Master's thesis

NTNU
Norwegian University of Science and Technology
Faculty of Economics and Management
Department of Economics

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The reaction of the Norwegian stock market to the conflict between Russia and Ukraine

Master's thesis in Finansiell økonomi
Supervisor: Joakim Blix Prestmo
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Kunnskap for en bedre verden

Abstract

When Russia invaded Ukraine 24.02.2022, it sent shock-waves through the stock market. As a response, the world came together and condemned the invasion by imposing sanctions on Russia and showing support to Ukraine.

This master's thesis analyses whether the invasion had a negative impact on the Norwegian and the Russian stock market through an event study. Using data for the Oslo Benchmark Index (OSEBX), and Moscow Exchange (MOEX), we found that the event had a negative impact on the indices. However, the abnormal return on the event day, was only significant for MOEX. We also compared the returns of former wars, and found that the Russo-Ukraine had more volatile returns in the event window.

Further, we looked at the "negativity effect" (Akthar et al., 2011) and volatility using GARCH models. We found that positive news had a more significant impact on OSEBX, and that negative news had a more significant impact on MOEX. The results also suggested that the conflict between Russia and Ukraine increased the volatility for the indices.

Abstrakt

Når Russland invaderte Ukraina 24.02.2022, sendte det sjokkbølger gjennom aksjemarkedet. Da dette skjedde, så samlet verden seg og fordømte invasjonen ved å innføre sanskjoner mot Russland vise støtte til Ukraina.

Denne masteroppgaven analyserer om invasjonen hadde en negativ innvirkning på det norske og det russiske aksjemarkedet gjennom en "hendelsesstudie". Ved å bruke data for hovedindeksen for Oslo Børs (OSEBX), og hovedindeksen for Russland (MOEX), så fant ci at hendelsen hadde en negativ påvirkning på indeksene. Den unormale avkastningen på hendelsesdagen, var bare signifikant for MOEX. Vi sammenlignet også avkastningene fra tidligere kriger, og fant at krigen mellom Russland og Ukraina hadde mer volatil avkastning i "hendelsesvinduet".

Videre så vi på "negativitetseffekten" (Akthar et al., 2011) og volatiliteten ved å bruke GARCH modeller. Vi fant at positive nyheter hadde størst påvirkning på OSBEX, og at negative nyheter hadde størst påvirkning på MOEX. Resultatene antydet også at konflikten mellom Russland og Ukraina økte volatiliteten for indeksene.

Preface

This master's thesis was written as the final part of NTNU's Master of Science program in Financial Economics during the spring semester of 2022.

I have always been very interested in how news influences the world, so that is why I picked this topic. The idea to write about the Russo-Ukraine war came as the war broke out, and I started to do some research regarding the topic. That is when I discovered the gap in literature, and saw the possibility to write about something that was very topical at the moment.

I want to thank my supervisor Joakim Blix Prestmo for the feedback throughout the process.

Trondheim, June 2022.

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1 Introduction

In the past, there has been a number of studies that study the effect international conflicts have on stock markets. This paper will study how the Russia-Ukraine conflict has affected the Norwegian market (OSEBX), and compare it to how the Russian stock market (MOEX) has been affected. The focus will be on the daily closing price of the stocks during the prelude to the war, and after the war broke out.

Our world is more interconnected than ever. That means that a conflict, like the war in Ukraine, poses a threat to the global economy. Usually, neighbouring countries are the most impacted by geopolitical tensions and refugee flow. This can put a major strain on resources. Countries with strong trade links can also be severely impacted. In March 2022, 3,5% of Norwegian import, was from Russia (Bøe, 2022). Some of the things that are imported the most are food, metals, fuel and chemical products (Fossanger, 2022). After Russia's invasion, Norway wanted to stop importing goods from Russia. This requires a substantial change in trading policy. The continuous lockdowns in China are also putting strain on global supply chains (Pilkington, Rechtschaffen, 2022). This has significantly increased operational risk for companies.

The contraction in commodity trade have not only raised prices for commodities, but it has also put a dent on purchasing power. Since inflation is high right now, real incomes diminishes and demand for goods and services are suppressed, eating into consumer spending. When this happens, financial conditions could tighten as central banks raise interest rates. The Central Bank of Norway, have said that the interest rate will be raised 0,25% every quarter until 2024 (Sant, 2022). Policymakers will have to strike the delicate balance between containing inflation and supporting the economic recovery from the pandemic. This can be especially challenging as volatility in global financial markets reduce business confidence and limits investment. Longer term, this could have implications on the global supply chain system and integrated financial markets. While the future is very uncertain, we may see significant changes in the global economic order as the energy trade flows shift, payment systems fragment, and countries rethink their financial dependence on each other.

To the best of the authors knowledge, there has not, been a comprehensive study on how the recent events of the Russia-Ukraine conflict has affected the Norwegian stock market. There actually seem to be a lack of studies that examine the effect of war on the Norwegian stock market. This paper will analyse whether the Norwegian and Russian stock markets had a significant reaction to the invasion of Ukraine 24 February 2022 through an event study, and take a look at how the conflict have impacted the volatility for the markets. However, the main focus will be on Norwegian stock market. The study will also examine the negativity effect, and determine if stock returns reacted more strongly to negative events than positive events.

The rest of the paper is set up in the following manner. In section 2, we look at the background that the study is based on, and section 3 the data and research methodology will be presented. Section 4 contains the empirical results, in section 5 the results will be discussed, and section 6 will summarise the findings and provide conclusions.

2 Theoretical background and hypothesis development

2.1 The war puzzle

The war puzzle is that increasing war likelihood decrease stock prices, while the outbreak of the war itself seems to increase stock prices. The economic and social consequences of war lead to a debate that has an empirical problem. Almost no reliable figures exist on the key economic activities in war-affected societies (Schneider, Troeger, 2006). This makes it easier for both sides of a war to downplay or exaggerate the human and economic costs of combat.

The major scientific theories do not make the dispute easier to solve. Marxists expect that the capitalist world profits from a major war (Schneider et. al., 2006). Realism and liberalism on the other hand, have speculated over the causal arrow going from trade to conflict rather than the one pointing in the opposite direction. There is a hardly a mention of the alleged causal path leading from war to economic activities and trade in the two paradigms in international relations (Barbieri and Levy 1999, 2001, 2003). The two different major theories both agree that economic exchange will suffer from warfare. In the comparative studies of Barbieri and Levy, they show for some dyads that war did not lead to a significant drop in the amount of traded goods and services between the warring parties. Moreover, the findings of the study suggested that current liberal and realist theories fail to provide a relationship between economic independence and international conflict. The liberal view is most often right, but if the conflict comes as a surprise, the bilateral level of trade is affected negatively (Li and Sacko 2002). Trade might not be ideal to account for the market responses to international political events, but trade relationships have a tenacity that consequently biases examinations in favour of the null hypothesis. This paper will therefore concentrate on how stock markets react to war.

2.2 Past impacts of war on the Norwegian stock market

There has not been a lot of research on how the Norwegian stock market is impacted by the outbreak of wars, so the author of this paper has looked at 10 major conflicts from 2001 to this date, and calculated the returns for the day of the events (t_0), the three following days (t_1, t_2, t_3), and the average returns from the event day to 10 trading days after the event ($\overline{[t_0 : t_{10}]}$). Results are in Table 1. The average returns of the 10 conflicts that has been picked has been calculated in the bottom row, and they show that there is a slight negative return on the event days of conflicts. In some cases, there is not be a reaction before the day after the event. The reaction to the terrorist attack on 9/11 is an example of that. In the event analysis on the outbreak of the Russo-Ukrainian war, we will compare it to these former conflicts. The average return of the period from the event day to 10 days after the event day is -0,15%. This result indicate that the Norwegian stock market has an initial negative reaction to the outbreak of a major conflict.

These wars were chosen because the author deemed these conflicts as the most representative of the wars during the chosen period.

Table 1

OSEBX returns in relation to 10 major conflicts from 2000-2015. If the event happened on a trade day, the closest trade day following the event has been used as t_0.

	Start date	**Event day (t_0)**	t_1	t_2	t_3	$[t_0: t_{10}]$
War on terror (9/11)	11.09.2001	0.16 %	-3.66 %	-0.46 %	-1.68 %	-1,57 %
War in Afghanistan	07.10.2001	-1.11 %	0.60 %	0.55 %	2.25 %	0.16 %
Iraq War	20.03.2003	-0.60 %	1.57 %	-2.50 %	0.63 %	-0.04 %
Lebanon War	12.07.2006	1.71 %	-1.36 %	-1.24 %	-1.98 %	-0.13 %
Russo-Georgian War	01.08.2008	-2.87 %	-1.21 %	-2.27 %	1.90 %	-0,48 %
Gaza War	27.12.2008	2.46 %	2.20 %	5.92 %	1.66 %	0.15 %
Libyan Civil War	15.02.2011	-0.60 %	0.25 %	-0.94 %	-0.09 %	-0.07 %
Syrian Civil War	15.03.2011	-1.86 %	0.19 %	2.37 %	0.79 %	0,33 %
Annexation of Crimea	20.02.2014	0.44 %	0.47 %	0.46 %	-0.91 %	0.15 %
Yemeni Civil War	16.09.2014	0.15 %	0.68 %	0.30 %	-0.11 %	-0.04 %
Average return		**-0.21 %**	**-0.03 %**	**0.22 %**	**0.25 %**	**-0.15 %**

2.3 Norwegian dependency on oil prices

The oil sector is 20% of the weight in OSEBX, and that means that oil prices have a substantial impact on the Norwegian stock market. Bakken (2017) examined the dynamics of oil price and stock movements in Norway during a 10-year period (2006-2016). The study found that that there is a bi-directional relationship between Brendt Crude oil prices and OSEBX with the use of GARCH models. That means that OSEBX returns Granger-caused Brent crude prices. Park and Ratti (2008), estimated effects of oil price shocks and volatility, and found that Norway was the only country that showed a statistically significant positive response in stock returns intra-month and up to one month later. A study of oil-sensitive stock indices by Hammoudeh (2005), found that even though Norway's market returns display relatively strong dynamic sensitivity to oil price growth, it can be affected by event effects.

The war has led to a surge in oil and gas prices. Russia is a large exporter of oil and gas. Because of the Vladimir Putin's actions, a large portion of the world decided that it would stop importing goods from Russia. That has led to an increase in prices for commodities the country export. The prices for goods that are exported from Ukraine, have also increased, because the war hinders export. This generates implications on the global supply chain system and integrated financial markets.

Higher oil prices are bad for the world capital market as a whole (Hammoudeh, 2005). The results of a study on market reaction to the war in Iraq, suggest that moving from a 0 to a 100 probability of war raises oil prices by 10$, and reduces the S&P 500 by 15 percent (Leigh, Wolfers, Zitzetiz, 2003). In contrast to the global economy, it is beneficial for Norway. This is attributed to the fact that Norway exports both oil and gas, and that revenues from oil-related business plays a substantial role in the Norwegian economy, even though the oil sector only make up for about 20% of it. The growth in income related to oil and gas, led to a statement from the Polish prime minister Mateusz Morawiecki. He said that Norway should share the increased income with Ukraine, because it is not fair that Norway is benefitting from this war (NTB nyheter, 2022).

2.4 The global response to Russian aggression

"Trading with the enemy" is a phenomenon that is compatible with broad conceptualizations of liberal or realist theory (Barbieri et. al, 1999). Stopping trade with the enemy may result in loss of trade to a third party, or lead to an alienation of neutrals. The continuation of trade during wartime may create the opportunity to make relative gains at the expense of third parties, or it may gain influence over the adversary by making him economically dependent. Commercial or financial interests at home, may also have an interest in continuing trade because they expect private gain. If the government is dependent of the economic support of these corporations in order to fund the war effort, they might sway them to continue trade. However, in the war between Russia and Ukraine, no other country is directly involved, possibly with the exception of Belarus. That means that there is no need for huge sums of money to fund a war. That gives the rest of the world leeway to find the best economical punishment they can come up with, and impose sanctions on Russia.

Sanctions have become a key tool in the EU's response the Russian aggression towards Ukraine (Dreyer I, Popescu N, 2014). The idea behind these sanctions, is to make them so effective that the economic impact on Russia is so effective that it leads to a change in Russia's behaviour. The Russian invasion of Ukraine on 24. February 2022 has been met with several sanctions, but cutting major Russian banks from SWIFT, might be the one that stands out the most. This sanction was imposed on 26. of February, two days after the invasion. There are arguments both for and against imposing sanctions on Russia. The cases against imposing sanctions on Russia, is that they have not coerced Russia into reversing its posture, and it has been used as a tool to help Putin unite Russians behind him. One study examined the effect of the sanctions that was put on Russia after the annexation of Crimea. The study concluded that economic sanctions had achieved results in contributing to Russia's economic decline, but significant economic costs alone, had not been enough to persuade the regime to back off and change its policy towards Ukraine a year after the sanctions were imposed (Oxenstierna, Olsson, 2015). Another study showed that a drop in oil prices has a larger effect on the Russian economy than the sanctions imposed on the country (Gurvich, Prilepskiy, 2015).

These sanctions can have a negative effect on other markets as well. Future leverage could decrease and trade will be hurt. There are also cases in favour of sanctions. One point, is that they minimise risk of further escalation by constraining Russia, and they signal to other actors that unilateral military ventures will come at a cost. Another important point, is that the absence of tangible economic prosperity hurts patriotism. Putin will lose war support if the economy gets too bad. Already, experts say that the global response has drastically altered Russia's economic future, and set the country back 30 years (Wilikie, 2022).

The invasion has also led to other consequences. Putin's plan to weaken NATO has made it stronger now that Sweden and Finland have applied to become members. The countries view Russia as a live threat now, and has concluded that they would not be able to defend themselves if Russia were to attack them.

2.5 Hypothesis development

The author expects the liberal argument to be right in most cases, but there are reasons to suspect that the effect of war on activities is not always negative. Stocks of arms manufacturers, gold and commodities like oil for instance, will experience a boost in times of growing tensions (Brandes, 1997). The other objection against commercial liberalism is the occurrence of stock market rallies during the course of combat. These kind of rallies, typically implies that the use of military force propels international traders to buy stocks instead of alternatives such as gold or government bonds. In this paper, we will explore how Oslo Stock exchange and the Russian stock market reacted to the outbreak of war in Ukraine. If the market expects the war to be long, traders will sell stocks and replace them with less risky alternatives. A collective negative belief about the market will decrease the aggregate value of the stock market, while the expectation of a positive development, increases the attractiveness of stocks. Brune, Hens, Rieger and Wang (2011) studied the war puzzle, and found that stock market decrease as the probability for war goes up, but that once the war breaks out, stock market prices do not decrease further. They actually increase significantly. This is true for wars with a lengthy prologue. Wars that come as a shock, tend to decrease stock market prices.

The closeness of a market to a conflict region is a very important factor to take into account when looking at the differences across markets. Investors trading on nearby markets will fear a conflict to spread to other markets. That means that they have a reduced tendency to react positively to an escalation in the conflict. The opposite is the case for markets that is far away. In this case, investors are inclined to evaluate how the war affects the domestic economy.

Troeger and Schneider (2012) wrote an article that shows that international markets react negatively rather than positively to war, but that "war rallies" at stock markets can also be occasionally observed. A rally is caused by a significant increase in demand because of a large influx of investment capital into the market. News stories or events that create a short-term imbalance in supply and demand, can be the cause of a rally. The study also found that stock market reactions to international crises were most often negative. There was also strong evidence for asymmetrical reactions, where conflictive events influenced the volatility of the stock market much more strongly than cooperative ones. Stock market reactions to international crisis largely depended on the severity of an anticipated or real international event, and the collective expectation that an event will materialize.

Hypothesis 1: The outbreak of the Russo-Ukraine war had a negative impact on the stock market

Larger volatility of an index during an international crisis, is one indication that the market suffers under politically induced uncertainty. This is why the severity of an event should have a direct impact on the stock market indices. This only holds if the event is important enough to affect the stock market. The impact largely refers to sectors or firms whose stocks are traded within a particular market. Especially severe conflictive events that cannot be easily forecasted, is expected to raise the stock prices.

Hypothesis 2: The Russo-Ukraine conflict increased the market volatility.

The negativity effect proclaims that stocks react more strongly to negative events, than to positive events. A study of the impact of World War 2 on the British stock market (Hudson, Urquhart, 2015), found that major negative events had a significant negative effect on stock returns on days following the event, whilst major positive events had a negative 1-day insignificant impact on the FT30, proving the negativity effect by Akthar et al. (2011). Positive events caused 1-day significant positive reaction, whilst negative events generated a 2-day significant negative reaction.

This has also been studied more generally on high frequency stock data from the Oslo Stock Exchange. Holm and Rødde (2019) found that negative news led to significant negative cumulative abnormal returns. The results suggested that negative news induced more significant price reactions than positive news. Moreover, unscheduled news affects both intraday volatility and trading activity for companies at the Oslo Stock Exchange.

Hypothesis 3: Negative news had a larger impact on the Russian and Norwegian stock markets during the Russo-Ukraine conflict.

3 Data and research methodology

This study uses data obtained from Refinitiv Eikon, Euronext and MSCI. The data includes the daily closing index price of OSEBX which represents the stock market in Norway, the daily close index price of MOEX which represents the stock market in Russia, and the Morgan Stanley Capital International (MSCI) All Country World Index (ACWI). ACWI represent the market return. Daily stock prices are used because they give the most accurate description to describe the response to the event. High-frequency data like this are especially volatile over time and have a time-dependent variance. Time dependency of the error variance violates one of the basic Gauss-Markov assumptions for linear regressions and renders the estimation of ordinary least squares (OLS) models inefficient. The data analysis consists of two methodologies; (1) an event study where the cumulative abnormal returns (CAR) are researched, and (2) a volatility analysis using the GARCH (1,1) method.

3.1 Event study

In order to test whether the Russo-Ukraine conflict had a negative impact on the Norwegian stock market, we use the study framework outlined by Campbell, Lo and MacKinlay (1996). To measure the impact of an economic event on the market value of a firm, an event study is used (Campbell et a., 1996). The efficient market hypothesis says that the impact of an event will be reflected immediately in the asset price (Fama, 1970). When we conduct an event study, we must first define the event, the event window and the estimation period. Then we can begin the data analysis. When we estimate the impact of an event, we must first estimate the normal return. The normal return, is the return that should have taken place if the event did not happen. We will use the market market model in our estimation model because it is considered a more accurate model than the constant-mean return model.

3.1.1 Defining the event

This paper investigates the Russia-Ukraine conflict from 14 September 2020 to 20 May 2022. The start date was chosen because this was the date Ukrainian President Volodymyr Zelenskyy approved Ukraine's new National Security Strategy, which included partnership with NATO. The possibility of a Ukrainian NATO membership was one of the major reasons to the outbreak of the war.

3.1.2 Defining the estimation and event window

The event period for daily event studies can be from 2 to 121 days (Chang et. al. 2018), and the estimation period can range from 100 to 300 days. For this study, 251 days was used as the estimation period (-250 to -11). The event window is defined from -10 to +10 where $t = 0$ is the event date (Feria-Domínguex et al. 2020). A short-term period like 21 days, is acceptable to measure the impact of a specific event on the stock price (Kothari and Warner 2006). The event study period is displayed in Figure 1.

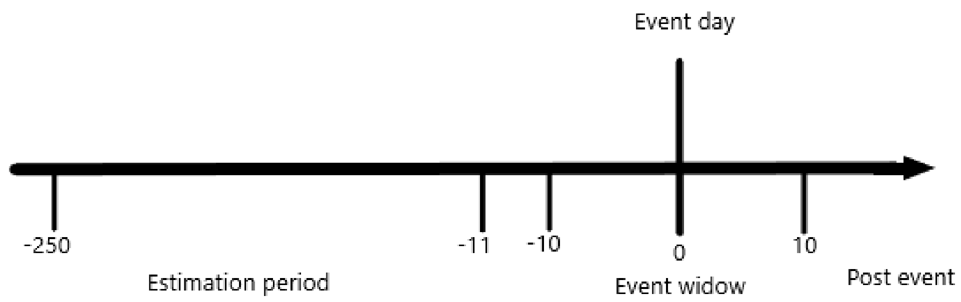

Figure 1.

Timeline for the event study.

3.1.3 Data analysis

To examine the Russia-Ukraine conflict on the Norwegian and Russian stock market, we examine the effect of the outbreak of war on abnormal stock returns and stock return volatility through an event study regression analysis. There are many methodologies used to model abnormal returns in event studies. This study will use the market model because it reduces abnormal return variance compared the mean-adjusted-returns approach by Brown and Warner (1985). The market model relates the return of any company to the return of the market's portfolio, and removes the portion of the return that is related to the variation in the market's return. Including additional risk factors could reduce the variance even more, but the empirical gains have shown to be limited (Campbell et al., 1996).

The first step of an event study in the market model is calculating the stock market returns:

$$R_t = LN\left(\frac{P_t}{P_{t-1}}\right)$$

R_t is the daily return of OSEBX. P_t is the price of OSEBX at the current time frame, and P_{t-1} is the price of the stock index in the previous period. The daily return of the stock market index (R_{mt}) is as follows:

$$R_{mt} = LN\left(\frac{P_t}{P_{t-1}}\right)$$

In this study, we have used Morgan Stanley Capital International World Index (MSCI World) as a proxy of the market return and a representation for the market index used in the market model. Now we must calculate the normal return $E(R_t)$:

$$E(R_t) = \widehat{\alpha_\iota} + \widehat{\beta_\iota}E(R_{mt})$$

Daily excess returns of the OSEBX are calculated by:

$$AR_t = R_t - E(R_t)$$

AR_t is the abnormal return for the stock index at time *t*, R_t is the actual observed rate of return for OSEBX on time *t*, and is the normal return in the estimation period. The abnormal returns are assumed to be jointly normally distributed (Campbell et al., 1996). The cumulative abnormal return (CAR) for the index over the event window is:

$$CAR_t(t_0, t_1) = \sum_{t=t_0}^{t_1} AR_t$$

t_0 is the event day, and t_1 is number of days after the event.

$$t_s = \frac{\overline{CAR}}{\sigma}$$

Finally, a t-test is performed to define stock market response to the event with significance at 5%. The critical value for rejection of the null hypothesis is $\pm 1{,}96$ with a confidence interval of 95%. The significance of the event will be calculated using a statistical test based on the CAR divided by the standard error at significance level at 5%. The event has statistically significance if the t-test is higher than the critical value at 1,96. If the t-value is lower than that, it means that the event is statistically insignificant (Brav and Heaton 2015; Ullah et al-2021).

Cumulative average abnormal return (CAAR) is the average CAR, and average abnormal returns (AARs), is the average of ARs.

$$AAR = \overline{AR}$$

$$CAAR = \overline{CAR}$$

The next part of the research methodology describes the method for how the regression analysis using GARCH models were conducted.

3.2 Regression analysis of stock market volatility

We further the analysis be conducting a volatility analysis on the OSEBX and MOEX returns in order to study how the market reacted during the Russia-Ukraine conflict. The study takes a look at the build-up and outbreak of the war in Ukraine (14 September 2020 to 20 May 2022).

The GARCH modelling technique is the standard approach used for analysing a statical model in which the variance of the dependent variable is dependent on time and substantive explanatory variables. GARCH stands for generalized autoregressive conditional heteroskedasticity and is an extension of the ARCH model of Engle (1982).

There are three conditions that must be met before applying a GARCH model. Firstly, we must check for stationarity. This can be done by the augmented Dickey Fuller-test. One can apply the test by estimating the model:

$$\Delta y_t = \theta_0 + \theta_1 t + (\delta - 1)y_{t-1} + \sum_{j=1}^{k} k_j \Delta y_{t-j} + \epsilon_t$$

Where lagged values of y_t, $\sum_{j=1}^{k} k_j \Delta y_{t-j}$, is included in order to capture autocorrelation in the process. We perform the following test with a t-test:

$$H_0: (\delta - 1) = 0$$

Secondly, we must check for volatility clustering. This is because we often observe that the variance seems to come in clusters. Lastly, we must perform an ARCH test to see if there is ARCH effect in our data. ARCH models assume that the variance is a function of past news, i.e. unexpected movement given by u_t affects the variance. The ARCH is developed by Engle (1982), and the model can be written like this:

$$\sigma_t^2 = a_0 + \alpha u_{t-1}^2$$

We observe that variance is a function of squared news in the previous period. A change in u_t will give an increase in the variance, regardless of the sign of the change. The model captures volatility clustering through how large changes in u_t are followed by more large changes. When testing for ARCH effects, we have a null-hypothesis that says that there are no ARCH effects. The alternative hypothesis is that there is ARCH effects in the model. There is a recipe for testing an ARCH process. First, we estimate the regression equation using OLS, and store residuals. Then we regress the residuals on lagged values of themselves, store the sample size (T) and R^2. The last step is to calculate TR^2. This has a $X^2(q)$ distribution where q is the number of lags-

GARCH models is generally used to estimate the volatility of returns for stocks, currencies and indices. The technique is developed by Tim Bollerslev (1986), and is an extension of Engels's original work. In a GARCH model, the conditional variance is allowed to be an ARMA process. The AR component of ARMA is an autoregressive component that checks how much inertia is there in the data. AR(1) is the first lag of dependent variable. The MA component is the moving average, and it checks how past random shocks affect the present value of the data. MA(1) is the first past error term. ARMA captures the changes of the mean return, while GARCH presents the variance change of the residuals issued from the mean equation. The standard GARCH (1,1) can capture the volatility clustering in the data (Brooks 2008), and can be expressed as the following:

$$R_t = \mu + \phi r_{t-1} + \theta u_{t-1} + u_t$$

R_t is the stock return, μ is a constant of the mean equation, ϕ is the autoregressive term, and θ is the moving average term. The simple GARCH (1,1) will be used in this study because it creates the best forecasts according to Hansen and Lunde (2005).

A general ARMA(p,q) process in a GARCH model, can be written as:

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{q} \alpha_i u_{t-i}^2 + \sum_{i=1}^{p} \beta_i \sigma_{t-i}^2$$

Including more variables in a GARCH model can help explaining the volatility. The variance specification of the GARCH model then becomes

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{q} \alpha_i u_{t-j}^2 + \sum_{j=1}^{p} \beta_j \sigma_{t-j}^2 + \sum_{k=1}^{n} \delta_k x_{k,t}$$

where the $x_{k,t}$ is a group of n variables used to explain volatility. Such variables may for example be trade volume, weekday dummies or data on policy announcements.

In our model, we will use one lag, which means that the model will look like this:

$$\sigma_t = \alpha_0 + \alpha_1 u_{t-1}^2 + \beta_1 \sigma_{t-1}^2$$

This is the variance equation, and α_0 is the constant, α_1 is associated with the error term square and detects the ARCH effect, and β_1 is associated with the variance of the past and detects the GARCH effect. α_0, α_1 and β_1 are non-negative and $\alpha_1 + \beta\_1 \leq 1$. The sum of α_1 and β_1 shows the magnitude of volatility persistence.

To allow for asymmetric responses in the variance, we make two modifications of the GARCH model. The reason for including these models, is that we hypothesised that negative events should increase the volatility of the stock more dramatically than positive events. Forecasting conflict is much more difficult than forecasting cooperation. Especially if the event has a notable element of surprise to it. The Threshold-GARCH (TGARCH) process was introduced independently by Zakoian (1994) and Glosten, Jagannathan, and Runkle (1994), and allows analysis on the effects of negative and positive return shocks on the volatility. The difference between a standard GARCH model, and a TGARCH model, is that the TGARCH model add up the asymmetric threshold effect. Another possible solution, is the EGARCH model, which was developed by Nelson (1991). The variance in a TGARCH model is specified as

$$\sigma_t^2 = a_0 + \sum_{i=1}^{q} \alpha_i u_{t-j}^2 + \sum_{j=1}^{p} \beta_j \sigma_{t-j}^2 + \phi^2 u_{t-1} d_{t-1}$$

where d_{t-1} is a dummy which equals one when $u_{t-1} < 0$. This gives that "bad news" have a stronger impact on volatility $(a_1 + \phi)$ than "good news" (a_1), given that $\phi > 0$. ϕ will be positive if a downward movement in the stock is followed be higher volatility; leverage effects.

Another way of modelling this is the EGARCH, which takes the form

$$ln\sigma_t^2 = a_0 + g(z_{t-1}) + \beta ln\sigma_{t-1}^2$$

$$g(z_{t-1}) = \gamma_1 \left(\frac{\epsilon_t}{\sigma_t}\right) - \gamma_2 \left(\left|\frac{\epsilon_t}{\sigma_t}\right| - \sqrt{\frac{2}{\pi}}\right)$$

Negative shocks $\left(\left(\frac{\epsilon}{\sigma}\right)_{t-1}\right)$ give a higher conditional variance than positive shocks.

The advantages of using an GARCH model is that the model can produce volatility clusters, and the tails of the distribution are heavier than a normal distribution. The weaknesses of the model are similar to that of the ARCH model. A standard GARCH model assumes positive and negative shocks have the same effect. That is why we include the asymmetric models in our regression analysis. The model is also somewhat restrictive because the parameters need to be within particular intervals. Further, it does not provide insight into the source of variations, and it over-predicts volatility as it responds slowly to large, isolated shocks.

We can find the best model by looking at Akaike's information criteria (AIC), and Bayes' information criteria (BIC). They are penalized-likelihood information criteria that determine lag lengths. AIC estimates the constant plus the relative distance between the unknown true likelihood function of the data and the fitted likelihood function of the data and the fitted likelihood function of the model. BIC estimates if the posterior probability of a model is true under a certain Bayesian setup. They have a goodness-of-fit term and a penalty to control over-fitting that balance having enough parameters to model the sensitivity, and not over-fit the model. The smaller the AIC or BIC is, the better the model is.

AIC often risk choosing a model that is too large, and BIC risk choosing a model that is too small. The penalty for AIC is less than for BIC, and that causes AIC to pick a more complex model (Murphy, 2012). The ideal thing to do, is to use them both to find the best model. However, if one has to choose, then AIC should be used for cases where N is small, and BIC should be used when N is large.

$$AIC = -\frac{2}{N} * LL + 2 * \frac{k}{N}$$

$$BIC = -2 * LL + \log(N) * k$$

N is the number of examples in the training dataset, LL is the log-likelihood of the model on the training dataset, and k is the number of parameters in the model.

4 Results

4.1 Event study

4.1.1 Norway vs Russia

Table 2 shows the statistical summary of OSEBX, MOEX and ACWI during the Russia-Ukraine conflict. The average return for MOEX during the 250-day estimation period before the war broke out, was 0,02%. During the event window, the average return sunk to -1,84%, and it reached -40,47% at its lowest, which was at the day of the event. The post event day period, which was during the 60-trading-day period after the war broke out $[t_1: t_{60}]$, the average rent went up to 0,30%. OSEBX had an average return of 0,08% during the estimation period. In the event window, the average return was negative at -0,04%. During the post event day period, the average return rose up to 0,09%. Table 2 shows that there is a pattern when we look at the average returns for the indexes. Both of the indexes have a positive average return during the estimation period and the post event day period, while the average return is negative during the event window. It is worth mentioning, however, that the Russian stock market was closed for 18 trading days (28.02.-23.03.), which were not so long after the war broke out.

Table 2

Statistical summary of ACWI, MOEX and OSEBX return in %.

	Trading days	Mean	Median	Min	Max	Standard deviation
MOEX						
Estimation period	250	0.02 %	0.09 %	-6.72 %	3.49 %	0.012782087
Event window	21	-1.84 %	0.00 %	-40.47 %	18.26 %	0.10190636
Post event day	60	0.30 %	0.00 %	-5.02 %	18.26 %	0.033529374
OSEBX						
Estimation period	250	0.08 %	0.05 %	-3.51 %	2.78 %	0.009050536
Event window	21	-0.04 %	0.16 %	-1.89 %	1.70 %	0.012295323
Post event day	60	0.09 %	0.12 %	-3.05 %	2.79 %	0.012288985
ACWI						
Estimation period	250	0.03 %	0.07 %	-2.26 %	2.08 %	0.007044963
Event window	21	-0.48 %	-0.86 %	-2.77 %	2.57 %	0.013518785
Post event day	60	-0.16 %	-0.19 %	-3.82 %	2.72 %	0.014326424

Table 2 is a statistical summary of the MOEX return and the OSEBX return, and when comparing the two indices, one notices that MOEX was the most volatile during the entirety of the event period. The index has both the highest and the lowest returns in all the three periods that was examined in this table. At the day of the event (24.02.2022), the daily return plummeted -40,47%. The following day, it rose 18,26%. After the event day, the lowest return at -5,02% was on 26.04.2022.

Both of the stock indices had a negative average return during the event window. MOEX was -1,80% lower than the OSEBX though. The highest return for OSEBX during the event window was 1,70% three trading days after the event (01.03.2022). The lowest return during the event window was -1,89%, which was six trading days (04.03.2022) after the event day. OSEBX had a higher average return in all the three periods examined in Table 1. MOEX had a lower average return than the market index in the estimation period and the event window, but not during the post event day period. The highest and lowest returns post event day for OSEBX, is 2,79% and -3,05%, respectively. The highest return was 16.03.2022, and the lowest was 09.05.2022.

Table 2 shows that the event has a more significant impact on MOEX than OSEBX. That is not surprising when they are the aggressor in this war, which many countries in the world have condemned the actions of. Russia’s economy has suffered from the long list of sanctions that has been directed towards the country by the rest of the world. MOEX had the most significant impact from the event before the event day. This is not surprising, because the Russian stock market was closed for nine of the ten days post event. The stock market was only open the day after the event day in this period. On the day of the event, the abnormal return for MOEX -40,02%.

The most impactful day of the event window for OSEBX, was three days after the event day (+3). Five of the ten days after the event day had a negative abnormal return. In the event window, there were more significant abnormal returns before the event day, than after. The day the war started, the abnormal return was -0,80%, and that is about fifty times lower than what the abnormal return of MOEX was the same day. The average abnormal return of OSEBX was 1,75% higher than MOEX during the event window. These findings make it seem like OSEBX was relatively stable during the event window. This is illustrated in Figure 1.

Table 2

The Abnormal Return and t-test for MOEX and OSEBX during the outbreak of the Russia-Ukraine war.

	MOEX		**OSEBX**	
Days	AR	t-stat	AR	t-stat
-10	1.14 %	0.974	0.85 %	1.133
-9	-1.95 %	-1.661*	1.61 %	2.144**
-8	-1.14 %	-0.969	-0.58 %	-0.775
-7	2.40 %	2.047**	-1.64 %	-2.174**
-6	1.04 %	0.889	0.55 %	0.730
-5	-2.70 %	-2.306**	0.40 %	0.526
-4	-2.79 %	-2.385***	0.16 %	0.212
-3	-10.85 %	-9.257***	-0.28 %	-0.370
-2	2.22 %	1.892*	0.29 %	0.391
-1	0.87 %	0.743	1.53 %	2.029**
0	-40.02 %	-34.148***	-0.80 %	-1.059
+1	16.53 %	14.104***	-0.79 %	-1.045
+2	0.05 %	0.044	1.36 %	1.807*
+3	0.98 %	0.836	2.61 %	3.474***
+4	-0.67 %	-0.569	-0.23 %	-0.308
+5	0.44 %	0.375	-0.89 %	-1.182
+6	1.20 %	1.026	-0.76 %	-1.011
+7	2.00 %	1.703*	1.14 %	1.512
+8	0.58 %	0.495	0.72 %	0.957
+9	-1.85 %	-1.582	-1.19 %	-1.586
+10	0.14 %	0.118	0.24 %	0.319
AAR	-1.54 %	-1.316	0.21 %	0.273

The sample consist of abnormal returns for OSEBX and MOEX from 10.02.2022-10.03.2022. The market model was applied in the calculation, using ACWI as a proxy of the market return. The t-test was applied to investigate whether the event has a significant effect on the indices.

*** Indicates significance at 1%, ** Indicates significance at 5%, * Indicates significance at 10%

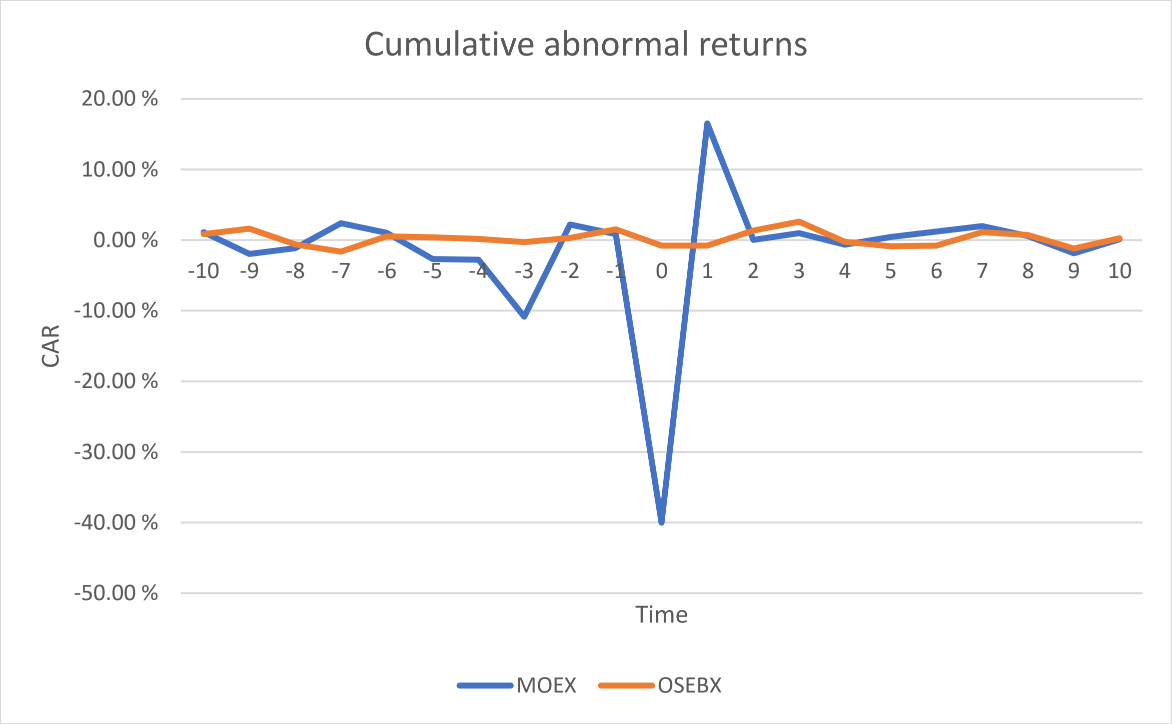

Figure 1

Cumulative abnormal returns for MOEX and OSEBX during the event window.

The cumulative abnormal returns (CAR), is calculated in Table 3. One can see that all the selected intervals was significant for MOEX, while the only significant interval for OSEBX was from 1 day to 3 days after the event day.

Table 3

The table shows the test statistics for OSEBX and MOEX during various intervals from our event window. The t-values are calculated from equation x. The intervals are shown in days.

Start (t_1)	Stop (t_2)	t-stat OSEBX	t-stat MOEX
-10	-1	1.126	-3.474***
-7	-1	0.470	-4.336***
-5	-1	1.155	-5.679***
-3	-1	1.096	-6.401***
1	3	2.265**	9.838***
1	5	1.137	7.522***
1	7	1.136	7.530***
1	10	0.860	5.951***
-3	3	1.829*	-12.108***
-5	5	1.250	-10.211***
-10	10	1.157	-6.580***

*** Indicates significance at 1%, ** Indicates significance at 5%, * Indicates significance at 10%

4.1.2 Norway vs other countries

The figure shows that Norway has done very well compared to other countries during the conflict period. The only country that did better at the end of the period portrayed in the figure, was Turkey. We can also clearly see that the war has had the most negative effect on the Russian stock market.

Figure 3 compares the average returns of countries that produce a lot of oil, and those who do not. The same countries that were used in Figure 2 was used in this calculation as well, except for Russia and Ukraine that were excluded from the calculation. A “oil country” in this context, is a country that produce over 700,000 barrels oil per day. The country that produced the lowest amount in this group was the UK, who produce 772,000 barrels per day (World Population Review, 2022).

We can observe that the biggest difference between the groups, was around event day. The graphs are relatively close at both the beginning of the period and at the end of the period, but on the 16th of February, they start to move further and further away from each other. At the 16th of March they are almost at identical again. That means that there is a whole month where there is relatively a big difference between the groups. Probably not so coincidentally, is that the event day is as good as in the middle of that period.

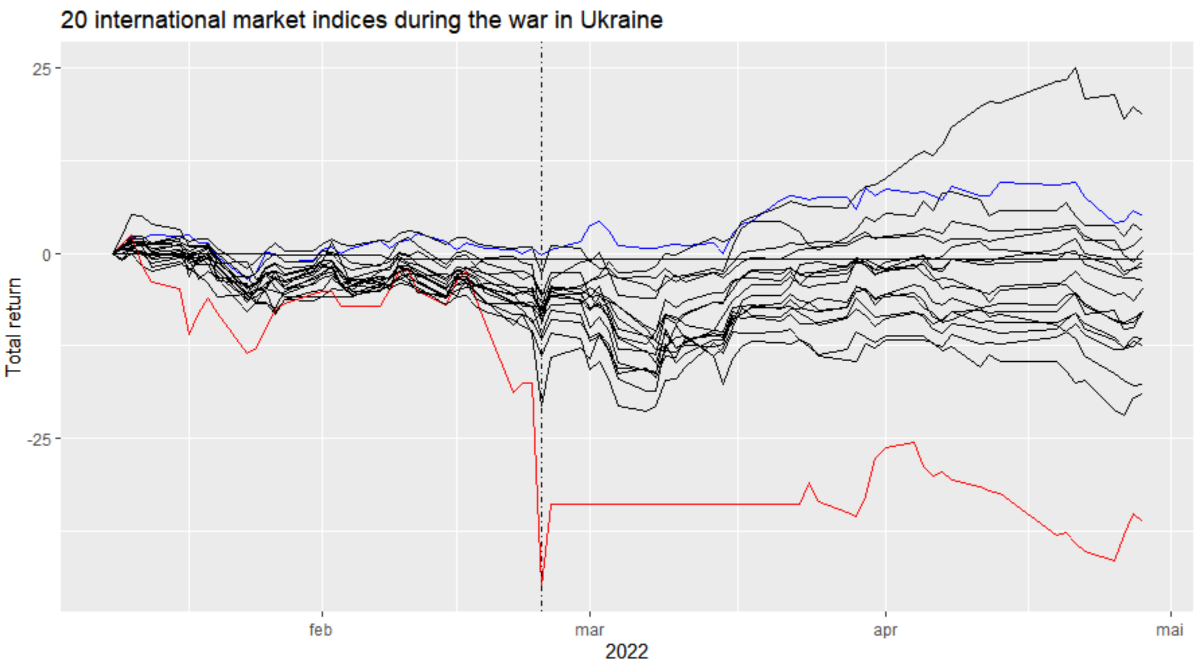

Figure 2

The figure shows how well 20[1] different indices did during the Russo-Ukraine conflict. The vertical line marks the event day. The blue line represents the Norwegian stock market, and the red line is the Russian stock market.

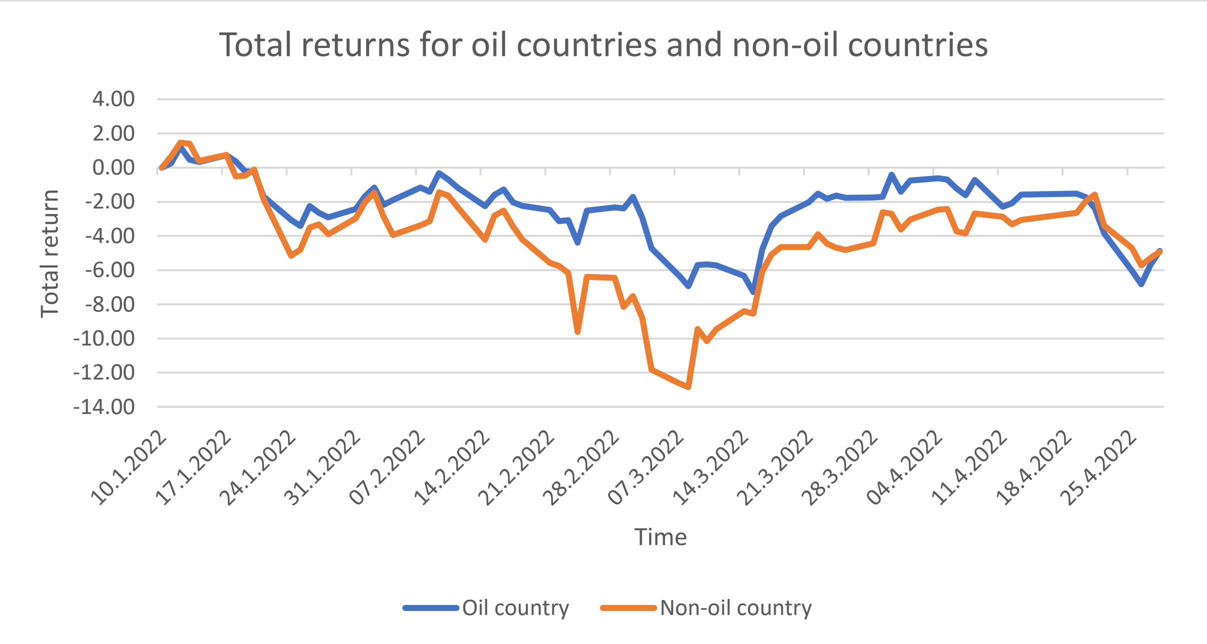

Figure 3

Total returns for oil countries and non-oil countries[2].

[1] The main indices for these countries: Norway, China, Russia, USA, Ukraine, UK, Poland, Germany, France, Denmark, Sweden, Finland, Australia, Japan, Netherlands, Italy, Spain, Switzerland, Turkey, Belgium.
[2] Oil countries: Norway, China, USA, UK. Non-oil countries: Poland, Germany, France, Denmark, Sweden, Finland, Australia, Japan, Netherlands, Italy, Spain, Switzerland, Turkey, Belgium. Russia and Ukraine were excluded from this calculation.

4.1.3 Comparing the event study to former wars

Table 4 compare the AAR for the 10 major conflicts in Table 1, and the AR from the event study. The market model was used in the calculation of the AARs, and ACWI was used as a proxy for the market here as well. The table show that the event window of the Russo-Ukraine war has been more positive for Norway than for the same event window for past wars.

Figure 4 is an illustration of Table 4, and show more clearly that this war has generated more volatile returns than wars have in the past. The event day generated a more negative return than it has done in the past. Another thing that stands out, is the high abnormal return on day 3 after the war started.

Table 4

AAR for OSEBX from 10 major conflicts since 2000, and the AR for OSEBX from the Russo-Ukraine conflict. See Table 1 for an overview of the conflicts.

Time	AAR	AR Russo-Ukraine conflict	Difference
10	0.72 %	0.85 %	0.13 %
9	0.70 %	1.61 %	0.91 %
8	-0.64 %	-0.58 %	0.06 %
7	0.51 %	-1.64 %	-2.15 %
6	0.16 %	0.55 %	0.39 %
5	-0.14 %	0.40 %	0.53 %
4	0.51 %	0.16 %	-0.35 %
3	-0.34 %	-0.28 %	0.06 %
2	-0.01 %	0.29 %	0.31 %
1	0.19 %	1.53 %	1.34 %
0	-0.07 %	-0.80 %	-0.72 %
-1	0.08 %	-0.79 %	-0.87 %
-2	0.14 %	1.36 %	1.22 %
-3	0.24 %	2.61 %	2.37 %
-4	0.24 %	-0.23 %	-0.47 %
-5	-1.15 %	-0.89 %	0.26 %
-6	0.05 %	-0.76 %	-0.81 %
-7	-0.60 %	1.14 %	1.74 %
-8	-0.88 %	0.72 %	1.60 %
-9	0.95 %	-1.19 %	-2.14 %
-10	-0.01 %	0.24 %	0.25 %
CAAR/CAR	**0.66 %**	**4.31 %**	**3.64 %**

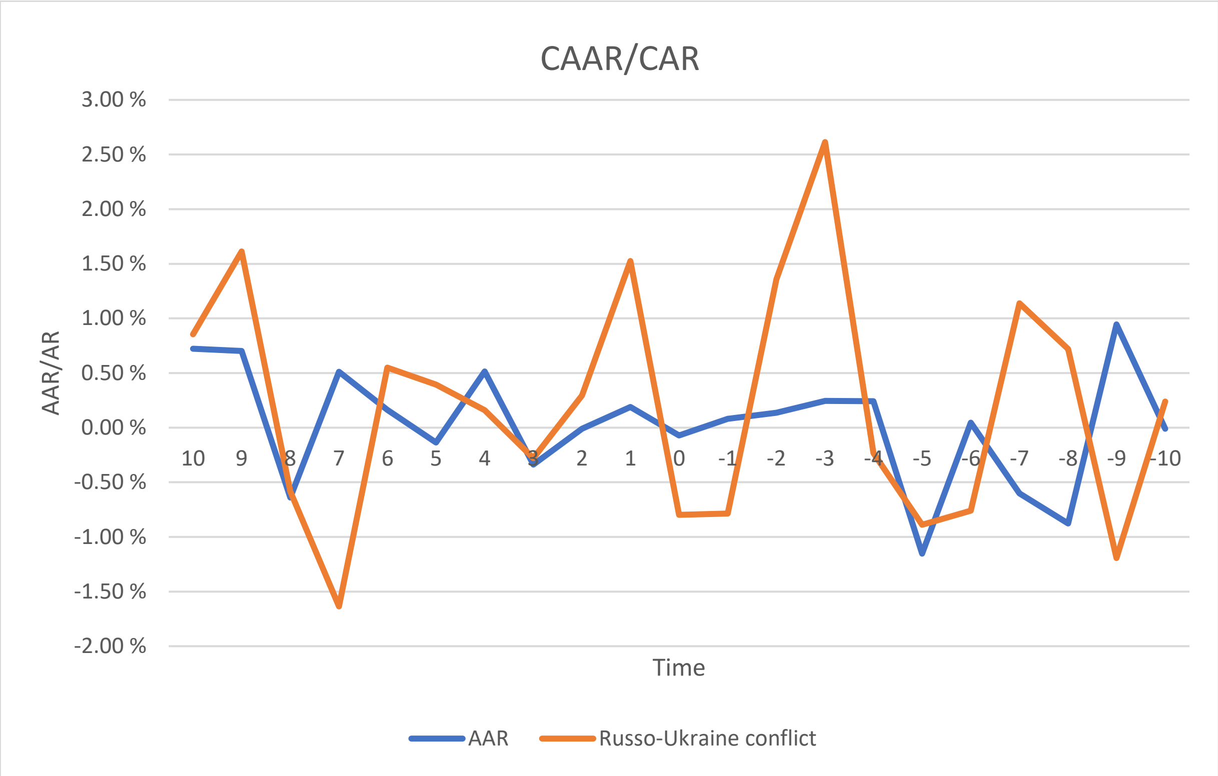

Figure 4

Illustration of Table 4

4.2 Regression analysis

The results of the regression analysis will now be presented. Before estimating the GARCH models, we checked if the dataset was stationary, if there was volatility clustering, and if there was an ARCH effect. All of these tests were done on both datasets. The Augmented Dickey-Fuller test was significant at 1% level, which allowed us to reject the null hypothesis of non-stationary.

Next, we checked the volatility clustering for the datasets. Looking at the returns for MOEX and OSEBX in Figure 5 and 6, we can see some volatility clustering in both graphs. The most evident clustering can be seen in the graph for MOEX. The quite notable spikes in return happened around the day of the event. The large negative spike was at the day of the event, while the large positive spike was at the day following. After these days, the Russian stock market was closed for almost the month. This is reflected in the flat line on the graph. The graph for OSEBX however, is quite different. The largest and smallest return was at the end of 2020. There is also some clustering around the very end of 2021 and the beginning of 2022. We can see some clustering again at the end of February 2022 when the war started.

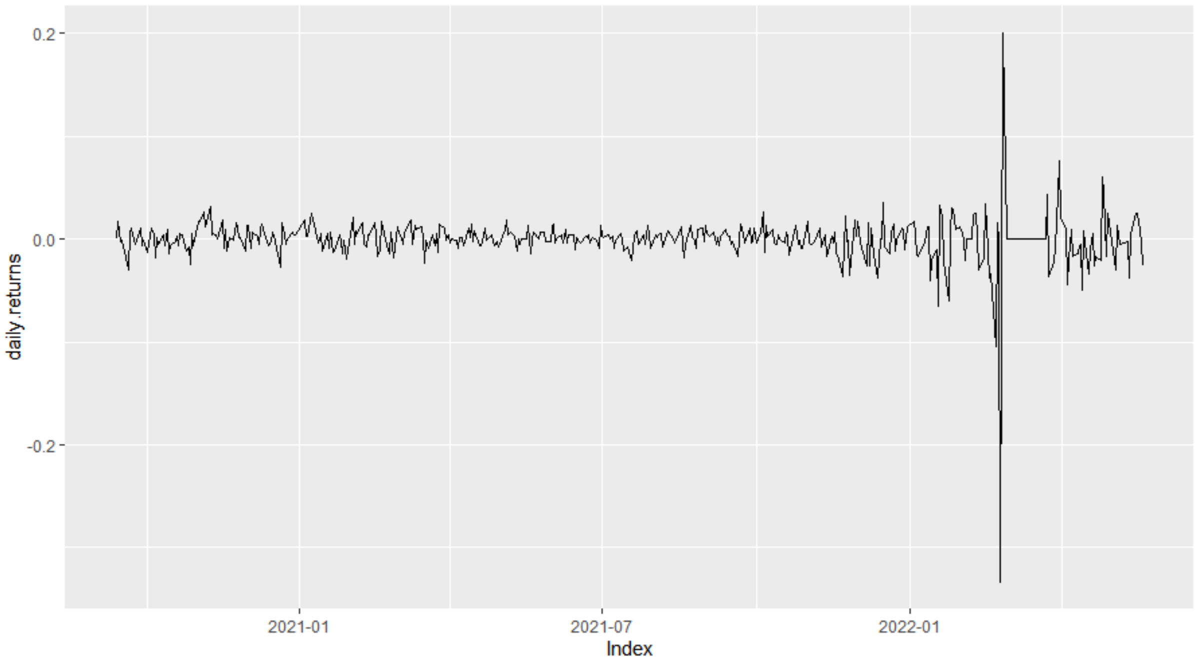

Figure 5

The returns MOEX form 14.09.2020 to 20.05.2022.

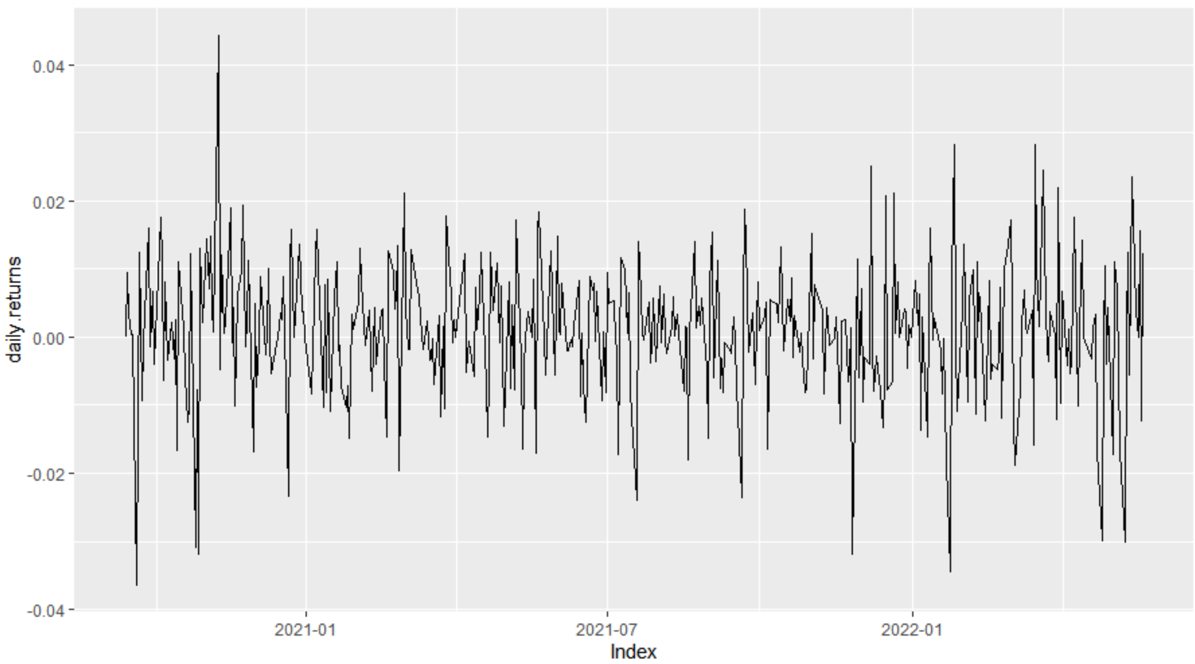

Figure 6

The returns OSEBX form 14.09.2020 to 20.05.2022.

In order to detect the autoregressive conditional heteroskedasticity (ARCH) of the variables, an ARCH test was performed. The Lagrange Multiplier coefficient was calculated to affirm the homoskedasticity or heteroskedasticity of the variables (Tsay 2005). This was done by the ArchTest() command in RStudio, and we can see the results in Figure 7 and Figure 8. The test revealed that both models had heteroskedastic residuals, which allowed the use of the GARCH models.

```
        ARCH LM-test; Null hypothesis: no ARCH effects

data:  rOBX
Chi-squared = 26.437, df = 12, p-value = 0.009304
```

Figure 7

Checking the OSEBX dataset for ARCH-effect.

```
        ARCH LM-test; Null hypothesis: no ARCH effects

data:  rMOEX
Chi-squared = 52.581, df = 12, p-value = 4.889e-07
```

Figure 8

Checking the MOEX dataset for ARCH-effect.

Stationarity was tested by an Augmented Dickey-Fuller (ADF) test, and found that the p-value was less than 0,01. The tests were done by the help of the adf.test() command in RStudio, and Figure 9 and 10 show the results. This allowed the rejection of the null hypothesis of non-stationarity data, and accept the alternative hypothesis which says that the variables do not have a unit root and that the date is stationary.

```
        Augmented Dickey-Fuller Test

data:  rOBX
Dickey-Fuller = -7.9573, Lag order = 7, p-value = 0.01
alternative hypothesis: stationary
```

Figure 9

The results from the ADF-test on OSEBX dataset.

```
        Augmented Dickey-Fuller Test

data:  rMOEX
Dickey-Fuller = -7.8289, Lag order = 7, p-value = 0.01
alternative hypothesis: stationary
```

Figure 10

The results from the ADF-test on MOEX dataset.

Before estimating the GARCH models for the datasets, the AR and MA components were determined. Using a few ARMA-fit-tests in RStudio where BIC was used as a criterion, revealed that ARMA (5,2) was the best fit for the MOEX dataset, and ARMA (1,1) was the best fit for the OSEBX dataset.

Table 3 shows the estimation results for the GARCH models for MOEX. The standard GARCH (SGARCH) assumes that there is an equal impact of bad news, as well as good news. The ARCH coefficient (alpha), the GARCH coefficient (beta), and the constant (omega), are all positive, and that justifies the positive value of the conditional variance. The total of alpha and beta are also less than 1. Since the model passes these basic conditions, we can say that the model is robust. All of the AR and MA parameters, as well as alpha, beta and mu (mean), are significant in the SGARCH model. Omega is not significant.

The asymmetric models assumes that bad news has a larger impact than good news. The EGARCH model has fewer significant parameters than the SGARCH model. The significant parameters are ar1, ar2, ar4, ma1, ma2, alpha, beta and gamma. In this model, omega, alpha and beta do not need to have positive coefficients because the EGARCH model is a log-model. The TGARCH model is the preferred model because it has the lowest AIC and BIC values. All of the coefficients are significant in this model, except for omega.

Table 5

GARCH (1,1) ARMA (5,2) estimation results for MOEX.

MOEX			
	SGARCH	**EGARCH**	**TGARCH**
mu	0.001***	0.000*	0.000***
ar1	0.286***	0.145***	0.491***
ar2	-1.038***	-1.022***	-0.939***
ar3	0.060***	-0.051	0.055***
ar4	-0.109***	-0.147***	-0.084***
ar5	0.129***	0.053	0.157***
ma1	-0.375***	-0.248***	-0.601***
ma2	1.041***	0.918***	1.048***
omega	0.000*	-0.241*	0.000
alpha1	0.314***	-0.165***	0.136***
beta1	0.685***	0.970***	0.890***
gamma1		0.419***	
eta11			0.686***
AIC	-5.688	-5.676	-5.749
BIC	-5.583	-5.618	-5.635

*** Indicates significance at 1%, ** Indicates significance at 5%, * Indicates significance at 10%

Table 4 shows the estimation results for the GARCH models for the OSEBX dataset. All of the parameters for the different GARCH models are significant expect for omega in the TGARCH model. The EGARCH is the best fit for the OSEBX dataset according to the AIC and BIC score.

Table 6

GARCH (1,1) ARMA (1,1) estimation results for OSEBX.

OSEBX			
	SGARCH	**EGARCH**	**TGARCH**
mu	0.001***	0.001***	0.001***
ar1	0.892***	0.983***	0.975***
ma1	-0.946***	-0.999***	-1.000***
omega	0.000***	-0.520***	0.001
alpha1	0.016***	-0.167***	0.079***
beta1	0.967***	0.942***	0.801***
gamma1		-0.127***	
eta11			1.000***
AIC	-6.375	-6.489	-6.403
BIC	-6.318	-6.423	-6.337

*** Indicates significance at 1%, ** Indicates significance at 5%, * Indicates significance at 10%

5 Discussion

5.1 Event study

5.1.1 Norway vs Russia

The statistical summary of the indices in Table 2 shows that the mean return during the event window was the lowest for all three indices. This result suggest that the event window was the most negative period of the three periods that is portrayed in the table for Russia, Norway and the world in general. However, the most negative return and the most positive return for the stocks is only found in the event window for MOEX. OSEBX has the most negative return during the estimation period, and the most positive return post event day. The largest return was on 16.03.2022, and on this day President Zelenskyy spoke to the American Congress. The speech made a big impression on the Americans, and it ended with a standing ovation from the Congress. This is an example of how important political figures is under times of distress (Saunders, 2011). The day before this, all 46 members of the Council of Europe decided to expel Russia. The lowest return for OSEBX was on 24.01.2022. The tension was growing at the Ukraine border, where Russia had over 100,000 soldiers deployed. On this day, the President of the United States, Joe Biden, signalled the possibility of a change in strategy regarding the growing tensions. Now there was a possibility that the US would go from diplomacy to sending thousands of soldiers to Eastern Europe. He also warned Americans against traveling to Ukraine, and ordered people that worked at the American embassy in Ukraine to come home. This drop in the stock coincides with the study on the war puzzle by Brune et. al (2011), which found that the stock market decreases as the probability for war goes up.

ACWI which is used as a proxy for the global market, had both the highest return and the lowest return post event day. The highest return was at the same day as the OSEBX return, and the lowest return was 09.05.2022. May 9 is an important day in Russia because it is known as “Victory Day” there, because it commemorates the Soviet Union’s role in defeating Nazi Germany in WWII. For this reason, western officials believed Putin could formally declare war on Ukraine on this day (Bertrand, Lillis, Hansler, Marquardt, Lendon, 2022). This behaviour can also be explained by the war puzzle (Brune et. al, 2011).

The lowest return for MOEX was on 24.02.2022 - the day Russia invaded Ukraine. As a response, USA, EU and UK signalled new impactful sanctions on Russia that would really hurt the Russian economy. Investors fled the Russian market in fear of the sanctions that would come, and it ended up falling -40,47%, which support the efficient market theory which reveals that stock prices reflect the state of the world quite quickly (Fama 1970). The largest return for MOEX during the conflict period, came on the day after the war broke out. The reasons for this could be that the sanctions that were imposed on Russia was milder than investors thought, and that the possibility for a global war went down (Mackintosh, 2022). This could be described as a war rally. These days also generated significant abnormal returns in the event study, as can be seen in Table 2.

The abnormal returns (ARs) in Table 2 show that 6 of the days in the event window was significant for the Russian market, and 4 of them were significant for the Norwegian market. Only one of the days were significant for both markets, and that was at t_{-7}, which was on 15.02.2022. This was probably because Russia announced that it was pulling back 10,000 of the estimated 130,000 troops it had gathered near the Ukraine border. The announcement also said that it still was continuing military drills. This decreased the possibility of a war, so the Russian market had a positive return, while the Norwegian market had a negative return.

The Russian stock market was closed for 18 trading days (28.02.-23.03.) right after the war broke out. This is reflected in the results, because we can see that all of the significant ARs were on days before the market closed. The ARs from t_{-3} to t_{-5} were significant. This corresponds to the dates 17.02.2022, 18.02.2022 and 21.02.2022. On 17.02.2022, US and NATO officials said that Russia was adding forces to the Ukraine border, not withdrawing them like Moscow claimed two days earlier (Maas, 2022). Ukraine also claimed that Russia was behind a cyberattack, that Ukraine's defence ministry described as the worst it had ever experienced. Russia denied responsibility for the cyberattack. On 18.02.2022, US officials warned that Moscow was laying the groundwork to justify a war and was preparing to launch an attack on Ukraine in the near future (The Week, 2022). President Joe Biden said that military action could begin imminently, but also stressed that a diplomatic solution was still possible. On 21.02.2022, Russia recognised the Donetsk People's Republic and the Luthansk People's Republic, which is two self-proclaimed breakaway republics in Donbas controlled by pro-Russian separatists (Hernandez, 2022). All of these events increased the probability of a war, and that generated negative returns for MOEX. This is consistent with the liberal view.

The significant abnormal returns for OSEBX were at t_{-9}, t_{-1}, t_3, and t_{-7}, which is already mentioned. t_{-9}, t_{-1} and t_3, corresponds to the dates; 11.02.2022, 23.02.2022 and 01.03.2022.

On 11.02.2022, Biden warned that a Russian invasion of Ukraine could happen any day (Thesen, Ekroll, 2022). The day before the war began, on 23.02.2022 Biden announced sanctions against Russia over what he described as "the beginning of a Russian invasion of Ukraine" (Maas, 2022). European allies also imposed sanctions on Russia, and Germany halted the approval of the Nord Stream 2 natural gas pipeline from Russia. On 01.03.2022, satellite images were showing a 40-mile Russian military convoy advancing towards Kyiv (The Week, 2022). Other than that, the oil price was rising, largely, because of the war. All of these three events generated positive abnormal returns. Most of the significant abnormal returns was from before the event day. This aligns with the Marxist view, which say that one profits from wars (Schneider et. al., 2006).

Figure 1 illustrates the abnormal returns from Table 2, and it shows how the MOEX was more volatile than OSEBX during the event window, especially around the event day. The cumulative abnormal returns in Table 3 were only significant for the interval $[t_1 : t_3]$ for OSEBX, while for MOEX, all of the selected intervals were significant. This three-day period was significantly positive for Norway. The reason for this, could be that the outbreak of the war made the oil price increase, which is good for the Norwegian economy (Park et. al, 2008). Both positive and negative events were significant for MOEX. These results suggest that Russia was more impacted by the war in the event window than Norway.

5.1.2 Norway vs other countries

Figure 2 graphs the return of 20 different indices during the Russo-Ukraine conflict. These 20 indices were chosen because they either are major stock markets, or because the country is close to the conflict. The author deemed these markets as interesting in relation to the war. Continents like Africa and South-America, are not represented.

The figure show that there is a noticeable dip in returns for all countries on the event day. We can also observe that Russia did the worst during this period, and that Norway did pretty well compared to the other countries. This might be because the oil price went up during the conflict, and that was positive for the OSEBX return. The study by Park and Ratti (2008), found that the Norwegian stock market react positively to an increase in oil price. In the graphs in Figure 3, we can see that there is a relatively significant difference between oil and non-oil countries between February 16, and March 16. The oil countries actually did better for most of the period displayed in the figure. This result indicates that being a country that produce over 700,00 barrels of oil per day, was positive for the economy during this period.

5.1.3 Russo-Ukraine war vs former wars

Table 4 reveals that wars usually have a positive average return over an event window from ten trading days before a war starts to ten days after the war started, and that the abnormal return for the Russo-Ukraine war, has been more positive for OSEBX than what wars usually is for the index. Figure 4 illustrate this, and show how volatile this war has been compared to other wars. This is not so surprising, because the war is of a scale that has not been seen in Europe for a long time, and because it is not very far away. The war has also had a collective global response, where “all” countries has agreed on who the bad guy is, and that has brought both NATO and EU closer together.

The uncertainty of an escalation of the war, have risen and fallen in probability during the conflict, and that has led to volatility in the market.

5.2 Regression analysis

The volatility during the conflict period was investigated through a regression analysis. Both AIC and BIC were used in order to determine the best models for the indices, and because both of them were showing unanimous results in both instances, it made the decision easy. The GARCH model for MOEX was the TGARCH model, and for OSEBX it was EGARCH model.

Looking at Table 5, we can see that all of the parameters in the TGARCH model was significant, except for omega, which is the coefficient. The significant alpha means that there was volatility clustering in MOEX during this period. Beta represents the persistence of volatility in the long-run. The alpha is smaller than the beta, and that implies that the stock market's volatility is more sensitive to their past volatility than their past shocks. The asymmetry term, et11, is significant, which means that there is a leverage effect. MOEX reacts more to negative news, than to positive news.

Table 6 show the results for the GARCH models for OSEBX. All the parameters in the EGARCH model are significant. Significant alpha and beta means that there is volatility in the data. Gamma is the leverage effect. The gamma is significant and negative, and that means that negative shocks have a greater impact on the volatility than positive shocks of the same magnitude. That means that bad news decreases the volatility. The markets react more to positive news than negative news. This is not consistent with the "negativity effect" (Akhtar et al. 2011). Akhtar found that the equity markets react significantly to the announcement of bad sentiment news, but fails to react to the announcement of good sentiment news.

6 Conclusion

There exists a lot of literature investigating the connection between the Norwegian stock market and oil prices, but there is not a lot of literature on of how the Norwegian stock market is affected by wars since WWII, and that was a motivation for conducting the study. There have been some studies on how war affects other markets, however. Hudson and Urquhart (2015), found that the negative events had a more significant impact on the British stock market during WWII, than what positive events had. Troeger and Schneider (2012) found that market reactions to wars were most often negative, and that conflictive events influenced the volatility of the stock market much more strongly than cooperative ones.

The results of the event study showed that the Russo-Ukraine conflict had a negative impact on the stock market. Figure 2 illustrated that all of the market indices had a negative dip on the event day. However, the event day did not have a significant abnormal return for OSEBX, but it did for MOEX. When we compared this war to former wars in Figure 4, we could see that the abnormal returns for the event window of this war, has been more volatile than the average abnormal returns for former wars. The cumulative average return of the event window [-10:10] was positive, but unsignificant for OSEBX. CAR of the same period was negative and significant for MOEX. The results suggest that OSEBX did better than MOEX, as well as most other countries. This could be because of the increase of oil prices. Figure 3 showed that oil countries did better than non-oil countries during the event period.

The regression analysis confirmed hypothesis 2, that the conflict increased the market volatility for OSEBX and MOEX. It did not, however, confirm that there was a "negativity effect" in OSEBX. Since the gamma of the EGARCH model was negative and significant, it meant that positive news had a bigger impact on the index, than negative news. The opposite was true for the MOEX index.

It is important to mention that there are many factors to consider when analysing how the war has impacted the stock market. The market movements could be the cause of something different than effects the direct effects of the war. One of the effects of the war, was the rise in commodity prices, and that affected the Norwegian stock market significantly. Another important factor to consider, is that the world is still recovering from covid. Policymakers has to find the balance between containing the high inflation and supporting the economic recovery from the pandemic. Continuous shutdowns because of covid in China, is also a factor to consider because they are threatening supply chains.

A weakness of the study, is that other factors than effects of the war could be impacting the stock market. This is specially the case for when the AAR for former wars was calculated. Two examples of this are the Russo-Georgian War, and the Gaza War that happened during the financial crisis. During this time, it possible that other things than the outbreak of the wars had bigger impacts on the Norwegian stock market. The impact of an outbreak of war is often dependent on how close the conflict is, and how big of a shock the event is considered to be. Since the war between Ukraine and Russia is on the same continent as Norway, and because the war came as a shock to many, the impact has been more significant. The impact on the Norwegian stock market has been bigger than other wars has been since WWII. Russia is also the neighbouring country to Norway, and because Russia invaded Ukraine without provocation, the possibility for the same thing to happen in Norway has risen. That causes unrest, and the same thoughts has led Sweden and Finland to apply for NATO membership.

Further studies could try to go more in-depth on how wars after WWII affect the Norwegian stock market. There are few studies that look in to this, so this is a literature gap that needs to be filled. Another possibility is to look into how the Russo-Ukraine war has affected inflation. Inflation is very high after the pandemic, so it would be interesting to study if the war made it worse. A third option, is to study how the sanctions against Russia that came because of the Russo-Ukraine war has impacted the Russian economy, and if the effects will have a long-lasting impact.

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