The impact of terrorist incidents on the sub financial and non-financial sectors: Evidence from the United States

Dlawar Mahdi Hadi ^{(a)*} Bawan Yassin Sabir ^(b) Farman Marif Ahmed ^(c)

^(a) Ph.D., Chairman, Department of Accounting, College of Business, Komar University of Science and Technology, Sulaymania, 460002, Iraq

^(b) Assist Lecturer, Department of Accounting, Kurdistan Technical Institute, Sulaymaniyah, 460002, Iraq

^(c) Assist Lecturer, Finance Officer, Rehabilitation, Education and Community Health (REACH) – Iraq. Ashty quarter, Ainkawa, Erbil, Iraq

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ABSTRACT

This paper examines the impact of the September 11th attacks on the United States financial and non-financial sectors. The empirical analysis includes 5 financial and 28 non-financial sub-sector indices using the event study method, structural break test, and volatility analyses. The results of the estimation show that except for the short-lived impact on the real estate sector, the attacks had no significant impact on financial sector indices. Different reactions among non-financial sectors are observed. Travel and leisure and leisure goods sectors were the two industries that were mostly affected by the attacks due to the nature of their business. The outcomes of the analyses provide several diversification strategies and speculation opportunities for both portfolio managers and investors.

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Introduction

Stock prices reflect investors' hopes and fears about the future value of an individual stock price. The economic and financial costs of terrorist incidents vary across economic activities, sectors, and times (Chen and Siems, 2004). Certainly, terror activities constitute a significant economic impact and hence, they should be counted for and their implications should be measured. This study aims to measure and compare the vulnerability of various industries to terrorist incidents in the U.S. market which in turn provides precious diversification policy for investors and portfolio managers to hedge against unexpected risk or volatility and for the purpose of speculation.

Goel et al., (2017) consider the 11th September attacks new and unexpected information to the financial market based on the Efficient Market Hypothesis (EMH). The study further evident that among 33 incidents in the U.S. only 11th September attacks had a negative and significant impact on stock and bond market returns. Brounen and Derwall (2010) report that among 31 terrorist attacks targeted major economies in the world, the September 11th attacks turn out to be the only event that caused long-term effects on financial markets, especially in terms of industries' systematic risk. The novelty of this study is to focus on the U.S. market in addition the present study investigates and compares the effects of the September 11th attacks on 5 financial and 28 sector indices. Intuitively, one would think that although the general market index is conversely affected by terror activities, the effects may vary across industries. Thus, it is particularly interesting to examine the sectoral effects of the terrorist incidents as this study does. Through which some hidden diversification, hedging and speculation opportunities can be revealed.

* Corresponding author. ORCID ID: 0000-0003-1013-7230

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This study contributes to the literature in two ways. First, the study provides a comprehensive analysis of the implications of terrorist attacks on the vast majority of financial and non-financial sectors in the U.S. market in detail. Second, despite the other techniques, the exposure of financial and non-financial sectors to the terrorist attacks is examined by structural break analysis. This study documents some remarkable findings. (1) Financial sectors were least affected by the attacks while non-financial sectors showed different reactions to the attacks. (2) Travel and leisure and leisure good sector showed the negative, highest, and longest response to the attacks.

The prime objective of this study is to measure the exposure of various industries to terrorist activities. To this end, we include 33 US financial and non-financial sectors in our analysis attempting to measure their response to the September 11th attacks. Further, we utilize three econometric techniques to employ our analysis namely Event Study, Structural Break Points, and Volatility analysis.

The remainder of this paper is organized as follows. Section 2, presents a review of the literature on the influences of terrorist attacks on the financial market and industries. Section 3, demonstrates the data and methodology. In section 4, Empirical results are presented and discussed while section 5 concludes.

Literature Review

Considerable empirical researches have been employed in recent years to document the implications of terrorist activities on financial markets such as (Ahmad et al., (2022); Arfaoui and Naoui (2021); Laborda and Olmo (2021); Balcilar et al., 2018; Goel, Cagle, and Shawky (2017); Essaddam, and Karagianis, 2014; Chesney, Reshetar, and Karaman (2011); Kollias et al., 2011; Liargovas and Repousis, 2010; Brounen and Derwall, 2010; Chen, and Siems, 2004). Except for Kollias, Papadamou, and Stagiannis (2011) who examined the impact of local terrorist incidents on the different sectors in Spain and the United Kingdom, all the other studies investigated the impact of terror on the financial markets using the major stock market index alone for many countries.

The September 11th attacks consequences have been always examined in the relevant financial literature using different conceptual and methodological techniques. In most of the previous studies, the implications of the attacks introduced as an extreme event to the financial market (Goel et al., 2017; Chen and Siems, 2004). Moreover, other studies report the transnational effects of the attacks (Brounen and Derwall, 2010).

With respect to the sectoral effect of terror, Chen and Siems (2004) examined the impact of terrorist attacks on the global capital market. Using an event study, specifically, they examined the vulnerability of the U.S. and the global capital market to the September 11th attacks. The study found evidence that U.S. capital markets are more resilient than they were in the past and that they recover faster from terrorist/military attacks than other global capital markets. The authors are further evidence that a high level of resilience in the U.S. market can be explained by the support of the banking/financial sector that provided adequate liquidity to stabilize the market. The global airline industry was another industry that was extremely affected by the September 11th attacks as Drakos (2004) reports. Chesney et al., (2011) found that the Global airline index and European insurance index exhibit the highest susceptibility to terrorism, while the Global banking index is the least sensitive. Berrebi and Klor (2010) note that defense-related companies were positively responding to terrorist attacks compared to other companies of Israeli companies that are traded in American markets. Apergis and Apergis (2016) reach the same conclusion. Further, Kollias et al., (2011) showed that the real estate and life insurance sectors were negative while the banking sector was positively responded to Madrid and London attacks in both the Spanish and London market respectively. Though, the reaction of non-financial sectors substantially varied. Analyzing 27 of the largest U.S., Canadian, and European airlines, Kolaric, and Schiereck (2016) show that the terrorist attacks in Paris and Brussels had a strong negative short-term effect on the valuation of airline companies. Moreover, Zopiatis et al., (2018) conclude that global travel and leisure sectors are negatively reacting to terror activities in terms of both return and volatility except the region of Australia. Lastly, Hadi, Katircioglu, and Adaoglu (2019) report a high vulnerability of tourism, travel, and leisure firms' performance to terrorist activities in the world's top tourist countries.

Based on the review above, a lack of a comprehensive study that examines the implications of terrorist incidents on all individual sectors in the stock market can be observed. The current study fills that gap.

Research and Methodology

For the purpose of this study's analysis data is collected from Thomson Reuters Data-Stream database where it was able to include 5 financial sectors and 28 non-financial sectors indices which categorized by the Industrial Classification Benchmark (ICB)¹.

Although the incident occurred in the early morning on 11th September 2001, the American Stock Exchange and New York Stock Exchange have been shut down for almost a week. The market plummeted on its first day of trading on 17th September. Thus, the

¹ See www.icbenchmark.com.

event day was considered 17th September instead of 11th September. The sample covers the period 17th September 1999 to 13th September 2002. Returns of indices are calculated as $\ln(P/P_{t-1})$.

The analysis consists of three main steps where start with event study methodology to examine the impact of the incident on the sector indices. This follows by a unit root test with break point which aims to examine the stationarity of the indices' returns as a preliminary test to volatility analysis as well as investigates whether the incident causes a break in the series returns or not. Lastly, by using GARCH family models the impact of the terrorist attack on time-varying volatility of the financial and non-financial sector indices returns are examined.

Event Study Methodology

An event study is the most commonly used method to examine the impact of an event on stock returns in the relevant financial literature. In this study, the market model of the event study technique is adapted. The estimation window consists of 500 trading days prior to the incident day. The event window covers 20 days prior and 20 days after the incident (-20, +20). The below equation used to estimate the expected returns:

$$R_{it} - R_{rf,t} = \mu + \beta[MKT - RF_t] + \varepsilon_{it}$$

Where $R_{it} - R_{rf,t}$ is the actual return on sector i in excess of the 1- month Treasury bill rate, $MKT - RF_t$ is the return on the market portfolio which is calculated as the value-weighted return of all CRSP stocks incorporated in the U.S. in excess of the 1-month Treasury bill rate and ε_{it} is the idiosyncratic error term which assumed to be approximately normally distributed. Hence, the abnormal return is calculated as follow:

$$AR_{it} = [R_{it} - R_{rf,t}] - \mu - \beta[MKT - RF_t] - \varepsilon_{it}$$

Where AR_{it} is the abnormal return of index i on the incident date i . The AR can be aggregated for index i over the entire event window to get a cumulative abnormal return CR_{it} over event window. Specifically, in this study CRs are aggregated over one day $CR(0, +1)$, five days $CR(0, +5)$ and ten days $CR(0, +10)$ following the incident.

Zivot and Andrews Unit Root Test

Before applying volatility analysis, the stationarity of the time series must be asserted. Zivot and Andrews (1992) (ZA) argue that the results of the conventional unit root hypothesis may be reversed by endogenously determining the time of structural breaks. For each index, the test is applied with trend alone, with intercept alone, and with both intercept and trend. The outcomes of ZA test ensures the stationarity of the indices' returns as a requirement for the volatility analysis. In addition, this study investigates whether the captured break is the incident day or not. The optimal lag length is determined on the basis of the Schwartz Information Criterion allowing for a maximum of 17 lags.

Volatility Analysis

This study further investigates the effects of the incidents on the volatility of sectoral stock returns in the U.S. market using GARCH family techniques. Specifically, for the purpose of this study ARCH (Engle, 1982), GARCH (Bollerslev, 1986), and EGARCH (Nelson, 1991) models are used adopting the below equations:

$$R_{it} - R_{rf,t} = \alpha + \beta[MKT - RF_t] + \varepsilon_{it} \quad h_t = C + \omega\varepsilon_{t-1}^2 + \gamma h_{t-1} + \delta L_t + \theta D_t$$

Where equation (3) is already introduced previously. C is the intercept, $\omega \geq 0$, $\gamma > 0$, and $\omega + \gamma \leq 1$. δ measures the leverage effect. D_t is the dummy variable that takes the value of 1 on the event day as following (Kollias et al., 2011). To emphasize the best mean and variance models various ARMA (p, q) and GARCH (p, q) have been estimated across the indices. Moreover, to test the significance of the coefficients, this study followed Generalized Error Distribution (GED). Further, the goodness of fit of the estimated models tested by using the ARCH effect (LM) test, Ljung-Box Q_z -statistics and Q_z^2 -statistics.

Empirical Results

Event Study Analysis

Before present and analyze the findings, it is particularly important to mention that the attacks took place on September 11th but the market was closed until September 17. One week off was a sufficient time period for investors to evaluate and discount the implications of the attacks. Moreover, the U.S. Federal Reserve System took steps to stabilize the economy and the market by providing liquidity via the bank and financial sector. Table 1 exhibits the results of the event study analysis. With the exception of the real estate investment and service development sector, other financial sectors did not show significant reactions to the attacks. The real estate sector reacted negatively and significantly only on the event day and over 5 days following the attacks by -2.46% and -4.11% ARs respectively and it took more than 20 days for its price to recover to the pre-attack level. The reason for this reaction by the real estate sector can be attributed to the fact that terrorist attacks always lead to significant damage in properties. An explanation for the least effects of the attacks on the financial sector indices is that typically the banking and financial sector is considered a safe

sector during the period of chaos. Probably, the Fed's support can be the main factor that protected the financial sector from the attacks' effects (Chen and Siems, 2004).

Table 1: Event study analysis: response of sector indices to 11-Sep. terrorist incidents

Indices	Event-Day AR	CR(0,+1)	CR(0,+5)	CR(0,+10)	Days to Rebound
Financial Sectors					
Banks	-0.13%	1.48%	1.82%	6.47%	11
Finance & Credit Services	-0.35%	0.28%	1.51%	6.24%	12
Life Insurance	-2.90%	-2.58%	-1.52%	4.04%	12
Nonlife Insurance	-1.63%	-2.51%	-0.28%	7.93%	8
R/E Investment & Services Development	-2.46% (*)	-1.12%	-4.11% (**)	1.32%	>20
Non-financial Sectors					
Software & Computer Services	2.16%	4.56%	8.41%	2.14%	14
Technology Hardware & Equipment	3.29%	2.49%	5.25%	-4.62%	18
Oil & Gas Producers	-1.76%	-3.94%	-12.42% (*)	-4.74%	17
Oil Equipment, Services & Distribution	-1.79%	-7.19% (**)	-13.88% (**)	-13.51%	>20
Chemicals	-7.24% (*)	-5.94% (**)	-4.65%	0.18%	18
Forestry & Paper	-7.26% (*)	-5.27%	-7.00%	-5.53%	>20
Industrial Metals & Mining	-7.55% (*)	-6.60% (**)	-7.49% (**)	-4.75%	>20
Mining	2.36%	2.96%	-1.22%	7.63%	0
Construction & Materials	-3.95% (*)	-3.70%	-7.44% (**)	-3.46%	18
Aerospace & Defense	-4.51% (*)	-5.63% (**)	-5.84%	-2.74%	15
General Industrials	-5.22% (*)	-6.63% (*)	-2.44%	1.05%	>20
Electronic & Electrical Equipment	1.37%	1.56%	7.28%	-0.12%	18
Industrial Engineering	-4.05% (**)	-3.34%	-1.91%	-5.90%	>20
Industrial Transportation	-2.93% (**)	-4.49% (**)	-4.75%	-5.05%	>20
Automobiles & Parts	-11.26% (*)	-10.55% (*)	-10.42% (*)	-7.38%	>20
Beverages	1.69%	2.27%	-0.61%	1.31%	0
Food Producers	-0.69%	-0.03%	-3.90%	0.23%	>20
Household Goods & Home Construction	-0.80%	-0.97%	-5.67%	-0.32%	>20
Leisure Goods	-12.71% (*)	-15.10% (*)	-14.20% (*)	-15.13% (*)	>20
Personal Goods	-1.07%	-0.80%	-2.81%	0.15%	>20
Tobacco	2.40%	1.36%	0.04%	5.92%	0
Health Care Providers	-0.81%	-1.44%	-3.41%	4.53%	9
Pharmaceuticals & Biotechnology	1.75%	0.74%	-2.53%	6.89%	10
General Retailers	-2.50%	-0.98%	1.38%	4.44%	12
Media	-3.00% (*)	-2.39%	0.84%	0.25%	>20
Travel & Leisure	-14.28% (*)	-14.89% (*)	-15.53% (*)	-11.68% (*)	>20
Electricity	-0.91%	-1.24%	-3.08%	-3.89%	>20
Gas, Water & Multi-utilities	-1.27%	-6.24% (*)	-9.04% (*)	-2.40%	12

Note: * and ** denote the significance level at 1% and 5% respectively. Days to rebound are the number of days taken on the index price to reach the pre-event level.

However, the reaction of the non-financial sector indices considerably varied where 15 out of 28 non-financial sectors were significantly affected by the terrorist incidents. Nonetheless, the effect was not long-lasting as it was significant only on the event day, 1, and 5 days following the attacks. The only exception was the travel and leisure and leisure goods sectors that showed the strongest inverse reaction to the attacks by -14.28% and -12.71% ARs respectively. It took more than 20 days for their price to rebound. This can be explained by the nature of the business that's these two industries attract millions of foreigners to the U.S. through entertainment, lodging, and traveling facilities.

Figure 1: ARs and CRs of U.S. financial sectors in response to the September 11th attacks.

The negative reaction of the rest of the non-financial industries to the attacks can be attributed to a fear of possible economic slowdown and decline in consumer confidence which in turn, leads to less consumption. The case can be due to the nature of their business as well. The short-run effects of the attacks only on the event day and a few days following the incidents indicate the resilience of these sectors and the ability to bounce back from the attacks. The reactions of non-financial industries are presented graphically in Figure 1. Lastly, 13 out of 28 non-financial sectors were not significantly affected by the September 11th attacks implying that these sectors are at most driven by fundamental news rather than tentative events.

Figure 2: ARs and CRs of U.S. non-financial sectors in response to the September 11th attacks.

Structural Break Points

Using the ZA approach the structural break analysis is summarized in Table 2. In line with the event study analysis, among the financial sector indices, the attacks cause a break (in both intercept and trend) only for the real estate sector. A break also occurs on September 21 (4 days following the attacks) for the life insurance sector. While testing non-financial sector indices show a break at the attack day for 9 sectors, the ones that are the most influenced by the attacks indicate the immediate response to the attacks. However, for 8 non-financial sector indices, break point was observed at 3-4 days following the attacks implying that it took a long time for the investors to absorb the real implications of the attacks. Lastly, no break points surrounding the date of the attack are observed for the rest of the 11 non-financial sector indices.

Table 2: Zivot and Andrews (1992) unit root test and ARCH effect on the indices returns at level.

Indices	ZA_i	Break Date	ZA_t	Break Date	ZA_{it}	Break Date	ARCH
Financial Sectors							
Banks	-21.85 *	12.10.2000	-21.79 *	04.03.2002	-22.08 *	08.10.2001	15.13 *
Finance & Credit Services	-24.73 *	10.04.2001	-23.82 *	27.12.2001	-24.70 *	10.04.2001	68.39 *
Life Insurance	-21.99 *	21.09.2001	-21.76 *	27.02.2002	-22.18 *	21.09.2001	4.916 *
Nonlife Insurance	-21.00 *	29.07.2002	-20.62 *	11.02.2002	-21.05 *	23.07.2002	11.30 *
R/E Investment & Services Development	-17.14 *	10.04.2002	-17.03 *	31.01.2002	-17.52 *	17.09.2001	62.76 *
Non-financial Sectors							
Software & Computer Services	-22.62 *	03.10.2000	-22.46 *	10.10.2000	-22.60 *	03.10.2000	15.41 *
Technology Hardware & Equipment	-21.17 *	28.09.2000	-21.16 *	25.09.2000	-21.17 *	10.10.2000	13.89 *
Oil & Gas Producers	-20.54 *	22.07.2002	-20.28 *	25.02.2002	-20.72 *	22.07.2002	6.886 *
Oil Equipment, Services & Distribution	-20.54 *	22.07.2002	-20.28 *	25.02.2002	-20.72 *	22.07.2002	11.38 *
Chemicals	-21.56 *	17.09.2001	-20.84 *	21.02.2002	-21.73 *	17.09.2001	9.031 *
Forestry & Paper	-22.97 *	17.09.2001	-22.39 *	12.02.2002	-23.22 *	17.09.2001	6.157 *
Industrial Metals & Mining	-21.57 *	17.09.2001	-21.19 *	29.09.2000	-21.79 *	17.09.2001	4.616 *
Mining	-25.02 *	23.07.2002	-24.30 *	24.11.2000	-24.95 *	23.07.2002	7.279 *
Construction & Materials	-19.89 *	17.09.2001	-19.59 *	14.02.2002	-20.14 *	17.09.2001	5.280 *
Aerospace & Defense	-21.34 *	20.09.2001	-20.77 *	19.02.2002	-21.46 *	20.09.2001	11.94 *
General Industrials	-21.99 *	24.09.2001	-21.53 *	18.12.2001	-22.16 *	20.09.2001	7.972 *
Electronic & Electrical Equipment	-21.39 *	20.10.2000	-21.17 *	19.09.2000	-21.36 *	20.10.2000	8.994 *
Industrial Engineering	-21.57 *	20.09.2001	-21.23 *	14.02.2002	-21.74 *	20.09.2001	4.954 *
Industrial Transportation	-20.76 *	20.09.2001	-20.48 *	28.01.2002	-20.98 *	20.09.2001	8.386 *
Automobiles & Parts	-24.41 *	17.09.2001	-23.43 *	26.02.2002	-24.69 *	17.09.2001	3.699 **
Beverages	-21.32 *	19.07.2002	-20.86 *	25.02.2002	-21.57 *	19.07.2002	17.11 *
Food Producers	-19.54 *	21.09.2001	-19.99 *	16.01.2002	-20.64 *	21.09.2001	51.17 *
Household Goods & Home Construction	-21.90 *	21.09.2001	-21.19 *	01.02.2002	-22.33 *	21.09.2001	18.95 *
Leisure Goods	-22.44 *	17.09.2001	-20.59 *	01.03.2002	-22.68 *	17.09.2001	5.482 *
Personal Goods	-21.67 *	19.10.2000	-21.46 *	28.01.2002	-21.87 *	20.09.2001	5.744 *
Tobacco	-21.18 *	24.06.2002	-20.74 *	25.02.2002	-21.14 *	24.06.2002	3.731 **
Health Care Providers	-20.68 *	04.01.2001	-19.94 *	27.03.2002	-20.73 *	04.01.2001	13.59 *
Pharmaceuticals & Biotechnology	-21.05 *	21.03.2001	-20.62 *	23.11.2001	-21.12 *	21.03.2001	22.33 *
General Retailers	-21.22 *	12.10.2000	-20.82 *	20.12.2001	-21.36 *	17.09.2001	10.14 *
Media	-17.26 *	17.09.2001	-16.95 *	05.12.2001	-17.47 *	17.09.2001	11.70 *
Travel & Leisure	-22.43 *	17.09.2001	-19.49 *	21.02.2002	-22.88 *	17.09.2001	3.458 **
Electricity	-20.26 *	04.01.2001	-19.83 *	04.03.2002	-20.93 *	23.07.2002	11.56 *
Gas, Water & Multi-utilities	-20.67 *	28.11.2001	-19.36 *	23.10.2001	-20.66 *	28.11.2001	17.13 *

Note: * and * denote the significance level of 1% and 5% respectively. The basic test for ZA includes both trend and intercept. ZA_i , ZA_t , and ZA_{it} reflect the break in intercept, trend, and trend and intercept respectively. The F-statistic criterion is followed for the ARCH effect.

Volatility Analysis

For the study's analysis, the impact of the September 11th attacks on the volatility of financial and non-financial sectors in the U.S. market has been examined². As shown in Table 2, all the sample series are stationery and evidence for the ARCH effect³ is found. In Table 3, the volatility analysis for the purpose of this study is summarized. The estimation of the return equation indicates that the market return effect is positive and significant except for the mining sector which is found to be insignificant. The ARCH parameter in all of the cases is statistically significant indicating the clustering effect. GARCH parameters are on average 0.77 and 0.86 for financial and non-financial sectors respectively implying that 77% and 86% of the past volatility carried to the future and the variance moves toward the long-run slowly. The leverage effect is observed for the banking sector and 7 non-financial sectors. Not surprisingly, the volatility of financial sector indices was not affected by the attacks indicating the resilience and sustainability of these sectors. In contrary to event study analysis, the coefficient of the dummy variable for software and computer service, electronic and electrical equipment, household goods and home construction, and health care providers' indices are statistically significant implying that the attacks affected their volatility. The attacks further impacted not only returns but also the volatility of four other indices namely chemicals, industrial metals and mining, industrial engineering, and travel and leisure indices. The volatility analyses are supported by robustness checking as exhibited in the last three columns in Table 3.

² This test is examined using ARCH, GARCH and EGARCH models. To reach to the best model various ARMA (p, q) and GARCH (p, q) models have with difference (p and q) lags have been estimated.

³ Both stationarity and ARCH effect are preliminary requirements for volatility analysis.

Table 3: the impact of the September 11th attack on the volatility of financial and non-financial sector indices

Indices	α	β	ζ	ω	δ	γ	θ	$Q_z(10)$	$Q_z^2(10)$	LM
Financial Sectors										
Banks	-0.011 *	0.009 *	-0.527 *	0.110 **	-0.109 **	0.953 *	0.068	11.4(0.11)	5.15(0.88)	0.02(0.86)
Finance & Credit Services	-0.008 **	0.010 *	0.000 *	0.240 **	-	-	0.000	13.3(0.10)	5.42(0.79)	0.84(0.36)
Life Insurance	-0.011	0.006 *	0.000 **	0.170 *	-	0.666 *	0.000	13.6(0.10)	11.2(0.34)	0.00(0.93)
Nonlife Insurance	-0.012	0.007 *	0.000 **	0.181 *	-	0.640 *	0.000	22.2(0.10)	11.9(0.29)	0.002(0.95)
R/E Investment & Services Development	-0.008	0.002*	0.000 **	0.120*	-	0.806 *	0.000	11.4(0.23)	3.50(0.96)	0.24(0.62)
Non-financial Sectors										
Software & Computer Services	-0.113 *	0.017 *	0.000 **	0.242 *	-	0.587 *	-0.000 *	6.65(0.46)	12.7(0.23)	0.88(0.34)
Technology Hardware & Equipment	-0.129 *	0.020 *	0.000	0.095 *	-	0.848 *	0.000	12.3(0.13)	10.6(0.39)	0.14(0.70)
Oil & Gas Producers	-0.002	0.005 *	0.000	0.065 *	-	0.910 *	0.000	10.9(0.14)	7.08(0.71)	1.54(0.21)
Oil Equipment, Services & Distribution	-0.013 *	0.006 *	0.000	0.008	-	0.963 *	0.000	13.4(0.14)	10.6(0.44)	1.17(0.27)
Chemicals	-0.005	0.008 *	0.000	0.064 *	-	0.905 *	0.000 *	13.8(0.10)	11.1(0.34)	0.11(0.73)
Forestry & Paper	-0.006 *	0.007 *	0.000 *	0.173* *	-	0.746 *	0.000	4.49(0.72)	7.74(0.65)	0.22(0.63)
Industrial Metals & Mining	-0.002	0.010 *	-0.101 *	-0.050 **	-0.040 *	0.983 *	0.672 *	8.58(0.19)	4.36(0.93)	0.83(0.36)
Mining	-0.012	-0.001	0.000	0.061 **	-	0.888 *	0.000	7.05(0.30)	6.58(0.76)	0.37(0.54)
Construction & Materials	-0.012	0.007 *	0.000	0.144 **	-	0.741 *	0.000	11.3(0.12)	10.3(0.41)	2.52(0.11)
Aerospace & Defense	-0.009 **	0.007 *	-0.000 *	0.067 **	-	0.894 *	0.000	7.12(0.52)	2.49(0.99)	0.00(0.93)
General Industrials	-0.002	0.011 *	0.000	0.073 **	-	0.783 *	0.000	5.10(0.75)	15.9(0.10)	1.75(0.18)
Electronic & Electrical Equipment	-0.667	1.582 *	0.180 **	0.281 *	-	0.705 *	-2.78 *	6.05(109)	4.56(0.92)	0.98(0.32)
Industrial Engineering	-0.009 **	0.008 *	0.000 *	0.042 **	-	0.973 *	0.000 **	6.20(0.62)	12.4(0.25)	0.49(0.48)
Industrial Transportation	-0.001	0.007 *	0.000	0.072 **	-	0.739 *	0.001	10.3(0.17)	9.57(0.44)	0.00(0.92)
Automobiles & Parts	-0.017	0.008 *	0.000 **	0.124 **	-	0.658 *	0.005	5.18(0.63)	14.5(0.15)	0.38(0.53)
Beverages	-0.004	0.003 *	0.000 **	0.080 *	-	0.881 *	0.000	12.3(0.14)	2.85(0.99)	0.37(0.54)
Food Producers	-0.006	0.002 *	-0.211 *	0.082 **	-0.127 *	0.970 *	0.427	9.44(0.31)	8.39(0.59)	0.00(0.94)
Household Goods & Home Construction	-0.008 *	0.004 *	-0.228 *	-0.094 *	-0.144 *	0.966 *	0.110 **	8.18(0.41)	16.6(0.08)	2.65(0.10)
Leisure Goods	-0.005	0.009 *	0.000 **	0.158 **	-	0.792 *	0.003	5.26(0.73)	1.90(0.99)	0.01(0.90)
Personal Goods	-0.010 **	0.004 *	-0.282 *	0.094 *	-0.170 *	0.960 *	-0.421	8.57(0.28)	12.7(0.24)	0.26(0.60)
Tobacco	-0.009 *	0.002 *	0.000	0.034 **	-	0.954 *	0.000	12.4(0.19)	13.6(0.19)	1.83(0.10)
Health Care Providers	-0.013 *	0.004 *	-0.241 *	-0.095 **	-0.159 *	0.962 *	-1.355 *	9.73(0.28)	4.57(0.92)	0.77(0.38)
Pharmaceuticals & Biotechnology	-0.001 *	0.007 *	-0.486 **	0.029 **	-	0.960 *	0.937	10.9(0.09)	4.42(0.92)	0.00(0.92)
General Retailers	-0.008	0.002 *	0.000 **	0.120 *	-	0.806 *	0.000	11.4(0.17)	3.50(0.97)	0.24(0.62)
Media	-0.010 **	0.009 *	0.000	0.043 *	-	0.943 *	0.000	3.51(0.74)	9.66(0.47)	1.29(0.25)
Travel & Leisure	-0.015 *	0.006 *	0.000 *	0.115 **	-0.126 *	0.908 *	3.407 *	4.68(0.91)	8.03(0.43)	0.45(0.50)
Electricity	-0.013 *	0.003 *	-0.846 *	0.208 *	-0.191 *	0.921 *	-0.517	12.6(0.12)	9.12(0.52)	2.10(0.15)
Gas, Water & Multi-utilities	-0.011 *	0.004 *	0.000 **	0.269 *	-	0.707 *	0.002	8.80(0.45)	4.61(0.91)	0.17(0.67)

Note: $Q_z^2(10)$ and $Q_z(10)$ are Box-Pierce statistics at lag 10. LM is the F-statistics of heteroscedasticity test, where the null hypothesis is there is no heteroscedasticity issue or remained ARCH effect. Values between parentheses

Conclusion

This paper shows the industrial effects of the September 11th attacks on the U.S. financial and non-financial markets. Specifically, this study examines the implications of the September 11th attacks on 5 financial and 28 non-financial indices using three different methods namely, event study methodology, structural break test, and volatility analysis via GARCH family. The findings, in particular, show no effect of the attacks on the financial sector except a short-lived effect on the real estate sector. While different reactions of the non-financial sector indices to the attacks were observed. 15 out of 28 non-financial sectors were temporarily and significantly influenced by the incidents on the event day, 1 and 5 days following the attacks. Though, the travel and leisure, and leisure goods sectors showed the strongest negative reaction to the attacks by -14.28% and -12.71% ARs respectively. The analyses, specifically, provide several hedging, diversification policies, and speculation opportunities for portfolio managers, investors, and financial market participants.

Lastly, our study is not free from limitations. We investigate the response of various sectors only to the September 11th attacks. However, for more rigorous insight future studies can adopt other time series estimation techniques and numerous other proxies of terrorist activities to explore the causal link of these proxies to the various industries across the US stock market as well as global stock markets.

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References

- Ahmad, T., Hussain, S., Akbar, M., & Rehman, A. U. (2022). Impact of terrorism on stock market: Evidence from developed and developing markets. *International Journal of Disaster Risk Reduction*, 102786. <https://doi.org/10.1016/j.ijdr.2022.102786>
- Aksoy, M., & Demiralay, S. (2017). The Effects of Terrorism on Turkish Financial Markets. *Defence and Peace Economics*, 1-23. <https://doi.org/10.1080/10242694.2017.1408737>
- Arfaoui, N., & Naoui, K. (2021). Terrorism, investor sentiment, and stock market reaction: Evidence from the British and the French markets. *Finance Research Letters*, 102462. <https://doi.org/10.1016/j.frl.2021.102462>
- Arin, K. P., Ciferri, D., & Spagnolo, N. (2008). The price of terror: The effects of terrorism on stock market returns and volatility. *Economics Letters*, 101(3), 164-167. <https://doi.org/10.1016/j.econlet.2008.07.007>
- Balcilar, M., Gupta, R., Pierdzioch, C., & Wohar, M. E. (2018). Terror attacks and stock-market fluctuations: evidence based on a nonparametric causality-in-quantiles test for the G7 countries. *The European Journal of Finance*, 24(4), 333-346. <https://doi.org/10.1080/1351847X.2016.1239586>
- Berrebi, C., & Klor, E. F. (2010). The impact of terrorism on the defence industry. *Economica*, 77(307), 518-543. <https://doi.org/10.1111/j.1468-0335.2008.00766.x>
- Bollerslev, T. (1986). Generalized autoregressive conditional heteroskedasticity. *Journal of econometrics*, 31(3), 307-327. [https://doi.org/10.1016/0304-4076\(86\)90063-1](https://doi.org/10.1016/0304-4076(86)90063-1)
- Brounen, D., & Derwall, J. (2010). The impact of terrorist attacks on international stock markets. *European Financial Management*, 16(4), 585-598. <https://doi.org/10.1111/j.1468-036X.2009.00502.x>
- Chen, A. H., & Siems, T. F. (2004). The effects of terrorism on global capital markets. *European journal of political economy*, 20(2), 349-366. <https://doi.org/10.1016/j.ejpoleco.2003.12.005>
- Chesney, M., Reshetar, G., & Karaman, M. (2011). The impact of terrorism on financial markets: An empirical study. *Journal of Banking & Finance*, 35(2), 253-267. <https://doi.org/10.1016/j.jbankfin.2010.07.026>
- Drakos, K. (2004). Terrorism-induced structural shifts in financial risk: airline stocks in the aftermath of the September 11th terror attacks. *European Journal of Political Economy*, 20(2), 435-446. <https://doi.org/10.1016/j.ejpoleco.2003.12.010>
- Engle, R. F. (1982). Autoregressive conditional heteroscedasticity with estimates of the variance of United Kingdom inflation. *Econometrica: Journal of the Econometric Society*, 987-1007. DOI: 10.2307/1912773
- Essaddam, N., & Karagianis, J. M. (2014). Terrorism, country attributes, and the volatility of stock returns. *Research in International Business and Finance*, 31, 87-100. <https://doi.org/10.1016/j.ribaf.2013.11.001>
- Goel, S., Cagle, S., & Shawky, H. (2017). How vulnerable are international financial markets to terrorism? An empirical study based on terrorist incidents worldwide. *Journal of Financial Stability*, 33, 120-132. <https://doi.org/10.1016/j.jfs.2017.11.001>
- Hadi, D.M., Katircioglu, S., & Adaoglu, C. (2019). The vulnerability of tourism firms' stocks to the terrorist incidents. *Current Issues in Tourism*. <https://doi.org/10.1080/13683500.2019.1592124>
- Kolaric, S., & Schiereck, D. (2016). Are stock markets efficient in the face of fear? Evidence from the terrorist attacks in Paris and Brussels. *Finance Research Letters*, 18, 306-310. <https://doi.org/10.1016/j.frl.2016.05.003>
- Kollias, C., Papadamou, S., & Stagiannis, A. (2011). Terrorism and capital markets: The effects of the Madrid and London bomb attacks. *International Review of Economics & Finance*, 20(4), 532-541. <https://doi.org/10.1016/j.iref.2010.09.004>
- Laborda, R., & Olmo, J. (2021). An empirical analysis of terrorism and stock market spillovers: The case of Spain. *Defence and Peace Economics*, 32(1), 68-86. <https://doi.org/10.1080/10242694.2019.1617601>

- Liargovas, P., & Repousis, S. (2010). The impact of terrorism on Greek Banks' Stocks: an event study. *International Research Journal of Finance and Economics*, 51, 88-96.
- Mnasri, A., & Nechi, S. (2016). Impact of terrorist attacks on stock market volatility in emerging markets. *Emerging Markets Review*, 28, 184-202. <https://doi.org/10.1016/j.ememar.2016.08.002>
- Nelson, D. B. (1991). Conditional heteroskedasticity in asset returns: A new approach. *Econometrica: Journal of the Econometric Society*, 347-370. DOI: 10.2307/2938260
- Zivot, E., & Andrews, D. W. (1992). Further Evidence on the Great Crash, The Oil-Price Shock, and The Unit-Root. *Journal of Business & Economic Statistics*, 10(3), 251-270. <https://doi.org/10.2307/1391541>
- Zopiatis, A., Savva, C. S., Lambertides, N., & McAleer, M. (2019). Tourism stocks in times of crisis: an econometric investigation of unexpected nonmacroeconomic factors. *Journal of Travel Research*, 58(3), 459-479. <https://doi.org/10.1177/0047287517753998>
- Apergis, E., & Apergis, N. (2016). The 11/13 Paris terrorist attacks and stock prices: The case of the international defense industry. *Finance Research Letters*, 17, 186-192. <https://doi.org/10.1016/j.frl.2016.03.002>

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