THE IMPACT OF 2023 KAHRAMANMARAŞ EARTHQUAKES ON REAL ESTATE RELATED SECTORS: AN EVENT STUDY ANALYSIS[1]

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ABSTRACT | Kahramanmaraş earthquakes devastatingly hit the northern Syria and 11 provinces of Türkiye, causing thousands of deaths, injuries and property losses. The magnitude of the earthquakes and the extent of their impacts were huge enough to affect the entire Turkish economy. Real estate industry has been one of the most affected sectors as thousands of buildings were collapsed or damaged by the quake. This study aims to explore the impacts of Kahramanmaraş earthquakes on real estate related sectors in the Turkish stock market: Construction, cement-concrete, iron-steel, real estate investment trusts, and insurance. Using an event study methodology, our short-run analyses indicated that all given sectors were affected by the earthquakes. According to our findings, abnormal returns varied among the sectors: The construction materials sectors had positive abnormal returns while the insurance sector did abnormal returns on the opposite way. The findings are vital for market participants, policymakers and governments.

Keywords : *Real estate sector, earthquake, event study, stock indices*
JEL Codes: *G14, G32, M21*

Scope: *Economics*
Type: *Research*

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[1] Compliance with the ethical rules of the relevant study has been declared.

2023 KAHRAMANMARAŞ DEPREMLERİNİN GAYRİMENKUL VE İLGİLİ SEKTÖRLERE ETKİSİ: OLAY ANALİZİ

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ÖZ | Kahramanmaraş depremleri, kuzey Suriye'yi ve Türkiye'nin 11 ilini yıkıcı bir şekilde etkilemiş ve binlerce kişinin hayatını kaybetmesine, yaralanmasına ve mal kaybına yol açmıştır. Depremin şiddeti ve hissedilen alanın büyüklüğü Türkiye ekonomisini bir bütün olarak etkilemiştir. Depremden binlerce binanın yıkılması veya hasar görmesi nedeniyle gayrimenkul sektörü en çok etkilenen sektörlerden biri olmuştur. Bu nedenle araştırma kapsamında Kahramanmaraş merkezli depremin gayrimenkul ile ilgili sektörlere olan etkisinin incelenmesi amaçlanmıştır. İnşaat, çimento ve beton, demir ve çelik, gayrimenkul yatırım ortaklıkları ve sigorta sektörleri seçilmiştir. Olay analizi metodolojisi kullanılarak yapılan analizlerde, seçilen tüm sektörlerin depremlerden etkilendiği sonucuna ulaşılmıştır. Araştırma bulgularına göre; anormal getiriler sektörler arasında farklılık göstermektedir. İnşaat malzemeleri ile ilgili sektörlerde pozitif, sigorta sektöründe ise negatif yönlü anormal getiriler dikkat çekici olarak bulunmuştur. Elde edilen sonuçlar piyasa katılımcıları, politika yapıcılar ve hükümetler için önem taşımaktadır.

Anahtar Kelimeler: *Gayrimenkul sektörü, deprem, olay analiz çalışması, borsa endeksleri*
JEL Kodları*: G14, G32, M21*

Alan: *İktisat*
Türü: *Araştırma*

1. INTRODUCTION

The February 6, 2023 twin earthquakes with magnitudes of 7.7 and 7.6 occurred with their epicentres in Pazarcık and Elbistan districts of Kahramanmaraş respectively hit neighbouring eleven provinces in the southern side of Turkiye, and also northern Syria. Approximately 51,000 people were killed, more than 100,000 injured, and thousands of buildings collapsed or severely damaged in the affected provinces, Kahramanmaraş, Gaziantep, Şanlıurfa, Diyarbakır, Adana, Adıyaman, Osmaniye, Hatay, Kilis, Malatya, and Elazığ (Presidency of Strategy and Budget, 2023) (Figure 1). Therefore, strengthening the damaged properties and reconstruction of new buildings have become urgent needs in the country after the worst natural disaster in the European region for a century (WHO, 2023).

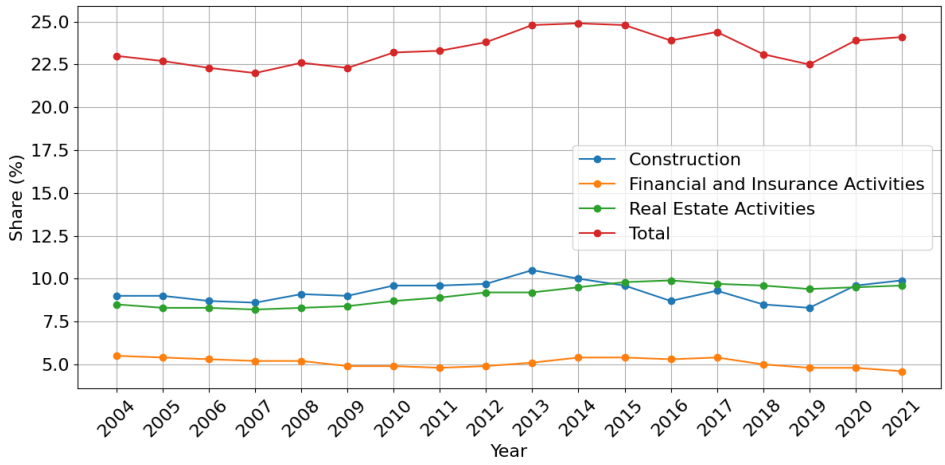


Figure-1: 11 cities affected by Kahramanmaras Earthquake

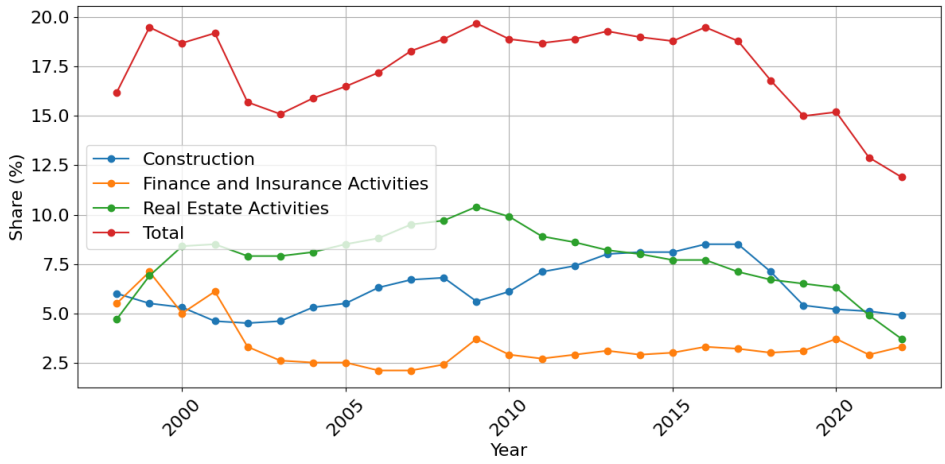
Besides the sorrow and grief caused in the community, the twin-earthquakes have affected the Turkish economy adversely because the disaster area is large in size and also constitutes a major component of the economy. As of the year 2022, total population of the provinces hit by the earthquakes is 14 million, accounting for 16.4% of the country population (TurkStat, 2023a). Approximately 13.3% of the total employment (3.8 million individuals) lives in the disaster-stricken region (TurkStat, 2023b). Out of approximately 2.6 million buildings in the region, residential buildings make up around 90% of the building stock (TurkStat, 2023c). At around 14% of the total housing stock of Turkiye is located in the disaster area. Thus, the major components of the economic burden of the twin-earthquakes are the damages of housing units and destruction of infrastructure and public service buildings. The former is estimated around 56.9

billion US Dollars, and the latter is 12.9 billion US Dollars. Construction and real estate sectors have obviously become two prominent subjects in the government agenda (Presidency of Strategy and Budget, 2023).

Real estate and construction sectors are considered as the "locomotive sector" in the literature (Hatipoğlu & Tanrıvermiş, 2017, p. 65). Over the past two decades, real estate activities and construction sector accounted for a significant share of 12.5% in the Gross Domestic Product (GDP) of Turkiye. While the share of construction and real estate activities within the GDP has decreased due to rising raw material costs, particularly in the post-pandemic era (Pamidimukkala & Kermanshachi, 2021, p. 4; Ayat & Kang, 2023, p.735; Guo et al., 2023, p. 2; Zhao, Hao, Chang & Wang, 2023, p. 4), studies have shown that the real estate sector continues to impact macroeconomic balances, primarily because it affects 250 subsectors (Urak, 2016, p. 1; Kızıl, 2023, p. 188). Furthermore, the 11 provinces affected by earthquakes have accounted for approximately 10% of the total GDP over the past two decades. This corresponds to the collective contribution of construction, real estate, finance, and insurance activities within these earthquake-affected provinces, making up about 10% of the total GDP (Figure 2).



(a)



(b)

Figure-2: (a) share of real estate sector in total GDP in earthquake affected provinces (b) share of real estate related sectors in total GDP by production method

Source: (TurkStat, 2023d)

Therefore, we aimed to explore how real estate related sectors are affected by the twin earthquakes in this study. In addition to their physically tradable nature, real estate properties can also be traded as securities in the capital markets (Şengül Güneş & Tanrıvermiş, 2020, p. 432). The listing of companies in the construction and related sectors on stock exchanges is crucial for providing insights into the current status of these industries. By using data from the Istanbul Stock Exchange (BIST), we measure the immediate effect of the quakes on five indexes that are closely related to the real estate sector. We have selected Real estate investment trusts (REITs) (XGMYO), Construction (XINSA), Non-Metal Mineral Products (XTAST), Basic Metals (XMANA), and Insurance (XSGRT) indexes in the study. XTAST consisting of cement and concrete companies, XMANA covering iron and steel companies, and XINSA are the major indexes on construction sector in Turkiye. XGMYO is an important index reflecting the price trends of the REITs. XSGRT index is included because the disaster insurance has been compulsory for all real properties in the country since the beginning of 2000s which is a lesson learned from another devastating earthquake in Gölcük district in Turkiye in 1999.

We investigate the abnormal returns of investors before and after the earthquake by employing an event study methodology commonly used in

financial literature and dependent sample t-tests. The data period is based on the date of the earthquake, February 6, 2023, with data collected 180 days prior to the earthquake, 5 and 10 days before, and 5 and 10 days after the earthquake ([-10, -5] [+5, +10]). Additionally, the results of the Elazığ Earthquake that occurred in 2020 are also evaluated to compare the two disasters occurred 3 years apart. Our findings indicate that abnormal returns were obtained from the subject sectors after the earthquake, and these abnormal returns vary among the subsectors of the real estate and construction industries. Our results are found consistent with existing studies in the literature, and implications for future research are discussed in the conclusion. To the best our knowledge, this paper is the first study in the literature on the impact of a natural disaster on only real estate and related sectors.

The remainder of this paper is organized as follows: Section 2 provides the theoretical background and literature review on both event study methodology and impacts of natural disasters. Section 3 summarises the event study methodology. Section 4 presents the data and empirical results. Section 5 concludes the study.

2. THEORETICAL FRAMEWORK

In the financial literature, it is widely accepted, based on Fama's seminal work in 1970, that the "Efficient Market Hypothesis" posits that stock prices reflect all available information, and investors make rational investment decisions (Fama, 1970, p. 384). Consequently, all changes in the market are known to rational investors, and price changes can be easily predicted. According to one of the proponents of the Efficient Market Hypothesis, Malkiel (2005), stock prices already incorporate all available information, leaving no room for investors to achieve above-average returns through arbitrage. However, it remains uncertain whether events like natural disasters or any unexpected economic shocks can be foreseen in advance or if investors can generate abnormal returns from their investments. In other words, the question arises as to whether markets are truly efficient in the face of events like earthquakes.

Event study analysis in the literature typically examines abnormal changes in stock returns in response to corporate announcements (Dos Santos, Peffers & Mauer, 1993; Çavuşoğlu, Mishra & Raghunatran, 2004; Norden & Weber, 2004; Capron & Shen, 2007; Flammer, 2013; Ardia, Bluteau & Boudt, 2022; Ali, Jia, Lou & Xie, 2023; Li, Wang, Jia, Chen & Meng, 2023; Rudkin & Cai, 2023). More recently, studies have investigated the changes in stock prices due to shocks such as Covid-19 (Bento et al., 2020; Maneenop & Kotcharin, 2020; Varma, Venkataramani, Kayal & Maiti, 2021; Thukral, Singh, Ghosh &

Pant, 2022; Mohammed, 2023). Within this context, there are also studies that examine the impact of natural disasters on companies listed on stock exchanges. These studies may compare the responses of different country stock markets to the same event, or they may focus on measuring how a single country's stock market reacts to different sectors.

Among studies comparing different countries' responses to the same natural disaster, French (2018, p. 504) conducted a study analysing the impact of 64 repeated events such as bombings, natural disasters, and sports matches in six different countries between 2007 and 2016. The research found that adverse events in developed economies had a greater impact on market returns compared to events in developing economies. Pagnottoni, Spelta, Flori, and Pammolli (2022) examined the effects of climate change and resulting natural disasters on international stock markets in 104 countries between 2001 and 2019, revealing that changes in stock markets varied by country and the type of disaster. Similarly, Di Tommaso, Foglia and Pacelli (2023) investigated the relationship between sovereign CDS spreads and natural disasters in various European countries between 2007 and 2021, finding heterogeneous responses to natural disasters across regions.

In studies that compare different sectors within the same country, Robinson and Bangwayo-Skeete (2017) analysed the impact of events including natural disasters, parliamentary elections, and credit rating reviews on six leading stock markets. They found evidence of relationships between significant events and the stock market. In another study, Malik, Faff, and Chan (2020) researched how stocks in different sectors in the United States responded to natural disasters between 1960 and 2015, revealing that responses varied by sector. Chen, Guo, Ji, and Zhang (2023) examined the effects of natural disasters on stocks traded in China between 2014 and 2021, concluding that the risk of impact on stock prices varied by sector and type of natural disaster.

Recent studies have also explored the role of Corporate Social Responsibility (CSR) in responding to natural disasters. Malik, Chowdhury and Alam (2023) observed that companies with CSR activities in the United States performed better in the market following natural disasters. Additionally, the impact of changes in credit ratings resulting from natural disasters has been investigated. Brahmana, Puah, and Chai (2016) showed that credit ratings improved after the Nias tsunami in Indonesia. Another study by Azuma, Dahan, and Doh (2023) evaluated 1,775 listed companies on the Tokyo Stock Exchange following the Kumamoto earthquakes in Japan in 2016. The study found positive shareholder reactions to Corporate Disaster Relief (CDR) announcements.

In the literature, there are publications that measure abnormal returns in the stock market following the Kahramanmaraş earthquake using the event study method. Say and Doğan (2023) examined the earthquake's impact on stock prices listed on Borsa İstanbul. Their analysis revealed that abnormal returns were obtained on the event day, the day after the event, and the second day after the event, with cumulative abnormal returns being positive on the event day and all days following. Akkuş and Kışlalıoğlu (2023) compared the returns of 18 BIST sectoral indices and found no abnormal returns. Kırkağaç and Karpuz (2023) analyzed the returns of companies listed on the Istanbul Stock Exchange banking index (XBANK) and insurance index (XSGRT) following the earthquake. According to the analysis results, CAR averages on the day of the earthquake, before the earthquake, and after the earthquake were different and statistically significant.

Based on the findings in the literature, the ability to generate abnormal returns through stock markets following natural disasters varies from region to region and even from sector to sector. Therefore, the situation of sectors following natural disasters should be examined as a specific research topic. Additionally, it has been observed that the real estate sector and its relationship with the phenomenon of earthquakes have not been adequately researched in the literature. This study attempts to fill this gap by examining the status of the construction and real estate sectors following an earthquake, which are among the sectors most affected by natural disasters in terms of abnormal returns, using Türkiye's stock market data.

3. EVENT STUDY METHOLOGY

The event study methodology (Fama, Fisher, Jensen, & Roll, 1969) is an empirical approach to measure the impact of an event or company/sector related announcements on stock price reactions. It has been widely applied in the finance literature to explain stock market reactions towards many various events including but not limited to corporate spin-offs, metaverse-related announcements of corporates (Xu, Liu, He, & Tsai, 2023), Covid-19 outbreak (Heyden & Heyden, 2021; Martins & Cró, 2022), policies and agreements (Kumari, Assaf, Moussa, & Pandey, 2023), conflicts (Umar, Riaz, & Yousaf, 2022), natural disasters (Tao, 2014; Valizadeh, Karali, & Ferreira, 2017).

The event study analysis has three major components: event day, event window, and estimation window. In this study, event day is the day of Kahramanmaraş earthquakes. Thousands of buildings were collapsed in Turkiye (and northern Syria as well). Rebuilding of many neighbourhoods after the catastrophe has become a very major need in the country's short-term agenda.

Therefore, this study investigates how real estate related indexes in the Turkish stock market reacted to the twin-earthquakes. We employed two event windows, which consist of 5 ($t \pm 5$) and 10 ($t \pm 10$) trading days before and after the event to explore the short term impacts in the market.

An estimation window calculates the expected and abnormal returns. The estimation window is suggested that to be long enough to enable measuring the effects of the event, and also short enough to prevent the effects of the event meaningless (McWilliams, Siegel, & Teoh, 1999). Estimation windows varies from 100 to 345 days in the literature (Baş, 2018, p. 273). For example, Takao, Yoshizawa, Hsu, and Yamasaki (2013) adopt 200 training-days in their study investigating how the Great East Japan earthquake affected the non-life insurance companies in the stock market; Tao (2014) uses 243 training-days to estimate the Lushan earthquakes on various sectors in the stock market; and Kumari et al. (2023) use 90 days to explore the impact of Glasgow Climate Pact on oil and das sectors; Afik, Cohen, and Lahav (2022) take 180 trading days as their estimation window in their study exploring the impact of entering a specific drug related industry on the market values of the firms). In this study, adopting a longer period of estimation window may cause biases because of Russia's invasion of Ukraine on February 25, 2022, we use an estimation window of 180 trading-days to avoid potential impacts of this conflict that has boosted the demand from Russian nationals for houses in Türkiye (Balcılar, Usman, Yülek, Ağan, & Erdal, 2023, p. 18).

Under the null hypothesis that the twin-earthquakes have no effect on the real estate related indexes in the Turkish stock market, the daily return of each sector is calculated through the estimation window and event window as follows:

$$R_{it} = \frac{P_{it} - P_{i,t-1}}{P_{i,t-1}} \quad (1)$$

where R_{it} is actual return on stock market price index for sector i for trading day t, P_{it} is the closing price for sector i for trading day t, and $P_{i,t-1}$ is the closing price for sector i for trading day $t-1$.

The expected return for the event study is calculated with a simple regression model on the data through the estimation window. The market model is:

$$E(R)_t = \alpha + \beta R_{it} + \varepsilon_{it} \quad (2)$$

where $E(R)_t$ is expected return on stock market price index for sector i for trading day t, α is intercept of the regression equation, β is Beta value of sector

i (slope), and R_{it} is actual return on stock market price index for sector i for trading day t.

The abnormal return is the difference between the actual return and expected return over the event window, which is estimated as follows:

$$AR_{it} = R_{it} - E(R)_{it} \quad (3)$$

where AR_{it} is the abnormal return on stock market price index for sector i for trading day t, R_{it} is actual return on stock market price index for sector i for trading day t, and $E(R)_t$ is expected return on stock market price index for sector i for trading day t.

Abnormal returns are accumulated to capture the impact of the event on the stock prices. The cumulative abnormal returns (CARs) are calculated as follows:

$$CAR_i^{t_0,t_k} = \sum_{t=t_0}^{t_k} AR_{it} \quad (4)$$

where t_0 is the event day, and t_k symbolizes the event windows (in this study $k = \{5,10\}$) (Strong, 1992, p. 540).

4. DATA AND FINDINGS

4.1. Data

This study evaluates how real estate related sectors in Turkish stock market responded to the Kahramanmaraş earthquakes and also Elazığ earthquake in 2020 to make comparisons between the two disasters with different magnitudes. Indices (listed in Table 1) for (1) Real estate investment trusts (REITs) (XGMYO), (2) Construction (XINSA), (3) Non-Metal Mineral Products (XTAST)[2], and (4) Basic Metals (XMANA)[3] are chosen as the major sectors providing an insight for Turkish real estate sector variations in the İstanbul Stock Exchange (BIST). In addition to these indices, index for Insurance (XSGRT) is also included because the DASK Insurance (DASK: Turkish Natural Disaster Insurance Institution) is compulsory for all real estates in Turkiye, which provides financial security to insured homeowners against natural disasters including earthquakes. The stock market data is provided by the investing.com website. The

[2] Major components of this index include cement and concrete companies.

[3] Major components of this index include iron and steel companies.

overall market is represented with BIST All Shares index (XUTUM). Figure 1 compares the impact of the twin-earthquakes on the returns of selected sectors and the overall market. An obvious fluctuation is observed in the stock market right after the earthquakes.

Table-1: Turkish Stock Market Indexes in Our Sample

Index Name	Index Abbr.	Sector
BIST TUM	XUTUM	Market Index
BIST Real estate investment trusts	XGMYO	REITs
BIST Construction	XINSA	Construction
BIST Non-Metal Mineral Products	XTAST	Cement and concrete companies
BIST Basic Metals	XMANA	Iron and steel companies
BIST Insurance	XSGRT	Insurance

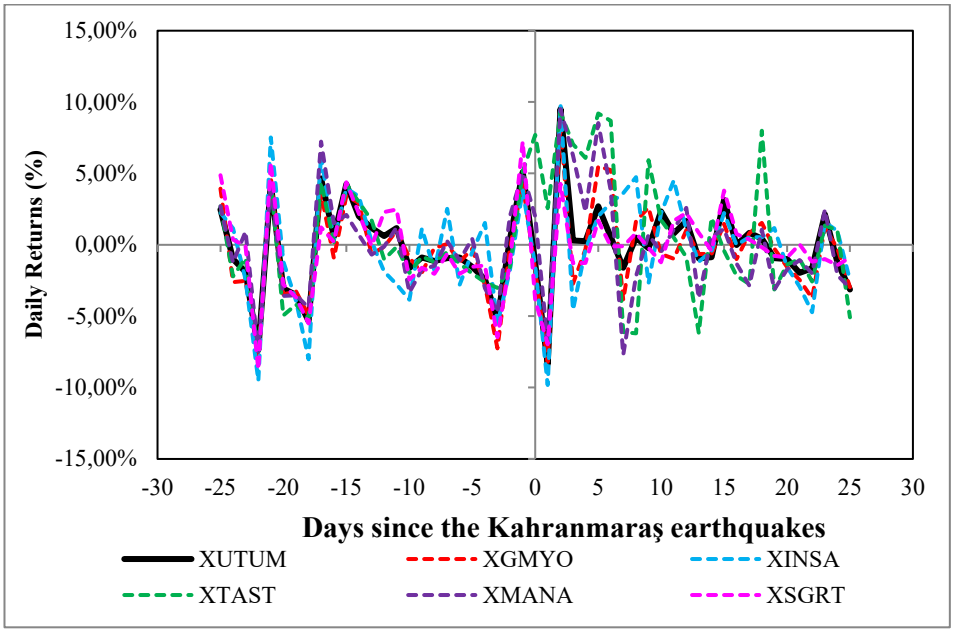


Figure-3: Total market and selected sector return-indices for Turkish stock market

4.2. Empirical Result

The abnormal returns (ARs) of five major industry indices related to real estate sectors in the event periods of 5 and 10 trading-days before and after the date of the twin earthquakes (February 6, 2023) are reported in Table 2 and Table 3.

Cement and concrete (XTAST), iron and steel (XMANA), and insurance (XSGRT) sectors reveal a significant reaction in the stock markets immediately on the day of the devastating earthquakes. The impact of the twin-disasters on the insurance sector is negative within the event window and abnormal returns are significant not only on the event day but also on the first trading-day of the stock market reopened after one-week break. Insurance companies are obviously the most adversely affected sector as tens of thousands of buildings were crumbled to dust and thousands of people are killed and trapped under the rubbles. The Turkish Catastrophe Insurance Pool (TCIP) institution reported that the total claim payments was 6.5 billion Turkish Liras by the end of March 2023, and reached 31 billion Turkish Liras as of August 2023 (TCIP, 2023). Insurance companies face with capital outflows arising from surging claim payments after natural disasters, and tend to increase their premium rates to cover the huge demand for health, life, automobile etc., and particularly for earthquake insurance compensations. Therefore, our short-run results showing large abnormal negative returns in the insurance sector in the post-earthquake period are consistent with expectations and the literature (Takao et al. (2013) and Hamurcu (2022) found similar results for the Great East earthquake in Japan in 2011, and İzmir earthquake in Turkiye in 2020).

On the other hand, raw material suppliers in the building industry gained positive abnormal returns after the Kahramanmaraş earthquakes. The sign and magnitude of the abnormal returns for both XTAST (cement and concrete) and XMANA (iron and steel) sectors are generally found positive and significant (Table 2 and Table 3). Construction sector index (XINSA) and REITs (XGMYO) reveal a small negative impact over the 5-day event window while the effect on these two sectors tends to be positive over the 10-day event window.

Table-2: Abnormal returns for the selected sector indices in the event window[-5, 5]

	XGMYO	XINSA	XTAST	XMANA	XSGRT
-5	0.0099	0.0066	-0.0086	0.0239	-0.0066
-4	-0.0084	0.0348	-0.0078	-0.0015	0.0003
-3	-0.0296**	-0.0112	0.0108	0.0120	-0.0304**
-2	-0.0053	-0.0225	-0.0200	0.0190	-0.0169
-1	0.0017	-0.0080	0.0096	-0.0010	0.0354**
0	**-0.0077**	**-0.0053**	**0.0860*****	**0.0364****	**-0.0318****
1	-0.0135	-0.0266	0.0915***	0.0236	-0.0140
2	0.0066	0.0137	0.0159	-0.0035	-0.0244
3	-0.0295**	-0.0498**	0.0672***	0.0625***	-0.0168
4	-0.0050	-0.0071	0.0578***	0.0236	-0.0163
5	0.0331***	-0.0052	0.0696***	0.0595***	-0.0035

*Notes: Estimation window is 180 training-days. XUTUM is used for market index. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.*

Table-3: Abnormal returns for the selected sector indices in the event window [-10, 10]

	XGMYO	XINSA	XTAST	XMANA	XSGRT
-10	0.0039	-0.0259	-0.0079	-0.0131	-0.0146
-9	-0.0122	0.0175	-0.0023	-0.005	-0.0114
-8	0.0069	-0.0097	-0.0042	0.0004	-0.014
-7	0.0081	0.0319	0.0013	0.0155	-0.0015
-6	-0.0048	-0.0218	-0.0073	0.0015	-0.0156
-5	0.0097	0.0065	-0.0089	0.0239	-0.0062
-4	-0.0086	0.0346	-0.0081	-0.0014	0.0009
-3	-0.0299**	-0.0117	0.0104	0.0123	-0.0295**
-2	-0.0055	-0.0224	-0.0202	0.0188	-0.0167
-1	0.0016	-0.0073	0.0096	-0.0016	0.0351**
0	**-0.0079**	**-0.0053**	**0.0858*****	**0.0364****	**-0.0313****
1	-0.0139	-0.0275	0.0909***	0.0242	-0.0127
2	0.0066	0.0148	0.0161	-0.0045	-0.0253*
3	-0.0297**	-0.0497**	0.067***	0.0624***	-0.0166
4	-0.0052	-0.007	0.0576***	0.0234	-0.016
5	0.033***	-0.0048	0.0695***	0.0591***	-0.0036
6	0.0478***	0.0232	0.0814***	0.0349**	-0.0065

7	-0.0256**	0.0485**	-0.0496***	-0.0568***	0.0087
8	0.0125	0.0416*	-0.0673***	-0.0245	0.0031
9	0.028**	-0.0266	0.0601***	0.0125	-0.0021
10	-0.0256**	0.0004	-0.0024	-0.0274*	-0.0301**

*Notes: Estimation window is 180 training-days. XUTUM is used for market index. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.*

The estimated Cumulative abnormal returns (CARs) from Equation 4 for two different event windows are shown in Table 4 and Table 5, and also graphically presented in Figure 4 and Figure 5. When we look at the CARs for different event windows, our results show that even though the impact of the twin earthquakes on the given sectors in the immediate short-run (5-day event window) is statistically significant, the CARs are found insignificant for REITs (XGMYO) and Construction sector (XINSA) for the longer event window (10-day). When it comes to the magnitude and sign of the impact of the earthquakes on the real estate-related sectors, XTAST and XMANA are the sector that are benefited from the earthquakes most while a negative reaction is observed in the index of insurance companies (XSGRT).

Table-4: Cumulative abnormal returns for the selected sector indices in the event window [-5, 5]

	XGMYO	**XINSA**	**XTAST**	**XMANA**	**XSGRT**
-5	0.0099	0.0066	-0.0086	0.0239	-0.0066
-4	0.0015	0.0413*	-0.0164	0.0223	-0.0063
-3	-0.0281**	0.0302	-0.0056	0.0343**	-0.0367**
-2	-0.0333***	0.0076	-0.0256*	0.0533***	-0.0537***
-1	-0.0316***	-0.0003	-0.016	0.0522***	-0.0182
0	**-0.0393*****	**-0.0056**	**0.07*****	**0.0886*****	**-0.0500*****
1	-0.0528***	-0.0322	0.1615***	0.1122***	-0.0640***
2	-0.0462***	-0.0185	0.1774***	0.1087***	-0.0884***
3	-0.0758***	-0.0684***	0.2446***	0.1712***	-0.1052***
4	-0.0807***	-0.0754***	0.3025***	0.1948***	-0.1215***
5	-0.0476***	-0.0806***	0.3721***	0.2543***	-0.1250***

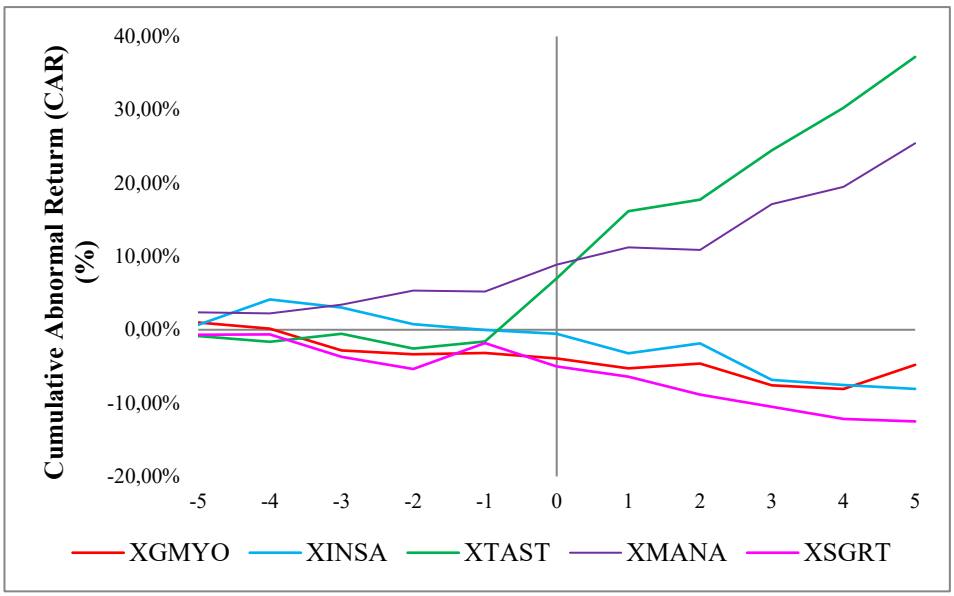


Figure-4: Cumulative abnormal returns for the selected sector indices in the event window [-5, 5]

Table-5: Cumulative abnormal returns for the selected sector indices in the event window [-10, 10]

	XGMYO	XINSA	XTAST	XMANA	XSGRT
-10	0.0039	-0.0259	-0.0079	-0.0131	-0.0146
-9	-0.0083	-0.0085	-0.0101	-0.0181	-0.0260*
-8	-0.0013	-0.0182	-0.0143	-0.0177	-0.0401***
-7	0.0068	0.0137	-0.0130	-0.0022	-0.0415***
-6	0.0020	-0.0081	-0.0203	-0.0007	-0.0571***
-5	0.0116	-0.0016	-0.0292**	0.0232	-0.0633***
-4	0.0030	0.0329	-0.0373***	0.0218	-0.0624***
-3	-0.0269**	0.0212	-0.0269**	0.0341**	-0.0919***
-2	-0.0323***	-0.0012	-0.0471***	0.0529***	-0.1085***
-1	-0.0307**	-0.0085	-0.0376***	0.0513***	-0.0735***
0	**-0.0386*****	**-0.0138**	**0.0482*****	**0.0877*****	**-0.1048*****
1	-0.0525***	-0.0413*	0.1391***	0.1119***	-0.1175***
2	-0.0459***	-0.0265	0.1553***	0.1074***	-0.1428***

3	-0.0756***	-0.0762***	0.2223***	0.1698***	-0.1593***
4	-0.0808***	-0.0832***	0.2799***	0.1932***	-0.1754***
5	-0.0478***	-0.088***	0.3494***	0.2523***	-0.1789***
6	-0.0001	-0.0648***	0.4308***	0.2872***	-0.1854***
7	-0.0257**	-0.0163	0.3813***	0.2304***	-0.1767***
8	-0.0132	0.0253	0.314***	0.2060***	-0.1736***
9	0.0148	-0.0013	0.3741***	0.2185***	-0.1756***
10	-0.0108	-0.0009	0.3717***	0.1911***	-0.2057***

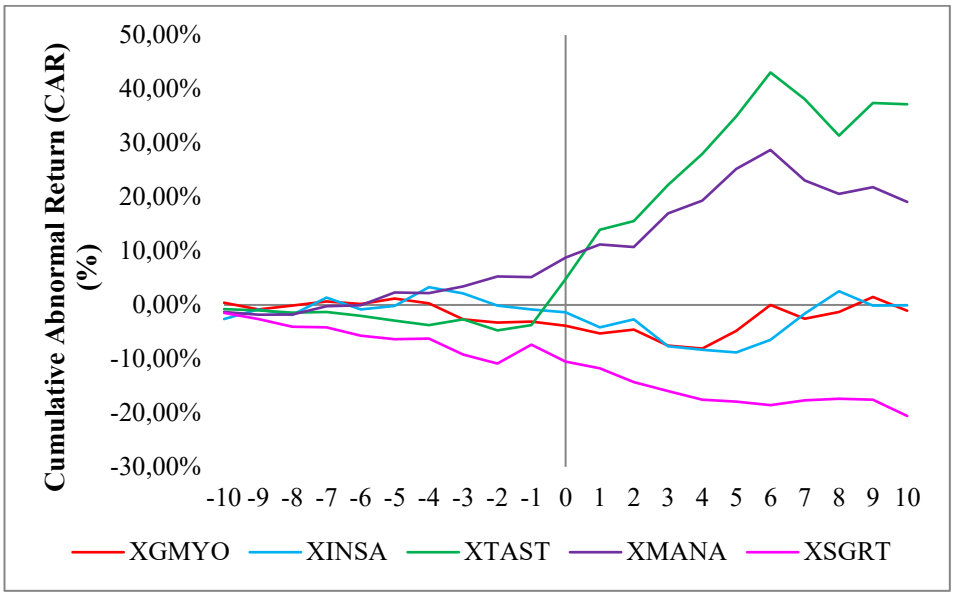


Figure-5: Cumulative abnormal returns for the selected sector indices in the event window [-10, 10]

We run the same analyses for the other recent earthquake with a high magnitude (6.8 Mw) occurred on January 24, 2020 in the Elazığ province in Turkiye. More than 45 people were killed and 1600 people were injured from the Elazığ earthquake. Figure 6 illustrating the actual returns of the selected sectors implies that the stock market was hardly affected by the earthquake compared to the Kahramanmaş struck which is not surprising as the size of the impacted area is far smaller than the Kahramanmaraş disaster. Cumulative abnormal returns are depicted in Figure 7 for the 10-day event period before and after the Elazığ

earthquake. Index for the cement and concreted companies (XTAST) is the only sector affected significantly in the positive way.

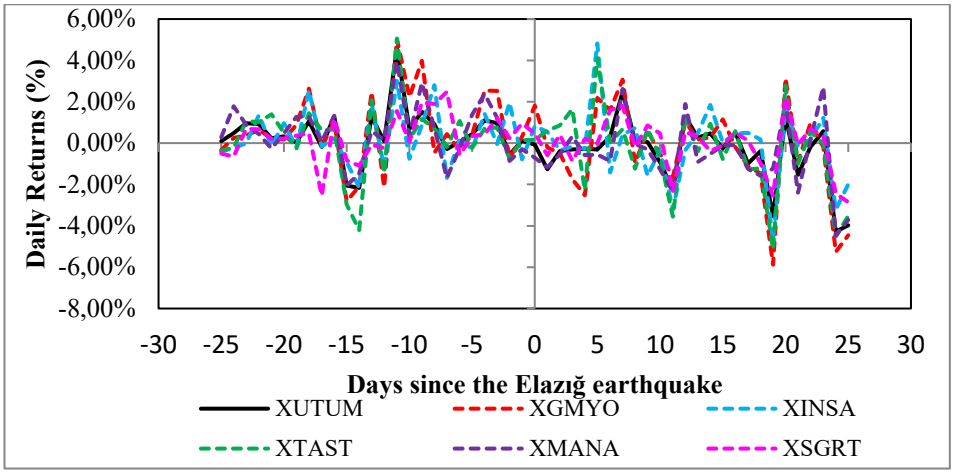


Figure-6: Elazığ Earthquake: Total market and selected sector return-indices for Turkish stock market

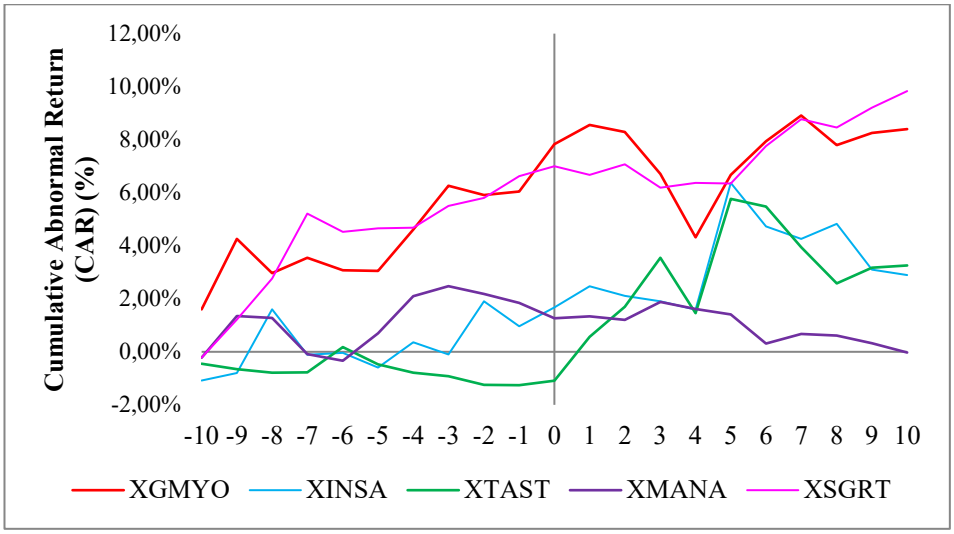


Figure-7: Elazığ Earthquake: CARs for the selected sector indices in the event window [-10, 10]

5. CONCLUSION AND DISCUSSION

Kahramanmaraş earthquakes occurred in early February 2023 have had a huge impact on eleven provinces in southern Turkiye resulting in numerous casualties and extensive property damages and losses. Damage assessment studies of the Ministry of Environment, Urbanization, and Climate Change identified a total of 518,000 residential units falling into the categories of requiring urgent demolition, severely damaged, or collapsed. The number of moderately damaged residential units was estimated at around 132,000, while slightly damaged units were estimated almost 1.3 million. More than 2.3 million people have found themselves in an uphill challenge of accessing a safe house after the earthquakes. Besides the traumatic impacts on the society, the two earthquakes adversely affected not only small businesses and local economy in the region, and also the country economy. The total burden of the quakes on the Turkish economy is estimated to be more than 104 billion US Dollars, half of which is attributed to the housing sector.

Real estate activities and construction sector constitute a significant portion of the Turkish economy. Even though their share in the GDP has been decreasing in the last several years, it reached to 15.5% on average annually from 2005 to 2016. Given the number of collapsed and damaged buildings in the earthquake region, real estate related sectors were expected to be directly affected by the disaster, and the Turkish economy as a whole. This destructive impact also manifested itself on the İstanbul Stock Exchange (Borsa Istanbul), as on the date of the earthquake, February 6, 2023, a decline was observed in the BIST-100 and other indices. According to the Efficient Market Hypothesis, all market changes are known to rational investors, and price changes can be predicted easily. Therefore, investors do not consistently achieve above-average returns. In this study, we explore the real estate and construction related sectors in the İstanbul Stock Exchange to investigate whether investors achieved abnormal returns following the earthquake.

We employ an event study methodology, an effective method in measuring short-term shocks, to explore the impact of the Kahramanmaraş earthquakes on the selected real estate related sectors, and tested with dependent sample t-test. Our findings reveal that the XTAST, XMANA and XSGRT indices exhibited a significant reaction in the stock markets immediately on the day of the devastating earthquakes. The impact on the insurance sector was negative within the event window, with abnormal returns being significant not only on the event day but also on the first trading day after a one-week break when the stock market reopened. This finding is consistent with the literature exploring the impact of a natural disaster on the insurance sector (e.g. Valizadeh, Karali, & Ferreira, 2017). Conversely, raw material suppliers in the building industry experienced positive

abnormal returns following the Kahramanmaraş earthquakes. The sign and magnitude of the abnormal returns for both XTAST and XMANA indices were generally found to be positive and significant. XINSA and XGMYO showed a slight negative impact over the 5-day event window, while the effect on these two sectors tended to be positive over the 10-day event window. Additionally, the results of the Elazığ Earthquake that occurred in 2020 were also evaluated and similar results are found only for the cement and concrete sector. This finding implies that magnitude of an earthquake and the size of affected region are significantly important. Obviously, selected sectors except the XTAST in the Turkish stock market were not affected by the Elazığ earthquake as much as by the Kahramanmaraş earthquakes. Our paper is the first study exploring the impact of the 2023 Kahramanmaraş earthquakes on real estate and related sectors. Akkuş and Kışlalıoğlu's (2023) included XGMYO and XTAST in their study on the twin earthquakes and our results are consistent with their findings.

Overall, our short-run results suggested that real estate related sectors in the İstanbul Stock Market were significantly affected by the massive earthquakes on February 6, 2023. Even though each country has their own particular circumstances in terms of their precautions against earthquakes, socio-economic conditions, sectoral approaches and regulations, our findings are vital for market participants, policymakers and governments in many most seismically active countries in understanding how real estate related sectors react to an external shock. Future comparative studies considering country and local market conditions could provide more comprehensive and beneficial outcomes for all parties from investors to policymakers.

6. CONFLICT OF INTEREST STATEMENT

There is no conflict of interest between the authors.

7. FINANCIAL SUPPORT

No funding or support was used in this study.

8. AUTHOR CONTRIBUTIONS

GSG: Idea;
GSG: Design;
TG, GSG, SG: Supervision;
TG, GSG, SG: Collecting and processing resources;
TG, GSG: Analysis and interpretation;
GSG: Literature review;
TG, GSG, SG: Writer;
TG, GSG, SG: Critical review

9. ETHICS COMMITTEE STATEMENT AND INTELLECTUAL PROPERTY COPYRIGHTS

Ethics committee principles were followed in the study. There has been no situation requiring permission within the framework of intellectual property and copyrights.

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