Distribution Agreement

In presenting this thesis as a partial fulfillment of the requirements for a degree from Emory University, I hereby grant to Emory University and its agents the non-exclusive license to archive, make accessible, and display my thesis in whole or in part in all forms of media, now or hereafter now, including display on the World Wide Web. I understand that I may select some access restrictions as part of the online submission of this thesis. I retain all ownership rights to the copyright of the thesis. I also retain the right to use in future works (such as articles or books) all or part of this thesis.

Xinyi (Miranda) Wang April 10, 2023

International Conflicts and the Stock Market: The Canadian Energy Stock Market's Reactions to the Russia - Ukraine War and Nord Stream Pipeline Attack

by

Xinyi (Miranda) Wang

Professor Tao Zha
Adviser

Economics

Professor Tao Zha
Adviser

Professor Caroline Fohlin
Committee Member

Professor David Jacho - Chavez
Committee Member

2023

International Conflicts and the Stock Market: The Canadian Energy Stock Market's Reactions to the Russia - Ukraine War and Nord Stream Pipeline Attack

By

Xinyi (Miranda) Wang

Professor Tao Zha
Adviser

An abstract of
a thesis submitted to the Faculty of Emory College of Arts and Sciences
of Emory University in partial fulfillment
of the requirements of the degree of
Bachelor of Arts with Honors

Economics

2023

Abstract

International Conflicts and the Stock Market: The Canadian Energy Stock Market's Reactions to the Russia - Ukraine War and Nord Stream Pipeline Attack

By Xinyi (Miranda) Wang

Geopolitical events usually have a profound and lasting impact on the economy and the stock market. In this study, I investigate the impact of geopolitical events such as the Russia-Ukraine war and the Nord Stream pipeline attack on the returns of Canadian energy stocks. I use beta, roll measure, vector autoregression, and event study methodology to examine how the 27 Canadian energy stocks react to these two shocks. As a result, I observed higher volatility among the Canadian energy stocks in 2020 and 2022 except for two companies. In terms of liquidity, the roll measure was ineffective because 24 out of the 27 companies have positive autocorrelation with their historical prices. Finally, with the event study methodology, I was able to find significant, positive average cumulative abnormal returns from the Russia-Ukraine war from both the market model and the Fama-French model. However, no significant abnormal returns were found for the pipeline attack. Finally, the impulse response graphs show that generally, energy stock prices rise as crude oil spot prices rise. Then, my study dives deeper into identifying the reasons for the results concluded. Overall, my paper will help readers understand the risks of investing in the Canadian energy market during this time of turbulence and take advantage of the positive abnormal returns.

International Conflicts and the Stock Market: The Canadian Energy Stock Market's Reactions to the Russia - Ukraine War and Nord Stream Pipeline Attack

By

Xinyi (Miranda) Wang

Professor Tao Zha
Adviser

A thesis submitted to the Faculty of Emory College of Arts and Sciences
of Emory University in partial fulfillment
of the requirements of the degree of
Bachelor of Arts with Honors

Economics

2023

Table of Contents

I. Introduction

Understanding geopolitics is crucial for asset managers who sometimes manage hundreds of billions of dollars. These large institutional investors can have a significant impact on our economy. For example, pension funds are responsible for the financial well-being of millions of retirees. Due to these investment firms' sheer size and impact, any small percentage change in their portfolios would result in significant gains or losses. In addition, these funds' assets are normally allocated globally and exposed to geopolitical risks. Geopolitical issues such as international conflicts affect investments across all asset classes, such as stocks, bonds, derivatives, and private equity. Therefore, most institutional investors have internal economics teams to monitor the impact of geopolitics on their investment returns. In the past year, the biggest geopolitical issue was the Russia-Ukraine war which has been going on since February 24, 2022. Besides the war, I am also interested in studying similar oil shocks such as the series of sabotage of Nord Stream pipelines on September 26, 2022. The Nord Stream 1 and Nord Stream 2 pipelines were used to transport natural gas from Russia to Germany. I believe energy shocks related to Russia would have a spiller-over effect on the Canadian market since Canada is also an oil exporter like Russia.

The economic impact of the Russia-Ukraine war is devastating and long-lasting. Russia is one of the biggest oil exporters and one of the largest economies in the world (Yahoo!). Since the onset of the war, crude oil prices increased significantly and sustained at a high level for months. The ripple effect from the elevated oil prices caused turbulence in the entire economy. Combined with the pent-up demand from the Covid-19 pandemic and remaining supply chain constraints, high oil prices accelerated the rise of inflation. In the U.S., inflation was as high as 7.9 percent in 2022 (Smialek). Naturally, stocks are affected by this complex economic backdrop. Therefore, it is essential for asset managers to understand the impact of the Russia - Ukraine war on stocks and rebalance portfolios accordingly. Ideally, this study will help investors assess any potential abnormal returns and risks caused by the ongoing war and similar events in the future. This study will focus on the Canadian stock market. Canada's sizable oil and gas industry is ranked 4th globally based on the level of production (Aizarani). Canadian energy companies, primarily based in Alberta and British Columbia, export heavily to the U.S. and the rest of the world (Kennedy). This paper intends to use an event study approach to study how the Russia – Ukraine war and the Nord Stream pipeline leak affect the stock returns of these Canadian energy companies.

II. Literature Review

Before diving into detailed empirical analysis, I surveyed existing literature on how wars affect the broad stock market. Existing research has shown that general "international markets react negatively rather than positively to war" (Schneider and Troeger 642). However, "'war rallies' can be occasionally observed' (Schneider and Troeger 642). This means that some stocks could actually outperform the market during the times of turbulence. The study continues to explain that a plausible cause for 'war rallies' is that the outperforming stocks are based in a third-party country. This third country would be "inversely related to stocks in the countries involved in the war" (Schneider and Troeger 624-626). Canada is a third-party country that potentially competes

with Russia in oil exports. For example, both countries export energy to the U.S. Therefore, I expect the Canadian energy stocks could react positively to the shocks.

In terms of the North American energy stock market specifically, scholars have found that energy firms outperformed the broader stock market immediately following the first day of the Russia – Ukraine war (Nerlinger and Utz 6). Using the event study methodology with the Fama French 3-factor model, the scholars identified that the firms which thrived in this uncertain time, compete with Russia in oil exports (Nerlinger and Utz 1). Therefore, these firms potentially benefitted from the Western sanction on Russian energy production. This study is similar to mine, but I am hoping to build upon it by using additional analytical tools such as the market model for the event study and vector auto regression. The scope of my study also differs as I will be looking at an additional event, the Nord Stream pipeline sabotage.

Some researchers dived deep into the specific factors that might cause some companies to perform better than their peers. For example, in the weeks after the invasion, stocks that are "exposed to the regulatory risks of the transition to a low-carbon economy did well" (Deng, Leippold, Wagner, and Wang 2). This finding makes sense because these companies have invested large amounts of financial assets in becoming less oil dependent and it paid off. I hope to compare the performance of individual energy companies to determine what if the Canadian energy companies experience similar impact from the war.

Finally, in addition to returns, I am also interested in other metrics, such as volatility and liquidity in the market. A study on the impact of 9/11 on airline stocks reveals that airline stocks had high systematic risk (Beta) after the crisis, and the companies could improve performance by reducing their operating leverage (Kim and Gu 2). This study is parallel to my study because 9/11 was also a violent event that impacted one specific industry. Although the 9/11 attack and the Russia-Ukraine war have major differences in length and scale, there is still a lot of insights I could extract from Kim and Gu's study. In conclusion, I will take a similar approach to understand the Beta and liquidity of oil company stocks and stocks in related sectors during the ongoing war.

In conclusion, my study aims to explore and assess the effects of the Russia - Ukraine war and the attack on the Nord Stream energy pipelines on specific company stocks in the energy sector and related sectors, as crude oil prices increased significantly. The section below describes my methodology and hypotheses.

II. Theoretical Framework

I have listed my detailed hypotheses and corresponding testing methods below:

Hypothesis 1: The Canadian energy stock market has semi-strong efficiency.

My event study methodology would allow me to examine the efficiency of the Canadian stock market. According to finance theories, "weak-form market efficiency means that all historical information is reflected by stock prices" (Smith 1). "Semi-strong form market efficiency means

that all publicly available information is already incorporated in stock prices" (Chen 1)." While the strong-form efficiency claims that all information, including insider information, is already priced into stock prices" (Liberto 1). I expect the Canadian energy stock market to have semi-string efficiency. Therefore, the war's outcome will create an initial shock, and soon the public information and be priced into stock prices quickly. Canada is a developed country and the stocks in this study are traded on the Toronto Stock Exchange (TSX). The TSX is the 9 largest exchange in the world in terms of market cap ($2.1 trillion), while the New York Stock Exchange is the largest ($19.3 trillion))(Winck 1). Therefore, I assume that the Canadian stock market would be able to price in public information quickly but still have inefficiencies because it is relatively smaller. This hypothesis is the premise that the following two hypotheses are built upon. Abnormal returns would quickly fade as the market prices in the information on the war and the pipeline attack its expectations to buy and sell assets.

Hypothesis 2: Higher systematic risks (Beta), higher volatility, and lower liquidity in the days immediately following the start of the war.

After considering the stock market, I will look into some overall responses from the stocks, such as volatility and liquidity. I expect liquidity to decline as investors feel more apprehensive about trading and become more risk-averse due to the uncertainties around the war. As a result, there could be more liquidity moved from risky assets to safe-haven assets. In addition, as oil prices and inflations increase, consumers and retail investors in the market would have less disposable income to invest in stocks. On the other hand, it is also possible that consumers would invest more money into the stock market as holding cash becomes less meaningful in the high inflationary environment. Moreover, there would be higher volatility. Overall, the Russia-Ukraine war and the high inflation would likely create mixed effects on the market, and I hope to investigate further using the following methods:

Method: Volatility Measure

I plan to use Beta (β) to measure volatility or systemic risk. Beta reflects how volatile a stock is, compared to the broad market. I will use the formula below:

$$\text{Beta } (\beta) = \text{Cov}(R_e, R_m)/\text{Var}(R_m) \quad (1)$$

Where R_e is the return on an individual stock e and R_m is the market return. The covariance calculation indicates how the stock return changes in relation to changes in market returns. The variance formula measures how much the market's return varies from the average value. I plan to calculate beta on an annual frequency to compare how volatility changes in reaction to the ongoing war.

Method: Liquidity Measure

The Roll's measure will be used to measure liquidity. Roll's measure uses the transaction prices alone, so it is simpler to calculate. The formula for Roll's measure is defined as:

$$S = 2*\text{sqrt}(-\text{cov}(\Delta p_t, \Delta p_{t-1})) \quad (2)$$

Cov ($\Delta p_t, \Delta p_{t-1}$) refers to the autocorrelation between transaction prices. Since the formula

requires us to take a square root value that could be negative, we need positive autocorrection to use this formula, therefore, Roll's measure can be applicable when the autocorrelation is negative. I plan to complete the liquidity analysis using Roll's measure and address this shortcoming in the next steps.

Hypothesis 3: The Canadian energy stock prices rises, and oil prices increases.

Method: Vector Auto Regression (VAR) Method

After calculating the volatility and liquidity measures, I plan to explore the relationship between the crude oil price and the portfolio of Canadian oil companies using the VAR method, a dynamic linear model. I construct the VAR data frame with two variables, the crude oil spot price and the prices of one of the 27 energy company stock prices. I aim to study how the two variables influence each other as they change over time. Each variable is modeled as a linear combination of historical values of itself and the past values of the other variable. Below are the equations I will be using:

$$y_{1t}=a_{11}y_{1t-1}+a_{12}y_{2t-1}+\epsilon_{1t} \quad (3)$$

$$y_{2t}=a_{21}y_{1t-1}+a_{22}y_{2t-1}+\epsilon_{2t} \quad (4)$$

Then, I will use the results from vector auto regressions to create impulse response graphs using a 0.68 confidence interval and a lag of p=1 formula (3) and (4) (Sims and Zha 1153). This way, I can visualize how the prices of specific securities change with crude oil prices and how crude oil reacts to its own shock.

Hypothesis 4: (a) There is a positive average cumulative abnormal return from the initial shock of the Russia - Ukraine war, and it would quickly fade away. (b) There is a positive average cumulative abnormal return from the initial shock of the pipeline attack, and it would quickly fade away.

Method: Event Study

This study uses the event study methodology to examine the returns of a sample of firms in the energy sector and other related sectors, during the Russia - Ukraine war. The goal of using an event study is to separate the impact of the Russia-Ukraine war on stock prices from the regular returns. The daily return R_t, defined as the rate of return at time t, is:

$$R_t = (P_t - P_{t1})/P_t \quad (5)$$

Where Pt is the price at time t, and Pt one is the stock price on the following day, t+1. After calculating daily returns, I plan to test the impact of the ongoing war on stocks by calculating abnormal returns using the event study method. Abnormal return is defined as:

$$AR_t = R_t - E(R)_t \quad (6)$$

Where AR_t is the abnormal return at time t, R_t is the observed return, and E(R) is the predicted or normal return. This way, I could ideally isolate the price reactions caused by the war from the regular price oscillations, and the difference would be the abnormal returns we are looking for. The cumulative abnormal return would be:

$$CAR^i_{t;t+k} = \sum AR_{i,t+k} \quad (7)$$

Where CAR is the cumulative return of each company over the event window observed and AR was the abnormal return calculated in formula (6). Then I take the average of the CAR to calculate the average cumulative return (ACAR).

$$ACAR = \sum AR_{i,t+k} / n \quad (8)$$

I will calculate the predicted returns $E(R)_t$ mentioned in formula (6) using the Fama-French 3-factor pricing model and market model.

The market model is the commonly used model for calculating expected return. The market model is:

$$E(R)_t = \alpha + \beta R_{s\&p} \quad (9)$$

Where $R_{s\&P}$ is the return of S&P 500, or any market index. In my study, I will be using the market model with the S&P/TSX Composite index as my market index.

In addition to the market model, I will also use the Fama French 3-factor model for my study. The 3-factor Fama-French Model is defined as (at time t):

$$R_{it} - R_{ft} = \alpha_{it} + \beta_1(R_{Mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \varepsilon_{it} \quad (10)$$

R_{it} = return of a stock i,
R_{ft} = risk free rate,
R_{Mt} = total market portfolio return,
$R_{it} - R_{ft}$ = expected excess return,
$R_{Mt} - R_{ft}$ = excess return on the market index,
SMB_t = size premium,
HML_t = value premium,
$\beta_{1,2,3}$ = factor coefficients.

To summarize, I will use the Fama-French model and market model to calculate expected returns, and then compute the average cumulative abnormal return described in formula (8). The null hypothesis is that the abnormal return is:

$$H_0: ACAR = 0 \quad (11)$$

$$H_1: ACAR \neq 0 \quad (12)$$

Formula (12) is the null hypothesis. Rejecting the null hypothesis would suggest that there was indeed an abnormal return. I will also use a t-test to test the significance of the difference in average cumulative abnormal returns of the time frames listed. The t statistic would be:

$$T = ACAR / (SD(CAR)/sqrt(n)) \quad (13)$$

Where SD(CAR) is the standard deviation of the cumulative abnormal returns of all the firms.

III. Data

Data used in this study include the stock prices of 27 Canadian energy companies, the market index (S&P/TSE index), and crude oil prices. I chose 27 Canadian energy companies that tracked by the TSX Capped Index and are traded on the Toronto Stock Exchange. The TSX Capped Energy Index is a market capitalization-weighted index with a cap of 25% weight for each stock. I chose the TSX Capped Energy Index because it is a key benchmark for Canadian energy stocks and investors often keep a close eye on it.

The Canadian company stock prices and crude oil spot prices were downloaded from Yahoo Finance. Table 1 includes a list of each stock used in the study, their corresponding tickers, and brief company descriptions. Note: WCSB refers to the Western Canadian Sedimentary Basin.

Each company is labelled by different categories including upstream, midstream, downstream, integrated energy companies and royalty companies. I expect companies in similar categories and who are operating in the same regions to share more common trends financially. For example, A and B are both oil and gas production companies operating only in Canada, not internationally. Then, A and B might behave similarly as international energy companies are more hedged away from the risks of the Canadian energy market. Besides the geography, the company's business segments influence their stock prices too. For example, upstream companies explore and produce oil; midstream companies refine oil; and downstream companies sell the refined oil products to consumers. In addition, oil and gas royalty companies get paid based on how much material is produced. Therefore, I expect pure-play upstream companies to be more closely tied to the changes in energy prices.

Finally, the Fama French factors were downloaded from Kenneth French's website.

IV. Empirical Analysis

First, I begin the empirical analysis by summarizing some descriptive statistics for the data used in this study. In Figure 1, I visualize the changes in individual energy company prices and the crude oil spot prices. The dark blue line represents the daily prices of crude oil while the other colored lines represent individual stocks, as labelled on the graph. On the first day of the Russa-Ukraine war (Feb 24, 2022), the crude oil spot price was around $99. Then, the price quickly rose to the peak of around $123 on June 08, 2022. Recently, the crude oil price declined to around $84 on Jan 31, 2023. The volatility in crude oil prices calls for our attention. The graph shows a similar trend shared by crude oil spot prices and energy stock prices, indicating the possible correlation among them. In this study, I will dive deeper into the relationship between Canadian energy stocks and crude oil prices.

Next, I estimate the beta of each stock over five time periods, five years from 2018 to 2023, to understand the changes in volatility. Figure 2 shows that most of the stocks share the trend. The volatility has increased in 2020 and 2022, possibly because of the Covid -19 pandemic and the Russia - Ukraine war. However, a few companies' stocks behaved differently. For example, TVE's beta decreased in 2020 and increased in 2021 and 2022. I believe that the different pattern in volatility can be attributed to micro factors such as companies' business models and operations. Through additional research, I discovered that Tamarack Valley Energy (TVE) initially had lower leverage ratios and started to become riskier in 2021 as it piled on debt and increased its total debt level increased by 888%. Similarly, Spartan Delta Group (SDE)'s total debt also increased in 2021.

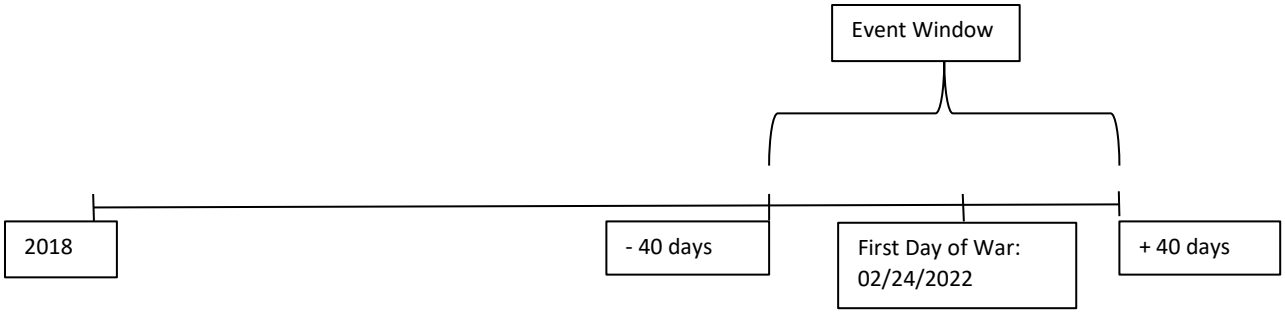
Then, I use the roll measure to measure liquidity. Unfortunately, I am only able to compute

the roll measure for 3 stocks because the formula uses a negative correlation. Most of the companies' historical stock prices have positive autocorrelation, therefore, roll measure is not applicable.

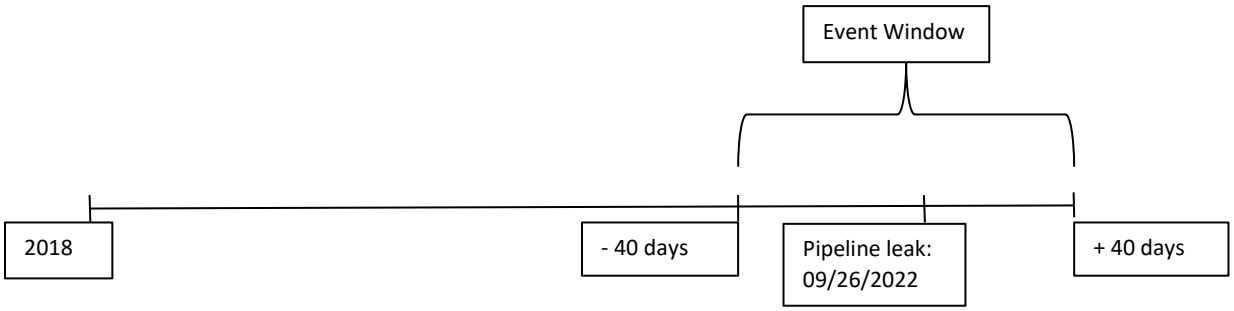
After studying volatility and liquidity, I use vector auto-regression calculations to generate impulse response graphs to examine how each stock reacts to changes in oil prices during the 80-day event window. Although some stocks, such as Secure Energy Services (SES, an oilfield waste treatment company), do not produce statistically significant results, 26 out of the 27 companies did have significant impulse response graphs, shown in Figure 3. In this case, a graph is considered significant if the error bands (red dotted lines) are either above zero or below zero. Each cell below contains the results of a pair of VAR (oil spot price and the stock's price). The graph on top is the oil price' response to its own shock and the graph below it shows the response of the stock's price to the crude oil spot price.

Companies such as SES do not produce significant impulse response results to crude oil at the 0.68 confidence interval and with p = 1. Secure Energy Services is an oil field waste management company that is in the industrial waste management industry and it also has a midstream oil processing, shipping, and market business. Therefore, SES is likely to be relatively less correlated to the changes in crude oil prices, compared to the upstream oil and natural gas companies themselves. The majority of the companies share a similar trend, the stock prices increase as a result of the increase in oil prices. For a few companies, the stock prices increase but the oil price declines a little then goes back up. In this case, the oil prices react to their own shock slightly differently. The impulse response of a crude oil's own shock can be affected by the different combination of stocks in the vector auto regression analysis. Therefore, it is possible that the graph shows an initial decline even though the crude oil price was increasing. It is possible that the relationship between the stocks and the oil prices does not perfectly match the actual oil price data. Overall, all of the stock prices show an increase in reaction to the change in crude oil prices.

Finally, I dive into the event study part of my research to find any potential abnormal returns that could have been a result of the war. Before starting the regression analysis as described in the methodology section, I graph the stock returns in histograms and find that they are all normally distributed, as shown in Figure 4. Then, I estimate the coefficients of the Fama-French model and market model using data from 2018 to 2022, up to 40 days before the first day of the war. In terms of the Fama-French model, I regress the excess returns from each stock against the North American Fama-French factors data downloaded from French's website, based on formula (10). In terms of the market model, I regress the returns of each stock against the returns of the market index, the S&P/TSX Composite index. Then, I use the estimated coefficients to predict returns in the event window, as defined below:



Similarly, I use the same procedures and event window to estimate the coefficients to study the Nord Stream pipeline attack. The event window for the pipeline attack is defined below:



I am including data from 40 days before the war in the event window because I assume there is tension and expectations leading up to the war which could affect the estimation of parameters. I use a 80-day event window because I consider it long enough to capture the impact of the war and the pipeline attack on stock prices, but not so long that it would introduce too many confounding variables.

After producing the coefficients, I conduct robustness checks before proceeding to predict returns. In the robustness check section, I conduct tests for heteroskedasticity. In statistics, heteroskedasticity exists when the standard errors of a variable are not constant over the time period used in the analysis. Therefore, having heteroskedasticity would undermine the accuracy of the regression. From the Fama-French model regressions, 15 companies have robust results. In terms of the market model, 19 companies have robust results. Therefore, the market model seems to be more successful.

After calculating coefficients, I used the coefficients to calculate expected returns. Then I calculated abnormal returns for both models using formulas (6) above. Figure 6 shows the abnormal returns calculated using the coefficients from the Fama-French Model and Market Model regressions. First, using the market model, I found positive, significant, average cumulative abnormal returns (ACAR) of around 0.105 for the 80-day window around the Russia-Ukraine war. I tested the significance of the ACAR by calculating the t statistic, 2.86. Since 2.86 is higher than the t statistic of 2.14 required by the 0.05 confidence level, the result is significant. Therefore, the null hypothesis of ACAR = 0 is rejected. For the attacks and leaks of the Nord Stream Pipelines, the market model did not produce a significant abnormal return. This makes sense because these pipelines supply natural gas instead of oil, from Russia to Germany. Germany

largely imports its oil and natural gas from Russia, Norway and the United Kingdom, instead of Canada (Karasz 1).

Then, using the Fama-French model, the results from the two events are consistent with the findings from the market model. The Russia-Ukraine war caused positive, significant average cumulative abnormal returns of 0.263 with a t statistic of 4.3; while the Pipeline model did not produce significant results.

V. Conclusion and Next Steps

The goal of this paper is to build upon existing research on how violent conflicts affect financial assets in a specific sector. In this study, I examined the effect of two recent geopolitical events, the Russia-Ukraine War and the Nord Stream Pipeline Attack, on the stock prices of Canadian energy companies. This paper aims to take a macro view to investigate the common trends shared by these stocks then take a micro approach to identify the factors causing the difference in behaviors, such as business models and operations.

First, I find that the 27 energy companies share a similar trend in volatility. Volatility generally increased in 2020, potentially due to the pandemic. Then volatility declined in 2021 and increased again in 2022 when the Russia-Ukraine war started. For the companies that did not experience this trend, they were experiencing unique challenges such as having an increased level of debt. In terms of liquidity, the roll measure fails to produce meaningful results because nearly all the companies had positive autocorrelation with their historical prices. In terms of VAR, most of the energy companies experience an increase in their stock prices as the crude oil spot price increased. Finally, I use the Fama-French and Market Model regressions to calculate abnormal returns. The market model is proven to be more effective in this study. Both models produce significant, positive average cumulative abnormal returns (ACAR) for the Russia-Ukraine war but not for the Nord Stream Pipeline attack. The results show us it is possible to exploit patterns in volatility and abnormal returns to invest strategically and achieve higher returns. Knowing these patterns would help us understand the risks of investing in the Canadian energy market during this time of turbulence and take advantage of the positive abnormal returns.

In conclusion, although this study has yielded meaningful results, it can be improved in a variety of ways. For example, I could improve my study by adding more companies to the sample; conduct detailed research on the business models of the companies to understand their performance; expand my study to include other sectors; use better liquidity measures such as the Ahimud's Illiquidity measure; and try different event windows and scenarios.

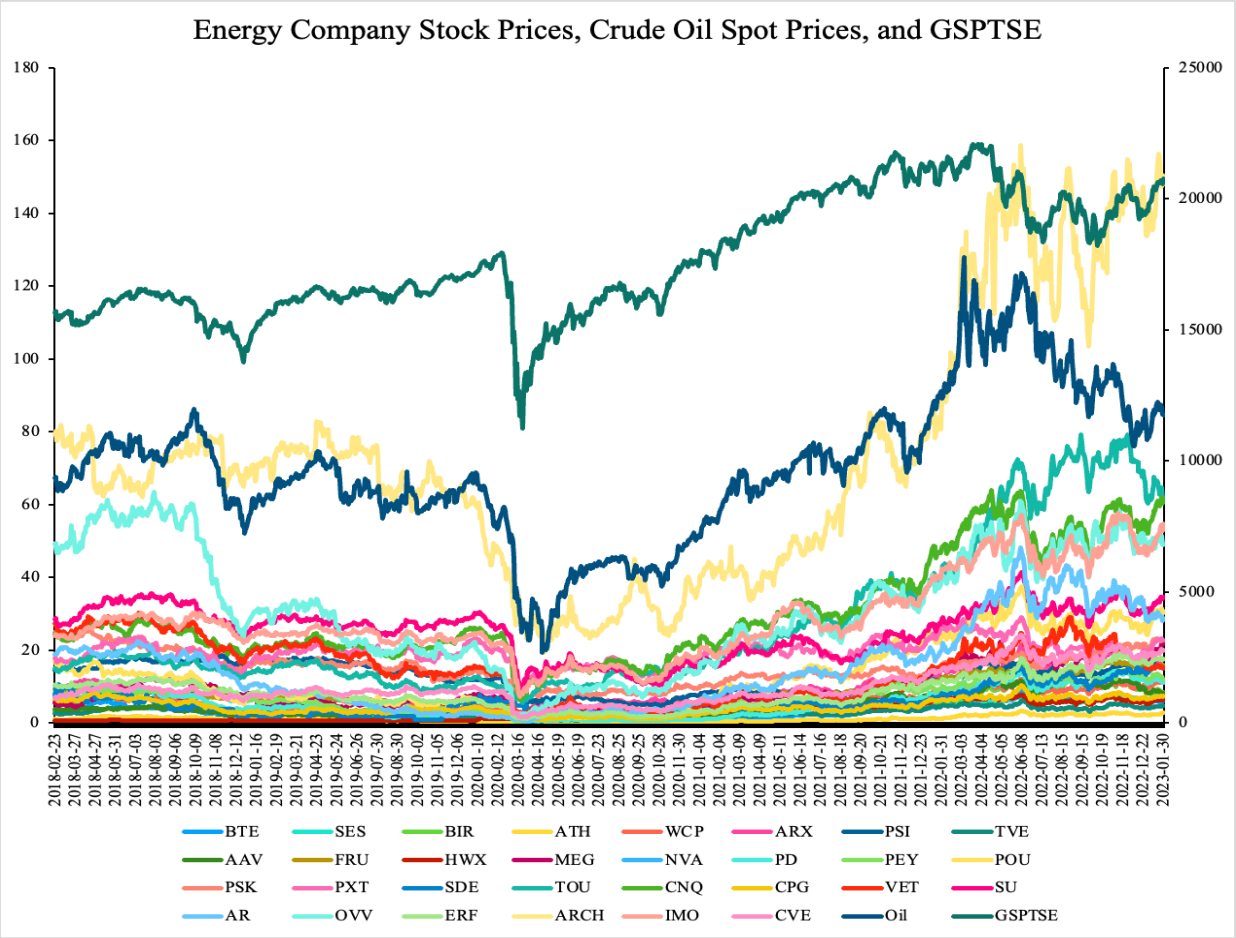
Tables and Graphs:

Table 1:

Ticker	Company Name	Brief Description	Category
SES	Secure Energy Services	Oilfield waste treatment and disposal in Canada and U.S. It also has a midstream oil processing business.	Industrials; midstream
BTE	Baytex Energy Corp.	Acquires, develops, and produces oil and natural gas, US and Canada	upstream
BIR	Birchcliff Energy Ltd	Acquires, explores for, develops, and produces natural gas and oil, just in Canada	upstream
ATH	Athabasca Oil Corporation	Exploration, development, and production of light and thermal oil resource plays, just Canada	upstream
WCP	Whitecap Resources	acquires and develops petroleum and natural gas properties, just Canada	upstream
ARX	ARC Resources Ltd	explores, develops, and produces crude oil, natural gas, condensate, and natural gas liquids in Canada.	upstream
PSI	Pason Systems Inc.	provides data management systems for drilling rigs in Canada, the U.S and internationally.	Data management
TVE	Tamarack Valley Energy	acquires, explores, develops, and produces crude oil, natural gas, and natural gas liquids in the WCSB.	upstream
AAV	Advantage Energy Ltd.	acquires, exploits, develops, and produces crude oil, natural gas, and natural gas liquids in the Province of Alberta, Canada.	upstream
FRU	Freehold Royalties Ltd.	an oil and gas royalty company, owns working interests in oil, natural gas, natural gas liquids, and potash properties in Western Canada and the U.S	royalty
HWX	Headwater Exploration	a junior resource company, engages in the exploration, development, and production of petroleum and natural gas in the WCSB and onshore in New Brunswick.	upstream
MEG	Montrose Environmental Group	operates as an environmental services company in the U.S. and internationally.	Environmental service
NVA	NuVista Energy Ltd.	Exploration, development, and production of oil and natural gas reserves in the WCSB	upstream

PEY	Peyto Exploration & Development Corp.	engages in the exploration, development, and production of oil and natural gas, and natural gas liquids in Alberta/	upstream
POU	Paramount Resources	explores for, develops, produces, and markets natural gas, crude oil, and natural gas liquids in Canada.	upstream
PSK	PrairieSky Royalty Ltd.	a pure-play royalty company, holds crude oil and natural gas royalty interests in Alberta, Saskatchewan, British Columbia, and Manitoba.	royalty
PXT	Parex Resources Inc.	engages in the exploration, development, production of oil and natural gas in Colombia.	upstream
SDE	Spartan Delta Corp.	engages in the exploration, development, and production of petroleum and natural gas in Canada	upstream
TOU	Tourmaline Oil Corp.	acquires, explores for, develops, and produces oil and natural gas properties in the WCSB	upstream
CNQ	Canadian Natural Resources Limited	acquires, explores for, develops, produces, markets, and sells crude oil, natural gas, and natural gas liquids (NGLs).	upstream
CPG	Crescent Point Energy Corporation	explores, develops, and produces light and medium crude oil, natural gas liquids, and natural gas reserves in Western Canada and the U.S.	upstream
VET	Vermillion Energy Inc.	engages in the acquisition, exploration, development, and production of petroleum and natural gas in North America, Europe, and Australia.	upstream
SU	Suncor Energy	an integrated energy company, Canada and international	integrated
OVV	Ovintiv Inc.	explores, develops, produces, and markets natural gas, oil, and natural gas liquids in the U.S. and Canada.	upstream
ERF	Enerplus Corporation	engages in the exploration and development of crude oil and natural gas in the U.S. and Canada.	upstream
IMO	Imperial Oil Limited	engages in exploration, production, and sale of crude oil and natural gas in Canada	Upstream, downstream
CVE	Cenovus Energy Inc.	develops, produces, refines, transports, and markets crude oil and natural gas in Canada and internationally.	Upstream/ midstream

Figure 1:



Source: Yahoo Finance

Figure 2:

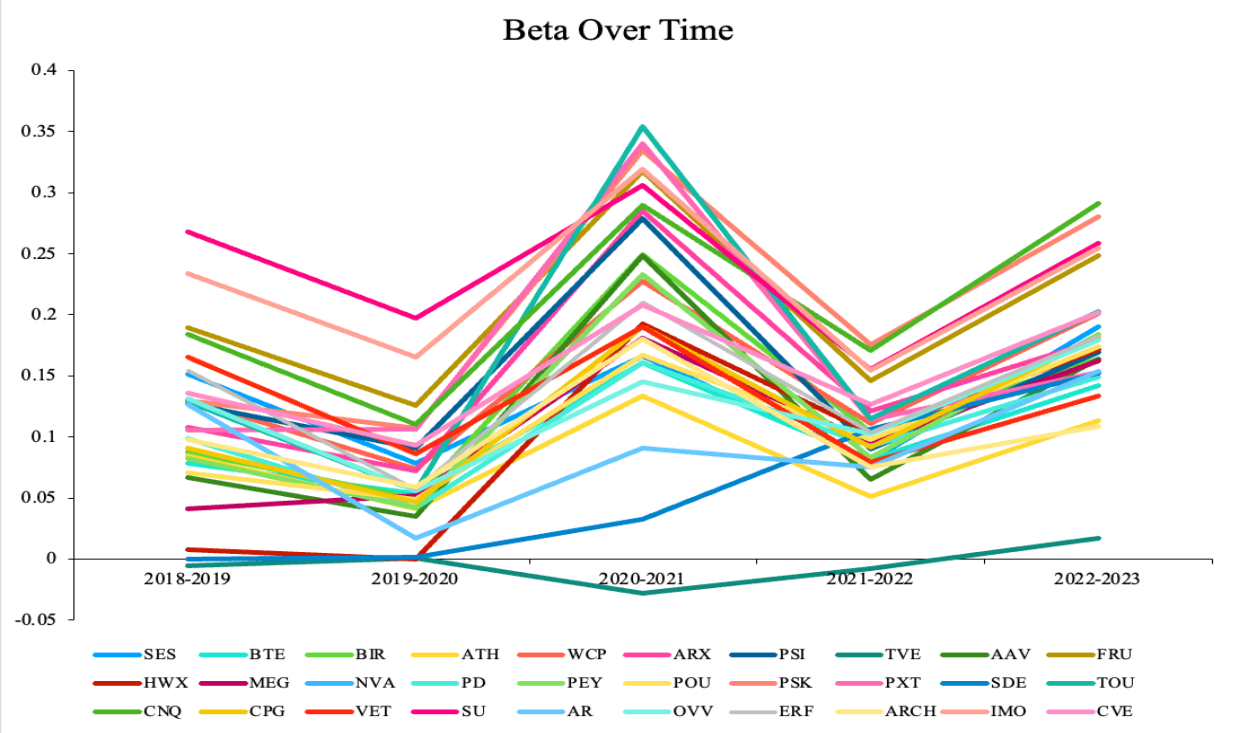
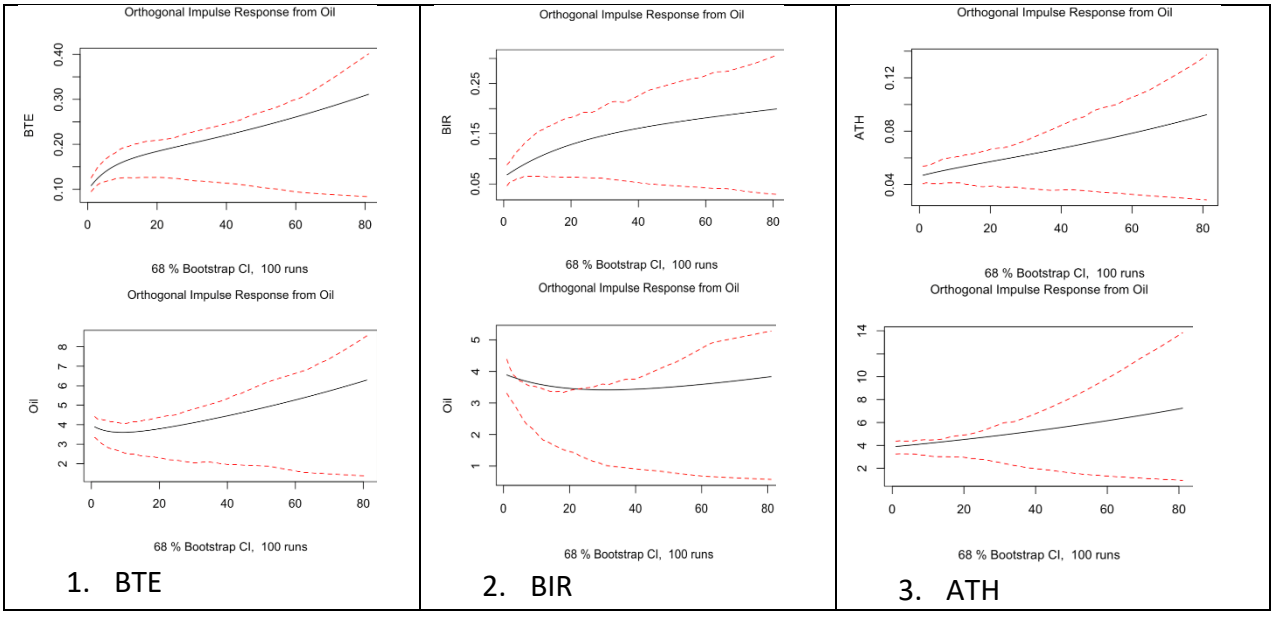
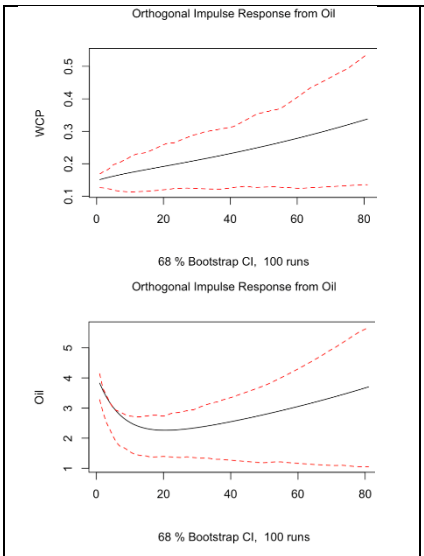
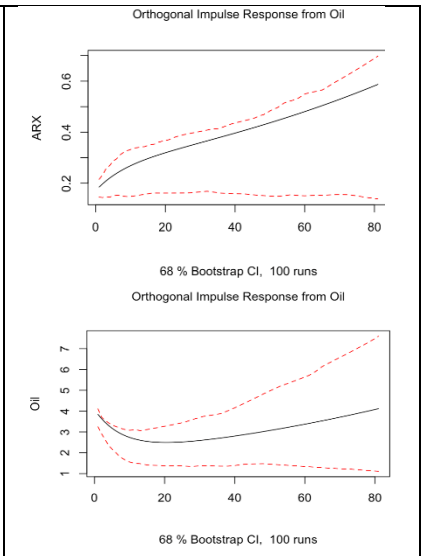


Figure 3: Impulse Response Graphs

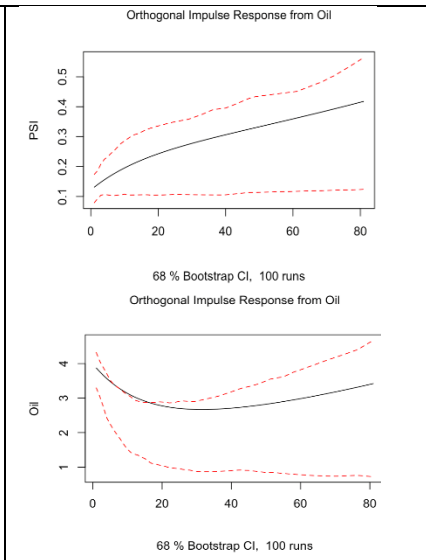




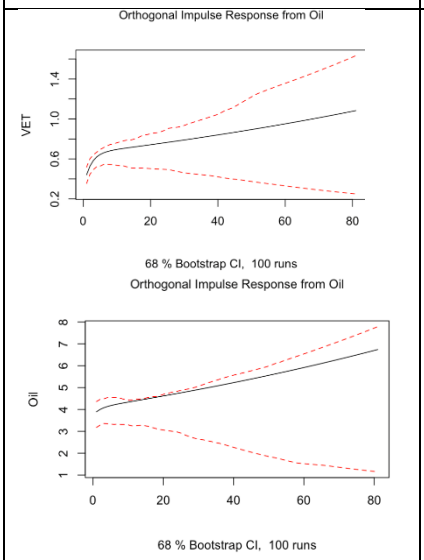
4. WCP



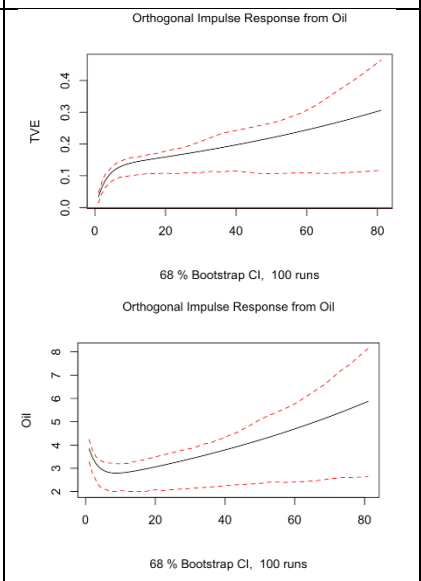
5. ARX



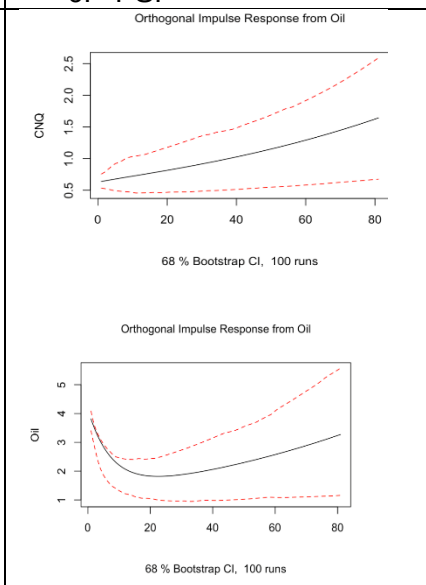
6. PSI



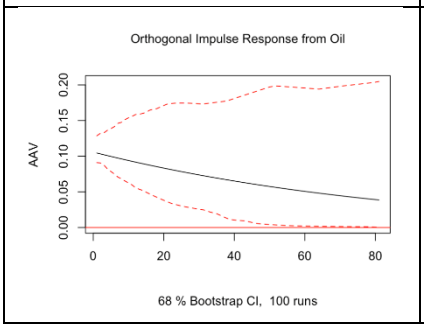
7. VET

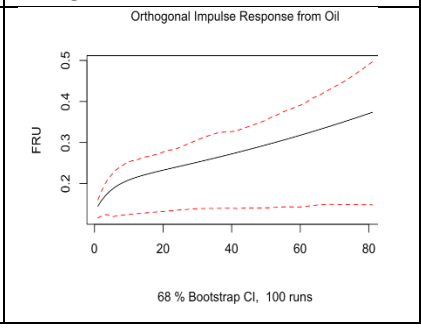


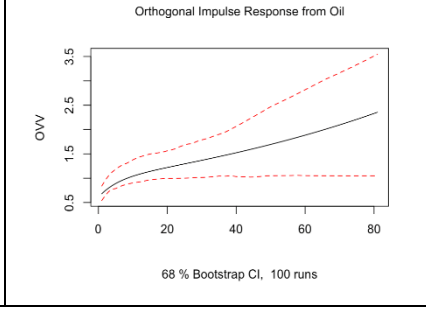
8. TVE

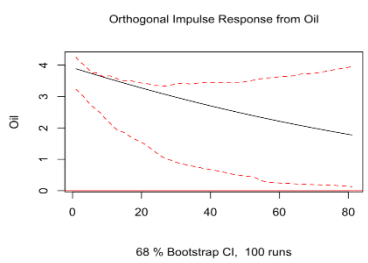


9.CNQ

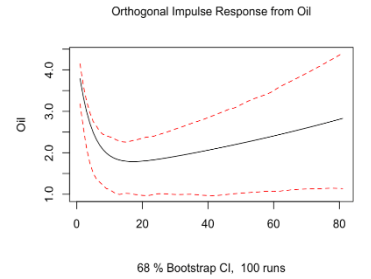




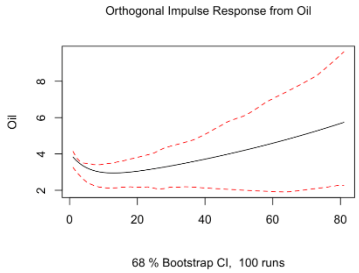




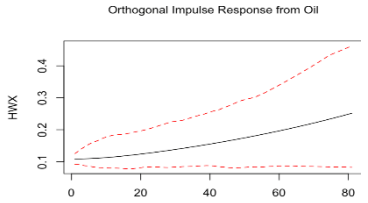
9. AAV

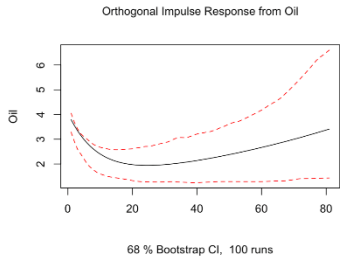


10. FRU

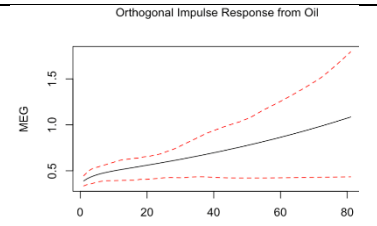


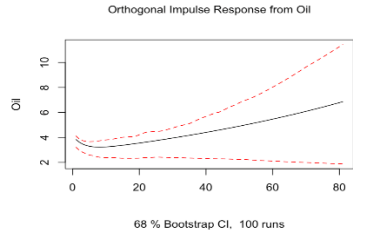
11. OVV



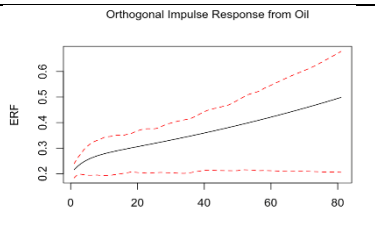


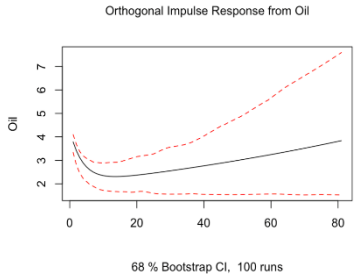
12. HWX



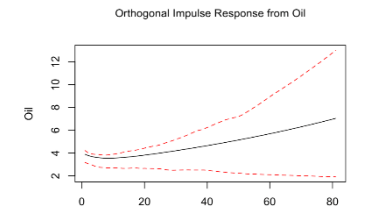


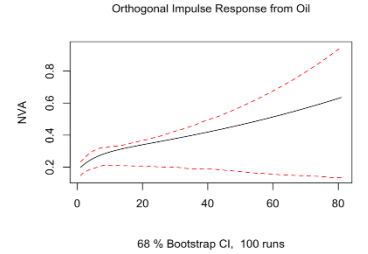
13. MEG



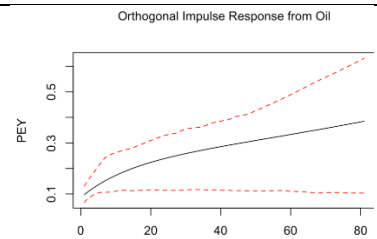


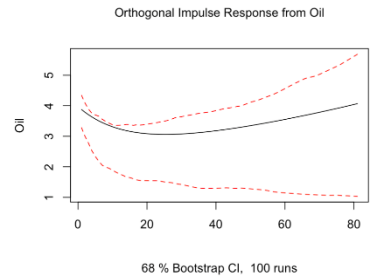
14. ERF



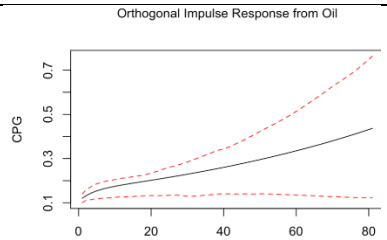


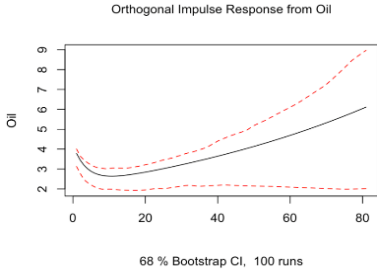
16. NVA



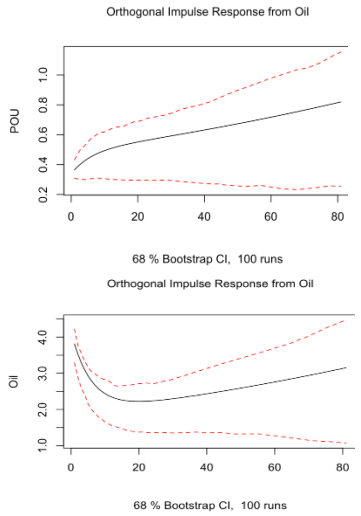


17.PEY

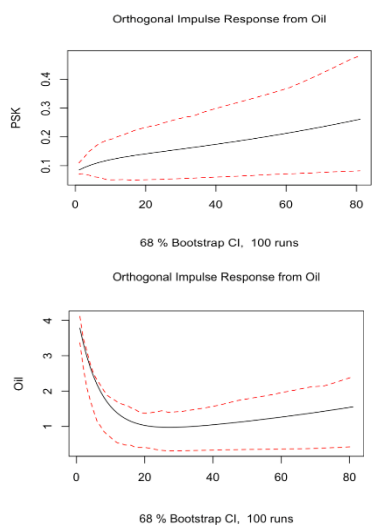




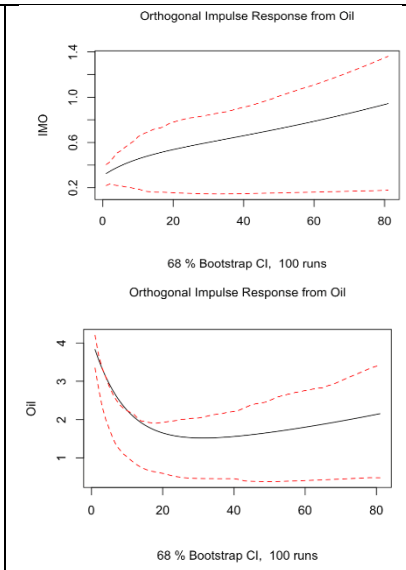
18. CPG



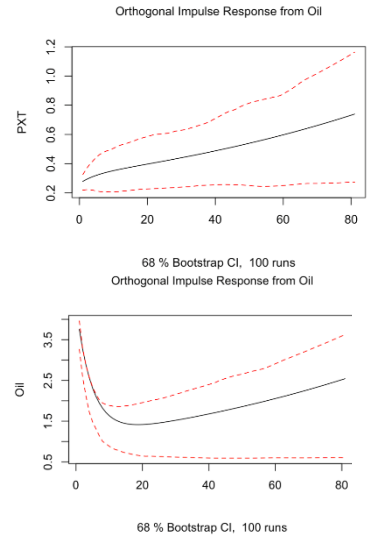
19.POU



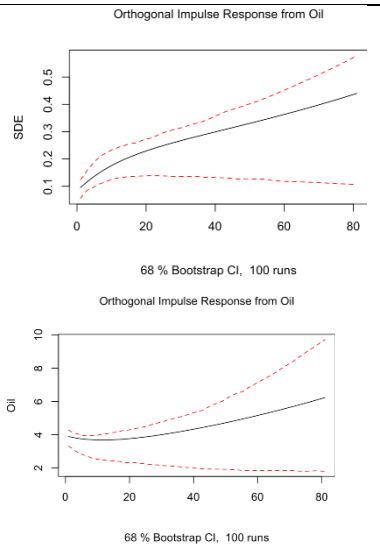
20.PSK



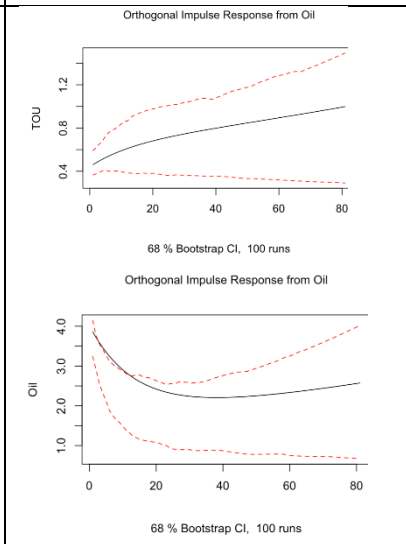
21.IMO



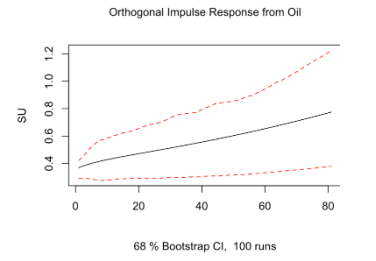
22. PXT

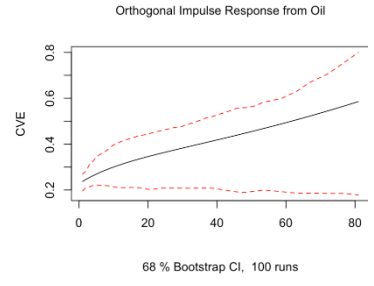


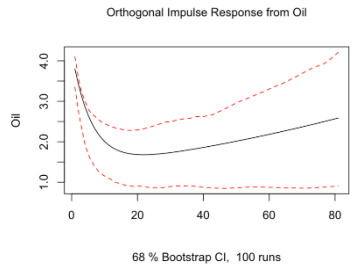
23. SDE



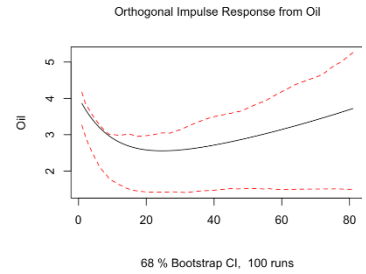
24. TOU





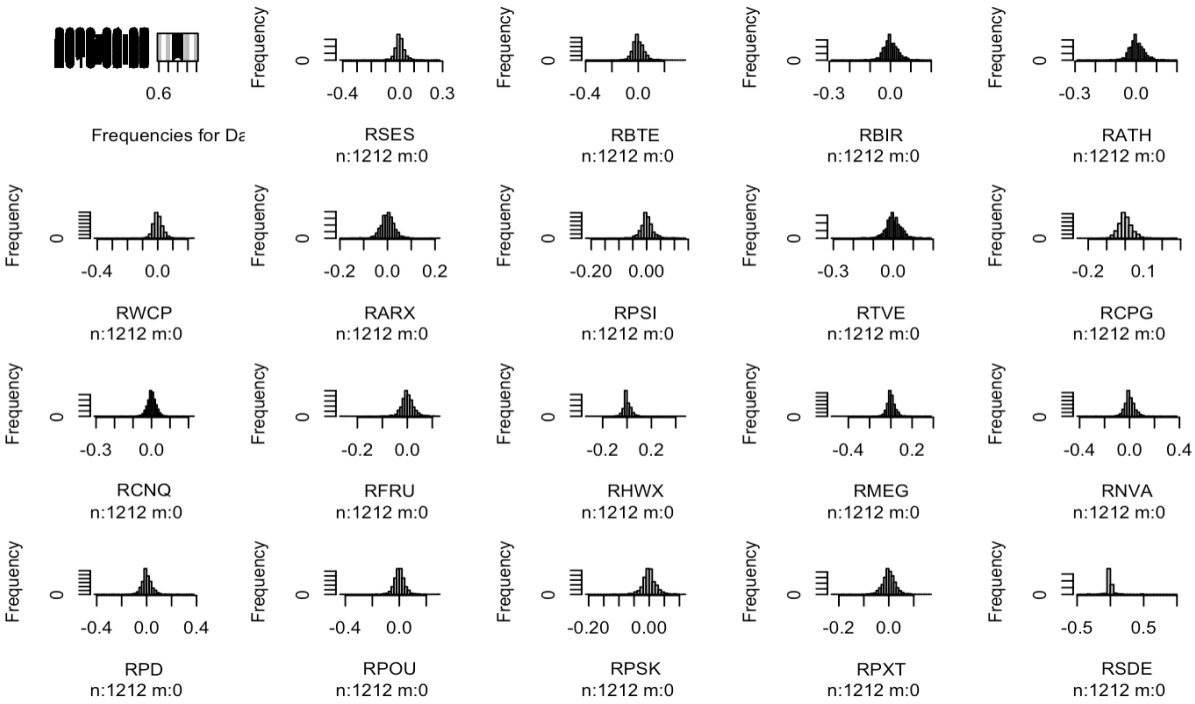


25. SU



26. CVE

Figure 4:



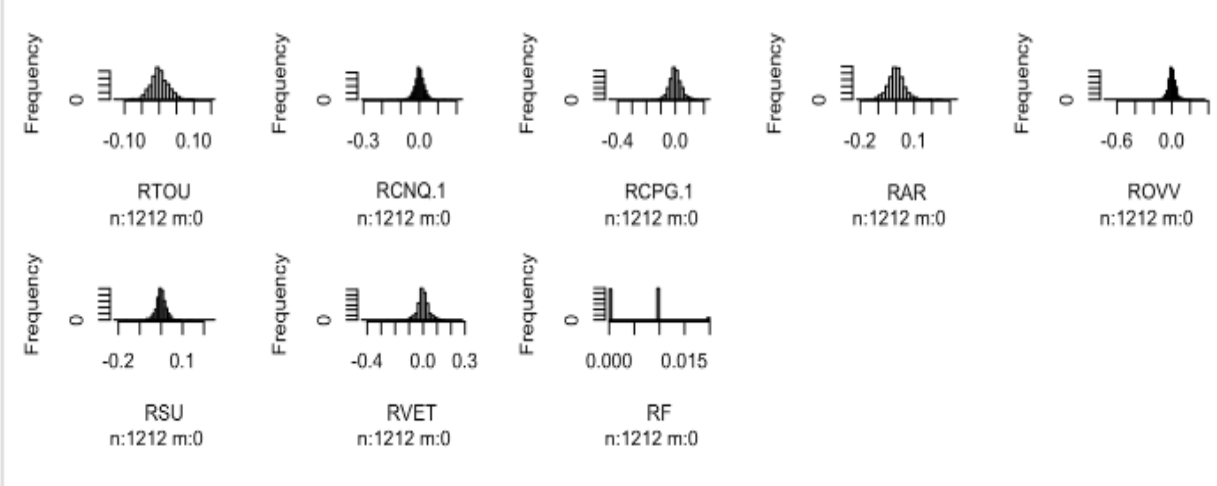


Figure 6: Average Cumulative Abnormal Returns and T Statistics

Market Model - Result 1: Russia – Ukraine War

	SES	BIR	WCP	ARX	PSI	TVE	AAV	FRU	HWX	MEG	NVA	PXT	SDE	CNQ	CPG	ERF
Cumulative AR	6.28E-02	3.32E-01	6.52E-02	1.89E-02	-1.88E-03	2.13E-02	4.01E-01	8.75E-02	-1.05E-01	6.96E-02	1.31E-01	-8.99E-02	1.55E-01	1.47E-01	3.43E-02	3.56E-01

ACAR	1.05E-01
T statistic	2.86E+00
T statistic for 0.05 significance	2.14

Market Model - Result 2: Nord Stream Pipeline Attack

	SES	BIR	WCP	ARX	PSI	TVE	AAV	FRU	HWX	MEG	NVA	PXT	SDE	CNQ	CPG	ERF
Cumulative AR	1.32E-01	-4.21E-02	2.13E-02	1.16E-01	5.38E-02	8.07E-02	-5.02E-02	1.43E-01	-1.20E-01	-1.18E-01	7.09E-02	-2.11E-01	-1.96E-01	4.97E-02	-7.04E-02	1.98E-01

ACAR	3.60E-03
T statistic	1.24E-01
T statistic for 0.05 significance	2.14

Fama French – Result 1: Russia – Ukraine War:

	SES	BTE	ARX	PSI	SDE	TVE	AAV	HWX	POU	PSK	PXT	TOU	CNQ
Cumulative AR	1.27E-01	3.63E-01	-2.29E-01	3.92E-01	2.79E-01	1.73E-01	7.17E-01	1.40E-01	1.52E-01	2.71E-01	1.53E-01	5.50E-01	3.36E-01

ACAR	2.63E-01
T statistic	4.30E+00
T statistic for 0.05 significance	2.16

Fama French – Result 2: Nord Stream Pipeline Attack

	SES	BTE	ARX	PSI	SDE	TVE	AAV	HWX	POU	PSK	PXT	TOU	CNQ
Cumulative AR	-4.71E-01	-6.42E-01	-3.57E-01	-4.00E-01	-6.76E-01	-3.77E-01	-4.05E-01	-4.87E-01	-6.72E-01	-2.66E-01	-5.84E-01	-3.49E-01	-3.87E-01

ACAR	-4.67E-01
T statistic	-1.29E+01
T statistic for 0.05 significance	2.16

References:

Guidolin, Massimo, and Eliana La Ferrara. "The Economic Effects of Violent Conflict: Evidence from Asset Market Reactions." *Journal of Peace Research*, vol. 47, no. 6, 2010, pp. 671–84. *JSTOR*, http://www.jstor.org/stable/20798955. Accessed 16 Sep. 2022.

Schneider, Gerald, and Vera E. Troeger. "War and the World Economy: Stock Market Reactions to International Conflicts." *The Journal of conflict resolution* 50.5 (2006): 623–645. Web.

"Impact of the 9/11 Terrorist Attacks on the Return and Risk of Airline Stocks." *Tourism and Hospitality Research*, vol. 5, no. 2, Apr. 2004, pp. 150-163 (14 pages).

Iglesias, Emma M., and David Rivera-Alonso. "Brent and WTI Oil Prices Volatility during Major Crises and Covid-19." *Journal of Petroleum Science and Engineering*, Elsevier, 25 Jan. 2022, www.sciencedirect.com/science/article/pii/S0920410522000730.

Khotari, S. P., and Jerold B. Warner. "Econometrics of Event Studies." *https://www.bu.edu/*, *Handbook of Corporate Finance: Empirical Corporate Finance*, 2006, www.bu.edu/econ/files/2011/01/KothariWarner2.pdf. Accessed 14 Dec. 2022.

Guardian News and Media. (2022, March 11). *Was it inevitable? A short history of Russia's war on ukraine | Keith Gessen*. The Guardian. Retrieved December 17, 2022, from https://www.theguardian.com/world/2022/mar/11/was-it-inevitable-a-short-history-of-russias-war-on-ukraine

Yahoo! (n.d.). *22 biggest economies in the world in 2022*. Yahoo! Finance. Retrieved January 27, 2023, from https://finance.yahoo.com/news/22-biggest-economies-world-2022-144215864.html?fr=yhssrp_catchall

Smialek, Jeanna. "Surging U.S. Inflation Raises Stakes as War Pushes up Prices." *The New York Times*, The New York Times, 10 Mar. 2022, https://www.nytimes.com/2022/03/10/business/economy/cpi-inflation-february-2022.html.

D'Souza, Deborah. "How War Affects the Modern Stock Market." *Investopedia*, Investopedia, 23 Sept. 2022, https://www.investopedia.com/solving-the-war-puzzle-4780889#:~:text=Another%20example%20is%20after%20Russia%20invaded%20Ukraine%20on,investors%20worried%20about%20the%20impact%20of%20commodity%20prices.

Topic: Oil industry in Canada. Statista. Retrieved March 11, 2023, from https://www.statista.com/topics/2963/canadian-oil-and-gas-industry/#topicOverview

Kennedy, C. (2022, March 11). *Canada considers ramping up oil exports to U.S.* OilPrice.com. Retrieved March 11, 2023, from https://oilprice.com/Energy/Crude-Oil/Canada-Considers-Ramping-Up-Oil-Exports-To-US.html

Mohammed, K. S., Usman, M., Ahmad, P., & Bulgamaa, U. (1970, January 1). *[PDF] do all renewable energy stocks react to the war in Ukraine? Russo-Ukrainian conflict perspective: Semantic scholar*. Environmental Science and Pollution Research International. Retrieved March 11, 2023, from https://www.semanticscholar.org/paper/Do-all-renewable-energy-stocks-react-to-the-war-in-Mohammed-Usman/36ed28e496e0e3882c1ab76a9e7835dc0c741e4a

The impact of the Ukraine-russia war on world stock market returns. (n.d.). Retrieved March 12, 2023, from https://www.researchgate.net/publication/359650424_The_impact_of_the_Ukraine-Russia_war_on_world_stock_market_returns

The impact of the Russia-Ukraine conflict on energy firms: A capital market perspective. Finance Research Letters. Retrieved March 30, 2023, from https://www.sciencedirect.com/science/article/pii/S1544612322004421

Winck, Ben. “Here Are the 10 Biggest Stock Exchanges in the World, Ranked by Market Cap.” *Business Insider*, Business Insider, markets.businessinsider.com/news/stocks/biggest-stock-exchanges-world-ranked-market-cap-nyse-nasdaq-trading-2020-6-1029325478

“U.S. Energy Information Administration - EIA - Independent Statistics and Analysis.” *Oil Imports and Exports - U.S. Energy Information Administration (EIA)*, www.eia.gov/energyexplained/oil-and-petroleum-products/imports-and-exports.php.

Chen, James. “Semi-Strong Form Efficiency: Definition and Market Hypothesis.” *Investopedia*, Investopedia, 13 Dec. 2022, www.investopedia.com/terms/s/semistrongform.asp.

Smith, Tim. “What Is Weak Form Efficiency and How Is It Used?” *Investopedia*, Investopedia, 11 Nov. 2022, www.investopedia.com/terms/w/weakform.asp.

Liberto, Daniel. “Strong Form Efficiency: Economic Theory Explained.” *Investopedia*, Investopedia, 5 Jan. 2023, www.investopedia.com/terms/s/strongform.asp.

“How Heavily Does Germany Rely on Russian Energy?” *The Economist*, The Economist Newspaper, www.economist.com/the-economist-explains/2022/05/04/how-heavily-does-germany-rely-on-russian-energy.

Error Bands for Impulse Responses - Sims - 1999 - Econometrica - Wiley ... onlinelibrary.wiley.com/doi/pdf/10.1111/1468-0262.00071.

Karasz, Palko. “Germany Imports Gas from Russia. but Is It a 'Captive'?” *The New York Times*, The New York Times, 11 July 2018, www.nytimes.com/2018/07/11/world/europe/trump-germany-russia-gas.html.

Market Efficiency, Long-Term Returns, and Behavioral Finance - Researchgate. www.researchgate.net/publication/228532383_Market_efficiency_long-term_returns_and_behavioral_finance.