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All Quiet on the Market Front

A stock market analysis of the Ukraine-Russia War 2022

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Acknowledgements

This master thesis is written as a part of our Master of Science in Economics and Business Administration at the Norwegian School of Economics. The goal of this thesis is to analyze the impact of wars on the European stock market, especially the war in Ukraine that started in 2022 and thereby contribute to the research field of behavioral finance.

While writing this thesis, we have gained valuable knowledge about stock market's behavior, especially with regards to the public's perception of impending wars and other aspects relevant to asset management. Furthermore, we were able to improve our knowledge within statistical programming and gained insights into financial theory and their real-world applications. Therefore, this thesis has been beneficial from an educational, personal, and analytical viewpoint.

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Abstract

This thesis examines the stock market reaction to changes in the public's perception of the likelihood of a conflict in an approach to find evidence for the "war puzzle" theorem by Brune et al. (2015). We use time series regression analysis including interaction terms to measure the impact of the outbreak of wars. Our focus lies on the war between Ukraine and Russia in 2022. We also investigate the outbreak of the Syrian civil war in 2011 and the annexation of Crimea in 2014. We do not find supporting evidence for the theorem in our analysis. Our discussion presents several potential reasons for this, reaching from the relevance of the conflicts to prospect theory (Kahneman and Tversky (1979)).

Keywords – Behavioral Finance, Conflicts, Ukraine-Russia 2022, Crimea 2014, Syria 2011, Stock Market Reaction, War Puzzle

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1 Introduction

1.1 Initial Situation and Problem Definition

Is indeed all quiet on the market front? There have been many global conflicts in the past decade, with some still ongoing and others that have recently started (Council on Foreign Relations (2022)). Previously, a variety of authors have analyzed the stock market behavior during the outbreak of conflicts with sudden outbreaks or where the outbreak of the conflict had been looming for some time (Amihud and Wohl (2004); Brune et al. (2015); Guidolin and La Ferrara (2010) and many more, cf. section 2.4.1).

The Council for Foreign Relations (2022) emphasizes the impact of these conflicts for the economy and political situation of the United States (US), but it is undeniably clear that the shown global conflicts affect or have affected other countries, for instance those in Europe.

An impending war, but also a sudden start of a war or global conflict, will have an impact on countries' economies, and therefore it will affect the individual stock markets (Barro (2006)). A global conflict can appear as a shock to the average investor which might further influence their investment behavior (Brune et al. (2015)). Previous research was conducted on investors' behavior based on the development of the Dow Jones Index (Chiţu et al. (2022)). We would like to research and analyze on a more local level and therefore chose the Eurostoxx 50 index's percentage return (excl. the MSCI world)[1] during an event window surrounding our chosen conflicts.

From the 27 current conflicts determined by the Council on Foreign Relations (2022) we have selected three conflicts where we investigate the market's behavior and rationality of the investors during the outbreak. Our main focus lies on the Ukraine-Russian 2022 conflict, as it is the most recent conflict and has a large impact on the energy sector in Europe (OECD (2022)). The Crimea Annexation of Russia (2014) is strongly connected to the crisis between Russia and Ukraine right now, so that is our second chosen conflict. Due to the involvement of major global powers, we also investigate the Eurostoxx 50

[1]From here on wards: when the Eurostoxx 50 (index) is mentioned, we are always excluding the MSCI: world (for further explanation cf. 3)

index's behavior during the conflict in Syria in 2011. The reasoning for not choosing some of the remaining 24 conflicts can be found in section 2.2.

Whether the markets remain calmer or show a different behavior than in previous global conflicts for the most recent three major conflicts with an effect on Europe is concluded on the next pages.

1.2 Aim of the Paper

Brune et al. (2015) realized an important paradox (the "war puzzle") when investigating stock market's behavior for different conflicts: When there is a prelude for the conflict, the stock markets decrease when a war is more likely. When the war breaks out, the stock prices increase. In a surprising outbreak of a war, however, stock prices decrease. They could not find a clear explanation on why the stock market behaves the way it does.

For our research question we investigate the Eurostoxx 50 index in two steps: We use the popularity in Google searches and percentage change in tweets with specific key words as a proxy on how likely an outbreak is seen by the public and compare that to the Eurostoxx 50 index. If we find "puzzling" events we find further potential explanations for it.

Based on our literature research and to get closer to an answer for our research goal we formulated the following hypothesis:

- H1. The conflict in Syria in 2011 follows the pattern observed in the "war puzzle".
- H2. The stock market behavior during the Crimea annexation in 2014 follows the pattern of the "war puzzle".
- H3. The stock market during the war between Ukraine and Russia, starting in the Spring of 2022, follows the stock market behavior observed in the "war puzzle".

  To be able to confirm or refute the hypotheses, we conduct a series of steps:

  - Finding an appropriate event window for the conflicts
  - Selecting the variables that should be regressed
  - Investigating whether the stock market shows puzzling observations

- Researching past research papers that identified potential explanations in case of puzzling observations
- Theorizing whether areas of behavioral finance can be applied to the observations

In the next sections, the aforementioned steps are conducted and further explained. This leads to an analysis of the stock market's behavior and rationality and in the case of not fully rational behavior we have found potential explanations. Lastly, we are able to make a statement with regards to the hypotheses 1 to 3.

1.3 Structure of the Work

Our paper is structured in seven parts to give the best and most comprehensive analysis of the stock market behavior and rationality. After the introduction, we give background information. First, we define the terms "conflict" and "war" to distinguish if the terms are used in different scenarios. In the next subsection, we explain the reasoning behind the choice in analyzed conflicts. In the third subsection of section 2, we give historic background information on the conflicts in Syria in 2011, the Crimea annexation in 2014 and the Ukraine-Russia conflict in 2022. We also determine whether they are conflicts or wars and if they are with a sudden outbreak or with prelude. The last part in the second section is the literature analysis, where we summarize the findings of previous research with regards to our research question.

Section 3 gives information about the used data, how we sourced them and visualizations. We investigate correlations of Google searches and Tweets for the respective conflicts and visualize the Eurostoxx 50 Index's behavior in comparison to the Twitter and Google data.

The chapter on methodology discloses more insights on the reasoning behind the chosen models and tests. We conducted the augmented Dick-Fuller test (ADF-tests) and explain why we used it. In the analysis section we look deeper into our data and run regressions. We further evaluate the statistical significance of our regressions. Before the conclusion, we discuss our findings of the analysis chapter and find possible explanations and reasons, so that we can end our paper with the seventh chapter, the conclusion. We also include

limitations and suggestions for future research in the conclusion.

2 Background

This section has the goal to provide background information on the discussed topics. First, we differentiate and explain important terminology and in section 2.3 we explain our choice in analyzed conflicts and give information on the three investigated conflicts and their significance. Lastly, we provide an overview over previous research with regards to our research topic of stock market rationality, especially in respective to the Ukraine-Russia conflict in 2022.

2.1 Definition War and Conflict

To lay the foundation for our research and analysis, we define what it means when a party is in a state of war contrary to parties in conflict. The Cambridge dictionary defines a conflict as either "an active disagreement between people with opposing opinions or principles" or "fighting between two or more groups of people or countries". The common theme is a substantial disagreement of two or more parties. It further distinguishes between internal conflicts ("Characters' struggles to change or understand themselves") and external conflicts ("[...] a struggle between characters or between characters and nature or society.") (Cambridge University Press (nd)).

While it can be assumed that personal internal conflicts might occur in our investigated scenarios, we are assuming that everything researched are external conflicts and we neglect any internal conflicts as they do not play a role in conflicts on the world stage. How does a conflict differ from a war?

Frankel (2022) shows that a war should be seen as an armed conflict: "[A war is] a conflict between political groups involving hostilities of considerable duration and magnitude." He adds criteria under which an armed conflict is considered a war. Wars exist when "the contending groups are sufficiently equal in power to render the outcome uncertain for a certain time." If it is an armed conflict of a powerful party with people that are isolated and/or powerless, one would call it pacifications, military expeditions or explorations. In case of a small state, we would speak of interventions or reprisals. If it is a conflict of internal groups, the word "rebellion" or "insurrection" is used. It is noteworthy in these cases that they can grow into wars if they reach the magnitude of war due to sufficient

strength or protract.

All investigated incidents are therefore conflicts, whether they reach the magnitude of a war will be determined in section 2.3.

2.2 Choice of Conflicts

As mentioned previously, according to the Council on Foreign Relations (2022), there are currently 27 conflicts happening globally that affect the US in different levels of severity. We are mainly interested in conflicts affecting Europe, so the level of gravity is not always the same for the US and the European countries. The conflict between Ukraine and Russia in 2022 has a major effect on energy prices and the stability within Europe and further was the most current conflict when we started our research in the summer of 2022 (OECD (2022)). As is visible in the following section (2.3), the Crimea annexation in 2014 is highly connected to the Ukraine-Russia conflict in 2022, which is why we chose to investigate the stock market behavior during the period, as well (Ray (2018)), even though it is not named explicitly by the Council on Foreign Relations. We chose to conduct an analysis on the war in Syria that started in 2011 due to the involved parties in the development of the conflict and the fact that it is still on-going (Bröning (2011) and United Nations Organisation (2022)).

We decided against analyzing the conflicts in the Americas in this paper. The Council on Foreign Relations (2022) considers the criminal violence in Mexico and the instability in Venezuela as a major conflict in 2022. Both conflicts have the status of "unchanging", we do not consider their outbreak as highly significant for a European investor, and therefore the impact on European stock indexes will not be of interest.

In the region of Sub-Saharan Africa, the Council on Foreign Relations (2022) names 7 conflicts of current interest. All of them do not seem to have a great impact on a European citizen, which is why we do not include them in our stock market analysis. The seven conflicts are: the conflict with Boko Haram in Nigeria, instability in Mali, instability in the Central African Republic, instability in the Democratic Republic of Congo, Civil War in South Sudan, conflict with Al-Shabab in Somalia and the war in Ethiopia.

In North Africa, the instabilities in Libya and Egypt are emphasized (Council on Foreign

Relations (2022)). They are without any major recent developments, and therefore not part of our analysis.

Besides the war between Russia and Ukraine, the Nagorno-Karabakh Conflict between Armenia and Azerbaijan is considered a conflict of global interest in Europe by the Council on Foreign Relations (2022). The conflict has been of relevance since 1918 and was already written about as an eternal conflict in 1992 (Auch (1992)). As we would like to focus on conflicts with a more recent outbreak (in the 21st century), we did not analyze it.

A major conflict region has been the Middle East (Council on Foreign Relations (2022)). The stock market behavior with regards to the instability in Iraq has been analyzed in previous papers (cf. Amihud and Wohl (2004), Brune et al. (2015)) and in recent years could not note an outbreak that could be considered new. Thus, it is not part of our analysis. The conflict between Israel and Palestine is considered one of the longest on-going conflicts in modern history (Johannsen (2017)). There is no recent outbreak that we can analyze. Consequently, it is excluded from this paper. Lebanon has ongoing instability (Council on Foreign Relations (2022)), but no specific outbreak of a conflict and is therefore not considered either. The confrontation in Iran is very US-centric in the conflict tracker (Council on Foreign Relations (2022)), so not part of the analysis. The Afghanistan conflict did not have a recent outbreak, and is, hence, not included in the paper. The war in Yemen has a limited impact on the US and a similarly limited impact on Europe (Council on Foreign Relations (2022)).

The remaining 6 conflicts determined by the Council on Foreign Relations (2022) are found in Asia: Territorial dispute in the South China Sea, the North Korea crisis, instability in Pakistan, conflict between India and Pakistan, confrontation over Taiwan, and instability in Myanmar. While they are major conflicts on a global scale, they have limited impact on European markets. Hence, we refrain from analyzing these conflicts.

2.3 Historic Development of the Researched Conflicts

2.3.1 Syria 2011

The Syrian government is led by president Bashar al-Assad who took over after his father Hafez al-Assad passed away in 2000. The government and regime are considered a

personalist dictatorship (Bröning (2011)). The ongoing conflict in Syria is seen as one of the largest civil wars in recent history, which means that in this thesis, if we speak of a Syrian conflict or war, we mean implicitly the civil war. It originated due to a variety of reasons, one of them being the Arabic Spring and the following successful uprisings in Tunisia and Egypt. It resulted in new governments in the respective countries and encouraged Syrian pro-democratic activists in 2011 (Al Jazeera (2018)).

In March 2011, it started with peaceful protests in Syria against the arrest and torture of teenage boys who were in support of the Arabic spring. The protesters were met with violence and security forces killed several demonstrators. In result, many demanded that the president Assad resigned which led to even more violence by the government's forces. Due to that, the number of protesters multiplied, so that hundreds of thousands were on the streets by July 2011 (Rodgers et al. (2016)). Additionally, the Free Syrian Army was founded with the goal to overthrow the government and more sectarian divisions and parties surfaced. President Assad is part of the Islamic Alawi sect, whereas most Syrian citizens are part of the Sunni Muslims (the largest branch of Islam). The religious component continued to play an important role throughout the development of the conflict. Most noteworthy and adding another dimension to the conflict was the upsurge of the jihadist group the Islamic State (IS) (Rodgers et al. (2016)). Further, severe droughts from 2006/07 until 2011 led approximately 1.5 million Syrians to leave the countryside and migrate into the larger cities, intensifying social unrest and poverty (Al Jazeera (2018)).

Rapidly, the Syrian conflict turned into a so-called "proxy war", with involvement and interests of major global powers. This is also the reason for this paper to analyze the outbreak of the conflict's effect on the Eurostoxx 50 index. Within Syria, there are 4 key players: the Assad regime, the IS militias, rebels (e.g. the Free Syrian Army) and Kurds. All of them have support from different global powers: The United States (US) support the Kurds militarily, fights against the IS directly, supports the rebels without direct support and would like to have a regime change. Russia on the other hand, fights actively against rebels and provides military support to the Assad regime. The Iran supports the Assad regime as well, whereas Saudi Arabia, together with other Gulf states, support rebel groups. Turkey is in addition also opposed to the Kurds (Alkousaa et al. (2016)).

The war has resulted in half of the Syrian population being displaced and the country's

economic situation is disastrous, after more than ten years of war (The World Bank (2022)). While likely no one expected the war to last that long and to have such a strong involvement of global (super-)powers, it is interesting to see from an economic perspective how and if the outbreak of the war affected the Eurostoxx 50 Index. We consider it a war with prelude due to the fact that it took several steps until it fully escalated.

2.3.2 Crimea 2014

Russia annexed the Ukrainian region Crimea, in the South of the country and North of the Black Sea, on the 18th of March in 2014. As a result, Russia suffered international sanctions, condemnation, and further conflict (Biersack and O'Lear (2014)).

To understand the current situation, it is necessary to have an overview over the (state)-political development of the Crimea region. Following the Second World War, Crimea was no longer an autonomous republic but was considered a region of the Russian Soviet Federated Socialist Republic. In 1954 it was transferred to Ukraine. During the period of the late 1980s and early 1990s, the Soviet Union disintegrated, so that by 1991 after it had shortly been an autonomous republic within the Soviet Union, it became part of the now-independent Ukraine again (Ray (2018)).

The Crimea region has a large conflict potential, as the majority of the Crimean population constitutes of ethnically Russians. Further, Russia has a large fleet in the Black Sea with the base in Sevastopol. The Budapest Memorandum was signed in 1994 and resulted in the confirmation of Ukraine's borders and Russia could have an extended lease on Sevastopol (Ray (2018)).

Nevertheless, conflicts arose in 2014 after former Ukrainian president Viktor Ynukovych was ousted (Grant (2015)). Before, he signed an agreement to extend Russia's lease of Sevastapol until 2042. The potential of the new Ukrainian government resulted in pro-Russian protests. At the time, unidentifiable people, which were later identified as Russian troops, seized the parliament in the Crimea and chose the leader of the Russian Unity Party as the Crimean prime minister. Russian soldiers were sent into Crimea on February 27th, 2014, which we use as the outbreak date for the conflict (Ray (2018)). While Russian and Ukrainian forces remained head to head, the parliament in Crimea voted to join Russia and leave Ukraine. Due to the number of irregularities, the vote was

not recognized by the Ukrainian government, the United States and the European Union. Russia's prime minister and president Vladimir Putin signed a treaty to add Crimea officially to the Russian territory on March 18th. According to international law, Russia is considered an occupying power in Crimea without any legal claims on its territory (Grant (2015)).

Even though the annexation took place with armed forces, we consider the incident as a conflict that is part of the Russian-Ukrainian war taking place later in the early 2020s. The annexation of Crimea can be seen as a "conflict with sudden outbreak" (Walker (2017)). This is a valuable differentiation criterion in our analysis of the Eurostoxx 50 index' behavior and in comparison to the other analyzed stock market behaviors during the outbreak of the Ukrainian-Russian war in 2022 and the conflict in Syria in 2011.

2.3.3 Ukraine-Russia 2022

The Ukrainian Russian conflict of 2022 builds up on several incidents between Russia and Ukraine, with the Crimea annexation as one of the main occurrences. On February 24th 2022 Russian president Vladimir Putin authorized "a special military operation" against Ukraine. This marks the start of the 2022 conflict. Russia claimed to strive for demilitarization and denazification in Ukraine and to bring to court people who have committed crimes against (Russian) citizens. Ukraine dismissed the claims and notes that Russia was using it as a pretext (Osborn and Nikolskaya (2022)).

Russia's interests in Ukraine lie in several areas: they have a long history together, with approximately 8 million ethnic Russians that live in Ukraine. Further, many saw the permanent loss of Ukraine to the West after the collapse of the Soviet Union as damaging to the former superpower Russia. As previously mentioned, the interest in the Crimea peninsula and with that the access to Russia's black sea fleet and better sea trade access was considered another reason. Ukraine used to be Russia's largest trading partner and a major gas recipient until the annexation of Crimea. Gaining Ukraine again as a trading partner and importer would be highly beneficial for the Russian economy (Masters (2020)).

What followed were the strongest financial sanctions against Russia historically by the United States (US), their allies in Europe, and the United Kingdom (UK). Some Russian banks were blocked from the Society for Worldwide Interbank Telecommunication (SWIFT)

which almost completely keeps them from doing global transactions on February 26th. The EU and United States further barred Russia from its airspace (Kirby and Guyer (2022)). The Russian ruble fell immensely with increased volatility, the Russian central bank suffers from increased monetary rates and capital restrictions. Accesses to foreign assets are severely restricted. Furthermore, the Russian markets were removed from international bases which means that stocks that were part of worldwide stock exchanges do not have any value anymore. The risk rating for Russia has been decreased to D (from B) and the forecasted adjusted GDP for 2022 is negative with -7.5% (Khudaykulova et al. (2022)).

While the effects for Russia are grave, it would be interesting to consider the effects for the global economy, especially when trying to understand (Eurostoxx 50) investors' behavior. Most vulnerable are the motor, shipping and chemistry sectors (Khudaykulova et al. (2022)). The winter of 2022/2023 is marked by an historic energy price shock. Inflation persists while real household income grows weakly on a global level. Economic growth will continue to be low as the overall confidence continues to fall and financial conditions stay tight (OECD (2022)). Within the Organization for Economic Co-operation and Development (OECD) area, inflation is projected at more than 9% in 2022. The OECD is hopeful that as soon as the monetary policies take effect, inflation can slow down to approximately 5.1% in 2024 (OECD (2022)). Whether any potential stock market effect in the Eurostoxx 50 index can be attributed to any of these effects on the global economy is evaluated in the later sections.

As of the end of 2022, the Ukrainian forces managed to gain back control over some of the previously occupied areas. Russia's Black Sea fleet in the Crimea region has suffered in October 2022 as well and major Western forces refuse to remove their sanctions on Russia (Kirby (2022)). How it will continue in 2023 and in further years remains to be seen.

Even though the communication of the conflict differs between Russia and e.g. the EU (Kirby (2022)), we consider the attack and ongoing armed conflict a war with a prelude between Russia and Ukraine.

We will use the terms 'war' and 'conflict' for the three discussed conflicts interchangeably but are always describing and discussing the incidents of the previous sections.

2.4 Literature Research

2.4.1 Literature Research with Possible Explanations for the "War Puzzle"

In the past, many researchers tried to illuminate the sometimes unexpected stock market behavior in times of impending international conflicts. We will investigate and provide an overview over the different approaches and findings and where we are going to undertake further research and analysis, especially with regards to the currently on-going conflict between Russia and Ukraine.

Amihud and Wohl (2004) investigate the relationship of the market's expectation of Saddam Hussein's end of power and stock prices, oil prices and exchange rates. To estimate the public's expectation they take the price of the "Saddam contracts" as a proxy. For them, the negativity of war on the stock prices stems from the high expected costs of a war but also due to the increased risk premium that is expected due to the raise in uncertainty. This reasoning would conclude a negative effect on stock market prices. Another impacting factor is the speed until the war is ended. They discover that the probability of a quick end of the war reduces (economic) uncertainty and, arguing from an US-American perspective, it is supposed to reduce risks of terror attacks and lower the overall oil price. It is noteworthy that the interpretation of what the increase in Saddam contract prices meant changed depending on whether it is the war period or the pre-war period. An increase in contract prices pre-war had translated negatively on the stock price, an increase in the contract prices in the war period meant a quicker ending to the war, ergo an increase in stock prices.

Chappell and Eldridge (2000) did research on the weak form efficiency of the UK FT30 stock index during the Second World War from 1939 to 1945. Like before, they split their investigation into two distinct periods: from September 1939 until June 1940 and June 1940 until 1945. In the first period, the index rose until February 1940 and then declined until June 1940. From there onward it increased steadily. The authors explain this with three reasons. The goods were rationed which resulted in a limited number of companies allowed to produce, so that they could ask for almost prices of a monopoly. Then, the increase in taxes and prices lead to a reduction in consumption but to an increase in

savings which could be invested in the equity market with higher returns. As a last reason they explain that in general the supply of available securities decreased (due to government's seizure, ban on issuing new securities to a certain extent) while the demand for them grew. Chappell and Eldridge (2000) find that the stock market returns do not follow an independent and identical distribution that would have been necessary for the stock market to be of the weak form efficiency (Fama (1965)).

For the period from 1974 to 2004 Guidolin and La Ferrara (2010) analyze 101 internal and inter-state conflicts and discover that many of them had an impact on the respective stock market indices, without it being explainable by coincidence. Interestingly, the significance for the results is substantially higher for international conflicts. To investigate the impact of conflicts on the asset market they used event study methodology and examine the cumulative abnormal returns (CAR). Just like Chappell and Eldridge (2000), the authors discover that US markets tend to react positively to the beginning of conflicts. Additionally, they explain the stronger impact of international conflicts since it impacts the macro- economic conditions of multiple countries. For conflicts in the Middle East, commodity prices are very responsive. They also acknowledge the increasing demand for the US dollar in advance to the outbreak of a conflict, with the explanation that the uncertainty acts like a "safe-haven" currency. The authors conclude, that in times of conflict, the exploitation of information related to it would be systematically possible.

The earliest types of research that was conducted on the influence of world events on stock prices is by Niederhoffer (1971). He used classified New York Times headlines as a proxy to measure the vicinity of the start of an event. As a result, he discovers that world events have indeed a strong impact on stock market averages. Contrary to Chappell and Eldridge in 2000 he does not find anything violating or supporting the random walk hypothesis, but he admits that more research would be interesting and exceeds the scope of his paper.

Brounen and Derwall (2010) study international stock market behavior with regards to terrorist attacks. By conducting an event study and multivariate dummy regressions they could show that terrorist attacks have a more significant impact on the stock market. Still, the negative impacts mostly resolved after the day of the event. The abnormal returns can be explained by differences in beta and once the market risk adjustment is accounted

for the, the initial price reactions disappear. The only peculiarity in this research was the terrorist attack on the twin towers in New York City, US where the systematic market risk was more lingering.

With a more political scientific background, the stock market's behavior regarding international conflicts is studied by Schneider and Troeger (2006). In their research they also distinguish between foreseeable and unforeseeable events and between conflictive and cooperative events. They discover and confirm that unforeseeable military conflicts have a bigger impact on trading than expected conflicts. Furthermore, their explanation for the different stock market lies in the traders' expectation. If an event occurrence turns out better than the initial expectation, the stock market will react positively to it. If it is graver than originally estimated, the stocks will experience a negative development.

Mackenzie (2020) has a different approach: He argues that in more recent years, independent of the political conflict, stock markets were rarely shaken by it. Ultimately, it will be decisive for stock and debt market development whether the valuations can be supported with economic data and the respective earnings.

As can be seen, a plenitude of investigations has been conducted where the stock market behavior is analyzed. Surprisingly, very little emphasis is put on the behavioral financial and rational aspects of the development of the stock market. We discovered that up until now a minority of the authors investigated in the direction of behavioral finance and investment behavior (Brune et al. (2015)).

The conducted research that comes closest to our prospective objective was written by Brune et al. (2015). Their aspiration is it to shed light on the "war puzzle": the likelihood of a war outbreak decreases stock prices, but the outbreak of a war increases them. This is not the case if the war outbreak is sudden. There, the outbreak decreases the stock prices. The authors use large international military conflicts after and including World War II as a study objective and try to explain their findings by behavioral financial theories. After they confirmed the existence of the "war puzzle" for the Iraq war, they also show that the same phenomenon occurs for other international conflicts. Additionally, the peculiarity is not exclusive for the US-American stock index. It is shown that the Japanese, German and also European stock indices display the same behavior.

Table 2.1: Stock Markets' Reaction to News (Brune et al. (2015), p.14)

	Stock market reaction to:		
	Increasing probability	Expected start	Surprising start
	0-99 %	99-100 %	0-100 %
World War II (start in Europe)	decrease	increase	
World War II (Pearl Harbor)			decrease
Korean War			decrease
Vietnam War	decrease	increase	
Gulf War (Kuwait invasion)			decrease
Gulf War ("desert storm")	decrease	increase	
Afghanistan War	lack of data at this point	increase	
Iraq War (2003)	decrease	increase	

2.1 summarizes the war puzzle for the research by Brune et al. (2015). Puzzling is that the behavior cannot be explained by the expectation of the country's respective future economic development, which was the explanation given by Amihud and Wohl (2004). The authors find a host of possible ideas that do not seem to be satisfactory explanations for the war puzzle:

That the war is like a stimulus package for the US economy. They quickly dismiss the explanation as it does not illustrate why the puzzle is also prevalent for countries that did not participate in the war. Additionally, it does not explain why stock prices would fall with more proximity of the war. Nevertheless, they acknowledge that the US plays a role in most of the researched conflicts. Still, the authors conclude that the structure of the conflict is much more significant than whether the US played an active role in it. If the, for instance increasing, stock prices were related to the US participation it would need another study to investigate how an active role of the US can influence the stock market.

The authors delve into the impact of time on the expectations about the war. It could be argued that as soon as the war breaks out, an ending is possible. The switch from despair to hope could explain the change of development of the stock prices. The authors find several reasons, why that is not the case: For once, they recognize that e.g. the Saddam Security as a proxy for the probability of an outbreak was a good indicator. With that reasoning, the investors expected the start of the war in the near future and Saddam Hussein to not be in charge by June. The expectations or hopes should have not changed with the outbreak of the war. Taking the example of the Second World War: one could argue that as soon as the war starts a prospective ending will decrease potential costs

and tensions. It is not rational to believe that investors thought the Second World War would end quickly as soon as it broke out, due to the fact that the First World War lasted four years. Additionally, if an outbreak means an ending shortly, the investors should appreciate the potential outbreak before the actual outbreak.

It could also be argued that stock prices started to increase as soon as it became obvious how destructive the war would be. That explanation however does not explain why the stock prices start to increase already at the very beginning of the war. This argument is also invalid for the case of the Second World War where the devastation did not seem to lighten up, but the war puzzle still occurred.

An intuitive explanation for the war puzzle would be that investors prefer security over ambiguity and therefore start to invest only when the war has broken out. However, in the authors' research it does not fit the empirical data. If that was the case it would mean that an investor would prefer a situation where it is unsure whether a war breaks out, over a situation where a war has broken out, which is clearly more devastating. This is not sensible, as an uncertain situation cannot be considered worse than its worst possible outcome.

Brune et al. (2015) explain that it could be that the investor would construct different investment portfolios depending on a war or a peace state. If it is uncertain what will happen the investors might stay out of the stock market entirely or invest significantly less. Considering all possible states and decision outcomes, they discover that it matches with the observed war puzzle. If for instance the likelihood of a war outbreak increases, the "peace portfolio" will be less attractive but a war portfolio is thus far even less attractive. When the war breaks out, the "war portfolio" becomes more lucrative and the entire market increases. Unfortunately, this theory fails to hold true in praxis. The authors show that typical "war stocks", e.g., from weapon manufacturers did not grow as much as the "peace stock", like travel or airline companies which increased the most at the outbreak of the war.

As a last explanation the mean-variance preferences are excogitated. As long as it is unsure what will happen, the investors will not buy due to their variance aversion even if the expected return is still better than the expected return when the war has started (cf. also the explanation about ambiguity aversion).

2.4.2 Literature Sources Examining the Economic Impact of the Ukraine-Russia War 2022

As of now (December 2022) the amount of available literature investigating the economic impact and specifically the effect on the stock market due to the outbreak of the Ukraine-Russia War in March 2022 has been limited. Nevertheless, a short overview will be provided below:

The European Central Bank (ECB) released a blog article discussing the markets' responses to war and corresponding geopolitics. Unlike us, they do not study the public's expectation of the likelihood of an outbreak of the war but measure the level of geopolitical tension and the impact on the stock market. They find that equity markets (they use individual countries' stock indices) price in a negative geopolitical risk premium. Hence, they measure the geopolitical risk by measuring the distance of the capital to Kyiv (Ukraine's capital). Higher geopolitical risk, i.e. lower distance to Kyiv, translates into being more affected by the war than countries that are more distant to Kyiv in Europe (Chiţu et al. (2022)).

Bougias et al. (2022) conduct research on the impact the war has on the valuation of European firms. They use the MSCI Europe All Cap Index for a time frame from February 10, 2022 up until March 9, 2022 and calculate the respective firms' value based on their stock value. They conclude that the Ukraine-Russia war led to lower security prices, combined with higher volatility. The authors mention that the impact of the war on the firm's value might differ depending on the revenue's exposure to Russian and Ukrainian trade. Like Chiţu et al. (2022), they group firms into levels of revenue exposure to Russian/Ukrainian. As expected, firms with a large revenue exposure are more affected by the outbreak of the war.

As described in section 2.3.3, the impact on economies due to the war will be considerable. Khudaykulova et al. (2022) and Liadze et al. (2022) measure the economic consequences of the Ukraine-Russia War 2022: As previously mentioned, Russia plays an important role in the energy supply to the European market. Therefore, the outbreak of the war lead to an increase in gas, oil and coal prices. In the long-run a supplier switch away from Russian oil imports which could limit the increase in prices (Khudaykulova et al. (2022)). Besides direct costs (lives and resources lost), indirect costs are often underestimated ex-ante (e.g.

costs for rebuilding or damages to international trade). Khudaykulova et al. (2022) states that the sanctions in the aftermath of the Crimea annexation 2014 negatively affected not only Russia but also the countries of the EU, due to indirect effects and inter-dependency. This could be the same with the Ukraine-Russia war in 2022.

Liadze et al. (2022) estimate that the costs of the war will amount to 1% of global GDP. They name several areas that will be affected, also due to the increasing inflation: affected by the war will be costs of food, transportation, energy prices and financial markets and expectations. 25% of the global wheat export market stems from Ukrainian and Russian wheat exports, and around 80% of the sunflower oil exports are from Ukraine or Russia. Higher food prices will affect countries where food has a larger share of the Consumer Price Index (CPI) basket. Palladium is used in engine exhausts to reduce emissions and is mainly produced in Russia. Likewise, titanium is used in aircraft and up to 15% of the global supply is exported by Ukraine and Russia. This might lead to production disruption or shortages in different industries. Energy prices might further increase, especially if the winter will be extraordinarily cold. The higher inflation might lead central banks to tighten monetary policies more than expected by the financial markets. Liadze et al. (2022) estimate the costs for the war and the impact on the economy. It remains to be researched if European shareholders expected the same costs and estimated the effects as accurately, so that it could be seen in the Eurostoxx 50 index at the outbreak of the war.

More specific for the Ukraine-Russia is the analysis by Boungou and Yatié (2022). Contrary to us, they investigate the global stock markets' reaction (94 countries) to the outbreak of the Ukraine-Russia war in 2022. They conclude that the outbreak has a negative impact on stock markets worldwide. They differentiate further between markets of countries that border on Ukraine and/or Russia and countries that share no border and countries that are part of the UN. We think it is more relevant to do research on a solely European index as, as previously mentioned, the war has a direct impact on the energy supply in many European countries, independent on whether they share a border with Ukraine or Russia or are part of the United Nations Organization (UN).

The paper released by Ahmed et al. (2022) this summer analyses the effects of the war's outbreak on the European stock market. They investigate the stock market's reaction based on the actual outbreak but not like we do, based on the market's expectation of the

outbreak. One of their main findings is that the impact of the perceived geopolitical risk depends highly on the country. There is a notable heterogeneity on country-level, even when just investigating on a European level and not a global level. Ahmed et al. (2022) further find that Ukraine-Russia war has a negative effect on the STOXX Europe 600, we will do research on the Eurostoxx 50 index and subtract the MSCI world index to exclude any macroeconomic trends[2].

[2]For a more detailed explanation cf. section 3

3 Data

In this chapter, we provide an explanation on how we sourced our data and the reasoning behind it. We further explain how we formatted the data and visualize the data development, also in comparison to the investigated Eurostoxx 50 index for the respective time frame.

3.1 Data Sources and Formatting

To conduct our analysis we used three different sources of data. We decided to use daily returns of the Eurostoxx 50 index as our dependent variable to see how stock markets in Europe are affected by expectations of the outbreak of a war. The Eurostoxx 50 index is an index consisting of the 50 largest publicly traded companies in the Euro-area. We sourced this data from Yahoo Finance[3]. For the pre-war period we decided on a time frame of three months leading up to two days before the outbreak of the war [-90;-2], as in this time it became clear whether a war was expected. To control for other macroeconomic trends, we substracted the returns of the MSCIWorld index (also sourced from Yahoo Finance). This was of importance especially in the beginning of 2022, the pre-war period of the Ukraine-Russia war, as central banks, globally, introduced stricter monetary policies which affected the markets negatively (Nelson (2022) and Born and Krys (2022)).

As proxies for the likelihood of a war data from Google searches and from Twitter was used. For the Google trends we filtered for three keywords per conflict and their frequency of searches. For the war in Syria with an outbreak in 2011 those were "syria", "assad" (the president of Syria) and "damascus" (Syria's capital). For the Crimea conflict and annexation in 2014 we analyzed the search data for the keywords "crimea", "russia" and "ukraine" and for the invasion of Ukraine in 2022 we looked at the keywords "war", "russia" and "ukraine".

We used those key words with the intent to exclude other conflicts and to only find indications with regards to the actual conflict and not mistakenly take increased interest in e.g. travelling into account. Had we for instance excluded the term "assad" in our filtering, we would have included searches where Google and/or Twitter users were interested in

[3]cf. yahoofinance.com

cultural and historic aspects of Syria's capital Damascus. It was further necessary to include Damascus as that was where the government and political center of the country is located (Rodgers et al., 2016).

For the searches with regards to Ukraine and Russia we had to include the reason for concern additionally. It would have not been sensible to only look for Google results and Tweets for Russia and Ukraine without also searching for Crimea, as that aspect of their relationship was the main point of interest in 2014 and also the main focus point in our analysis. The same is valid for the war in 2022: we wanted to find indication of the public's perception on the likelihood of a war. This would have not been possible if we excluded the term "war" in the analysis.

Google trends gave us scores for every keyword and every day over the three-month period in between 0-100, where 100 was the highest interest into a keyword in the respective time frame and acted as the reference point. This way we were able to compare the interest in the keywords before the outbreak of the war. To generate one proxy variable we generated the sum of the search scores for all three variables per day.

To get Twitter data we used the Postman tool[4] and the Twitter API v2[5] to analyze the number of Tweets on a specific topic. The Twitter API is a tool that offers programmatic access for developers. We could get broader accesses by registering as using it for research in academia. The Postman tool helps to analyze and comprise the data accessed by any application programming interface (API), in our case the Twitter API. The same time frame as for the Google data was used. We searched for all Tweets per day that included a specific keyword that is tied to the conflict. For the war in Syria that was "syria", for the Crimea crisis "crimea" and for the invasion of Ukraine "ukraine". The result was the total number of Tweets including the respective keyword per day.

For stationarity we also computed the daily changes as a percentage for both independent variables (Google and Twitter).

[4]https://www.postman.com/product/tools/.
[5]https://developer.twitter.com/en/docs/twitter-api.

Table 3.1: Data Crimea 2014 pre-war

	Day	Return Eurostoxx	Change Google	Change Twitter
1	2013-11-27	0.58%	-4.35%	6.05%
2	2013-11-28	0.44%	<0.00%	-14.19%
3	2013-11-29	-0.14%	<0.00%	-13.61%
4	2013-12-02	-0.07%	14.81%	5.59%
5	2013-12-03	-1.54%	-9.68%	-14.29%
6	2013-12-04	-1.32%	-3.57%	86.11%
7	2013-12-05	-0.35%	-3.70%	-44.69%
8	2013-12-06	0.42%	-3.85%	-3.75%
9	2013-12-09	0.30%	11.11%	-65.74%
10	2013-12-10	-0.59%	-10.00%	13.02%

First 10 entries of Data on pre-war period of Crimea conflict.

Table 3.1 shows the resulting data for the pre-war analyses. The table displays the first ten entries of the data on the Crimea conflict, including the daily change of the Eurostoxx 50 index (minus the MSCIWorld change) and the daily change in Google searches and Tweets on the topic. The tables for the outbreak of the war in Syria in 2011 and the Russian invasion of Ukraine in 2022 have the same layout.

Table 3.2: Data Crimea 2014 outbreak

	Day	Return Eurostoxx	Outbreak Dummy	Change Tweets	Change Google
1	2014-02-05	-0.18%	0	-98.04%	26.66%
2	2014-02-06	0.31%	0	78.05%	10.52%
3	2014-02-07	0.14%	0	-27.50%	80.95%
4	2014-02-10	-0.53%	0	-23.16%	-26.31%
5	2014-02-11	0.45%	0	18.25%	-17.85%
6	2014-02-12	0.73%	0	-16.72%	-8.69%
7	2014-02-13	-0.26%	0	3.79%	-4.76%
8	2014-02-14	0.1%	0	-6.90%	-5%
9	2014-02-19	-0.52%	0	99.27%	173.68%
10	2014-02-20	-0.6%	0	32.89%	11.53%

First 10 entries of Data on outbreak of Crimea conflict.

To analyze the impact of the actual outbreak of a war we used the daily return of the Eurostoxx 50 index minus the daily return of the MSCIWorld index to control for other macroeconomic trends again. We looked at a time frame of around 2 months of the respective outbreak [-30;+30]. We chose this relatively narrow time frame to isolate the

impact of the outbreak of the war as best as possible and to exclude any changes not related to the immediate war outbreak. We created a dummy variable that indicates whether each entry is from before the outbreak (dummy variable = 0) or from after the outbreak (dummy variable = 1). This will allow us to investigate the differences the outbreak of each war made in our analysis. The Twitter and Google data was sourced for the pre-war periods, as daily changes in percent. Table 3.2 shows the first ten entries of the resulting data for the Crimea conflict. Again, the data for the Syrian war and the invasion of Ukraine look the same.

3.2 Correlations in the Data

Before starting our analysis we needed to test whether the data was suitable and fulfilled the requirements for regressions. Therefore, we analyzed the correlation between the independent variables (changes of Google searches and Tweets) for the both pre-war periods and the periods around the outbreak.

Table 3.3: Correlation pre-war Syria 2011 (pre-war)

	Google Change	Tweets Change
Google Change	1	0.365
Tweets Change	0.365	1

Correlation between the daily changes (%) of Google searches and Tweets (pre-war).

We find a positive correlation of 0.365 between the daily change in Google searches and Tweets for the Syrian pre-war period, as can be seen in Table 3.3. This proves that there is a significant correlation but the two variables do not always follow the same trend.

Table 3.4: Correlation Syria 2011 (outbreak)

	Google Change	Tweets Change
Google Change	1	0.529
Tweets Change	0.529	1

Correlation between the daily changes (%) of Google searches and Tweets (pre-war).

For the data on the outbreak of the Syrian war there is a stronger correlation of 0.529 (see Table 3.4) between the two independent variables. This shows that the closer we were

to the conflict, the more in line were Google searches and Tweets.

Table 3.5: Correlation pre-war Crimea 2014 (pre-war)

	Google Change	Tweets Change
Google Change	1	-0.035
Tweets Change	-0.035	1

Correlation between the daily changes (%) of Google searches and Tweets (pre-war).

Table 3.5 shows the correlations for the Crimean pre-conflict period in 2014. Surprisingly, there is a slight negative correlation. However, the negative correlation is low. The fact that there is no positive correlation might be due to the choice of keywords, a low interest in the conflict in general or a a low expectation of a war. The low expectation for a war would coincide with our assessment in section 2.3.2 where it was stated that it was a conflict with a sudden outbreak. That means that the variables should be researched separately for our results in the analysis.

Table 3.6: Correlation Crimea 2014 (outbreak)

	Google Change	Tweets Change
Google Change	1	0.306
Tweets Change	0.306	1

Correlation between the daily changes (%) of Google searches and Tweets (pre-war).

Around the outbreak of the conflict, however, we find a positive correlation of 0.306 (Table 3.6) between the two independent variables. This shows, like for the Syrian war, that the correlation between Tweets and Google searches was much stronger around the outbreak of the conflict.

Table 3.7: Correlation pre-war Ukraine 2022

	Google Change	Tweets Change
Google Change	1	0.388
Tweets Change	0.388	1

Correlation between the daily changes (%) of Google searches and Tweets (pre-war).

The correlation between changes of Google searches and Tweets is high and positive for the

invasion of Ukraine in 2022. Table 3.7 shows a correlation coefficient of 0.388, indicating that the change of Google searches and Tweets in the time leading up to the war were correlated. The correlation is even stronger than for the Syrian war in 2011.

Table 3.8: Correlation Ukraine 2022 (outbreak)

	Google Change	Tweets Change
Google Change	1	0.985
Tweets Change	0.985	1

Correlation between the daily changes (%) of Google searches and Tweets (pre-war).

This high correlation get exceeded by the results in table 3.8. Around the time of the invasion the percentage changes in Tweets and Google searches were very similar at a correlation of 0.985.

3.3 Data Visualizations

3.3.1 Syria 2011

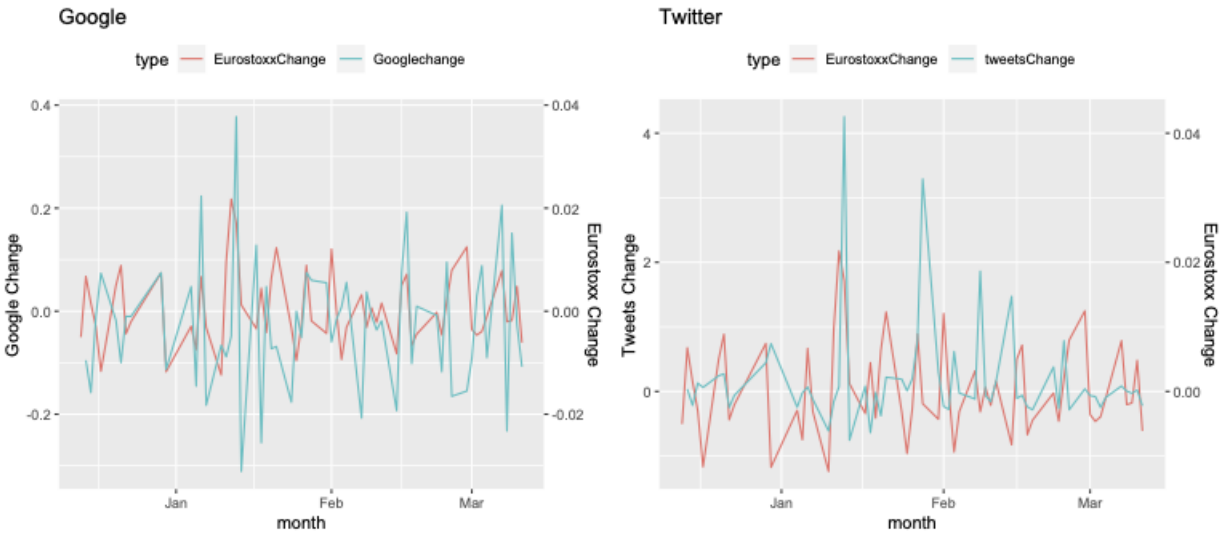

Figure 3.1: Changes (%) in Google and Twitter data in relation to returns in the Eurostoxx 50 index (minus returns in the MSCIWorld index) before the outbreak of the Syrian civil war 2011

Besides assessing the correlations, we plot the data to see if correlations or irregularities are already noticeable through the visualization of the data. Figure 3.1 shows the plot for

the Google searches on the left side and for the Tweets on the right side. In both plots the Eurostoxx 50 index ("EurostoxxChange") data represents the daily change of the index. If a higher expectation of the outbreak of a war leads to a decrease of the index, then a positive change in Google searches or Tweets should lead to negative daily returns. The visualization of the data leading up to the outbreak of the civil war in Syria does not give a clear picture. Throughout the time frame our proxies, especially the Google searches, do not seem to change significantly, neither is there a clear effect on the Eurostoxx 50 index. At some points the changes in Google searches and the daily returns of the Eurostoxx 50 index almost follow the same pattern while in others they appear to be negatively related.

The Twitter data shows some stronger spikes going up to a daily increase of up to 400%. However, these increases do not seem to be followed by a strong negative reaction of the Eurostoxx 50 index. The low change in Google searches could indicate that the war was not that expected, while the low impact on the index by the increase in interest in the topic on Twitter could be explained by the relatively minor importance of the conflict for European markets.

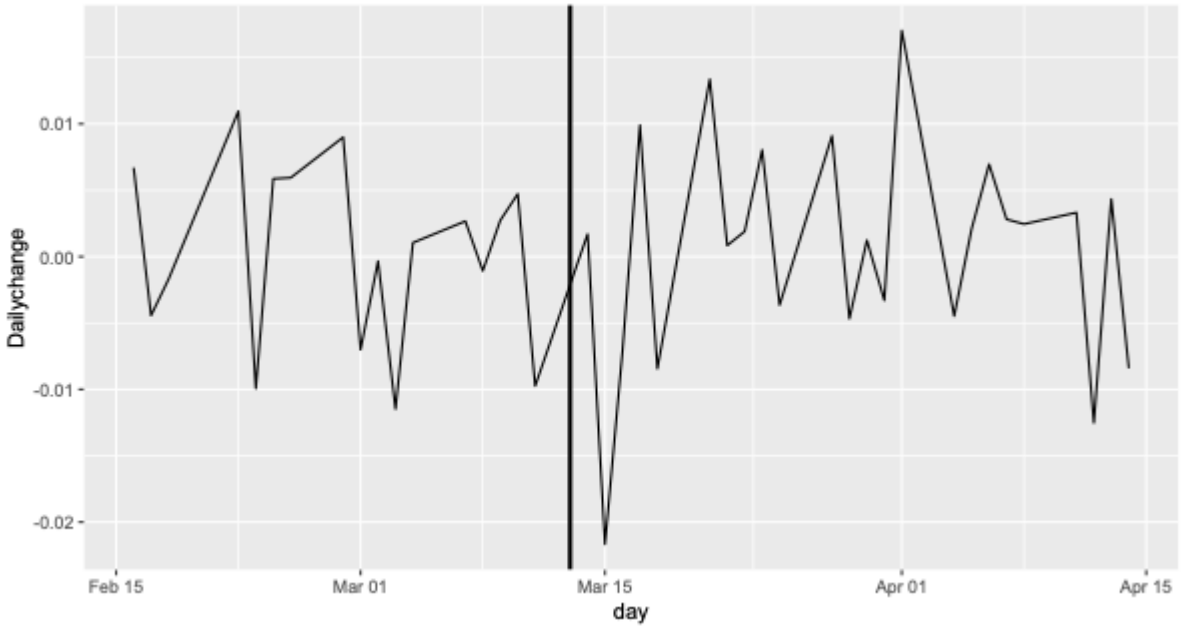

Figure 3.2: Eurostoxx 50 (minus MSCIWorld) daily returns around the outbreak of the Syria war

To visualize data on the outbreak of the war we show the daily returns of the Eurostoxx 50 index graphically and insert a visual break on the date where the war broke out. We could see any visual change in the daily returns before and after the outbreak. Looking

at the daily returns of the index for the Syrian war (Figure 3.2), it appears to be no strong negative trend once the war broke out (marked by the black line). There is one stronger negative return shortly after the outbreak but then the index returned to its former volatility pattern.

3.3.2 Crimea 2014

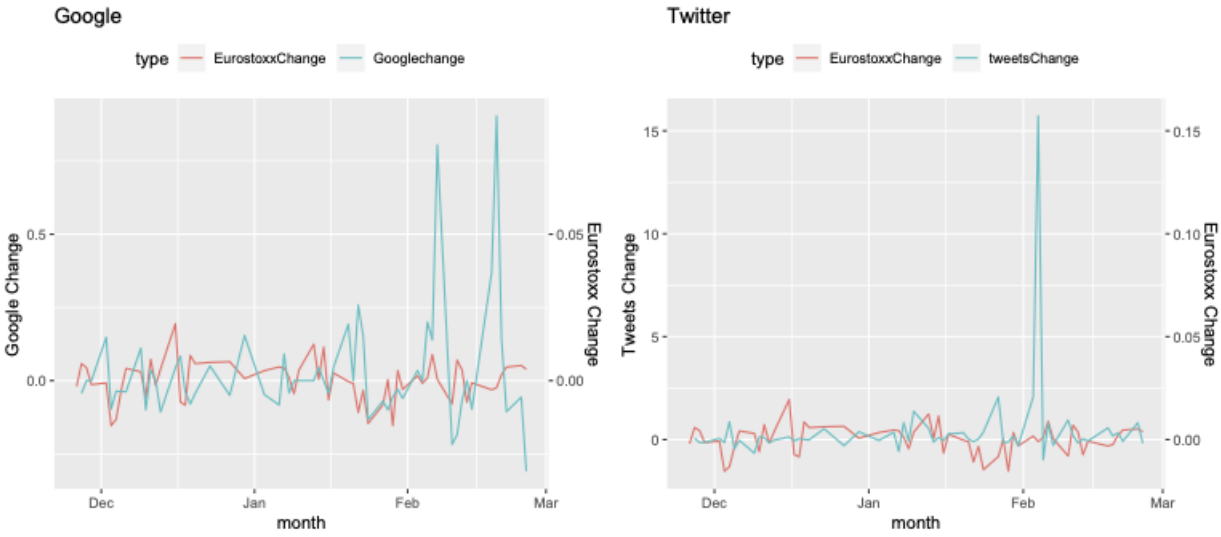

Figure 3.3: Changes (%) in Google and Twitter data in relation to returns in the Eurostoxx 50 index (minus returns in the MSCIWorld index) before the annexation of Crimea 2014

Figure 3.3 visualizes the data leading up to the Crimean conflict in 2014. For the Google data we see larger increases closer to the outbreak of the conflict followed by the annexation. We cannot notice a clear impact on the daily returns of the Eurostoxx 50 index. The Twitter data does not show a clear picture either, which is especially due to an outlier on the 4th of February 2014, on which the presidium of the supreme council of Crimea announced holding a referendum about the peninsula's status and asked the Russian government to guarantee the vote. This outlier makes it impossible to draw conclusions from the plot. In line with not being positively correlated, the Google data does not show this sharp increase on the 4th of February. We conclude that this difference could stem from the different functions of the websites: Google is generally used to inform oneself about topics. Twitter is used for the same thing but is additionally used to communicate with other users; it is a social-media website. In the past, Twitter was used as part of socio-economic discussions and was e.g. used majorly during the Egyptian revolution to

make sense of a politically unstable situation (Buettner and Buettner (2016)). Therefore, it would be sensible if Twitter was used more intensively during the referendum on February 4th, 2014, to mobilize voters to vote, share opinions and communicate to others in the same situation, whereas Google results are mainly informative.

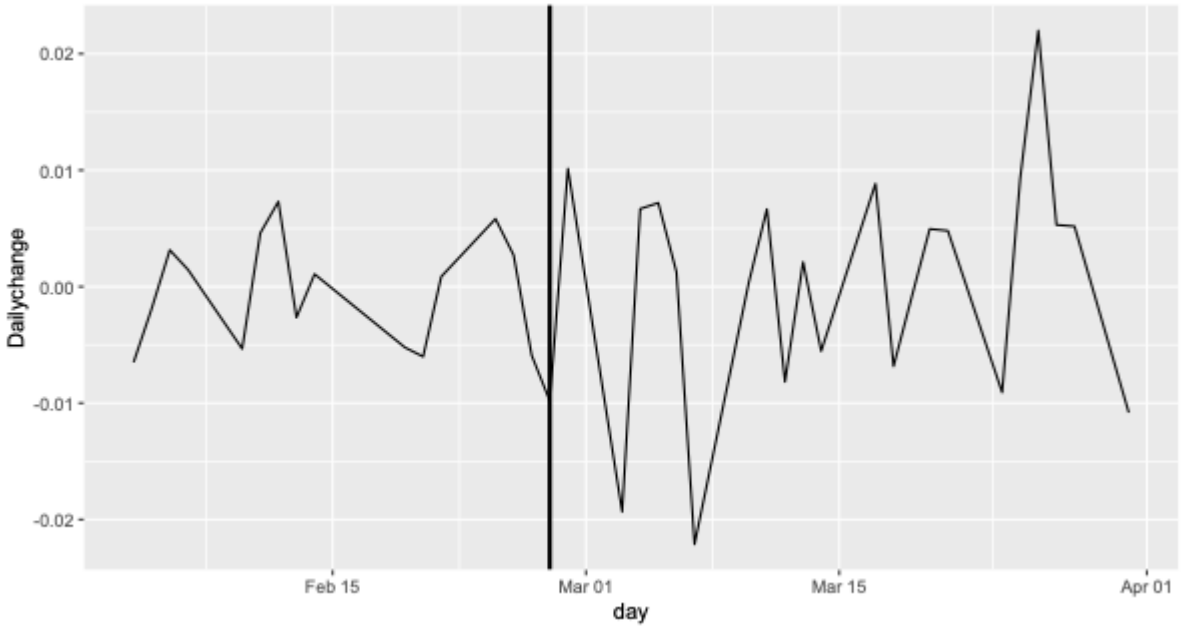

Figure 3.4: Eurostoxx 50 (minus MSCIWorld) daily returns around the outbreak of the Crimea conflict

Figure 3.4 shows the daily returns in the Eurostoxx 50 minus the MSCIWorld's returns around the outbreak of the conflict, February 27th, on which Russian troops captured strategic sites on the peninsula. This date is marked by the vertical line. On a first glance no clear change is visible around that date. After the outbreak of the conflict, however, the volatility appears to be higher.

3.3.3 Ukraine-Russia 2022

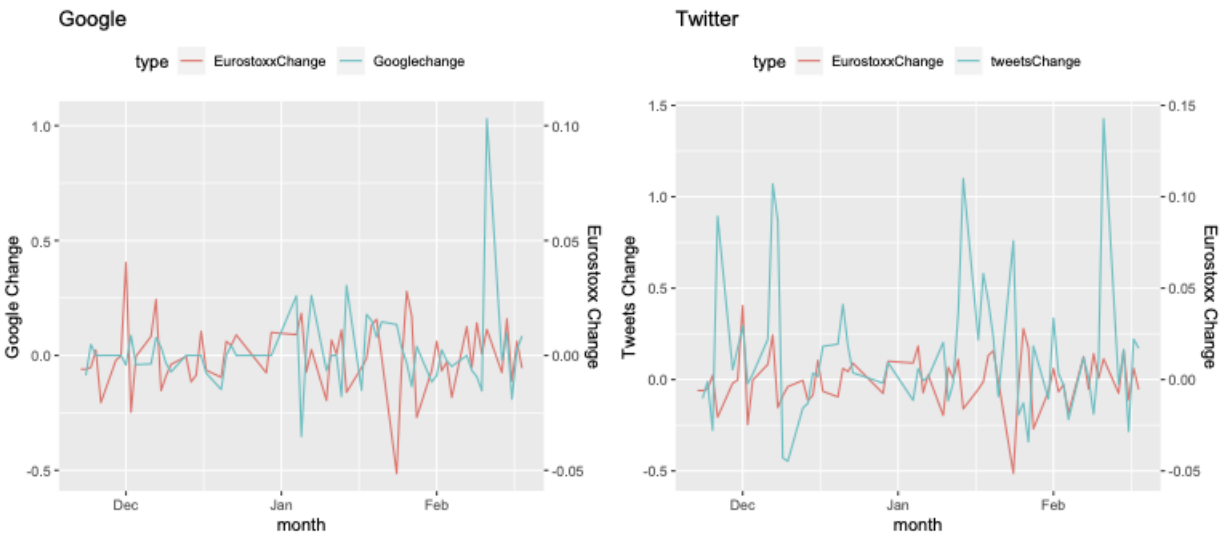

Figure 3.5: Changes (%) in Google and Twitter data in relation to returns in the Eurostoxx 50 index (minus returns in the MSCIWorld index) before the outbreak of the Ukraine war 2022

In the plots on the pre-war period in Ukraine in 2022 leading up to the Russian invasion (Figure 3.5), the positive correlation between Google searches and Tweets becomes partially clear: There are no big changes in Google searches in the beginning and more changes in Tweets, but the biggest increase in Google changes close to the outbreak is also visible in the changes in Tweets. In both plots, however, no big impact on the returns of the Eurostoxx 50 index is visible. Additionally, the strong increase in Google searches and Tweets close to the outbreak does not lead to a strong negative return of the index.

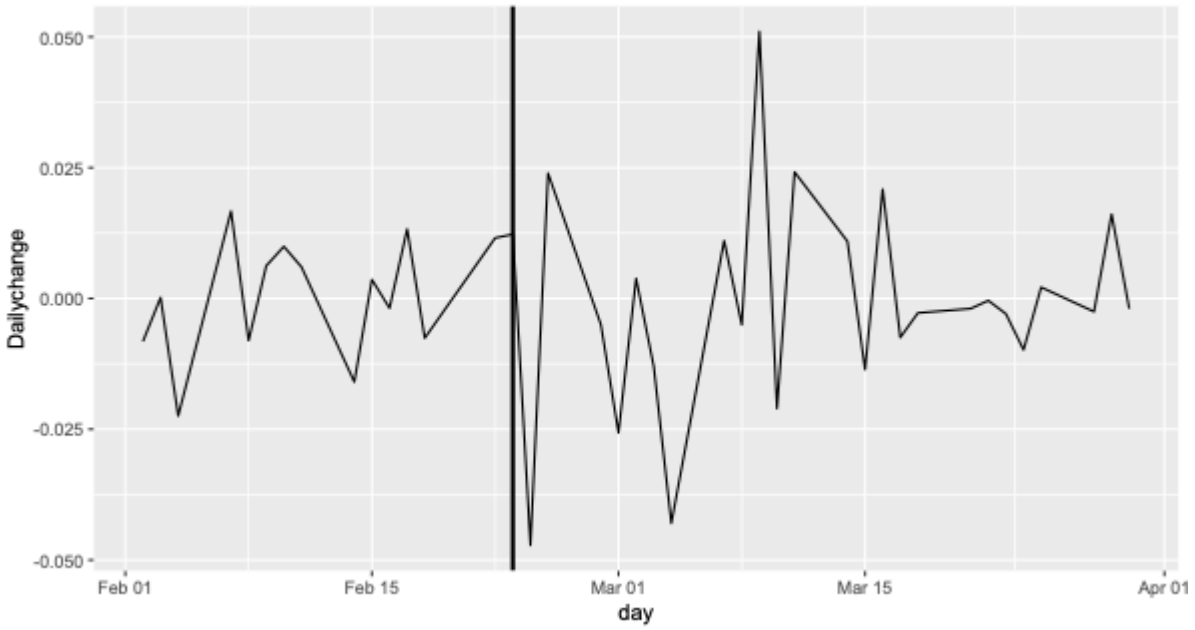

Figure 3.6: Eurostoxx 50 (minus MSCIWorld) daily returns around the outbreak of the Ukraine war

The plot on the daily returns of the index around the outbreak (Figure 3.6) gives, visually, no clear indications on whether the invasion of Ukraine on February 24th, 2022 had an immediate impact on stock markets. There is no clear change around the outbreak of the war. Again, volatility seems to be higher after the outbreak.

The visualizations of the data does not give clear indications towards proving out hypotheses. On the basis of this, further analysis will be carried out to investigate whether our hypotheses can be proven.

4 Methodology

To establish statistical models to investigate whether expectations of war have a significant impact on stock markets, we needed to test some assumptions of time series models. Looking at the plots for the pre-war periods it becomes clear that there is no auto correlation in the independent variables. We can also exclude seasonality, as we only look at a time-frame of three months. To check for stationarity augmented Dickey-Fuller tests (ADF-tests) for all three pre-war episodes and both proxy data sets (changes in Google & Twitter) are carried out.

The ADF test is a test created to test the null hypothesis that the autoregressive time-series has a unit root, the alternative hypothesis is that the variable is stationary. Stationarity is an important prerequisite and assumption for the majority of econometric models. Hence, we will test for it (Enders (2014)). The ADF test is more comprehensive than the Dickey-Fuller test but is based on the principle that due to the stationarity of the variable, a potential stationary variable can be split and will have a similar mean and variance (Dickey and Fuller (1979) and Dickey and Fuller (1981)).

To test the reaction of stock markets on the actual outbreak of a war we analyze how the daily returns of the Eurostoxx 50 index depend on the percentage changes of our proxy variables and whether there is a difference before and after the outbreak of the war. For this our dummy variable from Table 3.2 will be used. We will also take a closer look at interaction effects between our proxies and the dummy variable.

4.1 Syria 2011

Table 4.1: ADF-test Syria 2011

	Intercept	p-value
Changes (Returns)		
Google searches	-5.3682^{***}	0.01
Tweets	-4.1001^{**}	0.0115
Eurostoxx	-4.019^{**}	0.01495
First Differences		
Google searches	-8.3473^{***}	0.01
Tweets	-6.0587^{***}	0.01
Eurostoxx	-6.0876^{***}	0.01

* denotes significance at 10 %, ** at 5 %, and *** at 1 % level

Looking at the results for the ADF-tests (Table 4.1) on the data before the outbreak of the Syrian civil war in 2011, all three variables are stationary in changes. We therefore established two linear models, one for the Google data(4.1) and one for the Twitter data(4.2).

$$ReturnEurostoxx_t = \beta_0 + \beta_1 \Delta Google_t + \epsilon_t \tag{4.1}$$

$$ReturnEurostoxx_t = \beta_0 + \beta_1 \Delta Tweets_t + \epsilon_t \tag{4.2}$$

To analyze whether there is a change on the onset of the war, two regressions with interaction terms are set up. For the Google data the model looks as follows:

$$\begin{aligned} ReturnEurostoxx_t = &\beta_0 + \beta_1 \Delta Google_t + \beta_2 BreakoutDummy \\ &+ \beta_3 \Delta Google_t \times BreakoutDummy + \epsilon_t \end{aligned} \tag{4.3}$$

In addition to the impact of the percentage changes in Google searches on the index returns, we measure the effect before (dummy variable = 0) and after the war broke out (dummy variable = 1). Furthermore, the interaction term measures, whether there is a

difference in the effect of the changes in Google searches before and after the war in Syria broke out.

$$\begin{aligned} ReturnEurostoxx_t = &\beta_0 + \beta_1 \Delta Tweets_t + \beta_2 BreakoutDummy \\ &+ \beta_3 \Delta Tweets_t \times BreakoutDummy + \epsilon_t \end{aligned} \tag{4.4}$$

Formula(4.4) shows the model established for our other proxy, the daily percentage changes in Tweets. It is a similar concept as for the Google searches, measuring the effect of the daily changes in Tweets, whether the measurement was before or after the war broke out and the interaction term for the different effect of the changes in Tweets before and after the war broke out.

4.2 Crimea 2014

Table 4.2: ADF-test Crimea 2014

	Intercept	p-value
Changes		
Google searches	-5.5484^{***}	0.01
Tweets	-3.8182^{**}	0.02378
Eurostoxx	-2.9938	0.1733
First Differences		
Google searches	-4.3019^{***}	0.01
Tweets	-5.9905^{***}	0.01
Eurostoxx	-5.7456^{***}	0.01

* denotes significance at 10 %, ** at 5 %, and *** at 1 % level

Table 4.2 shows the test results for the pre-war period of the annexation of Crimea in 2014. We found the changes in Google searches and Tweets to be stationary. Unexpectedly, the changes in the Eurostoxx 50 index were only stationary in first differences. We, therefore, established two models, one for the Google data (4.5) and one for the Twitter data (4.6) following a first differences approach.

$$\Delta Eurostoxx_{t-1} = \beta_0 + \beta_1 \Delta Eurostoxx_{t-2} + \beta_2 \Delta Google_t +_3 \Delta Google_{t-1} + \epsilon_t \tag{4.5}$$

$$\Delta Eurostoxx_{t-1} = \beta_0 + \beta_1 \Delta Eurostoxx_{t-2} + \beta_2 \Delta Tweets_t +_3 \Delta Tweets_{t-1} + \epsilon_t \quad (4.6)$$

To investigate the impact of the outbreak of the Crimean conflict we used the same methodology as for the Syrian war, running two models with an interaction term: One for the Google data (4.7) and one for the Twitter data (4.8).

$$\begin{aligned} ReturnEurostoxx_t = &\beta_0 + \beta_1 \Delta Google_t + \beta_2 BreakoutDummy \\ &+ \beta_3 \Delta Google_t \times BreakoutDummy + \epsilon_t \end{aligned} \quad (4.7)$$

$$\begin{aligned} ReturnEurostoxx_t = &\beta_0 + \beta_1 \Delta Tweets_t + \beta_2 BreakoutDummy \\ &+ \beta_3 \Delta Tweets_t \times BreakoutDummy + \epsilon_t \end{aligned} \quad (4.8)$$

4.3 Ukraine-Russia 2022

Table 4.3: ADF-test Ukraine 2022

	Intercept	p-value
Changes		
Google searches	-4.4424^{***}	0.01
Tweets	-3.6502^{**}	0.03668
Eurostoxx	-3.8464^{**}	0.02242
First Differences		
Google searches	-6.715^{***}	0.01
Tweets	-5.2997^{***}	0.01
Eurostoxx	-6.9842^{***}	0.01

A* denotes significance at 10 %, ** at 5 %, and *** at 1 % level

The results of the ADF-test for the pre-war phase of the invasion of Ukraine in 2022 follow the expected pattern. All three variables are stationary in changes, allowing us to establish linear models:

Google:

$$\Delta Eurostoxx_t = \beta_0 + \beta_1 \Delta Google_t + \epsilon_t \quad (4.9)$$

Twitter:

$$\Delta Eurostoxx_t = \beta_0 + \beta_1 \Delta Tweets_t + \epsilon_t \tag{4.10}$$

We built two regressions with interaction terms. Both follow the same pattern as for the other conflicts. The model for the Google data (4.11) measures the effect of the proxy, whether a measurement was before or after the war broke out and if there is a change in the effect of the proxy before and after the war.

$$\begin{aligned} ReturnEurostoxx_t = &\beta_0 + \beta_1 \Delta Google_t + \beta_2 BreakoutDummy \\ &+ \beta_3 \Delta Google_t \times BreakoutDummy + \epsilon_t \end{aligned} \tag{4.11}$$

The model for the Twitter data (4.12) measures the same effects, but in relation to the percentage change of Tweets per day, not Google searches.

$$\begin{aligned} ReturnEurostoxx_t = &\beta_0 + \beta_1 \Delta Tweets_t + \beta_2 BreakoutDummy \\ &+ \beta_3 \Delta Tweets_t \times BreakoutDummy + \epsilon_t \end{aligned} \tag{4.12}$$

Based on our data and deriving from these results, we established regression models for all three wars, pre-war and on the outbreak of the war. The results of these models help us to answer whether expectations of the outbreak of a war and the actual onset of war affect stock prices and follow the war puzzle theorem.

5 Analysis

Given the regression formulas established in the last chapter, we ran our 12 models for the pre-war and breakout periods of all three conflicts. The results, including the indications, are presented below.

5.1 Syria 2011

5.1.1 Pre-War

Table 5.1: Regression results pre-war phase Syria 2011

	Model:	
	Linear Regression	
	Twitter	Google
$\Delta Tweets$	0.001	
	(0.001)	
$\Delta Google$		0.009
		(0.008)
Constant	0.0003	0.001
	(0.001)	(0.001)
Observations	58	58
R^2	0.022	0.024
Adjusted R^2	0.005	0.006
Residual Std. Error (df = 56)	0.007	0.007
F Statistic (df = 1; 56)	1.271	1.372
Note:	*p<0.1; **p<0.05; ***p<0.01	

For the pre-war phase of the Syrian civil war (Table 5.1) we do not get significant results indicating a reaction of investors to the likelihood of war. Neither the Twitter proxy nor the Google proxy for the likelihood of war indicates a significant effect on the daily returns of the Eurostoxx index. This means that our model does not detect any influence of the expectations of an outbreak of a war in Syria on the daily returns in the European stock market. The low adjusted R-squared values (0.005 and 0.006) demonstrate that our

descriptive variables do not describe the returns of the index well.

5.1.2 War-Outbreak

Table 5.2: Regression results war outbreak Syria 2011

	Model:	
	Regression with interaction term	
	Twitter	Google
$\Delta Tweets$	0.011*	
	(0.006)	
$\Delta Google$		0.021
		(0.018)
Outbreak Dummy	0.002	0.001
	(0.002)	(0.003)
$\Delta Tweets \times OutbreakDummy$	−0.014**	
	(0.006)	
$\Delta Google \times OutbreakDummy$		−0.025
		(0.021)
Constant	−0.00003	−0.0001
	(0.002)	(0.002)
Observations	40	40
R^2	0.221	0.043
Adjusted R^2	0.156	−0.036
Residual Std. Error (df = 36)	0.007	0.008
F Statistic (df = 3; 36)	3.411**	0.543
Note:	*p<0.1; **p<0.05; ***p<0.01	

Looking at the results of our analysis around the outbreak of the Syrian civil war (Table 5.2) the Twitter model provides some significant results. If the Tweets on the topic of the war double (100% daily increase) the return of the Eurostoxx index (minus the MSCI world return) is 1.1% higher. The result is significant on a 10% level and holds for both, before and after the war broke out in the event window [-30;+30]. The indication of this result is that increased interest in the war leads to positive daily returns. The Syrian war did not

break out unexpectedly, so if the war puzzle was right, this should only be the case after the war broke out. In the period leading up to the war, the impact should be negative.

This leads us to looking at the result for the interaction term, which indicates whether the relation between the changes in Tweets per day and the return of the index changed before and after the war broke out. The dummy variable was 1 for data entries after the war broke out and 0 for data entries from before the outbreak. The result shows that after the war broke out, the impact of the changes in Tweets changed negatively, compared to before the war broke out. The result is significant at the 5% level. This stands in contrast to the war puzzle theorem, which would expect a positive change after the war broke out (Brune et al. (2015)).

The coefficient of the dummy variable is not significant, meaning there was no identifiable difference in average daily returns before and after the war broke out. The adjusted R squared value for the model is relatively low (0.156) but higher than for the models that analyzed the pre-war period. The variation of the dependent variable can only be explained by the descriptive variables to a small extent.

The model using the Google search data does not give significant results, despite having identified a high correlation (0.529) between the daily changes in Tweets and Google searches in the Data section (3). The negative adjusted R squared value indicates, that the model does not explain the daily returns of the index well.

5.2 Crimea 2014

5.2.1 Pre-War

Table 5.3: Regression results pre-war phase Crimea 2014

	Regression model:	
	First Differences Regression	
	Twitter	Google
$\Delta Eurostoxx_{t-2}$	0.131	0.138
	(0.137)	(0.137)
$\Delta Tweets_t$	−0.0001	
	(0.0004)	
$\Delta Tweets_{t-1}$	−0.0001	
	(0.0004)	
$\Delta Google_t$		0.004
		(0.005)
$\Delta Google_{t-1}$		−0.001
		(0.005)
Constant	0.0003	0.0001
	(0.001)	(0.001)
Observations	57	57
R^2	0.020	0.030
Adjusted R^2	−0.036	−0.025
Residual Std. Error (df = 53)	0.007	0.007
F Statistic (df = 3; 53)	0.352	0.548
Note:	*p<0.1; **p<0.05; ***p<0.01	

Table 5.3 shows the results for the pre-war phase of the Crimean conflict in 2014. For this war we constructed the first differences models, as we did not find stationarity in the dependent variable. For both Twitter and Google data there are no significant results proving that an increase in expectations of a war has an impact on the Eurostoxx 50 index returns and therefore the stock market. This is the case for both models, despite having found a slightly negative correlation between the proxies in chapter 3. As we identified

the Crimean conflict to be unpredicted, we did not expect an effect of expectations. Also a low R squared and even negative adjusted R squared values underline that our models cannot detect a explanatory function of the descriptive variables to the index returns.

5.2.2 War-Outbreak

Table 5.4: Regression results war outbreak Crimea 2014

	Model:	
	Regression with interaction term	
	Twitter	Google
$\Delta Tweets$	0.0002	
	(0.002)	
$\Delta Google$		−0.003
		(0.004)
Outbreak Dummy	0.001	0.001
	(0.003)	(0.003)
$\Delta Tweets \times OutbreakDummy$	−0.002	
	(0.003)	
$\Delta Google \times OutbreakDummy$		−0.004
		(0.005)
Constant	−0.0001	0.0003
	(0.002)	(0.002)
Observations	36	36
R^2	0.012	0.136
Adjusted R^2	−0.081	0.055
Residual Std. Error (df = 32)	0.009	0.008
F Statistic (df = 3; 32)	0.126	1.679
Note:		*p<0.1; **p<0.05; ***p<0.01

For the period around the outbreak of the Crimean conflict we do not get significant results (see Table 5.4). Neither of our proxies nor the dummy variable have a significant effect on the returns. The interaction terms of the models do not affect the dependent variable in a significant way. Very low adjusted R squared values (-0.081 and 0.055)

further underline that the independent variables cannot explain the daily returns of the Eurostoxx 50 index (minus the MSCI World returns).

5.3 Ukraine-Russia 2022

5.3.1 Pre-War

Table 5.5: Regression results pre-war phase Ukraine 2022

	Regression model:	
	Linear Regression	
	Twitter	Google
$\Delta Tweets$	−0.002	
	(0.005)	
$\Delta Google$		−0.001
		(0.011)
Constant	−0.0001	−0.0004
	(0.002)	(0.002)
Observations	59	59
R^2	0.002	0.0001
Adjusted R^2	−0.015	−0.017
Residual Std. Error (df = 57)	0.015	0.015
F Statistic (df = 1; 57)	0.135	0.005
Note:	*p<0.1; **p<0.05; ***p<0.01	

The war that is of our main interest, the Ukrainian-Russian war in 2022, does not deliver significant results for the pre-war period. As stationarity was present in the variables we used linear models again, like for the Syrian war. Both models, for our Twitter and Google proxies, however, did not deliver a measurable effect of the increase of expectation of war on the index returns, as table 5.5 illustrates. The negative adjusted R squared values strengthens this result.

5.3.2 War-Outbreak

Table 5.6: Regression results war outbreak Ukraine 2022

	Dependent variable:	
	Dailychange	
	(1)	(2)
$\Delta Tweets$	0.004	
	(0.006)	
		0.003
		(0.011)
Outbreak Dummy	−0.001	−0.002
	(0.006)	(0.006)
$\Delta Tweets \times OutbreakDummy$	−0.010	
	(0.006)	
$\Delta Google \times OutbreakDummy$		−0.011
		(0.011)
Constant	0.001	0.001
	(0.005)	(0.005)
Observations	39	39
R^2	0.195	0.189
Adjusted R^2	0.126	0.120
Residual Std. Error (df = 35)	0.017	0.017
F Statistic (df = 3; 35)	2.832*	2.721*
Note:	*p<0.1; **p<0.05; ***p<0.01	

Additionally, for the period around the invasion of Ukraine on February 24th, 2022 we do not find a significant impact on the returns of the Eurostoxx 50 index (Table 5.6). There is no evidence for the percentage changes in Tweets or Google searches throughout the entire event window [-30;+30] or for an effect of the outbreak itself (the dummy variable has no significant effect) in our model. The interaction terms do not prove that there is a change in the relation of the proxies and the daily returns before and after the invasion took place. With 0.126 and 0.12 we get higher adjusted R squared values than for previous models. However, the models can still only poorly explain the variation in returns.

Taking our findings further, we will subsequently discuss the consequences for our analysis and hypotheses. Most of the effects we were looking for were not measurable, only for the period around the outbreak of the Syrian war did we get significant results. In the following we will elaborate on what this means for the war puzzle theorem.

6 Discussion & Limitations

In none of the three analyzed conflicts did we find significant results confirming the "war puzzle" theorem.

The data on the pre-war period of the Syrian war did not deliver significant results, indicating that a higher expectation of the war led to a decrease in stock markets. We could acquire some significant results on the outbreak of the war. However, they are not in line with the theorem, as after the war started the relation between the returns and the interest in the war changed negatively. If the results would confirm the war puzzle theorem the opposite would have been the case for a war with prelude. Hence, we reject H1 (The conflict in Syria in 2011 follows the pattern observed in the "war puzzle".).

Similarly, the analysis on the Crimean conflict in 2014 could not provide proof of the war puzzle theorem. Neither the analysis on the period leading up to the war, nor the analysis on the period around the war outbreak resulted in significant results that support the theorem. No direct influence of the conflict on European stock markets could be detected. We, therefore, also reject H2 (The stock market behavior during the Crimea annexation in 2014 follows the pattern of the "war puzzle".).

The war of our main interest, the Russian invasion of Ukraine in 2022, did, like the Crimean conflict, not deliver significant results. We did not find evidence that, in the period leading up to the invasion, an increase in expectations of an outbreak of the war had an impact on European stock markets. Furthermore, when the war broke out, we did not find evidence that the daily returns of the Eurostoxx 50 index were affected in a way that would be compatible with the war puzzle theorem. H3 (The stock market during the war between Ukraine and Russia, starting in the Spring of 2022, follows the stock market behavior observed in the "war puzzle".) is therefore also rejected.

None of our results prove the theorem right or wrong. In the following, we will discuss why that could be the case and will afterwards conclude the indications of our findings.

6.1 Relevance of Conflicts

One of the reasons for the result in our regression could be that the investigated conflicts are not as relevant to an European investor, as we initially assumed.

6.1.1 Syria 2011

As stated before, the Syrian civil war outbreak in 2011 followed after/in a similar time frame as the revolutions of the "Arabic Spring" (Council on Foreign Relations (2022)). The Syrian civil war started as protests and expressions of unhappiness with the Assad regime (Al Jazeera (2018)). It is likely that no investor could have foreseen that the protests in Syria would result in a decade-long proxy war (Alkousaa et al. (2016)). The involvement of Russia, the US, Turkey, Iraq and several other countries was not a given consequence in 2011 as well as the "refugee waves" towards Europe. The main refugee wave in result of the Syrian war in 2011 happened in 2015, four years after the outbreak date (Barlai et al. (2017)). The severity of potential economic consequences were therefore not visible in 2011. This could be an indicator for a less-relevant conflict from a 2011-Eurostoxx 50 index-investor while retrospectively, it would have been of importance for the investors with a longer-term outlook into the decade to come.

6.1.2 Crimea 2014

The outbreak of the conflict in Crimea was quite sudden, according to the war puzzle theorem that would have meant a negative reaction of stock markets on the outbreak. A reason for why we could not measure such an effect could be, similar to the Syrian war, that the conflict was not too relevant to European economies. Russia suffered international sanctions that interrupted trade with Europe (Biersack and O'Lear (2014)). However, most trade and big joint projects like the Nordstream 2 pipeline continued (European Parliamentary Research Service (2021)). The annexation of Crimea by Russia was never acknowledged but, in large parts accepted (Grant (2015)). This might be because the peninsula has an extensive history of Russian heritage and a large part of the population being ethnical Russians. The fact that this was only the beginning of a much larger conflict that would lead to the Russian invasion of Ukraine in 2022 was not foreseen in 2014.

6.1.3 Ukraine-Russia 2022

The Ukraine-Russia war in 2022 was our main research topic and we could also conclude that it should have been highly relevant to a European investor (2.3.3). The effect it has and had on energy prices, the reliance on trade with Russia and Ukraine and the overall insecure geopolitical and economic situation is decidedly relevant from a European perpective, and therefore relevant to the Eurostoxx 50 index. Not having detected any patterns that support the war puzzle theorem here could be partly due to the dependent variable, the Eurostoxx 50 minus the MSCIWorld return, as the war very likely also had a huge impact on the MSCIWorld index.

6.2 Variables

Further, the choice in only looking at the Eurostoxx 50 index could have been too broad. The Eurostoxx 50 consists of the 50 largest corporation within the Euro-area, which is still quite diverse. The effects of the outbreak of the wars, but specifically the Ukraine-Russia war in 2022, could have been more noticeable by differentiating further: Effects of a war outbreak might be widely different depending on the industry, the distance to Ukraine or Russia (or Syria) and the amount of trade the respective country/company has with the affected country (Ahmed et al. (2022)). For instance if the effect of the outbreak is only on firms within a certain amount of energy reliance on Russia, the reliance on Russian gas varies greatly even within countries of the Euro-zone (Buchholz (2022)). This might have been an insightful split of the Eurostoxx 50 index.

As mentioned before, deducting the returns of the MSCIWorld index to control for other macroeconomic effects perhaps already, also covers some effects from the conflicts. In a more and more globalized world financial markets are more interconnected and do more often follow the same trends. Especially the outbreak of the war in Ukraine in 2022 affected markets globally and not only in Europe (Ozili (2022)).

The choice to look at changes in Google trends and amount of Tweets on the social-media network Twitter seems like a good perception of the public's war expectation. As a third proxy, mapping the daily amount of key words across European newspapers for the event window could have been a more accurate indication as Twitter and Google operate globally

and therefore display the worldwide opinion of Twitter/Google users.

6.3 Expectations of the Outbreak

The protests in Syria in 2011 could be seen as being expected, to a certain extent. As mentioned before, the Arab Spring movement was in full development, which meant that similar movements in Syria were not improbable (Barlai et al. (2017)). This could also explain the limited detectable influence of the Tweets/Google trend changes on the Eurostoxx 50 index at the time of the outbreak in 2011. The longevity of the war and the effect it would have on Europe, as well as the mentioned proxy-war and the significance of the different parties (e.g. the militant Islamist group Islamic State) were not expected and would have perhaps impacted the decision of the investors (Barlai et al. (2017)). Further, with the Syrian civil war one could also assess the situation as a war that developed gradually, so no specific outbreak date (from an investor's perspective) should have been determined.

As we discussed in section 2.3.2, the dispute over the Crimea peninsula has been on-going, even if the forceful annexation came as a surprise. Their were indicators of a potential coup but it cannot be assumed that this was the sentiment of the general public (Eitel (2014)). Therefore, it would have been sensible that the change in Tweets and Google trends do not display an increase before the outbreak of the conflict, which could be seen in our data. The outbreak of the war between Russia and Ukraine did not came as a complete surprise to the European population (2.3.3). An average investor during the outbreak of the Crimean annexation was surprised by it, whereas the Syrian war or the Ukraine-Russian war should have not been surprising.

6.4 More Relevant Macroeconomic Trends

With regards to the Ukraine-Russia war 2022, an impending recession could be noticed beforehand. Inflation increased and the Federal Reserve in the US and the European Central Bank (ECB) countered with increased interest rates (Marcos (2022) and Fitzgerald (2021)). While the war in Ukraine and Russia did not help in slowing down the inflation, it might have been that the macroeconomic trends happening at the same time were more relevant than the outbreak of the war. We controlled for that by substracting

the MSCI world index from the Eurostoxx 50 index and this would explain the lack of significant results when looking at the change in Eurostoxx 50 index due to Google or Twitter changes.

A further potential macroeconomic trend is the COVID-19 pandemic that started to affect European citizen's daily life in March 2020. The aftermath of the pandemic could still be noticed in 2022, economically and politically in the (European) countries (McKinsey (2022)). It would be worth investigating if the effects of the COVID-19 pandemic mitigate partly the main effects of the Ukraine-Russia war 2022.

6.5 Explaining Investors' Behavior with Behavioral Finance Theory

As briefly mentioned in section 2.4.1, research has discovered that stock markets seem to be more resilient to shocks in recent years (Mackenzie (2020) and Shalett (2019)). This would also comply with our assumption in 6.4 where we assessed that there are trends that affect the stock market and the investors' behavior more severely than outbreaks of the war in Syria, the Crimea annexation or the Ukraine-Russian conflict.

An explanation for the resilience, especially with regards to the Ukraine-Russia war in 2022, could be an aspect of the Prospect Theory (Kahneman and Tversky (1979)): The Prospect Theory states that an investor changes their investment behavior and evaluates a situation based on a reference point. The reference point can change over time as well as the individuals' risk attitude (Bachmann et al. (2018) p.79ff.). Applying this theory on an informational level and taking past events into consideration, one could think that the investors use the events and the economic situation during the COVID-19 pandemic as their reference point[6]. The events during the COVID-19 pandemic were that grave and economically impacting that an impending war seemed less severe, from an economic perspective. A similar thought experiment could be conducted for the war in Syria in 2011: The Arabic spring was a series of revolutions that took place in Egypt, Algeria and others (Council on Foreign Relations (2022)), so an investor might use that as their reference point and consider the new information of Syria similarly and with less uncertainty in the

[6]S. also section before.

future of the global stock market.

The lack of noticeable reaction based on the changes in Tweets and Google trends could also stem from an information overflow and a general saturation in the processing of new information. This might not be an information processing bias per se, but, if it is the case, a lack of market efficiency, where new information should be immediately be reflected in the stock market (Fama (1970)).

6.6 Application of the "War Puzzle" Theorem

Lastly, it could also be that the "war puzzle" theorem is a phenomenon that can be observed in some conflicts, but not be established as a theorem. A "war puzzle" conjecture could be the more fitting terminology due to the fact that it is observable in some, but not in all investigated conflicts. Every conflict is different in complexity and affected areas, people and economies. It appears difficult to prove and establish the "war puzzle" as a general theorem. Nevertheless, we will conclude our findings in the following chapter and give an outlook on potential future research on the theorem.

7 Conclusion & Outlook

Concluding, we could not confirm any of our hypotheses. The public's expectation of the outbreak of a war did not affect the Eurostoxx 50 index in our research, neither for the Syria civil war in 2011, nor the Crimean annexation in 2014 or the Ukraine-Russian war in 2022. Potential reasons for this outcome were diverse.

For the Syrian civil war's outbreak in 2011, we have concluded that the outbreak in 2011 could not be seen at that time as a predictor of what the coming years would entail. Further, we have hypothesized that the European investors did not expect the length of the Syrian war and its impact on Europe.

Similar aspects hold for the annexation of Crimea in 2014. The conflict was seen as rather local and did not affect the European economies to a large extent. In 2014, the conflict was not seen as a prelude of a further escalation leading to the invasion of Ukraine in 2022.

For the war of our main interest, the invasion of Ukraine in 2022, we found it to be highly relevant for Europe. However, we did not find evidence for the war puzzle. We discussed how our choice of variables might have influenced the results and have attempted an explanation with the help of prospect theory (Kahneman and Tversky (1979)).

All this led us to the conclusion that the "war puzzle" theorem is not applicable to the conflicts we investigated, when using the proxies of the public's perception: changes in Tweets and Google trends.

For future research it would be interesting to see if the "war puzzle" pattern repeats itself for other conflicts. Other proxies for the public's perception on the likelihood of war could be chosen and the effect for different industries, sectors or countries could be investigated. Additionally, research on conflicts that do not involve physical combats, could be of interest for future work and exceed the scope of this thesis. Analyzing e.g. so-called trade wars, for instance the on-going conflict between the US and China and the effect of the public's perception on the stock market, would be a valuable addition to our research.

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