



THE IMPACT OF TERRORISM ON TURKISH FINANCIAL MARKETS: THE SECTORAL APPROACH

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ABSTRACT

Purpose- This study investigated the financial effects of the environment of uncertainty and fear resulting from terrorist attacks on sub-sectors such as industry, tourism, and service.

Methodology- In order to examine the interaction between the variables, EGARCH models, which are frequently used in the econometric literature and take into account the asymmetric effect of shocks, were used. Unlike studies in the literature, terrorist attacks not only within the country but also outside the country were taken into consideration in this study.

Findings- According to the findings obtained, the terrorist attacks and uncertainty environment in both Turkey in the developing country status and the US in the developed country status have an adverse affect the sub-sectors in financial markets at different levels. This adverse impact has been found that is not equal for each sub-sectors, and the tourism sector is more affected by terrorist attacks compared to the industrial and service sectors. Also, it has been found that news about terrorist attacks affected volatility more than good news in the same period.

Conclusion- Considering the borderless structure and the size of the trade volume of financial markets in the globalizing world, it cannot be thought that terrorist attacks will not affect another country while they occur in one country. In view of the share of the tourism sector in the GDP of Turkey and the rational behavior of human factors in an environment of uncertainty and fear, the fact that the environment of uncertainty most affects this sector gives a result that is in line with expectations. In addition, it has been determined that financial market shocks resulting from the activities classified as terrorism experienced by countries with a large economic volume and market share in the world, especially the USA, have a short-term spill over effect on the global market. In this context, although ensuring government security creates an environment of trust, measures to be taken with the joint work of global security organizations to minimize these effects will help to protect the stable structure of the markets more effectively.

Keywords: Financial markets, terrorism, exponential GARCH, sectoral analysis, volatility.

JEL Codes: C22, C58, E44

1. INTRODUCTION

Terrorist attacks have been a source of great fear and anxiety for societies for many years. The climate of fear and the environment of uncertainty formed as a result of these attacks affect daily life significantly and have remarkable effects on financial markets and economic indicators. Especially in the twenty-first century, increasing terrorist attacks and the resulting material and moral losses have an important place in the agenda of many countries. The effect of this destruction on markets varies according to many variables, such as the economic structures of countries and their fragility. Although the terrorist acts of September 11, the Charlie Hebdo attack, and the 2003 bombing attacks in Istanbul are openly referred to as terrorist events in the press, there is no clear consensus on the definition of terrorism in the legal literature. However, this situation did not constitute an obstacle to adopting many international conventions (Dumitriu, 2019). Especially the terrorist attacks that took place on September 11, 2001, created great uneasiness for the American people and marked the beginning of a new era in the perspective of international markets on terrorism. The September 11 attacks also brought the immediate or delayed effects of terrorist attacks on national economies and financial markets to the agenda of academic studies (Charles and Darné, 2006; Rider, 2003; Shannon, 2012; Palkar, Larson, and Larson, 2012).

Understanding the extent of the damage caused by terrorist attacks is one of the prerequisites for reducing the costs caused by the attacks and making the national economies resilient against these attacks (Karolyi and Martell, 2010). Like many social,

economic, or psychological variables, financial markets can react to terrorist attacks outside of their normal flow. When the studies based on stock markets are reviewed, it is observed that social (Czudaj, 2018; Piñeiro-Chousa, Vizcaíno-González, and Pérez-Pico, 2017), political (Lehkonen and Heimonen, 2015; Füss and Bechtel, 2008; Döpke and Pierdzioch, 2006; Chau, Deesomsak, and Wang, 2014), and economic (Wasserfallen, 1989; Gunasekarage, Pisedtasalasai, and Power, 2004; Bhuiyan and Chowdhury 2020; Camilleri, Scicluna, and Bai, 2019) events have significant effects on stock markets.

The aim of this article is to examine the effects of terrorist attacks in both Turkey and the USA on stock exchange returns and volatility by examining daily time series for Turkey. In this context, exponential generalized autoregressive conditional heteroscedasticity (EGARCH) models, which are frequently used for volatility modeling in the economic literature, were used, and economic and political fluctuations were excluded with the help of dummy variables to interpret the effect of terrorism on markets more accurately.

In the following sections of the paper, studies investigating the effects of terrorist incidents, financial crises and natural disasters on the globalizing world economy are included and the findings obtained as a result of the empirical analysis are interpreted.

2. HISTORICAL PERSPECTIVE AND LITERATURE REVIEW

Although the rising globalization trend in the century we live in provides great convenience, especially for the business world, it has made countries interdependent on many issues. Accordingly, the international effects of national-scale terrorist attacks, financial crises, and natural disasters have become the subject of many studies (Beine, Cosma, and Vermeulen, 2010; Christiansen and Rinaldo, 2009; Bilson et al., 2012).

Niederhoffer (1971), who is considered one of the pioneers of studies examining the effects of non-economic shocks on financial markets, analyzed the shocks created by the Korean War, the Suez Crisis, the Kennedy assassination, and similar global events in financial markets and revealed that these events had a noticeable effect on financial markets. However, the recent terrorist attacks of September 11 are one of the most prominent examples of the contagious effects of globalization due to the damage they caused to international markets (Richman, Santos, and Barkoulas, 2005; Mun, 2005). Unlike these studies, Reilly and Drzycimski (1975) focused on hourly changes during the first opening day after the events that had a global impact. According to the findings obtained in the study, the effect of these events on the markets takes place between the closing moment before the announcement of the event to the market and the opening moment of the next day. Examining similar events on a sectoral basis, Barrett et al. (1987) focused on completely unexpected events such as commercial airline accidents and showed that the negative reaction of financial markets to these accidents was only significant for the next trading day.

In addition to political crises and unexpected events, financial markets also seem to give clear reactions to events related to security factors such as terrorism, military coups, and internal disturbance. Considering the effects of terrorist attacks on investments and the frequency of their occurrence, it can be stated that they have a very strong impact on the markets. Studies examining the effects of terrorist attacks on foreign direct investments (Enders, Sachsida, and Sandler, 2006; Powers and Choi, 2012; Bandyopadhyay, Sandler, and Younas, 2014; Lee, 2017) and stock markets (Khan et al., 2020; Markoulis and Katsikides, 2020; Chaudhry et al., 2018; Memdani and Shenoy, 2019; Aslam and Kang, 2015) in the literature generally confirm the power of this impact.

3. DATA AND METHODOLOGY

When the terrorist attacks in the two countries (Turkey and the USA) included in the econometric analysis are classified according to their target types, it is observed that there are differences arising from variables such as the geopolitical position, sociological structure, and management system of the countries. Upon reviewing the data obtained from the GTD (Table 1), it is observed that law enforcement officers are mainly targeted in terrorist attacks that take place in Turkey, while civilian citizens are targeted in attacks in the USA. Furthermore, it is seen that the number of terrorist attacks targeting citizens in the USA, where the rate of individual armament is high, is lower than in Turkey.

Table 1: Classification of Terrorist Attacks according to Target Types Source: Global Terrorism Database (GTD)

Turkey		United States	
Target Type	Terrorist Attack	Target Type	Terrorist Attack
Military	501	Private Citizens and Property	142
Private Citizens and Property	308	Business	121
Police	288	Religious Figures/Institutions	113
Business	130	Government (General)	54
Government (General)	111	Abortion Related	32
Unknown	83	Educational Institution	30
Educational Institution	75	Police	26

This study examined the effects of terrorist attacks in Turkey and the USA between January 2, 2001, and December 31, 2019, on the sub-sector indices in Borsa Istanbul (BIST) with the help of EGARCH models. Data on terrorist acts were obtained from the Global Terrorism Database (GTD) and were included in the analysis by being calculated as in equation 1 (University of Maryland, 2021).

$$Terrorism_t = (Fatalities_t + Injured_t) \tag{1}$$

$Fatalities_t$ represents the number of people killed as a result of terrorist attacks at time t, and $Injured_t$ represents the number of people injured. The return rates of the stock exchange indices are calculated using the formula in equation 2.

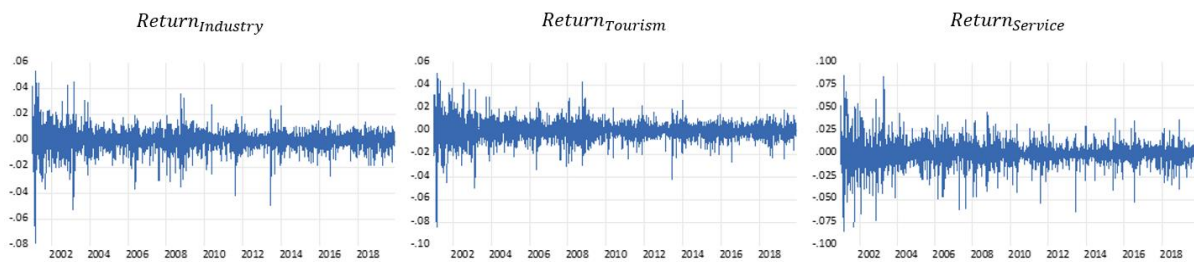
$$Returns_t = Ln\left(\frac{Stock_t}{Stock_{t-1}}\right) \tag{2}$$

In equation 2, Ln represents the natural logarithm, $Stock_t$ represents the current period index price, and $Stock_{t-1}$ represents the past period index price.

$$Returns_t = \beta_0 + \beta_1 TerrorisMTUR_t + \beta_2 TerrorisMUSA_t + \beta_3 D_t + \omega_t \tag{3}$$

$TerrorisMTUR_t$ indicates the terrorist attacks in Turkey, $TerrorisMUSA_t$ indicates the terrorist attacks in the USA, β_0 indicates the constant parameter, D_t indicates the dummy variable corresponding to economic or political shocks, and ω_t indicates the error term of the model¹. The time series graphs of the return series used in the analysis are shown in Figure 1. In the graphs of all three sectors, it is observed that the periods of high volatility are similar, but the severity of the markets' reactions is different.

Figure 1: Stock Market Returns



Time series generally have an increasing or decreasing trend, and accordingly, they have a non-stationary structure. This led researchers to find different methods for modeling time series apart from conventional time series analyses. Engle (1982) became an important reference point for modeling volatility by proposing the Autoregressive Conditional Heteroscedasticity (ARCH) model in his study examining inflation data in the United Kingdom. Engle (1982) suggested that the similarity method should be used, arguing that effective results could not be obtained if the least-squares method was used in predicting ARCH models.

$$X_t = \beta_0 + \sum_{i=1}^k \beta_i X_{t-i} + \omega_t \tag{4}$$

In the ARMA model defined in equation 4, ω_t represents the conditional variance of the prediction error series in period t. Thus, the ARCH(p) model can be written as follows:

$$\sigma_t^2 = \beta_0 + \sum_{i=1}^p \beta_i \varepsilon_{t-i}^2 + \varepsilon_t \tag{5}$$

Parameters ε_{t-i}^2 in model p in equation 5 show the prediction errors of the past period.

In addition to the model proposed by Engle, Bollerslev (1986) developed generalized ARCH (GARCH) models, in which the variance of error terms is affected both by their past values and the past values of the conditional variance.

¹ A dummy variable was used to control the overvaluations that took place on April 27, 2001, November 7, 2002, and September 19, 2008.

$$c > 0 \text{ and } \theta_i, \varphi_i \geq 0 \quad (6)$$

$$\sum_{i=1}^q \theta_i + \sum_{k=1}^p \beta_k < 1 \quad (7)$$

When the assumptions in equations 6 and 7 are satisfied, the GARCH(p,q) model can be represented as in equation 8:

$$X_t = c + \sum_{k=1}^q \beta_k X_{t-k} + \sum_{i=1}^p \theta_i v_{t-i} \quad (8)$$

The most criticized aspect of both the ARCH model and the GARCH model is the assumption that positive and negative shocks in the markets have the same effect on volatility. However, data on financial markets show that these shocks have different effects on volatility. In line with this, Nelson (1991) developed the Exponential GARCH model for better modeling of asymmetric movements (Brooks 2008, p. 406).

$$\ln(\sigma_t^2) = \omega + \beta \ln(\sigma_{t-1}^2) + \gamma \frac{|u_{t-1}|}{\sqrt{\sigma_{t-1}^2}} + \alpha \left[\frac{|u_{t-1}|}{\sqrt{\sigma_{t-1}^2}} - \sqrt{\frac{2}{\pi}} \right] \quad (9)$$

4. FINDINGS AND DISCUSSIONS

In this section, the effect of terrorist attacks on the returns of sectoral indices in the stock exchange was examined, and the results were compared. In this context, this study focused on two different issues, including (a) the effects of attacks on financial markets and (b) examining these effects on a sectoral basis. To examine the sectoral effects, three different sub-sector indices were selected, including industry, tourism, and service sectors. According to Table 2, which shows the descriptive statistics regarding the variables used in the analysis, it is observed that the volume of the industry and service sectors is much larger than the tourism sector.

Table 2: Descriptive Statistics

	Industry	Tourism	Service
Mean	500.40	60.63	354.92
Median	405.32	59.25	341.59
Maximum	1,362.64	135.25	866.87
Minimum	52.89	11.67	40.66
Standard Deviation	354.49	23.90	223.82
Skewness	0.70	0.12	0.32
Kurtosis	2.45	2.54	1.94
Observations	4998	4998	4998

The basis of conventional time series analysis is the assumption that the variables used are stationary. In particular, there is a significant correlation between the stationarity of the series and their predictability. For this reason, unit root tests were applied to the variables defined as shown in equations 1 and 2, and according to the results obtained, it was revealed that the variables were stationary with their level states (Table 3).

Table 3: Unit Root Tests

Variables	Augmented Dickey-Fuller Test		Phillips-Perron Test	
	t-Statistics	Prob.	t-Statistics	Prob.
<i>Return</i> _{Industry}	-68,04*** (i)	<.01	-68,04*** (i)	<.01
<i>Return</i> _{Tourism}	-62,35*** (n)	<.01	-62,66*** (n)	<.01
<i>Return</i> _{Services}	-62,63*** (i)	<.01	-62,64*** (i)	<.01
<i>Terrorism</i> _{Turkey}	-20,09*** (i)	<.01	-78,24*** (i)	<.01
<i>Terrorism</i> _{USA}	-68,93*** (n)	<.01	-68,93*** (n)	<.01

Notes: *** indicates significance at 1 percent respectively, i(intercept), n(without trend or intercept)

To use ARCH type equations instead of the least-squares method, the ARCH effect in the predicted model should be tested. Therefore, equation 3 was predicted using the least-squares method using all sub-sector variables, and the ARCH test results

of the predicted models were examined. In addition, in order to select the optimum models, models with minimum variables were selected in accordance with the Box-Jenkins methodology. According to the results obtained, the presence of the ARCH effect was determined in all three models belonging to the sub-sectors (Table 4).

Table 4: ARCH Heteroskedasticity Test

	Industry Sector	Tourism Sector	Services Sector
	ARMA(5,2)	ARMA(3,3)	ARMA(2,2)
F Statistics	394.18	721.79	254.35
Probability	<.01	<.01	<.01
$N * R^2$	364.13	626.84	241.53
Probability	<.01	<.01	<.01

The determined ARCH effect shows that there is a problem of heteroscedasticity in these models and the least-squares method is not sufficient for predicting these models. Therefore, to see the impact of terrorist attacks on financial markets, equation 3 was predicted for all sub-sectors using the EGARCH method.

Table 5: Results of EGARCH Models²

Variable	Industry		Tourism		Service	
	ARMA(5,2)-EGARCH(1,1)		ARMA(3,3)-EGARCH(3,1)		ARMA(2,2)-EGARCH(1,2)	
	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.
$Terrorism_{Turkey}$	-0.000018	<.01	-0.000032	<.01	-0.000009	<.10
$Terrorism_{USA}$	-0.000006	<.01	-0.000022	<.01	-0.000009	<.01
Constant	0.000375	<.01	0.000130	.33	0.000232	<.01
AR(1)	-0.847594	<.01	-0.607312	<.01	-0.182945	<.10
AR(2)	-0.572870	<.01	0.384419	<.01	-0.751708	<.01
AR(3)	0.076638	<.01	0.903457	<.01	-	<.01
AR(4)	0.045068	<.05	-	-	-	<.01
AR(5)	0.044868	<.01	-	-	-	<.01
MA(1)	0.892214	<.01	0.629620	<.01	0.209659	<.10
MA(2)	0.643273	<.01	-0.355332	<.01	0.752050	<.01
MA(3)	-	-	-0.887548	<.01	-	<.01
Dummy	0.044589	<.01	0.055613	<.01	0.044809	<.01
Variance Equation						
Constant	-0.615230	<.01	-0.237025	<.10	-0.417589	<.01
β	-0.097682	<.01	-0.016760	<.01	-0.058835	<.01
θ_1	0.239665	<.01	0.403986	<.01	0.233037	<.01
θ_2	-	-	-0.147881	<.01	-	<.01
θ_3	-	-	-0.106822	<.01	-	-
λ_1	0.957571	<.01	0.986087	<.01	0.519168	<.01
λ_2	-	-	-	-	0.456888	<.01
R^2	0.022865		0.015012		0.022831	
Durbin Watson	2.066607		1.871039		2.046580	
ARCH LM						
F Statistics	0.546406	.46	0.315598	.57	1.637511	.20
$N * R^2$	0.546573	.46	0.315710	.57	1.637636	.20

Upon examining the results in Table 5, it was revealed that terrorist attacks in both Turkey and the USA had a negative effect on financial markets and these negative effects were felt more clearly in the tourism sector than in other sectors. The fact that the structure of the tourism sector is foreign-dependent and its market volume is smaller compared to the other two sub-sectors caused it to be affected by terrorist attacks at a higher level. When changes in the service sector are reviewed, it is observed that the response to internal and external terrorist attacks is very close to each other, unlike other sectors.

² $\theta = \text{ABS}(\text{RESID}(-1))/\text{SQRT}(\text{GARCH}(-1))$, $\beta = \text{RESID}(-1)/\text{SQRT}(\text{GARCH}(-1))$, $\lambda = \text{LOG}(\text{GARCH}(-1))$

Furthermore, the asymmetry (β) coefficient was found to be negative and statistically significant in all predicted models. In other words, terrorist news affects volatility more than the good news of the same significance.

The findings obtained as a result of the empirical analysis cover the direct effects of terrorist attacks on the financial markets. However, in addition to these findings, it will be useful to examine the indirect effects of terrorist attacks on financial markets in order to determine future policies. Based on other studies in the literature, it can be easily said that economic variables such as capital movements and foreign direct investments are sensitive to terrorist attacks. It is quite normal to expect the indirect effect of the deterioration in these two variables to be stronger than the direct effects of terrorist incidents on the financial markets. Especially in developing countries, this negative cycle is more destructive.

5. CONCLUSION

The environments of fear and uncertainty created by terrorist attacks are two of the most important factors that have an adverse impact on financial markets. In a market dominated by fear and uncertainty, it is difficult for investors and monetary policy-makers to make rational decisions. Thus, the fragile financial structures of developing countries cause them to be affected by a possible terrorist attack at a higher level.

According to the results obtained in this study, in which the effects of terrorist attacks in Turkey and the USA on the financial markets in Turkey were examined, it was observed that the attacks had a negative effect on the financial markets as expected. However, the severity of the sub-sectors being affected by these attacks differs from each other. In particular, the tourism sector is more sensitive to terrorist attacks due to its structure. Considering the share of the tourism sector in the GNP of Turkey, it is highly possible that the environment of uncertainty created by such terrorist attacks will have adverse effects on the Turkish economy. For this reason, increasing the security measures in tourism regions and making these regions more reliable against terrorist attacks are among the important conditions of a sustainable economy.

Nowadays, the fact that the financial markets of countries become significantly interconnected causes the instant shocks in any market to have a significant effect on the markets of other countries. Shocks that occur in high-volume markets, especially in the USA, create contagious effects in the short term. To minimize these effects, both non-governmental organizations and military and security organs of countries should cooperate intensively on the measures to be taken against terrorist attacks.

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