Master Thesis

Financial Economics

"Conflicts around the world and their effects on the oil price"

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Abstract

This paper investigates the effects of various conflicts around the world associated with crude oil and their impact on the oil price. The examination occurs for both BRENT and WTI prices by implementing an event study methodology and a linear regression. Furthermore the conflicts are studied based on their characteristics, including time that took place, the type of conflict and region of the conflict. After the initial comparison the variable of previous oil exports from the region of the conflict is included in the regression.

The findings of this thesis answers the question of the effect of conflicts in the oil price by presenting significant results. Moreover, the comparison between time periods indicate higher abnormal returns on the time frame after 2008. The comparison between types of conflicts indicate that while armed conflicts present high abnormal returns before the official start of the conflict the height of the cumulative abnormal returns are similar to armed conflicts in the end of the event window. The region of the conflict plays a more significant role for the WTI oil price rather for BRENT. Finally it is found that previous oil exports indeed have a highly positive and significant effect on the oil price, producing high abnormal returns.

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Introduction

Fossil energy has been one of the most important parts of the world's economy for more than fifty years. The most important and precious form of fossil energy is oil since it has been the literal fuel for both people's everyday life and growth of the economy.

Oil is such an invaluable resource and commodity for the world economy that is closely watched by the market in an attempt to predict possible movements in the price. Although oil is closely watched it is still considered very difficult to predict and more often than not conjecture about its price movements is wrong. The reason behind this unpredictability is the amount of variables that affect it.

The sudden growth of emerging markets and the degree of focus in industrialization by various countries has increased the demand around the world. The fact that demand was steadily increasing meant that supply would have to be increased as well and that led to some supply shocks and oil price fluctuation.

Another important part in the oil price movements was the great advancements in technology. Innovation in various oil processes like extraction, refining, and transport have changed the landscape and created a very strong industry with a significant role. Moreover the technological advancements in everyday life played a role in the growth of the economy and in extension in the demand for more oil than previous years.

Other reasons for the oil price volatility are the renewable energy market that is constantly expanding in combination with the stricter regulation in the industry in order to protect the environment and avoid the consequences of climate change. The state of the economy significantly affects the oil price movement too, as evident by the financial crisis in 2008.

Lastly, a very important factor in oil price volatility is the geopolitical instability that exists in regions where vast amounts of oil are present. In the last thirty years there have been numerous conflicts that in some instances led to human casualties and in other instances only to economic and political repercussions. The majority of those conflicts take place in the Middle East but in recent years countries around the world that have increased their production of oil have seen similar conflicts. The reasons behind these conflicts vary from cultural, political or economic differences, but in all cases the countries involved have

economies centered in fossil energy, more specifically in the production and export of crude oil. Whether oil is the true reason behind all these conflicts, it does not change the fact that a significant part of the world's oil production comes from these countries and one significant conflict in the area can have effects on the oil price and the world's economies to an extend.

Whenever a new conflict breaks out in regions where oil is an integral part of the economy, sudden movements in the oil price are often evident and watched closely. When conflicts arise in regions like the Middle East or countries like Venezuela and Nigeria, where oil is the primary resource for the economy, the price of oil becomes unstable as the markets react to a possible disruption of the available supply of oil. This reaction can have significant effects and lead to "oil price shocks", where the price of oil has a sudden and sharp increase. The possibility of these shocks in the oil price makes the understanding of the consequences of a conflict imperative.

The existing literature has sufficiently covered wars and conflicts from the Second World War till the US - Iraq war of 2003 but the connection between oil and conflicts has not been sufficiently studied. Previous literature in armed conflicts was focused mostly on the US economy and the consequences of the country's involvement, while others focused on American wars before 2001 or the effect on US stock market (Brune, Hens, Rieger and Wang 2011). The literature also somewhat covers the effects of tariffs in the oil price, the effects of regulation and OPEC announcements on crude oil (Demirer, Kutan 2010). After careful examination, there is a clear literature gap. There is not enough research of the effects of conflicts in the oil price and what is the magnitude of these effects. Moreover the conflicts examined previously are either full scale wars, where usually the US was a participant or conflicts in the region of the Middle East exclusively. The current literature does not include conflicts in other regions, where oil still plays a pivotal role or different types of conflicts such as economic restrictions and political maneuvers. The significance of non-armed conflicts can be seen throughout history with the most evident example of the Cold War between the US and the Soviet Union, a war that never progressed to an armed conflict but nevertheless shaped the world as we know it. This research focuses on this gap in the literature and attempts to quantify the effects and the magnitude of various types of conflicts from various regions in a time frame of thirty years.

The objective of this thesis is to study the effects of conflicts that either could have potentially disrupted the global oil supply or actually disrupted the oil supply due to the conflict. This goal is achieved by performing an Event Study analysis based on MacKinlay (1997), in a plethora of conflicts of various types (armed/non-armed), locations and time periods. The time frame selected for the examination of the potential conflict effects on the oil returns is measured in weeks, where usually it is in days, as the disruption of the oil supply and the instability that follows can have longer lasting effects. By performing this analysis this thesis tries to translate potential effects of conflicts on the oil price and quantify their magnitude. The assumption that this thesis follows is that a possible disruption in global oil supply will lead in a surge of the oil price. The inclusion of conflicts from different periods of time, location and type of conflicts provides the opportunity for this thesis to further compare the effects on oil, based on the above mentioned classifications and draw further conclusions on whether more pronounced results are evident. Moreover as the next step of the analysis an ordinary least squares regression is performed on the results on the event study. The variables that are examined are based on the above mentioned classifications of the event study. The goal of the regression is to study the effects of these variables and to understand at what degree affect the possible abnormal returns due to conflicts. Lastly, a second regression is implemented with the inclusion of a new variable, the oil exports of the country in conflict. The inclusion of this variable provides the opportunity to bolster the assumption that the possible disruption on the flow of oil because of conflicts drives prices higher and the higher the amount of oil in jeopardy the higher the effect on the price. The ultimate goal of this study is the attempt to ask the question what happens in the oil price when a new conflict arises.

Lastly, it is important to be stated that in this data sample of various conflicts, there are conflicts included that have never been studied before either due to the fact that none of the "superpowers" like US or Russia was involved or due to the fact that a lot of the included conflicts happened in the last ten to twelve years and there was not particular interest yet. This opportunity provides a chance to quantify the significance of conflicts that have never been studied before but also to see the significance of conflicts through time, where the importance of certain regions in the production and export of oil has steadily decreased throughout the years. This steady decrease of their importance could be due to the fact their

reserves have been declining as well but the biggest factor that changed the landscape in the global oil production is the resurgence of oil production in the US.

1. Literature Review

The literature that can be found about the subject of conflicts and oil can be classified in various types. Some of the literature focuses on various international conflicts and their effects on the economy or the capital markets, with few instances where a connection between oil and conflicts is drawn. The second type of literature focuses mostly on identifying oil shocks and their magnitude while examining the exogenous factors behind them. Finally the third type of available literature draws a connection between the various oil shocks that have been identified throughout the years and attempts to quantify their effects on the financial markets. All these aspects of the available literature is presented below and in the end of the chapter certain remarks are made about the possibility of a gap in the literature.

1.1 International conflicts and their effects

The international conflicts that took place in the Middle East throughout the years is a subject that has been researched thoroughly, since one of the main countries involved is the US. The previous literature is mostly focused on the First Gulf War (1990) and the Iraq War (2003), two of the most significant conflicts in the region due to the participation of the US. The research about those wars is a very lively subject for various fields. Jhaveri (2004) focuses on the political reasons and policies that ultimately led to the conflicts, suggesting that US oil interests in the region were the main motivator.

An approach focused more on the financial consequences of international conflicts and wars in the region involving the US was taken by Looney (2003). In his research he observes that due to the volatility of the oil price at the start of the armed conflict, specifically the Iraq war of 2003, prediction of the future movements is unwise. Although the conflict caused the oil price to have a volatile reaction, this movement is much smaller than it was in the previous

significant armed conflicts in the region (First Gulf War etc.). A reason behind this significant difference is the fact that the Iraq war was the result of a prolonged period of tensions where war was the inevitable result, something that was reported heavily during the time. Moreover, in order for the global oil supply to remain stable, OPEC had already increased the production quotas for the year 2003 and 2004 significantly (more than 3.5% yearly increase in oil production). Moreover in Looney (2003), the event window of the analysis is focused on the first days of the announcement of the war, a measurement that does not capture the prolonged effects of a conflict.

Along the lines of Looney (2003) the research paper by Kilian (2004) comes to similar findings while focusing on a macroeconomic view of the consequences of international conflicts and oil price. At first he attempts to establish the importance of oil shocks in the economy and its effects. After establishing the significance of oil shocks he focuses behind the reasons of said shocks. While he acknowledges that war and conflicts in general have an important effect on the oil price since a possible war can impact the world oil supply, he also suggests that there are various factors behind the creation of an oil shock. Some of those factors are current demand conditions and the response of the rest of oil suppliers. He also acknowledges that even the political instability and uncertainty to a region can have an effect on the oil price and in order to prove this assessment he points to the Iraq War of 2003, where this was alluded to a long time before the actual start of the conflict but due to uncertainty the price still spiked.

A different approach was adopted by Jee Young Bae & Eunnyeong Heo (2017) than the previous literature on the subject. Their focus was the connection between international conflicts and international oil companies. Using the event study methodology, they showed that oil companies experienced a spike in their price that led to abnormal returns. This spike is connected with the oil shock that was created during the time of conflict in the Middle East. In order to bolster their findings they used four different wars in the region and more than nineteen oil companies. Moreover they divided the international oil companies in US and non US companies in order to observe if the findings were even more significant since the US was a main participant in all of the studied wars. Their findings showed that the abnormal returns were even more pronounced for the US companies, a finding that shows a possible connection between political decisions of the participating countries and higher stock market

returns. Although their research shows a relationship between conflicts and oil companies, the amount of conflicts studied is not enough to draw certain conclusions on the significance and the magnitude of their relationship. Moreover the effect of different time periods is not examined and the sample of examined conflicts was confined in only one region.

The research by Brune, Hens, Rieger and Wang (2011) on the effects of the wars in the capital markets is very intriguing and may be used to explain contradictory findings in previous literature. The research was focused on the reaction of the US stock market to wars the US has taken part in, going back to the Second World War until the War in Afghanistan in 2001. With a news analysis proxy used in order to estimate the likelihood of a conflict to result in war they came to some puzzling findings. The stock market was very sensitive in its reaction, specifically it was observed that when the probability for war was high the stock market was affected negatively but when the actual war started the prices in the capital markets were increasing. In the case of wars that were unexpected to the public the capital markets had a negative response. The reasons behind this puzzling effect could not be clearly identified but nevertheless this might help future research with explanation of the movement of the oil price during the time of conflict. As suggested by this paper as well, some conflicts were indicated before their actual start and might provide contradictory evidence.

1.2 Oil price shocks and exogenous factors

The second category of the available literature consists of research that indeed focused on the price volatility and spikes of crude oil, the various shocks that have been identified throughout the years, either demand or supply shocks, the exogenous factors that create these shocks and the global reaction and countermeasures.

The research by Baumeister and Lutz (2016) is one of the above mentioned literature. The authors try to identify and measure oil shocks that have happened from 1973/1974, the date of the oil crisis that resulted in significant changes in the economy, until 2014. In the examined period of forty years, the authors identify various supply and demand shocks and the events that caused them. In their effort to examine how these events have such a significant amount of effect in the oil price, the authors connect that the magnitude of oil price volatility depends

on the oil price expectations. Further the authors document that oil price expectations differ between the participants of the economy since a change in the oil price has different effects on the consumers, the policymakers and the financial markets participants. Those differences increase in the unpredictability of the oil price, where a plethora of other factors affect it already.

Another research inspired by the oil crisis of the 1970's by Economou and Agnolucci (2016) focuses on oil shocks. The authors focus on the oil supply shocks from 1990 to 2014, in order to test the conclusions of various research that suggested that oil supply shocks are rare and of limited importance compared to demand shocks. In order to achieve that the authors identify the oil supply shocks in the examined period and further they differentiate between shocks due to exogenous and endogenous factors. Their results show that exogenous effects do affect the price of oil. In the 1990s geopolitical episodes account for 7% of the variability in global oil production. From the 2000s the pattern changes and market specific events account for 6%. Another noteworthy result of the study is that from 2010 till 2014 the main factors that affected the oil price are exogenous and that is the reason the authors study various conflicts of the time such as the Libyan Civil War and the Arab Spring in general. Their findings manage to bring proof against previous research that suggested supply shocks are of limited importance and further prove that exogenous effects indeed affect the price of oil, aligning with the existing view that disruptions on the supply of oil, especially in a period of increasing demand will lead to sharp increase of the oil price.

The research on the effects of exogenous factors like international conflicts on oil prices is very important in order to understand the variables that induce volatility and price spikes, something that the previous literature in chapter **1.1** has covered in a certain amount. Another important factor that was investigated by Loutia, Mellios and Andriosopoulos (2015) was the possible connection between OPEC announcements and oil price volatility. Implementing the event study methodology and using more than one ways for abnormal return calculation they observe the oil returns for the period of 1991 – 2015 in relation with OPEC announcements. Their results help draw some interesting conclusions on yet another variable that affects the oil price. Specifically, they found OPEC announcements indeed affect oil price but it varies across periods, states of current oil price and the production decisions made by OPEC. For example when there is a decision to reduce production of oil has a

significantly more pronounced effect on the oil price than the opposite. Another example of their findings is that when oils prices are currently high, OPEC announcements have a much smaller impact than the opposite. Therefore a dilemma is created on whether to attempt to keep oil prices down since it is harder for competitors to penetrate the market or to attempt to raise oil prices for the benefit of OPEC member's revenues.

1.3 Oil shocks and capital markets

The remaining literature on oil and oil shocks due to international conflicts or other exogenous factors tends to focus more on the effect on capital markets and not oil itself. One of the most commonly cited articles about the impact of oil price shocks and the capital markets is the research of Kilian and Park (2009). The research is confined to the US stock market but the methodology and results are noteworthy. The authors identify possible problems that might skew the results when implementing similar models with previous researchers and that is why he uses the structural vector autoregression method. Their findings suggest that oil supply shocks are very insignificant in relation to their effect on stock prices. The shocks in oil demand are very important and have a negative relationship with stock prices. The article also presents evidence that an oil price that is driven higher by global economic growth will have a positive relationship with stock returns and produce gains.

Based on the previously mentioned Kilian's and Park's research and due to the surge of oil production in the US from 2009 and onwards, Kang, Ratti and Vespignani (2016) investigate the claims of supply shock insignificance even further. Separating between US oil supply shocks and non US oil supply shocks they attempt to find differences in relation with the stock market. The article splits the investigation in two periods. The first period is from 1973 to 2006 in order to coincide with Kilian's research time frame and the second t is from 1973 to 2014. In terms of methodology the authors use a similar structural VAR model developed by Kilian in his previous article. Their results show the existence of a positive relationship between US oil supply shocks and US stock returns even for the period that Kilian had investigated and found no important connection. The relationship is statistically significant

and the authors argue that the differentiation between US and non US oil supply shocks is an important factor that it was not previously considered by Kilian and Park (2009).

The research about oil price shocks and stock returns about the US economy was even more specialized by Elyasiani, Mansur & Odusami (2011), where they investigated the possibility of oil shocks during the period 1998-2006 had affected excess stock returns and excess stock volatility in thirteen different US industrial sectors. By focusing on the industries and not just the capital market as a total, they had the opportunity to properly understand the impact of oil shocks in the economy. The article employed a Garch (1,1) model to capture the risk and return patterns for the different sectors. Their findings provide evidence that oil price fluctuations are a systematic asset price risk at the sector level since at least nine out of thirteen sectors show a statistically significant relationship between oil returns and industry returns. The results also show that the degree of the relationship between oil and industries varies across industries. For example oil substitutes and oil related industries are affected more from the oil returns, while oil users industries are affected more from the oil returns volatility. This research comes along with the one by Kang, Ratti and Vespignani (2016) to suggest that there is a connection between the US stock market and oil shocks or oil prices in general.

The bulk of the literature in the subject of oil price and capital markets is focused mostly in the US but there are noteworthy research papers that examine different markets and countries, producing very interesting results. One of the aforementioned research papers is the one by Basher, Haug & Sadorsky (2011). Using the “structural vector autoregression”, a method initially implemented by Kilian (2009), they investigated the relationship between oil price and emerging stock market prices and also oil price and its link with exchange rates. The results of the research show that positive shocks in the price of oil tend to affect negatively emerging stock markets and also the US dollar exchange rate in the short term. Moreover the model shows that a positive shock in oil production leads to lower oil prices, a logical finding in accordance with the economic theory of supply and demand. Lastly the authors find that a positive shock to economic activity leads to increase of oil prices, a finding in line with Kilian and Park (2009) findings that in a period of economic growth the oil price may be affected positively.

The link between crude oil price and capital markets has come to changes throughout the years. In their research, Miller and Ratti (2009) studied this relationship for various international capital markets and for the period 1971–2008. In order to study this connection the authors used cointegrated vector error correction model with additional macroeconomic variables as regressors to capture short term effects. Their findings show a clear long term relationship for all tested capital markets and the world oil price during the periods 1971 - 1980, 1988-1998 with positive statistical significance. The results show that in the long run when the world oil price increases the stock market price decreases. The 1988-1998 period presents a much less pronounced significance of the mentioned effects and is a precursor for the future. The last period 1999-2008 shows an even further disintegration of the relationship between crude oil price and capital markets and sometimes even opposite effects. The findings support the generally accepted theory that the relationship between oil and markets has changed throughout the years due to numerous variables.

The link between oil price shocks and capital markets is a very interesting issue and has been examined by different avenues. A new avenue of investigation is the research paper of Wang, Wu & Yang (2013). In their research the authors examine oil shocks and capital markets from oil importing and oil exporting companies, assuming that the effects in those countries will be more pronounced than other countries with not as strong connection to oil. The countries are studied separately in two categories with the same methodology Kilian and Park (2009) implemented, the “structural vector autoregression”. The period investigated is January 1991 to December 2011, nine oil importing and seven oil exporting countries were investigated. Their findings show there are a lot of varying reactions in terms of magnitude, duration and direction of the response. These reactions depend on whether the country is oil importing or oil exporting and whether there is a demand shock or a supply shock. Their results show that the oil market has a big impact in capital markets for both categories. More specifically the effects oil demand uncertainty has a long term effect in oil exporting countries while in oil importing countries the effect is smaller and short term. During oil price shocks the effect in the capital markets of oil exporting countries is very pronounced and countermeasures should be established like investment on the futures market. In the case of oil importing countries the effect is minimal in comparison with the other set of countries.

1.4 Remarks on the Existing Literature

After the careful examination of the available literature on the subject of conflicts, oil and their relationship, it is clear that there is a gap. Specifically, while most of the research papers accept that exogenous factors like conflicts were the cause of oil shocks in the past, the effects of these conflicts on the oil price are either not examined or are constrained due to a small amount of conflicts examined, conflicts that usually resulted in full scale wars. Other reasons are that the examination is focused on exogenous effects in general and not specifically on conflicts, thus preventing to draw clear conclusions on the true effect of conflicts or the preference for studying the capital markets and how they are affected by said exogenous effects. The subject of this thesis aims to cover this literature gap by focusing solely on the effects of conflicts on the oil price.

2. Theoretical Framework

The subject of conflicts and their effects on the economy is a subject that has been researched from various points of view. As can be seen from the examination of the literature review though, those points of view do not include a clear examination of the impact and magnitude of the geopolitical conflicts with potential to disrupt the global oil supply. While some studies denote the fact that conflicts can indeed create price volatility and sharp price increases, these studies do not go in depth of the actual effect of said conflicts. Other studies while they indeed examine the effects of conflicts either on the oil price or the capital markets, they tend to focus on a small amount of conflicts and often only conflicts that escalated to wars or the US was involved. While these studies provide a glimpse on the possible impact, they do not focus on this important exogenous factor specifically, but they blend various exogenous factors in the same sample.

The purpose of this thesis is to shed light on the impact of various conflicts that happened throughout the years around the world, including both armed and non-armed conflicts and find the connection with abnormal oil returns. The methodology used is the event study method according to MacKinlay (1997) and an OLS regression on the results of the event

study. Using these methods a lot of questions are tried to be answered that previously were unknown or not quantified in order to draw safe conclusions. These questions are, the existence or not of an oil shock due to conflicts, the degree of abnormal oil returns due to conflicts, the duration of said abnormal returns and the possibility of information leakage before the official start of the conflict. Another opportunity provided by using a bigger sample consisting only of conflicts is the possibility of comparison between various aspects of those conflicts. This thesis tries to answer not only the question about the magnitude of the effect of conflicts on the price of oil but also the different effects between armed and non- armed conflicts, pre 2008 and after 2008 conflicts and finally conflicts in the Middle East and conflicts in the rest of the world. In order to understand the significance and the differences of these variables the OLS regression tries to estimate each variable's effect on the abnormal returns found from the event study. Moreover the inclusion of another variable, oil exports of the country in conflict, is tested in order to examine the significance of a possible disruption on the global oil supply due to conflicts and the effects on the oil price.

3. Methodology

In this chapter the methodology that was followed for this thesis is presented. The chapter is separated in two parts, the event study methodology and the regression methodology.

3.1 Event Study

The event study method is an essential tool that was used mostly in finance at first, although in the last twenty years it has been adopted in economic, accounting and even law research. The first use of this method was by Dolley (1933), where he studied the price effects of stock splits and the changes that prices were incurred at the time of the split. Throughout the years the method continued to grow and the modern and more complete version of the event study was first introduced by Fama et al. (1969). This thesis follows the seminal work of MacKinlay (1997) in order to implement this method correctly and efficiently.

The reason event study is such a useful analytical tool is because it provides the researcher a tool to examine the behavior and impact of a specific event on a firm/stock/commodity etc. With the assumption that the marketplace is rational, the impact of an event will be reflected on the security's/commodity's price. Therefore the economic magnitude of an event can be observed more expediently this way.

There is not a unique structure in an event analysis, but all of them follow the same basic principles. The first step is to identify the event date and the event window that will be examined. In the case of this thesis the official start of the conflict is the event date and the period slightly before and after is the event window. Specifically the event window consists of five weeks before the event date and five weeks after the event date. The inclusion of time before the announcement in the event window provides an opportunity to study if the conflicts were alluded to before their start or if the market was taken by surprise. As mentioned by Brune, Hens, Rieger and Wang (2011), the Iraq war was indicated before the official invasion and it will be interesting to see the extent of the validity of their findings when including a large amount of conflicts. The event time is measured in weeks rather than the most commonly used measurement of days, since a conflict is an event that can have prolonged effects due to the fact that it lasts more than a day. Also often the escalation of tensions before a conflict tends to last more than a few days prior and incorporating weeks as the measurement can potentially capture this more efficiently.

As the examined commodity two different oil price indicators are selected, BRENT crude and WTI (West Texas Intermediate), since historically they are the two most prominent indicators and they are frequently used in most research.

In order to appraise the impact of the various events selected, the abnormal returns need to be calculated for each conflict. The abnormal returns considered as the actual returns of the two crude oil prices selected during the event window minus the expected returns of the commodity index during the event window. The expected returns are considered to be the normal returns without the event taking place.

The available event study models that can be used for this study vary and there are merits for each use but the most common is the Market Model. This model is found to be easy to implement and provides stable results consistently, something that have been tested thoroughly by MacKinlay (1997) and others. In this model the normal returns are calculated

by relating the returns of the selected crude oil commodity with the returns of a commodity index. In this thesis the Thomson Reuters Commodity Research Bureau index (CRB) and Bloomberg Commodity Index (BCOM) have been chosen. The event study method of the Market model is implemented for both BRENT and WTI against both commodity indices. The reasoning behind the selection of two different commodity indices and two crude oil price indicators is that the differences in pricing between the two crude oils and the difference between weights of components for the commodity indices can result in slightly different results due to the explanatory power of the model. In order to test the fit of the model the R Square value is estimated, meaning that the higher the R square value the better is the model in identifying abnormal returns.

From the linear expression, the Market Model's mathematical relationship for the crude oil price indicator i takes the form of $R_{it} = a_i + \beta_i R_{mt} + \varepsilon_{it}$

Where R_{it} is the returns of the crude oil indicator for the examined period t, R_{mt} is the returns of the commodity index examined at period t , a_i and β_i are the parameters of the model and ε_{it} is the zero mean disturbance term with $var(\varepsilon_{it}) = \sigma^2 \varepsilon_i$

In order to proceed with the calculation and analysis of abnormal returns in the selected event window and the various conflicts selected, some clarifications are made. The estimation window that is considered for the calculations is 50 weeks. This means that it starts from one week before the established event window until it reaches 51 weeks before the established event window.

The estimation of the returns through the market model is done with the use of the method of Ordinary Least Squares (OLS). From the OLS method, parameter $\widehat{\alpha_i}$ is calculated the following way: $\widehat{\alpha_i} = \widehat{\mu_i} - \widehat{\beta}_i \widehat{\mu}_m$.

Where $\widehat{\mu_\iota}$ is the mean of the crude oil price's returns and $\hat{\mu}_{mt}$ is the mean of the commodity index returns. The parameter $\widehat{\beta_\iota}$ is calculated through the following known relationship:

$$\widehat{\beta_\iota} = \frac{\sum_{\tau=T_0+1}^{T_1} (R_{it} - \widehat{\mu_\iota})(R_{mt} - \widehat{\mu_m})}{\sum_{\tau=T_0+1}^{T_1} (R_{mt} - \widehat{\mu_m})^2}$$

Using the parameters and the actual returns of both the examined crude oil price and commodity index for each conflict, the abnormal returns are estimated for the event window. This estimation can be written mathematically as : $\widehat{AR}_{i\tau} = R_{i\tau} - \hat{a}_i - \hat{\beta}_i R_{m\tau}$.

After the calculation of abnormal returns for all conflicts separately, for BRENT and WTI and for each commodity index as well, the results are aggregated. Similarly to Demirer and Kutan (2010) the abnormal returns of each conflict for each crude oil and commodity index are aggregated in order for the average impact of conflicts to be studied. The abnormal returns of these conflicts are further aggregated based on the three categorizations established. The category of time period of the conflict, the category of the type of conflict and the category of the region the conflict takes place.

After the aggregation between events/conflicts, the cumulative abnormal returns (CAR) are calculated in order to study the total impact during the selected event window of five weeks before and five weeks after the event. The CAR estimation can be written mathematically as

$$CAR_{it} = \sum_{-5}^{+5} AR_{it}$$

With the estimation of all abnormal returns and the cumulative abnormal returns of the event windows of every conflict for each crude oil and commodity index the null hypothesis is rejected or accepted, where it states that the abnormal returns presented at the event date will equal to zero.

In order to test the significance of the results, one of the significance tests suggested by MacKinlay (1997), Kothari and Warner (2006) and further adapted by Corrado (2011) is implemented for the CARs in each day of the event window. This is implemented for two confidence levels, 90% confidence level and 95% confidence level. The significance levels for both commodity indicators, BRENT and WTI, are expected to vary due to the fact that the crude oil classifications vary in regions of production and quantity. Moreover the weights of BRENT and WTI in each commodity index vary and this is also reflected on the significance and explanatory power of the results as well.

As suggested previously in this chapter, before taking the results of the Market model into consideration, the explanatory power of the model (R-squared) is examined. It is expected that the explanatory power of the conflicts will somewhat vary due to the fact that the estimation window for each conflict is different in terms of time and the fact that each

commodity index has different explanatory power due to the variance of BRENT's and WTI's weights as components.

3.2 Regression

In order to study the results of the event study and to estimate the effects of the event study categories (Time period, Conflict Type, Region) an ordinary least squares (OLS) regression is performed. This method is a common tool used by other event studies in order to compare and conclude on the various reasons behind the CARs found. A regression analysis on the findings of CARs is a suggested tool in Kothari and Warner (2006) and it has been performed in various studies such as Beltratti et al. (2011) and Fioravanti et al. (2011). Through this method the difference between categories is studied in order to draw conclusions about the significance and magnitude of the possible differences. Furthermore, after the regression of the three variables based on the categorization of the event study, a new variable is introduced the previous year's amount of oil exports from the country in conflict. This variable is introduced to study the results of the event study even further and in order to draw a connection between the abnormal returns of the conflicts and the oil exports in jeopardy due to conflict. The assumption in this case is that a significant and positive relationship between the oil exports variable and CARs will further prove that abnormal returns in the price of oil are created by conflicts, especially when a large quantity of crude oil exports might be in jeopardy. Moreover the magnitude of this relationship is studied.

In order to study the categories Time period, Conflict Type and Region of Conflict, three dummy variables are created. The dummy variables take binary values of 1 and 0.

In the case of Time period the variable T_PERIOD is established where the binary value 1 equals the 2008-2019 period and 0 the 1990-2007 period. In the mathematical model of the regression the variable is symbolized as X_T.

In the case of Conflict type the variable C_TYPE is established where the binary value 1 equals Armed Conflicts and 0 the non-armed conflicts. In the mathematical model of the regression the variable is symbolized as X_C.

In the case of Region of Conflict the variable REGION is established where the binary value 1 equals the Middle East and 0 the conflicts happened in the rest of the world. In the mathematical model of the regression the variable is symbolized as X_R.

In the case of oil exports for the country in conflict the variable OIL_EXPORT is established where the amount of thousands barrels per day used after its division by the number 1000 in order to make the number appropriate and easy to fit in the model. Meaning that 1.1 equals to one thousand and one hundred barrels of crude oil per day. In the mathematical model of the regression the variable is symbolized as X_{EXP}

After the creation of the variables the Model takes the following form:

$$CAR = \beta_0 + \beta_{EXP}X_{EXP} + \beta_T X_T + \beta_C X_c + \beta_R X_R + \varepsilon$$

Where CAR is the dependent variable symbolizing the cumulative abnormal returns, β_0 is the intercept, β_{EXP} is the coefficient of the regression for oil exports, β_T is the coefficient of T_PERIOD variable, β_C is the coefficient of C_TYPE variable and β_R is the coefficient of the REGION variable. The term ε (epsilon) of the model is the random error and is assumed to have a population mean of zero.

For the first regression of the study, the variable X_{EXP} is excluded in order for the first three variables to be studied and compared with the classifications of the event study. The oil exports variable is added in the second regression of the sample.

Finally, the fit of the model is studied through various measurements such as R Square, Adjusted R Square and F statistic. As the selected conflicts are limited in terms of data for the regression, the explanatory power is expected to be low for the normal standards.

4. Sample and Descriptive Statistics

In this chapter of the thesis a more in depth examination of the conflicts sample is provided as well as the reasoning for the various classifications and estimation periods. The second part of this chapter includes descriptive statistics about the sample such as historical price movements of BRENT and WTI and the explanatory power of the Event study model applied.

4.1 Conflicts Sample and Classification of Results

In order to decide on which conflicts are to be tested, the first step is to define what a conflict is. Generally, conflict is considered to be the expression of a disagreement between two or more parties. These parties can be countries-states, individuals, organizations, corporations or even groups within the same environment. The nature of the parties involved in the disagreement affects the scale and ways this disagreement is expressed. This research focuses on conflicts between countries, inside the countries. Usually more than two countries are actively involved or affected by the conflicts but that does not have to be the case. An excellent example of this exception is the civil wars of various Middle Eastern countries during the “Arab Spring”.

Further in order to draw some more genuine conclusions about conflicts, there are two categories. Armed and non-armed conflicts. Armed conflicts include situations where tensions escalated, led to the use of arms either by the regular army or by civilians and casualties were recorded. Situations where tensions between countries or between two groups inside the country were high, though did not escalate to armed conflicts but other measures were used such as political pressure and economic sanctions and civil disobedience are characterized as non-armed international conflicts and are investigated as well. This classification provides the opportunity to observe if the effects of a non-armed conflict is as

severe as an armed conflict, at least in the first weeks of the announcement and if not, how significant is their difference.

The category of armed conflicts include events such as the first Gulf War that started on August 2, 1990, the terrorist attack on US soil on 09/11/2001 and the war that followed between the US and Afghanistan on 07/10/2001, the US war against Iraq on March 20, 2003 the pipeline bombings in Nigeria that resulted to dozens of victims and the various civil wars that broke out in regions of the Middle East and North Africa. The complete list with the selected conflicts is presented on Table 1 of the Appendix. All conflicts are selected based on their significance in their subsequent region, the global market and the potential disruption of the global oil supply due to the conflict. After examining the selected conflicts and countries involved, it is observed that most of the countries participated, have either oil based economies or at the very least consider crude oil an invaluable resource for the growth of their economy.

Non-armed conflicts that fulfill the same criteria mentioned above while not as a common occurrence as actual conflicts, they do indeed exist. These conflicts usually arise due to disagreements between countries with similar economic interests but different economic and political goals. Other reasons that led to conflicts are sociological and cultural differences that have festered between countries for years, for example the war between Israel and Lebanon in 2006. The forms of non-armed conflicts can vary but the selected sample takes two different forms. The first and most common is economic sanctions against countries that go against the world's "superpowers' or country coalitions. In the selected sample there are various conflicts between countries that resulted in economic sanctions as a form of punishment. Another form of non-armed conflict is considered civil disobedience in the forms of revolutions that did not escalate in civil war but remained in the confines of protests. Lastly political maneuvers due to increasing tensions are also considered as non-armed conflicts. A prime example of this instance is the withdrawal of the US from the Iran Nuclear Deal as a response to the growing tensions between the nations and the sanctions that followed with quotes from President Donald J. Trump such as these "The Iran deal is defective at its core" and "If we do nothing, we know exactly what will happen. In just a short period of time the world's leading state sponsor of terror will be on the cusp of acquiring the world's most

dangerous weapon. Therefore I am announcing today that the United States will withdraw from the Iran nuclear deal".

The next classification of the event study results is based on two time periods. The first period includes all manner of conflicts from 1990 to 2007 and the second is from 2008 to 2019. The reasoning behind this selection is based on the increasing production and demand of crude oil globally from 2008 and onwards as can be seen in Figure 4.1.1 and the significant change of the economic landscape due to the financial crisis.

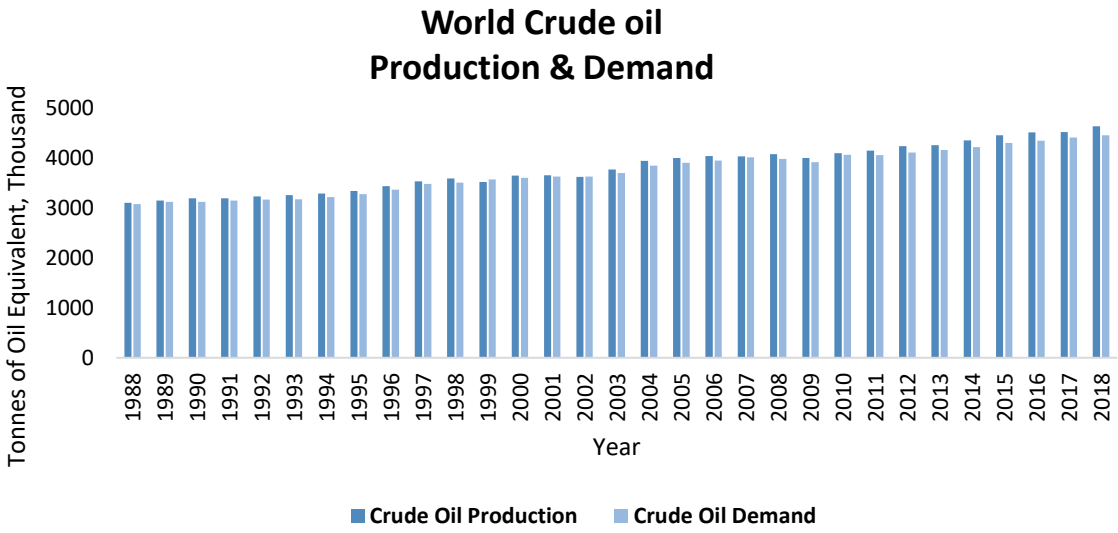


Figure 4.1.1 *Global Crude oil Production and Demand per year, in thousand TOE. Source: https://www.eia.gov*

The factors of the oil production increase are numerous but the two most commonly stated are the gradual expansion of the global economy after the financial crisis of 2008 and the restart of crude oil production in the US in a large scale, events that seem to be related for some researchers. From 2008 and after, the US quickly became one of the top global producers of crude oil and changed the landscape of the oil market. This can be observed in Figure 4.1.2.

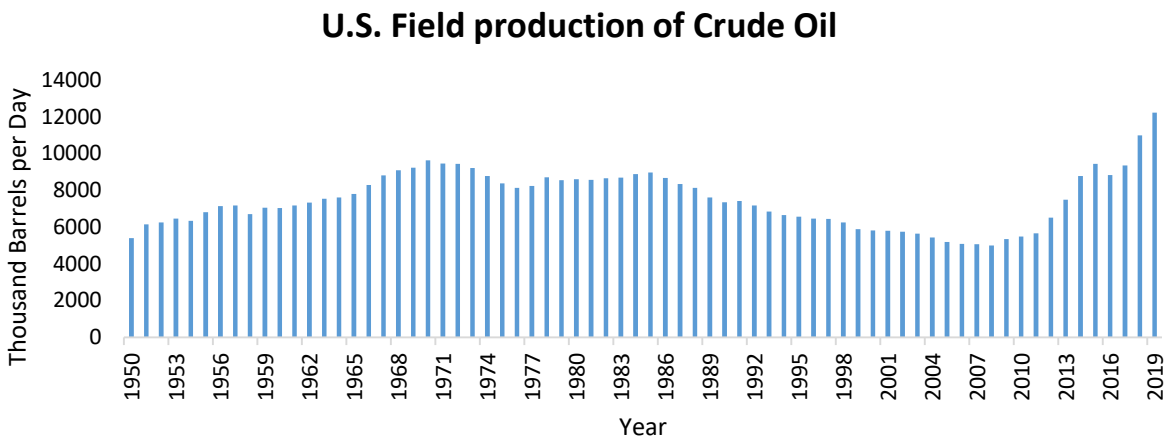


Figure 4.1.2 *US field production of Crude oil per year, in thousand Barrels per day. Source: https://www.eia.gov*

Finally this classification of the results provides the opportunity to observe if the significance of geopolitical events is waning or increasing throughout the years and if the results found from Economou and Agnolucci (2016) stand true in our sample as well.

The last classification of the event study results is based on the location of the conflict. As can be seen in Table 1 of the Appendix, the majority of the conflicts was either instigated or took place in the region of the Middle East. The existing literature has clearly focused on the region when examining oil shocks or international conflicts and their economic effects. Whether this happens due to the fact that the US usually takes part in wars in the region or not it does not change the fact that a large percentage of the global oil supply originates from the region. The region is very high with political, economic and cultural tension for more than 40 years and it merits a comparison with conflicts from the rest of the world.

4.2 Data and Descriptive Statistics

As already mentioned in the Methodology Chapter, BRENT and WTI crude oil classifications are used for the analysis of the results. The data consists of all weekly spot prices from the period of 1988 until 2019. These and all other datasets used in the thesis were obtained through Datastream and the Energy Information Administration (EIA).

In Table 4.1.1 some descriptive statistics about the two oil classifications are presented. As it can be observed the mean of BRENT is slightly higher from WTI, something that is true for the current price as well. The skewness of the samples are both positive at ~ 0.8 and the kurtosis for both samples is slightly negative at ~0.5. The standard deviation for BRENT is 32.88 and for WTI 29.22.

Table 4.1.1 Descriptive Statistics for BRENT and WTI

	BRENT	WTI
Mean	47.96	46.40
Standard Error	0.81	0.72
Median	34.02	36.175
Mode	109.50	20.30
Standard Deviation	32.88	29.22
Sample Variance	1081.34	853.92
Kurtosis	-0.53	-0.46
Skewness	0.80	0.78
Range	134.58	134.50
Minimum	9.82	10.79
Maximum	144.40	145.29
Sum	79426.29	76839.19
Count	1656	1656

In Figure 4.1.1 the price movement of BRENT and WTI throughout the years is presented. It can be observed that before 1998 there was some stability in the price with both indicators having similar prices. From 1998 and after the “Asian Crisis” (1997) there is a steady but slow increase of price for both crudes. From 2004 and onwards the growth of price ramps up significantly until reaching the highest price in the history of Crude oil in 2008. The financial crisis of 2008 reduced the oil price significantly and instantly, until reaching one of the lowest prices ever in 2009. The price of oil though, started to recover from late 2009 and onwards with very high volatility during that period. This volatility was caused by many factors and one of them is studied by this thesis. The geopolitical events that unfolded in the Middle East dubbed as the “Arab Spring” is one of the explanations various researchers have given such as Economou and Agnolucci (2016) and others. During that period of uncertainty, BRENT surpassed WTI’s pricing in a high degree and this distance between the two crudes remains until today.

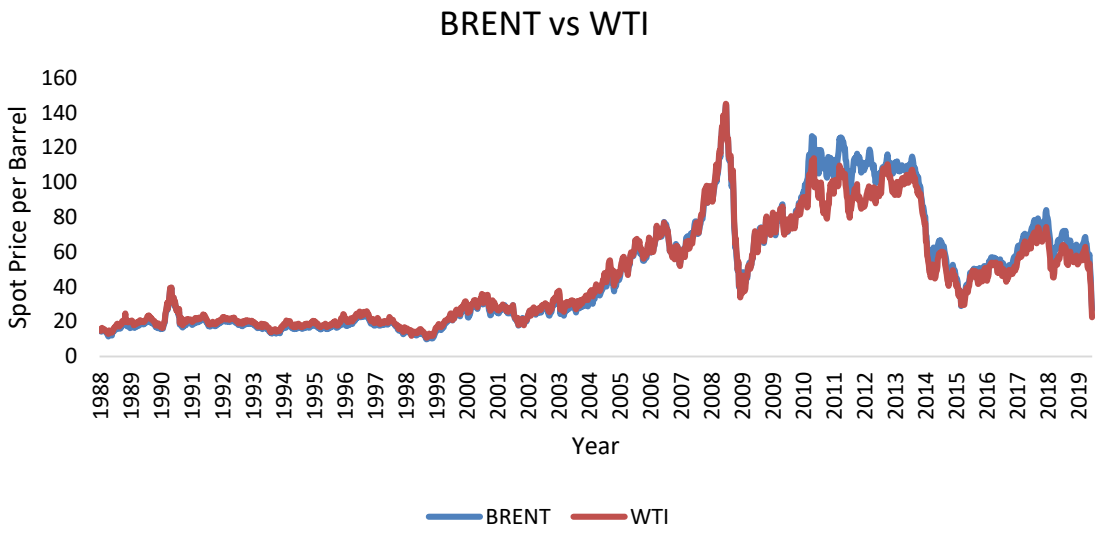


Figure 4.1.1 *BRENT and WTI yearly spot prices, in dollars ($) per barrel. Source: https://www.eia.gov*

The two benchmarks used in this analysis are Bloomberg Commodity Index (BCOM) and Thomson Reuters Commodity Research Bureau index (CRB). In the case of BCOM, it is a quite diversified commodity index and its biggest components are energy at 30%, followed by grains at 23%, industrial metals at 18% and precious metals at 16%. The commodity contains both WTI and BRENT as components applying similar weights to both, with WTI has a slight advantage of few percentage points. This fact may have an effect on the results as well. In regards to CRB, this commodity index works as one of the most significant barometers when it comes to tracking of commodities in the market. This index was one of the first established indices and is composed of 19 different commodities. The components of CRB are categorized in a similar fashion with BCOM. The "heaviest" components of CRB are grains/agriculture at 41%, followed by energy at 39%, industrial metals at 13% and precious metals at 7%. As BRENT is the most prevalent crude oil around the world, it is expected that due to CRB's unique structure it affects BRENT's results and explanatory more than WTI.

Event Study

Before proceeding with the analysis of the results from the model, the explanatory power for each event is investigated. In order to ascertain the explanatory power of the model and sample selected, the parameter R-Squared is calculated. In Table 4.1.2 these results are presented

Table 4.1.2 R-Squared Values per Conflict

Conflict/Event	BRENT		WTI	
	BCOM	CRB	BCOM	CRB
First Gulf War	0.473	0.539	0.373	0.521
Oil Crisis in Nigeria	0.417	0.502	0.391	0.413
US Sanctions against Iran	0.488	0.608	0.589	0.712
09/11 Attack and Afghan War	0.508	0.556	0.521	0.670
Oil Crisis in Venezuela	0.743	0.787	0.747	0.808
US - Iraq War	0.752	0.810	0.666	0.739
Conflict in Niger Delta	0.421	0.673	0.509	0.651
Iran - PJAK Conflict	0.767	0.738	0.847	0.788
Bombings in Nigeria	0.682	0.741	0.565	0.733
Israel - Lebanon War	0.546	0.624	0.466	0.674
Bombings in Nigeria	0.441	0.693	0.499	0.591
Bombings in Nigeria	0.543	0.740	0.548	0.648
Bombings in Nigeria	0.518	0.633	0.569	0.682
Insurgency of Boko Haram	0.527	0.641	0.573	0.664
Civil Uprising in Tunisia	0.565	0.707	0.539	0.638
Civil War in Egypt	0.651	0.754	0.558	0.694
Civil War in Libya	0.624	0.733	0.527	0.675
Civil War in Syria	0.709	0.730	0.528	0.682
EU sanctions on Iran	0.788	0.859	0.607	0.703
Benghazi Conflict	0.738	0.774	0.783	0.877
US Sanctions against Iran	0.677	0.707	0.427	0.666
Ukraine - Russia Conflict	0.638	0.724	0.433	0.577
Civil War in Iraq	0.665	0.798	0.622	0.726
Civil War in Libya	0.675	0.793	0.529	0.680
ISIS Insurgency and War	0.664	0.698	0.629	0.787
Political Crisis in Venezuela	0.647	0.571	0.582	0.654
Civil War in Yemen	0.496	0.776	0.698	0.737
Conflict in Niger Delta	0.601	0.765	0.682	0.765
US Sanctions against Venezuela	0.660	0.720	0.554	0.654
Kurdish Conflict in Iraq	0.665	0.798	0.634	0.787
Duma Chemical Attack	0.604	0.753	0.624	0.780
US withdraws from Iran "Nuclear Deal"	0.639	0.736	0.595	0.776
India -Pakistan Conflict	0.752	0.753	0.665	0.735
Political Crisis in Venezuela	0.760	0.720	0.660	0.720
Iran - Saudi Arabia Conflict	0.725	0.722	0.753	0.774

Note: The following acronyms are used.WTI: West Texas Intermediate, BCOM: Bloomberg Commodity Index, CRB: Thompson Reuters Core Commodity Research Bureau Index

The R-squared values vary from 0.4 to 0.8 for both commodity indices but CRB seems to fit the model slightly better. Moreover it can be observed that earlier conflicts have slightly worse explanatory power and this has an impact on the results, especially on the classification

of the event study results per time period as mentioned in the next part of this chapter. The difference between the two indices is due to the difference in structures and weights of their components, something already investigated in previous paragraphs of this section. This difference leads to some variation between the results produced by each commodity index and is investigated further in the section of the event study results.

Regression

In order for the regression to be performed the required data are gathered. From the Energy Information Administration (EIA) the amount of crude oil exports per year is gathered. In some cases more than one countries are involved in the conflict and this fact raises questions as to which country's oil exports should be considered as the correct data to use. This depends on the location of the possible disruption of oil export. For example in the case of the war between US and Iraq the oil exports considered are the ones of Iraq, as the invasion caused a halt in production and severe disorganization. Similarly for non-armed conflicts, the country that is the target of sanctions or other political pressures is the oil exports used. Another consideration on the oil exports data is that due to the start of the conflict the annual data for that year are skewered. In order to have a clearer picture of the true oil exports before the possible effect of the conflict the oil exports from the year prior are selected. The complete list of the amount of crude oil exports per conflict can be found in Table 2 of the Appendix.

The rest of the data needed for the regression are provided by the event study as the CARs of the event study is the subject investigated and its relation with the various selected variables. It is noteworthy that by observing Table 1, Table 3, Table 4 and Table 5 of the Appendix it can be surmised that the amount of data available is relatively small, since only 35 conflicts have been selected and most of them are characterized as armed conflicts. While this amount of conflicts is significant for the real world, it is not as strong of a sample for a regression. Nevertheless the regression can provide valuable information even on a sample of that scale.

5. Results

In this section the results of this thesis are presented. The first sub-chapter includes the results of the event study analysis for all selected events and the classifications mentioned in Chapter 4. The second sub-chapter includes the results of the regression of CAR with variables based on the classification of the event study and also another explanatory variable.

5.1 Event Study

In Table 5.1.1 the results of the event study for all the conflicts selected are presented. The results are categorized per crude oil and then per index. The null hypothesis for all event studies conducted is rejected as all conflicts presented abnormal returns although in varying degrees. The results show that the abnormal returns of the conflicts selected reach up to 9.5%. This percentage is obtained by BRENT when the commodity index used for the Market Model is BCOM. Between BCOM and CRB there is a difference in CAR of 1.7%, a fact that can be explained by the weight structure of each Indices' components and the fit of the MM. In the case of CRB, the existing amount of crude oil globally, determines the weight of the component leading to different weights between the two indices and consequently different results. The results of CAR are significant at the 95% level for t=0 in the case of BRENT and t=-1 for CRB. The CARs before for t=-1,-2 are also significant, something that suggests that there was some knowledge in the market about the upcoming events beforehand that lead to abnormal returns before the official announcement or incident. These results in other event studies would need further consideration for validity but in this case can be explained, since conflicts are the end result of the escalating tension that affects oil prices. This connection has been an interest for various researchers that have focused on international conflicts and one prime example is the study of the effects of news coverage and information before the breakout of wars by Brune et al. (2011).

In the case of WTI the results are similar, albeit lower than BRENT. The BCOM index produces higher CARs as well, reaching 8.2%. The difference between BCOM and CRB is again evident and around 2.1%. The difference between BCOM and CRB results again are accounted

for by the weight structure of the indices' components and fit of the MM. The results for WTI are significant for both indices from t=1 and onwards.

Table 5.1.1 CARs during Event Window, all conflicts included.

	BRENT		WTI	
Event Week	**BCOM**	**CRB**	**BCOM**	**CRB**
5	0.095**	0.078**	0.082**	0.061**
4	0.088**	0.074**	0.065**	0.048**
3	0.074**	0.062**	0.055**	0.040**
2	0.067**	0.058**	0.047**	0.035**
1	0.058**	0.051**	0.041*	0.032*
0	0.052**	0.047**	0.032	0.026
-1	0.050*	0.046**	0.027	0.023
-2	0.044*	0.039*	0.026	0.020
-3	0.037	0.031	0.027	0.020
-4	0.026	0.018	0.016	0.007
-5	0.007	0.003	0.002	0.000

Note: The following acronyms are used.WTI: West Texas Intermediate, BCOM: Bloomberg Commodity Index, CRB: Thompson Reuters Core Commodity Research Bureau Index

** Indicates significance at 10% level*

*** Indicates significance at 5% level*

In Figure 5.1.1 the paths of CARs for both crude oils are presented. From the graphs, it can be observed that both crude oils from t=0 and onwards started a sharp increase of the abnormal returns value. As it was indicated by the significance test in the case of BRENT, the increase was somewhat existent before the event day. Another explanation about this difference between BRENT and WTI can be found in the fact that WTI accounts mostly for the crude oil produced in the United States and BRENT is considered the international price standard. Since most conflicts had either no or small participation from the US, with the exception of the three major wars in the sample, the WTI price should be somewhat more insulated than BRENT.

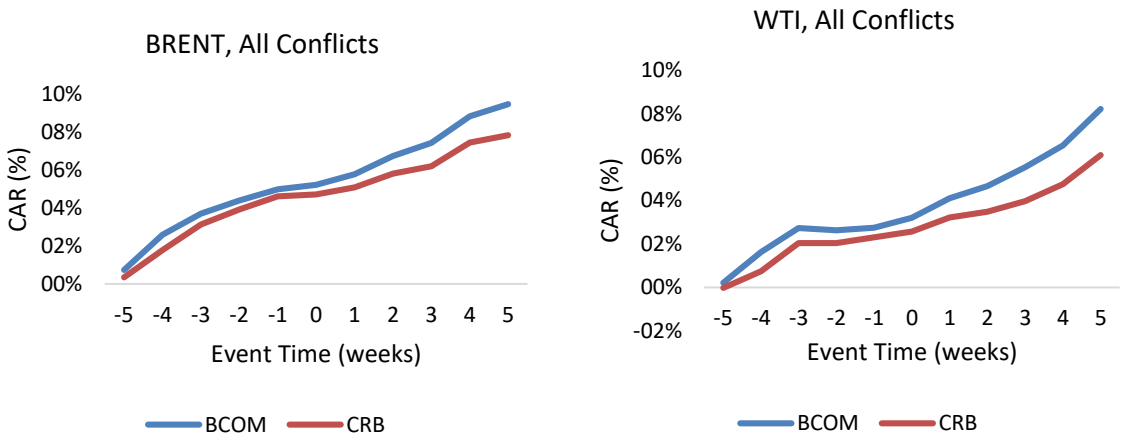


Figure 5.1.1 *CAR for the event window, All conflicts included, in percentage (%)*

Per Time Period

In Table 5.1.2 and 5.1.3 the results of CAR are presented for the two time periods 1990-2007 and 2008-2019, respectively. This classification provides the opportunity to compare against the literature about the effect of exogenous effects and geopolitics in the price of oil. As mentioned by Economou and Agnolucci (2016) there are differing views on the topic where various researchers suggested that these effects were at the highest in the 90's but no longer of consequence. The reasoning behind their conclusions was that market events and endogenous factors have a higher effect on a globalized economy. Economou and Agnolucci (2016) found that exogenous effects such as geopolitics have a higher importance from 2010 and after, accounting for more than 10% of the abnormal returns of crude oil. The results of this event study allude to similar conclusions as the CARs for both BRENT and WTI in terms of BCOM are ~ 1.5% lower for the 1990-2007 period. Interestingly in the case of the CRB index both BRENT and WTI present the exact opposite results. The 1990-2007 period in terms of the CRB index has ~ 1.5% higher CARs. Different results between commodity indices while not preferable have been found in other event studies, such as Loutia, Mellios and Andriosopoulos (2015). These differences can be attributed to the difference in explanatory power of the model at the time of the event and the change of crude oil weights throughout the years by the commodity indices.

In Figure 5.1.2 the paths of CARs are presented for all time periods, crude oils and indices. As it can be observed, in the case of 1990-2007 period CARs are steadily increasing even

before the event date while in 2008-2019 period the sharp increase starts from t=0. This difference can be subscribed to the fact that all major wars that transpired in the examined sample took place before 2008. As mentioned previously, the study by Brune et al. (2011) sheds some light to this fact, as the authors study the amount of information about the major wars that the US was part of. One of their findings was that the sentiment around the market and people, before the official start of the wars, was that the increasing tensions will lead to war. In the case of the 2008-2019 period, no conflict is at the same scale of the US wars in the Middle East and there is no available literature about the information and sentiment about the breakout of the conflicts selected in the sample.

Table 5.1.2 CARs during Event Window, 1990 - 2007 period.

	BRENT		WTI	
Event Week	**BCOM**	**CRB**	**BCOM**	**CRB**
5	0.085**	0.089**	0.075**	0.079**
4	0.085**	0.089**	0.062**	0.067**
3	0.061**	0.063**	0.054**	0.056**
2	0.066**	0.069**	0.050**	0.053**
1	0.052	0.057	0.043*	0.050
0	0.049*	0.053	0.038	0.043
-1	0.041	0.046	0.027	0.033
-2	0.041	0.036	0.031	0.026
-3	0.028	0.023	0.027	0.023
-4	0.016	0.010	0.008	0.002
-5	-0.005	-0.009	-0.008	-0.010

Note: The following acronyms are used.WTI: West Texas Intermediate, BCOM: Bloomberg Commodity Index, CRB: Thompson Reuters Core Commodity Research Bureau Index

** Indicates significance at 10% level*

*** Indicates significance at 5% level*

Table 5.1.3 CARs during Event Window, conflicts during 2008 - 2019 period.

	BRENT		WTI	
Event Week	**BCOM**	**CRB**	**BCOM**	**CRB**
5	0.101**	0.071**	0.087**	0.053**
4	0.091**	0.065**	0.067**	0.038*
3	0.083**	0.061**	0.057**	0.032*
2	0.068**	0.051*	0.045*	0.025*
1	0.062**	0.047*	0.040*	0.023*
0	0.054**	0.044*	0.028	0.016
-1	0.055**	0.046*	0.028	0.018
-2	0.046	0.041	0.023	0.018
-3	0.043	0.036	0.028	0.020
-4	0.032	0.023	0.022	0.011
-5	0.016	0.012	0.009	0.006

Note: The following acronyms are used.WTI: West Texas Intermediate, BCOM: Bloomberg
Commodity Index, CRB: Thompson Reuters Core Commodity Research Bureau Index

** Indicates significance at 10% level*

*** Indicates significance at 5% level*

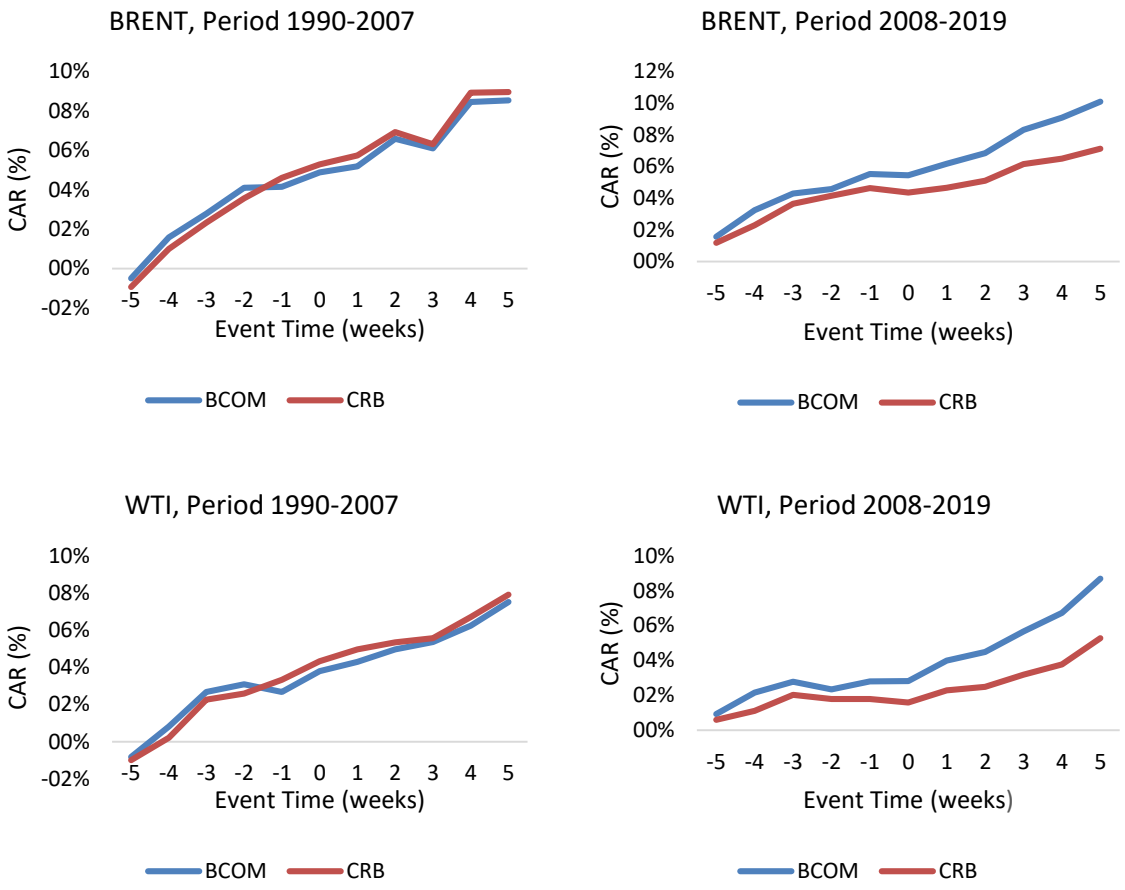


Figure 5.1.2 *CAR for the event window, time periods of 1990-2007 and 2008-2019, in percentage (%*

Per Type of Conflict

In Table 5.1.4 and 5.1.5 the results of CARs are presented based on the type of conflict. In the case of BRENT the CARs between armed and non-armed conflicts are similar. For BCOM non-armed conflicts have 9.6% CAR on the end of the event window while armed conflicts 9.0%. For CRB the armed conflicts have higher CAR at 8.1% while non-armed at 7.4%. The difference between these indices is relatively small and can be explained by the variation in

their energy components and explanatory power of the Model. In this classification the different results are not as pronounced as in the time period classification and that is due to the blending of events and their various explanatory powers from different points of time.

For WTI the results are significantly different from BRENT. Armed conflicts have CARs of 8.6% and 7.0% for BCOM and CRB respectively. For non-armed conflicts the cumulative abnormal returns reach 6.9% and 3.7% for BCOM and CRB, respectively. This difference between BRENT and WTI is due to the fact that WTI accounts for mostly crude oil that was produced in the US and BRENT is more of an international indicator. The US has participated only in armed conflicts, either actively such as the Iraq War etc. or passively by providing support to their allies and almost none of the conflicts selected took place in US soil. In terms of non-armed conflicts, the US usually was the one instigating the conflicts by imposing sanctions and political pressure on other countries without disrupting their own oil production and trade significantly. While these sanctions had an effect on the oil price as evident, this effect was much lower than armed conflicts. Nevertheless oil price, despite the different varieties and indicators is affected simultaneously. The fact that WTI is mostly crude oil produced in the US can minimize the effect.

Table 5.1.4 CARs during Event Window, Armed conflicts.

	BRENT		WTI	
Event Week	**BCOM**	**CRB**	**BCOM**	**CRB**
5	0.090**	0.081**	0.086**	0.070**
4	0.088**	0.080**	0.071**	0.057**
3	0.077**	0.068**	0.065**	0.051**
2	0.070**	0.065**	0.056**	0.048**
1	0.062**	0.059**	0.051*	0.045**
0	0.053*	0.053**	0.033	0.032
-1	0.050*	0.053**	0.027	0.029
-2	0.045*	0.045*	0.028	0.027
-3	0.039	0.037	0.027	0.024
-4	0.025	0.020	0.012	0.007
-5	0.005	0.003	-0.003	-0.003

Note: The following acronyms are used.WTI: West Texas Intermediate, BCOM: Bloomberg
Commodity Index, CRB: Thompson Reuters Core Commodity Research Bureau Index

** Indicates significance at 10% level*

*** Indicates significance at 5% level*

Table 5.1.5 CARs during Event Window, Non - Armed conflicts.

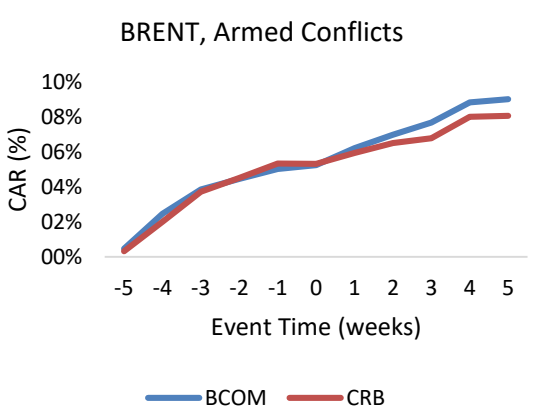
Event Week	BRENT		WTI	
	BCOM	CRB	BCOM	CRB
5	0.096**	0.074**	0.069**	0.037**
4	0.073**	0.053**	0.044	0.019
3	0.052**	0.040**	0.021	0.005
2	0.046**	0.032	0.011	-0.006
1	0.031	0.019	0.006	-0.009
0	0.042	0.025	0.028	0.008
-1	0.039	0.020	0.029*	0.007
-2	0.033	0.017	0.020	0.000
-3	0.025	0.009	0.028*	0.009
-4	0.026	0.009	0.032*	0.012
-5	0.015	0.004	0.019	0.011

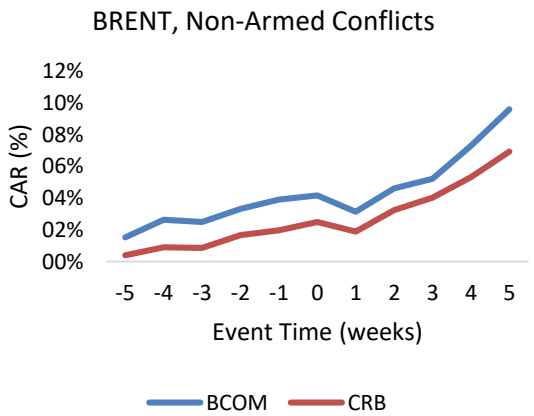
Note: The following acronyms are used.WTI: West Texas Intermediate, BCOM: Bloomberg
Commodity Index, CRB: Thompson Reuters Core Commodity Research Bureau Index

** Indicates significance at 10% level*

*** Indicates significance at 5% level*

In Figure 5.1.3 the paths of CARs for the types of conflict are presented. The CAR path for armed conflicts shows that there is already an increase before the event date, especially for BRENT. Moreover it can be observed that the path is very similar to the one followed by the CARs of all conflicts presented in Figure 5.1.1. This similarity is due to the fact that most of the conflicts of the sample are armed. The path of non-armed conflicts is very different. The CARs start to steadily increase from t=1 sharply while at t=0 recorded a slight drop. This result bares similarity to the results from Loutia, Mellios and Andriosopoulos (2015) where there was a lag of one day for the reaction on the OPEC announcements.





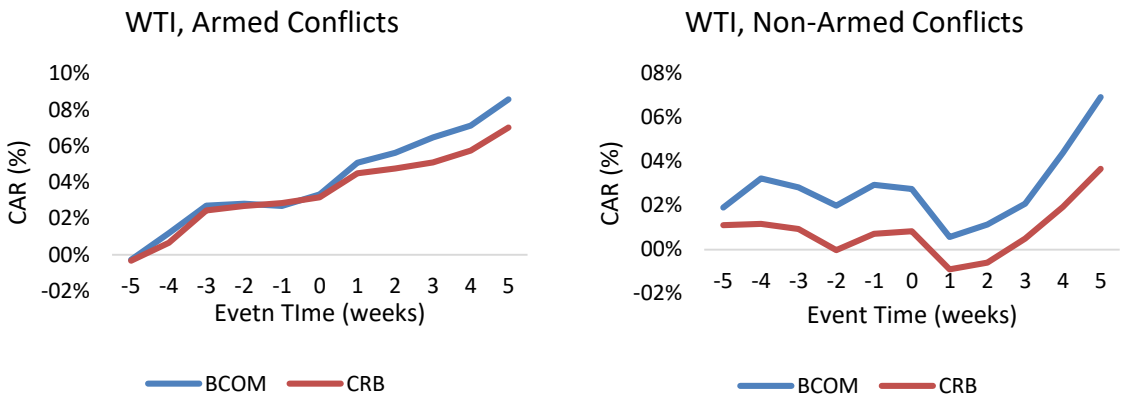


Figure 5.1.3 *CAR for the event window, based on the type of conflict, in percentage (%)*

Per Region

In Table 5.1.6 and Table 5.1.7 the CARs of the conflicts selected based on region are presented. It can be observed that for BRENT there is no significant difference between the Middle East and the rest of the World. The BCOM CAR for Middle East at the last week of the event window is 9.3% and for the rest of the world 9.7%. The CRB CAR for the Middle East is 7.5% and for the rest of the world at 7.0%.

The CARs for WTI have prominent differences with the ones of BRENT. Specifically for BCOM the CAR of the Middle East is at 8.7% but the CAR for the rest of the World is at 7.5%. The CAR for CRB is at 7.1% for the Middle East but only 5.0% for the Rest of the World. These differences can be connected to the possible explanation provided previously for the types of conflicts results. It is a fact that the US has been active in the region of the Middle East for numerous years, either through political maneuvering and alliances or even either through combat and war. This activity has been proved and studied by numerous research papers, some of them already analyzed in the section of Literature Review. Moreover it has been proved that US interference in the region has an effect on the country's economy. Therefore it is safe to assume that the global effects on oil price will be more pronounced for WTI when the conflicts take place in a region US has interests in or when the country is actively involved. This assumption provides a possible avenue of further research by analyzing and examining what non US soil events have effects on the US oil price.

Table 5.1.6 CARs during Event Window, conflicts in the region of the Middle East.

Event Week	BRENT		WTI	
	BCOM	**CRB**	**BCOM**	**CRB**
5	0.093**	0.075**	0.087**	0.071**
4	0.094**	0.076**	0.075**	0.059**
3	0.084**	0.066**	0.070**	0.054**
2	0.075**	0.059**	0.061**	0.046**
1	0.065**	0.051**	0.056**	0.044
0	0.062**	0.050*	0.050*	0.039*
-1	0.054*	0.044*	0.037	0.030
-2	0.045	0.034	0.035	0.025
-3	0.041	0.030	0.029	0.019
-4	0.028	0.016	0.017	0.006
-5	0.003	0.001	-0.004	-0.004

Note: The following acronyms are used.WTI: West Texas Intermediate, BCOM: Bloomberg Commodity Index, CRB: Thompson Reuters Core Commodity Research Bureau Index

** Indicates significance at 10% level*

*** Indicates significance at 5% level*

Table 5.1.7 CARs during Event Window, conflicts in the rest of the World

Event Week	BRENT		WTI	
	BCOM	**CRB**	**BCOM**	**CRB**
5	0.097**	0.070**	0.075**	0.050**
4	0.079**	0.061**	0.050**	0.033**
3	0.059**	0.046**	0.033	0.021*
2	0.055**	0.048**	0.025	0.020
1	0.047*	0.042**	0.018	0.016
0	0.037	0.036**	0.004	0.007
-1	0.044*	0.042**	0.012	0.015
-2	0.043*	0.040**	0.013	0.015
-3	0.031	0.027	0.025	0.024*
-4	0.022	0.017	0.015	0.011
-5	0.014	0.006	0.012	0.005

Note: The following acronyms are used.WTI: West Texas Intermediate, BCOM: Bloomberg Commodity Index, CRB: Thompson Reuters Core Commodity Research Bureau Index

** Indicates significance at 10% level*

*** Indicates significance at 5% level*

In Figure 5.1.4 the paths of CARs of the event window are presented for the region of the Middle East and the Rest of the World classification. As it can be observed the Middle East CARs follow a similar path to the one of armed conflicts presented in Figure 5.1.3. This similarity can be ascribed to the fact that most of the conflicts in the Middle East are armed conflicts that took place for a longer period of time than non-armed conflicts and were precipitated by rising tensions or previous conflicts. In the case of the Rest of the World

category the CAR path starts to increase significantly at the event date until it reaches its highest point at the end of the event window. The reasons for no increase before the event date in this case are that most of non-Middle East conflicts can be classified as sudden attacks and battles by insurgents (Bombings in Nigeria) or non-armed conflicts where as observed previously, the reaction to the event starts usually at t=1.

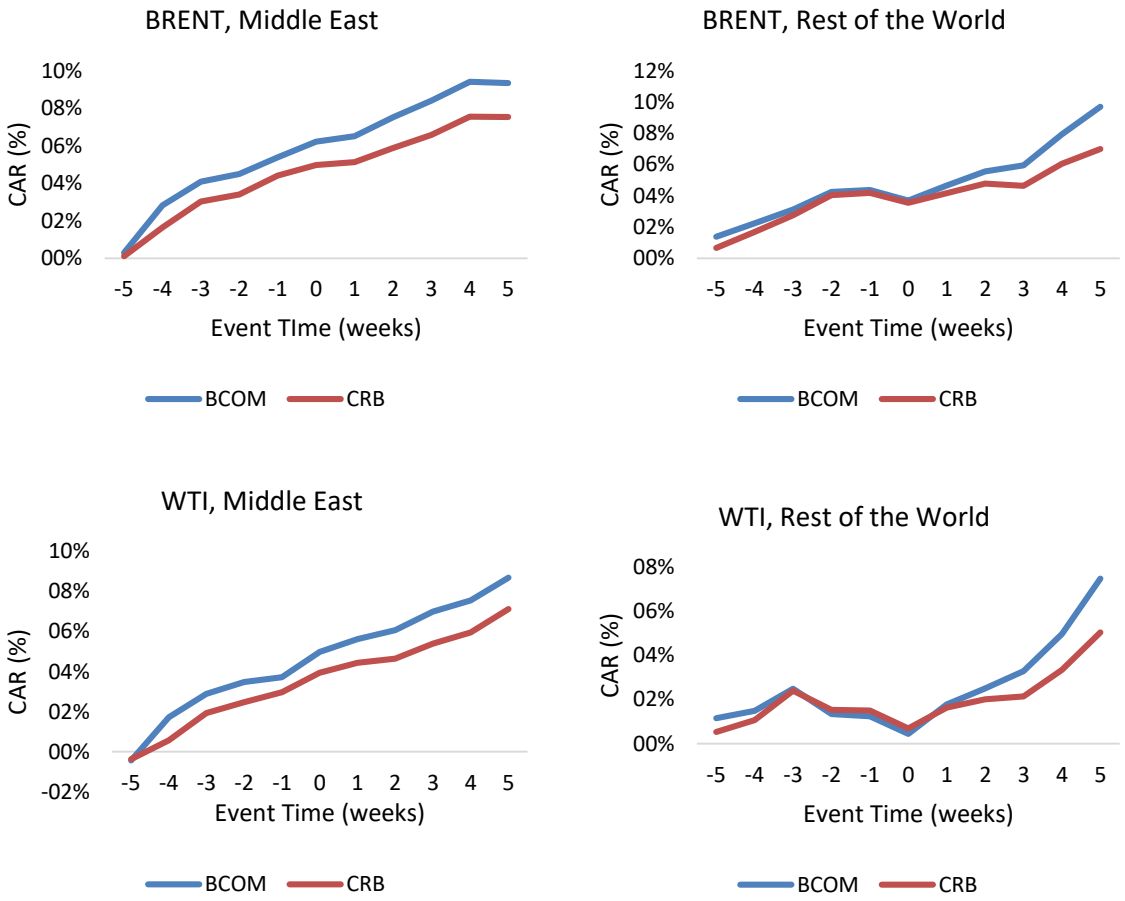


Figure 5.1.4 *CAR for the event window, based on region, in percentage (%)*

5.2 Regression

In this part of the chapter the results of the OLS regression performed on the CARs of all conflicts selected are presented. The tables on this part of the Results chapter present the regression results based on commodity index used in order to estimate the CARs and moreover the event window of [-5,5] is further broken down in two parts [-5,0] and [0,5] in

order to see the reaction in different times of the event window. Since the sample used for the regression is small with only 35 conflicts taken into account, the R-square, Adjusted R Square and F statistic are very low and the standard errors of all coefficients are high. While the measures of fit of the regression are not the desired values and they indicate that the amount of variables examined with that amount of observations is not possible to produce significant and safe results, nevertheless this first stage of the regression is used as a comparison for the categories of the event study.

In Table 5.2.1 and Table 5.2.2 the results of the regression are presented for BRENT and WTI respectively. The tables show the coefficients of three variables Time period, Conflict Type and Region exactly as the classifications of the event study results. Through the coefficients of these variables the impact of each variable on CARs can be studied.

From Table 5.2.1 it can be observed that the coefficients for the Time Period variable are in line with the findings and observations in the event study results. Specifically BCOM and CRB produce opposing results for this variable, with the highest coefficient in each case being in the [-5,5] window. For BCOM the coefficient is at 0.019 and for CRB at -0.018. These results mean that for BCOM the time period of 2007-2019 affects CARs more than 1990-2008, while the opposite is true for CRB. For the Conflict Type variable it seems that both BCOM and CRB are affected more by armed conflicts at the [-5,0] window. This result is logical as armed conflicts tend to be precipitated by increasing tensions and escalations. These results are in line with the observations made for Figure 5.1.3, where the inflation of CARs before the official start of the conflict was observed. Interestingly when the window [0,5] is observed in both indices the results are similar, showing that non-armed conflicts have a higher impact on CARs for that period. The complete event window [-5,5] indicates that no significant differences between the two types of conflicts are present. Finally the region variable shows results in line with the event study, proving that no there is no significant difference between regions, with the exception of the [-5,0] window where in both cases Middle East seem to have a bigger impact on CARs. This difference is already addressed in the event study results paragraph of Figure 5.1.4 comments. This difference can be ascribed to the fact that most conflicts that took place in the Middle East were alluded to before the event date since they were major conflicts that lasted for longer periods of time and they were a product of escalating tensions. While the results of the table are very useful to draw conclusions about

the effect of the variables of conflicts on CARs, the constraints of a small sample produced non-statistically significant results in any level above 90%. While there are differences between variables the magnitude of these differences cannot be safely estimated.

Table 5.2.1 presents the BRENT results of the OLS regression of the CARs from the examined conflicts. Time Period (T_PERIOD) is estimated through a dummy variable where period 1990-2007 = 0 and 2008-2019=1. Conflict Type (C_Type) is estimated through a dummy variable where Armed=1 and non-armed=0. Region is estimated through a dummy variable where Middle East=1 and Rest of the World=0. The standard errors are presented in parenthesis (). P value for 90% is *, for 95% is ** and 99% is ***.

BRENT		**BCOM**			**CRB**	
	[-5,0]	**[0,5]**	**[-5,5]**	**[-5,0]**	**[0,5]**	**[-5,5]**
T_PERIOD	-0.003	0.013	0.019	-0.016	-0.012	-0.018
	(-0.039)	(0.030)	(0.058)	(0.039)	(0.029)	(0.056)
C_TYPE	0.015	-0.015	0.000	0.028	-0.024	0.010
	(0.046)	(0.036)	(0.068)	(0.047)	(0.034)	(0.067)
REGION	0.027	-0.017	-0.007	0.018	0.004	0.008
	(0.040)	(0.030)	(0.058)	(0.040)	(0.029)	(0.057)
Constant	0.026	0.060	0.088	0.023	0.055	0.076
	(0.053)	(0.040)	(0.078)	(0.053)	(0.039)	(0.076)
R Square	0.022	0.024	0.005	0.028	0.024	0.005
Adj. R Square	-0.092	-0.098	-0.120	-0.092	-0.097	-0.119
F-statistic	0.176	0.198	0.388	0.227	0.200	0.043
No of Observations	35	35	35	35	35	35

Note: The following acronyms are used. BCOM: Bloomberg Commodity Index,
CRB: Thompson Reuters Core Commodity Research Bureau Index

From Table 5.2.2 it can be observed that similarly to BRENT the effect of the Time Period variable is different from BCOM to CRB. The main difference is at the full event window [-5,5] where the variable for BCOM has a 0.014 coefficient while CRB a -0.028 coefficient. In terms of BCOM period 2008-2019 has a bigger impact on CARs for all event windows except [-5,0]. In the case of CRB 1990-2007 period has a higher impact on CARs, especially for the full length of the event window [-5,5]. For the variable Conflict Type all event windows and indices present positive coefficients. The results are in line with the results of the event study and

they show that armed conflicts in the case of WTI affect the CARs more. Specifically for the event window [-5,5] armed conflicts have a coefficient of 0.019 for BCOM and 0.032 for CRB. In the case of the Region variable, the coefficients are highly positive as well, for both indices. For the full event window [-5,5] BCOM has a coefficient of 0.010 and CRB 0.028. The meaning of these coefficients is that for WTI conflicts that take place in the Middle East have a higher impact on CARs, specifically the amount shown as the coefficient. These results are in line with the findings of the event study and a partial explanation for them is the fact that most conflicts in the Middle East are armed conflicts that were the product of escalation of the tension. WTI is an indicator for the price of crude oil produced mostly in the US and since the US is more heavily involved politically and militarily in the region for years, it is expected that conflicts in the region will have a higher impact on the US economy, trade and subsequently the US oil price. As in the case of BRENT the results presented on Table 5.2.2 are not significant above the 90% level and that means that while they are helpful to compare variables and their impact they are not safe to draw explicit conclusions.

Table 5.2.2 presents the WTI results of the OLS regression of the CARs from the examined conflicts. Time Period (T_PERIOD) is estimated through a dummy variable where period 1990-2007 = 0 and 2008-2019=1. Conflict Type (C_Type) is estimated through a dummy variable where Armed=1 and non-armed=0. Region is estimated through a dummy variable where Middle East=1 and Rest of the World=0. The standard errors are presented in parenthesis (). P value for 90% is *, for 95% is ** and 99% is ***.

WTI	**BCOM**			**CRB**		
	[-5,0]	**[0,5]**	**[-5,5]**	**[-5,0]**	**[0,5]**	**[-5,5]**
T_PERIOD	-0.023 (-0.039)	0.026 (0.031)	0.014 (0.058)	-0.039 (0.037)	-0.002 (0.029)	-0.028 (0.055)
C_TYPE	0.007 (-0.046)	0.021 (0.037)	0.019 (0.069)	0.022 (0.044)	0.012 (0.034)	0.032 (0.065)
REGION	0.050 (-0.039)	-0.017 (0.031)	0.010 (0.058)	0.041 (0.038)	0.007 (0.029)	0.028 (0.055)
Constant	0.010 (0.052)	0.034 (0.042)	0.053 (0.079)	0.007 (0.051)	0.026 (0.039)	0.037 (0.074)
R Square	0.068	0.042	0.007	0.082	0.0076	0.028
Adj. R Square	-0.048	-0.081	-0.117	-0.032	-0.116	-0.090
F-statistic	0.587	0.353	0.055	0.718	0.061	0.229
No of Observations	35	35	35	35	35	35

In both BRENT and WTI regressions with the variables Time Period, Conflict Type and Region is observed that these variables do not do a satisfying job of explaining the results of CARs. Either this is due to the small sample used for the regression or is due to the fact that these variables do not affect enough the CARs in order to explain their movement cannot be safely estimated. Nevertheless, the results are useful in order to compare the different categories established in the event study.

Inclusion of Variable: Oil Exports

In Table 5.2.3 and Table 5.2.4 the results of the regression are presented for BRENT and WTI respectively. The tables show the coefficients of the previously examined variables Time period, Conflict Type and Region but now the variable Oil Exports is included in the regression. Through the coefficients of these variables the impact of each variable on CARs can be studied.

In Table 5.2.3 the coefficients of the examined variables for BRENT are presented. The inclusion of Oil Exports per conflict has a clear effect on the results. The coefficients for the oil exports variable is highly positive and significant at the 99% and 95% level. The coefficient for BCOM in the full event window [-5,5] is 0.066 with significance at 99% while for CRB is at 0.065 with a 95% level of significance. This result shows clearly that the amount of oil exports originated from the location of the conflict significantly affects the CARs of conflicts. Moreover when considering oil exports as well as the previous three variables the results are highly affected. Specifically the more affected Time period in terms of CARs is clearly 2008-2019. The results show that when considering the variable of oil exports as well the period 2008-2019 clearly produces higher CARs, those findings are more in line with the conclusions of Economou and Agnolucci (2016). Specifically the BCOM coefficient for the time period is 0.048 and 0.01 for CRB for the full event window [-5,5]. While the results for CRB are slightly positive they are still highly different with the previous regression, where they tend to reach negative values. In the case of the Conflict type variable the results are highly positive for the whole event window [-5,5], although these results are mainly affected from the [-5,0] window, meaning that armed conflicts do indeed affect CARs more than non-armed conflicts but only before the event date. A logical result if the escalating tensions and acts before the

official start of the conflict are considered. The same findings are observed for the Region Variable, where the region of the Middle East tends to produce higher CARs for the [-5,0] period but, although in this case these high results are smoothed out in complete event window [-5,5]. Similar results were found both in the event study and the previous regression where a logical explanation about these findings was introduced. Finally the explanatory power of the results presented through the values of R square, Adjusted R Square and F significance are highly affected by the inclusion of the new variable. The R-square values reach almost 0.30 for both indices which in general is considered to be a low score although in this case the inclusion of 4 variables and only 35 observations clearly affects the explanatory power. Just by the inclusion of the oil exports variable the R Square value increased around 0.22 and the F statistic presents two significant results. The standard error values while they have improved from the previous regression, are still high.

Table 5.2.3 presents the WTI results of the OLS regression of the CARs from the examined conflicts. Oil exports (OIL_EXPORT) are measured by the average amount of barrels per day exported by the country in conflict. Time Period (T_PERIOD) is estimated through a dummy variable where period 1990-2007 = 0 and 2008-2019=1. Conflict Type (C_Type) is estimated through a dummy variable where Armed=1 and non-armed=0. Region is estimated through a dummy variable where Middle East=1 and Rest of the World=0. The standard errors are presented in parenthesis (). P value for 90% is *, for 95% is ** and 99% is ***.

BRENT		**BCOM**			**CRB**	
	[-5,0]	**[0,5]**	**[-5,5]**	**[-5,0]**	**[0,5]**	**[-5,5]**
OIL_EXPORT	0.038**	0.037***	0.066***	0.039**	0.035***	0.065***
	(0.017)	(0.012)	(0.025)	(0.017)	(0.012)	(0.024)
T_PERIOD	0.013	0.029	0.048	0.001	0.003	0.010
	(0.037)	(0.026)	(0.052)	(0.037)	(0.026)	(0.052)
C_TYPE	0.037	0.007	0.039	0.051	-0.003	0.048
	(0.045)	(0.032)	(0.064)	(0.045)	(0.031)	(0.062)
REGION	0.027	-0.017	-0.007	0.019	0.004	0.008
	(0.037)	(0.026)	(0.052)	(0.037)	(0.026)	(0.051)
Constant	-0.067	-0.031	-0.073	-0.073	-0.031	-0.082
	(0.066)	(0.047)	(0.093)	(0.066)	(0.046)	(0.091)
R Square	0.182	0.290	0.237	0.200	0.281	0.238
Adj. R Square	0.040	0.166	0.104	0.061	0.1565	0.105
F-statistic	1.282	2.343 *	1.781	1.441	2.252*	1.795
No of Observations	35	35	35	35	35	35

In table 5.2.4 the results of the regression for WTI are presented. As in the case of the BRENT regression oil exports indeed are significantly associated with positive CARs. For BCOM and CRB the coefficients are significant at the 95% for the full event window [-5,5], with values of 0.054 and 0.053 respectively. These results mean that conflicts on locations with higher oil exports tend to produce higher CARs. The results for the two other event windows are significant at the 90% confidence level. For the time period variable the coefficients between BCOM and CRB tend to show the same antithesis noted in the event study as well. In the case of BCOM the variable shows a positive relationship between 2008-2019 period and CARs with a coefficient of 0.037 for [-5,5], while for CRB this relationship is slightly negative for the same event window with a coefficient of -0.005. The conflict type coefficient seems to have doubled in this regression where oil exports are included with BCOM at 0.051 and CRB at 0.064. A big part of these values comes from the [-5,0] period, where the coefficients are 0.024 and 0.040 for BCOM and CRB respectively. The last variable of region seems to follow a similar path with the variable of conflict, especially at the [-5,0] window with BCOM coefficient of 0.027 and CRB at 0.019. For the next two event windows the results seem to be much smaller, something that alludes to the comments previously made in the results section about the connection of the Middle East and prolonged armed conflicts. Finally by observing the R square, Adjusted R Square and F significance values it can be surmised that the explanatory power in the case of the CARs for WTI is improved greatly when it is compared to the regression of WTI that excluded the oil exports variable. The R Square values are close to 0.20 and the values of standard errors still remain high. These two observations reinforce again the comments about constraints by the small size of the sample.

Table 5.2.4 presents the WTI results of the OLS regression of the CARs from the examined conflicts. Oil exports (OIL_EXPORT) are measured by the average amount of barrels per day exported by the country in conflict. Time Period (T_PERIOD) is estimated through a dummy variable where period 1990-2007 = 0 and 2008-2019=1. Conflict Type (C_Type) is estimated through a dummy variable where Armed=1 and non-armed=0. Region is estimated through a dummy variable where Middle East=1 and Rest of the World=0. The standard errors are presented in parenthesis (). P value for 90% is *, for 95% is ** and 99% is ***.

WTI		**BCOM**			**CRB**	
	[-5,0]	**[0,5]**	**[-5,5]**	**[-5,0]**	**[0,5]**	**[-5,5]**
OIL_EXPORT	0.029 (-0.018)	0.026* (0.014)	0.054** (0.026)	0.031* (0.017)	0.024* (0.013)	0.053** (0.024)
T_PERIOD	-0.011 (-0.038)	0.037 (0.031)	0.037 (0.056)	-0.026 (0.037)	0.009 (0.028)	-0.005 (0.053)
C_TYPE	0.024 (-0.046)	0.036 (0.036)	0.051 (0.067)	0.040 (0.044)	0.027 (0.034)	0.064 (0.063)
REGION	0.050 (-0.038)	-0.017 (0.031)	0.010 (0.055)	0.041 (0.036)	0.007 (0.028)	0.028 (0.052)
Constant	-0.061 (0.068)	-0.030 (0.054)	-0.079 (0.098)	-0.069 (0.065)	-0.034 (0.049)	-0.093 (0.092)
R-Square	0.158	0.160	0.159	0.193	0.134	0.189
Adj. R Square	0.012	0.014	0.013	0.052	-0.016	0.048
F-statistic	1.082	1.095	1.087	1.372	0.893	1.338
No of Observations	35	35	35	35	35	35

6. Conclusions

This study tries to shed some light on the exogenous factor of conflicts and geopolitics that affect the oil price, as the existing literature proved to be lacking in this subject. The questions asked in this research are is there an effect on the oil price due to conflicts, what is the magnitude of this effect and what is the effect of certain characteristics of conflicts.

In order for this to be achieved in the first stage of the thesis, thirty five conflicts around the world are selected and examined under the event study analysis based on MacKinlay (1997), Kothari and Warner (2006) and others. Moreover two different crude oil price indicators are selected in BRENT and WTI as well as two different commodity indices BCOM and CRB. The

conflicts selected are further categorized based on time period, by grouping them to 1990-2007 and 2008-2019 groups, based on conflict, by grouping them to armed and non-armed conflicts, and based on region, by grouping them to conflicts that took place in the Middle East and conflicts that took place in the rest of the world. After the implementation of the event study, the results of cumulative abnormal returns per conflict are incorporated to an OLS regression in order to study them further. The variables established for this regression are based on the categorization of the event study, Time Period, Type of Conflict and Region the conflict took place. Moreover a fourth variable is incorporated, the amount of oil exports that originated from the countries that the conflicts take place.

From the results of the event study it is evident that conflicts have indeed an effect on the oil price as they produced CARs between 6.1% and 9.3% depending on the crude oil and index examined. Moreover it was found that conflicts during the time period of 2008-2019 produced higher abnormal returns, at least when examined for the BCOM index. Those results are opposite when CRB is examined. Interestingly, the type of conflict produced similar results for BRENT around 9% for BCOM and 8% for CRB while in the case of WTI armed conflicts seem to be highly more impactful on abnormal returns. In the case of the region category BRENT presented a similar level of abnormal returns for both indices but in the case of WTI the region of the Middle East is much more impactful on CARs than the rest of the world. Based on WTI's results for both the type of conflict and the region of the Middle East, an argument arises as to the possible explanation of this different impact from BRENT. Specifically it is argued that as WTI it accounts mostly for the US crude oil production and is affected by the US economy as well as the rest of the world, the activity of US in the region and its participation in various conflicts and wars in the region might have impacted these results as it has a more direct effect on their economy and subsequently the US oil price.

From the results of the regressions, the variables of time period, conflict type and region are studied. The relationship between CARs and the variables are shown to be similar with the findings of the event study but in the case of the regression a more quantified coefficient is provided. By examining the results of the regression it can be seen that both the variable of armed conflicts and the variable of Middle East present similarly high results on the event window before the event date [-5,0]. This result is ascribed to the fact that armed conflicts are the result of prolonged and serious tension in the region and it is reported beforehand.

Moreover before the breakout of war there is sentiment and information leakage that leads to higher CARs before the official start of the conflict. Similar comments were made in Brune et al. (2011) about information beforehand and the impact on the market. While the results of the regression were noteworthy and useful to study patterns and relationships between CARs and the variables, due to the limited sample there was no significant result that achieved 90% confidence level or higher and moreover the low values of the various measures about the model's fit prevents this study to draw explicit conclusions.

In the second part of the regression the variable previous oil exports from the country that the conflict takes place is incorporated. The inclusion of this variable brought different results. First and foremost it was proved that there is a highly significant, at the 99% and 95% level in most cases, and positive relationship between the abnormal returns of conflicts and the amount of previous oil exports from the countries that the conflict takes place. This result bolsters the assumption that conflicts indeed affect the oil price due to the possibility of interruption in the supply of crude oil. Moreover, the explanatory power of the regression increased significantly although it still remained in low levels. The inclusion of the oil exports variable the results for both BRENT and WTI showed that indeed 2008-2019 period had a higher impact on CARs, findings in line with Economou and Agnolucci (2016).

The results and findings of this study, while indeed shedding some light on the effects of conflicts in the oil price, are subject to some limitations. The size of the sample with the selected conflicts may be considered sufficient for the implementation and quantification of the event study but that is not the case for the regression implemented. The constraints of the sample led to a limited fit of the model and three out of four variables selected could not be studied as sufficiently as expected, despite the noteworthy results. The sample of conflicts also contained a limited amount of non-armed conflicts, something that prevented comparisons and aggregation of the results in more equal terms. Moreover, as it was pointed out by previous literature some conflicts were expected by the market as the tensions that led to the conflict were heavily reported, analyzed and in some cases preemptively priced by the market. While in the event study this effect was observed by the expanded event window in order to include a time period before the event date, this effect could not be quantified. Lastly, the lack of literature, to my knowledge, with a focus specifically on the effects of

conflicts and oil made the comparison of this thesis results harder as there was no similar benchmark to be followed.

The findings of this thesis and the limitations that arisen during the analysis provides a spark of ideas for future research. A study in conflicts and oil price could be focused solely on non-armed conflicts, like the impact of political pressure and economic measures against countries, since from the limited sample examined in this thesis the impact of these types of conflicts may be understated and underreported. Another possible research could be the in depth study of oil price movements before the initiation of a conflict based on the available information at the time. Finally, by looking at the current situation of the COVID19 crisis, another avenue of research could be on rare disasters and their effect on the economy.

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Appendix

Table 1. Selected conflicts for the examined sample

Conflict	Type	Region	Date
First Gulf War	Armed	Middle East	2/8/1990
Oil Crisis in Nigeria	Non-Armed	West Africa	12/7/1994
US Sanctions against Iran	Non-Armed	Middle East	15/3/1995
09/11 Attack and Afghan War	Armed	Middle East	11/9/2001
Oil Crisis in Venezuela	Non-Armed	Central America	2/12/2002
US - Iraq War	Armed	Middle East	20/3/2003
Conflict in Niger Delta	Armed	West Africa	9/9/2004
Iran - PJAK Conflict	Armed	Middle East	9/7/2009
Bombings in Nigeria	Armed	West Africa	12/3/2006
Israel - Lebanon War	Armed	Middle East	12/7/2006
Bombings in Nigeria	Armed	West Africa	26/12/2006
Bombings in Nigeria	Armed	West Africa	8/5/2007
Bombings in Nigeria	Armed	West Africa	16/5/2008
Insurgency of Boko Haram	Armed	West Africa	26/7/2009
Civil Uprising in Tunisia	Non-Armed	North Africa	18/12/2010
Civil War in Egypt	Armed	North Africa	25/1/2011
Civil War in Libya	Armed	Middle East	15/2/2011
Civil War in Syria	Armed	Middle East	15/3/2011
EU sanctions on Iran	Non-Armed	Middle East	23/1/2012
Benghazi Conflict	Armed	Middle East	8/6/2013
US Sanctions against Iran	Non-Armed	Middle East	31/7/2013
Ukraine - Russia Conflict	Armed	East Europe	21/11/2013
Civil War in Iraq	Armed	Middle East	1/1/2014
Civil War in Libya	Armed	Middle East	16/5/2014
ISIS Insurgency and War	Armed	Middle East	13/6/2014
Political Crisis in Venezuela	Non-Armed	Central America	9/3/2015
Civil War in Yemen	Armed	Middle East	26/3/2015
Conflict in Niger Delta	Armed	West Africa	16/2/2016
US Sanctions against Venezuela	Non-Armed	Central America	27/7/2017
Kurdish Conflict in Iraq	Armed	Middle East	25/9/2017
Duma Chemical Attack	Armed	Middle East	7/4/2018
US withdraws from Iran "Nuclear Deal"	Non-Armed	Middle East	8/5/2018
India -Pakistan Conflict	Armed	South Asia	14/2/2019

Political Crisis in Venezuela	Non-Armed	Central America	9/1/2019
Iran - Saudi Arabia Conflict	Armed	Middle East	14/9/2019

Table 2. Previous year's oil exports per conflict

Conflict	**Oil Exports (in thousands Barrels per day)**
First Gulf War	4.23
Oil Crisis in Nigeria	1.60
US Sanctions against Iran	2.60
09/11 Attack and Afghan War	0.01
Oil Crisis in Venezuela	1.65
US - Iraq War	1.50
Conflict in Niger Delta	2.25
Iran - PJAK Conflict	2.65
Bombings in Nigeria	2.25
Israel - Lebanon War	0.02
Bombings in Nigeria	2.25
Bombings in Nigeria	2.10
Bombings in Nigeria	2.00
Insurgency of Boko Haram	2.00
Civil Uprising in Tunisia	2.32
Civil War in Egypt	0.10
Civil War in Libya	1.30
Civil War in Syria	0.39
EU sanctions on Iran	2.54
Benghazi Conflict	1.24
US Sanctions against Iran	2.10
Ukraine - Russia Conflict	0.04
Civil War in Iraq	2.39
Civil War in Libya	0.84
ISIS Insurgency and War	2.39
Political Crisis in Venezuela	1.96
Civil War in Yemen	1.02
Conflict in Niger Delta	2.11
US Sanctions against Venezuela	1.84
Kurdish Conflict in Iraq	3.80
Duma Chemical Attack	0.30
US withdraws from Iran "Nuclear Deal"	2.13
India -Pakistan Conflict	0.50
Political Crisis in Venezuela	1.28
Iran - Saudi Arabia Conflict	2.60

Note: The amounts of oil exports on the table represents estimates of the oil export estimates for the location the conflict takes place, these values represent previous year's oil estimates. Source: https://www.eia.gov

Table 3. Frequency of Time Period Variable

Variable	**Frequency**
1990-2007 Period	12
2008-2019 Period	23
No of Conflicts	35

Table 4. Frequency of Conflict Type Variable

Variable	**Frequency**
Armed	25
Non-Armed	9
No of Conflicts	35

Table 5. Frequency of Conflict Type Variable

Variable	**Frequency**
Middle East	19
Rest of the World	16
No of Conflicts	35