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SCHOOL OF ACCOUNTING AND FINANCE

Daria Sinkkonen

HAVE INVESTORS GROWN NUMB TO TERRORISM?

Evidence from attacks in developed countries

Master`s Thesis in

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UNIVERSITY OF VAASA
School of Accounting and Finance
Author: Daria Sinkkonen
Topic of the Thesis: Have investors grown numb to terrorism?
                                               Evidence from attacks in developed countries.
Name of the Supervisor: Denis Davydov
Degree: Master of Science in Economics and
                                               Business Administration
Department: Department of Accounting and Finance
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ABSTRACT

Effects of terrorist acts on financial world have been extensively studied in the past few decades. There is no doubt that terrorist acts affect the investor sentiment as it has been documented in numerous papers (e.g. Nikkinen and Vähämaa 2010; Drakos 2010; Chesney, Reshetar and Karaman 2010). Most of the previous studies have attempted to capture if certain selected events affected asset prices, how long such possible effects last and what characteristics of terrorism drive change in investor sentiment. The purpose of this thesis is to study if the investor sentiment to terror attacks has decreased over the past two and a half decades, in other words whether investors have grown numb to terrorist attacks. This study contributes to the existing literature by providing a prolonged examination of effects that modern terrorism has on stock markets. Time period used in the study ranges from 1995 to the end of 2017. Forty terrorist attacks are examined from the S&P 500, Euro Stoxx 50, FTSE 100, MSCI Europe and MSCI World indices.

Results of the empirical study suggest that, unlike hypothesized in this thesis, investor sentiment to terrorism hasn't decreased but instead increased: investors' negative reaction got in fact stronger from more recent attacks. Explanatory regressions also contribute to these results, by showing that between 1995 and 2010 cumulative abnormal returns were higher during the attack days. Significant results suggest that the number of people killed and wounded in the attack affected investor sentiment negatively. Individual characteristics of the attacks didn't affect the investor sentiment in any negative way.

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KEYWORDS: Investor sentiment, Terrorism, Event study, Risk taking, Abnormal returns

1. INTRODUCTION

Every day investors receive tens if not hundreds of news that can alter their investment decisions, their sentiment. With social media, internet and globalization the extent and pace of news coverage have changed, as almost all of the information is available to consumers at the very instant the news agencies get a hold of them. When one faces hundreds of very relevant and somewhat relevant news each day, it leads to the inevitable question whether the human mind has grown numb to the news? It's dubious, if anything can surprise investors anymore, especially relating to terrorism as the most horrible terrorist attack in human history that occurred on September 11th, 2001, showed that markets do recover rather fast even after such massive attacks (Nikkinen and Vähämaa 2010).

Instabilities caused by unpredictable events can have a drastic negative or a positive impact on the economy. There are numerous studies that have documented the change in stock returns after important sports events like the Super Bowl (Payne, Tresl and Friesen 2018). Even more important events and news that have a straightforward effect are corporate news like stock split announcements, news about executive appointments or simply earnings announcements affect how the investors perceive the future of certain companies and are therefore reflected in the prices of stocks (Pevzner, Xie and Xin 2015; Bessembinder and Zhang 2013). Leaning on these observations it may be expected that investors will also react to the news that shake the world, destroy infrastructure and cause loss of human lives, and cause extra costs to the economy.

Investors reaction to the prevailing situation in the world and their expectations about the future of the financial markets is called an investor sentiment. When the investor sentiment about the future is high, the stock prices keep rising, and the market situation is called bullish. When the investors are not trusting that in the near future the market will be doing well, the stock market prices can be seen sliding down and talks about bearish markets begin. The Efficient Market Hypothesis assumes all news are rationally evaluated and reflected in the stock prices according to the impact of the news. There are however different behavioural biases that affect the investor sentiment and go against the Efficient Market Hypothesis. Barberis, Shleifer and Vishny (1998) and Chan, Jegadeesh and Lakonishok (1996) argue in their research that investors are rather slow to intercorporate news in their short-term beliefs about the market and rather continue to reflect the pattern of thoughts that has prevailed before. In other words, if the company's returns in past years have been good and their view on their business situation hasn't

changed, investors expect the pattern to continue, despite occasional news that could signal risks for the whole financial market. The same goes also for companies that have been on the losing end of the spectrum, with returns that don't satisfy the investors. When it comes to events that don't affect one company in particular, but rather the infrastructure of the country, investors could be hesitant to reflect the news to the stock prices. One can also think that some companies can even benefit from the terrorist attacks that destroy infrastructure, as the consequences must be repaired and this means orders and more work for certain business sectors.

Terrorist attacks are the kind of events that cause significant chaos, destruction and in extreme cases loss of human lives. Terrorism fuelled by religious and political beliefs isn't a new phenomenon, the first documented "terror" events can be traced back to the 11th century but it's presumed that it has been around for even longer period of time. The word *terrorism* comes from the French expression "regime de la terreur" that occurred in the late 18th century, but the French expression derives from the Latin word "terrere" *to frighten* (Burgess 2015, Walker 2001).

Even today terrorism doesn't have any uniform international definition, but every country and political organization tries to give terrorism some definition of their own. The most definitive explanation of term *terrorism* was given by Organisation of Islamic Cooperation stating that: "means any act of violence or threat thereof not withstanding its motives or intentions perpetrated to carry out an individual or collective criminal plan with the aim of terrorizing people or threatening to harm them or imperilling their lives, honour, freedoms, security or rights or exposing the environment or any facility or public or private property to hazards or occupying or seizing them, or endangering a national resource, or international facilities, or threatening the stability, territorial integrity, political unity or sovereignty of independent States" (Pawlak 2015).

What has changed over the centuries and even past few decades is how the acts of terrorism are executed. The goal of terrorism has always been to cause as much fear, destruction, lack of confidence and even death as possible. For that purpose, the big attacks are the most effective, such as plane crashes similar to in Lockerbie in 1988 or huge bombings akin to Oklahoma City bombing in 1995, or even combinations of these two in the case of the terror event that occurred on 11th of September 2001. Today these kinds of acts are rather hard to implement, due to the counterterrorism actions, that countries have been investing in, resulting in spotting the big terror attacks in their planning phases and preventing the attacks of being carried out. Therefore, smaller

attacks that do not require a lot of equipment, like a van speeding into a human groups, have been becoming more general, meaning that terror attack can occur almost anywhere at any time.

In the past few years due to a rapid development in information technology (IT) terrorism has crossed past the line of physical attacks into a cyber world. Cyber terrorism is a rather new threat to the world and attacks have increased each year, bringing new threats to globalized world and through that to financial world. In Worldwide threat assessment report made by National Intelligence of the United States, cyber threats are categorized as one of the largest threats of the globalized world (2018). This can be a massive game changer also in financial world, as the markets have switched to electronic format and cloud-based databases. By doing so they expose themselves to enormous risk of cyber terrorism, that could crash the market and cause extreme havoc like the Stuxnet virus caused in the Iranian power plants.

1.1 Prior research

This study is influenced by research papers by Nikkinen and Vähämää (2010) and Chesney, Reshetar and Karaman (2011). They and many researches that also studied the effects of terrorism on investor sentiment come to the conclusion that the immediate effects on day of the terrorism and few after it are significant and are reflected in stock market sentiment, but the effect is momentary and that investor sentiment and stock market reaction to terrorism is short term and isn't reflected in stock prices in the long run.

One of the extensive studies was done by Drakos (2010), where he studies multiple terror attacks from 1994 to 2004, with the conclusion that the terror attacks affect stock returns in a negative way. His study also suggests that the number of fatal casualties caused by the attack has an effect on how markets react to the event.

Study by Goel, Cagle and Shawky (2017) studies how fast the markets rebound after the attack, same kind of sub-study was also made by Nikkinen and Vähämaa (2010). The conclusion in both studies was that there is a significant effect of the terror attacks on the stock market, but markets rebound to the pre-attack returns very quickly.

The effect of terror attack can easily spill to other markets also as was recorded in study by Nikkinen, Omran, Sahlström and Aijö (2008) and Kumar and Liu (2013). While the Nikkinen et al. focuses on studying how 9/11 was reflected on 53 different markets, Kumar and Liu provide explanations to the possible spillover effect. Markets that had a tight trading partnership with each other reacted more significantly to each other's terror events.

1.2 Purpose of the study and the contribution to the existing literature

In the core of the financial theory is the Efficient Market Theory. The Efficient Market Theory states that the markets are rational, but the investors not so much and therefore the in the short-term time period there could be lags in how information is reflected in the stock prices, as investors react firstly with their feelings especially to the negative news, instead of Fama's proposition of the Brownian effect (Barberis. Shleifer and Vishny 1998; Baker, Wurgler and Yuan 2012; Chan, Jegadeesh and Lakonishok 1996).

This study focuses on the terrorist attacks that occurred between the beginning of January 1995 until the end of 2017. Filtration of the attacks was applied to include only attacks that occurred in Europe (excluding Turkey and Israel, but including Russia) and United States, and also focusing on the attacks targeted towards civilians, therefore excluding the attacks where the military was a target group. To capture the investor sentiment this study focuses on stock indices FTSE 100, Euro Stoxx 50, S&P 500, MSCI Europe and MSCI World. Article by Nikkinen, Omran, Sahlström and Äijö (2008) supports that not all regions have the same reaction to terrorist attacks and capture that European and U.S. markets reflect each other's moves in the stock market post September 11th attack and in some extent Asian market follows them too.

The purpose of this study is to examine whether the investors have grown numb to terrorist attacks. Increasing media coverage should increase the fear expectations, but previous studies that have proven that the effect of the terrorism on the stock market is not long lasting (Melnick and Eldor 2004). Researches have proven that markets rebound after few weeks if not days to the pre-attack state (Nikkinen & Vähämaa 2010). Despite Melnick and Eldor (2004) providing the evidence that location of the terror attack has no effects, this article assumes that increasing amount of terrorist attacks in western world and wider coverage by media has larger effect on investors, as was suggested in study by Jetter (2017:32).

Contribution of this thesis to the existing literature is an aim to provide an extensive overview of the terrorist events in the developed countries and evaluate if the terrorism as a phenomenon still has an effect on the markets and should be studied in the future. Also, the investors reaction captured in this study could provide information of investors behaviour and the way they evaluate events through stock pricing.

1.3 Structure of the study

The study is organized as follows. The first chapter acts as an introduction to the topic this thesis discusses. Important previous studies this thesis leans on are briefly introduced, the research questions are presented as well as the main drivers behind the study, purpose and the way this thesis contributes to the existing literature.

The second chapter is a brief introduction to terrorism. First the chapter discusses the political risk from a financial perspective in order to provide a general picture of what end results of terrorism could be expected, as terrorism is one form of political risks. Then terrorism as a phenomenon is described in more detail, focusing on of the effects of terrorism on the economy and probability of terrorism effect occurring in the western countries. Economic aspects, as certain terrorism events are described in more detail in their own subsections.

Chapter three focuses on describing the investor sentiment. Chapter begins with the theory of the Efficient Market Hypothesis, weaving it into the investor sentiment theorem and how the previous literature has viewed investor sentiment as an important factor in the asset pricing models, where it should be taken into account.

The fourth chapter's focus is on previous literature about the effects of terrorism on investor sentiment and what factors the previous studies have shown affecting the investor sentiment during the terror attacks.

Chapter five provides the hypothesis of this study in detail and also describes the sample data that was used to perform the event study to test the hypothesis. Data is evaluated in the subsection of the chapter and the refining method is described. In the last subsection the empirical models used in this study are described in detail, providing the reader with the understanding how the results of the study were acquired.

Chapter six focuses solely on the results of the empirical study and their analysis. Chapter seven is a conclusive chapter of the study, summing up the results with the previous findings in the literature.

2. POLITICAL RISKS AND ACTS OF TERRORISM

Terrorism is not a recent phenomenon. First documentation of terrorism, as we widely define it today, can be found in the beginning of the Common Era (Burgess 2015, Walker 2001). However, globalization, internet and media make it look like terrorism is a recent phenomenon and that terrorism event occurrence has increased in the past few decades. In reality the amount of terrorism events has decreased due to strict counterterrorism measures that for example European Union has taken to fight the terrorism in the past decade (Zimmermann 2011; Jetter 2017). But in the past two decades terrorism has changed and developed in, some could say intelligent ways, so that it threatens not only human lives, overall safety and infrastructure, but also even more the financial world.

This chapter focuses on describing modern terrorism, how it affects the society from the economy viewpoint and provides analysis about the possible future forms of terrorism and what that would mean to economy and finance.

2.1 Political risks

Financial literature on political risks and their effect on the financial markets has been studied for years with different methodologies and for different purposes. The definition of political risk is according to Huang, Wu, Yu and Zhang (2015) is that it's a risk that arises from action of government or the risks are somehow related to the political actions, such as legislations, government policies or actions that affect the structure and activities of the country. Political risks are as much injurious to private investors as to institutional investors and companies. Countries with high political risks often suffer from the increased corruption that could have a negative effect on the future expected cash flows of the companies (Bekaert, Harvey, Lundblad and Siegl 2016).

While terrorism isn't the most common political risk, it is categorized as a political event as it more often than not carries a political message, or it aims to cause a disorder in the country which will affect the political choices. The counterterrorism measures are also executed by the government and therefore results and analysis of studies that handle political risks can also be applied in the cases of terrorism events.

The most extreme political events are wars, which affect not only the everyday lives of people, but also the economy and in the end on investor sentiment (Wisniewski 2016:

18). Consequences of increase in political risks are such as capital flight as documented by Lensink, Hermes and Murinde (2000). In risky situations, fear fills minds of investors who withdraw their investments from the riskier countries and riskier assets and invest in safer countries with a very good investor protection legislation like the United States. There are numerous studies on different assets that have a reputation of being a safe haven. Hood and Malik (2013) studied whether gold acts better as a safe haven than the CBOE Volatility Index known as VIX. They argue that in fact VIX is a far better safe haven and a hedge tool than traditional safe haven asset, gold.

When looking at the geographic breakdown of terrorism one can note that most terrorist attacks occurred in countries with already high political risks, as top ten countries sorted by most terrorist attacks in 2016 were in some kind of political conflict (Global Terrorism Index 2017: 21-41). Most of the conflict countries are autocratic and that by itself is an explanatory factor of for example low returns as research by Lahkonen and Heimonen (2015) indicates. Democratic countries are more agile to changes in government policies and external factors. Parotti and van Oijen (2001) study whether emerging economies benefit from decrease of political risk and the results of their study suggest that the benefits are significant for the overall financial market of these countries and therefore the total stock returns also tend to increase when the political risk decreases.

Usually studies of political risks concentrate on countries with a high political risk factors, as of course the effects of the risk are much easier to detect in these countries. These studies however are a good example of what could be expected to happen after the terrorist attacks in the developed countries like the United Kingdom or France, even if the effects would be much weaker. If the investor sentiment drops due to terrorist attacks will the investors redirect their investments to the countries that they consider safer or redirect their assets to safe havens?

2.2 Terrorism

In the past few decades there were several devastating terror attacks in the western world, that have shaped modern understanding of terrorism and most likely, it will be changing once more. Daniel R. Coats from National Intelligence of the United States has pointed out that terrorism continues to be one of the main threats for the world, with cyber threats (including cyber terrorism) increasingly growing into a major global threat (2018). Goel, Cagle and Shwaky write on terrorism the following: "Great societal harm comes from a

sense of fear and helplessness within communities, which erodes consumer confidence and consequently stunts economies, which can lead to a real slowdown in the economic development of nations" (2017: 120.)

When talking about international terrorism the problem is how to define it. There is not one coherent definition of what terrorism is and every country and union define differently what kind of actions can be considered terrorism. Arif and Suleman (2017) describe terrorism as a "tactic designed to set in oppressiveness and fear, aimed to attain a religious, political, economic or social objective. It is defined as an action with a purpose focused on explicit targets scattered over numerous geographical locations and is highly unpredictable. Unlike other disasters, where the predictions for the occurrence of such events are possible, there is a very little possibility of predicting terrorism. It predominantly comprises the use of explosives and firearms. Moreover, the reaction time after identification of a potential terrorist event is substantially limited when compared to other disasters. This innate suddenness of terrorist events may initiate societal reaction by disrupting markets" (366.) Despite the varying definition across nations and organizations, all agree, that it's a very aggressive and violent form of usually political attack with an aim to cause either serious damage to infrastructure or great number of human casualties, usually both. Terrorism is always an unpredicted attack that carries a negative message and outcome.

While the financial market instability is not always the main purpose of the terrorism, terrorism always affects the markets, as the financial markets are one of the corner stones of modern societies. Terrorism affects financial markets through three ways. First: international trading may suffer and experience increased costs of trade due to postponed shipments and also loss of trading goods in a terror act. Trading can also be hindered due to a stricter regulations and customs. Secondly: terrorism affects companies who can slow down or discard their investment plans altogether. Also, companies operating in terrorist countries can face unexpected costs of destroyed property and goods. Thirdly terrorism increases investors fear about the future, in other words sentiment, which shows up as increased volatility on stock markets and increased withdrawal of risky stocks to safe haven assets such as gold, because risk avoidance increases as bad investor sentiment increases (Essaddam and Karagianis 2014:89).

Effects of terrorism can be roughly separated to direct and indirect, where the direct effects or costs are those that are straightforward for example: human life losses, damage to infrastructure and property. Effects that are caused to economy are considered indirect,

as they are caused for example through change in consumer behaviour or loss of investors' confidence in the market situation. Usually the effects of terrorism on economy are negative, meaning that investors in fear of market uncertainty or further attacks withdraw their investments to the safer countries (Kumar and Liu 2013: 42).

Several studies focusing on economic effects of terrorism have documented that economic consequences are not only experienced by the country that was targeted by the terrorism act, but also other countries. The effects are especially experienced by important trading partners of the country under the terror attack (Kumar and Liu 2013). Study by Melnick and Eldor (2004) suggests that frequent and prolonged periods of terrorism didn't desensitize the financial markets, which served as a motivator for this thesis to study if over time with frequent terrorism occurrences have lessened investor sentiment and therefore have milder effect during the terrorist act on stock market.

Analysis in the Global Terrorism Index from 2017 showed that in 2016, in developed countries, ISIS was the main terrorist group behind continuing terrorism acts. And despite the fact that deaths from terrorism declined, for OECD countries 2016 was deadliest year (excluding 2001 when the attack 9/11 occurred) since 1988 and for Europe deadliest year was 2014 (Global Terrorism Database, Global terrorism index 2017:3)

The development of the past few years has seen a shift in the target group of the terrorists in developed countries. Instead of targeting military troops, like the trend was in 1980's, for example with Irish separatist, the recent trend has been to target civilians, as this causes larger disruption and also the size of the attacks has switched towards smaller attacks as they are much easier to carry out until the end (Global terrorism index 2017:57) The spreading trend of terrorism can affect the investor sentiment. Looking at the statistics in 2006 there were 106 countries that had experienced at least one terrorist attack, meaning that only 30 countries in the world hadn't experienced any terror attacks at all. When compared to 2002 when there were 44 countries that hadn't experienced terrorism, the trend of spreading is obvious (Global terrorism index 2017:14-15). Assuming that investors act according to semi-strong form of market efficiency and have access to this information, these facts can lead investors to withdrawal of their money in the aftermath of the attack or it can become such a normal phenomenon, that it wouldn't affect the investor sentiment as they get used to it and learn that the effect of the market drop doesn't last long after the terrorist attack.

Most terrorism events occur in conflict countries, with very poor or non-existent democratic establishments, which leads to terrorism booming and becoming more of an everyday event (Global terrorism index 2017:14-20.) Europe and the United States have a low global terrorism index (GTI) score, meaning that they are rather safe countries to live in without everyday worry about possible terrorist acts. The score however, has been deteriorating significantly since the beginning of the 00's when the score measurement started. For example, in 2002 there were 129 attacks in Europe and as a result only fourteen people died in these attacks, when in comparison with 2016 there were 630 attacks (if Turkey is included) which led to 826 fatalities (GTI 2017:49.) Worsened score of Europe on GTI scale is due to the fact, that deaths from terrorism have increased significantly since the beginning of 00's, peaking in 2014 at over 4000 deaths a year.

Since 1970 there have been different terrorist groups driving the statistics in OECD countries, in the early 70's the Irish Republican Army (IRA) and the Basque Fatherland and Freedom (ETA) were responsible for most of the terrorist attacks. In the 80's the peak was due to Air India flight 182 crashing. But after the 9/11 most of terrorist attacks came from the extremist group that goes by the name *the Islamic State in Iraq and Syria* (ISIS). The group is at fault of increase in terrorism in the OECD countries after 2010. Terrorist group was able to execute few very deadly attacks, that shook the world and these terror acts do not aim at government or military, but civilians which creates fear and disruption more effectively. With the ISIS coming into picture, terrorism in the OECD countries has taken a completely different turn. Both IRA and ETA tried to target mostly military personnel, but there were incidents when also civilians got hurt unintentionally according to the groups. With ISIS the story is different, as the terrorist group wants to target the civilians, which in turn creates fear and could increase bad investor sentiment as investors fear that simply anyone could be a victim of their attack (GTI 2017: 60.)

Because terrorism has been around as a documented event for decades, countries have increased investing into prevention of terrorism, especially countries with history of terrorism. In Global terrorism index from 2016 their research didn't find relationship between number of terrorism attacks in the country and the success rate of terrorism prevention. There is however linkage between prevention rate and the type of terrorist attacks. Attacks that use explosives are prevented much more often, because they require higher amount of preparation and police is able to track for example when high quantities of ingredients needed for explosives are being bought in the country (GTI 2017: 55-56.) Therefore, the increasing intelligence in terrorism prevention could be an explanatory factor, if the investor sentiment has decreased. At the same time new types of attacks have

emerged, such as using automobiles for terrorism. These kinds of attacks are easy to arrange and carry out, and therefore they are very hard to prevent. However, increase of these type of attacks, small and quickly realizable, has forced countries to take preventive measures around mass events, such as closing off streets around event venues and placing bollards around that would stop vans driving on a high speed into crowds.

2.3 The economic consequences of terrorism

The economic costs of terrorism are a rather vague concept, as all effects of terrorism are not yet known or cannot be calculated effectively in every country. Most of the financial research concerning terrorism focus on how the financial markets react to the events. Few studies have however investigated how the terror attacks affect the economy. The Global Terrorism Index calculates the effects as broadly as possible, but even the researchers say that the estimates of the figures are conservative, taking into account that the figures of terrorism account only for about one percent of the global cost of violence in 2016 (Global terrorism index 2017:82.) Calculation of the figures mostly comprises of estimation what human capital loss would have accounted for in GDP of the country, but there is no estimate of how much the loss of property caused by terrorism is in numbers(except for 9/11 where the property loss has been calculated to be 65 US$ billions) (Global terrorism index 2017: 80; Prieto-Rodríguez, Rodríguez, Salas and Suarez-Pandiello 2009:812). In a study by Estrada, Park, Kim and Khan (2015) the model of terrorism impact on economy suggests that countries having a low GDP growth rate suffer from the attacks more, as economic leakage (cash flows reinvestment to safer countries) affects their performance and there are signs of prolonged effect on long term growth.

Aligning with the broader studies of the political risk and events, terrorism has short and long-term effects on economy. Short term effects can be associated with the terror event right away, like loss of human capital and destruction of property. Zi and Sullivan (2017) link the calculation of costs of the short-term effects to the costs of repairing the damage and getting the infrastructure to its' normal level of operation. The long-term effects arise from increase of negative investor sentiment. Part of the investor sentiment comprises of images, ideas and perceptions of the situations and political climate, it is hard to pin

Figure 1 Terrorist attacks used in the study, modelled around the MSCI
World index. Return is calculated on starting investment of 100.

Timeline of the attacks matched with MSCI World return
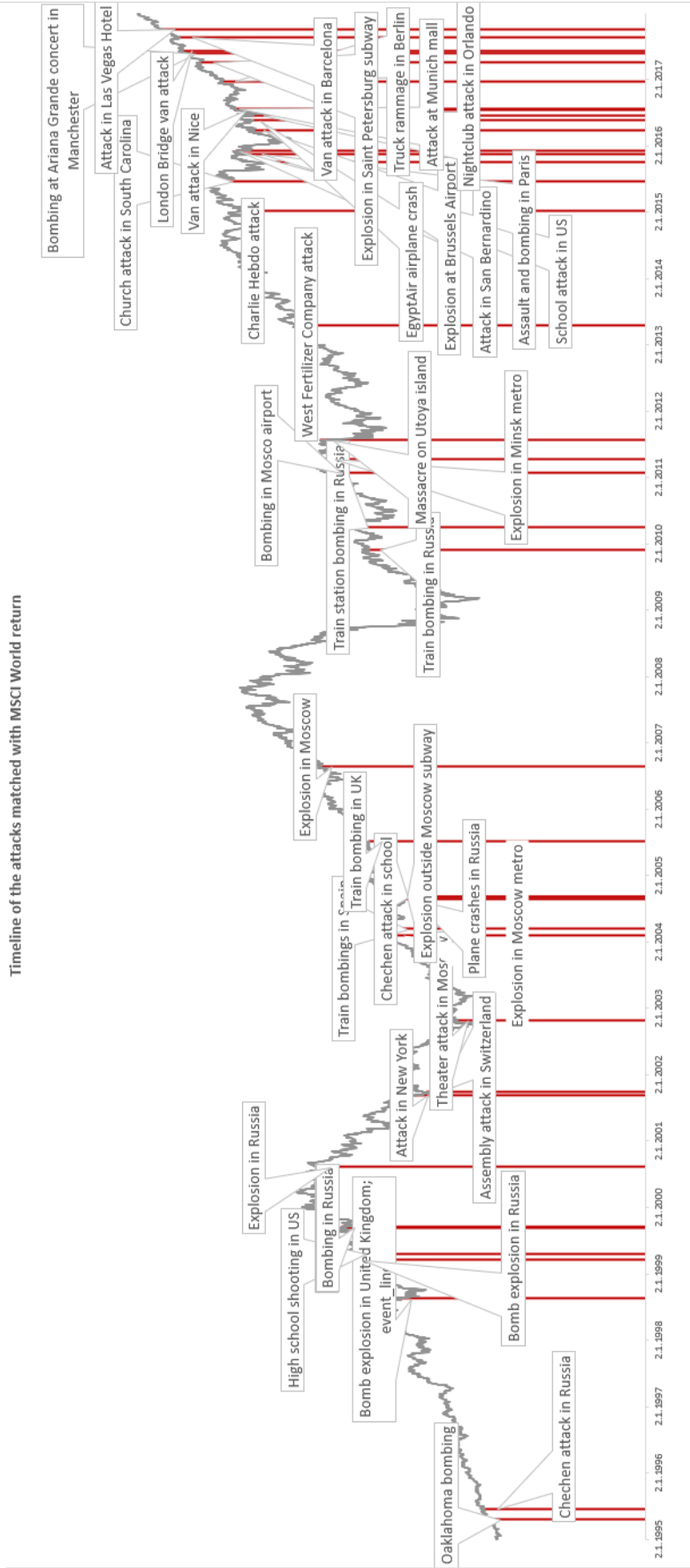
down when the flight for quality in assets, increasing cost of debt or asset pricing is due to terrorism or some other event or action. UK political risk index has declined in 2018 (Marsh political risk map 2018), but is it due to terrorism events, especially Manchester, or is it due only to Brexit referendum that increases investors' fear barometers concerning the future. Mostly the effects of terrorism are short term and the development of the economy depends on how the attacked country bears the consequences, developed countries tend to recoup from the terror attacks much quicker than developing countries (Llussa and Taveres 2011: 53, Eckstein and Tsiddon 2004).

From 2012 the cost of terrorism has risen to a completely new level and reached its peak in 2014 when it amounted to 104 US$ billion, but since then the figure has been decreasing, totalling 84 US$ billion in 2016. Most of the economic impact comes from the loss of human capital. If the effect of 9/11 is deducted, then the total economic effect from year 2014 to 2016 is more than the total effect of preceding 12 years starting from 2000. While terrorism has increased in the developed countries in the past decades, most of the economic impact of terrorism is stills suffered in the conflict countries that are mostly located in the Africa, South Asia and the Middle East (Global terrorism index 2017). But true costs and financial effects of terrorism are still not completely clear and the idea that they might be much higher than the Global Terrorism Index indicates calls for a more in depth research, if the terrorist attacks continue.

2.4 Cyber terrorism

Cyber terrorism is a recent threat in the world, that emerged only during the past 20 years, when the internet and information technology (IT) came to wide use of general public. Olaf Theiler describes that the attack of 9/11 changed the perception of cyber terrorism, in one event it was no longer abstract possibility discussed by IT – professionals but something very real and very dangerous to the world, breaking all the possible boundaries and rules. Theiler describes that "Cyber dimension might sooner or later be used for serious attacks with deadly consequences in the physical world" (2011).

Cyber terrorism is even harder to define than classic terrorism, as it's still unclear what cyber terrorism actually is and what is just cyber crime, such as environmental activism. While in conventional terrorism the use of explosives and firearms is more common than not, causing destruction of infrastructure and loss of human lives, things are different with cyber terrorism. The harshly simplified idea of terrorism is to cause fear and chaos, that

would hinder the normal operation of society as much as possible but digital attacks haven't yet created such amounts of havoc and horror as terrorist may have hoped for. This however isn't lasting, as cyber-attacks such as Stuxnet have proved.

Stuxnet is a computer worm that appeared in 2010 and was used to disrupt Iranian nuclear enrichment by taking over the control of pumps, valves, generators and other industrial machines. (Lindsay 2013:365; Weinberger 2011:142). The attack was the first of its kind: extremely sophisticated, technologically complicated and precisely targeted. Stuxnet upgraded cyber-attacks from random, activism-type that wasn't planned to cause any physical harm to "military-grade cyber missile" with the purpose of causing physical damage through cyber action (Lindsay 2013). In 2009 U.S president Barack Obama wrote that cyberthreats pose the highest-level challenges in the US not only from national security perspective, but also from economic perspective as well (New York Times 2009.) And while the danger of Stuxnet has passed as antiviruses against it have been created and the security loops it used have been patched, the highly intelligent code of Stuxnet is available for terrorists and other potential attackers to modify and develop for the future attacks (Weinberg 2011: 144).

As our world becomes more and more connected to internet and important operations such as government operations and stock markets move their main operations to internet, many dangerous physical damages can be done which in turn affects investor sentiment and in worst case can hinder or stop market operations altogether. While digitalization has simplified our life in various ways, the same dependence that we now have on digital services is a threat. The threat for the financial world is enormous as money has gone from being physical paper to being just numbers on servers. Not only that, but completely digital currencies like Bitcoin have emerged, challenging old ways of thought. This change is however, very prone to possible disasters. Stuxnet opened door for extremely horrible possibilities, as like the attack on nuclear power plant was possible, so is the attack on financial markets, on stock markets that are now almost completely located in web. Should that happen, the reaction most likely would be disastrous, as the investors' confidence in the system would drop and the flight from the markets could be of an unprecedented size and the length of the reaction could be completely different than as it is with conventional terrorism (Baranetsky 2009).

2.5 Terrorist events

This study focuses on terrorism events that occurred between 1990 and 2017 in Europe and United States. Occurrence of the events modelled around MSCI World index could be examined in figure 1. During this time, there were three waves of terrorism, with less tragic years in between when measured by causalities. As can be seen from the figure 2, first wave begun around 9/11 terror attack, which was the most devastating attack of all times. Fatality reached a number of 2996 and number of wounded reaches over ten thousand people. First wave slowed down after 2004, when the second peak was reached with 804 fatalities and over 3000 non-fatal injuries. In 2004 there were 73 terror attacks in Europe and US in total, the most fatal happening on the 11th of March in Madrid, where four simultaneous train terrorist bombings took place.

Figure 2 Visualisation of rate of fatal and non-fatal causalities caused by terrorism. On the right is the axis for the number of killed in the act and on the right is the axis for the wounded victims of the terror attacks.
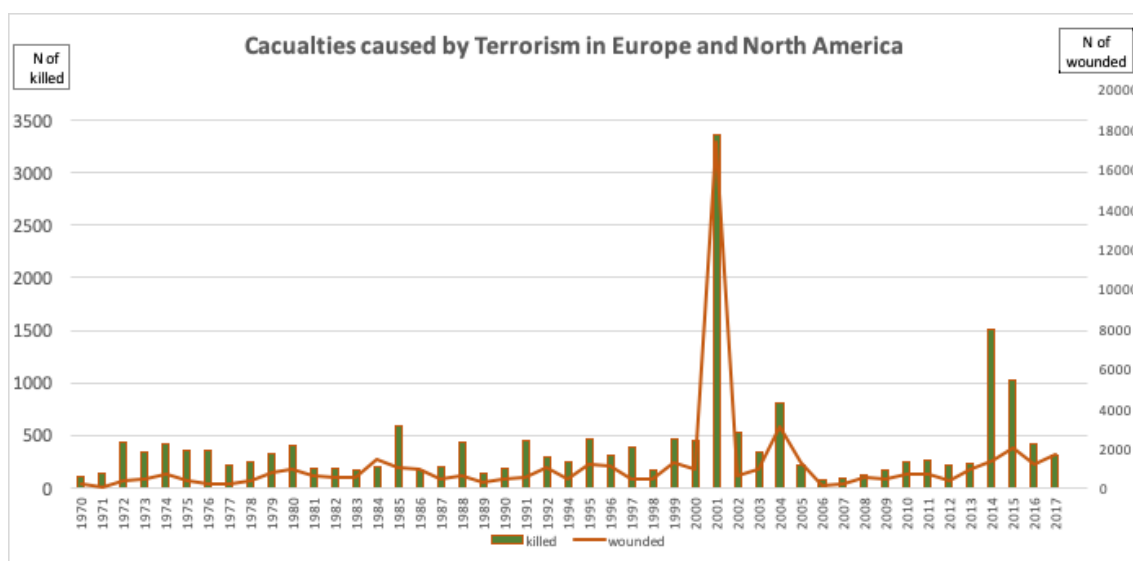
Second wave of attacks was milder than the one during the change of century. It peaked in 2011, when 257 fatalities and 694 non-fatal injuries occurred. The most devastating terror attack took place in 2011 in Utoya, Norway on the 22nd of July, when 69 people were killed and 60 wounded. Third wave started in 2014 and it was the most fatal year, if the attack of 9/11 is excluded from consideration. Behind the increase of fatalities caused by terrorism in 2014 is the Russian military intervention in Ukraine and most of the terrorist attacks in western countries occurred in Ukraine, but for the most part they were

attacks directed towards the military. The most fatal attack in 2014 was the crash of the Malaysian Airlines flight MH17 in Ukraine, in which 298 people died. No one took the credit for the crash of the airliner and it's dubious if it indeed was a terror attack, therefore the attack is not included in the research of this thesis. In 2015 the military intervention in Ukraine continued, however there were also other serious terrorist attacks that could affect the mood of investors. On 13th of November in Paris group of assailants performed an attack using firearms, in which people died and 368 sustained non-fatal injuries.

The figure 2 shows that there are three possible waves, where investor sentiment could turn negative, which in turn would lead to negative abnormal results. Based on several studies (Drakos 2010; Kollias, Manou, Papadamou and Stagiannis 2011; Estrada, Park, Kim and Khan (2015) the amount of casualties should be linked with the negative investor sentiment. But as Chen and Siems (2004), Kollias, Manou, Papadamou and Stagiannis (2011), Kolaric and Schiereck (2016) and Goel, Cagle and Shawky (2017) argued in their research there are evidence that investor sentiment isn't as straightforward and although the fatalities in the events would be high, the market could be still and show no reaction. Reasons for this could be a previous terrorist event that was close by to the event under consideration and the investors would already have corrected the market price accordingly with possible terror occurrence.

3. INVESTOR SENTIMENT

This chapter presents the basic concepts of what the investor sentiment is, how it has been presented in the academic research and what methodologies are usually used when the investor sentiment is measured in order to capture the phenomenon. One important part of this chapter is to provide the reader with an understanding of whether the investor sentiment really plays a role in the stock prices, as the classic pricing models do not account for it.

3.1 The Efficient Market Hypothesis

The Efficient Market Hypothesis is at the core of modern finance theory and research. While it was already introduced in its infantile form in the beginning of the 20th century, the idea took off only in 1960's when Eugene Fama popularized the theory. Eugene Fama states in the first sentences of his article that an "ideal is a market in which prices provide accurate signals for resource allocation: that is, a market in which firms can make production-investment decisions, and investors can choose among the securities that represent ownership of firms' activities under the assumption that security prices at any time "fully reflect" all available information" (1970: 383.) When these assumptions come together, and investors are rational, the markets could be called efficient. Rationality is reached when the decisions and beliefs of market operators rely simply put on Bayes' theorem, which shortly described is a probability given to certain events; the probability is formed around the knowledge of factors that have affected the same type of events in the past. For example, in the case of terrorism, investor relaying on the Bayesian theorem would know, that it's not the most common form of violence that occurs in western countries yearly, especially from the point of view of economy and that the effect of terrorism on the stock market is not lasting, if the investors had read academic researches about the topic. Another vital thing for investors is the understanding that markets do not offer "free lunches", meaning that in order to get higher returns, one must bear higher risks. No strategies exist that provide excess return, without adding more risks of losing in same or even higher proportions according to the Efficient Market Hypothesis (Barberis and Thaler 2002). But studies have shown that investors are sometimes able to avoid these constraints and earn excess return with different strategies, that do not increase their risk levels in the same proportions (De Long, Shleifer, Summers and Waldmann 1990).

The Efficient Market Hypothesis (later abbreviated as "EMH") doesn't state straight forwardly that investors are rational, instead the markets are believed to be rational, as they reflect all available information on the market about the security. Efficiency also requires that there shouldn't be any transactions or trading costs, all of the information should be available to the investors without costs, for example financial information of the companies should be freely available for all companies, and the last necessary condition is the agreement of what all the available information means for the current price and its' possible development in the future (Fama 1970:387-388). But even Fama himself understood in his article that these rules are only theoretical and are hardly met in the real life, at least at the same time, but according to his words it doesn't really matter as long as they occur at some scale (388).

Event studies are based on Efficient Market Hypothesis and the reliance, that investors get the information about the event in question, evaluate and analyse the information correctly and are able to reflect their beliefs in market prices through their sentiment.

Three different kinds of efficiency forms can be recognized by the way how information is reflected in the stock prices and how it can be processed from the stock market. In the weak form of efficiency, the researchers are interested to test how well the history predicts the future. With the weak form of information prevailing, the only option of financial market analysis is technical analysis, where variables like interest rates and dividend yield can help in predicting returns (Fama 1991: 1576.) Semi-strong form of efficiency is tested with how information, that must be announced by the regulations and legislations, is reflected in the stock prices as soon as it's released. This kind of information is for example: stock splits, earnings announcements, merger and acquisition announcement etc. The event study methodology assumes the semi-strong form, as its' idea is to test how quickly the information released for public availability is reflected in the asset prices. The only way to beat the market in the semi-strong market form is by having insider information before anyone else, this is however a very risky path as misuse of insider information is illegal in all countries that have established financial markets. Third form is a strong form of market efficiency, under which no investor could be able to use any private information for own advantage as all of the prices are already reflected in the market prices. Under this form of market efficiency, the only option for the investors to gain the extra return is by accepting the higher risks that come with it (Fama 1970; Fama 1991).

3.2 Investor sentiment theory

In comparison with traditional rational theory that states that the value of a stock is a sum of the present value of the stock's future cash flows, the traditional theory can't explain why assets without known common principal risk are so significantly correlated with each other (Changsheng and Yongfeng 2012). In more recent studies existing irrationality in the markets has been recognized and studied and a few studies about relationship between irrational sentiment and price of risk have been made (Verma and Soydemir 2009: 1130).

Investor sentiment, which also may be called a market sentiment, can be regarded as universal mood of the investors in prevailing market situation, towards expectation about financial assets. Investor sentiment is a mood that reflects investors idea in which direction the markets will be going in the future. When the investors are positive about the future of the economy and markets, it's reflected in asset prices by rising asset prices, markets are then called bullish, the negative mood toward the economy makes the assets prices fall and the market situation is called bearish (Brown and Cliff 2004: 2; Chnagsheng and Yongfeng 2012:166).

Investor sentiment plays a key role in the event study methodology, as it can be seen as a driver in the market adjustments to the event news. Do the investors see the news as negative or positive? Do they consider that the news will bring positive return to the company in the future, or do they view that the choice made by the company is irrational and will decrease its value? Event studies that measure investor sentiment try to find the answer to all of these questions.

In research about the investor sentiment connection to the EMH, researches have divided the investor sentiment to two explanatory parts: rational (arbitrageurs) and irrational, that can also be called *noise-trading* because they are irrational and make their investment decisions based on impulses and *surrounding gossips* rather than on rational Bayesian theorem (De Long at al. 1990). In order for the EMH to be fulfilled, the following pattern between the two types of investors should occur. When the irrational traders are bullish, the rational traders should be bearish and vice versa. This would offset any kind of irrational pricing effect, and the stock would only reflect the present value of the future cash flows (Verma and Soydemir 2009; Changsheng and Yongfeng 2012).

But does it really go that way in real life? De Long, Shleifer, Summers and Waldmann (1990) examine the noise traders in their study and especially focus on whether the noise traders could affect the stock prices despite Fama stating otherwise and also whether the rational arbitrageurs really tend to engage in the offsetting trading. They analyse that for the rational arbitrageurs to start the offsetting trading against the noise traders, they would need to go against their willingness to take risks, as the arbitrageurs wouldn't know for how long the bullish or bearish phase of noise traders would be prevailing. In other words, the deceitful optimism of the noise traders could keep on going for the longer period than arbitrageurs would calculate, leading to great losses for the arbitrageurs. And like De Long et al. point out, this would lead to noise traders getting much higher expected returns than rational arbitrageurs.

Investors can be categorized in other ways than rational and irrational, as it would simplify the complex species that humans are. According to Bethke, Gehde-Trapp and Kempf (2017) there are investors that have sentiment that differs from average, for example investors with normally bad sentiment react more strongly to unfavourable news than investors with usually normal sentiment. To the same conclusion come Affuso and Lahtinen (2018) in their study of Twitter tweets. Their study documents that negative tweets caused more reaction in the stock market than the positive ones and same can be applied the other way around. Bethke et al. studies how investor sentiment affects bond correlation. Their study finds very significant evidence that investor sentiment affects the bond correlation through risk correlation, in bad sentiment scenarios the negative bond correlation is high, especially in case of low rated bonds (2017).

Academic research on investor sentiment has noted that investors tend to overreact or underreact when it comes to events or news that according to Efficient Market Hypothesis require a rational and well-constructed reaction (Barberis, Shleifer and Vishny 1998; Baker, Wurgler and Yuan 2012). In a short period of time (lasting under a year) the investors tend to react to the news slowly, leading to underreaction but if the pattern of the news continues for a longer period of time, investors tend to overreact to the news (Barberis et al. 1998: 307-308). To the same conclusion comes Blau (2017) who showed that investors with high sentiment tend to load on positively skewed stocks in the period of high sentiment and they were overly optimistic about the probabilities of the future returns in these cases, which leads to underperformance in the stocks that are positively skewed.

Barberis, Shleifer and Vishney suggest that investors that are familiar with this behaviour could take advantage of it and aspire for the abnormal returns, against the Efficient Market Hypothesis assumptions, that imply that all the information is reflected in price that are corrected by the investors analysis, in other words investor sentiment.

3.2.1 Capturing the investor sentiment

Good part of the financial theory relies on rationality, factors that can be controlled and measured. The famous Capital Asset Pricing Model doesn't take the sentiment into account, as it shouldn't be accountable according to the EMH. But something is always left unexplained in the models, and that is reflected in the idiosyncratic volatility of the asset pricing models. Aabo, Pantzalis and Park (2017) test if the idiosyncratic volatility in the asset pricing models is indeed the sign of the noise trading in the market and their results suggest, that there is significant sign of noise trading reflected in the idiosyncratic volatilities.

Chan, Jegadeesh and Lakonishok (1996) study momentum investing strategy and how their results could be explained by the investor sentiment. In their study they note that stocks that had high past returns and got a positive return announcement tend to perform better than companies with negative past returns and negative announcements, concluding that investors tend to incorporate new information into the asset prices slowly, which is against the efficient market hypothesis, that relies in its semi-strong form on immediate reaction from investors when the news or announcements reach them. However, in his article Fama (1970) says that overreactions and underreactions should cancel each other out, at least in the long run.

As investor sentiment is seen to be captured in the movements of the financial markets there are numerous ways it has been measured with. The problem is choosing the correct methodology in order to capture only the investor sentiment, as the market movements can contain "non-sentiment-related idiosyncratic variation" (Baker at al. 2012: 273). Options are an efficient tool in measuring investor sentiment, as they are used as tools to hedge the risk of unexpected and unwanted asset price movements of assets like stocks, commodity prices, exchange rates etc. Option prices reflect the information of the investors view of asset price in the future, and therefore are good tools to look at their outlook on the future. The most convenient and easiest way of measuring investor sentiment is by applying the event study methodology and seeing how investors react to the news announcements of different kinds. Abnormal returns are used for this validation,

as they show the difference between what was the reaction to the event (closing price of the event window) compared to the expected return of the asset. It shows how well the investors adapt to the new information and what are their forecasts for the future in light of the new information.

Baker at al. (2012) point out also a few other ways of measuring investor sentiment. Simple way to look at the sentiment is by using the market turnover. They have an overview of a vast amount of literature where the main point is that investors with a high sentiment are inclined to trade more, which drives the volumes up (275). They also examine if the contagion is a key driver in sentiment and their research suggest that both local and international sentiment play a role in predicting the "high sentiment-beta portfolios such as those including high volatility stocks or stocks of small distressed and growth companies" (286).

This thesis focuses on a classic way of measuring investor sentiment, that has been used in many studies focusing on terrorism, i.e. the abnormal returns of the event days.

4. PRIOR EMPIRICAL EVIDENCE

This chapter's focus is on providing a brief overview of significant academic research that has studied the effects on terrorism on financial markets. Some explanatory studies that offer explanation to the investors reaction to terrorism are also reviewed.

The terrorism incident that happened on 9th of September 2001 in New York started the flood of financial research on what effects terrorism has on the financial world. The academic researchers are debating on whether terrorism has an impact on asset markets. The most common conclusion is that there is an impact, but it's short-lived. Eventually news stop, people move on, life goes on and asset markets return to their pre-terrorism attack levels.

4.1 Terrorism effect on financial markets

One of the key studies in terrorism was done by Drakos (2010) in which he focuses on a large number of terrorist attacks instead of just 9/11, in order to measure the comprehensive effect of terrorism on stock markets from 1994 to 2004. The results of his study show a significant suggestion, that terrorism indeed effects the investors' mood by showing up as a negative stock returns on the terror event day. According to Drakos, the higher psychological impact (more fatalities) increases the investor sentiment in a negative way, leading to a significantly lower returns during the event days.

Study by Nikkinen and Vähämaa (2010) focused on examining how terrorism affects stock market sentiment during terrorist attacks. Their study focus solely on the FTSE 100 index and they used option implied probability density functions. They find that after the terrorist event the expected value of the index drops and that markets suffer from uncertainty for some time, although it's not long-lasting. Descriptive statistic in their study of three major terrorism events show increase in kurtosis with every terrorist attack despite 9/11 being the most severe attack of the three. High value of kurtosis, in other words fat tails of implied probability densities after the terrorist attacks explains that investors' expectation of future extreme changes in the index increases, meaning that investors expect more terrorist attacks which will affect the index (268-269). Their study also shows how long it took for markets to rebound after each of the three attacks. Their study showed that despite all of the three being a major terrorism attacks, it took less time

for markets to rebound after July 7, 2005 terrorism attack than after September 11, 2001 and March 11, 2004 terrorist attack.

Study by Nikkinen, Omran, Sahlström and Aijö (2008) focuses only on the attack of September 11, with a one-year examination period. Purpose of the study is to determine terrorist attack's effects on stock returns and volatility. They focus on recording how indices from 53 different countries reacted to the 9/11 attack. The empirical results of the study show that not all regions respond to the attack in the same magnitude and results can be explained by the markets' levels of integration with the international markets. Their study provide support to previous studies by showing that European markets' reactions are much more sensitive to US market fluctuations and some Asian markets also. The study records that these markets exhibit more volatile behaviour, making them more prone to react jointly to unexpected events such as terrorism.

Study by Chesney, Reshetar and Karaman (2011) in which they observe 77 terror attacks from 25 countries over a time period from 1994 to 2005. The purpose of their study is to examine what kind of impact terrorism has on stock markets, but also how it affects bonds and commodities. Their study uses a comparison of different methodologies that try to capture the effects of terrorism on financial markets and their conclusion is that non-parametric methodologies have a best performance out of all. Their study documents that out of 77 terrorist attacks around the world, the Swiss markets were the most vulnerable to experience negative impact and in contrast the U.S. markets were the least affected by the number of terrorist attacks. Also, airline and insurance industries experienced the worst drops, while the banking sector experienced the least downfall in sector comparison. They also document significant results on both bond and commodity markets when testing the effects of terrorism.

Abadie and Gardeazabal (2008) study the effect of terrorism on the world economy as a part of endogenous growth model. The results of their model show that if the investors are free to move their assets and can easily diversify their portfolios and risks, there should be large movements of capital between the countries. Results of their regressions support their model and their estimation is that increase in the standard deviation of intensity of terrorism by one deviation results in a 5% fall in the net FDI position of the country.

In the past two decades terrorist attacks in the developed western countries have changed. In 70's and 80's terrorism was mostly from domestic terrorist groups, like Irish

Republican Army and Basque Homeland and Liberty, claiming to fight for freedom. In past few decades however, terrorism in western countries has become more international, meaning that terrorists are more often than not from other ethnic backgrounds than majority of the people in the attack country. Kumar and Liu (2013) study if a spillover effect could be detected in the stock markets during the terrorism events. Motivation for the study is now not only global but highly interconnected infrastructure between the countries. Through internet news can reach most parts of the world within minutes, meaning that the fear and chaos could spread as fast. Their study focuses on time period from 1990 to 2010 with large coverage of countries. Results of their event study suggest, that there is a significant spillover effect between the financial markets of different countries, but only between countries that have an active trading relationship between each other. Financial markets of countries that don't have prominent trading partnership with country experiencing terror attack are not contaminated with bad investor sentiment.

4.2 Studies with mixed results

Because most of the studies focused on multiple terror events, there are studies that observed contradicting results, as not all events were equally significant. There were numerous explanations to these results.

Arin, Ciferri and Spagnolo (2008) study the effect of terrorism in six different markets: Indonesia, Israel, Spain, Thailand, Turkey and UK from 2002 to 2006. They use a time-series framework and develope a daily terror index that they used in the bivariate VAR-GARCH(1,1) calculations. The results of their study show statistically significant effects in both mean and variance regarding the causality effects. However, their study also noted that investors in the European stock markets don't show as much reactions to the terror actions as do investors in developing countries' markets. This can be a sign of a higher trust in the governments' counteraction strategies. Arif and Suleman (2017) used a normalized cointegration vectors to study terrorist attacks that occurred in Pakistan during the time period of 2002 to 2011. Their study reports significant negative results on overall markets. Their study also focuses on recording how different market sectors react to terrorism: the study shows that oil and gas industries have a negative reaction but financial, consumer, tobacco and healthcare industries exhibit a statistically significant positive relationship. They do not find any explanatory evidence for this behaviour other than a need for insurance grows when the probabilities of terrorism occurrences increase.

One important thing that researches want to capture in the event studies, is the longevity of the effects on the markets, for example how fast markets returned to their pre-terrorism state after the attack. Nikkinen and Vähämää (2010) note that the markets rebound to their normal state very quickly (2010), the longest rebound period was experienced after the attack of 9/11. Goel, Cagle and Shawky (2017) focus in their study on capturing how vulnerable the financial markets are to terrorism, in other words, how fast do they rebound to their normal state. Their time period starts from 1991 and last to 2010 and they focus only on major events in terms of damage. The results of their study are contradicting with the commonly held opinion about the terrorist attacks effect on financial markets. They are not able to find a pattern in abnormal returns, as there are both negative and positive market reactions on the day of the terror events. They argue that when the negative returns occur, the moving power behind them is often something else than terrorism. Exception is the attack of 9/11 which was a case of extremity, as the size and proportion of the attack was never experienced before. Goel et al argue that the fact that investors have grown numb to terrorism explains the lack of significant negative returns.

Kollias, Manou, Papadamou and Stagiannis (2011) want to document if the investors' reaction is significant and what kind of factors are its' major drivers. Their research focuses on London's and Athens' stock markets from year 1990 to 2009. They don't detect patterns in the investors' sentiment reaction to the terrorist attacks and therefore aren't able to report if the markets reactions had changed towards the events. Their study points out that Athens stock markets are much more sensitive to terrorism than London's markets, and they argue this could be due to smaller capitalisation of the Athens markets. By observing attacks individually with the focus on their individual characteristics Kollias et al. suggest that factors that could affect the proportions of the investors reaction to the attacks could be size, maturity and many other individual factors of the attacks, such as type of attack (bombing, plane explosion, truck drive through etc). To the same conclusion come also Estrada, Park, Kim and Khan (2015) who study the effects of terrorism on economy. They suggest that size and intensity of the attack have a high significance to the economic consequences. Based on this evidence there shouldn't be difference whether the attacks of the same magnitude occurred in the late 90's or in 2017.

Kolaric and Schiereck (2016) study the effect of two terror attacks, the attack in Paris on November 13th 2015 and in Brussels on March 22nd 2016. Unlike most studies, they focus only on one industry of stock markets: airlines. Their empirical findings show significant negative market reactions in a one-day event window frame, but an event window up to 5 days doesn't show any significant reaction from the markets. However, their results

show that investors reaction towards the Paris attack is much stronger than towards the Brussels attack that occurred only 4 months after the attack in Paris. Kolaric and Schiereck analyse these results as efficient market reaction and in the case of Brussels they suggested that the prices of airline stocks are adjusted by the investors from the attack in Paris to include the risk of terrorism.

Most of the studies focus on terrorist attacks that occurred in the 21st century, but there were numerous attacks before that and several studies focus on examining some of them. Chen and Siems (2004) focus in their study on 14 terrorist/military attacks starting from the 1915 and the most recent one being attack of 9/11. Results of the study that focuses on U.S. capital markets show that markets have grown flexible to the unexpected negative events as the recovery from the dip to the pre-terrorist attack state happens in much shorter period of time. For example, it took the U.S stock market 795 days to rebound (i.e. to return to the pre-attack state) from the invasion of France on May 12th of 1940, 232 days to rebound from Pearl Harbour attack on December 7th, 1941 and 40 days after 9/11. The abnormal returns of the older events are much more significant than of the more recent events. Chen and Siems explain this by the quick advancement of technology that has led to more efficient data acquirement, as also more flexible and well managed monetary and fiscal policies and antiterrorism countermeasures give the investors higher sense of safety, so they don't act on the negative news as dramatically as before.

Finally, media coverage plays a significant role in investor sentiment. Study by Melnick and Eldor (2010) tries to explain how the terrorism affects economy and what role media plays in it, or how much exactly does the media affect the sentiment of investors. Study brings to light the fact that terrorists use media for their own purpose, to spread fear, panic, trepidation and mistrust in the government and through that mistrust in the safety of infrastructures Their study is in contradiction with study by Estrada et al. (2015) who suggest that the magnitude and severity of the attack affects the investor sentiment. Melnick and Eldor's study suggests that in fact the amount and way how media covers the attack affects the investor sentiment and through that the stock market. It's not about what you say, but how you say it. Publishing gruesome pictures on the front page of a daily newspaper will most likely affect the mind of people more, than short article comprising of facts and numbers, no matter how shocking they might be.

Despite some studies not getting as significant results as others, it is an undeniable fact that terrorism affects the investor sentiment. The question is how much and has the effect deflated over time.

5. DATA AND METHODOLOGY

This chapter focuses on presenting the hypothesis and methodology of the empirical study and explains how it was performed in detail. The chapter is divided as following: first subchapter presents the hypothesis that is tested in this thesis, second chapter focuses on describing the data indices and event dates used in the study, data sources from which they were acquired, and the filtering principles of the events selected for the study. Descriptive statistics are presented in this part in order to understand the data in a statistical way. Third part of this chapter focuses on presenting in detail the event study methodologies that were performed in the empirical part of the study.

5.1 Research hypothesis

This thesis aims to study whether investors have grown numb to terrorist attacks over the time frame of two decades. The idea is to take a look at several terror attacks in the western developed countries, in order to distinguish whether the investors have been rational in their pricing of the stocks.

H_1: *Investor sentiments towards the terrorist attacks has decreased, which in turn has led to a milder reaction in stock prices during the terrorist attacks.* H_1: *= 0*

H_0: *Investor sentiment hasn't been affected, and their negative reaction to terrorism acts persists and is reflected in the stock prices.*

5.2 Data description

Terrorism incident data was retrieved from the Global Terrorism Database (GTD), which is moderated by the National Consortium for the Study of Terrorism and Responses to Terrorism (START); a Department of Homeland Security Centre of Excellence led by the University of Maryland. At the moment the GTD dataset is the most extensive, including many types of terrorist events from all over the world. GTI index is composed of over 180 000 terrorist events, which were filtered to fit this thesis according to several principles. GTI index had events starting from the 1970's, but 1970's and 1980's events were filtered out from this study, because the stock markets were extremely volatile in the years before 1990's, which can bias the results of event study. Second filtration

principle was that, only terrorist attacks that occurred in the United States of America, Western and Eastern Europe were taken into account (excluding Turkey and Israel). Third filtration principle was that terrorist attacks in which military was a targeted group were not included, as they are less covered in media and therefore aren't available for investors analysis at the time of the attack. Military bases are usually also placed outside the civil population, which in turn doesn't affect the economy in a same way that the attacks towards the populated infrastructures do and therefore don't cause the expected market fluctuations. Fourth filtration principle was that only the events that are know for certain to be terrorist attacks are taken into examination. Taken these principles into account, the total amount of terrorist events, that was analysed in this study, is 40. See the appendix 1 for the detailed description of the terrorist events.

For the measurement of the effect of the attacks, several indices were used. For the events that occurred in Europe or Russia, European market indices such as FTSE 100, Euro Stoxx 50 and MSCI World were used. Events that occurred in the U.S. were studied using the S&P 500 index. Index S&P 500 represents the most used index from the United States as it gives good representation of 500 most valuable companies measured by market capitalization, and the companies represented in the index make up a total of 80% of the all US market capitalization. Euro Stoxx 50 consists of fifty blue chip companies from eleven Eurozone countries, making it a good representative of very liquid European stocks and this is a must-have criterion in capturing investor sentiment. MSCI Europe represents 400 large and mid-cap companies from fifteen developed European markets and is a bit larger representative of the European markets. IT was chosen based on the fact that some terror events occurred in countries that other European indices do not cover. Also, the MSCI World index was used to test the abnormal returns of all terrorist events. The MSCI World index consists of 1634 large and mid-cap companies from 23 developed markets. It comprises of stocks from eleven industries and the companies that are chosen from each country should make for about 85% of the free float-adjusted market capitalization in each country. Therefore, using the MSCI World index for observing the investors reaction to terror events is also justified, especially for the terrorist event of September 11, as S&P 500 was closed for a week after the event day.

The time period of the data is from December 1994 to January 2018 and consists of daily returns. All terror events were matched with the corresponding indices that reflect their markets in some way, Russia being the only exception. In order to measure the abnormal returns produced by the terrorist attacks in Russia, MSCI Europe index was used. Leaning on the study of Kumar and Liu (2013) it is presumed that a spillover effect could occur

between the countries, therefore European investors might also be eager to invest in neighbouring countries' stock markets, thus several European indices are used for measuring the effect of European terrorist attacks. Index S&P 500 was used in capturing abnormal returns of terrorist events that occurred in United States.

If the terrorist event occurred on the trading day, that trading day's closing price was used. However, if the event occurred during the weekend or bank holiday, when stock markets were closed, the next available closing price was used (for example Monday closing price). In the case of the 9/11 attack, the New York Stock Exchange (NYSE) and Nasdaq (both trade stocks included on the S&P 500 index) were closed for almost a week and reopened on 17th of September. Therefore, the closing price of 17th of September was used in the event study of the 9/11 attack when calculating the abnormal returns of S&P 500, but with MSCI World the original attack day (9th of September) was used. In total five event dates were moved forward, and the dates of these events can be seen from table 1.

Table 1 Shifts of terror event dates in the stock data. The terror attack of September 11th 2001 shut down the S&P 500 and the stock markets opened in New York only on 17th of September. All other events occurred during the weekends, when the market was closed.

Day of the attack	Event study date
15.8.1998	17.08.1998
11.9.2001	17.09.2001
5.9.2006	06.09.2004
3.6.2017	05.06.2017
1.10.2017	02.10.2017

The daily prices of the Euro Stoxx 50, FTSE 100, MSCI Europe, MSCI World and S&P 500 were obtained from the Datastream database. Data was edited using MS Office Excel and STATA-software was used to perform the event study and statistical regressions.

5.2.1 Descriptive statistics

The two tables below describe the normal log transformed data that is used to perform the econometric study in this thesis. Table 2 shows the descriptive statistics of S&P 500, FTSE 100, EuroStoxx50, MSCI Europe and MSCI World indices for the entire time

period from the beginning of the 1995 until the end of the 2017. The mean daily returns are positive for all indices with modest returns of 0.02% for four indices out of five. Highest return was observed in the S&P 500 index and all other indices also got impressive daily returns at some point. MSCI Europe experienced lowest returns of -10.18%.

Table 2 Descriptive statistics for the whole data sample of returns ranging from 1995 to 2017

LN - returns	Index				
	S&P 500	**Euro Stoxx 50**	**FTSE 100**	**MSCI Europe**	**MSCI World**
Mean	0.03%	0.02%	0.02%	0.02%	0.02%
Median	0.03%	0.03%	0.01%	0.06%	0.06%
Min	-9.47%	-9.01%	-9.27%	-10.18%	-7.33%
Max	10.96%	10.44%	9.38%	10.70%	9.10%
Std.Dev	0.01151	0.01403	0.01130	0.01266	0.00950
Skewness	-0.26	-0.10	-0.16	-0.20	-0.40
Kurtosis	11.93	7.87	9.27	10.65	11.24
Observations	6000	6000	6000	6000	6000

Table 3 shows the descriptive statistics of every terrorist event that is studied in this thesis from MSCI World index's natural log transformed returns. Days that were used to get descriptive statistics are the days of estimation window and event window jointly, resulting in the 122 daily observations. The MSCI World index is chosen for this observation, because it's the only index that examines every terrorist event chosen for this study, as other indices are used only in connection with the origin of the terrorist event. The normal log transformed returns during the whole event window can give a hint of the prevailing situation of the market around the events. For example, the descriptive statistics around the terror attack of September 11th, 2001 tell that the market was sloping down, as the mean return was -0.09% and median return -0.11% and the smallest return was -2.5%. When compared with the return, -1.5% on the attack day ($t = 0$) and -0.46% on the next day ($t = 1$), it's clear that the market was rather negative before the event, which can affect the significance of the abnormal returns. While the skewness and kurtosis of the events timeframe observation are not zero, the figures are not extreme. While skewness is for the most part close to 0, indicating that the tails of the distribution are close to normal distribution and the kurtosis indicates that the centrum of the normal

distribution is steeper than in the ideal situation. During the 122 trading days the mean has remained low, for the most part with positive daily returns around 0.10%.

When comparing the overall time frame observations of the indices to event specific observations, we can ultimately say that even if there were negative or positive reactions from investors during the terrorist events, they weren't the most dramatic reactions that indices have experienced in the one day.

Table 3 Descriptive statistics for individual terror attacks using MSCI World index.

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EVENTDATE	MEAN	MEDIAN	STD.DEV	MIN	MAX	SKEWNESS	KURTOSIS	OBS
19 April 1995	0.08%	0.07%	0.0055	-1.94%	1.28%	-0.4530	4.5219	122
14 June 1995	0.06%	0.07%	0.0056	-1.94%	1.28%	-0.4143	3.9067	122
15 August 1998	0.01%	0.09%	0.0084	-2.27%	2.26%	-0.3696	3.3484	122
19 March 1999	0.21%	0.18%	0.0095	-1.96%	2.79%	0.1380	2.9960	122
20 April 1999	0.12%	0.07%	0.0088	-2.06%	2.47%	-0.0400	2.9329	122
09 September 1999	0.07%	0.04%	0.0072	-1.70%	1.80%	0.0613	2.4759	122
13 September 1999	0.05%	0.03%	0.0070	-1.70%	1.80%	0.0616	2.5313	122
08 August 2000	0.02%	0.01%	0.0097	-3.99%	3.22%	-0.2280	5.3413	122
11 September 2001	-0.09%	-0.11%	0.0095	-2.50%	2.98%	0.3967	3.7607	122
27 September 2001	-0.12%	-0.18%	0.0102	-3.15%	3.68%	0.2543	4.7189	122
23 October 2002	-0.16%	-0.35%	0.0159	-3.69%	4.60%	0.4306	3.4386	122
06 February 2004	0.13%	0.16%	0.0057	-1.26%	2.04%	0.0458	3.5671	122
11 March 2004	0.10%	0.12%	0.0059	-1.72%	2.04%	-0.0941	4.0070	122
24 August 2004	-0.04%	0.02%	0.0069	-2.32%	1.73%	-0.4289	3.4480	122
01 September 2004	0.00%	0.07%	0.0065	-2.32%	1.73%	-0.4286	3.7571	122
05 September 2004	0.00%	0.07%	0.0064	-2.32%	1.73%	-0.4513	3.8218	122
07 July 2005	0.01%	-0.01%	0.0050	-1.20%	1.15%	0.1900	2.6677	122
21 August 2006	0.03%	0.08%	0.0076	-2.04%	2.07%	-0.0738	3.3396	122
27 November 2009	0.12%	0.20%	0.0109	-2.83%	2.77%	-0.4083	3.1419	122
29 March 2010	0.04%	0.12%	0.0089	-2.90%	2.23%	-0.2743	3.4974	122
24 January 2011	0.11%	0.09%	0.0083	-2.88%	2.81%	0.0511	4.7860	122
11 April 2011	0.07%	0.10%	0.0077	-2.29%	2.36%	-0.1528	4.1732	122
22 July 2011	0.01%	0.11%	0.0085	-2.29%	1.93%	-0.2997	2.9271	122
17 April 2013	0.07%	0.06%	0.0062	-1.76%	2.17%	0.0757	4.6863	122
07 January 2015	-0.03%	0.05%	0.0065	-1.98%	2.00%	-0.0588	4.2366	122
17 June 2015	0.03%	0.07%	0.0065	-1.98%	1.90%	-0.0848	3.5551	122
01 October 2015	-0.09%	-0.06%	0.0093	-3.79%	2.08%	-0.7203	5.3602	122
13 November 2015	-0.06%	-0.07%	0.0096	-3.79%	2.08%	-0.6233	4.9666	122
02 December 2015	-0.04%	-0.07%	0.0095	-3.79%	2.08%	-0.6945	5.0442	122
22 March 2016	0.00%	-0.03%	0.0089	-2.12%	2.57%	0.0055	3.0030	122
19 May 2016	-0.03%	-0.02%	0.0090	-2.12%	2.57%	0.0621	2.9956	122
13 June 2016	-0.02%	0.00%	0.0087	-2.12%	2.57%	0.0330	3.2232	122
14 July 2016	0.09%	0.08%	0.0095	-5.03%	2.18%	-1.2208	8.8045	122
22 July 2016	0.08%	0.05%	0.0092	-5.03%	2.18%	-1.3106	9.6551	122
19 December 2016	0.05%	0.03%	0.0051	-2.11%	1.52%	-0.3573	5.2879	122
03 April 2017	0.07%	0.02%	0.0040	-0.76%	1.52%	0.6601	3.8799	122
22 May 2017	0.09%	0.04%	0.0040	-1.25%	1.59%	0.4093	4.7129	122
03 June 2017	0.08%	0.04%	0.0038	-1.25%	1.59%	0.3976	5.1753	122
17 August 2017	0.03%	0.03%	0.0041	-1.25%	1.59%	0.1451	4.7272	122
01 October 2017	0.08%	0.08%	0.0040	-1.25%	1.59%	-0.0181	4.9602	122

MSCI World's most negative one day return over the time frame of 1995 to 2017 was -7.33% and the most negative return in the time frame of the events was -5.03% for 14th and 22nd of July 2016 terror attacks, and these negative returns didn't occur on the terror event days.

5.3 Event study methodology

Event studies focus on events that are specifically chosen for research purposes in order to identify if those events have affected for example financial markets. The events could either have positive or negative effects, as the information of the event should be reflected in the markets and the main requirement of the event studies is that the markets are efficient, otherwise the effect of the event would be biased. In this study the methodology of abnormal returns is used to test the effect of terrorist events on investor sensitivity. Negative abnormal returns appear as a result of an unwanted event with negative consequences, such as terrorist attack. Positive abnormal returns are a sign of positive news and positive development, such as an announcement of huge order for manufacturing company or other news that could affect companies' results in positive ways possibly for several years.

Abnormal return is usually measured for individual stocks or portfolios, but when used with indices it tells the picture of a whole market reaction to the event, as usually terrorism (except environmental terrorism, that takes an individual target) doesn't target one specific company, but rather the goal is to cause as much distress and destruction as possible, so the normal operations of the country would be hindered.

The methodology used in this study is the same that was used by many researches, but from the articles that were mentioned in the literature review the research of Chen and Siems (2004) is the closest one. They based their empirical study on classical methodology paper by Brown and Warner (1985). The idea of abnormal return testing is finding statistically significant deviation from the expected returns or past averages in this case. The results of abnormal returns during the event must be significant in order to be classified as affecting investor sentiment, otherwise they can be interpreted as insignificant from the investor point of view.

Abnormal return of the event is calculated from the event days. Some events, like terrorism, are unexpected and therefore there is usually no need to time the event window beforehand, but for example earning announcements are usually expected events and possible news leakages should be accounted for, therefore event windows are extended few days before the event day itself, to account for possible early investor sentiment. Event day returns are compared to the market's expected returns, that can be calculated using average returns of the event's estimation window. There is not any universal length for the estimation window, which can be a reason why different event studies that rely on the abnormal return methodology get different abnormal returns for the same events. Abnormal returns can be either positive or negative, but terrorist events carry always a negative information and that should show up as a decrease in market prices around the event.

For the calculation of the abnormal returns the date of the event is $t = 0$ and the estimation period ranging between $t = -120$ and $t = -10$ is used in determining the normal behaviour, or in other words the expected return of the financial market for the period. As the terrorist events are unexpected the event window is $t = 0$ and $t = +1$. In case the event occurred after the markets were already closed for the day, the effect of the trading would only be visible in the markets on the next day of the terrorist event. The longer event window of $t = 0$ to $t = +5$ is also tested, to see if the market reaction got stronger.

Abnormal returns are calculated using the equation 1,

(1)
$$AR_{it} = R_i - \bar{R}_{it}$$

where:

     R_i = return of the index on the day in the event window
     $\bar{R}_{it}$ = simple average returns of the same index as in the estimation window,
     here $t = -10$ to -120, as in equation 3.

Daily return R_i is defined as in equation 2

(2)
$$R_i = \ln\left(\frac{SRI_{it}}{SRI_{it-1}}\right)$$

where:

     SRI_{it} = is the stock index i return at time t

(3)

$$\bar{R}_{it} = \frac{1}{111} \sum_{t=-120}^{-10} R_{it}$$

where:

R_{it} = is the one-day return of an index during the estimation period.

In order to test the abnormal returns for the significance, cumulative abnormal returns (CAR) is calculated like is shown in equation 4, this equation is used to test the two-day abnormal returns.

(4)

$$CAR_i = \sum_{t=T_1+1}^{T_2} AR_{i,t}$$

For the significance testing, the t-statistics is performed according to the equation 5

(5) $$ts = \frac{\bar{y} - m_0}{\hat{\sigma}/\sqrt{n}}$$

where:

$\bar{y}$ = either the AR or CAR to be tested for significance
m_0 = the hypothesized value, in this study 0
$\hat{\sigma}$ = the standard deviation of the average abnormal returns
n = is the sample size, in this case the amount of returns in the event window

5.4 Explanatory regression for the Abnormal returns

To understand the results of the event study presented above, explanatory regression of the abnormal returns is applied for testing the explanatory variables.

Because terrorism events do not always occur during the trading hours and in the same time zone, the two-day event window is used to study the difference. The two-day CAR is used as a base in the explanatory regression as the dependent variable. The CAR is calculated as presented in the previous subchapter.

The regression that was applied to study the effects is as presented in the equation 6 and 7.

(6) $$AR_{i,t} = \beta_0 + \beta_1 Country + \beta_2 Killed + \beta_3 Year + \varepsilon$$

(7) $$AR_{i,t} = \beta_0 + \beta_1 Country + \beta_2 Wounded + \beta_3 Year + \varepsilon$$

Where the independent variables are:

> *Country,* variable that tells the country of terrorist event occurrence. The data is acquired from the Global Terrorism Database. The countries of the terrorist attack can be viewed in the terrorist event description in the Appendix 1.
> *Killed,* is a control variable that tells how many people died in the terror attack. Data is acquired from the Global Terrorism Database, the description of the amount of numbers of victims can be viewed from the Appendix 1.
> *Wounded,* is a control variable that tells how many people were wounded in the terror attack. Detailed figures can be viewed from the Appendix1.
> *Year,* variable stands for the year when the terror attack occurred.

Variables *Wounded* and *Killed* are decided to regress separately in their own regressions, as they had extremely high variance inflation factor (VIF) between them, affecting at the same time the other variables of regression.

(8) $$AR_{i,t} = \beta_0 + \beta_1 Country + \beta_2 Killed + \beta_3 EarlyYearsDummy + \varepsilon$$

(9) $$AR_{i,t} = \beta_0 + \beta_1 Country + \beta_2 Wounded + \beta_3 EarlyYearsDummy + \varepsilon$$

The equations 8 and 9 differs from the equations 6 and 7 only in how the independent variable *Year* is treated. The purpose of the equations 8 and 9 is to perform additional regressions with the control for the year effect in order to capture if the numbing effect of terrorism could be captured through years.

In addition to the additional testing of equations 8 and 9, the effects of individual countries are tested by appointing to each country own dummy variable. In the regression models 10 and 11 the same principles apply as in models 6,7,8 and 9. Variables *Killed* and *Wounded* are regressed separately as is the dummy variable for the early years in the period.

(10) $AR_{i,t} = \beta_0 + \beta_1 Killed \, / \, Wounded + \beta_2 Year + \beta_3 Country1 + \beta_4 Country2 + \beta_5 Country3 \ldots + \cdots + \varepsilon$

(11) $AR_{i,t} = \beta_0 + \beta_1 Killed \, / \, Wounded + \beta_2 EarlyYearsDummy + \beta_3 Country1 + \beta_4 Country2 + \beta_5 Country3 \ldots + \cdots + \varepsilon$

After applying the additional regressions presented above, additional explanatory variables are tested like presented in equations 12 and 13 in order to test if the possible explanatory factors presented by Estrada, Park, Kim and Khan (2015) and Kollias et al (2011). Additional explanatory independent variables are

(12) $AR_{i,t} = \beta_0 + \beta_1 Killed \, / \, Wounded + \beta_2 Year/EarlyYearsDummy + \beta_3 Target + \beta_4 Type + \beta_5 Attacker + \varepsilon$

(13) $AR_{i,t} = \beta_0 + \beta_1 Killed/Wounded + \beta_2 Year/ \, EarlyYearsDummy + \beta_3 Target + \beta_4 Type + \beta_5 ChechenRebels + \beta_6 MuslimExtremists + \beta_7 WhiteExtremists + \beta_8 RIRA + \varepsilon$

> *Target* = target of the terrorist attack. Data retrieved from the Global Terrorism Database and is included in Appendix 1.
> *Type* = type of the terror attack, most of the attacks were bombings or explosions.
> *Attacker* = Attackers were separated in their own group.
> *Attacker Dummies* = Attackers were studied more closely by attacker dummies, where each type of the attacker got a value of 1 when the attack was done by the group in question and 0 otherwise.

6. EMPIRICAL RESULTS

This chapter presents the empirical results and findings that were obtained with the statistical methodologies presented in the previous chapter. Firstly, abnormal return results of the event study will be presented of each terrorist event. After that, abnormal returns are regressed with multiple explanatory and control variables in order to capture if these variables could have acted as explanatory drivers in investor sentiment.

6.1 Cumulative abnormal returns

The results of the event study are presented in tables 4 and 5, by showing the cumulative abnormal returns (CARs) of the two-day event window, $t = 0$ and $t = 1$. In the tables the two-day CAR returns are presented alongside the t-statistics of returns. The statistically significant events are bolded, and the significance stars are positioned next to values of the t-statistics. Seventeen events with negative returns were statistically significant from the forty events, and five of these were extremely significant. In addition to this, some events experienced positive returns that were statistically significant. This is a suggestion that investor sentiment is easily affected by terrorist events, but unlike it was believed, effect is not always negative. The positive reactions can also suggest that not all terrorist acts affect the sentiment as much as some.

6.1.1 Early years results

The first twenty terrorist attack events from the event selection that this study observes are presented in table 4. Events in table 4 start from 1995 and span to 2010. During this time period eight events with negative CARs were significant, two were at 1% significance level and six at a 5% level. The two attacks that were significant at the 1% level occurred on 13th of September 1999 in Russia where Chechen rebels bombed an apartment building causing the death of 118 civilians and the other one occurred on 21st of August 2006 in Moscow Russia, where a bomb was detonated on a public market place resulting in a death of 10 people. While it's believed that the attack was motivated by race and was performed by Muslim extremists, no terrorist groups admitted the responsibility for the attack.

The attack of 11th of September 2001 was significant at 5% level in both S&P 500 and MSCI World indices. It's important to note, that the CAR return for the event 9/11 in S&P 500 was calculated from 17th and 18th of September, as the stock markets were closed in New York for a week after the attack. This is a significant factor, as no other attacks caused a market shutdown and after seven days of the attacks all markets had recovered from the attacks, only the 9/11 was an exception to this as the effects lasted up to 40 days (Nikkinen and Vähämaa 2010). These results are in line with the wide documentation in other studies.

From twenty events, eight had significantly positive returns. Some of the events resulted in large fatal losses of human lives, like for example the 1st of September 2004 in Beslan, Russia when Chechen terrorist attacked a school resulting in death of 344 people many of whom were children. These results suggest an inconsistent and irrational reaction from the investors. The question of the origin of the attack arises, does the origin of the attack matters? The two most significant events in the first-time period occurred in Russia, therefore the origin of Beslan attack can't be regarded as explanatory factor for the positive returns. However, many factors affect the daily mood of investors in the case of positive returns on the days of terrorist attack, there are countless possibilities of what could have affected the minds of investors. Some documented examples could be for example the January effect, that could drive the greed for higher returns more than fear for the future.

6.2 Results from 2011-2017

Returns and t-statistics for the terror events that occurred from 2011 up until the end of 2017 are presented in table 5. From twenty terrorist attack events presented here, nine are statistically significant, meaning that investors reacted more negatively than before in more current time period. Especially the significance of the events was higher, six events were significant at the 1% level compared to two in the period of 1995 to 2010. The significance of the negative cumulative abnormal returns increases notably towards the more recent attacks and the reaction of the markets to the terrorist attacks is more coherent than in the first-time period. As can be seen from the table 5, if there is a significant reaction it usually showed up in all indices that were chosen for the examination of the terrorist events.

The most significant events were the most recent ones that occurred on 3rd of June 2017 in United Kingdom and 17th of August 2017 in Spain. Both attacks were performed in the same way, the terrorists driving a van into crowds. The number of fatalities remained under twenty, this result seemingly contradicts with studies of Estrada et al. (2015) and Kollias et al. (2011), that suggested that the size of the attack could be connected with the severity of the bad investor sentiment. At the same time the attack in Paris on November 13th, 2015 was the most fatal one in the time period of 2011 to 2017, but while the reaction was significant at the 10% level it didn't show up across the indices. To test for the role that the number of fatalities plays in the return during the terror events, the explanatory regressions are discussed later in the chapter.

In the study by Kolaric and Schiereck (2016) two significant terror events are observed, the attack in Paris on November 13th, 2015 and the one in Brussels on March 22nd 2016. Both events appear significant also in this thesis's study, but the attack in Brussels appeared more significant than the attack in Paris. The reason for difference could be that the airline industry, on which Kolaric and Schiereck focus in their study, had a different reaction than the market as a whole, which this study focused on by studying the effects of investor sentiment in indices.

Like Kollias et al. suggest in their study, attacks that occurred closely to each other could affect the investor sentiment in such way that the subsequent attacks do not experience as significant reaction as the earlier attacks. Reactions of investors were incoherent in 2001, when the attack of 9/11 caused extreme market reaction with almost -6% downfall in the market for two days, and then the attack of 27th of September in Switzerland caused a positive significant reaction across the European markets. Same type of reaction could be observed in 2017, when concert shooting in Las Vegas resulted in significant positive returns on the market shortly after the two van attacks had caused significant negative returns in Spain and London. Cases are somewhat similar as the earlier attacks were caused by Muslim extremists and the later ones by white extremists. The case could indeed be, that when the investors adjust their views about the future from earlier terrorist attacks by pricing the risk of terrorism in the assets, the attacks several months apart do not result in significant shifts on the market and other factors drive the prices in those cases.

When looking at the events together in table 4 and 5 there are no signs of the investor sentiment numbing to terrorist attacks.

Table 4 Event Study: two-day CAR returns and t-statistics in parentheses for individual terror attacks. Negative returns statistically significant at the 10% (*), 5% (**) and 1% (***) level are shown next to t-statistics. Positive returns statistically significant at the 10%('), 5%(") and 1%("') level.

Event date	Stock index			MSCI Europe	MSCI World
	S&P 500	FTSE 100	EuroStoxx50		
19.4.1995	-0,3%				-0,2%
	(-3.703)**				(-0.788)
14.6.1995				-0,1%	0,2%
				(-0.314)	(2.644)"
15.8.1998		3,5%	2,8%	2,4%	2,7%
		(2.208)'	(1.562)'	(1.780)'	(4.892)"
19.3.1999				-0,4%	-0,8%
				(-0.593)	(-4.523)**
20.4.1999	3,2%				0,7%
	(6.603)"'				(1.266)
9.9.1999				-0,3%	0,6%
				(-0.515)	(1.453)
13.9.1999				-1,9%	-0,85 %
				(-3.850)**	(-25.110)***
8.8.2000				-0,1%	-0,12 %
				(-0.080)	(-3.571)**
11.9.2001	-5,6%				-1,96 %
	(-2.503)**				(-3.709)**
27.9.2001			4,9%	3,6%	3,23 %
			(5.895)"'	(8.497)"'	(5.169)"
23.10.2002				-0,2%	-0,15 %
				(-0.077)	(-4.074)**
6.2.2004				2,0%	1,07 %
				(9.127)"'	(2.051)'
11.3.2004		-1,8%	-3,3%	-3,1%	-1,51 %
		(-1.354)	(-2.174)*	(-2.688)**	(-1.382)
24.8.2004				-0,6%	0,47 %
				(-1.207)	(1.277)
1.9.2004				1,1 %	1,20 %
				(3,914)"	(10.327)"'
5.9.2004				0,5%	0,89 %
				(1.797)'	(14.124)"'
7.7.2005		-0,1%	-0,1%	-0,5%	0,54 %
		(-0.039)	(-0.069)	(-0.317)	(0.766)
21.8.2006				0,1%	-0,09 %
				(0.097)	(-6.108)***
27.11.2009				-0,5%	-0,77 %
				(-0.405)	(-1.207)
29.3.2010				0,3%	0,57 %
				(0.596)	(2.021)'

Table 5 Event Study: two-day CAR returns and t-statistics in parentheses for individual terror attacks. Negative returns statistically significant at the 10% (*), 5% (**) and 1% (***) level are shown next to t-statistics. Positive returns statistically significant at the 10%('), 5%(") and 1%("') level.

| Event date | Stock index | | | | |
	S&P 500	FTSE 100	EuroStoxx50	MSCI Europe	MSCI World
24.1.2011				0,1%	0,45 %
				(0.172)	(1.077)
11.4.2011			-1,8%	-1,7%	-1,46 %
			(-3.281)**	(-2.469)**	(-3.247)**
22.7.2011			-0,7%	0,0%	-0,24 %
			(-0.924)	(-0.041)	(-0.502)
17.4.2013	-2,3%				-1,94 %
	(-5.991)***				(-5.004)**
7.1.2015		3,2%	4,1%	2,4%	2,40 %
		(4.330)"	(2.865)"	(1.496)'	(3.362)"
17.6.2015	1,2%				0,89 %
	(2.940)"				(1.573)'
1.10.2015	1,7%				1,72 %
	(2.805)"				(4.211)"
13.11.2015		-0,3%	-0,6%	-0,8%	-0,15 %
		(-0.485)	(-1.490)*	(-1.266)	(-0.169)
2.12.2015	-2,5%				-1,79 %
	(-14.692)***				(-14.272)***
22.3.2016			-0,1%	-0,9%	-0,72 %
			(-0.592)	(-20.561)***	(-1.942)*
19.5.2016			0,5%	-0,4%	-0,02 %
			(0.363)	(-0.274)	(-0.028)
13.6.2016	-1,0%				-2,11 %
	(-3.239)**				(-16.542)***
14.7.2016		-0,1%	1,2%	0,4%	0,25 %
		(-0.548)	(1.761)'	(0.568)	(0.728)
22.7.2016			0,2%	-0,1%	-0,19 %
			(5.192)´	(-0.734)	(-1.445)
19.12.2016			0,5%	0,1%	0,33 %
			(1.526)	(1.017)'	(7.840)"'
3.4.2017				-0,7%	-0,37 %
				(-1.241)	(-2.383)**
22.5.2017		0,0%	-0,1%	0,1%	0,44 %
		(0.196)	(-0.318)	(0.621)	(1.986)'
3.6.2017		-0,4%	-1,2%	-1,1%	-0,61 %
		(-2.979)**	(-6.651)***	(-9.600)***	(-10.770)***
17.8.2017		-1,5%	-1,1%	-1,1%	-1,33 %
		(-11.460)***	(-12.125)***	(-5.911)***	(-4.379)**
1.10.2017	0,5%				0,30 %
	(5.535)"'				(14.786)"'

It looks like results, documented in studies, that show that the negative reaction caused by terrorism event do not last, are not on the minds of the investors when the terror attack occurs, and results suggest that fear creeps into the minds of investors, which results in temporary loss of confidence in the future (Nikkinen and Vähämaa 2010). Investor confidence however returns quickly, suggesting that rational investors, who are aware of the fact that drop in the prices from the terrorist attack is not lasting, take the advantage of drops in the asset price which returns to the normal market level very quickly. As the negative reaction not only has remained, but also increased in the significance, its significance in recent years strongly speaks against the hypothesis that the investor sentiment towards the terror attacks had lowered over time.

6.3 Explanatory regressions

The explanatory regressions were made using the two-day Cumulative Abnormal Returns of MSCI World, that were calculated in the first part of the event study. Firstly, presented are the main regressions followed by the more detailed look at the regressions with the country effect and additional attack specific independent variables.

6.3.1 Correlation matrix

In the table 6 is the correlation matrix of all the variables used in the performing the explanatory regressions. This is important for performing the correct regressions, as the significant correlation between the variables can bias the regression. The correlation between two variables means that the movement is to some extent integrated, depending on the correlation factor. In other words, they tend to move in the same direction and therefore explain the dependent variable in regression in the same way. As can be seen from the correlation matrix table, there is a significant correlation at the 5% level between some variables that are marked with the star. Variables *Killed* and *Wounded* have an extremely high correlation of 0.99 between each other. Because the events with less than ten casualties were dropped, all events had people killed, but there are events where no one was wounded. In most cases there are both wounded and killed people, and each variable for casualties increases when other does.

Table 6 Correlation matrix of variables used in the explanatory regressions. Values for Killed, Wounded, Country and Year were obtained from the Global Terrorism Index. The Cumulative Abnormal Returns(CAR) of MSCI World were calculated with the abnormal returns event study methodology, and CAR figure represents the 2-day CAR in order to account for possible events that occurred after the markets were already closed. Correlations that are statistically significant at the 5% level correlations are marked with a star *.

Correlation matrix

	Killed	Wounded	CAR	Year	Early Years Dummy	Belarus	Belgium	France	Germany	Greece	Norway	Russia	Spain	Switzerland	United Kingdom	United States	Country	Attacker	Target	Type	Chechen Rebels	Muslim Extremists	RIRA	Unknown	White Extremists
Killed	1																								
Wounded	0.991*	1																							
CAR	-0.2690	-0.2851	1																						
Year	-0.2182	-0.1837	-0.1922	1																					
Early Years Dummy	0.2106	0.1827	0.2064	-0.904*	1																				
Belarus	-0.0416	-0.0289	-0.1995	0.0548	-0.1601	1																			
Belgium	-0.0350	-0.0174	-0.1019	0.1644	-0.1601	-0.0256	1																		
France	-0.0308	-0.0360	0.1879	0.2664	-0.2847	-0.0456	-0.0456	1																	
Germany	-0.0606	-0.0527	0.0051	0.2356	-0.2294	-0.0367	-0.0367	-0.0653	1																
Greece	-0.0231	-0.0392	-0.0083	0.1644	-0.1601	-0.0256	-0.0256	-0.0456	-0.0367	1															
Norway	-0.0221	-0.0354	-0.0370	0.0548	-0.1601	-0.0256	-0.0256	-0.0456	-0.0367	-0.0256	1														
Russia	-0.1129	-0.1504	0.0238	-0.431*	0.524*	-0.1175	-0.1175	-0.2089	-0.1683	-0.1175	-0.1175	1													
Spain	-0.0145	0.0429	-0.2780	0.0628	0.0000	-0.0367	-0.0367	-0.0653	-0.0526	-0.0367	-0.0367	-0.1683	1												
Switzerland	-0.0412	-0.0381	0.426*	-0.1644	0.1601	-0.0256	-0.0256	-0.0456	-0.0367	-0.0256	-0.0256	-0.1175	-0.0367	1											
United Kingdom	-0.0771	-0.0536	0.2032	0.0342	0.0000	-0.0534	-0.0534	-0.0949	-0.0765	-0.0534	-0.0534	-0.2446	-0.0765	-0.0534	1										
United States	0.2931	0.2870	-0.1723	0.0395	-0.1155	-0.0925	-0.0925	-0.1644	-0.1325	-0.0925	-0.0925	-0.423*	-0.1325	-0.0925	-0.1925	1									
Country	0.2021	0.2042	0.0107	-0.2167	0.2300	-0.374*	-0.317*	-0.463*	-0.2922	-0.1473	-0.0906	-0.1558	-0.1005	0.0793	0.0325	0.2830	1								
Attacker	-0.1082	-0.0805	0.2312	0.1548	-0.2279	0.1544	-0.0702	-0.1248	0.1407	0.1544	0.2666	-0.432*	0.1714	0.2666	-0.0876	0.314*	0.1364	1							
Target	0.0408	0.0735	-0.1395	-0.1242	0.2348	0.1880	-0.2905	0.0506	0.0735	-0.2905	0.0513	0.2797	0.2040	-0.2905	0.0356	-0.2588	-0.1548	-0.1814	1						
Type	0.0637	0.0232	-0.0548	0.0402	-0.0503	-0.0726	-0.0726	0.0621	0.1270	-0.0726	-0.1800	-0.1214	-0.1057	-0.1800	0.0727	0.0872	0.0819	-0.2691	-0.0698	1					
Chechen Rebels	-0.0171	-0.0694	0.0564	0.536*	0.461*	-0.0737	-0.0737	-0.1311	-0.1057	-0.0737	-0.0737	0.490*	-0.1057	-0.0737	-0.0737	-0.1140	-0.0047	-0.525*	0.1755	0.0563	1				
Muslim Extremists	0.1346	0.1594	-0.330*	0.4215*	-0.2503	-0.1683	0.1523	0.2708	-0.0115	-0.1683	-0.1683	-0.0367	0.2182	-0.1683	-0.1683	-0.1445	-0.0992	-0.461*	-0.0053	0.2294	-0.484*	1			
RIRA	-0.0360	-0.0251	0.357*	-0.2302	0.1601	-0.0256	-0.0256	-0.0456	-0.0367	-0.0256	-0.0256	-0.1175	-0.0367	-0.0256	-0.0256	-0.0925	0.1380	0.0421	0.0513	-0.0726	-0.0737	-0.1683	1		
Unknown	-0.0464	-0.0488	-0.1488	0.1570	-0.2294	0.698*	-0.0367	-0.0653	-0.0526	0.698*	-0.0367	-0.1683	-0.0526	-0.0367	-0.0367	-0.1325	-0.373*	0.2212	-0.0735	-0.1039	-0.1057	-0.2412	-0.0367	1	
White Extremists	-0.1078	-0.0926	0.2876	-0.0123	-0.0599	-0.0863	-0.0863	-0.1534	0.1511	-0.0863	0.2972	-0.2699	-0.1236	0.2972	0.2972	0.380*	0.2669	0.897*	-0.1342	-0.2441	-0.2482	-0.567*	-0.0863	-0.1236	1

Table 7 presents the results of the explanatory regressions that were introduced in chapter 5. Table 7 shows the regression results of the two-day cumulative abnormal returns as dependent variable. In the first model, *Country* and *Year* are independent variables and *Killed* is the control variable. The first column shows first the coefficient of the variable and below in the brackets are the t-statistics. In the second column variance inflation factor (VIF) between variables of each regression model is presented separately, as the collinearity between the variables is an issue that can affect the coefficients and their significance in the regression. All of the models have low VIF figures, that tell there is no collinearity issue between the variables.

First model examines how *County, Killed* and *Year* variables explain the figure of the two-day CAR obtained by the Event study. The R-squared, that tells how well the model

Table 7 Explanatory regression of Cumulative Abnormal Returns. Where the dependent variable is the two-day CARs calculated with the Event Study Abnormal Return technique. Variables Country and Year are independent and obtained from the Global Terrorism Index. Early Years Dummy is constructed to test for the effect of the years on the CAR variable, it takes the value of 1 during the years 1995-2010 when the first twenty events this study focus on happened. The years from 2011 to 2017 take the value of zero. Variables Killed and Wounded are the control variables that were acquired from the Global Terrorism Index. Numbers in parentheses show the t-statistics of the coefficients that are shown above them. Statistically significant coefficients at the 10% (*), 5% (**) and 1% (***) are shown.

	2-day Cumulative Abnormal Returns							
	(1)		**(2)**		**(3)**		**(4)**	
Variables	Coefficients	Collinearity	Coefficients	Collinearity	Coefficients	Collinearity	Coefficients	Collinearity
	(t-stat)	VIF	(t-stat)	VIF	(t-stat)	VIF	(t-stat)	VIF
Country	0.000	1.08	0.000	1.08	0.000	1.08	0.000	1.09
	(0.131)		(0.159)		(0.118)		(0.091)	
Killed	-0.000	1.08	-		-0.000	1.07		
	(-2.054)**		-		(-2.061)**			
Wounded	-		-0.000	1.07			-0.000	1.07
	-		(-2.110)**				(-2.127)**	
Year	-0.000	1.09	-0.000	1.07				
	(-1.611)		(-1.556)					
Early Years	-		-		0.007	1.09	0.006	1.08
Dummy	-		-		(1.694)*		(1.653)	
Observations	40		40		40		40	
R-squared	0.139		0.144		0.145		0.151	

explains the returns, is low at 0.139 which is not surprising as with three variables the explanation of returns of 40 separate events is impossible, as so many factors affect the returns and investor sentiment. As can be seen from the first model the variable for *Killed* is negatively significant at the 10% level, which means that for the whole event period the increase in the amount of fatalities during the terror attack affects the abnormal returns negatively. This suggest that investors bad sentiment increases the more attack causes fatalities, despite the fact that statistically significant events in the event study didn't have the largest amount of fatalities. The variable *Country* is positive and not significant, because interpretation of the variable is not straightforward from this regression, the additional regression is performed for proper understanding if the investors react to the terror events of different countries differently. *Years* is an important variable from the hypothesis point of view, because it can tell how the progress of time has affected CARs and therefore the investor sentiment. When interpreting the hypothesis from the time point of view, it's expected that the variable *Years* would be positive, as this would signal that when the abnormal returns increase, so would the years also. But instead, the variable *Years* is negative, signalling that to the contrary to the hypothesis, reaction to the terrorism has increased over the years and in the earlier time period of 1995 to 2010 the reaction of markets was less negative and resulted in higher returns.

6.3.2 Explanatory regressions with focus on countries

Additional explanatory regressions are presented in table 8, with the examination if the origin of the attack could have an effect on the cumulative abnormal returns. The dummies for all the countries of the attack occurrence were formed so that country in which attack occurred got a value of 1 and all other countries dummies got in that event a value of zero, in total there are eleven country-dummies for every country that experienced an attack during the forty chosen attacks for this study.

In table 8 are five different models, with variation in the control variables, independent year variable and country dummies because of the significant collinearity issues between them. Introducing the country dummies increased the explanatory factor of the regressions, the R-squared, to almost 0.5, this is an expected R-squared figure for the model with few variables that account only for the terror attack, as rather many factors affect the stock markets. When taking look at the distribution of negative to positive CAR's in the tables (event study tables) then it's evident that there were many explanatory factors, that are not accounted for in these models, that for example explain why there were positive market reaction during the terror attacks. The control variables killed and

wounded remained negatively significant. Variables *Year* or *Early Years Dummy* didn't play the significant role in these models.

Table 8 Additional explanatory regression of MSCI World index two-day Cumulative Abnormal Returns during the terrorist attacks. CAR figures were calculated according to the Event Study Abnormal Returns –methodology. Variables Country and Year are independent. Variable Early Years Dummy was constructed that the years of the first twenty events ranging from 1995 to 2010 got the value of 1, and the years of the latest 20 events ranging from 2011 to 2017 got the value of zero. Dummies for countries were constructed that each time the terror attack occurred in country in question the value for that country was 1 and for other countries it was 0. Numbers in parentheses show the t-statistics of the coefficients that are shown above them. Statistically significant coefficients at the 10% (*), 5% (**) and 1% (***) are shown next to t-statistics.

| VARIABLES | 2-Day Cumulative Abnormal Returns | | | | |
	(1)	(2)	(3)	(4)	(5)
Killed	**-0.000**			**-0.000**	**-0.000**
	(-1.808)*			**(-1.876)***	**(-1.876)***
Year	-0.000	-0.000			
	(-1.355)	(-1.319)			
Belarus Dummy	-0.014	-0.013	-0.010	-0.011	-0.010
	(-1.271)	(-1.228)	(-0.888)	(-0.931)	(-0.909)
Belgium Dummy	-0.004	-0.004	-0.003	-0.003	-0.003
	(-0.396)	(-0.353)	(-0.233)	(-0.283)	(-0.237)
France Dummy	0.011	0.011	0.013	0.013	**0.013**
	(1.525)	(1.527)	(1.634)	(1.625)	**(1.872)***
Germany Dummy	0.003	0.004	0.005	0.005	0.005
	(0.386)	(0.411)	(0.540)	(0.509)	(0.617)
Greece Dummy	0.003	0.003	0.004	0.004	0.005
	(0.248)	(0.229)	(0.335)	(0.349)	(0.420)
Norway Dummy	-0.001	-0.001	0.002	0.002	0.003
	(-0.120)	(-0.128)	(0.155)	(0.164)	(0.227)
Russia Dummy					0.001
					(0.116)
Spain Dummy	-0.013	-0.012	-0.012	-0.013	-0.012
	(-1.620)	(-1.485)	(-1.472)	(-1.623)	(-1.500)
Switzerland Dummy	**0.029**	**0.029**	**0.03**	**0.029**	**0.03**
	(2.689)**	**(2.716)****	**(2.758)****	**(2.730)****	**(2.576)****
United Kingdom Dummy	0.008	0.008	0.009	0.008	0.009
	(1.292)	(1.354)	(1.425)	(1.356)	(1.368)
United States Dummy	-0.002	-0.002	-0.000	-0.001	
	(-0.461)	(-0.403)	(-0.057)	(-0.116)	
Wounded		**-0.000**	**-0.000**		
		(-1.764)*	**(-1.847)***		
Early years Dummy			0.007	0.007	0.007
			(1.380)	(1.398)	(1.398)
Observations	40	40	40	40	40
R-squared	0.492	0.490	0.493	0.494	0.494

In the first model, where the dummy for Russia was left out, Switzerland had a significant positive impact on the CAR figure. From the forty events, only one occurred in Switzerland and that was the attack on 27th of September 2001. As can be seen from the table (Event study table 1) the market reaction during the event was significantly positive. The reason might be, that the price for terror risk has already been reflected in the prices as the attack of 9/11 was just two weeks before. There is also a possibility that the investors react to the attackers differently. Behind the attack of 9/11 was an organized terrorist group Al Qaida, while in the case of Switzerland it is at least not known if there was any terrorist organization backing the Swiss attacker. Switzerland dummy remained significant at the 5% level in every of the 5 models. The closer inspection if the attackers had an impact on investor sentiment is presented in Table 9 and discussed later.

Interesting observation is that in the fifth model, when the dummy for Russia was introduced and dummy for United States was abandoned, dummy for France became significant at 10% level. From the forty attacks three occurred in France during the years of 2015-2016. First was the attack of Charlie Hebdo that took place on 7th of January 2015, the market didn't show any negative reaction during the attack, instead there was a positive significant reaction, to which one explanation could be the January effect. Second attack occurred during the concert of Eagles of Death Metal, investor sentiment could be seen dropping, but it wasn't anything extreme, that would result in significant results. Attack in 2016 was when a van rammed into the crowd in Nice in July. This attack didn't result in negative reaction, but similar terror attacks in United Kingdom and Spain in 2017 shows significant drop in investor sentiment that resulted in immediate fall of stock prices on the event days.

Table 9 Additional explanatory regressions of two-day Cumulative Abnormal Returns of MSCI World index. Variables Target, Type and Attacker are independent. From the attacker variable, the dummy variables for each type of attacker are formed in a way, that every time the attack was done by certain group it would get a 1 and 0 otherwise. Numbers in parentheses show the t-statistics of the coefficients that are shown above them. Statistically significant coefficients at the 10% (*), 5% (**) and 1% (***) are shown next to t-statistics.

VARIABLES	2-day Cumulative Abnormal Returns				
	(1)	(2)	(3)	(4)	(5)
Country	-0.000	-0.000	-0.001	-0.000	-0.001
	(-0.334)	(-0.557)	(-1.438)	(-0.294)	(-1.405)
Killed	-0.000*	-0.000*	-0.000		
	(-1.856)	(-1.911)	(-1.465)		
Wounded				-0.000*	-0.000
				(-1.905)	(-1.508)
Year	-0.001*			-0.001*	
	(-1.963)			(-1.906)	
Early years Dummy		0.010**	0.006		0.006
		(2.369)	(1.469)		(1.456)
Target	-0.001	-0.001	-0.001	-0.001	-0.001
	(-0.805)	(-1.124)	(-1.441)	(-0.726)	(-1.370)
Type	0.000	0.000	0.001	0.000	0.001
	(0.235)	(0.351)	(0.522)	(0.169)	(0.463)
Attacker	0.002	0.002*		0.002	
	(1.439)	(1.696)		(1.471)	
ChechenRebels			0.009		0.009
			(0.948)		(0.917)
MuslimExtremists			0.007		0.007
			(0.837)		(0.849)
RIRA			0.037**		0.037**
			(2.565)		(2.577)
WhiteExtremists			0.018*		0.018*
			(1.884)		(1.889)
Observations	40	40	40	40	40
R-squared	0.215	0.250	0.406	0.219	0.408

6.3.3 Impact of attack characteristics on CARs

The results of regular explanatory regression lead to closer investigation if the characteristics of the attack had any explanatory power in CARs. In table 9 are shown the

results of explanatory regressions with five different models that test different regression scenarios. Model one and four represent the basic regressions with control variables *Killed* and *Wounded* respectively and *Year* as in independent variable. In these models where the whole-time period was tested, none of the type of the attacker, the target of the attack or the type of the terrorist act had any significance.

However, the model three and five, where the independent variable *Years* was switched to *Early Years Dummy,* show interesting results. Firstly, the *Attacker* variable became significant, which led to a closer examination of the variable, by creation of an individual Dummy variable for each attacker group. The dummy variable for *Unknown* was left out of regressions in order to avoid dummy trap. Dummy variables for Real Irish Republican Army(RIRA) become significant at 5% level, when the dummy for the *Early Attack Years* is used. Dummy for *White Extremists* becomes also significant at 10% level when the dummy for the early years is used in both scenarios. The signs of these variables suggest that during the early years, when the attacks were made either by RIRA or white extremists, the cumulative abnormal returns tended to increase. These results however, can't be generalized as in the data sample of terrorist events, only one was carried out by RIRA. To draw a suggestive line between the attacks of the terrorist group RIRA and CAR returns, much broader sample of terrorist events performed by the group should be analysed.

All attacker dummies got positive coefficients. The dummy variable for *White Extremists* got an interesting coefficient, as it not only is positive, but also statistically significant. In time period from 1995 to 2010 there were four terrorist attacks and in time period of 2011 to 2017 five attacks were performed by white extremists. Regression results show that in the earlier time period attacks performed by white extremists got significantly higher CARs thank attack with Muslim attackers or Chechen Rebels. Cautious suggestion is that white terrorist do not cause the same amount of fear in investors of developed countries as other terrorist groups. There is a possibility that investors had already intercorporated the fear of domestic terrorism in their stock prices and therefore, these attacks do not cause falling in stock prices.

7. CONCLUSIONS

The effects of terrorism have been a hot topic in the financial studies mostly since the attack of 9th of September 2001. The market's negative reaction to terrorism has been documented widely, but most of the studies focus mainly on several events. The main objective for this study was to examine the development of the investor sentiment to the terror attacks over time. The study offers examination of prolonged time period of modern terrorism, focusing on forty terror attacks in developed western countries from 1995 to 2017. The indices were chosen to reflect the regions of occurrence of the attacks. In order to identify the change in the investor sentiment during the years, the event study methodology is used to identify the abnormal returns around the attack. The abnormal returns are then tested with explanatory regressions, in order to identify what factors closely related to terror attacks could possibly affect the investor sentiment.

The hypothesis of this thesis was, whether investors have grown numb to terrorism over time. The effect should be seen by decrease in a bad investor sentiment, in other words less significant negative reactions in event CARs. Study was motivated by the study of Goel, Cagle and Shawky (2017) whom in their study couldn't see coherent results between the attacks, which in their study was analysed as a suggestion that it could be a sign of investor sentiment numbing.

The study of abnormal returns during the event days of terrorist attacks shows that like Goel et al (2017) notice, the results are incoherent, and investor sentiment is not uniform from attack to attack, there isn't also evidence of the numbing effect on the contrary the significance of the returns in the more recent years suggest the opposite: investor sentiment to the terrorist attack has increased over the years.

Data sample, from forty terrorist events chosen for this study, was split in half for the easier observation of hypothesis. First twenty events span from 1995 to 2010, had eight negatively significant events, from which two were significant at the 1% level. The period from 2011 to 2017 represents most current twenty terror events examined in this study. During this time period there were nine statistically significant terrorist events, from which six were extremely significant at the 1% level. In order to accept the hypothesis, the abnormal returns should have been much milder in the more current time period and the amount of significant terrorist events should have also been lower. Because the earlier time period span is fifteen years and more current time period span is only seven, the

development of the investor sentiment suggests that unlike hypothesized, no numbing effect in the investor sentiment towards terrorist attacks could be seen in the stock indices. Therefore, the hypothesis of this thesis was rejected, because the results of the abnormal returns event study suggests the contrary: investors reaction to terrorist attacks is more negative in more recent years that it was before.

Both time periods experienced the same amount of significantly positive abnormal returns, but in more recent period they were less statistically significant than in the earlier time period. While it can't be stated that terrorist attacks caused positive reaction in the investors, the comparison between the two-time periods is suggesting that in more recent time period terrorism could be hindering the positive development of asset prices.

In order to find explanation to the abnormal returns, explanatory regressions were applied in different variations. The main purpose was to test, whether the time periods had any effect. And regression results suggest, that during the earlier years, the abnormal returns were significantly higher than during the events in more current time period. Regressions also showed that amount of killed and wounded in the attack had a significant negative effect on abnormal returns, which is in line with previous studies.

Because markets reaction to the terrorist events were incoherent, additional attack specific variables were regressed in order to gain more insight on if these factors could explain why certain events cause negative and other positive abnormal returns. Only in regressions with dummy accounting for earlier attack years did the additional *Attacker* variable became significant, but even then, it was positive. Meaning that in earlier attack years, certain attacker types resulted in more positive abnormal returns. Still the most explanatory variables to the abnormal returns were the amount of people died and got wounded in the attack.

This study offered an expanded overview of the attacks that occurred in western non-conflict countries in over past two (or three?) decades. Based on the results of the study, the hypothesis that investor sentiment has decreased towards terrorist events had been rejected, as the results show the contrary effect, investor sentiment can be seen increasing compared to the time period of 1995 to 2010. Further investigations on the factors that drive negative investor sentiment should be made to make conclusions, why some terrorist attacks result in negative reactions and some with positive.

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APPENDIX

Country of attack	Date of attack	N of killed	N of wounded	Attacker	Target	Type	Description
United States	19.4.1995	168	650	White extremist	Government Building/Facility/ Office	Bombing/ Explosion	The Oklahoma City bombing was a domestic terrorist truck bombing on the Alfred P. Murrah Federal Building.
Russia	14.6.1995	140	415	Chechen Rebels	Private Citizens & Property	Armed Assault	Group of 80 to 200 Chechen rebels attacked the city of Busyonnovsk, taking the local hospital under hostage.
United Kingdom	15.8.1998	29	220	Real Irish Republican Army (RIRA)	Private Citizens & Property	Bombing/ Explosion	A car bomb exploded in in the center of Omagh, the Real Irish Republican Army took the responsibility for the attack.
Russia	19.3.1999	64	104	Chechen Rebels	Private Citizens & Property	Bombing/ Explosion	Extremely strong car bomb was detonated in the central market of Vladikavkaz, attackers were believed to have connection to Al-Qaida.
United States	20.4.1999	15	24	White extremist	Educational Institution	Hostage Taking	Two armed high school students opened fire in Columbine High School, ending the attack with a suicide.
Russia	9.9.1999	90	180	Chechen Rebels	Private Citizens & Property	Bombing/ Explosion	Chechen rebels planted a bomb in an apartment building in Moscow. Organizers of the attack were also responsible for the attack of 13.09.1999
Russia	13.9.1999	118		Chechen Rebels	Private Citizens & Property	Bombing/ Explosion	Chechen rebels exploded an apartment building in Moscow.
Russia	8.8.2000	12	94	Chechen Rebels	Transportation	Bombing/ Explosion	Explosion on Pushkin Square in Moscow. Chechen rebels were blamed for the attack.
United States	11.9.2001	2977	16000	Muslim extremists	Private Citizens & Property	Hijacking	Most massive attack in the history of terrorism, where two planes were hijacked by al-Qaeda terrorist and crashed in World Trade towers in New York, causing their collapse.

Country of attack	Date of attack	N of killed	N of wounded	Attacker	Target	Type	Description
Switzerland	27.9.2001	14	18	White extremist	Airports & Aircraft	Armed Assault	A Massacre of Zug. A Swiss man disguised himself as a policeman and opened a fire in Zug's parliament building.
Russia	23.10.2002	170		Muslim extremists	Private Citizens & Property	Hostage Taking	Group of 40 Chechen rebels attacked Dubrovka theater taking the theater attendans as hostages. The situation lasted three days and ended when the special forces attacked the building.
Russia	6.2.2004	40	122	Chechen Rebels	Transportation	Bombing/ Explosion	A bomb explosion in the Moscow underground, in the msot busiest metro stations during the rush hour.
Spain	11.3.2004	193	2050	Muslim extremists	Transportation	Bombing/ Explosion	Series of ten train bomb attacks that occured in Madrid
Russia	24.8.2004	90		Muslim extremists	Airports & Aircraft	Bombing/ Explosion	Two airplanes were exploded outside Moscow and on Rostov-on-Don in the joint attack.
Russia	1.9.2004	344	727	Chechen Rebels	Educational Institution	Hostage Taking	Chechen rebels attacked school in Beslan and took around 1200 people (teacher, children and parents) hostage.
Russia	5.9.2004	10	51	Muslim extremists	Transportation	Bombing/ Explosion	Woman terrorist blew herself outside Moscow metro station.
United Kingdom	7.7.2005	41	450	Muslim extremists	Transportation	Bombing/ Explosion	Four suicide bombers caused fatal explosions in London underground.
Russia	21.8.2006	10		White extremist	Private Citizens & Property	Bombing/ Explosion	Explosion on a crowded market place in Moscow, with foreigners being a target.

Country of attack	Date of attack	N of killed	N of wounded	Attacker	Target	Type	Description
Russia	27.11.2009	26	100	Muslim extremists	Transportation	Bombing/ Explosion	Very powerfull bomb was exploded on a train between Moscow and Saint Petersburg.
Russia	29.3.2010	40	95	Muslim extremists	Transportation	Bombing/ Explosion	Explosion on a train in a central Moscow train station.
Russia	24.01.2011	38	168	Muslim extremists	Airports & Aircraft	Bombing/ Explosion	Sucide bomber exploded itself in Domodedovo airport in Moscow.
Belarus	11.04.2011	13	161	Unknown	Trnasportation	Bombing/ Explosion	Bomb controlled by a radio exploded in Minsk underground.
Norway	22.07.2011	69	60	White extremists	Private Citizens & Property	Armed Assault	Massacre at Utoya island and a small explosion in Oslo performed by right wing terrorist Anders Breivik.
United States	17.04.2013	15	151	Unknown	Business	Facility/In frastructu re Attack	West Fertilizer Company in Texas was set on fire by unknown terrorist group.
France	07.01.2015	12	12	Muslim extremists	Journalists & Media	Armed Assault	Firearm sssault by two terrorist at Charlie Hebdo - magazine's office in Paris
United States	17.06.2015	9		White extremists	Religious Figures/Instituti ons	Armed Assault	Firearm assault at Emanuel African Methodist Episcopal Church
United States	01.10.2015	10	7	White extremists	Educational Institution	Armed Assault	Firearm assault and hostage situation at Umpqua Community College.
France	13.11.2015	149	439	Muslim extremists	Private Citizens & Property	Armed Assault	Eight coordinated terror attacks were carried out in Paris. Most massive explosions at Eagles of Death Metal concert. Hostage situation and firearm assaults were carried out around nightime Paris.

Country of attack	Date of attack	N of killed	N of wounded	Attacker	Target	Type	Description
United States	02.12.2015	16	17	Muslim extremists	Private Citizens & Property	Bombing/ Explosion	Firearm assault at Inland Regional Center for disabled people in San Bernardino.
Belgium	22.03.2016	32	340	Muslim extremists	Airports & Aircraft	Bombing/ Explosion	Bomb suitcase explosions at Brussels Airport performed by two terrorists.
Greece	19.05.2016	66		Unknown	Airports & Aircraft	Bombing/ Explosion	Egyptair airplane crashed in Meditteranian sea on its way to Cairo from Paris
United States	13.06.2016	50	53	Muslim extremists	Business	Armed Assault	Firearm assaults at gay nightclub in Orlando
France	14.07.2016	87	433	Muslim extremists	Private Citizens & Property	Armed Assault	A truck attack during Bastille Day celebration in Nice
Germany	22.07.2016	10	27	White extremists	Private Citizens & Property	Armed Assault	Firearm assaults at shopping mall in Munich
Germany	19.12.2016	12	48	Muslim extremists	Private Citizens & Property	Unarmed Assault	Terrorist drove truck in a crowded Christmas market in Berlin
Russia	03.04.2017	16	63	Muslim extremists	Transportation	Bombing/ Explosion	Bomb explosion in Saint Petersburg underground
United Kingdom	22.05.2017	23	119	Muslim extremists	Business	Bombing/ Explosion	Bomb explosion at Ariana Grande concert in Manchester
United Kingdom	05.06.2017	11	48	Muslim extremists	Private Citizens & Property	Unarmed Assault	Van attack against pedestrians at London bridge.
Spain	17.08.2017	14	101	Muslim extremists	Private Citizens & Property	Unarmed Assault	Van rammed into a crowd in Barcelona
United States	02.10.2017	59	851	White extremists	Private Citizens & Property	Armed Assault	Firearm assaults in Las Vegas at the Route 91 Harvest Festival concert.