The effect of the Russian-Ukrainian war on the emerging green financial market: empirical evidence from Singapore

A research on the effect of a conflict on the green finance market in Singapore

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Date: 28-06-2024

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Introduction

The environment has been damaged by humans in the past decades, which causes unprecedented challenges like pollution, deforestation, climate change and resource depletion. These problems require immediate attention (Hussain & Reza, 2023). We all made use of the earth without acknowledging its beauty. Fortunately, humanity has finally seen the light and currently we are building a healthy environment all together. All sectors are contributing to this aim. Companies are busy with incorporating ESG which stands for Environment Social and Governance. This states that companies must do their activities in a way that will enhance the environment and in a way which is better for their employees. Finance has its own way of contributing to this environmental problem, namely through green finance. Green finance is an overarching term for financial products, markets and policies related to environmental protection and sustainable evolution (Shuyang et al., 2021). One of the countries that has been called out for their bad behavior towards the environment is Singapore. Singapore is a very important hub for maritime and air trade. Singapore is a part of the Association of Southeast Asian Nations (ASEAN), a group of Asian countries that find it important to trade and cooperate with its members and to make Asia more green. The group consists of: the Philippines, Singapore, Thailand, Vietnam, Myanmar, Malaysia, Laos, Indonesia, Cambodia and Brunei. But within this group Singapore is accused of greenwashing against environmentally beneficial instruments. This is because of Singapore's achievements when it comes to sustainability. They are currently 14th on the 2016 Environmental Performance index with a low level of carbon intensity, although they do not have a green finance market which is suspicious (Chang, 2019). According to this allegation the Singaporean government did value the environment more. So they made it their mission to improve the “greenness” of Singapore. ASEAN also stands for good trade positions and good relationships with other continents, but they lack interest in impactful situations in Europe like the Russia-Ukraine war. Singapore actually did care in the beginning, while the biggest part of ASEAN did not. Furthermore, ASEAN does have some connections to Russia when it comes to trading, which could be the reason that they don’t want to interfere in the conflict. In this research, we would like to fill the gap in the literature where there has not been much research on the impact of a war on the green stocks where it will be compared to brown stocks. We will investigate the hypothesis that the event will have an effect on the green stocks. Furthermore, we

will investigate if the effect has a relationship with quantitative data of the green stocks and of the brown stocks, like the founding year and the industry and this all will be compared with brown stocks which are stocks that do not take into account the enhancing of the environment. With these variables we can answer the following subquestions: does the war have a different impact on the green stocks than on brown stocks?

Literature review

Humanity has desecrated the environment over the past few decades. As a reaction to this phenomenon, governments from all over the world have come with incentives to redeem the world from absorbing more harm from humanity. Different sectors want to contribute to the treaty by drawing up rules. Companies try to contribute by incorporating corporate social responsibility (CSR). This is an act that forces businesses to act in a manner that benefits the well-being of the society and the environment. Finance also tries to contribute to this phenomenon by incorporating green finance. According to Aulia et al. (2023) "green finance is a broad term that can refer to financial investments that flow into sustainable development projects and initiatives, environmental products, and policies that encourage sustainable economic development".
Although green finance has drawn more attention in the past years, it lacks academic research (Yu et al., 2021). Recent studies show that green finance is becoming a very important topic in research nowadays, but compared to the emerging popularity, the top theoretical research results are missing or not decent enough (Wen, 2023).

It is well known that green finance is a key consideration in encouraging sustainable development. Furthermore, the following characteristics make it more interesting and profitable for companies to engage in green finance. First, as mentioned earlier, the fact that green finance has become more popular and is attracting more and more attention. Moreover, it is a required incentive for sustainable development. Secondly, through green finance there will be more focus on the living environment benefits of human society. It deals with a harmonious and balanced occurrence of economic activities, the ecological environment and tries to ultimately achieve sustainable social development (Wang et al., 2022).

The development and popularity of green finance have especially been strong since the introduction of green stocks. With this development, companies and the government try to seek the opportunities and diversify their bond portfolio by including social and sustainability factors. On the authority of a report by Sustainalytics (2019), investors are more and more using sustainable development goals as a benchmark for impact investing. Green finance is emerging all over the world from Europe, to North America to Asia. While Europe is the leading pioneer

when it comes to green finance, green finance is steadily increasing in Asia. There ASEAN, a group that comprises Thailand, Singapore, Vietnam, Malaysia, the Philippines and Indonesia as the largest countries are engaging in green finance, allocating more construction, energy, transportation and water-related projects. Singapore seems to be the leading country in the ASEAN group. They have significant growth in the issuance of green finance loans and bonds. The proceeds of these investments will mostly be used for building projects such as green building and building energy efficiency to accommodate environmental development in the face of climate change. In Singapore green loans account for fifty percent of all green issues. Nonetheless, when it comes to greener energy, Singapore still has a lot to learn to go in transitioning to sustainable energy, which includes all renewable energy sources. Although a lot of change has already been made in Singapore when it comes to green finance, they still need to improve renewable energy in power generation, because it has remained very low since 1990 compared to non-renewable energy sources. According to a report of Powering the World, Singapore depends on fossil fuels more than other countries. Green finance bestows instruments like loan guarantees, risk sharing agreements and insurance products that attract financial institutions and investors buying financial instruments, which are monetary contracts that can be traded, to invest in renewable energy projects. This question arose because Singapore is a leading country in the ASEAN group but has not fully transitioned to renewable finance yet (Subramaniam & Loganathan, 2024).
This discussion leads to the question: does green finance in Singapore affect the transition to renewable energy.

Chang (2019) elaborates about some issues and challenges the firms in Singapore face when it comes to issuing green bonds. Small and medium enterprises in Singapore do not have access to the procedure of issuing bonds, because they are too small to take on projects that will enhance the environment. These small companies do not have awareness when it comes to green finance. Furthermore, the domestic stock market is also compact which causes ambiguity when it comes to green finance and issuing green stocks and green bonds. Like in every industry transparency and reporting is a very important facet of the process, which seems a big risk for the companies in Singapore. In order to solve these problems, Chang (2019) proposed the following solutions:

- Comprehensibility when it comes to reporting what is considered green.

- Singapore needs to release more information about the ESG performance of the bond issuers to create more awareness and more clarity among companies that want to participate or companies that already participate.
- The market needs to be more clear about the quality of the financial instruments. Financial instruments are monetary contracts that can be traded. These could be stocks, bonds, derivatives, etcetera.
- Establish green pockets in order to create demand for green finance or green investments.
- Educate more about green finance to give companies more knowledge about finance.
- Make green finance and green investment work quickly and effectively.

(Peterson, 2022)

Since the invasion of Russia in Ukraine, the United States persuaded Southeast Asian states and the secretariat of the ASEAN, to criticize the aggression of Russia and to obey Western sanctions against Moscow. In December 2022 a joint statement followed by an EU-ASEAN summit, arbitrators fell short to draft a common critique against Russia's actions. Western leaders did not have success either in securing Southeast states to support the disapproval of the war at a consensual level. They only secured Singapore. When the war passed its one-year anniversary, South East countries became less interested in the conflict and in criticizing Russia. There are polls that show that South-East Asian countries have the largest disinterest in the war. Singapore believes (with a result of 44% of the poll) that the war is not of their interest. Therefore, they should not interfere in the conflict. There are several reasons why these South-East Asian countries are the least interested. There is a shortage of awareness on the origins, strategic direction and global impact of the war in the company of South-East Asian states and within ASEAN. They are simply not educated enough on the origin and motivations of the Russia-Ukraine war. Moreover, most states are still interested in economic, political and social ties with Russia and that is why they still want to remain neutral when it comes to Russia. Last, these South-East Asian states are misanthropic when it comes to the motivation of the Western community against the war. They think that Europe uses this to further isolate China and to expand its influence in Asia.

This research focuses on the impact of a big event as a war on the financial market. The effect on the green stocks will be compared to the effect on the brown stocks in order to investigate

whether such an event has a bigger impact on green finance or regular finance. We think that the green stocks will be affected more heavily by the event than brown stocks, because regular stocks are more stable due to the fact that they are on a larger scale and due to the fact that they exist for a longer period of time.

Theoretical framework

Russian-Ukrainian war

The day that Russia invaded Ukraine was 24 February 2022, which would have an impact on various industries across the world. The financial markets as well. Research has shown that this war does have an impact on the stability of the Chinese economy and financial markets, so there is some evidence already on the effect of the war in Asia (Wang & Su, 2023). Boubaker et al. (2023) investigated that war does have an inverse effect on the global stock returns. So there is enough evidence that the war does have an impact on the stock returns. Russia and Ukraine both are very important when it comes to the global barley and maize trade. Together they are responsible for 27 percent of the global barley and 17 percent of the maize trade (Abay et al., 2023). They are big players when it comes to trading in these kinds of exports, which implies that the conflict also causes a lot of inconvenience when it comes to the economy. Furthermore, Russia is a leading participant in exporting nitrogen and potash fertilizers. Nevertheless, Russia is very predominant in the export of energy which is a very interesting aspect for green finance and green stocks, because most of the companies that issue green stocks invest their proceedings in energy projects. This will be further elaborated on in this research. (Abay et al., 2023).

Relationship between Russia, Ukraine and Singapore

After the Russian invasion of Ukraine, the Singaporean Ministry of Foreign Affairs published a statement judging “the unprovoked invasion of a sovereign country under pretext” and determining that “the sovereignty, independence and territorial integrity of Ukraine must be respected”. After that Singapore did sanction Russia and in particular businesses that are endorsed by the Kremlin, but with this action they did not state that Russia is their enemy. These sanctions did not come without risk to the Singaporean economy, because of their role as global shipping hub and base for transnational wholesalers and resellers. Their action stood against the rest of Southeast Asia countries that muted the response of Putin’s invasion of Ukraine (Tan, 2023). Furthermore, later Singapore decided to adopt the same attitude as the other countries which were ignoring the whole situation in Europe, also with a fear because of the trade that they have with Russia.

“Singapore is considered a middle power in Asia, which is wielding geopolitical influence by strengthening and affecting greater powers. A power that will support smaller powers by functioning as a balancing mechanism, whose greatest contributions are often at the regional level” (Holbraad, 1984). From which can be concluded that Singapore is a big player in Asia.

According to Tan (2023b) the war in Russia and Ukraine has an undeniable indirect and direct strategic, political, and economic effect for the biggest part of the world and especially the Indo-Pacific region, but why? According to Tan (2023b) Singapore imposed sanctions on the businesses backed by the Kremlin that can prove detrimental for the city state’s status as a base for multinational retailers and wholesalers and their role as shipping hub which make them quite important in Asia. Furthermore, Singapore is recognized as being on the US side with regard to Ukraine. Singapore is on the US side with the idea that they believe that Russia’s invasion on Ukraine’s jurisdiction and territorial integrity is a total violation of the internationally decided norms and the UN charter which will pose a threat to the small and weak states.

Green companies

A company that is considered “green” is a company that has adopted a beneficial strategy when it comes to environmentally friendly policies and practices. This could be incentives such as reducing waste, recycling of plastic or investing in green technologies. The benefits for starting companies to be green are that as a starter you can show that you care about the environment and that you are contributing to enhancing it. This will give the starter some positive exposure that will generate new customers and business partners who will share their values. Being a green company also generates economic advantages in the short run. It will reduce the operating costs by improving the energy efficiency and using sustainable materials which will contribute to the profitability of the company.

Green finance

"Green finance is the acquisition and utilization of funds for activities that protect the environment and deliver a fair return to investors or lenders" (Petersoni, 2022). In order to finance the projects and activities to stop the harm being done to the environment and to achieve the Paris Agreement objective and the COP26 mandate which are agreements between countries, financial resources are mobilized. This seems a viable solution to meet an applicable solution whereby the financial needs of individuals, corporations and governments involved in projects and certain activities to enhance the environment will be met. This incentive to enhance the environment comes with a lot of benefits: the low risk of green financing, the boosting the development of green investment and financing instruments. But green finance is just one part of sustainable finance for sustainable development. Other parts of sustainable finance are social finance, blue finance and digital finance and there are even more incentives to engage in sustainable finance (Peterson Kitakogelu, 2022). But these will not be elaborated further in this research.

In recent years several methods have been developed for financing green projects. Some examples are: green bonds, green banks, village funds, green stocks etcetera. Green banks and green bonds support clean energy development. The advantages are that they offer better credit conditions when it comes to clean energy projects and the ability to aggregate small projects in order to acquire a more commercially attractive scale. Another advantage of green banks is that they create innovative financial products and they have market expansion spreading information about the pros of clean energy (Sachs et al., 2019). People that invest in green bonds do believe that they can provide long-term rationally priced capital to refinance a project once it has the renovation period and is utilized successfully (Natural Resources Defense Council 2016). Green finance is a part of sustainable finance and social responsible investing. Although green finance has become more popular and more relevant it lacks decent research.

Unfortunately, fossil fuels still influence energy investment. The relationship between green finance and environmental degradation is still quite unknown, although it has a high relevance (Khan et al., 2022). Furthermore, banks consider most reinvesting projects to be hazardous. Because of that banks are hesitant in financing them. Another difficulty is that the resources of

the banks do come from deposits, but these are most of the time short or medium term, but green projects need long term financing because it finances longer term projects. Environmental problems aren't solved in one day which will result in a maturity mismatch. So, the banks cannot provide all of the incentives to finance these green projects. As a consequence of that fact, different manners to finance these long-term projects have been developed to fill the financing gap. Some examples are green stocks and green bonds. These could also be pension-funds or insurance companies (Sachs et al., 2019).

There are several influencing institutions that are determined to enhance the environment through the green finance market. Some examples are the government, financial institutions and firms. The government is an important facet when it comes to green finance. It motivates firms to engage in green finance by creating subsidies, incentives and publicity when it comes to green finance. Because of multiple different governments the ESG has become a key factor which is involved in risk management, valuation and regulatory compliance for companies. The overall financial performance element is in a position to increase the revelation of sustainability reports. The Covid-19 pandemic has shed light on the banking sector in recent years. Unlike normal finance, green finance puts more weight on the pros of the ecological environment. Furthermore, it puts more attention to the environmental protection industry (Aulia et al., 2023).

Green finance in Singapore

According to Ooi and Dung (2019) the building sector in Singapore is one of the largest consumers of energy. They are even the main contributor of carbon dioxide emissions in Singapore. In order to contribute to impact investing and in order to create a better public image of their financial market, Singapore decided to engage more in green finance. Although Singapore is quite new in the green financial market, there has been some evidence that the new environmental regulations are already achieving their desired outcomes in Singapore (Pham et al 2019). Therefore, polluters were undesirably affected by these environmental regulations and carbon tax. Whereby, they also found evidence that these regulations magnify the performance of environmental positive sectors. But, the relationship between green finance and environmental degradation is still not examined. Even though it has a high relevance (Khan et al., 2022)

According to Efficient Market Hypothesis (EMH), stock prices will convert according to new information releases which in these days also include news of environmental regulation. The EMH is the theory that suggests that securities markets are extremely efficient in reflecting information about single stocks and the stock market as a whole (Malkiel, 2003). According to the International Energy Agency, Singapore is examined as one of the biggest sinners in terms of carbon emissions per capita. In reaction to that, the Singaporean government shows its concern by protecting the natural ecosystem in response to global warming and climate change by financial regulation (Pham et al., 2019).

Green stocks versus Brown stocks

There has been some past research on green stocks and brown stocks since green finance is becoming a very important topic. Green stocks are stocks that are considered more environmentally sustainable or climate friendly, while less climate friendly stocks are so called "brown". There has been some past research on the profitability of incorporating environmentally sustainable practices into companies (Bauer et al., 2022). That showed that environmentally sustainable projects nowadays are more profitable because of the lower cost of capital. El Ghoul et al. (2011) obtained similar findings namely, companies that have a better corporate social responsibility are more likely to have lower cost of capital. Pastor et al. (2021) present with their model that green stocks outperform brown stocks when worries about climate change increase unexpectedly. They hypothesize that it can be caused by two mechanisms. The first mechanism is that investors could modify their expectations about upcoming green versus brown cash flows. These changing expectations could be caused by a change in the preferences of customers and regulators for sustainability solutions. The second mechanism is that legislators could impose new rules which could harm the cash flow of brown firms. This would force customers to buy sustainable products. Furthermore, it could be caused by their framework that agents nowadays do care about environmental, social and governance criteria (Ardia et al., 2023).

Bauer et al. (2022) found that over the past few decades green portfolios, using firm-level reported emissions data, have operated better than brown ones. Contrary, there is some empirical evidence that green stocks have lower returns. This could confirm the existence of a carbon

premium which is consistent with the basic asset pricing theory. There is some past research that confirms this. Bolton and Kacperczyk (2021, 2022) discover that higher-emitting firms do emerge to have higher returns. Furthermore, Bansal et al. (2021a) state that the growing climate change risk is priced in the stock market because small changes in global temperature do have a pessimistic effect on asset valuations which results in a positive risk premium. So there are some conflicting results between different studies which makes it an interesting subject to investigate. This research can contribute to the desire to create more clarity in this part of the literature.

Data

We investigate the reactions of the green stocks and the brown stocks on the war between Russia and Ukraine in 2022. Within this war, we investigate two events. These events are the invasion of Russia in Ukraine which took place the 24th of February 2022 and the day that Russia took over Donetsk and Luhansk which took place the 21st of February 2022. These events are close to each other. So this should give an acceptable overview of the reaction of the green and brown stock on the war. For each event multiple event windows will be used, which are the following: [0; 0], [0; 1], [0;2], [0;5], [0;10] using daily data. The benchmark date (t = 0) will be the date that the event occurred. For the green stocks, all the green companies are considered. This consists of 34 companies. For the brown stocks, only commercial companies were investigated, like restaurants and other leisure companies which consist of 96 companies. These brown stocks were chosen because these stocks are the most opposite of green stocks. The stock prices that will be used in the research to calculate the returns are obtained from Yahoo finance. From where qualitative data and quantitative were gathered. The qualitative data are the historical prices of the green stocks and the control group and the market index as well which in this case is the STI. All of this data is used to research whether the green stocks are affected by the event of Russia invading Ukraine. Moreover, quantitative data as industry will be gathered to research what kind companies are affected the most according to regression analysis. The material data is selected through dates. Furthermore, because of the novelty of the green stocks in Singapore the returns aren't that big or different from each other which insinuates that there aren't outliers. According to that information, outliers didn't need to be removed (Huntington-Klein, z.d.).

Methodology

In order to assess if the war in Russia Ukraine does have an impact on the green and brown stocks multiple event studies need to be performed for different event windows which are mentioned in the data part. After that a regression will be performed with Fama and French Four Factor strategy.

In this research we looked up all the green firms in Singapore from SGinvestors.io. These are listed in a table which can be found in the appendix. Using the data that we took from yahoo finance, namely the stock prices, the expected returns will be calculated. The method that is preferred in this approach is the Ordinary Least Squares (OLS) Market Model. The OLS capitulates the most superior patronizing outcomes for an event study analysis.
So, according to the OLS market model the expected returns will be calculated according the following formula:

$$E(R_{it}) = \alpha_i + \beta_i R_{mt} \quad (8)$$

Where R_{mt} stands for the market return on day t. In this research the market return is the return of the benchmark STI which is the S&P500 for Singapore. After the calculation of the expected returns we are able to calculate the actual returns for each stock by using the price change log.

$$R_{it} = ln\left[\frac{P_{it} - P_{it-1}}{P_{it-1}}\right] x\ 100 \quad (9)$$

In this mathematical problem the P_{it} stands for the current price level of the index i at time t and P_{it-1} stands for the index's lag price at time t.

In an effort to assess the risk-adjusted performance of the stocks, the abnormal returns will be calculated. These returns for each stock will be calculated by deducting the daily expected returns, which are calculated from equation(8), from the actual returns that are obtained from equation(9). Mathematically it looks like this:

$$AR_{it} = R_{it} - E(R_{it}) \quad (10)$$

In this equation AR_{it} represents the abnormal returns at time t for stock t, the R_{it} exhibits the stock's actual log-return at time t. $E(R_{it})$ exhibits the expected return at time t.

The cumulative abnormal returns can be used to assess the effects that an event study has on the stock prices. Moreover, the CAR is also useful for regulating the correctness of asset pricing models in forecasting the expected performance (Team, 2021).

The CAR will be calculated with the following equation:

$$CAR_i(p, q) = \sum_{t=p}^{q} AR_{it} \quad (11)$$

CAR_i represents the cumulative abnormal returns of stock i, over day p to day q. AR_{it} represents the abnormal returns which are calculated with equation(10). Eventually, the abnormal return and the cumulative abnormal return can be used to assess the effect and or impact of the Russian-Ukraine war for each stock.

After determining if the stock market in Singapore reacts to the war in Russia and Ukraine, we need to assess if the investment is still worthwhile after this event. In order to assess that the Capital Asset Pricing Model can be used. This model determines the expected rate of return for an asset or an investment, but this model was very limited in what it could capture. The Fama and French Three-Factor Model expands this model by adding size risk and value risk factors to the CAPM. In 2014 they made it more precise by including more factors and they came up with the Fama and French's Four Factor Model also called the Carhart Four-Factor Model. This model now also includes momentum. Due to this formula we could conclude that companies that would have higher future earnings, have higher returns in the stock market. The last added factor investment stands for internal investments and returns. That states that companies that manage their profit against projects are more conceivably to experience losses in the stock market (Hayes, 2024).

This formula will be used:

$$R_{it} - Rf_t = \beta_i(Rm_t - Rf_t) + s_i SMB_t + h_i HML_t + c_i UMD_t + e_{it} \quad (12)$$

Whereby $R_{i,t}$ stands for the return of the portfolio i at time t, the Rf_t is the risk-free rate at time t, $R_{m,t}$ stands for the return of the value-weighted market portfolio which is the STI in this case. SMB_t is the size factor, the HML_t is the value factor, and UMD_t is the momentum factor. The b_i, s_i, h_i c_i and w_i are the corresponding coefficients of the factors. At last, the e_{it} is the error term (Dimitrios, z.d.).

$$SMB = Average\ return\ of\ small\ portfolios - Average\ return\ of\ large\ portfolios \quad (13)$$

$$HML = 0.5(small\ value\ returns + big\ value\ returns) - 0.5(small\ growth\ returns + big\ growth\ returns \quad (14)$$

$$UMD = returns\ of\ the\ winner\ portfolio - returns\ of\ loser\ portfolio \quad (15)$$

Winners are stocks that had good performance in the past and the losers are stocks that performed poor in the past.

STATA

The event studies will be managed in excel because it is undemanding. After that abnormal returns can be gathered and must be structured in a file. This file will be uploaded into STATA. Once in STATA, an event study regression will be regressed because it will measure a long term effect of an event. The idea is to estimate a regression of an outcome on the time period prior to the event and the second regression is a time series of the outcome on the time period post the event. Following, the difference of these two regression must be considered. The Fama and French model will also be regressed in STATA.

Results

At first, the data will be structured on dates and on stocks. The data for the event study are historical prices which first need to be converted into stock prices before you can use it to do computations. Other qualitative information will be structured per stock. Before regressing the volatility per date in the market and per company. Furthermore, the covariance between the stocks and the marketindex (STI) will be measured as well.

Plotting the returns over time will give a decent overview of the distribution of the stocks.

Image 1: the distribution of the green stocks.

Looking at image 1, we can see that the green stocks are mostly distributed around 0.00 in our period and that there are just a few outliers which could be neglected.

As specified by the graph the distribution of the stocks are almost the same for all the green stocks over time.

Image 2: Distribution of the brown stocks

Looking at image 2, we see that brown stocks are distributed around zero as well. Hereby, there is one stock that has a lot of outliers. This stock is 1D3.si. This stock is the only one with large outliers, which could be caused by company specific reasons (internal factors). This could be reasons like companies profits and losses, innovation and product development, management decisions or changes in financial structures.

After the calculation of the returns, events studies will be conducted to assess the impact of the war on the green stocks.

	Brown stocks: The official invasion of Russia in Ukraine			
	AR	AAR	AR t-test	CAR
[-1, 0]	-0.9404246967	-0.9436887884	-0.7427303832	-0.9404246967
[-3, 0]	-0.7620144106	-1.0785360363	-0.6466826954	-0.7482367314
[-5, 0]	0.6135007997	0.2971005027	0.2382984403	0.1675165179
[-10, 0]	0.5213362647	0.5213362647	0.1360789826	2.0212531657
[0, 1]	-0.2132880593	-0.5297612841	-0.348221622	-0.2132880593
[0, 3]	0.5301047208	0.2136970678	0.1642326265	1.4653929781
[0, 5]	-0.9675437061	--0.970807162	-0.5587879257	2.0178189973
[0, 10]	0.1828812612	0.1796198113	0.387190234	3.7011573054

Table 1: the Abnormal returns, the Average Abnormal Returns, the Abnormal Return T-test and the Cumulative Abnormal Returns of the brown stocks at the invasion of Russia in Ukraine for different time windows.

Table 1 presents the results of the event studies for the date that Russia invaded Ukraine on a big scale. With using different event windows, because this event was not announced in the financial market in advance, we could have a more precise image of what the event caused. The results indicate that the CAR's become more negative close to the date. So, in the period towards the event, the brown stocks did underperform. Nonetheless, the cumulative abnormal returns become positive the first day after the event has passed which indicates that the event does have an impact on the financial but for a small amount of time.

	Brown stocks: The first cities are taken over by Rusland			
	AR	AAR	AR t-test	CAR
[-1, 0]	0.3022524497	0.2989909841	0.2175972962	0.3022524497
[-3, 0]	0.1549534728	-0.1614872708	-0.1827436554	1.0707067222
[-5, 0]	1.1354902611	0.8191360067	0.4287207209	3.0982964769
[-10, 0]	1.0477343229	1.0477343229	0.3200252372	4.8688889011
[0, 1]	0.9542023759	0.6378321308	0.2906329949	-0.2132880593
[0, 3]	0.5521493494	0.2357436408	0.2748892836	0.5659270285
[0, 5]	1.1485763165	1.1453148566	0.8686353956	1.5012152857
[0, 10]	-0.0511525935	-0.3676115169	-0.3528250771	2.3183387814

Table 2: the Abnormal returns, the Average Abnormal Returns, the Abnormal Return T-test and the Cumulative Abnormal Returns of the brown stocks when the first cities were taken over by Russia.

Table 2 presents the results of the event studies for the date that Russia took over two cities, but this action is on a smaller scale. With this date different event windows will also be used in order to have a more precise view on the event. Looking at the result of the CAR and the AR, the conclusion can be drawn that the brown stocks overperformed in the period towards the event and that there is a slight reaction of this event one day after the event happened.

	Green stocks: The official invasion of Russia in Ukraine			
	AR	AAR	AR t-test	CAR
[-1, 0]	-3.7075194	-1.2081165	20.3976865	-3.4205371
[-3, 0]	-2.4229517	-0.4526144	14.34295014	-7.4554297
[-5, 0]	-2.3790503	-0.4267944	-5.20710335	-11.4195850
[-10, 0]	-3.3730944	-3.3730944	-6.167495997	-13.4979358
[0, 1]	-2.7307203	-0.6336246	-1.201492792	-2.8930871
[0, 3]	4.3922985	3.5556878	54.8858929	-1.2874987
[0, 5]	-2.2701888	-0.3627689	-4.299739511	6.4949523
[0, 10]	2.3385603	2.3478080	-6.407061435	-3.7278302

Table 3: the Abnormal returns, the Average Abnormal Returns, the Abnormal Return T-test and the Cumulative Abnormal Returns of the green stocks at the invasion of Russia in Ukraine for different time windows.

Table 3 shows the results of the same event study as in table 1, but for green stocks. Looking at the cumulative abnormal returns we can conclude that the green stocks on average did underperform the period towards the event but also the period after the event. This event did have an impact on the green stocks which caused underperformance for a longer period.

	Green stocks: The first cities are taken over by Rusland			
	AR	AAR	AR t-test	CAR
[-1, 0]	-1.5929580	0.0355357	-0.2146016006	-1.6041436
[-3, 0]	0.0692946	1.0131684	3.346376385	-3.9497624
[-5, 0]	-3.9395053	-1.3445561	-10.02683122	-4.1430712
[-10, 0]	9.4325168	9.4325168	-5.885694477	-2.0536216
[0, 1]	-1.7296867	-0.0448795	-4.662680195	-1.7181761
[0, 3]	2.5413651	2.4670850	-20.1018124	-2.4746016
[0, 5]	-2.5263068	-0.5134014	-3.267435074	-7.9511823
[0, 10]	-7.6157464	-3.5066903	3.100222097	3.3347628

Table 4: the Abnormal returns, the Average Abnormal Returns, the Abnormal Return T-test and the Cumulative Abnormal Returns of the green stocks when the first cities were taken over by Russia.

When looking at table 4, the same conclusion can be drawn which is that for the smaller impact event the green stocks underperformed as well, the period before and the period after the event took place. The difference between the other dates is that the cumulative abnormal returns for the official invasion of Russia in Ukraine are larger which indicates that the event did have a bigger impact on the green stocks.

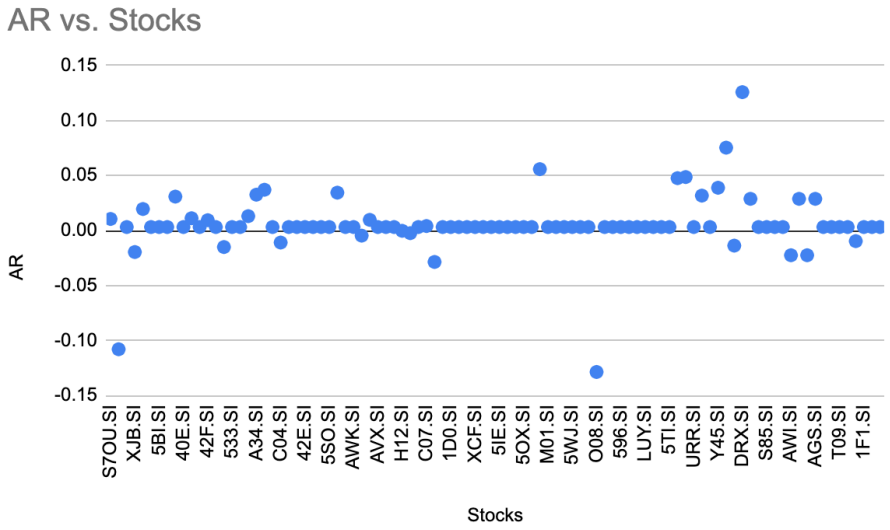

Image 3: The abnormal returns per stock of the brown stocks on the day of invasion.

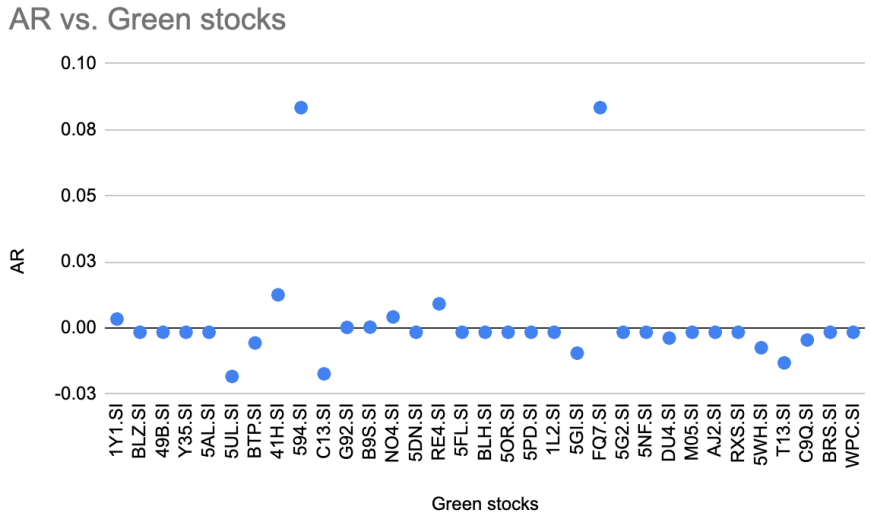

Image 4: The abnormal returns per stock of the green stocks on the day of the invasion.

According to the graph, most of the abnormal returns are within a reasonable scope, but two of them have extreme outliers which are 5GI.SI and 41H.SI for the green stocks. For the brown stocks, the abnormal returns are stable on the event except for two outliers which are from O08.SI and DRX.SI.
This relationship needs to be investigated further in order to be sure that there is not a big difference in the impact on the stocks. This will be investigated further by doing a difference in difference panel analysis within STATA. This method is a convenient tool in analyzing treatment effects of the pre- and post- treatment periods in a study (*Difference in Differences Event Study*, z.d.).

Furthermore, after the event study a panel regression, a difference in difference will be conducted in order to see if there is a significant effect of the war on the stocks. A difference in difference method measures two types of units and compares them before and after the treatment. These two groups are in this case the firms who issue green stocks and the firms who issue normal stocks or so called brown stocks. In case of an effect this effect will be captured by the mean change in the midst of untreated units (brown stocks). The difference in the treated components will capture the maturity effect and the treatment effect. Thereafter, the difference over time for the untreated units will be subtracted by the difference over time for the treated units. This will capture an estimation of the treatment effect under the assumption that the treatment is not allocated based on patterns or expected difference over time. An advantage of the panel method is that it will eliminate a negative selection bias. A negative selection bias is if units that are low-performing are assigned treatment, there would be a cross-sectional
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units that are low-performing are assigned treatment, there would be a cross-sectional comparison in the posttreatment period. But, if there are units that are expected to growth less in the future are differentially selected into treatment, this method does not eliminate this bias (*Difference-in-Difference and Panel Methods*, n.d.).

In order to carry out the diff in diff analysis, few dummy variables needed to be made. At first a dummy variable needs to be created that indicates the time when the treatment started. The dummy variable time is equal to zero and will be replaced if the date is equal to 24-02-2022 or further in time. Secondly, a dummy variable will be generated to identify the group that is exposed to the treatment. The dummy variable will be named and treated and will be equal to zero. Furthermore, it will be replaced by 1 if the stocks are 1Y1.SI until WPC.SI which are the green stocks. At last an interaction term will be created with the name did, which stands for difference-in-difference. It is the average effect on what was treated. Intending to analyze the difference in difference effect the following regression needs to be performed:

$$Volatility\ green\ stocks = \alpha + \beta_0 + \beta_1 time + \beta_2 treated + \beta_3 did + \varepsilon \quad (16)$$

Which gives the following results:

	Coefficient	Standard error	t	p-value	95% confidence interval	
Time	0.0335929	0.0087622	3.83	0.000	0.0163874	0.0507984
Treated	0.0690112	0.0009205	74.97	0.000	0.0672037	0.0708187
DID	-0.0599346	0.008846	-6.78	0.000	-0.0773046	-0.0425647
constant	0.1521287	0.0002995	508	0.000	0.1515407	0.1527168

Table 5: the results of the difference-in-difference regression

The coefficient for did is the average treatment effect on the treated. The effect is significant at 10%, with the treatment having a negative effect. For the difference in difference variable in this regression we can conclude that the effect is significant also on a 5%level and on a 1% level. Which implies that there is a negative effect of the treatment. So, there is a negative effect (when

you look at the coefficient as well) on the variability of the green stocks of the invasion of Russia in Ukraine.
This regression is followed by tests in order to test the significance of the difference in difference test and outcome.
Durbin-Watson test to test if there is serial correlation. Dl = 1.858 DU = 1.884 which indicates that there is positive serial correlation. A positive serial correlation indicates that values are probably to change in future time periods in the same way or direction that they have in recent past time periods. Which is a constructive fact because it assumes that the green stocks will behave the same as it did behave before the event. Whichever, is a good fact because it concludes that the green stocks are affected by the event. (Team, z.d.)
In order to prevent heteroskedasticity the robust standard errors will be implemented from which can be seen that the standard errors increase.

This outcome is other evidence that there is indeed an impact of the event on the stocks. The difference between the brown stocks or green stocks on the abnormal returns. In order to come to that regression, another step needs to be taken first. Namely, an equation with an interaction term which will capture the variables that will have a reaction on the interaction.
This interaction coefficient will consist of a dummy that represents green stocks. This dummy will be equal to one when it comes to green stocks. The other variable will be a post dummy which will be equal to one when the variable is 22-02-2022 or further in the future. This variable is equal to zero for dates that are earlier on in time than the event study.
The formula of the interaction term:

$$Interaction = green\ stocks * post \quad (17)$$

The interaction term will be the dependent variable which will be regressed against stocks of the green firms, a post war dummy, the volatility of the brown firms and the STI-marketindex which is the market return. That equation will give the following results:

	Coefficient	Standard error	t	p-value	95% confidence interval	
Green firm	0.6800423	0.184401	36.88	0.000	0.6438329	0.7162517
Post war	0.9731066	0.0055863	174.19	0.000	0.9621371	0.984076

Volatility brown stocks	-0.428851	0.1054269	-4.07	0.000	-0.6358701	-0.221832
Market index	0.000037	0.0000227	1.63	0.103	-7.52E-06	0.0000814
Constant	-0.690915	0.0671733	-10.29	0.000	-0.8228183	-0.5590117

Table 6: results of the regression of the interaction term.

Looking at the results, we can conclude that the results are significant. The stocks and the volatility of the green firms are significant at a 1% level and the STI is significant at a ten percent level. If the stock of the green stocks will increase with one unit the interaction term will increase with 0.68, when the post war dummy increases with one unit the interaction will increase with 0.97, if the volatility of the brown stocks increases with one unit the interaction term decreases with 0.429 and if the market index STI increases with one unit the interaction term will increase with 0.000037. Thus, the green firm stocks and the post war dummy have the biggest impact on the interaction term although this seems logical a check is never too much.

A difference in difference method measures two types of units and compares them before and after the treatment. These two groups are in this case the firms who issue green stocks and the firms who issue normal stocks or so called brown stocks. In case of an effect this effect will be captured by the mean change in the midst of untreated units (brown stocks). The difference in the treated components will capture the maturity effect and the treatment effect. Thereafter, the difference over time for the untreated units will be subtracted by the difference over time for the treated units. This will capture an estimation of the treatment effect under the assumption that the treatment is not allocated based on patterns or expected difference over time. An advantage of the panel method is that it will eliminate a negative selection bias. A negative selection bias is if units that are low-performing are assigned treatment, there would be a cross-sectional comparison in the posttreatment period. But, if there are units that are expected to growth less in the future are differentially selected into treatment, this method does not eliminate this bias (*Difference-in-Difference and Panel Methods*, n.d.).

In order to have a more in depth look on what kind of green companies will be affected the most, the Carhart Four Factor model will be conducted, because now we know that green companies are indeed more affected by the war and the brown stocks just a little bit. Because of that fact the

Carhart Four Factor model will only be conducted on the green stocks. At first, for the Small-minus-Big factor an overview will be presented to see which companies are big and which companies are small.

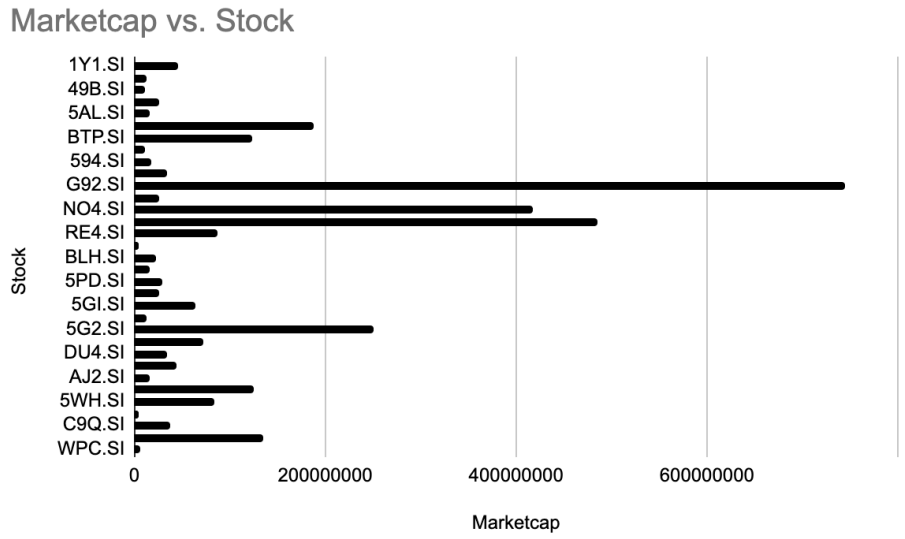

Image 5: an overview of the market capitalisation of the green stocks.

According to image 5 we see that the following companies are considered big: BTP.SI, G92.SI, RE4.SI and 5G2.SI. And the following companies are considered small: 49B.SI, 594.SI, BLH.SI, 5PD.SI, 5GI.SI, AJ2.SI and WPC.SI.

	Market Return	SMB	HML	UMD
Market Return	1.00000000			
SMB	0.02060000	1.00000000		
HML	-0.09560000	-0.13710000	1.00000000	
UMD	-0.00900000	-0.09130000	0.02630000	1.00000000

Table 7: Correlations between the four different factors.

The table above presents the correlation matrix. Looking at the results most of the absolute values fall between 0.02 to 0.096. Nevertheless, there are some extreme exceptions. Namely: UMD-SMB and HML-SMB.
These cases will be explained further. In the first case SMB-HML has a larger negative correlation of -0.1371 which falls outside the range. This indicates that companies that are high market capitalization tend to have a weak

profitability and inversely. For the other case, it has a smaller negative correlation. This indicates that companies with high market capitalization companies are disposed to have weak performing firms. Compatible with Fama and French (2015) and Nguyen et al. (2015).

	Mean	Std. Dev.	Min	Max	Obs
Rmt - Rft	0.1195130	0.0134313	0.0917815	0.1481525	655
Market Return	-0.0015461	0.0405947	-1.0000000	0.0476439	655
SMB	0.0008315	0.0017509	-0.0088619	0.0076327	655
HML	-0.0112890	0.0214664	-0.0712422	0.0440052	655
UMD	-0.0002124	0.0021991	-0.0098311	0.0031008	655

Table 8: Summary statistics for factor returns in the period of the event.

The table above presents the summary statistics for every factor within the model. The range (max, min) does not differ significantly. The average return for SMB is 0.08315% which is extremely small compared but positive to the other factors. The HML and Momentum factor generate negative average returns.

	Coef.	Std. Err.	t - value	p - value	95% Confidence interval	
Rmt - Rft	-0.0237468	0.0055594	-4.27	0.000	-0.0346635	-0.0128302
SMB	-1.808421	0.234192	-7.72	0.000	-2.268286	-1.348555
HML	-0.3831293	0.0162325	-23.6	0.000	-0.4150039	-0.3512548
UMD	-1.995339	0.1228917	-16.24	0.000	-2.236652	-1.754026

Table 9: Regressions Statistics for the Fama-French Four factor model

Table 9 demonstrates the regression statistics for the Fama and French Four factor model descriptive variables. Here four factors explain the excess return on the green stocks. The table shows the Small-minus-Big, the High-minus-Low and the momentum factor are significant, looking at the p-values of 0.000. These significant factors all have negative coefficients. The R-squared is 0.5012 which is considered big. From this we can conclude that a large percentage of the returns are explained by the Carhart-four-factors. Furthermore, it stands out that the coefficients of all the factors are negative. A negative Small-minus-Big points out a favor for bigger companies, which most of the time have lower risks and potential returns. A negative

High-minus-Low suggests that the portfolio is more focused on growth stocks instead of value stocks. A negative momentum factor presents that the portfolio tends to contain stocks which have a negative performance and will perform badly as well. These negative results could be a confirmation of the fact that the green stocks are affected by the war.
In times of war the SMB factor can be negative because large-cap stocks become more attractive than small-cap stocks because they are more stable and they represent more robust company models. A negative HML factor during war can be caused due to the fact that investors will be more focused on the growth stocks with a potentially higher yield. They would like to profit from the event and the consequences. Moreover, a negative momentum factor during war could be rooted by the fact that stocks with high momentum, which are stocks that performed well recently, suddenly decrease because of marketshock and high volatility. Investors prefer stocks that underperformed in the past, but will be more stable.

Furthermore, we will zoom in further on what kind of companies will be affected the most. Now it is clear to see that there is a reaction of the war on all the stocks, some more than others looking at the AR. But, currently we want to capture the interaction between the green stocks and the post war time which are the dates after the event. There is a variable created which should capture this interaction. Before that two dummy variables are created. The first one is the dummy variable green stocks which will generate 1 if the outcomes are green stocks. The stocks 1Y1.SI until WPC.SI. The dummy variable will have an outcome of 0 when there are brown stocks which are S7OU.SI until 5R.SI. The other variable is a variable about the date. The dummy variable post will generate 1 if the date is equal to 22 - 02 - 2022 or later in time and it will produce 0 if the date is before the event date. After this process a regression will take place with the following formula with the interaction term which was used earlier:

$$Volatility\ of\ green\ stocks = \alpha + \beta_0 + \beta_1 interaction + \beta_2 GDP + \beta_3 inflation\ rate + \beta_4 STI + \varepsilon \quad (18)$$

Which gives the following results:

	Coefficient	Standard error	t	p - value	95% confidence

					interval	
Interact	-0.0002318	0.0013846	-0.17	0.867	-0.0029506	0.0024871
GDP	-0.0004426	0.0000279	-15.85	0.000	-0.0004975	-0.0003878
Inflation Rate	-0.1633826	0.045107	-3.62	0.000	-0.2519566	-0.0748085
Stimarketindex	0.0001148	7.69E-06	14.93	0.000	0.0000997	0.0001299
Constant	0.0573516	0.0258659	2.22	0.027	0.0065601	0.108143

Table 10: results of the regression of the qualitative variables against the volatility of the stocks

This table states that the GDP, inflation rate and the marketindex indeed also have an effect on the volatility(riskiness) of the green stocks. Whereby, the GDP and inflation rate do have a negative effect on the dependent variable. Now we would like to know if the interaction variable can capture the green status of the firm by regressing the following regression:

$$Interaction = \alpha + \beta_0 + \beta_1 volatility\ green\ stock + \beta_2 GDP + \beta_3 inflation\ rate + \beta_4 STI + date + \delta green\ stock = 1 + \varepsilon \quad (19)$$

	Coefficient	Standard error	t	p - value	95% confidence interval	
Volatility green stocks	-0.2757784	0.2963455	-0.93	0.353	-0.8599556	0.3083988
GDP	0.0025856	0.001048	2.47	0.014	0.0005197	0.0046515
Inflationrate	3.64E+00	9.39E-01	3.88	0.000	1.79E+00	5.49E+00
STI	3.16E-04	1.25E-04	2.53	0.012	7.01E-05	5.63E-04
Date	0.0001152	0.0000525	2.29	0.029	0.0000117	0.0002187
Constant	-4.112629	1.497208	-2.75	0.007	-7.064031	-1.161227

Table 11: results of regression 9

The results state that interaction does capture the green status of the firms because overall the results because looking at the p value of the constant, the conclusion can be drawn that it is significant because the p value is significant at a 1% level. Which means that the variable can be used in the research.

In order to investigate which companies are affected the most by the event, another regression will be conducted. The qualitative data that is gathered are industry, founding year in order to see if older companies or younger companies are affected. Moreover, some more quantitative data is gathered as well like market cap, the firm size to investigate if bigger firms or smaller firms are more affected. These variables will be regressed against the abnormal returns in an effort to see which of these variables will affect the abnormal returns the most that are gathered from the event study.

The market capitalization is the total market value of the stocks that the company has outstanding. The market capitalization can be interesting to involve in the regression because it gives an estimation of the riskiness of the stocks and in the end of the company. Additionally a high market cap is a sign of a larger presence in the market of the company. In other words the market capitalization gives an approximation of how much the company is worth.

The volume is the number of units of the company which it sells during a specific period of time. Volume is explained by the price movements in the market that are consumed by the actions of buyers and sellers. The volume will be high if the buyers and sellers are actively participating in the market. The volume can be very useful because it gives an overview of the health of a growing or diminishing company. This variable will measure if companies that participate a lot in the market affect the abnormal returns the most or companies that don't participate a lot in the market.

The following regression:

$$Abnormal\ Return = \alpha + \beta_0 + \beta_1 industry + \beta_2 founding\ year + \beta_3 Volume + \delta green = 1 + \varepsilon \quad (20)$$

Will give the following results:

	Coefficient	Standard error	t	p - value	95% confidence interval	
Industry	-0.0785001	0.0957021	-0.82	0.42	-0.2760194	0.1190193

year	-0.0211252	0.0285795	-0.74	0.467	-0.0801103	0.0378599
Volume	2.14E-08	8.01E-08	0.27	0.792	-1.44E-07	1.87E-07

Table 12: the results of regression 10

According to this table we can conclude that the results are insignificant. The p values are too big. Which means that all these variables do not have an impact on the abnormal returns of the event when it comes to green stocks.
Exactly the same regression will be conducted but with a dummy variable for brown stocks which is equal to 1.

$$Abnormal\ Return = \alpha + \beta_0 + \beta_1 industry + \beta_2 founding\ year + \beta_3 Volume + \delta brown = 1 + \varepsilon \quad (21)$$

	Coefficient	Standard error	t	p - value	95% confidence interval	
Industry	0.0469234	0.0552797	0.85	0.399	-0.063691	0.1575378
year	0.0144747	0.0287442	0.5	0.616	-0.0430422	0.0719916
Volume	-6.47E-08	1.94E-08	-3.33	0.001	-1.04E-07	-2.59E-08
Constant	-0.5562172	1.36717	-0.41	0.686	-3.291917	2.179483

Table 13: the results of regression 10

According to the results, the volume of the company does have a negative impact on the abnormal returns. Which insinuates that this variable positively affects the abnormal returns. If volume goes up and if the founding year is newer, the abnormal returns will decrease. The industry and the market capitalization do have a negative impact on the abnormal returns because if the variable increases, then the abnormal returns increases as well. Nevertheless, looking at the p-values the conclusion can be drawn that industry and year are not significant at all even after the robust standard errors. Which means that the relation is due to chance and that there is a weak relationship between the industry and the abnormal returns and between the abnormal

returns and the founding year. In other words, the event does have an impact on the brown stocks but it has nothing to do with qualitative variables like industry or founding. After this part of the research we can say that the abnormal returns of brown stocks can be affected by volume and that it is not significant for green stocks.

Conclusion and discussion

After conducting this research the conclusion can be drawn that the invasion of Russia in Ukraine does have an impact on the stocks in Singapore, looking at the abnormal returns for the green stocks we can conclude that this impact is more intense on them than the impact on the brown stocks. The abnormal returns of the green stock are more negative and for a longer period of time for both events. Furthermore, there is a confirmation that there is an effect of the war on the green stocks through the panel data analysis. So the first subquestion is indeed true. We do not have to reject the hypothesis that the green stocks are more affected by the war. Moreover, with the Carhart-Four Factor model there is some evidence as well that the four factors all became negative at the period of the war.

When it comes to qualitative variables, this research showed that there is more evidence in favor of brown stocks that are affected by the war because the regression of industry, founding year, volume has an effect on the abnormal returns of the brown stocks. They do have significant effects and when the same equation was runned for green stocks, large p values were obtained for all the variables which mean that the regression was insignificant. In conclusion, the war in Europe does have a more significant impact on the green stocks in Singapore than on the brown stocks. So we do not need to reject our hypothesis that green stocks will be more affected by the war. Within these green stocks a distinction can not be made between qualitative variables. It implies that all the green stocks are approximately equally affected by the war. Which means that Singapore must work hard to get their green finance on a stable level. This will contribute to the existing literature because it broadens the research field of green finance and the volatility when it comes to market shocks like war.

Limitations

Unfortunately, there are some limitations in this research when it comes to conducting it. When it came to coming up with a controlgroup, the control group did not exist of all the stocks in Singapore. It would make the research unbalanced. The control group consists of commercial companies, which it's just a part of all the stocks within Singapore. Furthermore, the research about the industry for the green stocks and brown stocks was insignificant, but this could be because of the timespan that was chosen. This was from 21 September 2021 until 3rd of May 2024. Maybe this time span could be too small, it is possible that the results of the industry and other qualitative variables will show its effect when the time span would be larger, like five years. Furthermore, all the secondary information was gathered from Yahoo finance, which can not guarantee the accurateness of the data. Moreover, limited literature is available for this topic which makes us rely for the theory sometimes on the same papers. Furthermore, more in-depth research should take place when it comes to comparing the green stocks on an industrial level.

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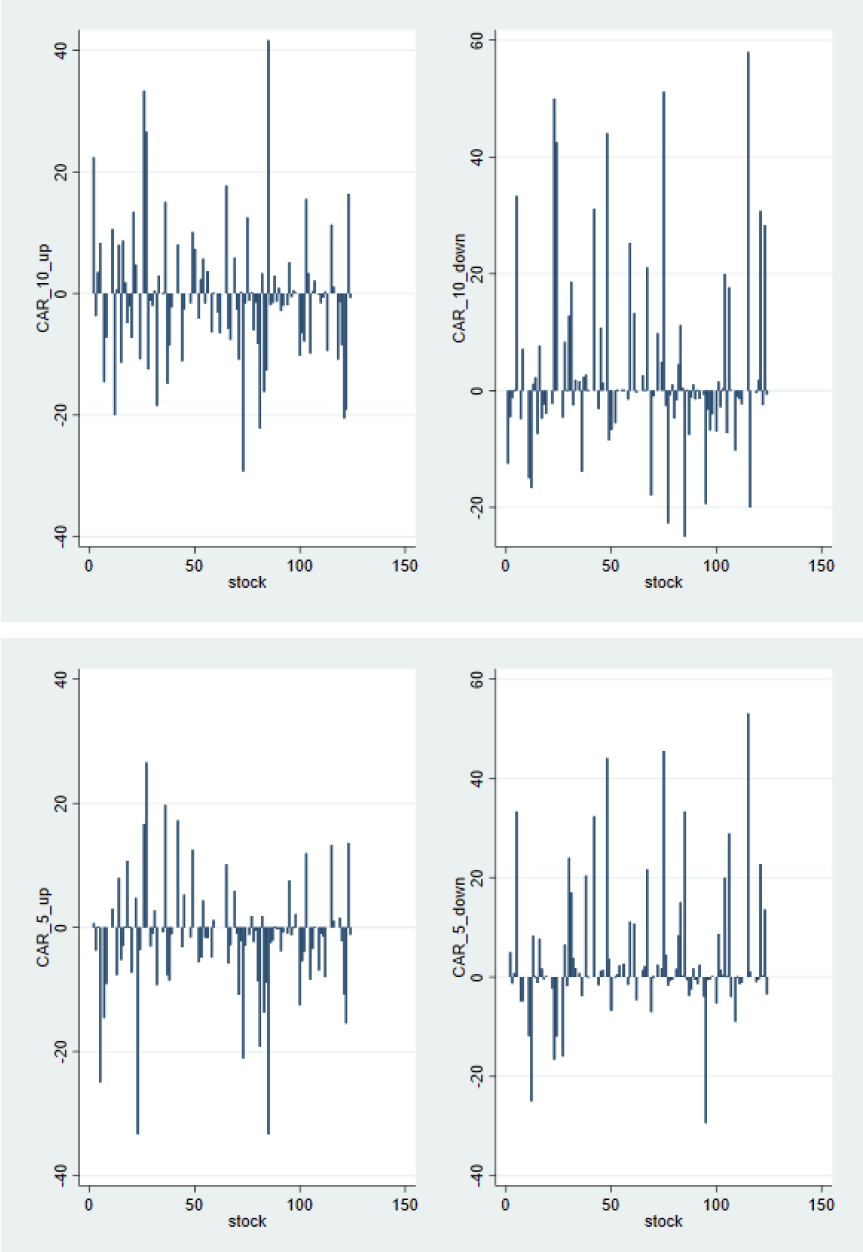
Appendix

Summary statistics

Stock	Mean	Std.dev	Min	Max
1Y1.SI	0.0586736	0.0142023	0.035	0.11021
BLZ.SI	0.0981024	0.0412178	0.054	0.245
49B.SI	0.1245321	0.0444025	0.038	0.205
Y35.SI	0.0200291	0.0052005	0.002	0.03
5AL.SI	0.001	0	0.001	0.001
5UL.SI	0.1566758	0.101704	0.042	0.375
BTP.SI	0.4970151	0.0830585	0.335716	0.672545
41H.SI	0.0082003	0.0042941	0.002	0.021
594.SI	0.0019725	0.0006181	0.001	0.004
C13.SI	0.0598823	0.0124229	0.036	0.095
G92.SI	0.8775687	0.0695045	0.633903	1.061419
B9S.SI	0.1137583	0.0180861	0.077534	0.153863
NO4.SI	0.2221443	0.1015504	0.085174	0.43087
5DN.SI	0.011	0	0.011	0.011
RE4.SI	0.2823999	0.0545201	0.145775	0.44
5FL.SI	0.026	3.47E-18	0.026	0.026
BLH.SI	0.3841903	0.0388422	0.265641	0.469303
5OR.SI	0.033682	0.0165094	0.02	0.08
5PD.SI	0.2149771	0.0455555	0.148	0.315
1L2.SI	0.0188563	0.0040834	0.002	0.02
5GI.SI	0.0370948	0.0046214	0.026	0.056
FQ7.SI	0.0019786	0.0008445	0.001	0.004
5G2.SI	0.0868524	0.0087225	0.071084	0.110034
5NF.SI	0.040604	0.0093864	0.028	0.085
DU4.SI	0.0818456	0.0130074	0.066	0.147
M05.SI	0.2620015	0.0569142	0.194572	0.397791
AJ2.SI	0.0698731	0.0109217	0.043	0.094

RXS.SI	0.371472	0.423484	0.017321	0.900714
5WH.SI	0.2211807	0.690601	0.116532	0.455994
T13.SI	0.2001468	0.0381558	0.13	0.41
C9Q.SI	0.1832816	0.0557223	0.071617	0.329559
BRS.SI	0.0765046	0.0254821	0.038	0.15
WPC.SI	0.0420015	0.0128301	0.022	0.075

Statistics on the cumulative abnormal returns.



Stock	CAR_5_up	CAR_10_up	CAR_5_down	CAR_10_down
1Y1.SI	3.01006952	10.60097013	-11.87824548	-14.98179094
BLZ.SI	5.90430202	5.90430202	-7.04225352	-17.93691442
49B.SI	10.71428570	-4.87435936	-0.44898101	-2.39703295
Y35.SI	-10.81871345	-20.58061821	22.76546982	30.74698107
5AL.SI	0.00000000	0.00000000	0.00000000	0.00000000
5UL.SI	-1.61290323	-1.61290323	44.09090909	44.09090909
BTP.SI	1.16109479	0.29691038	2.48459660	9.83627058
41H.SI	-5.43590686	0.64102564	8.33333333	1.19047619
594.SI	0.00000000	0.00000000	-16.66666667	50.00000000
C13.SI	-3.45606181	12.50000000	45.54988662	51.18368944
G92.SI	0.00000000	-1.55640627	-3.75809898	-7.57420459
B9S.SI	-0.07081655	0.06301256	11.14873053	25.30251028
NO4.SI	0.00000000	-6.48841202	8.67473702	1.57288053
RE4.SI	0.00000000	0.34161653	28.89105947	17.70945652
BLH.SI	2.72398239	0.00000000	0.00000000	0.00000000
5OR.SI	-1.03293544	0.00000000	0.00000000	0.00000000
5PD.SI	-8.57142857	0.00000000	0.00000000	0.00000000
1L2.SI	1.82405952	0.00000000	0.00000000	0.00000000
5GI.SI	2.12736386	0.51184399	17.06487473	18.64145224
FQ7.SI	4.35810811	41.66666667	33.33333333	-25.00000000
5G2.SI	0.00000000	-2.03885388	24.03443305	12.86502152
5NF.SI	12.48263338	-8.57142857	20.46568627	2.74761423
DU4.SI	13.26759215	3.32746750	8.42941125	4.50763277
M05.SI	1.78570024	0.12935167	0.18114804	-4.02971397
AJ2.SI	-10.86956522	5.72797112	2.33766234	0.00000000
RXS.SI	0.00000000	0.00000000	0.00000000	0.00000000
5WH.SI	-4.99752250	10.09664035	3.65993411	-8.50828097
T13.SI	19.82857217	11.32266658	53.11168506	57.98734196
C9Q.SI	0.00000000	0.21605404	-1.69387727	-22.70544410

BRS.SI	0.00000000	-10.86956522	0.00000000	0.00000000
WPC.SI	0.00000000	-10.86956522	0.00000000	0.00000000
S7OU.SI	-0.50229440	-1.52004594	-0.49917792	1.06057494
YYB.SI	16.66666667	33.33333333	0.00000000	0.00000000
BAI.SI	0.00000000	0.00000000	0.00000000	0.00000000
XJB.SI	-1.16124514	-0.76297693	-3.46125972	-0.69429132
1B0.SI	0.00000000	-20.00000000	-25.00000000	-16.66666667
CJLU.SI	-2.32552379	-6.07886829	-0.78728460	-0.76772082
5BI.SI	-13.73046259	-16.19635114	15.07145680	11.21120835
1F0.SI	-5.23753861	-11.37874050	-1.18462481	-7.41463990
Z74.SI	0.08720168	3.52242007	0.81300813	0.01977704
40E.SI	-8.41130604	-9.87716325	0.10355124	-7.29246016
CC3.SI	-7.29164351	-7.29164351	0.00000000	0.00000000
E27.SI	0.00000000	-12.50000000	6.54761905	8.33333333
42F.SI	-0.98039216	-1.94174757	-3.95068919	-0.72614940
1D1.SI	-5.63585836	-4.14574331	0.02012155	-5.57739893
OMK.SI	-4.83861309	-6.39944352	-1.55910977	-1.53086236
533.SI	0.00000000	0.00000000	0.00000000	0.00000000
5EF.SI	-21.11018364	-29.27423117	0.00000000	0.00000000
L38.SI	0.00000000	0.00000000	0.00000000	0.00000000
A34.SI	1.11111111	1.11111111	1.11111111	-20.00000000
B58.SI	7.98549313	7.98549313	0.02403917	2.27495760
BAC.SI	0.00000000	0.00000000	0.00000000	0.00000000
C04.SI	-1.20446329	-1.18940807	4.49999084	-2.59517222
5OU.SI	5.26280681	-2.63269891	1.22989154	10.77355074
UIX.SI	-3.05274972	-1.20089787	-1.81818182	0.03367003
42E.SI	-8.89328063	-12.68115942	0.21645022	0.43290043
N0Z.SI	0.00000000	0.00000000	0.00000000	0.00000000
C41.SI	-0.76913760	0.02441555	0.79960935	1.58085935
5SO.SI	-2.55194774	-1.89429201	-0.62343989	0.07356547

5G1.SI	-1.63934426	-1.63934426	0.00000000	0.08021390
F10.SI	-3.87469151	-2.89435642	-1.47050849	0.06783723
AWK.SI	-0.26800403	0.92959637	-0.59258125	-1.48987264
5IG.SI	-0.34131457	-1.31896015	1.71823069	1.04255525
G13.SI	-0.82642998	-2.01169249	2.46103258	-1.39730337
AVX.SI	-1.11840945	-2.28121197	0.01434339	0.01434339
H18.SI	-2.97150214	-1.64978741	1.77403508	4.93717709
H15.SI	0.02560476	1.82205739	1.69149563	-4.81914399
H12.SI	0.00000000	0.00000000	0.00000000	-12.50000000
I15.SI	-3.73438330	-3.71895272	-1.28226883	-1.28226883
5OI.SI	-2.87265227	-7.63453720	21.69257287	21.08647118
C07.SI	0.00000000	2.94117647	1.80952381	1.80952381
42R.SI	1.57335143	-1.41569679	-1.00193088	-0.45629596
1A0.SI	-25.00000000	8.33333333	33.33333333	33.33333333
1D0.SI	0.00000000	0.00000000	0.00000000	0.00000000
BJZ.SI	0.00000000	0.00000000	0.00000000	0.00000000
5I1.SI	0.00000000	0.00000000	0.00000000	0.00000000
XCF.SI	0.00636133	0.52581997	-0.46083191	-6.84495624
1D3.SI	17.24891570	8.04939359	32.38919181	31.15687911
BFT.SI	0.00000000	-9.44042200	0.00000000	0.00000000
5IE.SI	-3.19394276	-11.13121140	-1.63744399	-3.14205197
1H8.SI	-1.25199825	-0.58113099	-0.61305465	-3.27919270
M04.SI	-8.69565217	-8.29636202	0.00000000	-4.76190476
5OX.SI	0.00000000	7.31999075	-6.73864270	-6.73864270
SJY.SI	0.00000000	7.31999075	-6.73864270	-6.73864270
5RF.SI	0.00000000	0.00000000	0.00000000	0.00000000
M01.SI	4.76168224	4.76168224	-2.27237809	-2.27237809
CNE.SI	11.94619687	15.54996498	0.36764706	0.36764706
5WJ.SI	0.04082603	2.12439437	-4.00000000	0.16666667
5WJ.SI	0.00000000	3.33333333	20.00000000	20.00000000

9I7.SI	-3.67948718	-10.82234432	-12.00000000	42.54545455
543.SI	0.00000000	-6.52187770	-4.65110615	-0.34371327
O08.SI	-3.95827505	-7.89041498	1.51448639	-2.81324470
RQ1.SI	7.59493671	5.12580091	-29.41176471	-19.41176471
O9E.SI	-9.09554879	-7.25086325	-4.87829299	7.13016443
596.SI	26.59627954	26.59627954	-15.96595422	-4.59790990
BCV.SI	0.00000000	0.00000000	0.00000000	0.00000000
NR7.SI	0.04830421	-2.07719398	0.23342791	-3.97337506
LUY.SI	-6.91114382	-0.22930934	-9.01559736	-10.25378762
1G1.SI	0.00000000	0.00000000	0.00000000	0.00000000
5DO.SI	-9.28160920	-18.49317268	3.80999548	-2.52344911
5TI.SI	-7.69230769	-14.83516484	0.00000000	2.38095238
528.SI	-15.48653676	-19.11854647	0.19881001	-2.46416927
S07.SI	19.75332940	15.04709401	-3.84642897	-13.89372369
URR.SI	-12.56585617	-10.27352970	-5.30950747	-7.02513820
5HH.SI	-19.26797989	-22.21305820	1.66513329	-1.69683314
5LE.SI	0.07912248	2.90638294	-2.50000000	-1.20199604
Y45.SI	-1.05459343	-1.59573182	0.02121551	-1.07763673
5KI.SI	-8.02194743	0.31343830	-1.13251388	-2.35150511
NC2.SI	-5.81984274	-5.81984274	2.18535512	0.05768998
DRX.SI	-2.98507463	8.68159204	7.69230769	7.69230769
H07.SI	-1.65965123	3.68249297	2.61643399	0.05287769
S29.SI	-4.84933030	2.31824645	0.54152381	0.08953251
S85.SI	-1.65965123	3.68249297	2.61643399	0.05287769
BHU.SI	-4.84933030	2.31824645	0.54152381	0.08953251
42L.SI	0.00000000	0.00000000	0.00000000	0.00000000
AWI.SI	0.00000000	0.00000000	0.00000000	0.00000000
AGS.SI	0.00000000	0.00000000	0.00000000	0.00000000
AWI.SI	0.00000000	13.43654539	0.00000000	0.00000000
AGS.SI	10.16420970	17.74006099	1.36776265	2.64988455

BCZ.SI	-14.58333333	-14.58333333	-4.87804878	-4.87804878
KUH.SI	-0.97054376	-2.69267180	0.01979636	-0.95040507
T09.SI	-0.97054376	-2.69267180	0.01979636	-0.95040507
540.SI	0.00000000	0.00000000	1.41842339	1.41842339
BFU.SI	17100.41015500	34239.23998900	16313.38964800	32312.95971500
1F1.SI	0.00000000	0.00000000	0.00000000	0.00000000
BPF.SI	0.00000000	0.00000000	0.00000000	0.00000000
BPF.SI	0.00000000	0.00000000	0.00000000	0.00000000
5SR.SI	0.00000000	0.00000000	0.00000000	0.00000000

CAPM and Betas for green stocks

Stock	*beta*	*CAPM*
1Y1.SI	*0.12*	*-0.0447149*
BLZ.SI	*0.28*	*0.27276885*
49B.SI	*0.38*	*-0.1760782*
Y35.SI	*2.46*	*3.10560984*
5AL.SI	*0*	*0.01663*
5UL.SI	*-0.99*	*0.14181431*
BTP.SI	*0.83*	*0.33732851*
41H.SI	*0.91*	*-1.047739*
594.SI	*-0.77*	*-0.9431828*
C13.SI	*-0.26*	*0.20213109*
G92.SI	*0.89*	*0.45898845*
B9S.SI	*0.03*	*0.03293138*
NO4.SI	*1.03*	*0.38677557*
RE4.SI	*1.16*	*0.02267708*
BLH.SI	*0.27*	*-0.0003472*
5OR.SI	*-0.74*	*-1.0261145*
5PD.SI	*-0.26*	*-0.0485695*
1L2.SI	*0.16*	*0.05972063*
5GI.SI	*1.12*	*-0.005166*
FQ7.SI	*2.9*	*2.27007197*
5G2.SI	*0.99*	*-0.0286124*

5NF.SI	*-0.22*	*0.08619118*
DU4.SI	*1.28*	*0.66333993*
M05.SI	*0.66*	*-0.0618829*
AJ2.SI	*0.52*	*0.05199368*
RXS.SI	*0.12*	*0.06556112*
5WH.SI	*1.31*	*-0.5892857*
T13.SI	*1.32*	*-0.2381122*
C9Q.SI	*0.57*	*0.37929099*
BRS.SI	*-0.72*	*-0.2693243*
WPC.SI	*0.63*	*-0.2409879*

CAPM and betas for brown stocks

Stock	beta	CAPM
S7OU.SI	0.49	-0.2338617
YYB.SI	-0.05	-0.0291091
BAI.SI	0.77	-0.3738577
XJB.SI	0.14	0.1924256
1B0.SI	0.76	-0.5502675
CJLU.SI	0.22	-0.0111887
5BI.SI	2.72	1.06759378
1F0.SI	0.58	-0.661759
Z74.SI	0.54	0.68974545
40E.SI	0.73	-0.5042
CC3.SI	0.45	0.24029438
E27.SI	0.34	0.20137902
42F.SI	-0.21	-0.0588366
1D1.SI	0.43	0.01887159
OMK.SI	1.47	-0.0758013
533.SI	0.08	0.12935914
5EF.SI	2.18	0.56330295
L38.SI	0.7	0.20515151
A34.SI	0.66	0.00378594
B58.SI	0.7	0.56056427
BAC.SI	N/A	N/A
C04.SI	0.41	-0.1130067

5OU.SI	N/A	N/A
UIX.SI	0.39	-0.029764
42E.SI	0.25	0.03363177
N0Z.SI	0.03	0.02886278
C41.SI	0.56	-0.2423874
5SO.SI	0.48	-0.0760035
5G1.SI	1.12	0.72922703
F10.SI	1.08	0.44556148
AWK.SI	-0.09	0.05343255
5IG.SI	0.15	0.11965877
G13.SI	0.83	0.55473236
AVX.SI	0.59	-0.3633888
H18.SI	0.39	-0.1353485
H15.SI	0.43	0.09930307
H12.SI	0.09	-0.0116052
I15.SI	-0.02	0.00944808
5OI.SI	0.6	-0.0263056
C07.SI	0.4	-0.065607
42R.SI	0.77	0.10720253
1A0.SI	1.67	-0.2525829
1D0.SI	0.53	0.08553672
BJZ.SI	0.23	-0.0550496
5I1.SI	-0.1	0.01947076
XCF.SI	-0.21	0.05675757
1D3.SI	4.84	-8.3645992
BFT.SI	0.423	-0.6008024
5IE.SI	N/A	N/A
1H8.SI	0.81	1.52019911
M04.SI	0.52	-0.0950675
5OX.SI	-0.98	-0.2782979
SJY.SI	0.03	0.03004837
5RF.SI	-0.3	-0.1549339
M01.SI	0.37	-0.047241
CNE.SI	0.5	0.21088469
5WJ.SI	0.45	-0.0888003
5WJ.SI	0.45	-0.2155967

9I7.SI	1.02	0.03694171
543.SI	0.53	-0.0976409
O08.SI	0.22	0.11128776
RQ1.SI	0.27	-0.1360302
O9E.SI	1.55	-1.9349174
596.SI	1.47	0.57148853
BCV.SI	0.81	0.06695853
NR7.SI	0.33	0.11054311
LUY.SI	0.03	0.0272425
1G1.SI	0.74	-0.0918589
5DO.SI	0.26	0.21474479
5TI.SI	0.46	0.1502868
528.SI	0.69	-0.2450753
S07.SI	0.86	-0.0790872
URR.SI	0.49	0.17429001
5HH.SI	2.69	3.97103624
5LE.SI	-0.11	0.09563539
Y45.SI	0.85	0.56515785
5KI.SI	0.36	0.25683415
NC2.SI	0.41	0.29704622
DRX.SI	0.08	0.0764613
H07.SI	0.58	0.16686574
S29.SI	0.33	0.04432508
S85.SI	0.45	0.3578955
BHU.SI	0.83	0.15651033
42L.SI	0.18	-0.0178421
AWI.SI	0.15	0.0442272
AGS.SI	0.58	0.20520266
AWI.SI	0.15	0.02657478
AGS.SI	0.58	-0.1895717
BCZ.SI	0.19	-0.1808012
KUH.SI	1.36	0.98586854
T09.SI	N/A	N/A
540.SI	-0.25	0.14387251
BFU.SI	0.87	0.09140311
1F1.SI	1.63	3.31106905

BPF.SI	0.29	0.15690047
5SR.SI	-0.17	0.32733125