

The impact of Terrorist Attacks on the World Economy. Stock Market Case Study

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Abstract

The present paper aims to study the impact of terrorist attacks on the economy as a whole and on several European stock markets. Thus, the event study methodology used in this paper identifies negative abnormal returns during the day of the terrorist attack, showing that investor sentiment has been properly incorporated into stock market prices. Moreover, due to a highly integrated global financial system and to the contagion effect generated by the rapid dissemination of information around the world, more negative abnormal returns were identified on markets that present the same characteristics as the one directly affected by the terrorist attack.

Keyword: terrorist attack, stock market prices, event studies

JEL Classification: D53, E71, G15, G41

Introduction

One of the most mediatised recent terrorist attacks has been the drone attack that targeted the oil reserves of Saudi Arabia, claimed by the Houthi rebels, even though the Iranian administration is considered to be behind the attack.

In the past two decades, political and religious tensions have eroded the economic background around the world, the quest in exploiting more and more oil reserves becoming one of the primordial objectives of global political powers. Several terrorist attacks developed by different terrorist organizations such as Al-Qaeda or ISIS have taken place in these past two decades, the attacks being more and more aggressive. Besides serious psychological effects, the attacks have led also to

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economic and political implications. Due to the fact that the stock market is sometimes considered to be a barometer of the performance of an economy, the present paper aims to assess the economic consequences of terrorist attacks, concentrating mostly on the consequences felt on the stock market.

Stock price forecasting has always represented an activity intensely researched due to the fact that investors are always seeking to find investment opportunities that can be exploited. The common purpose of all the methods used is to identify future movements on the market with the help of past information, the success obtained by the method used depending on the resources available and on the applicability of the respective method on the market. Stock price forecasting contradicts the advocates of efficient market theory that consider information being completely incorporated and disseminated into stock market prices, the result being a completely unpredictable and random market.

Most studies that had as purpose to test stock market efficiency have been concentrated on the weak form of stock market efficiency in order to identify if the analyzed series follows a random walk. Closely related to stock price movements is to test whether terrorist attacks represent a threat with respect to the development of worldwide stock markets and also to the global market, with the help of event studies. Thus, the methodology of event studies helps us to identify if the information available on the market has been properly incorporated into market prices, and also to quantify the reaction of the market after an attack through the sentiment of investors.

The rest of the paper is organized as follows: *part two* synthesizes the literature regarding the economic impact of terrorist attacks over several macroeconomic indicators and the stock market, whereas, *part 3*, concentrates on evaluating the capacity of terrorist attacks to influence stock price movements, using event studies, for a constant mean return model and the market model. The final part of the paper presents the *conclusions*.

The Impact of Terrorism on the World Economy

Many researchers consider that terrorism does not generate major effects with respect to the development of general economic activity, affecting only in a small manner the macroeconomic activity of an economy, but the estimations made in practice contradict this perception (Becker and Murphy, 2001).

Recently, the attention of researchers has been redirected to evaluate the influence terrorist attacks could have on the overall economy, as well as on stock market investments. Looking from another point of view, there are studies that address the lack of correlation between the frequency of terrorist attacks and economic conditions, suggesting that terrorism does not have a direct impact over economic circumstances (Benmelech, Berrebi, Klor, 2014).

The advocates of efficient market theory consider that individual stock prices totally reflect the information available on the market, reflecting both the expectations and the fears of investors with respect to the future, stock price movements generating a whole wave of activity. Due to their liquidity, terrorist attacks, military invasions, as well as other events that have disastrous effects, show persistent influence on stock prices. "Chen and Siems (2004) have researched the answer given by global stock markets to terrorist attacks. They concluded that terrorist attacks and military invasions have a significantly short term effect on global stock markets." Due to a highly integrated global financial system, on the verge of the "*speed century*", news travels rapidly, the contagion effect being highly notable. "Johnston and Nedelescu (2005) have shown in their paper that the markets affected by the September 11 2001 attacks had the capacity to return to normality fairly quickly, although the structure and the operations on the market were affected, being thus demonstrated that the information available on the market was rapidly incorporated into market prices." "Drakos (2010) considers that the studies on this topic have not yet succeeded to demonstrate whether global terrorist activities have a systematic effect on stock markets. He considers that investor sentiments can represent a plausible channel through which terrorist activity could have a negative impact on stock returns. He tested in his paper the influence of terrorist attacks on stock returns, relating terrorism with the emotion state of investors, being tested at the same time whether if the negative impact of terrorism can be regarded as a function of the psychological impact level caused by terrorist attacks." "Eldor and Melnik (2004) use daily returns to analyze the way the stock and the exchange markets react to terrorist attacks. They separate the attacks with respect to location, type of the attack and target, the number of casualties and kills, and the hour of the attack. They conclude that suicidal attacks have a permanent effect on the stock and the exchange markets, the same result being found in the case of the number of casualties, whereas the location does not impose an effect on the market trends." "Eldor and Melnik (2010) have brought improvements to their initial study, in a new paper that evaluates the role of mass-media with respect to the magnitude of terrorist activity consequences on the economy, underlining that the impact is

highly correlated with the news in mass-media closely related to this subject. They study the press of year 2002 in order to evaluate the impact on the stock market of Tel Aviv, concluding that press articles represent an important channel through which terrorism produces important significant damage. "Chesney, Reshetar and Karaman (2011), consider that the risk of terrorist attacks is similar with the one of natural hazards like inundations, earthquakes, hurricanes and storms, because all these unforeseen events lead to substantial losses, their effects creating disequilibrium at macroeconomic level. Unlike terrorist attacks, natural disasters take place randomly without knowing previously the place and the time they develop. Terrorist attacks are characterized by dynamism according to their type (suicidal bombs, armed robbery, kidnapping and so on), their target (military, personal, governmental) and the place they happen. Terrorists can react as a response to changes in the measures of security by redirecting their attention towards new targets or by changing the type of the terrorist attack, the place and the moment. In other words, terrorists demonstrate a strategic behavior, while in the case of natural disasters, the actions that can prevent the losses caused by natural disasters do not affect the probability or the place or the progress of these events". Also "Cohen-Charash, Scherbaum, Kammeyer-Mueller and Staw (2013) study if press articles related to the investor sentiment can forecast stock price movement. They underline that global events, changes in economic conditions, or even trends can influence the sentiment of investors and can also lead to affective group reactions. Moreover, some subgroups can have a certain state of spirit that will eventually be spread around with the help of mass-media channels, social networks or through direct social interaction. They think that the global state of spirit of investors is influenced partly by news and they collect data about several emotional words used in newspapers, they code these words and create indices of the collective state of spirit for each trading day. They conclude that a pleasant state of spirit forecasts increases in NASDAQ prices, whereas an unpleasant state of spirit forecasts decreases in the prices."

The impact of terrorism on foreign direct investments

Duncan Meldrum, the former executive director of the National Association for Business Economics (NABE), estimated that terrorism represents the most important threat for the economy on short term. Moreover, more than 40% from 127 economists questioned in the year of 2004 considered terrorism as one of the most important threats to the economy. The study was published at a point in time when the economy showed signs of destabilization due to the increase in the oil price. However, terrorism has not yet destroyed the free circulation of

individuals and goods, the world economy increasing from 2001 with more than 20%.

Terrorism can have an important influence regarding the distribution of productive capital among world states, even though a small part of a national economy is influenced directly by the risks generated by a terrorist attack. Therefore, terrorist activities reduce the degree of absorption of foreign direct investments, and increase the degree of distrust of local and foreign investors generating a powerful shift of their interest towards other states. So, as long as the world economy is based on the hypothesis of free capital circulation, investors have the possibility to redirect their investments to areas that present a lower risk degree.

High levels of risk generated by terrorist attacks are correlated with low levels of foreign direct investments, even though these risks are held under control. On average, a 1% increase in the risk degree associated with a terrorist attack determines a 5% decrease of the foreign direct investments in GDP, suggesting that the impact of terrorist attacks on economies can be a major one (Abadie and Gardeazabal, 2008).

Terrorist attacks of the last two decades have put a print on the economies of the countries affected by the attacks, as well as on the world economy. The economic consequences of terrorist activity can be separated into direct consequences (short term), loss of trust regarding a proper economical context (medium term) and pour economic productivity (long term) (Johnston and Nedelescu, 2005).

The direct economic costs generated by terrorist incidents (including human casualties, material losses, economic resources spent on assessing the consequences of the attack, economic resources used to restore all critical systems affected, the costs allocated to protect the citizens, and so on) are higher immediately after an attack, thus representing a proper indicator only on short term. These types of economic costs are directly proportional with the intensity of the attacks and with the economic branches directly affected.

One of the most shocking example of terrorist attacks have been the September 11 2001 attacks, in USA, when even though all economic and financial activities have been seriously affected, the direct economic costs implicated were reduced, in comparison to the production capacity of the American economy. Thus, a report of the Organization for Economic Co-operation and Development has estimated the costs of the September 11 2001 terrorist attacks to be equal to 27.2

billion dollars, a value calculated to represent approximately 0.25% from the annual GDP in the United States (Bruck and Wickstrom, 2004).

The American economy recovered extremely rapidly after the shock of the attacks, even though the Federal Reserve of the United States reduced the interest rates in USA only afterwards, thus restoring the sentiment of trust of consumers and companies, the economy as a whole proving to be extremely resistant without being stimulated by cheaper credits.

The indirect costs of terrorism, that affect national economies on medium term, can undermine the trust of investors or consumers, a decrease in the degree of trust reducing the proportion of foreign direct investments or the citizen's individual consume, a phenomena that can become viral with the help of market tools.

From an economical point of view, we can identify for major disadvantages of terrorism: the reduction of capital investments (human and physical), the development of capital market insecurities and commercial trade, the increase of the expenditure's proportion in GDP allocated to fight terrorism (that generate a decrease in the funds allocated to stimulate other economic areas such as production, education, health and so on) and the underdevelopment of certain economical branches such as tourism (Keleher, 2002).

However, this classification does not include an evaluation of the correlation between an even higher number of terrorist attacks and free circulation of capital on international markets. In order to do so we must analyze the influence of the level of foreign direct investments with respect to the development of a national economy. The mobility of the production factors is considered to represent a significant indicator in order to determine the impact of terrorist attacks over the economy as a whole. Due to the fact, that the terrorism phenomena has local immediate effects, the capital is redirected towards economies that are not threatened by imminent terrorist attacks, the level of foreign direct investments being severely reduced in former economies.

So, due to the fact that the terrorism phenomena poses a threat to global economy, foreign direct investments will always be sensitive to the fluctuations of the terrorist activities around the world.

The impact of terrorism on investments

Terrorist attacks have a negative impact on economic growth taking into consideration the fact that these attacks represent a negative shock imposed with respect to capital development. Therefore a study that estimated the impact of terrorist attacks with respect to the proportion of investments in GDP using a country level regression concluded that there is a significantly negative connection between the two (Blomberg, Hess, Orphanides, 2004).

Moreover, the negative impact of terrorism on investments is accompanied by a positive effect of government spending, suggesting that terrorism activities conduct to a redirection of investment resources towards other areas, including towards government spending.

The impact of terrorism on capital stock

Terrorist incidents have an immediate economic and direct impact on capital stock, both physical and human of a nation.

While the September 11 2001 attacks have stimulated the development of new research in quantifying economic losses, other results have shown that capital stock is relatively affected in a small proportion.

Therefore, it has been estimated that terrorist attacks destroy only 0.06% of capital stock, being determined a small cost of capital (Becker & Murphy, 2001).

The impact of terrorism on stock markets

The *event study methodology* represents an approach that is concentrated on identifying abnormal returns caused by the impact of a certain event.

"Chen and Siems (2004) consider that in the case when investors react favorably to a certain event, then the abnormal returns calculated around the date of that particular event should be positive and negative when investors react unfavorably". Therefore, when we analyze stock market indices, the abnormal returns evaluate the response of the capital market to certain events.

This methodology is based on the *efficient market hypothesis*. So, starting from the idea that on the stock market investors are rational, any new information (that can arise after a certain event) must be incorporated in the prices.

The first step in developing an event case study is to identify the event and the period the analysis will take place, namely the „*event window*”.

The performance of the price of a stock can be considered abnormal only in comparison to a certain benchmark. Thus it is mandatory to estimate a model that must generate normal returns before the abnormal returns could be measured. (Brown and Warner, 1980). For each model, the abnormal return of stock i at time t is defined as the difference between the „*ex post*” return and the normal return obtained during the event window. For stock i at time t , the abnormal return is defined as:

$$AR_{i,t} = R_{i,t} - E(R_{i,t}/X_t) \quad (1)$$

where $R_{i,t}$ represents the observed return of stock i at time t and $E(R_{i,t}/X_t)$ represents the normal expected return of stock i at time t conditioned by the X_t information.

"According to MacKinaly (1997) there are two models that are frequently used in the literature on this topic in order to model normal returns: the constant mean return model (where $X_t = ct$) and the market model."

The constant mean return model

Let $\mu_{i,t}$ be the mean return of stock i . Then, the constant mean return model will be:

$$R_{i,t} = \mu_{i,t} + \varepsilon_{i,t}, \varepsilon_{i,t} \sim N(0, \sigma_{i,t}^2) \quad (2)$$

The market model

$$R_{i,t} = \alpha_{i,t} + \beta_{i,t}R_{m,t} + \varepsilon_{i,t}, N(0, \sigma_{i,t}^2) \quad (3)$$

where $R_{i,t}$ represents the return of stock i at time t , with $i = 1, \dots, n$, and $R_{m,t}$ is the market return at time t .

Let $(T_0 + 1, T_1]$ be the event window reserved for estimating the event, $(T_1 + 1, T_2]$ the event window and $(T_2 + 1, T_3]$ the ex-post event window. Let $L_1 = T_1 - T_0$ be the length of the estimation window, $L_2 = T_2 - T_1$ the length of the event window and $L_3 = T_3 - T_2$ the length of the post event window.

Usually it is common for the estimation window to not overlap the event window, such that the estimators of the normal model to not be influenced by the returns around the event date.

Under normal conditions the *ordinary least squares method (OLS)* represents a consistent estimation method.

Once the model is estimated, the abnormal returns can be calculated and analyzed. Let $t = T_1 + 1, \dots, T_2$ be the sample time horizon L_2 for stock i along the event window. Using the market model to calculate normal returns, the abnormal return will be:

$$AR_{i,t} = R_{i,t} - (\alpha_{i,t} + \beta_{i,t} R_{m,t}) \quad (4)$$

The abnormal returns represent in fact the error terms estimated by the market model, calculated outside the sample. The abnormal returns will be normally distributed with 0 mean and constant variance: $AR_{i,t} \sim N(0, \sigma_{AR_{i,t}}^2)$. In order to be able to make statistical inferences, the abnormal returns must be summed across the analyzed time horizon, thus being generated cumulative abnormal returns:

$$CAR_{i,t} = \sum_{t=T_1}^{T_2} AR_{i,t} \quad (5)$$

Stock Market Case Study

In the following part of the paper will be researched the impact of terrorist attacks on stock market benchmark indices from the European Union market using event studies. Therefore, the *constant mean return model* and the *market model* were used in order to estimate several simple regression models, having as dependent variables the selected indices and as independent variables the EURO STOXX 50 index, and an index comprised of the selected indices, each selected index having equal weights, namely INDEX. For INDEX were chosen equal weights in order to develop an equally-weighted global index that can resume the evolution of the European stock market, and also because EURO STOXX 50 is a super-sectorial index, not a global one, that synthetizes the sectorial evolution of the market. The

event considered was the attack in the train station in Madrid on March 11 2004. The selected estimation time horizon has been between *March 23 2003 – February 25 2004* ($L_1 = 120$ days) and the event window between *February 26 2004 – March 25 2004* ($L_2 = 30$ days).

Table 1. Selected benchmark indices

Country	United Kingdom	Austria	France	Germany	Italy	Holland	Romania	Spain
Index	FTSE 100	ATX	CAC40	DAX	FTSE MIB	AEX	BET	IBEX35

Across the specified time horizon were calculated continuously compounded returns for each of the eight indices, and also for EURO STOXX 50 and INDEX. For each index a simple regression model was estimated:

$$R_{i,t} = \alpha_{i,t} + \beta_{i,t}RSX5E_t + \varepsilon_{i,t}, \varepsilon_{i,t} \sim N(0, \sigma_{i,t}^2) \quad (6)$$

$$R_{i,t} = \alpha_{i,t} + \beta_{i,t}RINDEX_t + \varepsilon_{i,t}, \varepsilon_{i,t} \sim N(0, \sigma_{i,t}^2) \quad (7)$$

where $R_{i,t}$ is the return for i at time t , with $i = 1, \dots, 8$, $RSX5E_t$ is the return for the EURO STOXX 50 at time t and $RINDEX_t$ is the return for the global index at time t .

Constant mean return model results

For the *constant mean return model*, stock markets have reacted rapidly to the attack from the train station, investors having an unfavorable reaction due to the fact that the abnormal returns during that day are negative for the sectorial index EURO STOXX 50 model (except for the markets in Romania and Italy). According to the *t-Student* test, for the most restrictive significance level of 1%, the attack influenced all markets except the markets in United Kingdom and France. This result may arise due to the possible similarities between these markets or due to the fact that the information has not been incorporated in market prices at the same pace with the other markets. The results obtained for the INDEX model are consistent with those obtained for the EURO STOXX 50 model, meaning that the markets incorporated efficiently the information regarding the attack in the

prices, abnormal negative returns being obtained for all markets, except for the one in Romania. This result for the Romanian market, taking into consideration both models, could show that the Bucharest Stock Exchange was at that time a newly developing market, so not a very efficient one, even though the Romanian economy passed through a process of economic growth.

Table 2. EURO STOXX 50 model

	BET	AEX	ATX	CAC40	DAX	FTSE100	FTSEMIB	IBEX35
Alfa	0.004061	0.000244	0.002793	0.000559	0.000770	0.000096	0.010647	0.001069
Beta	0.141160	0.056115	-0.008253	0.155749	0.204766	0.108702	-2.065649	0.134104
Std. Err.	0.009118	0.011592	0.009130	0.009716	0.011783	0.007164	0.084015	0.009447

Table 3. INDEX model

	BET	AEX	ATX	CAC40	DAX	FTSE100	FTSEMIB	IBEX35
Alfa	0.002766	0.000077	0.002120	0.000557	0.000466	0.000317	-0.001019	0.000768
Beta	0.006788	0.127592	0.043519	0.093907	0.117270	0.054766	2.230013	0.065962
Std. Err.	0.009606	0.010465	0.007658	0.009400	0.012241	0.006875	0.009529	0.008014

Table 4. t-Student test

	ARBET	ARAEX	ARATX	ARCAC40	ARDAX	ARFTSE100	ARFTSEMIB	ARIBEX35
RSX5E	1.15*	-2.46*	-1.73*	-2.68	-2.44*	-2.78	-0.98*	-2.13*
RINDEX	1.46*	-2.51*	-1.89*	-2.97	-2.57	-3.11	3.12	-2.66

* Significant for a 1% level.

Table 5. Abnormal returns in comparison to RSX5E

ARBET	ARAEX	ARATX	ARCAC40	ARDAX	ARFTSE100	ARFTSEMIB	ARIBEX35
0.014021	-0.026230	-0.014441	-0.027886	-0.031505	-0.021366	0.029771	-0.021323

Table 6. Abnormal returns in comparison to INDEX

ARBET	ARAEX	ARATX	ARCAC40	ARDAX	ARFTSE100	ARFTSEMIB	ARIBEX35
0.010455	-0.028540	-0.015782	-0.026024	-0.028732	-0.019944	-0.082307	-0.020124

Market model results

The results of the *t-Student* test for the EURO STOXX 50 model show that for a significance level of 1% the information is incorporated in market prices except for the English and French markets, whereas for the INDEX model, significant results appear only in the case of the Romanian and Austrian markets. The abnormal returns calculated have negative values for all indices, except for BET in the case of the EURO STOXX 50 model, and FTSEMIB and BET for the INDEX model.

Table 7. EURO STOXX 50 model

	BET	AEX	ATX	CAC40	DAX	FTSE100	FTSEMIB	IBEX35
Alfa	0.004061	0.000244	0.002793	0.000559	0.000770	0.000096	0.010647	0.001069
Beta	0.141160	0.056115	-0.008253	0.155749	0.204766	0.108702	-2.065649	0.134104
Std.Err.	0.009118	0.011592	0.009130	0.009716	0.011783	0.007164	0.084015	0.009447

Table 8. INDEX model

	BET	AEX	ATX	CAC40	DAX	FTSE100	FTSEMIB	IBEX35
Alfa	0.002766	0.000077	0.002120	0.000557	0.000466	0.000317	-0.001019	0.000768
Beta	0.006788	0.127592	0.043519	0.093907	0.117270	0.054766	2.230013	0.065962
Std.Err.	0.009606	0.010465	0.007658	0.009400	0.012241	0.006875	0.009529	0.008014

Table 9. t-Student test

	ARBET	ARAEX	ARATX	ARCAC40	ARDAX	ARFTSE100	ARFTSEMIB	ARIBEX35
RSX5E	1.89*	-2.46*	-1.74*	-2.67	-2.51*	-2.65	-1.16*	-2.01*
RINDEX	1.49*	-2.60	-1.83*	-3.05	-2.70	-3.11	2.81	-2.66

* Significant for a 1% level.

Table 10. Abnormal returns in comparison to RSX5E

ARBET	ARAEX	ARATX	ARCAC40	ARDAX	ARFTSE100	ARFTSEMIB	ARIBEX35
0.017190	-0.028493	-0.015929	-0.025924	-0.029624	-0.019016	-0.097654	-0.018944

Table 11. Abnormal returns in comparison to INDEX

ARBET	ARAEX	ARATX	ARCAC40	ARDAX	ARFTSE100	ARFTSEMIB	ARIBEX35
0.014285	-0.027244	-0.014043	-0.028650	-0.033045	-0.021379	0.026770	-0.021321

Conclusions

Living in a world highly integrated through economic and political channels, events such as natural disasters or terrorist attacks generate consequences that show rapid signs of contagion around the world. Moreover, stock markets are considered to be the barometer of an economy due to the high volume of liquidities traded daily on these markets and due to stock market prices. This is why the economic literature of the past decades has concentrated frequently on studies that aim to identify a suitable method for stock price forecasting. Identifying such a method would contradict the theory of efficient stock markets that relies on the hypothesis that all the information available on the market is already incorporated into stock market prices. Thus, according to this theory, the sentiment of economic instability or insecurity generated by a terrorist attack should be incorporated into stock prices in the aftermath of an attack. This is why the present research concentrated on estimating both empirically and conceptually the economic effects generated by terrorist attacks on the economy as a whole and on the stock market.

The empirical research part of the paper used the event study methodology in order to identify abnormal returns after the train station terrorist attack in Madrid in 2004. According to the results obtained, abnormal negative returns were observed the day of the event, including in the case of the Spanish stock market, investors reacting aversively to these events. Moreover, due to the contagion phenomena, the shock generated by these events, affected the other markets included in the analysis, except the Romanian stock market. Moreover, more robust results were obtained for the EURO STOXX 50 model, in comparison to the INDEX model.

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