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The Effects of Natural Disaster on Financial Markets: The Empirical Analysis of 2023 Earthquakes in Türkiye

Doğal Afetlerin Finansal Piyasalara Etkileri: 2023 Türkiye Depremlerinin Ampirik Analizi

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Abstract

Purpose: The aim of the study is to investigate the effects of the February 6 earthquakes on financial markets

Design/Methodology: BIST100 index, BIST sustainability index and BIST 100 electricity index were analysed by the cross quantilogram method.

Findings: As a result of the analysis; According to the findings, the highest negative correlation values are seen in the period after the earthquake date. While the correlation relations between the sustainability and electricity indices included in the study and the BIST100 index were negative shortly before the earthquake, they followed a fluctuating course and maintained a negative effect since the earthquake date. In both indices, the dates when the negative effects are most visible coincide with the post-earthquake period. This situation reveals that both indices were negatively affected by the earthquake.

Limitations: The fact that the February 6 earthquakes are still new and their consequences have not yet fully emerged necessitates the study to be conducted with more comprehensive data in the future.

Originality/Value: It is thought that the study will make a significant contribution to the literature in terms of seeing short-term results and determining economic projections accordingly. Due to the devastating earthquakes that have occurred in recent years, the economic effects of natural events have become very important for Turkey. Therefore, it is inevitable to discuss the consequences of these effects and what needs to be done in the light of these consequences.

Keywords: Earthquake, Natural Disaster, Financial Markets, Sustainability, CAR

Öz

Amaç: Çalışmanın amacı 6 Şubat depremlerinin finansal piyasalar üzerindeki etkilerini araştırmaktır.

Tasarım/Yöntem: BIST100 endeksi, BIST sürdürülebilirlik endeksi ve BIST 100 elektrik endeksi çapraz quantilogram yöntemiyle analiz edilmiştir.

Bulgular: Analizler sonucunda; Elde edilen bulgulara göre en yüksek negatif korelasyon değerleri deprem tarihinden sonraki dönemde görülmektedir. Çalışmaya dahil edilen sürdürülebilirlik ve elektrik endekslerinin BIST100 endeksi ile korelasyon ilişkileri depremden kısa bir süre önce negatif iken deprem tarihinden itibaren dalgalı bir seyir izlemiş ve olumsuz etkiyi korumuştur. Her iki endekste de olumsuz etkilerin en fazla görüldüğü tarihler deprem sonrasına denk gelmektedir. Bu durum her iki endeksin de depremden olumsuz etkilendiğini ortaya koymaktadır.

Sınırlılıklar: 6 Şubat depremlerinin henüz yeni olması ve sonuçlarının henüz tam olarak ortaya çıkmaması, çalışmanın gelecekte daha kapsamlı verilerle yapılmasını zorunlu kılmaktadır.

Özgünlük/Değer: Çalışmanın kısa vadeli sonuçların görülmesi ve ekonomik projeksiyonların buna göre belirlenmesi açısından literatüre önemli bir katkı sağlayacağı düşünülmektedir. Son yıllarda meydana gelen yıkıcı depremler nedeniyle doğa olaylarının ekonomik etkileri Türkiye için oldukça önemli hale gelmiştir. Dolayısıyla bu etkilerin sonuçlarının ve bu sonuçlar ışığında yapılması gerekenlerin tartışılması kaçınılmazdır.

Anahtar Kelimeler: Deprem, Doğal Afet, Finansal Piyasalar, Sürdürülebilirlik, CAR

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1. INTRODUCTION

Natural events occur frequently in the world. Natural events have effects on human life, the economy, health, and any factor that directly or indirectly affects human life. In general, the impact of natural events varies depending on the countries' fragility levels. Earthquake events disproportionately affect underdeveloped and developing countries due to their relatively low or ineffective infrastructure investments (Kahn, 2005). Globally, 387 reported natural events occurred in 2022, resulting in 30,704 fatalities, 185 million affected individuals, and a total of 223.8 million dollars in economic damage (EM-DAT, 2022). As a result, the dimensions of these effects, as well as their effects on human life and the economy, are worth discussing.

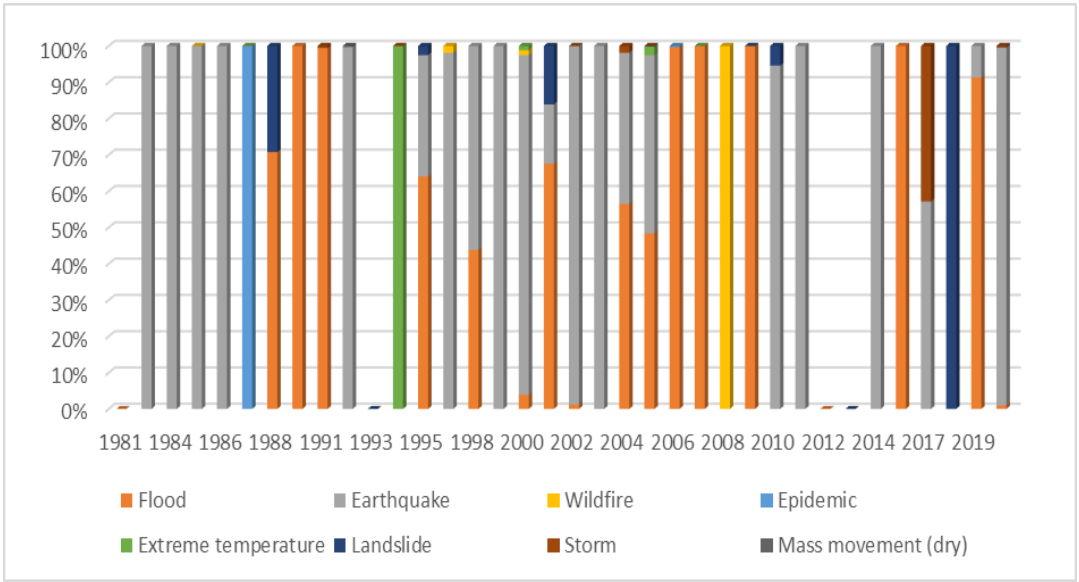
The economic effects of natural events have become very important for Türkiye due to the devastating earthquakes that have occurred in recent years. Therefore, we must discuss the implications of these effects and the necessary actions based on these results. This study is the first in literature, as far as is known. The fact that the earthquake is still new, and its results have not yet been fully revealed necessitates that the study be carried out with more extensive data in the future. However, scholars believe the study significantly contributes to the literature by examining short-term results and formulating appropriate economic projections. The economic effects of natural events have become very important for Türkiye due to the devastating earthquakes that have occurred in recent years. Therefore, it is inevitable to discuss the consequences of these effects and what needs to be done considering these results.

As far as we know, this study is the first study in literature. For this reason, firstly, a historical summary of the financial and economic effects of earthquakes in Turkey is presented in the study. The second part of the study presents the literature, methodology, and results of an empirical study using the qauntilogram method, divided into three parts. The last section contains the conclusion and discussion.

1.1. Earthquake and the impacts on Türkiye

Türkiye is one of the world's most active earthquake regions, and it is geographically located where many large earthquakes have occurred from the past to the present. In the earthquakes that occur, there is much damage, both materially, morally, and economically. Figure 1 shows key natural hazard statistics for 1980–2020 for Turkey. Türkiye is one of the world's most active earthquake regions, and it is geographically located where many large earthquakes have occurred from the past to the present. In the earthquakes that occur, there is much damage, both materially, morally, and economically. Figure 1 shows key natural hazard statistics for 1980–2020 for Turkey.

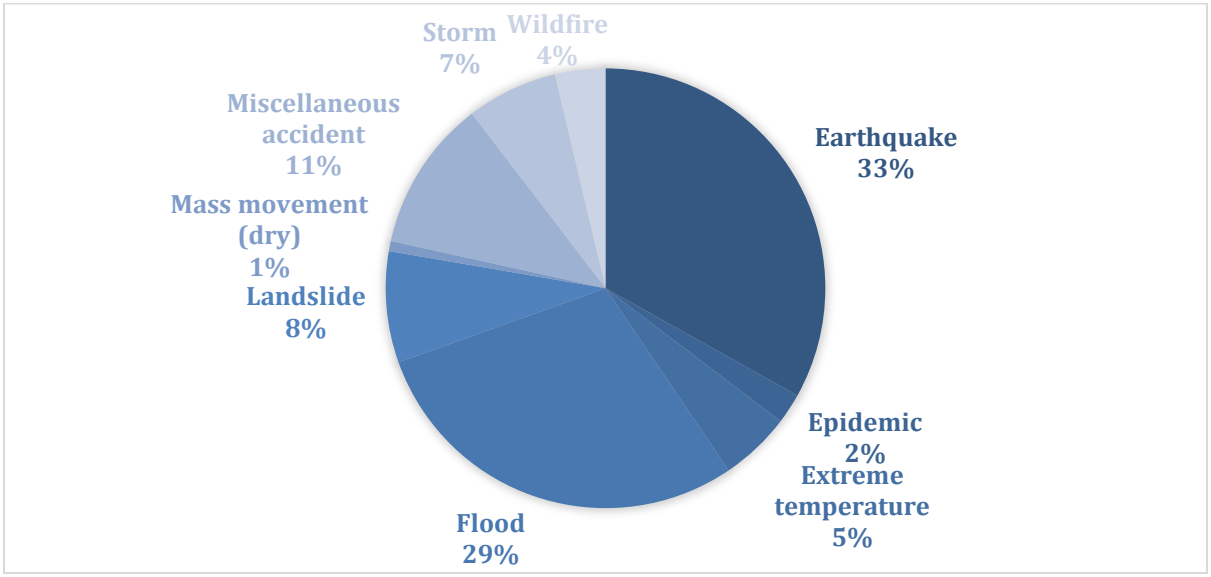
Figure 1: Key natural hazard statistics for 1980-2020 for Türkiye



Source: WB Climate Change Knowledge Portal, 2023

Examining the information in Figure 1 reveals the dimensions of the effects of natural events between 1980 and 2020. When we look at the number of people affected by the events that have occurred, it is possible to state that the most significant effects occur as a result of earthquakes. Figure 2 includes the average natural hazard occurrence for 1980–2020 data to further examine the effects of natural events.

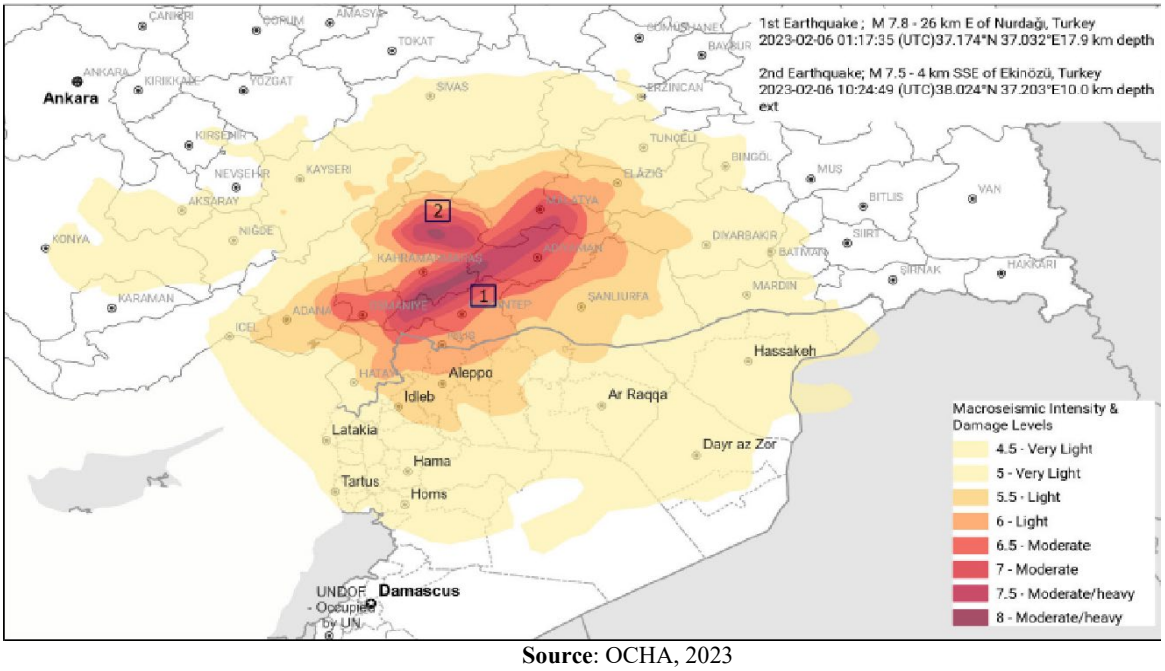
Figure 2: Average Natural Hazard Occurrence for 1980-2020 (%)



Source: WB Climate Change Knowledge Portal, 2023

When examining the average effects of natural events, Figure 2 reveals that earthquake and flood have the highest rates. Therefore, an examination of historical data reveals that the earthquake events, which have the greatest impact, peaked with the February 2023 earthquakes. Türkiye was damaged by two earthquakes of magnitude 7.8 and 7.5 on February 6 and 7, 2023. The earthquake greatly affected 11 provinces (Kahramanmaras, Gaziantep, Malatya, Diyarbakir, Kilis, Sanliurfa, Adiyaman, Hatay, Osmaniye, and Adana), resulting in the destruction of many settlements. According to the latest data, the number of people who lost their lives because of the earthquake was over 50,000 (SBB, 2023). Figure 3 below shows the areas affected by the earthquake.

Figure 3: Türkiye Earthquake 6 Feb. 2023



Source: OCHA, 2023

As can be seen in Figure 3, the impact area of the earthquake is quite large. Therefore, its economic effects are expected to be high. The analyses indicate that the total cost of the earthquake is about 100,000 billion liras (Aksoy et al., 2023). Although it is not compared to the loss of life in the financial markets economically, it has been greatly affected. In the earthquakes that occurred on February 6, 2023, first search and rescue operations continued, followed by those of the Ministries of Treasury and Finance, Trade, Agriculture and Forestry, Labor, and Social Security, the Banking Regulation and Supervision Agency (BRSA), the Capital Markets Board (CMB), Borsa Istanbul A. (BIST), and the Banks Association of Türkiye (TBB) in order to protect the financial markets and the real sector from the negative conditions created by the earthquake. A series of preventive and remedial arrangements have been put into practice (Selçuk, 2023). These decisions were made in order to stabilize stock prices by stopping the declines that occurred in the first two days following the BIST earthquake, to avoid market volatility, to guarantee the continuation of real sector activities in the disaster zone by ensuring the smooth operation of the banking sector's credit mechanism, and to lessen the adverse effects of the disaster on the nation's economy generally.(Selçuk, 2023).

On February 20, 2023, the World Bank released its assessment report on the Kahramanmaras earthquakes, which was part of the "Global Rapid Post-Disaster Damage Estimation (Grade)" approach, aimed at assessing the extent of the disaster in the initial weeks following major disasters. The report calculates the direct cost of earthquakes at $34.2 billion (4% of GDP in 2021), with residential buildings accounting for $18 billion, non-residential buildings for $9.7 billion, and infrastructure damage accounting for the remaining $6.4 billion. Global experience suggests that the potential cost of an earthquake could exceed estimates by up to twice. The report states that the estimated cost includes physical damage but does not include humanitarian and emergency response costs, indirect costs (production disruption, reduction in sales, etc.), or secondary effects (World Bank 2023, 6).

The European Bank for Reconstruction and Development (EBRD) has also included its estimates on the effects of the Kahramanmaraş earthquakes in its report titled "Regional Economic Prospects," published on February 16, 2023. The report asserts that, despite the significant uncertainty arising from the ongoing rescue efforts, the earthquake's negative impact on 2023's growth rate is likely to be less than 1 point. Given that the earthquake occurred in the early months of the year, the year's reconstruction efforts can significantly mitigate the earthquake's negative economic effects (EBRD 2023, 13–15). In its report titled "Türkiye: The Economic Implications of the Earthquake," published on February 16, 2023, JP Morgan stated that the physical damage caused by the earthquake will cost the Turkish economy 25 billion dollars (2.5% of GDP) and that there are upside risks (Reuters, 2023).

To see the short-term initial effects of this earthquake, which is likely to have a large impact on the country's economy, the cross-qauntilogram method expected to occur was examined. For this purpose, the BIST-100 index, the BIST-100 sustainability index, and the BIST-100 electricity index were examined. What the study has added to the body of knowledge is thought to be the first study investigating Türkiye’s 2023 earthquake as well as the use of the cross-qauntilogram method, which is one of the second-generation analysis methods. For this purpose, the study consists of three sub-headings. In the first part, a literature review is included. In the second part, data, methodology, and empirical results are explained, while the last part includes conclusions and recommendations.

2. LITERATURE

Research on stocks and their returns is evident in the literature. On the other hand, studies examining the effects of natural disasters on stock returns are generally limited. Specifically, research focuses primarily on how disasters impact insurance companies in the financial markets. In this direction, we have scanned the literature to examine the effects of disasters on financial markets from a general perspective.

Odell and Weidenmier (2002) examined the effects of the 1906 San Francisco earthquake on the American economy and financial markets. They concluded that real shocks have significant effects on both the financial and monetary sectors of the economy, as well as economic output. Using the Ordinary Least Squares technique, Yamori and Kobayashi (2002) investigated how the 1995 Tokyo

earthquake affected the stock values of Japanese insurance companies. The enormous load this earthquake placed on insurance firms led to the creation of the Japanese earthquake insurance system. results showed that there were negative stock price reactions between the first and ninth days following the earthquake.

Worthington and Valadkhani (2004) examined how natural disasters affected the Australian stock market from December 31, 1982, to January 1, 2002, using daily price and savings returns. The study determined that the shocks caused by 42 major natural disasters, such as storms, floods, hurricanes, earthquakes, and forest fires, had an impact on market returns. Worthington (2008), on the other hand, investigated the effects of natural events and disasters in Australia on Australian stock returns using the GARCH-Mean model. It is concluded that the severe storms, floods, hurricanes, earthquakes, and forest fires experienced during the period from January 1, 1980, to June 30, 2003, which was analyzed using daily price and savings returns, did not have a significant effect on stock market returns. In addition, Bolak and Süer (2008) examined the effect of the Marmara earthquake of August 17, 1999, on the stock returns of companies traded in the ISE and operating in the finance sector. The analysis of a total of 20 companies in the Turkish financial sector revealed a significant number of troubled companies, particularly financial institutions. Conversely, the stock market experienced a value loss of -0.1038 on the first trading day following the earthquake. Asongu (2012) examined the effects of the Japan earthquake, tsunami, and nuclear crisis on financial markets. We conducted an analysis based on correlation coefficients to test whether these disasters had contagion effects in 33 economies. The results demonstrate that two months later, no foreign currency market had much stronger connections with the Japanese yen. However, the global stock markets have determined that South Africa, Taiwan, Bahrain, Saudi Arabia, and Bahrain are contagious. Using GARCH models for Japan and the USA, Wang and Kutan (2013) investigated the effects of natural disasters on the insurance industry and the composite stock market. As a result of the data, they concluded that there were considerable wealth impacts in the insurance sector, even if no wealth effect of natural catastrophes could be detected on the composite stock markets in the USA and Japan. All other markets are vulnerable to the hazards of natural disasters, except for the Japanese composite stock market. Additionally, Scholtens and Voorhorst (2013) examined the impact of earthquakes on financial markets between 1973 and 2011, which led to over 100 fatalities across 21 nations across five continents. The empirical results led them to the conclusion that the value of the stock market is significantly negatively affected. Additionally, there was no variation in the responses offered based on the magnitude of the earthquakes or the various income levels in the nations.

Valizadeh et al. (2017) studied the impact of the 2011 earthquake in Japan on 19 stock market sector returns in Japan and its trading partners. The analysis revealed that the earthquake's effects extended beyond Japan and the sectors it immediately affected. The earthquake adversely impacted most examined industries, but it also brought benefits to others. Fakhry et al. (2018) aimed to analyze the long- and short-term effects of the devastating earthquake, also called the Great Tohoku or Sendai earthquake in Japan in 2011, and the tsunami on Japanese stock, debt, and foreign exchange markets, as well as gold, using daily data. Natural disasters have a shorter-term than a longer-term impact on the efficiency of the market, according to the findings from the C-GARCH-t volatility model. Conversely, the financial market experienced minimal impact from the earthquake. On the other side, Sakariyahu et al. (2023) looked at how market performance changed between February 1 and February 20, 2023, following the most recent earthquakes in Syria and Turkey. The study's findings, which used daily stock market data from 21 important Türkiye trading partners, showed that the earthquake significantly decreased the stock market returns of the sample countries. India's coastlines were struck by tsunami waves in 2004 as a result of the earthquake in Sumatra, Indonesia. Valizadeh et al. (2017) studied the impact of the 2011 earthquake in Japan on 19 stock market sector returns in Japan and its trading partners. The analysis revealed that the earthquake's effects extended beyond Japan and the sectors it immediately affected. The earthquake adversely impacted most examined industries, but it also brought benefits to others. Fakhry et al. (2018) aimed to analyze the long- and short-term effects of the devastating earthquake, also called the Great Tohoku or Sendai earthquake in Japan in 2011, and the tsunami on Japanese stock, debt, and foreign exchange markets, as well as gold, using daily data. Natural disasters have a shorter-term than a longer-term impact on the efficiency of the market, according to the findings from the C-GARCH-t volatility model. Conversely, the financial market

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3.DATA AND METHODOLOGY

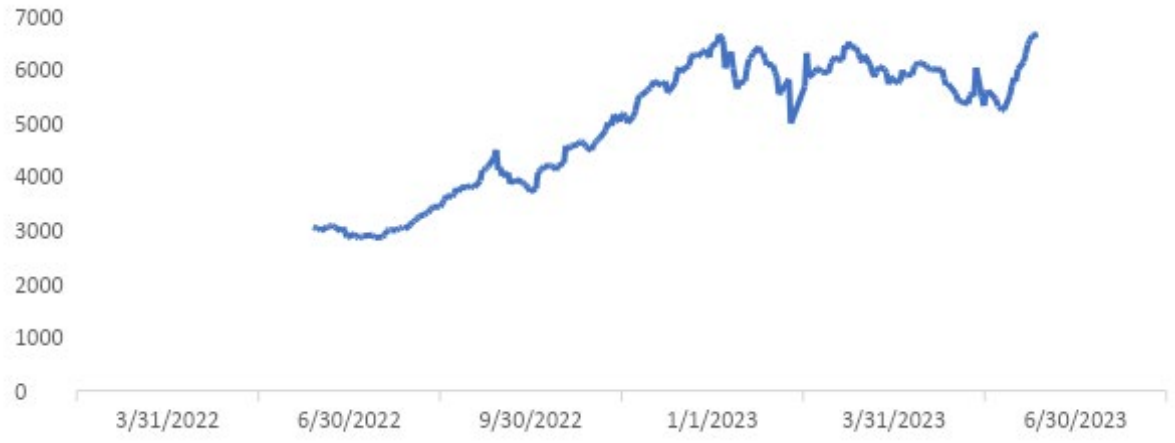
In this section, the data used in the analysis of the study and the application method will be given.

3.1. Data

The Investing database provided the BIST100 index, BIST Sustainability Index, and BIST Electricity Index data for the study. We used daily closing data from 13.06.2022 to 12.06.2023 in the data set. Specifically, we preferred a short-term time series to better understand the impact of the earthquake on the indices. During the earthquake and the following period, both electricity and natural gas cuts occurred, as well as major problems in the infrastructure of energy provider companies. In this context, experts estimate that the earthquake will significantly impact the energy market. In addition, the BIST Sustainability Index is a platform that aids businesses in developing policies addressing the risks of stock exchanges on matters of corporate governance, social responsibility, and the environment and disseminating information about the sustainability practices of businesses to responsible investors (BIST, 2023).

Examining the impact of the earthquake disaster on the BIST Sustainability Index is crucial in this regard. The study kept the time series short and attempted to minimize the impact of global and domestic developments on the analysis. This approach aims to provide more precise conclusions about the date of the earthquake and its aftermath. Comparing the sustainability and electricity indices included in the study with the BIST100 is important to see and compare the financial effects of the earthquake on the stock market.

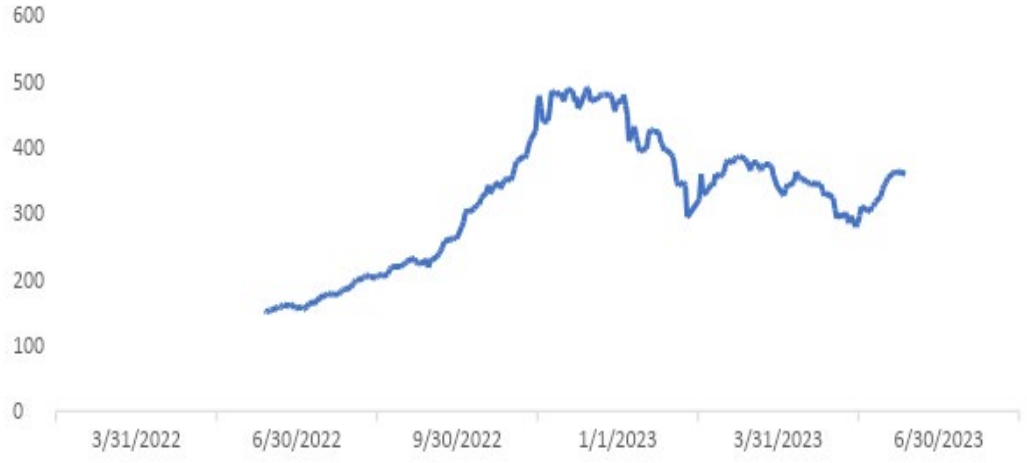
Figure 4: Sustainability Index



Source: Investing, 2023

The figure shows that the date of the earthquake marked the biggest break in the sustainability index. Before this breakout, the index followed an upward trend until the first half of January, when a short-term breakout took place. After this break, a major break took place in the history of the earthquake, and the index rose to a negative level in a short time, but the upward trend left its place for the downward trend.

Figure 5: Electricity Index



Source: Investing, 2023

When we look at the graph created with the data of the electricity index, it is seen that the biggest break and the lowest value of the index in the last 4 months were on the date of the earthquake. Before the earthquake, the index was in an upward trend until mid-November, but it progressed steadily from November to mid-January and the 2nd of January. While a small fracture occurred in half of the index, a large fracture occurred on February 6, 2023, the day of the earthquake. After that, the index was unable to return to its previous value and maintained its stability at a lower value.

3.2. Methodology

For the practical part of the study, the cross-qauntilogram dependence between BIST100 and BIST Sustainability Index returns and BIST100 and BIST Electricity Index returns will be examined in order to determine how the intensity and duration of the spreads between the indices will change under downward and upward market movements. Han et al. developed the cross-qauntilogram method in 2016. This approach, based on quantile points, does not use moment conditions. Because of this, it performs well when analyzing the variables in a financial time series. Additionally, the cross-qauntilogram approach permits simultaneous determination of the direction, amount, and duration of dependence in all components of the rotation distributions and can accommodate extended delays at relatively cheap computational costs (Pham, 2021). The cross-qauntilogram method has some advantages over other techniques. First, this method measures predictability from one time series to another in terms of the quantities of each variable's distribution. Thus, as in Figures 1 and 2, it allows us to measure the directional spreads of decline, normality, and rise between financial assets in a wide range of market conditions. Another benefit is that, compared to traditional regression-type models, this method has very long delays. Therefore, it can measure the strength of directional spreads in short-, medium-, and long-term investments. A prerequisite for the cross-qauntilogram method is that the series be stationary. A cross-qauntilogram is a method that examines the relationships between two series according to their distribution characteristics in the right and left tails. Cross-correlations are one of the most frequently used methods to estimate correlations between variables in a time series. Cross-correlation reveals the correlations between the time t of one variable and the time t-1, t-2, and t-3 of the other variable. This allows one variable to predict the future value that the other variable will receive. The methodology of The cross-qauntilogram method is as follows:

y_{it} has to be a static time series. where i is the index and t is the time series (i = 1, 2, t = 1, … , T). Assuming that has distribution and density functions of $f_i(.)$ ve $f_i(.)$, y_{it}, i = 1, 2. $q_{it}\ (\tau_i) = \inf\{v : F_i\ (v) \geq \tau_i\}\ \tau_i \in (0, 1)$ Let be the corresponding quantile function for .

The cross qauntilogram between the two events $\{y_{1t} \leq q_{1t}(\tau_1)\}$ ve $\{y_{2t-k} \leq q_{2t-k}(\tau_2)\}$, in this equation "k" represents the delay length (k = $\pm 1, \pm 2, \ldots$) and τ_1 and τ_2. It is formulated as follows for the pair;

$$\rho_\tau(k) = \frac{E[\psi_{\tau_1}(y_{1t} - q_{1t}(\tau_1))\,\psi_{\tau_2}(y_{2t-k} - q_{2t-k}(\tau_2))]}{\sqrt{E[\psi_{\tau_1}{}^2(y_{1t} - q_{1t}(\tau_1))]}\sqrt{E[\psi_{\tau_2}{}^2(y_{2t-k} - q_{2t-k}(\tau_2))]}} \quad (1)$$

In this equation, ,-a .(u) = 1[u < 0] is a The cantil process. When a rigid monotic transformation, such as the logarithmic transform, is given to both series, the cross-qauntilogram, which records the series dependence between two series at various quantile levels, remains unchanged. In the event of two events $\{y_{1t} \leq q_{1t}(\tau_1)\}$ and $\{y_{2t-k} \leq q_{2t-k}(\tau_2)\}$, $\rho_\tau(k) = 0$, from $\{y_{2t-k} \leq q_{2t-k}(\tau_2)\}$ to $\{y_{1t} \leq q_{1t}(\tau_1)\}$ indicates that there is no cross-dependency or directional predictability.

To test the null hypothesis $H_0 : \rho_\tau(1) = \ldots\ldots = \rho_\tau(p) = 0$ Han vd, (2016) suggests that Ljung-Box test statistics.

$$Q_\tau{}^*(\mathrm{p}) = \mathrm{T}(\mathrm{T}+2)\sum_{k=1}^{p} \hat{p}^2{}_\tau(k)/(T-k) \quad (2)$$

Given in this equation $\hat{p}_\tau$ (k) Formulated below is the cross cantilogram.

$$\hat{p}_\tau(k) = \frac{\sum_{t=k+1}^{T} \psi_{\tau_1}(y_{1t} - \hat{q}_{1t}(\tau_1))\,\psi_{\tau_2}(y_{2t-k} - \hat{q}_{2t-k}(\tau_2))}{\sqrt{\sum_{t=k+1}^{T} \psi_{\tau_1}{}^2(y_{1t} - \hat{q}_{1t}(\tau_1))}\sqrt{\sum_{t=k+1}^{T} \psi_{\tau_2}{}^2(y_{2t-k} - \hat{q}_{2t}(\tau_2))}} \quad (3)$$

The quantile function anticipated for each time series is indicated by the symbol I = 1, 2) in the formula. Han et al. (2016) suggests using the stationary bootstrap process to approximate the empty distribution of the cross-qauntilogram and the aforementioned Q statistic without relying on the unsettling asymptotic distribution's parameters.

4.EMPIRICAL RESULTS

At this stage, first, descriptive statistics about the data in the analysis are included. In addition, as in Table 1, stationarity tests of variables are also included.

Table 1: Descriptive Statistics

Values	Jarque-Bera	Skewness	Kurtosis	ADF	Q1	Q2
BIST100	25.87890 (0.000002)	-0.480071	1.750000	-13.66029 (0.0000)	244.97 (0.0000)	483.60 (0.0000)
Sustainability	25.34093 (0.000003)	-0.471659	1.757873	-13.70387 (0.0000)	244.56 (0.0000)	482.65 (0.0000)
Electrical	10.48548 (0.005286)	-0145221	2.039662	-14.16968 (0.0000)	247.38 (0.0000)	489.55 (0.0000)

Note: JB and ADF stand for Jarque-Bera normality test and Augmented Dickey Fuller unit root tests. Q and Q^2 refers to the Ljung-Box test of serial correlation in returns and square of returns.

The results of the Jargue-Bera test reveal that the distributions of the series are not normal. In both variables, obliques are close to 0, and flattening is close to 3. It means that the farther away the

oblique value is from 0 and the flattening value is from 3, the less likely it is to disperse normally. All series exhibit series correlation and volatility clustering, according to Ljung-Box statistics on returns and the square of returns, and according to Jarque-Bera tests, series do not follow a normal distribution. Ultimately, the ADF unit root tests did not find the series stationary, so we continued the analysis after taking the first difference and stabilizing the series. The study expressed the findings by calculating the cross-quantile dependencies between the two indices in its findings section. The study used the Ljung-Box test described in the methodology section of the cross qauntilogram to determine the statistical significance of each cross qauntilogram. In figures, black columns above 0 represent a positive cross correlation, and black columns below 0 represent a negative cross correlation. The red lines represent the limits of trust.

Figure 6: The cross-qauntilogram results

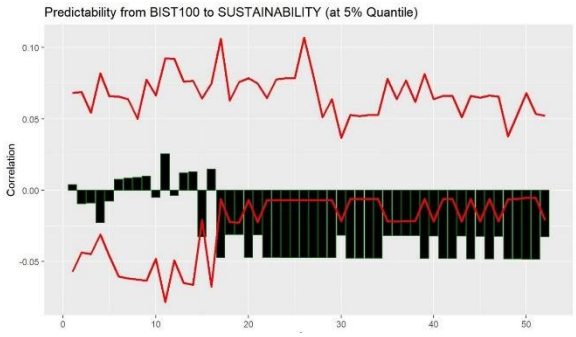


Figure 7: The cross-qauntilogram results

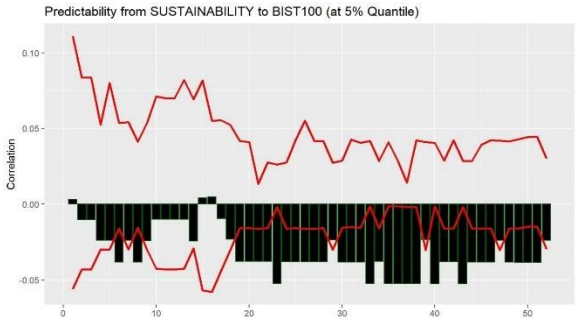


Figure 6 shows the cross-qauntilogram results at a 5% quantile value from the BIST100 index to the BIST Sustainability Index. Figure 7 shows the cross-qauntilogram results of the 5% quantile value from the BIST Sustainability Index to the BIST100 index. 17 in Figure 6. Up until the following week, the correlation relationship between the two indices was meaningless, whereas Figure 18 showed a significant negative correlation. During the week, the correlation relationships turned negative and significant. Figures 7, 6, and 8 reveal a significant negative correlation from the beginning to the end of the time series, particularly in the 18th century. The earthquake occurred at 33. It falls during the week. 33 to 43. Over a 10-week period, the negative correlation has peaked, particularly in figure 7, which presents the results from the sustainability index to the BIST100 index.

Figure 8: The cross-qauntilogram results

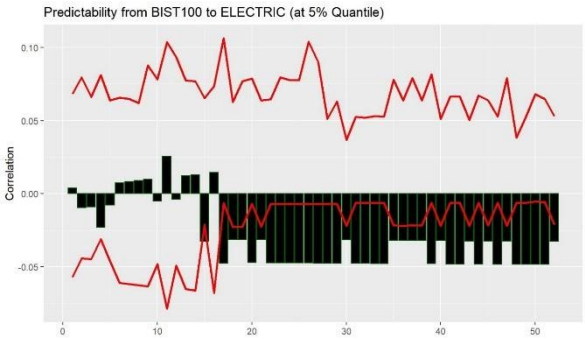


Figure 9: The cross-qauntilogram results

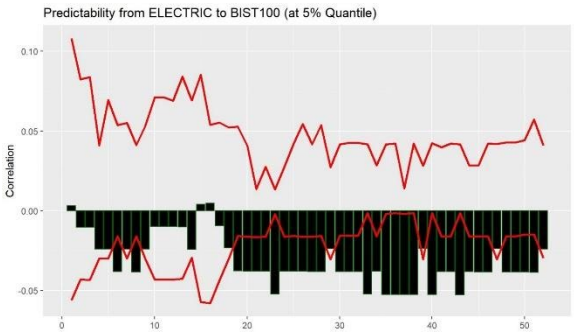


Figure 8 shows the cross-qauntilogram results in a 5% quantile value from the BIST100 index to the BIST Electricity index. Figure 9 displays the qauntilogram results at a 5% quantile value from the BIST Electricity index to the BIST100 index. As seen in Figure 8, 17 The relationship between the two indices, which were meaningless until week 18, continues with a significant and negative correlation relationship until the end of the time series for the week. 6 and 8 in Figure 9. We observed significant and negative relationships in week 19. We observe a significant and negative correlation relationship from the start of the time series until its conclusion. The highest negative correlation values are seen in the period after the earthquake date.

5. CONCLUSION

Natural disasters can cause many destructions in human life. Many problems arise such as damage to cities, loss of life of people and animals, destruction of nature, and psychological problems. In addition to psychological, sociological, and structural problems, natural events have many economic effects. The 7.8 and 7.6-magnitude earthquakes affecting 11 provinces in Türkiye made the cities uninhabitable and caused many people to die. Estimates suggest that the earthquake's economic effects amount to 104 billion dollars, representing approximately 9% of the country's income in 2023, despite the lack of full clarity. Therefore, the catastrophic effects of the earthquake on a human scale also point to a great economic loss. The impacts of the Türkiye earthquake in 2023 on financial markets are investigated in this paper, considering all these effects and causes. In this case, the event research approach was used to examine how the stocks in the BIST-100 index, BIST-100 Sustainability index, and BIST-100 Electrical index responded to the seismic tragedy.

In the study, the dates before and after the earthquake are considered as a whole in order to see the effects of the earthquake disaster on the sectors more clearly. The study investigated the effects of the earthquake on selected indices between June 13, 2022, and June 12, 2023. In this context, the correlation relations of the sustainability and electricity indices included in the study with the BIST100 index were negative shortly before the earthquake but fluctuated since the earthquake date and preserved the negative effect. The dates that show the most negative effects in both indices align with the post-earthquake period. This situation reveals that both indices were adversely affected by the earthquake.

The reason for the continuity of the negative correlation relationship between the electricity index, one of the indices we discussed in the study, and BIST100 after the earthquake date, is that 44 dams, which are Türkiye’s largest energy resources, are in the earthquake zone. Apart from this, according to the data of the General Directorate of Meteorology of Türkiye (MGM, 2023), the earthquake occurred in one of the most suitable regions for wind energy production and affected the wind power generation facilities there. The severity of the earthquake caused significant damage to the power plants, leaving the earthquake region without energy for an extended period. The earthquake had a negative impact on the stock market values of companies operating in the energy sector.

The study also examines the sustainability index. The sustainability index defines companies as those capable of managing risks arising from these factors by adapting economic, environmental, and social aspects. To achieve long-term value, corporate governance concepts should be combined with social aspects (BIST, 2023). This definition indicates that the earthquake significantly impacted economic, environmental, and social factors. The earthquake has had a 104-billion-dollar impact on the Turkish economy. Aside from that, it is a disaster that causes intense environmental and social destruction. The stock market values of companies that purchase saddles in the sustainability index experience negative effects, particularly after the earthquake. Index data saw the lowest levels after the earthquake.

Due to the limited data following the earthquake, we conducted the study using a short time series. Future studies can expand the analysis by incorporating information from more sectors and longer time series. Since the study is the first in the accessible literature in which the cross-qauntilogram method is used on earthquakes, it is a guide for future studies.

***Etik Beyan**: Bu çalışmada "Etik Kurul" izni alınması gerektiren bir yöntem kullanılmamıştır.*
***Yazar Katkı Beyanı**:1. Yazarın katkı oranı %35, 2. Yazarın katkı oranı ise %35, 3. Yazarın katkı oranı %30' dur.*
***Çıkar Beyanı**: Yazarlar arasında çıkar çatışması yoktur.*
***Ethics Statement**: In this study, no method requiring the permission of the "Ethics Committee" was used.*
***Author Contributions Statement**: 1st author's contribution rate is 35%, 2nd author's contribution rate is 35%, 3rd author's contribution rate is 30%.*
***Conflict of Interest:** There is no conflict of interest among the authors.*

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