmir earthquake on 30 October 2020 on the stocks of companies in the BIST insurance sector. At the end of the research, it was determined that the earthquake affected the insurance sector stocks negatively.

Pagnottoni et al. (2022) examined the effects of five categories of natural disasters that occurred in 104 countries around the world on global stock market indices. At the end of the study, it has been determined that stock markets give different reactions according to the type of natural disasters and the location of the events. Accordingly, while climatic disasters tend to affect financial markets negatively, other disasters (biological, geophysical, hydrological, meteorological) tend to affect them positively.

Say & Doğan (2023) examined the effect of the February 6, 2023 Kahramanmaraş earthquake on the stock prices traded in Borsa Istanbul using the event analysis method. As a result of the research, it was found that positive cumulative abnormal returns were obtained for BIST 30 companies on the day of the event and all days after the event, and according to this result, they reached the conclusion that the relevant market is not an efficient market in a semi-strong form in terms of the BIST 30 index.

The details of the literature studies described so far are presented in the tables below.

Table 1. Literature Review

Source	Events	Samples/Variables	Data and Frequency	Method
Shelor et al. (1990)	California earthquake of 17.10.1989	19 adet San Francisco Bay Area and 44 other California real estate firms, S&P 500 index for a market proxy	18.10.1989 (-100 to -1; 0 to 20 trading days) (Daily)	T-test SUR model
Worthington & Valadkhani (2004)	42 natural disasters in Australia	Australian All Ordinaries Index (AOI)	31.12.1982-01.01.2002 (Daily)	ARMA regression model
Worthington & Valadkhani (2005)	Natural, industrial and terrorism disasters in Australia	Australian 10 sektörel index	02.01.1995-02.07.2003 (Daily)	ARMA regression model
Lee et al. (2007)	South-East Asia earthquake of 26.12.2004	26 international stock indices and exchange rates	26.12.2003-25.03.2005 (Daily)	Correlation coefficient method
Worthington (2008)	01.01.1980-30.06.2003 period severe natural events and disasters	Australian stock market returns	01.01.1980-30.06.2003 (Daily)	GARCH-M model
Scholtens & Voorhorst (2013)	101 earthquakes in 5 continents and 21 countries	Stock markets of 21 countries	1973–2011 (Daily)	Wilcoxon test
Takao et al. (2013)	Japan earthquake of 11 March 2011	Japanese insurance industry (life and non-life)	11.03.2011- 04.04.2011 (Daily)	Market model regression
Wang & Kutan (2013)	Natural disasters in the USA and Japan	US S&P 500 Insurance Composite and S&P indices; Japan TOPIX Insurance and the Nikkei 225 indices	11.09.1989-08.04.2011 (Daily)	EGARCH(1,1) model
Ruiz & Barrero (2014)	Chile earthquake of 27.02.2010	42 listed companies in the Santiago Stock Exchange	23.01.2009-06.04.2010 (Daily)	GARCH(1,1) model
Ferreira & Karali (2015)	24 distinct earthquakes	35 stock markets, GDP, trade openness, exports and main features of earthquake	03.02.1994–08.08.2013 (Daily)	Regression-based event study methodology GARCH-X(1,1) model
Bourdeau-Brien & Kryzanowski (2017)	1990-2014 period 247 major natural disasters	US stock market	01.1990-06.2015 (Daily)	ARMA-EGARCH model GARCH model
Fakhry et al. (2018)	Japanese earthquake of 11.03.2011	Japanese Nikkei 225 stock index, Japan All Maturities Index, Japanese Yen, gold	31.12.1997- 31.12.2016 (Daily)	Variance bound test using C-GARCH-t model
Tavor & Teitler-Regev (2019)	344 significant events	Pessimism index, fatalities, casualties, location, financial loss	02.09.1983-06.03.2013 (Daily)	Regression model
Yıldırım & Alola (2020)	Earthquakes in Türkiye in the period of 02.2000-02.2017	BIST REIT index, USD Exchange rate, GEPU	02.2000-02.2017 (Monthly)	ARDL model
Hamurcu (2022)	Izmir earthquake of 30 October 2020	Stocks of 6 companies in BIST insurance sector	13.07.2020- 15.02.2021 (Daily)	Paired samples t-test Wilcoxon signed rank test
Pagnottoni et al. (2022)	Natural disasters occurring in 104 countries around the world	27 global stock market index, GDP growth, financial development index	08.02.2001 -31.12.2019 (Daily)	Seemingly Unrelated Regression (SUR) model
Say & Doğan (2023)	Kahramanmaraş earthquake of 06.02.202	BIST 30 companies	16.01.2023-03.03.2023 (Daily)	One sample t-test

When the above studies are evaluated, the effects of earthquakes on both stock market index returns and volatility have been studied. In addition, studies on the stock market indices, especially on the insurance sector, are intense. Comprehensive studies covering many different sectors have not been found in the literature.

3. METHODOLOGY

In the study, the effect of the Kahramanmaraş/Türkiye earthquake of February 06, 2023, on selected BIST sectoral index returns was analyzed by the event study method. The event study method is used to examine any event's effect on returns. Using selected BIST sectoral index data in the examinations, statistical significance, t statistics and calculated probability values were used to determine whether abnormal returns were obtained on a sectoral basis during the earthquake period.

In order to determine the tests to be applied in the analysis, first of all, the typical distribution characteristics of the data should be examined. Accordingly, parametric methods are used for the variables showing normal distribution, and non-parametric methods are used for variables that do not. In this study, since the data belonging to the same variable will be compared by dividing it into sub-periods before and after the earthquake, test methods suitable for "two related variables" are applied in the study. In this context, Paired Samples t-Test, which is a parametric test, and the Wilcoxon Signed Rank Test, which is the non-parametric equivalent of this test, were used.

As it is known, Paired Samples t-Test is applied to measure the mean of a variable observed in two different situations and to understand whether there is a statistically significant difference between these measurements. The hypotheses of the related test are shown below (Güriş & Astar, 2014: 205):

H_0: $\mu_1 = \mu_2$ (There is no significant difference between the means)

H_1: $\mu_1 \neq \mu_2$ (There is a significant difference between the means)

If the p-value obtained in the above test method is less than the previously accepted alpha value (0.05), the H_0 hypothesis is rejected (Baştürk, 2010: 122); the alternative hypothesis is accepted. According to this, it is concluded that there is a significant difference between the means.

On the other hand, Wilcoxon Signed Rank Test is applied to measure the medians of a variable observed in two different situations and to understand whether there is a statistically significant difference between these measurements. This test converts the values into two periods to rank and compare the "values" instead of the "means". Then, it is tested whether there is a difference in the values for these two time periods (Demirgil, 2009: 104). The hypotheses of the related test are shown below:

H_0: $M_1 = M_2$ (There is no significant difference between the medians)

H_1: $M_1 \neq M_2$ (There is a significant difference between the medians)

As a result of the Wilcoxon Signed Rank Test, Z value and Asymp. Sig. (2-tailed) values, which indicate the level of significance, are obtained. Accordingly, in cases where the significance level is less than or equal to 0.05, it is concluded that there is a statistically significant difference between the two corresponding values. Otherwise, if the significance level is more significant than 0.05, it is understood that there is no statistically significant difference between the two corresponding values (Demirgil, 2009: 106).

4. DATASET AND DESCRIPTIVE STATISTICS

In the study, daily data covering the period of 30.11.2022-19.04.2023 belonging to 18 sectors in the BIST share markets were used.[1] In addition, the study is carried out on the basis of two equal sub-periods, pre-earthquake and post-earthquake. For the study, the daily closing price series obtained from the Eikon Datastream database were first converted into daily return series with the help of $Ln(P_t/P_{t-1})$ formula. In order to analyze the effects of the earthquake in the near term and at the same time to have statistically sufficient data for analysis, 48 data in each sub-period were included in the analysis. In the financial markets, quicker reactions can be given to any new event, and accordingly, faster data can be obtained compared to macroeconomic data. Therefore, in this study, data on stocks are analyzed. In addition, Scholtens & Voorhorst (2013) state that stock markets are generally accepted as seismographs of the economy and the business world, although they do not provide very precise information on the assessment of the impact of earthquakes.

[1] The full list of BIST sectoral indices included in the study is in Appendix A with their index codes.

Tables 2 and 3 show descriptive statistics for each of the 18 BIST sectoral indices included in the analysis. In addition, since the normality test results are important in determining the methods to be applied in the study, the normality test results are shown side by side in Table 4, pre-earthquake and post-earthquake.

Table 2. Descriptive Statistics of BIST Sectoral Indices (Pre-Earthquake)

	Index Codes	Mean	Median	Max.	Min.	Std. Dev.	Skew.	Kurto.	Obs.
1	**XBANK**	-0.0011	-0.0033	0.0983	-0.0920	0.0389	0.2662	3.3876	48
2	**XBLSM**	-0.0045	-0.0020	0.0560	-0.0769	0.0255	-0.3629	3.5700	48
3	**XELKT**	-0.0054	-0.0048	0.0420	-0.0820	0.0259	-0.4412	3.3073	48
4	**XGIDA**	-0.0020	0.0022	0.0506	-0.0741	0.0268	-0.4388	3.1606	48
5	**XGMYO**	-0.0004	0.0007	0.0475	-0.0788	0.0279	-0.5786	3.5454	48
6	**XHOLD**	0.0003	0.0028	0.0604	-0.0734	0.0270	-0.5139	3.3597	48
7	**XILTM**	0.0028	0.0030	0.0995	-0.0763	0.0387	0.0909	2.6840	48
8	**XKMYA**	-0.0008	0.0012	0.0697	-0.0619	0.0279	0.1243	2.6384	48
9	**XMADN**	0.0068	0.0005	0.0948	-0.0967	0.0460	-0.0013	2.5262	48
10	**XMANA**	-0.0007	0.0039	0.0724	-0.0747	0.0278	-0.0665	3.3686	48
11	**XMESY**	0.0024	0.0064	0.0591	-0.0618	0.0278	-0.4447	3.0563	48
12	**XSGRT**	-0.0008	-0.0010	0.0723	-0.0874	0.0300	-0.1724	3.8332	48
13	**XSPOR**	0.0011	0.0040	0.0678	-0.0830	0.0291	-0.3535	3.6470	48
14	**XTAST**	-0.0008	0.0032	0.0512	-0.0763	0.0270	-0.3702	3.0439	48
15	**XTEKS**	-0.0014	0.0022	0.0602	-0.0767	0.0303	-0.2842	2.8813	48
16	**XTRZM**	-0.0046	0.0022	0.0512	-0.0827	0.0278	-0.4968	3.0097	48
17	**XULAS**	0.0043	-0.0021	0.0761	-0.0633	0.0333	0.2205	2.5913	48
18	**XYORT**	-0.0013	0.0035	0.0374	-0.0603	0.0246	-0.4632	2.5056	48

Table 3. Descriptive Statistics of BIST Sectoral Indices (Post-Earthquake)

	Index Codes	Mean	Median	Max.	Min.	Std. Dev.	Skew.	Kurto.	Obs.
1	**XBANK**	0.0034	-0.0007	0.0996	-0.0829	0.0324	0.7862	4.8919	48
2	**XBLSM**	-0.0008	0.0010	0.0853	-0.0858	0.0240	-0.2503	8.0066	48
3	**XELKT**	-0.0003	-0.0027	0.0868	-0.0829	0.0270	0.2265	5.1967	48
4	**XGIDA**	0.0016	0.0041	0.0940	-0.0807	0.0250	0.0751	7.6063	48
5	**XGMYO**	-0.0005	-0.0025	0.0842	-0.0820	0.0260	0.3093	5.7676	48
6	**XHOLD**	0.0011	-0.0038	0.0970	-0.0867	0.0269	0.4626	6.7390	48
7	**XILTM**	0.0002	-0.0011	0.0999	-0.0998	0.0338	-0.0623	4.3874	48
8	**XKMYA**	-0.0011	-0.0019	0.0990	-0.0952	0.0296	0.2368	5.9571	48
9	**XMADN**	-0.0008	-0.0006	0.0999	-0.0715	0.0335	0.6353	4.4039	48
10	**XMANA**	0.0001	-0.0016	0.0951	-0.0770	0.0311	0.6036	5.1061	48
11	**XMESY**	0.0023	0.0015	0.0972	-0.0892	0.0245	0.1075	9.7010	48
12	**XSGRT**	-0.0007	-0.0019	0.0427	-0.0696	0.0181	-0.7501	6.7407	48
13	**XSPOR**	0.0004	0.0027	0.0430	-0.0986	0.0247	-1.2909	6.8835	48
14	**XTAST**	0.0054	-0.0047	0.0927	-0.0621	0.0401	0.5879	2.8537	48
15	**XTEKS**	0.0008	0.0006	0.0858	-0.0805	0.0234	0.3538	7.9305	48
16	**XTRZM**	-0.0007	-0.0006	0.0605	-0.0545	0.0209	-0.0277	4.0425	48
17	**XULAS**	-0.0008	-0.0041	0.0991	-0.0926	0.0295	0.4745	5.9756	48
18	**XYORT**	0.0010	0.0035	0.0890	-0.0856	0.0263	-0.1204	6.3243	48

When Table 2 and Table 3 are evaluated together, the most striking feature is that the post-earthquake kurtosis values of the relevant sectors are considerably higher than pre-earthquake. Accordingly, post-earthquake, the sectoral index values became flatter than the normal distribution. Table 4 shows the Jarque-Bera normality test results of BIST sectoral index returns. In the research, the results of the same index are shown side by side, since it will be evaluated together whether there are significant differences between the pre-earthquake and post-earthquake returns in the relevant sectors. According to these results, if the pre- and post-earthquake normality test results of any index show that the series are normally distributed, the parametric test method is preferred for the analysis, and if any normality test result shows that there is no normality distribution, the non-parametric test method is preferred.

Table 4. Normality Test Results of BIST Sectoral Index Returns

	Index Codes	Pre-earthquake Returns		Post-earthquake Returns	
		Jarque-Bera	Probability	Jarque-Bera	Probability
1	XBANK	0.86745	**0.64809**	12.10349	0.00235
2	XBLSM	1.70327	**0.42672**	50.63422	0.00000
3	XELKT	1.74581	**0.41774**	10.06158	0.00653
4	XGIDA	1.59171	**0.45119**	42.48173	0.00000
5	XGMYO	3.27273	**0.19469**	16.08387	0.00032
6	XHOLD	2.37170	**0.30549**	29.67239	0.00000
7	XILTM	0.26589	**0.87551**	3.88094	**0.14364**
8	XKMYA	0.38505	**0.82487**	17.93724	0.00013
9	XMADN	0.44907	**0.79889**	7.17033	0.02773
10	XMANA	0.30702	**0.85769**	11.78662	0.00276
11	XMESY	1.58871	**0.45187**	89.90000	0.00000
12	XSGRT	1.62630	**0.44346**	32.48813	0.00000
13	XSPOR	1.83706	**0.39911**	43.49583	0.00000
14	XTAST	1.10035	**0.57685**	2.80756	**0.24567**
15	XTEKS	0.67437	**0.71378**	49.62082	0.00000
16	XTRZM	1.97493	**0.37252**	2.17964	**0.33628**
17	XULAS	0.72317	**0.69657**	19.50900	0.00006
18	XYORT	2.20522	**0.33200**	22.21743	0.00002

Note: Probability values of normally distributed series are written in bold.

According to the Jarque-Bera normality test results, both pre- and post-earthquake probability values of XILTM, XTAST and XTRZM indices are greater than 0.05, and the probability value for at least one of the other indices is less than 0.05.

5. FINDINGS AND DISCUSSION

As explained above, according to the Jarque-Bera normality test results, since both the pre- and post-earthquake probability values of the XILTM, XTAST and XTRZM indices are greater than 0.05, a parametric method, Paired Samples t-Test, will be applied in the analysis of these three indices. Non-parametric Wilcoxon Signed Rank Test will be applied in the analysis of the other fifteen indices. Table 5 shows the Paired Samples' t-Test results. However, first of all, the hypotheses tested with this test are included.

H_0: $\mu_1 = \mu_2$ (There is no significant difference between the pre-earthquake and post-earthquake returns means)

H_1: $\mu_1 \neq \mu_2$ (There is a significant difference between the pre- and post-earthquake return means.)

Table 5. Paired Samples t-Test Results

Index Codes	Mean	Std. Dev.	S. E. Mean	95% Confidence Interval of the Differ.		t	df	Sig. (2-tailed)
				Lower	Upper			
XILTM	0.0026	0.0557	0.0080	-0.0136	0.0188	0.320	47	0.750
XTAST	-0.0062	0.0494	0.0071	-0.0205	0.0081	-0.870	47	0.389
XTRZM	-0.0039	0.0372	0.0054	-0.0147	0.0069	-0.726	47	0.471

According to the Paired Samples t-Test results in Table 5, since the sig. (2-tailed) value is greater than 0.05 in the 95% confidence interval, the H_0 hypothesis (there is no difference between the means) is accepted and the alternative hypothesis is rejected. Accordingly, no statistically significant difference was found between the pre-earthquake and post-earthquake average returns of the XILTM, XTAST and XTRZM sector indices. Table 6 shows the non-parametric Wilcoxon Signed Rank Test results applied when both series do not exhibit normal distribution pre-earthquake and post- earthquake. However, first of all, the hypotheses tested with this test are included.

H_0: $M_1 = M_2$ (There is no significant difference between the pre- and post-earthquake return medians)

H_1: $M_1 \neq M_2$ (There is a significant difference between the pre- and post-earthquake return medians)

Table 6. Wilcoxon Signed Rank Test Results

	Index Codes	Z	Asymp. Sig. (2-tailed)
1	**XBANK**	-0.349[a]	0.727
2	**XBLSM**	-0.892[a]	0.372
3	**XELKT**	-1.292[a]	0.196
4	**XGIDA**	-0.841[a]	0.400
5	**XGMYO**	-0.174[a]	0.862
6	**XHOLD**	-0.154[b]	0.878
7	**XKMYA**	-0.051[b]	0.959
8	**XMADN**	-0.964[b]	0.335
9	**XMANA**	-0.051[a]	0.959
10	**XMESY**	-0.051[a]	0.959
11	**XSGRT**	-0.103[a]	0.918
12	**XSPOR**	-0.123[b]	0.902
13	**XTEKS**	-0.544[a]	0.587
14	**XULAS**	-0.328[b]	0.743
15	**XYORT**	-0.523[a]	0.601

Note: a; based on negative ranks, b; based on positive ranks.

According to the Wilcoxon Signed Rank Test results in Table 6, since the sig. (2-tailed) values in the 95% confidence interval are greater than 0.05 in all sector indices, the H_0 hypothesis (there is no difference between the medians) is accepted and the alternative hypothesis is rejected. Accordingly, no statistically significant difference was found between the pre-earthquake and post-earthquake medians of all sector indices in Table 6.

The findings show that, in the case of investing in BIST sectoral indices, abnormal returns cannot be obtained depending on the earthquake event. In the Kahramanmaraş/Türkiye earthquake of February 06, 2023 within the scope of this study, although the transactions in BIST continued between 06-07 February 2023 by the BIST management, they were closed for five trading days between 8-14 February 2023. This situation may cause the initial panic effect of the earthquake to disappear. In addition, it can be stated that BIST sectoral indices are an efficient market in a semi-strong form.

The findings of this study are consistent with Shelor et al. (1990) (for real estate sectors in other parts of California), Lee et al. (2007), Worthington (2008), Ferreira and Karali (2015), Yıldırım and Alola (2020) (for short-term results) findings.

6. CONCLUSION AND EVALUATION

Natural disasters have economic, financial, social, political, and psychological effects etc. in many ways. The aim of this study is to examine the effects of two earthquakes in Kahramanmaraş/Türkiye on February 06, 2023 on Borsa Istanbul (BIST) stock markets on a sectoral basis. In this context, it is investigated whether there is a statistically significant difference between sectoral stock returns before and after the earthquake. In the study, the effect of the earthquake in question on the returns of 18 BIST sectoral indexes was analyzed with the event study method, Paired Samples t-Test, which is a parametric test, and Wilcoxon Signed Rank Test, which is the non-parametric equivalent of this test, were used.

According to the findings obtained as a result of the analysis; no statistically significant difference was found between the pre-earthquake and post-earthquake returns of BIST sector indices. The findings show that, in the case of investing in BIST sectoral indices, abnormal returns cannot be obtained depending on the earthquake event. Accordingly, it can be stated that BIST sectoral indices are an efficient market in a semi-strong form. According to the result obtained, the importance of the measures taken by BIST management is also seen here. According to these results, it is possible to re-evaluate the measures that can be taken to protect investors in extraordinary situations such as earthquakes.

The procedures to be applied for earthquakes and similar extraordinary situations should be determined in advance by BIST management. The fact that Turkey is an earthquake zone should be taken into account in all areas and necessary policies should be determined in other areas as well. Investors should consider appropriate

diversification opportunities in their investments accordingly. Investors should be conscious of diversification, especially in investments based on certain regional indices such as city indices.

In this study, researches were carried out on a sectoral basis. However, in future studies, it will be possible to conduct research on city indices, which are among the BIST share indices. In particular, two of the mentioned indices (Adana and Kayseri share indices) are in the earthquake zone. In addition, other indices such as indices, indicator indices, and participation indices belonging to other sectors that are not included in the scope of this study will be discussed in future studies. The effects of different natural events can be compared by including natural events that took place in previous years. Finally, the impact of natural disasters, only the impact on other countries that have a relationship with the country where the natural disaster occurred, can also be examined.

AUTHORS' DECLARATION

This paper complies with Research and Publication Ethics, has no conflict of interest to declare, and has received no financial support.

AUTHORS' CONTRIBUTIONS

Conceptualization, writing-original draft, editing – HTA and VK, data collection, methodology, formal analysis – HTK, Final Approval and Accountability – HTK and VK

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APPENDIX

Appendix 1. BIST Sectors Included in the Analysis

	CODE	BIST SECTORAL INDEX NAME
1	XBANK	BIST BANKS
2	XBLSM	BIST INF. TECHNOLOGY
3	XELKT	BIST ELECTRICITY
4	XGIDA	BIST FOOD BEVERAGE
5	XGMYO	BIST REAL EST. INV. TRUSTS
6	XHOLD	BIST HOLD. AND INVESTMENT
7	XILTM	BIST TELECOMMUNICATION
8	XKMYA	BIST CHEM. PETROL PLASTIC
9	XMADN	BIST MINING
10	XMANA	BIST BASIC METAL
11	XMESY	BIST METAL PRODUCTS MACH.
12	XSGRT	BIST INSURANCE
13	XSPOR	BIST SPORTS
14	XTAST	BIST NONMETAL MIN. PRODUCT
15	XTEKS	BIST TEXTILE LEATHER
16	XTRZM	BIST TOURISM
17	XULAS	BIST TRANSPORTATION
18	XYORT	BIST INVESTMENT TRUSTS