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THE EFFECT OF GEOPOLITICAL MARKET SHOCKS ON DOW JONES INDUSTRIAL AVERAGE STOCKS

Bachelor's thesis

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I hereby declare that I have compiled the thesis independently
and all works, important standpoints and data by other authors
have been properly referenced and the same paper
has not been previously presented for grading.

The document length is 9484 words from the introduction to the end of the conclusion.

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ABSTRACT

This thesis examines the effect of 11 geopolitical events, spanning from 2001 to 2023, on the returns of the Dow Jones Industrial Average stock components. Quantitative methods were employed, primarily utilizing the event study methodology with a window of 15 days before and after each event. The study also employed Ordinary Least Squares regression analysis to examine the influence of event characteristics and companies' sectoral affiliation on the abnormal returns. The abnormal returns and cumulative abnormal returns were calculated using the market model. The results indicate that the events generally had statistically significant negative effects on the stock components. The average abnormal return on the event day for all the chosen events is -0.57%. While the event with the largest negative abnormal returns was 9/11 terrorist attack. The results also show that the negative effects of geopolitical shocks are more pronounced for events that occurred in the United States and for industrial sector stocks.

Keywords: Abnormal Returns, Cumulative Abnormal Returns, Dow Jones Industrial Average, Event Study

INTRODUCTION

Recent decades have witnessed an excess of negative global events, with wars and terrorist attacks featuring often. Over the past century, such events have not only increased in frequency but have also collected considerable academic attention, particularly over the last thirty years. There is plenty of evidence of the effects of these events on several aspects of society, economy, and governance, yet their specific effects on financial markets remain less explored. This study aims to examine the impact of these geopolitical events such as terrorist acts, wars, and conflicts on the stock market. Specifically, this study will analyze the effect of 11 chosen events, detailed in chapter one, on the stock components of the Dow Jones Industrial Average enhancing our knowledge of its direct and indirect effects. Previous studies made by Verma and Hasan (2023), Leight et al. (2003) and Markoulis and Katsikides (2020) discovered that geopolitical events had significant effects on markets. All the studies were made using event study methodology, additionally, study made by Papakyriakou et al. (2019) used ordinary least squares regression to get additional information about their chosen events.

This study will be conducted using quantitative methods and the main methodology will be event study methodology. This study will also have additional analysis with ordinary least squares regression that will provide additional information regarding the events.

The anticipated result for this thesis is that the chosen geopolitical events will create a reaction to the abnormal returns of the components of the Dow Jones Industrial Average. Therefore, the research question for this thesis is:

How do the abnormal returns of Dow Jones Industrial Average stock components differ during market shocks.

To get a better overview of the research question one hypothesis is formed:

H1: Market shocks have negative returns for the stock components of the Dow Jones Industrial Average.

For this study, the abnormal returns (AR), cumulative abnormal (CAR), average abnormal returns (AAR), and cumulative average abnormal returns (CAAR) are calculated using the market model to find out how the chosen events affect the stock components of the Dow Jones Industrial Average. The data was gathered from Yahoo Finance from 01.02.2001-31.03.2004 and Thomson Reuters Eikon for a period of 31.03.2004 to 06.11.2023. Thomson Reuter Eikon has 20 years of data available and therefore Yahoo Finance was used for the earlier days. The component data was taken from these databases individually. The thesis will also have additional analysis by using ordinary least squares regression to seek additional information about the event effects.

The thesis consists of three chapters. The first chapter examines the chosen events and has theoretical and empirical literature used to understand the effects of events in Dow Jones Industrial Average components. The second chapter will go through the data and methodology used in the thesis. The third chapter will present the findings of the event study calculations and the regression analysis and offers a discussion of the results. Conclusion is the concluding chapter that provides an overview of everything in the thesis.

1. LITERATURE REVIEW

This chapter will examine the theoretical and empirical background of the thesis and introduce the chosen events. The events will be introduced, and characters will be informed on the chosen terrorist attacks and wars, and previous studies made from geopolitical events to enhance the information related to this study.

1.1. Efficient market hypothesis

The principal idea of the Efficient Market Hypothesis (EMH) is that the prices of the traded stocks will already reflect all the publicly available information (Fama, 1970). This means that if you are investing based on the information that is publicly available, you will not be able to outdo the market over period. The information that is publicly available makes both the buyer and the seller aware of the same information. The stock returns are hard to predict as the old information of the stock is already incorporated with the current stock price and the new information is not available as it is unexpected or random. Malkiel (2003) in addition implies that new information is unpredictable and random which will make the price changes of stocks also random and unpredictable and that for the prices fully reflect all the known information. Samuelsson (1965) indicated in his study that when there is a competitive market there is a buyer for every seller. If the seller would be sure that the price will rise, it would already have risen.

Efficient market according to Fama (1970) can be categorized into three forms of efficiency. Fama (1970) named them to be *Weak form, semi-strong form, and strong form.* The weak form takes into factor only the historical prices, and it is the only subset of information that is of any interest. The second form is a semi-strong form where the stock prices reflect to historical prices and to all publicly available information which can include financial statements, articles, and economic forecasts. The third form is strong form, in this form the stock prices reflect all the available information including public and private (Fama, 1970).

1.2. Efficient market hypothesis critiques and challenges

Efficient market hypothesis includes challenges and some critiques. Shiller (2003) introduces in the study that efficient markets can be drastically wrong for example when interpretating major stock market bubbles.

Malkiel (2003) states in his study that in twenty-first century efficient market hypothesis has become less universal. He provides insights that financial economists and statisticians have begun to believe that the stock prices would be only partially predictable. His study gives outcome of a new class of economists that emphasizes more the psychological and the behavioral elements of the determination of stock price. The new economist tends to believe that there is a pattern on the past stock prices that reflect also to the future pricing. Malkiel (2003) in addition writes that the new economists claims that predictable patterns would enable the investors to earn risk adjusted rates of return.

1.3. Spillover effects

Spillover effects refers to that events happening in one nation, the impact can be seen in other nations that was not involved in the event (Kenton, 2020). This study might prove that the spillover effects can be seen if the events occurred outside of the United States have had negative or positive impact on the Dow Jones Industrial Average components.

Study made by Kim, Kim, and Lee (2015) examined the spillover effects that U.S. financial crisis had on emerging Asian countries. The study discovered that the Lehman Brothers bankruptcy in 2008, September resulted in a direct shock in the emerging markets of Asia. The equity price in Taiwan dropped by 38.5% in three months after the Lehman brothers' bankruptcy. Korean Won also experienced the effect and depreciated at the same time against the U.S. dollar by 19.2%.

Li and Giles (2013) studied the relationships of stock markets across U.S., Japan, China, India, Indonesia, Malaysia, Philippines, and Thailand from 1993 to 2012. The study showed that there were spillovers from volatility and unidirectional shocks from the U.S. market to the chosen countries. The effect of the spillovers was significant for China, India, Indonesia, Malaysia, Philippines, and Thailand. The negative shocks occurred significantly in the short run but not in the long run.

Kumar (2013) investigated in his study the economic consequences of terrorist attacks spillover through trading partners. Kumar (2013) introduced that when a bigger economy is targeted the spillover effect is larger for smaller trading partners. This means that the bigger economies are more resilient to the spillover of terrorist attacks that are targeted at a smaller trading partner. In addition, the study found that it is important to counter the terrorism because if it fails the costs are not limited to only the attacked countries. (Kumar, 2013)

1.4. Events chosen

The events were chosen for this study as they represent the biggest and most significant geopolitical events that has happened in the world in the past 25 years. The chosen events have also been studied before between different markets, and therefore the results can be discussed more thoroughly.

U.S. Terrorist attacks

September 11, 2001, U.S. faced the biggest terrorist attack in the history. 19 terrorists affiliated with Islamic extremist group Al-Qaeda, hijacked in total of four airplane. Two of the hijacked planes were flown into the World Trade Centers south and north towers. The attack ended the lives of approximately 3000 people. (History.com Editors, 2023)

U.S. Iraq war

On March 20, 2003, former U.S. president George W. Bush announced that U.S. forces have started military maneuvers into Iraq. The reason for the maneuver was to destroy Iraq's mass destruction weapons and to end the dictatorial Saddam Hussein's life. The war was ongoing until 18th of December 2011. The war had 4500 Americans and over 100 000 Iraqis dead. (Bassil, 2012)

Madrid Bombing

March 11, 2004, Madrid impacted coordinated bombing attacks on the commuter trains. 10 bombs were detonated in four different commuter trains and the explosions caused 191 casualties and more than 1800 injured people. This terrorist attack was one of the deadliest terrorist acts in Europe since the World War II. The bombings network had two connections remnants of al-Qaida and Moroccan Islamic Combatant Group. (Reinares, 2009)

London bombings

London faced an attack by four suicide bombers on 7 of July in 2005. The attacks targeted the city's transportation network in the morning. The bombings resulted in 52 deaths and over 770 injuries. Three explosions occurred on the underground near Aldgate, Edgware Road and Russell Square stations fourth explosion happened in a bus in Tavistock Square. British Transport Police (BTP) officers and personnel were instrumental in both the immediate rescue attempts and the later investigations. They assisted with the coroner's investigation, performed rescue operations, and recovered bodies. (BBC, 2015)

Boston marathon bombing

The Boston Marathon is an annual running event. In 2013 April 15, the event had more than 26000 runners participating brothers Dzhokhar and Tamerlan Trarnaev planted two pressure cooker bombs to the event. The bombs were placed near the finish line on the event. The explosion caused three deaths and injured 281 people. The bombing was motivated by a revenge against the military action in Iraq and Afghanistan. (O´Neill, 2015)

Paris terrorist attacks

Six coordinated attacks happening in Paris and in Saint-Denis on November 13, 2015. Suicide bomber attempted to enter the stadium where the president of France Hollande was with 80 000 spectators. The attempt failed and the bomb detonated at the entrance of the stadium killing only a passer-by. Five minutes later a gunmen attacked two bars in Paris killing 15 people and leaving others wounded. The attackers continued their killing spree with another hit to restaurant killing

19 people and injuring nine. Other attackers attacked Bataclan Theatre and killed 89 people during concert, the total casualties for the day were 124 people. (BBC, 2015)

Brussels bombing

March 22, 2016, Brussel encountered two bombings by terrorist group affiliated with Islamic State. Two suicide bombers detonated bombs in Brussels Airport in Zaventem and another two in a train leaving Maelbeek metro station. The two bombings killed 34 people and left more than 300 people injured. The perpetrators were involved in the terrorist cell that oversaw the November 2015 Paris attacks. (Frazee, 2016)

Sri Lanka bombing

Colombo Sri Lanka faced six deadly bombings in Easter April 21, 2019. The responsible group for these bombings were National Thowheeth Jama'ath an local Islamic terrorist group. The suicide bombers attacked three churches and three hotels in the capital of Colombo. The bombings killed 259 people and the amount included 45 different nationalities left more than 500 injured. (Imtiyaz, 2019)

United States and Irans tension

Trump was elected to be the president of the United States in 2017 and a week after his start, Trump signed an executive order and banned seven Muslim-majority nations, including Iran from entering the US premises for 90 days. The tension proceeded to grow and strengthen after Persian Gulf attacks on oil tankers in Saudi Arabia, as well as downing U.S. drone which were blamed on Iran by Washington and allies. In 2020, United State forces hit targets in Syria and Iraq that are associated with pro-Iranian militias, that assault U.S. service members in Iraq. A militia supported by Iran claims that at least 25 people have died. In January 2020 Trump ordered airstrike in Iraq to kill Irans top general Qasem Soleimani. This event led Iran to shoot missiles to Iraqi bases where American soldiers were few days after the airstrike. As the tension rose once again Iran mistakenly shot down a Ukrainian passenger jet and let 176 people killed. (Kaur, H, Kim, A and Sherman I, 2020)

Russia Ukraine war

Russia-Ukraine war began on February 24, 2022, when Russia launched complete invasion to Ukraine. The war marked the largest conflict in Europe since the World War II. On February, 24 Russia's president Vladimir Putin began a special military operation to shut off Ukraine and to put an end to the Russian genocide on Ukrainian land. The invasion had severe reaction internationally and was met with severe sanctions from European and U.S. allies against Russia. The total number of casualties from the war in 18 months were nearly 500 000 people. (Fitzgerald & Davis Jr, 2024)

Israel Hamas war

The Israel-Hamas war began on October 7, 2023. Hamas started the war by launching a land, sea, and air assault on Israel from the Gaza strip. The Gaza strip attack led to over 1200 deaths primarily among Israeli citizens. 350 000 reservists were called over the next several days. October 8, 2023, Israeli declared itself into a state of war. Day later Israel cut off water, electricity, food, and fuel from Gaza strip. As of March 5, 2024, there has been more than 31 000 people killed during the war. (Hutchinson, 2023)

1.5. Previous study on geopolitical events

Previous study regarding the stock market effects from geopolitical shock was made by Sharma, Verma and Hasan (2023). The study examined 9/11 terrorist attacks and their effect on stock market. The study concluded that the terrorist attacks had economic and social negative impact. Sharma et al. (2023) discovered that the impact on stock market did affect the global market, but it was majorly affected in the local market. The study additionally found out that the stock market recovered quickly, and that the stock market was only closed for four trading days. Nikkinen, Omran, Sahlström and Äijö (2006) had similar results to Sharma et al. (2023) when it comes to the negative abnormal returns from September 11 attacks. Nikkinen et al. (2006) study showed also that the markets recovered quickly afterwards.

Study made by Leigh, Wolfers and Zitzewitz (2003) analyzed the financial market data of the economic aftermaths of U.S. war with Iraq. Leigh et al. (2003) analyzed that the effect of war on national stock market had a fall in stock market in 32 countries of 45 countries examined. Amihud

and Wohl (2004) studied the association between Saddam Hussein's fall from control and the market expectations. Amihud and Wohl (2004) found similar results from their study as Leight and Zitewitz (2003) to the consequences of the U.S. war with Iraq.

Markoulis and Katsikides (2020) studied the effects of terrorism on stock markets in the 21st century. They studied 11 geopolitical events and examined how the stock market was affected in the country of the event, and in the global stock market. The study used event study methodology in their study, and event windows of 5, 10, 15 and 30 days. Markoulis and Katsikides (2020) found out that eight out of 11 events caused significant negative abnormal returns on the day of the events. None of the events had negative CAR for more than 15 days, which means that the events effects are not permanent. Nevertheless, the study revealed that the most recent events did not have as big effect on the home market, nor the global market. Markoulis and Katsikides (2020) argued that the reason behind the results might be that the investors have learnt to assess these kinds of events more calmly and rationally.

Study conducted by Kollias, Papadamou and Stagiannis (2011) examined the effects of 2004 Madrid bombing and 2005 London attacks. Kollias et al. (2011) investigated the effects of these events in the stock market of Barcelona, Madrid, Valencia, and London. The study was made by using event study methodology and they used EGARCH models to investigate the effects of these events on conditional volatility. The study also followed the impact on sectoral indices. The study concluded that Spain's stock market reacted more heavily to the attacks and the market took more time to rebound to the ''normal state''. In addition, London stock market rebounded in a single trading day back to normal. Kollias et al. (2011) have thought that the difference in the rebounding days might be because of London attacks were executed by suicide bombers and the imminent threat after the bombings were gone. Kollias et al. (2011) implied that in the case of Madrid bombing the attackers were captured few days after the bombing so the threat for more was present and it might have affected more. Study made by Kalivis and Lyroudi (2006) studied the Madrid train bombing effects on New York stock exchange. The study discovered that there were negative abnormal returns on four of nine chosen industries on the event day.

Papakyriakou, Sakkas and Taoushianis (2019) examined in their study the effects of 28 major terrorist acts in G7 countries all the data from the terrorist acts were collected from Global Terrorism Database in the period of 1998-2017. The impact on a sample of stock market indices were collected from 66 countries. The data was collected by Thomson DataStream, and it included

67 equity return indices from the DS market. The indices were changed into US dollars that the foreign exchange rates would not affect the results. The study was conducted by using short-horizon event study analysis and OLS regression model. The study discovered that the stock markets had significant economic losses especially on the event day and the next trading day. The markets declined more gradually after the first two days but did not rebound back to normal for up to 10 trading days. Papakyriakou et al. (2019) were benefitted from the regression analysis that demonstrated convincing evidence of a positive relationship between the investor sentiment and the reaction in stock markets.

Chen and Siemens (2007) found out that modern U.S. capital markets have become more resistant from the past and are able to recover sooner from terrorist and military attacks than other global markets. Chen and Siemens (2007) further believe that the banking sector provides liquidity to promote stability into markets and this helps the market to be more resilient than in the past. The authors discussed about the real-time information economy that they describe as the news spread out in a truly short time around the globe the negative consequences spread in a very short time. Healthy banking and financial sectors and the efficient performance of monetary policies are most important for grooving economies. (Chen & Siemens, 2007)

Karolyi and Martell (2005) studied 75 attacks that happened between 1995 and 2002 where the publicly traded companies were the targets. The study was conducted using event study methodology and revealed negative stock reaction of -0.83%. The study used cross-sectional analysis of the abnormal returns and the results indicated that the impact of terrorist attacks gives different reactions to market according to the country that it happened. The wealthier the country where the attack happened the larger negative share price reactions were. Karolyi and Martell (2005) discovered in their study that personal attacks towards companies such as kidnappings of executives were given more negative impact on the stock price than bombings or terrorist attacks on infrastructure. The study proved that each attack into the 75 individual firms decreased the market capitalization of 401 million US dollars.

1.6. Hypothesis development

Study made by Papakyriakou et al. (2019) discovered that the stock markets had significant negative returns especially on the event day. Chen and Siemens (2007) discussed the brief time that negative events spread news around the globe. Markoulis and Katsikides (2020) studied the effect of 11 geopolitical effects on the stock market and found out that eight out of 11 events caused negative abnormal returns. These studies suggest that geopolitical events present reaction on stock markets. Based on the studies, this study will focus on finding out that how does Dow Jones Industrial Average stock components react to 11 geopolitical events. The research question is as follows: How do the abnormal returns of Dow Jones Industrial Average stock components differ during market shocks. To get a better overview of the research question one hypothesis is formed:

H1: Market shocks have negative returns for the stock components of the Dow Jones Industrial Average.

2. DATA AND METHODOLOGY

In this chapter the design of the thesis, sample selection and methodology will be introduced. The design will give an overview of what methodology was chosen for the matter. Sample selection will share the details of chosen index and its components, and the data collection method used. Methodology will give an overview of all the calculations and formulas used.

2.1. Sample selection

This study is conducted over a period of 23 years, starting from 135 days before the first event which was U.S. terrorist attacks happened in 9 of November 2001. The period is ending 30 days after the last event which was Israel Hamas war that started in 07 of October 2023. The 23-year study period was chosen because it encompasses the chosen 11 significant geopolitical shocks together with periods of prosperity and neutrality to provide the market with a more realistic view.

This study will focus on the Dow Jones Industrial Average (DJIA) stock components. DJIA is known to be one of the oldest and most widely recognized stock market indices in the world. DJIA includes 30 components from different sections of the U.S. economy. The index offers a comprehensive overview of the different market trends and investor sentiments. The DJIA components were selected for this study as they have shown a resilience impact on the American economic landscape and their historical resilience to market fluctuations and changes making them leading candidates for assessing the effects of these geopolitical market shocks. The DJIA components span across diverse sectors such as communication services, consumer cyclical, consumer defensive, energy, financial services, healthcare, industrials, technology, and basic materials providing a broad perspective on the reactions to the chosen geopolitical events.

The stock performance data for the Dow Jones Industrial Average components are sourced from Thomas Reuters Eikon DataStream and Yahoo finance as Eikon DataStream only provides 20 years of data. The first three events performance data needed to be collected from Yahoo Finance. Thomas Reuters Eikon DataStream is known for its accuracy and reliability. The geopolitical event information is compiled from various sources including historical databases, and news reports ensuring correctness and comprehensive representation of the events.

The study has 303 observations in total between the components in Dow Jones Industrial Average (DJIA) index over the study period of 23 years. The amount of observation gives accurate measures for each of the events. There have been 43 different components of DJIA index over this study period, the amount gives this study also implications if the sectors are affected by these events.

2.2. Event study

Measuring the effect of an event that has some cause to stock market and the value of firms. The study method that should be utilized would be event study. Event study methodology is constructed to find out the effects of an event to the market using financial market data the methodology studies the impact of the chosen event on the value of the firm. (MacKinlay, 1997)

The first task of event study is to identify the timeline and the event where the prices have changed due to an event, this is called event window. The event window according to MacKinlay (1997) could be estimated over 120 days before the event. The event period does not include the event window time to prevent the influence on the normal performance model parameter estimates. MacKinlay (1997) states that the period of interest should be at least the announcement day and the following day to capture any price effects of the announcement.

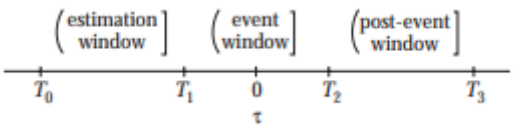

Figure 1. timeline of event study

Source: MacKinlay (1997)

This study aims to provide an overview of the impact on Dow Jones Industrial Average stocks, with the chosen events. As this study is focusing on event effects, the event study methodology is the proper choice. The estimation period for this study is 120 days before the event window. This study will use the event window of 15 days prior to the event happening, until 15 days after the event has happened. During this period, the stock performance will be measured, and abnormal returns calculated. As outlined by MacKinlay (1997), various approaches exist for conducting an

event study, but the overall procedure of the analysis remains consistent. This study will focus on the analysis framework proposed by MacKinlay (1997). To assess the influence of a specific event on stock prices, it is required to compute abnormal returns.

2.2.1. Abnormal return

Study made by Fama and French (1992) shows that the stock prices can change due to market factors as industry news, interest rates which results in normal return. Abnormal returns could take place during important events which the normal market factors cannot interpret. The overabundance return might affect to the events effect on the chosen company's stock.

Geopolitical events chosen for this study will be assessed by estimating the abnormal returns (AR) in the event period for the components of Dow Jones Industrial Average with the following formula where i = stock and τ = time:

$$AR_{i,t} = R_{i,t} - (\alpha_i + \beta_i R_{m,t}) \quad (1)$$

where $AR_{i,t}$stands for the abnormal return, $R_{i,t}$ for the actual return for asset *i* and at time *t*, and α_i for the alpha for asset *i,* βi is beta for stock *i* and $R_{m,t}$ is the return of the market portfolio.

Additionally, this study also calculated average abnormal returns to get the average for each event for the components in Dow Jones Industrial Average. The average abnormal return was computed using the following formula:

$$AAR_t = \frac{1}{N}\sum_{i=1}^{N} AR_{it} \quad (2)$$

where,

N = is the number of observations

AR_{it} = is the stock i abnormal return at time t.

2.2.2. Cumulative abnormal return

Cumulative abnormal returns (CAR) are calculated by summing the calculated abnormal returns for each wanted event windows. CARs were calculated for several event windows: (0,5), (-3,3), (-5,5), (-10,10) and (-15,15). Calculating CAR by using the market model, Abnormal return for every event window is being summed like in the following formula.

$$CAR(t_1, t_2) = \sum_{t=t_1}^{t_2} AR_{i,t} \quad (3)$$

In this formula the t_1 is the first accountable abnormal return for our event window and t_2 is the ending point. The sum of abnormal returns is taken for an example between all the dates from -5 to 5. AR is the abnormal return and *i* is the chosen stock and *t* is the total chosen period. This is calculated comparative to the expected return on the market model.

This study also studied the cumulative average abnormal returns which is the sum of average abnormal returns for a specific event window with the following formula:

$$CAAR(T_1, T_n) = \sum_{t=t1}^{Tn} AAR_t \quad (4)$$

The t-statistic is a frequently used metric in event studies to assess the statistical significance of abnormal returns. The variation between the expected and the actual returns is referred to as abnormal returns. These returns show the degree to which an event has affected the stock price of a corporation. Calculating the t-statistic, the Cumulative abnormal returns need to be divided with standard deviation of the calculated abnormal returns (sdAR) and the square root of the days in event window, as shown in the formula below:

$$t_{car_i} = \frac{CAR_i}{\sqrt{L}\ x\ sdAR_{i,}} \quad (5)$$

CAAR t-statistics was calculated with the following formula:

$$t_{CAAR_T} = \frac{CAAR_T}{S_{CAR_T}} \quad (6)$$

where,

t_{CAAR_T} = is the t statistics for CAAR throughout the estimation window T

$CAAR_T$ = is the cumulative average abnormal return throughout estimation window, T
S_{CAR_T} = is the standard deviation of the individual CAR throughout the estimation window T

T-statistics help to identify that the abnormal return of a security on a specific event day is significantly different from zero. T-statistics also help to identify whether the event has a significant impact over the chosen event windows. (Muller S, 2023)

2.2.3. Market model

MacKinlay (1997) in his study describes market model (MM) as a statistical model that links the return of chosen security to the return of the market portfolio. MacKinlay (1997) implies that the MM gives a potential enhancement over the constant mean return model. MM can lead to better ability to detect the event effects by removing the portion of the return that is linked to the variation in the markets return. The market model assumes that there is a stable linear relation between security return and the market return. Study made by Dyckman, Philbrick, and Stephan (1984) present three models: Mean adjusted returns model, Market-Adjusted Returns Model and Market Model. The study concludes that among these three models detecting the abnormal performance is similar, but the Market Model is slightly more preferred. Brown and Warner (1984) concluded that MM is powerful and well specified under a variety of conditions. Brown and Warner (1984) also found that the OLS market model exceeds the mean adjusted return procedure which is known to be simpler. MacKinlay (1997) discusses about the CAPM model's deviations in event studies. Findings regarding the CAPM raise doubts about the applicability of the limitations the model places on the MM. This has led to a possibility that these CAPM restrictions could be avoided by using the market model.

Market model for any security I the market model is:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \quad (7)$$

where R_{it} is the return of security ί for period τ and R_{mt} the return of the market portfolio for period τ. Respectively α_i and β_i are the parameters of the market model, and ε_{it} is the zero mean disturbance term. (MacKinlay, 1997).

Calculating the Ordinary Least Squares for market model parameters following (MacKinlay, 1997) study the Ordinary Least Squares for estimators for estimation window for firm ί are calculated with these formulas:

$$\hat{\beta}_i = \frac{\sum_{\tau=T_0+1}^{T_1} (R_{i\tau} - \hat{\mu}_i)(R_{m\tau} - \hat{\mu}_m)}{\sum_{\tau=T_0+1}^{T_1} (R_{m\tau} - \hat{\mu}_m)^2} \tag{8}$$

$$\hat{\alpha}_i = \hat{\mu}_i - \hat{\beta}_i \hat{\mu}_m \tag{9}$$

$$\hat{\sigma}^2_{\varepsilon_i} = \frac{1}{L_1 - 2} \sum_{\tau=T_0+1}^{T_1} (R_{i\tau} - \hat{\alpha}_i - \hat{\beta}_i R_{m\tau})^2 \tag{10}$$

where,

$$\hat{\mu}_i = \frac{1}{L_1} \sum_{\tau=T_0+1}^{T_1} R_{i\tau}$$

and

$$\hat{\mu}_m = \frac{1}{L_1} \sum_{\tau=T_0+1}^{T_1} R_{m\tau}.$$

where R is security i return and R_{mt} for the market in the event period τ.

2.3. Regression analysis

The analysis utilizes Ordinary Least Squares regression also known as OLS Regression to investigate the impact and to find out if sectors have influence on the results of the chosen events on the abnormal returns for the components of the Dow Jones Industrial Average (DJIA). The dependent variable that was used in this OLS regression was cumulative abnormal return for each event window, providing the foundation for examining the influence of various events on DJIA components. The independent variables called regressors for this OLS regression were designed to categorize the events based on several criteria:

- Event type: this was coded as 0 for War related events and 1 for terrorist events.
- Happened in the USA: coded as 0 if the event did not happen in the U.S. and 1 if the event happened in the U.S.
- Direct impact on the USA: this was coded as 0 for the events that USA did not have straight connection and 1 for those that USA had direct connection.
- Sectors were changed into dummies for discrete variables.

The dependent variable is cumulative abnormal return on the five different event windows. The explanatory variables were chosen to get additional analysis on the event effects. The following regression model was used:

$$CAR_i(T0, T+t) = \alpha + \beta_1 Eventtype: 0 = War, 1 = terrorist_i + \beta_2 HappenedintheU.S., 0 = no, 1 = yes + \beta_3 DirectimpactonU.S., 0 = no, 1 = yes + \beta_4 Sectors + \varepsilon_i \quad (11)$$

where,

Eventtype: 0=War, 1=terrorist – tells the nature of the event

HappenedintheU.S.,0=no,1=yes – tells that if the event occurred in the U.S.

DirectimpactonU.S., 0=no,1=yes – tells that if the event had direct impact on U.S. meaning that if U.S. was involved in it.

Sector – from nine sectors eight were chosen and one left for base sector.

There is total of five OLS regression tables where the explanatory variables do not change but the dependent variable change for the specific event window.

3. RESULTS AND DISCUSSION

This chapter will provide an overview of the findings regarding the main analysis of event study and the additional analysis using the OLS regression. The analysis includes the data for 23 years of the components of Dow Jones Industrial Average index. The calculations were made to show the possible negative effects of the index components from the chosen geopolitical events.

3.1. Event study results

Table 1: CAR Descriptive Statistics for all the events

Variables	Mean	Median	St. Dev	Min	Max
CAR (0,5)	-0,33%	0,47%	0,051	-34,01%	14,45%
CAR (-3,3)	-1,35%	-0,19%	0,071	-44,27%	15,26%
CAR (-5,5)	-0,64%	0,39%	0,068	-37,45%	17,36%
CAR (-10,10)	-1,27%	-0,59%	0,089	-44,26%	27,43%
CAR (-15,15)	-0,67%	-0,10%	0,088	-30,11%	26,77%

Source: Author's calculations

Table 1 presents the descriptive statistics for the sum of every event and every component of Dow Jones Industrial Average (DJIA). The CARs were calculated for event windows: CAR (0,5), CAR (-3,3), CAR (-5,5), CAR (-10,10) and CAR (-15,15). The minus numbers represent the days before the event occurred and positive numbers after the event occurred. The mean CAR for all the 11 events combined for period of (0,5) was -0.33% there is a difference between the mean and median as the median was for period (0,5) positive 0.47%. The standard deviation is 0.051 which indicates that there was quite low variation in the abnormal returns between all the events and components. The min was -34.01%, and the max 14.45%. CAR (-3,3) had mean of -1.35% and median of -0.19%. The standard deviation was 0.071. This indicates that for CAR (-3,3) the variation was a little bit high. Min was -44.27% and max 15.26%. CAR (-5,5) had a mean of -0.63% median of 0.39%. Standard deviation was 0.068, min 37.45% and max 17.36%. CAR (-10,10) had a mean of

-1.26% median -0.59%. Standard deviation was 0.089, min -44.26% and max 27.43%. Finally, the CAR (-15,15) had a mean of -0.65% median of -0.10%. Standard deviation 0.088 min -30.11% and max 26.77%. The descriptive statistics show that there was negative mean CAR for every event window with all the components of Dow Jones Industrial Average included for all the events.

Table 2: Cumulative average abnormal returns and p-value calculations for all events.

Variables	CAAR	St. Dev	Min	Max	t-stat	p-value
CAR (0,5)	-0,33 %	0,051	-34,01 %	14,45 %	-1,14	0,25
CAR (-3,3)	-1,35 %	0,071	-44,27 %	15,26 %	-3,33	0,000***
CAR (-5,5)	-0,64 %	0,068	-37,45 %	17,36 %	-1,64	0,10*
CAR (-10,10)	-1,27 %	0,089	-44,26 %	27,43 %	-2,47	0,013**
CAR (-15,15)	-0,67 %	0,088	-30,11 %	26,77 %	-1,32	0,18

Significance levels are indicated by * for $p < 0.1$, ** for $p < 0.05$, and *** for $p < 0.01$

Source: Author's calculations

Table 2 presents the cumulative abnormal returns (CAAR) from every event window chosen. The event windows were (0,5), (-3,3), (-5,5), (-10,10), (-15,15). CAAR aims to present the information for all the events chosen for this study. The statistical significance was found by calculating the p-value for each CAAR. Three significance levels were taken into consideration. The first significance level was 0.10 which is slightly significant, the second significance level is 0.05, and it is statistically significant, finally the third significance 0.01 is highly significance.

When examining Table 2 the first CAAR (0,5) was negative by -0.33% but it was not significant due to p-value being larger than 0.10. The second CAAR (-3,3) was negative by -1.35% and was highly significant. The third CAAR (-5,5) is also negative by -0.64% and it is slightly significant with p-value being 0.10. The fourth CAAR (-10,10) is also negative by -1.27% the CAAR is also considered to be statistically significant as the p-value is less than 0.05. Finally, the last CAAR (-15,15) is negative by -0.67% but it is not statistically significant as the p-value is more than 0.10. The table additionally shows that the longer period CAAR's were negative, and it indicates that the negative effects of the events were long.

Table 3: Average Abnormal Returns for all the events and components.

AAR	Std. Dev	Min	Max	t-stat	p-value
-0,57%	0,030	-26,08%	5,90%	-3,211	0,0014***

Significance levels are indicated by * for p < 0.1, ** for p < 0.05, and *** for p < 0.01

Source: Author's calculations

Table 3 presents the average abnormal return on the event day for all the chosen events. The results show that the average abnormal return was negative by -0.57% and it was highly significant. This result indicates that among the 11 chosen geopolitical events the average abnormal return was negative.

Table 4: Average Abnormal Returns for every chosen event and p-value.

Event:	AAR	MIN	MAX	t-statistics	p-value
9/11 terrorist attack	-5,68 %	-26,08 %	5,90 %	-3,53	0,0017***
U.S. Iraq War	1,63 %	-1,75 %	5,32 %	5,06	0,0000***
Madrid bombing	-1,76 %	-4,00 %	1,18 %	-6,37	0,0000***
London bombing	0,06 %	-1,95 %	1,70 %	0,31	0,7558
Boston marathon bombing	-1,74 %	-4,89 %	0,27 %	-7,63	0,0000***
Paris terrorist attack	-0,95 %	-5,83 %	1,39 %	-3,42	0,0019***
Brussel bombing	-0,29 %	-1,54 %	1,07 %	-2,46	0,0200**
Sri Lanka easter bombing	-0,18 %	-2,04 %	2,26 %	-1,08	0,2890
U.S. Iran tension	-0,53 %	-2,55 %	1,19 %	-3,64	0,0010***
Russia Ukraine War	1,90 %	-2,91 %	4,93 %	5,55	0,0000***
Israel Hamas War	0,47 %	-1,23 %	2,72 %	2,63	0,0133**

Significance levels are indicated by * for p < 0.1, ** for p < 0.05, and *** for p < 0.01

Source: Author's calculations

Table 4 represents the results for Average abnormal returns (AAR) for each of the chosen events. As the results represent, there were four events that did not have negative AAR. These events were U.S. Iraq war, London bombing, Russia Ukraine War, and Israel Hamas war. The highest negative AAR event was 9/11 terrorist attack. The AAR was negative by -5.68%. Madrid bombing had a negative AAR by -1.76% and it was highly significant. Boston marathon bombing was negative by -1.74% and highly significant. Paris terrorist attack was negative by -0.95% and was highly significant. Brussel bombing had negative AAR by -0.29% and it was statistically significant. Sri Lanka easter bombing had negative AAR by -0.18% but it was not statistically significant. U.S. Iran tension had negative AAR by -0.53% and it was highly significant. The positive AAR events

were U.S. Iraq war by 1.63%, Russia Ukraine war by 1.90%, Israel Hamas war by 0.47% these results were statistically significant. Finally, the London bombing had positive AAR by 0.06% but it was not significant. The positive events were mostly wars, this could indicate that war events do not have as negative impact on the event day abnormal return, as terrorist events. Terrorist events are unexpected and cause usually more negative response at first than wars.

In Table 5 from appendix, the cumulative average abnormal returns for all the events that did not have direct impact on U.S. are displayed. The events were following Madrid bombing, London bombing, Paris terrorist attack, Brussel bombing, Sri Lanka bombings, Russia Ukraine War, and Israel Hamas War. The results for Table 5 are presented as CAAR (0,5), CAAR (-3,3), CAAR (-5,5), CAAR (-10,10) and CAAR (-15,15).

The results indicates that the events that did not have direct impact on U.S. had only one significantly negative CAAR on event window (-10,10) by -1.33%. The CAAR (0,5) was positive by 0.89% and it was highly significant. The other event windows for CAAR's (-3,3), (-5,5), (-15,15) were negative but they were not statistically significant. This would imply that the observed CAAR's with negative outcome which were not statistically significant could be negative by chance.

Based on the results in Table 5 we can inference some level of spillover effect from the events to the components of DJIA. There was an immediate positive reaction with statistically significant CAAR on the short-term event window (0,5). This suggest that following the events happened outside of U.S. the investors might interpret the events as potentially favorable implications for the U.S. market. However, the mid-term negative adjustment that was seen on CAAR (-10,10) can suggest that as the market incorporates more information about the events the initial optimism may be diluted which could result in negative spillover effect.

Table 6 from appendix presents the results for CAARs for events that had direct impact on U.S. These events either happened in the U.S. or U.S. participated in them. The table presents five CAARs for event windows, (0,5), (-3,3), (-5,5), (-10,10), and (-15,15). The results showed that all CAARs were negative but only CAARs (0,5), (-3,3), and (-5,5) were all statistically significant. The CAAR (0,5) was negative by -2.6%, CAAR (-3,3) by -3.82%, and CAAR (-5,5) by -1.80%. CAAR (-10,10) was negative by -1.13% and CAAR (-15,15) by -0.75%. However, CAARs (-10,10), and (-15,15) were not statistically significant.

3.2. Regression results

Table 7: OLS regression for CAR event window (0,5), base sector left out is healthcare.

Variable	Coefficient	t-ratio	p-value
Event type: war = 0, terrorism =1	−0,0041	−0,572	0,5677
Happened in the U.S., No = 0, Yes =1	−0,032	-2,78	0,0057***
Direct impact on the U.S. 0 = no, 1 = yes	−0,019	−2,22	0,0268**
Communication services	−0,005	−0,433	0,6647
Consumer cyclical	−0,015	−1,403	0,1618
Consumer defensive	−0,0016	−0,154	0,8776
Energy	−0,015	−1,150	0,2509
Financial sector	−0,015	−1,511	0,1318
Industrials	−0,024	−2,549	0,0113**
Technology	−0,013	−1,379	0,1689
Basic materials	−0,021	−0,749	0,4543
Significance levels * for p < 0.1, ** for p < 0.05, and *** for p < 0.01			
F-significance of the model: 0,0000***			

Source: Authors calculations

Table 7 results for OLS regression on event window (0,5) shows that specific event type does not significantly affect the CAR as the p-value is not statistically significant. Happened in the U.S. variable indicates that events happened in the U.S. compared to events happened outside of U.S. have statistically significant CAR results by -3.2%. Direct impact on U.S. is also negative and it indicates that the events that had direct impact on the U.S. has statistical CAR of -1.90% when comparing to the events that did not have direct impact on the U.S. The only statistically significant result regarding the sectors was industrial sector that was -2.40% compared to the base sector healthcare. All the other sectors are negative but not statistically significant.

Table 8: OLS regression for CAR event window (-3,3), base sector left out is healthcare

Variable	Coefficient	t-ratio	p-value
Event type: war = 0, terrorism =1	−0,0047	−0,4798	0,6317
Happened in the U.S., No = 0, Yes =1	−0,0777	−4,895	0,0000***
Direct impact on the U.S. 0 = no, 1 = yes	−0,0003	−0,0269	0,9785
Communication services	−0,0091	−0,516	0,6062
Consumer cyclical	−0,0214	−1,401	0,1624
Consumer defensive	−0,0036	−0,254	0,7996
Energy	−0,0035	−0,1878	0,8511
Financial sector	−0,0129	−0,935	0,3503
Industrials	−0,0313	−2,370	0,0185**
Technology	−0,0093	−0,6974	0,4861
Basic materials	−0,0491	−1,278	0,2023
Significance levels * for p < 0.1, ** for p < 0.05, and *** for p < 0.01			
F-significance of the model: 0,0000***			

Source: Authors calculations

Table 8 continues the same trend as in Table 7 that the event type does not significantly affect the CAR. Happened in the U.S. variable has a significant result of -7.7% compared to the events that did not happen in the U.S. Direct impact on the U.S. variable does not provide any statistically significant results. The sectors follow up with the same results as in Table 7. Industrial sector is the only statistically significant result that was -3.1% compared to the base sector healthcare. All the other sectors are negative but not statistically significant.

Table 9: OLS regression for CAR event window (-5,5), base sector left out is healthcare

Variable	Coefficient	t-ratio	p-value
Event type: war = 0, terrorism =1	0,0123	1,228	0,2204
Happened in the U.S., No = 0, Yes =1	−0,081	−5,138	0,0000***
Direct impact on the U.S. 0 = no, 1 = yes	0,0254	2,108	0,0359**
Communication services	0,0004	0,027	0,9778
Consumer cyclical	−0,0154	−1,005	0,3159
Consumer defensive	−0,0006	−0,045	0,9640
Energy	−0,0194	−1,023	0,3069

Financial sector	−0,0105	−0,759	0,4485
Industrials	−0,0299	−2,256	0,0248**
Technology	−0,0130	−0,972	0,3316
Basic materials	−0,0595	−1,542	0,1242
Significance levels * for p < 0.1, ** for p < 0.05, and *** for p < 0.01			
F-significance of the model: 0,0000***			

Source: Authors calculations

Table 9 does not show statistically significant results to the event type. Happened in U.S. variable shows significant result of -8.1%. Direct impact on the U.S. shows positive coefficient by 2.54% and is statistically significant. The sectors show similar results as in the previous tables that the only statistically significant result is in the industrial sector, which is -2.99% compared to the base healthcare sector. All the other sectors are negative except the communication services, but the results are not statistically significant.

Table 10: OLS regression for CAR event window (-10,10), base sector left out is healthcare

Variable	Coefficient	t-ratio	p-value
Event type: war = 0, terrorism =1	0,0445	3,433	0,0007***
Happened in the U.S., No = 0, Yes =1	−0,1402	−6,801	0,0000***
Direct impact on the U.S. 0 = no, 1 = yes	0,0807	5,178	0,0000***
Communication services	−0,0112	−0,4876	0,6262
Consumer cyclical	−0,0150	−0,7609	0,4473
Consumer defensive	−0,0194	−1,036	0,3011
Energy	−0,02394	−0,9750	0,3304
Financial sector	−0,0191	−1,067	0,2870
Industrials	−0,0487	−2,843	0,0048***
Technology	−0,0332	−1,917	0,0563*
Basic materials	−0,0589	−1,181	0,2387
Significance levels * for p < 0.1, ** for p < 0.05, and *** for p < 0.01			
F-significance of the model: 0,0000***			

Source: Authors calculations

Table 10 shows statistically significant results of 4.45% to the event type variable. The result indicates that terrorist related events have positive CAR result compared to the war events.

Happened in U.S. shows significant results by -14.0%. Direct impact on the U.S. shows positive result of 8.07% and is statistically significant. Sector results show that industrial sector coefficient was -4.87% and statistically significant, and technology sector coefficient was -3.32% and statistically significant compared to the base sector healthcare. All the other sectors are negative but not statistically significant.

Table 11: OLS regression for CAR event window (-15,15), base sector left out is healthcare

Variable	Coefficient	t-ratio	p-value
Event type: war = 0, terrorism =1	0,04850	3,622	0,0003***
Happened in the U.S., No = 0, Yes =1	−0,0992	−4,666	0,0000***
Direct impact on the U.S. 0 = no, 1 = yes	0,0583	3,625	0,0003***
Communication services	−0,0050	−0,2103	0,8336
Consumer cyclical	−0,0094	−0,4632	0,6435
Consumer defensive	−0,0072	−0,3715	0,7106
Energy	−0,0145	−0,5731	0,5670
Financial sector	−0,0021	−0,1172	0,9068
Industrials	−0,0329	−1,862	0,0635*
Technology	−0,0176	−0,9865	0,3247
Basic materials	−0,0669	−1,299	0,1948
Significance levels * for p < 0.1, ** for p < 0.05, and *** for p < 0.01			
F-significance of the model: 0,0026***			

Source: Authors calculations

Table 11 shows statistically significant results to the event type by 4.85% the result indicates that terrorist related events have positive CAR result compared to the war events. Happened in U.S. shows significant result to coefficient by -9.92%. Direct impact on the U.S. shows positive coefficient of 5.83% and is statistically significant. Sector results show that industrial sector results in -3.29% and is slightly significant compared to the base sector healthcare. All the other sectors are negative but not statistically significant.

3.3. Discussion

Previous studies by Markoulis and Katsikides (2020), Verma and Hasan (2023), Kollias et al. (2011), Papakyriakou et al. (2019) and Karolyi and Martell (2005) bring support to these findings. The studies found negative impacts for abnormal returns and cumulative abnormal returns from geopolitical events effects on the stock markets. This study also proved that geopolitical events have had a negative impact on the Dow Jones Industrial Average components. The average abnormal return with all the 11 chosen events combined was –0.57% and it was highly significant.

Table 4 provided a breakdown of the average abnormal returns (AAR) on the specific event days. There were notable findings regarding the high negative returns on 9/11 terrorist attacks and the Madrid bombings. Conversely there were positive AAR on the U.S. Iraq war and the Russia Ukraine War which suggest that the markets might perceive positively due to the anticipated benefits or relief from uncertainty.

The calculations on Table 1 shows that the mean CARs are negative in all event windows, which suggest that there is a general trend of negative impact on stock returns following the market shocks. The CAARs, however, reported negative values in windows (-3,3), (-5,5), (-10,10) with significant p-values. While (0,5) and (-15,15) did not show statistically significant results. The overall pattern supports a trend of negative effects. Additionally, Table 3 shows that the average abnormal return for all the events combined has a result of -0.57%. The hypothesis: ‘’Market shocks have negative returns for the stock components of the Dow Jones Industrial Average’’ the results show that we fail to reject the hypothesis as there is consistent and statistically significant evidence that these events had negative effects on the stock components on general. However, if we would observe the events separately the hypothesis would need some corrections as there is evidence that some events have experienced positive abnormal returns. When looking at the results for events happened in the U.S. Table 6, we can see that all the CAARs in different event windows were negative, but two out of five were not statistically significant. These results would suggest that the events happened in the U.S. have more negative impact on the stock components of Dow Jones Industrial Average compared to the Table 5 results of events happened outside of U.S.

The results and the data suggest that there are spillover effects both negative and positive for the components of Dow Jones Industrial Average. There were several events occurring outside of U.S.

and given the results of negative or positive reaction for the U.S. based market this study claims that there are spillover effects.

The additional analysis was made by using ordinary least squares for all the event windows (0,5), (-3,3), (-5,5), (-10,10), (-15,15). The F-significance displays if the calculations for OLS regressions were significant as a whole model and when looking at the tables for OLS regression every event window was below the 0,01% mark, that indicates that all the tables were highly significant.

The chosen base sector was healthcare as it had great amount of different stock components between all the events. As a result, the base sector provides comprehensive results for the other sectors as the sector has been in the DJIA index from the start.

The regression results show that the event type does not have statistically significant results in the short event windows, the event type results implied that in the longer event windows war events have more negative outcome to the components than the terrorist events. Based on the results on the direct impact on the United States the regression shows that in all event windows there is more negative returns to the components when the events have happened in the U.S. This result was anticipated as the chosen index is U.S. based. There were interesting results when it comes to the variable direct impact on the U.S. comparing that to the events happened in the U.S., we can see statistically significant positive results in the longer event windows (-5,5), (-10,10), and (-15,15). The variable direct impact on the U.S. includes four events, 9/11 terrorist attack, Boston marathon bombing, U.S. Iraq war, and U.S. Iran tension. While the immediate terrorist attacks like 9/11, and Boston marathon bombing caused a negative shock, the prolonged events might lead to different market behaviors. The events U.S. Iraq war and U.S. Iran tension could have been anticipated by the markets. The investors might have had strategy responses to these prolonged events, or the results might also indicate that the events that did not have direct impact on the U.S. have had more negative response in the longer event windows than the events that was directly impacted with the U.S.

Sector results indicated that while all the sectors were negative in most of the event windows the only significant sector in all event window was the industrial sector compared to the healthcare. The industrial sector shows statistically significant result as the industrial companies are seen as more vulnerable to international events due to the supply chain disruptions or the changes in the trade dynamics with different countries.

The limitation of this study is important part to understand. This study focused only on the 11 chosen events with the components of Dow Jones Industrial Average. The study could have had more background information of the components as macroeconomic variables and global market conditions. The future studies could also study the returns for longer period to see when the components go back to the so-called normal state. The results cannot be directly linked to other indexes performance under the same events. As in every study, there may be deviations that could affect the results in someway and this study is not an exception.

CONCLUSION

This thesis examined the effects of 11 chosen geopolitical events on the components of the Dow Jones Industrial Average. The aim of this study was to examine the reaction from the chosen events for the components of Dow Jones Industrial Average. The study utilized event study methodology on an event window of 15 days prior the event until 15 days after the event occurring. The study also employed Ordinary Least Squares regression. The 11 chosen events were: 9/11 terrorist attack, U.S. Iraq war, Madrid bombing, London bombings, Boston marathon bombing, Paris terrorist attacks, Brussel bombing, Sri Lanka bombing, U.S. Iran tension, Russia Ukraine war, and Israel Hamas war. The impact of these events was measured by abnormal returns, cumulative abnormal returns, average abnormal returns, and cumulative average abnormal returns. Based on the aim of the thesis the following research question was formulated: How do the abnormal returns of Dow Jones Industrial Average stock components differ during market shocks. Based on this research question one hypothesis was developed.

H1: Market shocks have negative returns for the stock components of the Dow Jones Industrial Average.

After reviewing the results, the study discovered that there were negative returns from the chosen events to the components of Dow Jones Industrial Average and therefore the hypothesis was failed to reject as the results showed consistent and statistically significant evidence that the chosen 11 events had average negative returns on the stock components on general. However, examining the events separately there would be need to adjust the hypothesis as some of the events had positive reaction on the event day.

The answer to the research question based on the results is that abnormal returns was mostly negative with highly statistical significance. In short event windows the event type did not show any statistical significance but in the longer event windows the war related events experienced more negative reaction than the terrorist related events according to the regression calculations.

The efficient market hypothesis suggest that markets incorporate all available information (Fama, 1970). However, the different impacts that were observed for different events might indicate that the market's ability to process information could be event specific. The examples for this could be the complexity and unpredictability as some of the events have unpredictable consequences making it harder for markets to assess the full implications instantly. The information of the events is not distributed evenly which could lead to discrepancies in how quickly the prices reflect the information. The investors are humans and may react emotionally to certain events which could lead to overreactions on short term or underreactions in the long term.

The spillover effects were involved in events that did not have any direct impact on the United States but had still negative or positive reaction from the market. Some of the highest spillover effect was seen in the Madrid bombing where the abnormal return on the event day was -1.76%. Some positive spillover effect was in the event's Russia Ukraine war, and Israel Hamas war with event day abnormal returns 1.90% and 0.47%.

Based on the results obtained in this thesis, the investors can benefit from the findings. Investors will have a better understanding and anticipation, as the results present that the event effects on the chosen market are short-term. Investors should know that based on the results the event type does not contribute to the market reaction in short time. Longer event windows show that war events have more negative impact than terrorist events.

Future studies regarding geopolitical market shock effects could benefit from adding a macroeconomic factors and global market conditions as they would provide more deep information and additionally correct some anomalies that the results might present. Exploring also more long-term results and the time it takes to the components to get into the so-called normal state would be good addition to future studies.

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APPENDICES

Appendix 1. List of Dow Jones Industrial Average index components

Table 12. The list of Dow Jones Industrial Average components during the events

Dow Jones Industrial Average components	**Column1**	**Column2**
3M	MMM.N	1.1.1994 - Present
AIG	AIG.N	8.4.2004 - 22.9.2008
Altria Group	MO.N	1.1.1994 - 19.2.2008
American Express	AXP.N	1.1.1994 - Present
Amgen	AMGN.OQ	31.8.2020 - Present
Apple	AAPL.OQ	19.3.2015 - Present
Boeing	BA.N	1.1.1994 - Present
BofAML	BAC.N	19.2.2008 - 23.9.2013
Caterpillar	CAT.N	1.1.1994 - Present
Chevron	CVX.N	19.2.2008 - Present
Cisco Systems	CSCO.OQ	8.6.2009 - Present
Citigroup	C.N	8.10.1998 - 1.6.2009
Coca-Cola	KO.N	1.1.1994 - Present
Dow	DOW.N	2.4.2019 - Present
Dupont De	DD.N	1.9.2017 - 02.04.2019
Exxon Mobil	XOM.N	1.1.1994 - 31.8.2020
GE	GE.N	1.1.1994 - 26.6.2018
Goldman Sachs	GS.N	23.9.2013 - Present
Home Depot	HD.N	1.11.1999 - Present
Honeywell Intl	HON.OQ	31.8.2020 - Present
Honeywell Intl	HON.OQ	1.1.1994 - 19.02.2008
Howmet	HWM.N	1.1.1994 - 23.9.2013

HP	HPQ.N	17.3.1997 - 23.09.2013
IBM	IBM.N	1.1.1994 - Present
Intel	INTC.OQ	1.11.1999 - Present
Intl Paper	IP.N	1.1.1994 - 8.4.2004
Johnson&Johnson	JNJ.N	17.3.1997 - Present
JP Morgan	JPM.N	1.1.1994 - Present
Mcdonald's Corp	MCD.N	1.1.1994 - Present
Merck & Co	MRK.N	1.1.1994 - Present
Microsoft	MSFT.OQ	1.11.1999 - Present
Mondelez Intl	MDLZ.OQ	22.9.2008 - 24.9.2012
Nike	NKE.N	23.9.2013 - Present
Pfizer	PFE.N	8.4.2004 - 31.8.2020
Procter Gamble	PG.N	1.1.1994 - Present
Rtx Corp	RTX.N	1.1.1994 - 31.8.2020
Salesforce	CRM.N	31.8.2020 - Present
Travelers	TRV.N	8.6.2009 - Present
UnitedHlth Grp	UNH.N	24.9.2012 - Present
Verizon	VZ.N	8.4.2004 - Present
Visa	V.N	23.9.2013 - Present
Walgreens Boots	WBA.OQ	26.6.2018 - Present
Walmart	WMT.N	17.3.1997 - Present
Walt Disney	DIS.N	1.1.1994 - Present

Appendix 2. CAAR for events that did not have direct impact on U.S.

Table 5: CAAR for Events that did not have direct impact on U.S.

Variables	CAAR	St. Dev	Min	Max	t-stat	p-value
CAR (0,5)	0,89 %	0,034	-7,18 %	4,39 %	3,616	0,00038***
CAR (-3,3)	-0,02 %	0,036	-10,39 %	1,39 %	-0,089	0,9287
CAR (-5,5)	-0,01 %	0,047	-10,59 %	3,46 %	-0,043	0,9651
CAR (-10,10)	-1,33 %	0,065	-13,44 %	6,87 %	-2,834	0,0050**
CAR (-15,15)	-0,63 %	0,076	-18,18 %	7,25 %	-1,133	0,25
Significance levels * for $p < 0.1$, ** for $p < 0.05$, and *** for $p < 0.01$						

Source: Authors calculation

Appendix 3. CAAR for events that had direct impact on U.S.

Table 6: CAAR for events happened or impacted U.S. directly.

Variables	CAAR	St. Dev	Min	Max	t-stat	p-value
CAR (0,5)	-2,60 %	0,066	-34,01 %	11,71 %	-4,025	0,0001***
CAR (-3,3)	-3,82 %	0,104	-44,27 %	15,26 %	-3,773	0,0003***
CAR (-5,5)	-1,80 %	0,094	-37,45 %	16,06 %	-1,973	0,0511*
CAR (-10,10)	-1,15 %	0,121	-44,26 %	27,43 %	-0,975	0,3319
CAR (-15,15)	-0,75 %	0,106	-30,11 %	26,77 %	-0,729	0,4677

Significance levels * for $p < 0.1$, ** for $p < 0.05$, and *** for $p < 0.01$

Source: Authors calculation

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