

The Impact of Russia -Ukraine War on The U.S. Stock Market– Based on Event Study Methodology

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Abstract. Since Russia is important energy exporter in the world, the conflict between Russia and Ukraine became a world focus nowadays. According to former researchers' works, we choose the event analysis method to gain an insight into the typical effect on energy sector caused by this conflict and give two hypotheses. Firstly, we propose that the event would have a negative shock on the energy career showed with volatilities of index. And then we present that the fungibility of energy industry remains the stability of returns of index and stocks. By extracting returns and volatilities of SP500 index and returns of the Great consumption index of China from Wind database, also filtrating the famous energy sector U.S. stocks based on the list in the Eastern Wealth, we prove the assumptions with examining the significance of statistics. Using the event analysis method to examine the difference of before and after the event, we get the results which indicate the significances of volatilities of SP500 index. But the returns of SP500 index, the Great consumption index of China, and U.S. stocks do not show the significance differences. Contents above prove two assumptions we mentioned before. It is honorable for us that this research might be practical to offer advice and give a little guidance for market investors.

Keywords: Russia-Ukraine war; event analysis method; SP500 index; Great consumption index

1. Introduction

In the spring of the year 2022, the tense situation between Russia and Ukraine has been elevating for many years until this period. After a series of political negotiations between the two nations, the war has still become inevitable, and it has lasted until now and seems non-stopping. Eventually, the conflict between Russia and Ukraine is considered the important geopolitical event of the year. Moreover, Russia and Ukraine are the world's two largest grain-producing countries, and at the same time, Russia has a large source of energy that Europe relies on heavily. Therefore, the resources determine that the war will have a profound and long-lasting impact on world trade in general.

From the Economics perspective, the war between Russia and Ukraine is believed to be a "black swan" incident. Before the Russian President declared war on Ukraine on February 24, the United States and NATO warned about the outbreak's impact, but the war has still largely impacted the entire market. The impact reveals to be the lower market expectations in short term such as the price of energy and food. Also, the supply chain of chemical products has also suffered a huge impact [1]. These facts caused turbulence in the financial market. People can also experience aggravating the global economy's inflation, resulting in the damage of globalization and intensifying trade protectionism. In the following passages, the specific impact of the Russia -Ukraine War on the stock market and the global economy will be further analyzed.

Based on the information given, The Russia-Ukraine conflict has caused an unprecedented impact on global trade and economic development. For unpredictable situations that are not similar to any previous experience, researchers often use the Event Study Methodology to complete further research. According to existing investigations, Event Study Methodology is a measurement method used to study the short-term impact of major events on variables. Among the studies that have been done previously, this method was mainly used in the financial field and was mainly used to measure the

impact of a specific event on the company's stock price. The Event Study Methodology, based on the research, has the advantage of a precise analyzing process. It is believed to be logical, and many researchers are using this method in many other fields of study. Therefore, the impact of the Russian-Ukrainian conflict on the global economy and the stock market is consistent with the analysis of the Event Study Methodology. In the following research, the R will be used to analyze the collected data. The U.S. stock market data will also be selected for this research. The reason is that, when some unpredicted events have happened in the world, the U.S. stock market reflects the most intuitional and immediate change to the investors. The market data is chosen around Feb 22, 2022. The 18 U.S. stocks among the well-known energy stocks data from East Money Information Co., Ltd. are being chosen as the first research and analysis object. Also, the SP500 energy index and the consumer index will be selected as the second research sample.

2. Literature Review

Since the outbreak of war between Russia and Ukraine, the global situation has undergone earth-shattering changes, exerting a far-reaching and profound influence on the political and military fields. Typical of rare disaster risk is the process of this political crisis eventually leading to the outbreak of war. The works of Chen and Hu have verified the role of rare disaster risk to explain and predict stock market returns [2-3]. This shows that the Russia-Ukraine war is also of certain research significance in its impact on the stock market return in the domain of finance and securities.

The latest Black Swan event is COVID-19 which suddenly occurred in 2020. Since March 2020, US stocks have melted down several times, resulting in liquidity risk and followed by a rare phenomenon that risky assets and hedging assets fell simultaneously [4]. Corresponding to the dramatic changes in the ecological and political environment, there are obvious changes occurring in the financial market. In the U.S., the most financially developed country in the world, the stock market is extremely significant as a reference and guidance to the global financial environment. According to the research of Li, U.S. stocks have important weathervane significance in terms of the response to financial risks, and the financial contagion effect on Hong Kong stocks and the A-share market [5]. Based on the research of Chen and Zeng, there is a strong linkage between U.S. corporate bonds and stocks [6]. Since the U.S. market is relatively mature and rational, investment and trading behavior mainly reflects the changes in economic fundamentals. Therefore, the response of the U.S. stock market to economic changes is more suitable as the research object to verify other theories.

As for disaster risk, the rarity and extreme loss of the disaster have greatly interfered with the real data in the early research. Researchers led by Chen have verified that tail risk is suitable as a proxy index of disaster risk and can reasonably explain and predict the stock market return and portfolio return on the cross-section [7]. Scholars also propose some methods to measure the tail risk that represents disaster [8]. The subsequent researchers are interested in the role of tail risk as a market indicator. Researcher Jiang found that when major events are triggered by sudden and unpredictable Black Swan events, the network relevance will be dramatically enhanced after the crisis [9]. Therefore, the study regarding the impact of the Russia-Ukraine war on the U.S. stock market is also a major supplement to the study of financial risks.

In terms of specific research perspectives, the shocks caused by the conflict between Russia and Ukraine in the bulk commodity and video market are hindering the fragile economic recovery of the global market in the background of the epidemic, exacerbating the global inflationary pressure. According to the work of Li and other researchers, there is a strong and enduring negative impact brought by commodity prices on stock market returns during inflation [10]; Yang also found that the inflation rate is negatively correlated with the real return of stocks to an obvious extent [11]. This transmission relationship provides ideas for us to study the impact of Russia-Ukraine relations on the U.S. stock market. Expanding the research on the risk of U.S. stocks via inflation as a clue, it is found that the concern from the market about inflation policies is often one of the factors why the stock declines. For the research on stock market return and inflation risk, Deng proposed that the Bayesian

Markov transformation VAR model is more accurately describes the nonlinear dynamic characteristics of the fluctuation relationship between these two variables, proving that the Fisher Effect and agency effect are established in different mechanisms of the market as well as showing that many relationships exist between inflation and return [12].

3. Theoretical Analysis and Hypothesis Formulation

3.1 Research Framework

The war between Russia and Ukraine, as a major energy supplier to Europe, has not only triggered international commercial sanctions against Russia, but has also led to a severe impact on Ukraine's indigenous energy extraction. Based on this we build the research framework as shown below. On the supply side, Russia is inclined to briefly reduce its energy production in response to the freeze on energy exports, while on the buying side, it is also reluctant to compromise its energy use and is actively looking for alternative international suppliers or alternative energy sources as well as focusing on the development of new energy sources to fill the energy gap. The tug-of-war between these two sides will have a serious impact on the energy market, and the corresponding energy index should see significant fluctuations.

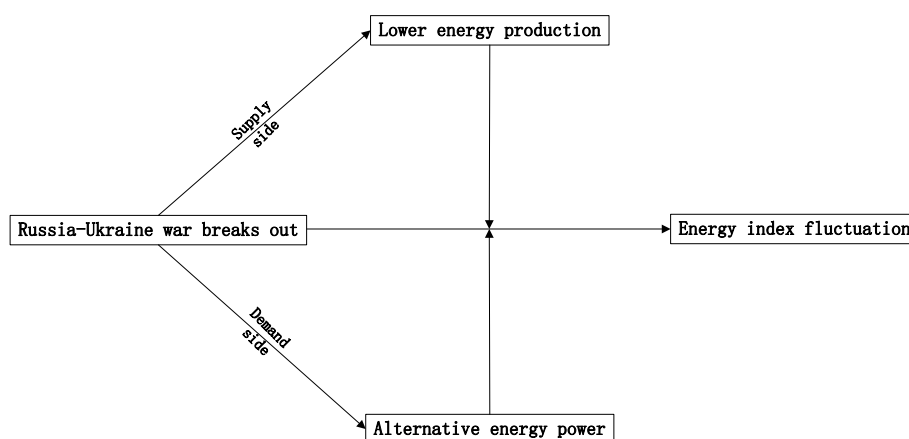


Fig 1. Research framework

3.2 Impact of the Russia-Ukraine Conflict on the Stability of the Energy Sector

According to the BP2021 report global oil production has been declining since the outbreak of the epidemic in 2020, the demand side and the supply side have turned low at the same time, and the global energy market continues to be depressed. In its 2022 survey report, the widespread availability of effective vaccines in 2021 has led to the relaxation of epidemic prevention restrictions in many countries of the world, and the economic recovery has gained significant momentum, which has also driven a significant rebound in energy demand and consumption. In energy consumption, fossil energy supply growth has been slower than demand growth, and prices have generally risen sharply. Russian economy has always relied on energy seriously, in this war Russia would respond to the international community sanctions and temporarily suppress oil production, while Europe and other pipeline gas trade region also proposed to refuse to buy Russian energy, the confrontation between the two sides led to another surge in international energy raw material prices, such large price fluctuations on major energy companies are grievous impacts, serious interference in the market expected pricing and follow-up operations, and thus the index of short-term generate shocks. Accordingly, the following hypotheses are proposed.

4. Methodology

4.1 Research Data

Firstly, this paper extracts daily returns on SP500 energy index and the Great consumption index of China as a control group which has weak correlation between index and event, all of them based on Wind database. The study also extracts daily returns based on well-known energy sector U.S. stocks listed in Eastern Wealth, during the sample period from 2015.1.1 to 2022.7.15, the relevant data is downloaded from CAMAR database, a major financial dataset in China. And some detail information samples are shown in the below Table 1 and Table 2.

Table 1. Descriptive statistics of SP500 energy index and Great consumption index of China

Name	Mean	Val	Max	Min
SP500	565.3391	1612.305	635.51	476.81
GCI	2746.394	73039.91	3228.81	2296.36

Table 2. Descriptive statistics of sample data of well-known U.S. stocks in the energy sector

Symbol	Mean	Var	Max	Min
AES	22.85659	2.453567	26.22	19.45
BP	29.63063	3.918985	33.34	25.65
CAT	209.4429	124.0917	235.08	182.83
COP	89.88881	139.5903	109.02	68.6
CVX	143.7272	445.3838	174.03	112.1
DUK	128.825	46103.76	1199.78	12.44
ETR	130.2707	49040.89	1199.78	12.44
F	73.22662	9.240504	235.08	12.44
GM	76.17498	3821.669	235.08	12.44
HAL	44.37024	416.6131	84	21.15
HMC	69.1229	3.131418	235.08	12.44
RIO	72.61286	38.16136	84	61.33
SLB	42.57769	325.7925	84	21.15
SO	125.4508	43710.02	1199.78	12.44
TM	78.44256	4061.937	235.08	12.44
TSLA	131.4145	52243.38	1199.78	12.44
WMB	72.92785	3684.866	235.08	12.44
XOM	56.33306	637.0923	109.02	21.15

Using the event analysis method, February 22, 2022, was used as the event date, and 90 days before and after respectively were selected as the sample range. 10 days, 15 days (half a month), and 60 days (two months) before and after the event date are used as the event window period. The t-test is performed on the return and volatility before and after the event.

4.2 Calculation Method

In this study, volatility is calculated in standard form. Let be the daily volatility between day 1 and day 2, and let be the market value at day 1, then defined as:

$$u_i = \ln\left(\frac{S_i}{S_{i-1}}\right) \quad (1)$$

Further:

$$\sigma_n^2 = \frac{1}{m-1} \sum_{i=1}^m (u_{n-i} - \bar{u})^2 \quad (2)$$

Where:

$$\bar{u} = \frac{1}{m} \sum_{i=1}^m u_{n-i} \quad (3)$$

5. Result

5.1 S&P500 Index of Energy and Domestic Consumption Index

As is observed from the S&P500 index of energy, the return rate rose rapidly just before the event, and after the event, it fell slightly, then immediately rebounded and remained high temporarily. This demonstrates that the event exerts a profound impact on the energy industry in a short term, triggering the active self-rescue mechanism of market.

Based on the statistical data, however, it is found that there are no significant changes in S&P500 index of return before and after the event. The p value is calculated to be 0.9193 by selecting a 60-day window period and conducting t-test on the S&P500 energy index. See figure 2 and figure 3 for the specific change of yield:

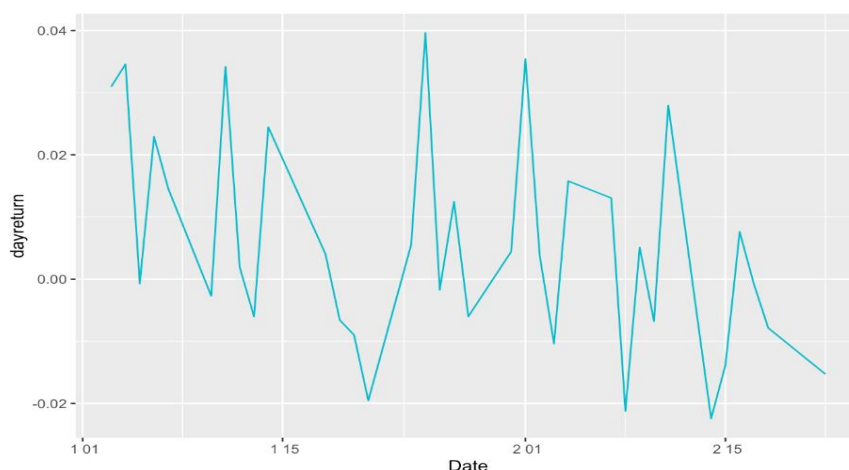


Fig 2. Index Return of SP500 Energy Index before the Event(60 days window period)

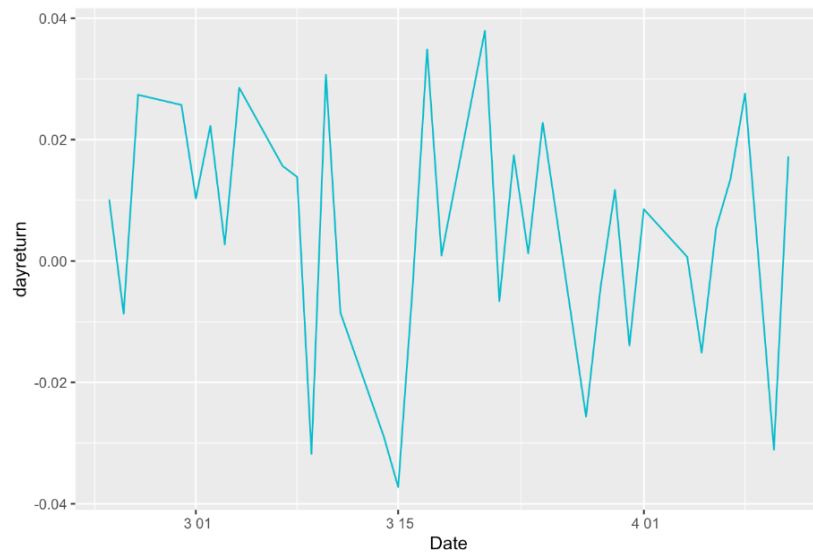


Fig 3. Index Return of SP500 Energy Index after the Event(60 days window period)

Meanwhile the study regarding the volatility of SP500 energy index proves that under the setting of 60-day, 45-day and 10-day window periods, the of S&P500 volatility invariably shows significant changes before and after the event. See figure 4 and figure 5 for detailed data.

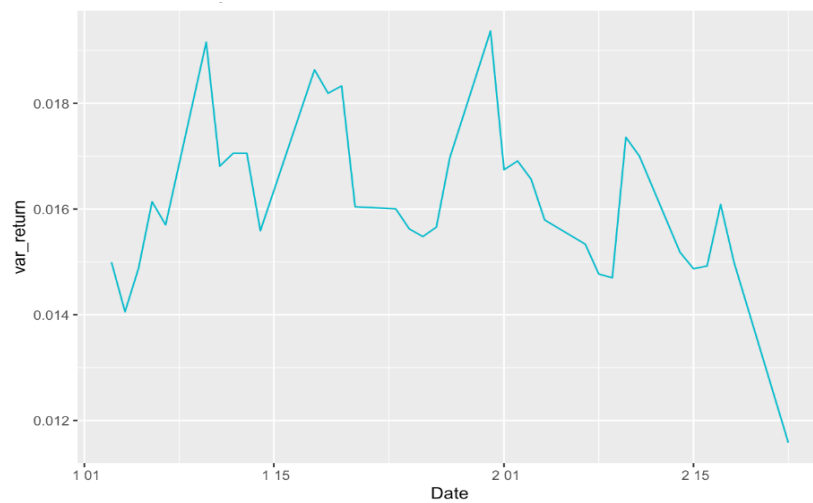


Fig 4. Volatility of SP500 Energy Index before the Event (60 days window period)

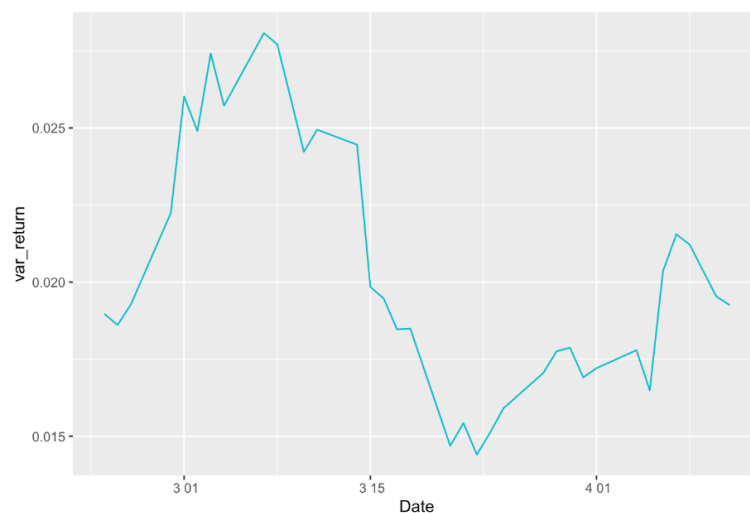


Fig 5. Volatility of SP500 Energy Index after the Event (60 days window period)

The comparison of the domestic consumption index before and after the event shows that when the 60-day window period is selected, the return rate is not statistically significant. See figure 6 and figure 7 for the specific change.

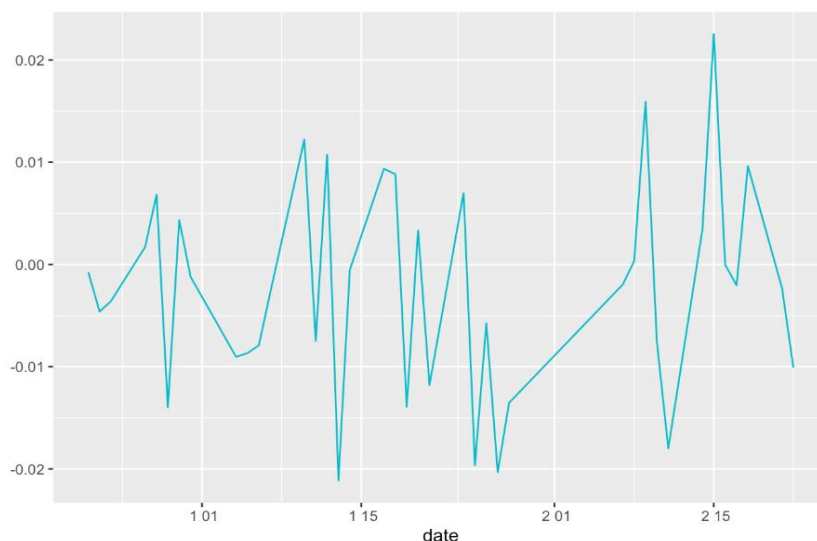


Fig 6. The Return Rate of Consumption Index before the Event (60 days period)

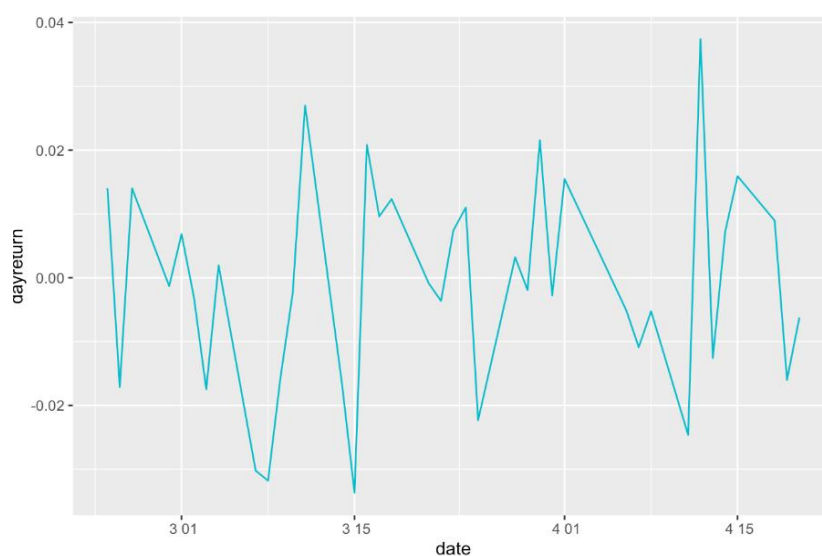


Fig 7. The Return Rate of Consumption Index after the Event (60 days period)

There was no significant change in the returns of S&P500 energy index and domestic large consumption index within the 60-day window period before and after the event, which indicates that the impact of the Russia-Ukraine war on American energy stocks is not more special than is brought by other industries. However, the war has a significant impact on the volatility of S&P500 energy index. These three types of data analysis indicate that despite the changing structure of energy market, the rate of return can be maintained by the alternation of producing areas and the supplement of new energy while the market volatility still changes, which verifies the hypothesis H1.

5.2 Energy Stocks

The war between Russia and Ukraine exerted a great impact on the energy sector. It is found from the K-line of 18 stocks that heavy machinery manufacturers, such as Caterpillar (CAT), and electric power enterprises, like AES, experienced a serious drop in stock prices before and during the war, and rose back in the later adjustment. By contrast, ExxonMobil (XOM) and other local oil companies in the United States witnessed their share prices ascend before and after the event, while some oil

companies announced that they would withdraw from their oil and gas business in Russia and would no longer make new investments, which verifies the hypothesis H1 again.

Figure 8 and figure 9 exhibit the trend of return rate in the selected three-month window period, comparing the changes of the return rate of 18 well-known US stocks before and after the Russian Ukrainian war. It can be directly observed from the chart that there is no significant difference in the change of the average return rate before and after the event. The results after T-test of relevant samples show that the p value is far greater than 0.05, and there is no significant difference between it and the value of 0. Therefore, the average return rate of the well-known US stocks in the energy sector did not significantly vary before and after the Russian Ukrainian war. The specific results are shown in Appendix one. Overall, there is no significant difference between the S&P500 energy index and the return rate of famous US stocks before and after the event, which indicates that the market adjustment compensated for the dramatic fluctuations of short-term returns. The hypothesis H2 is therefore verified.



Fig 8. The Average Rate of Return of 18 Energy Stocks before the Event (90 days period)

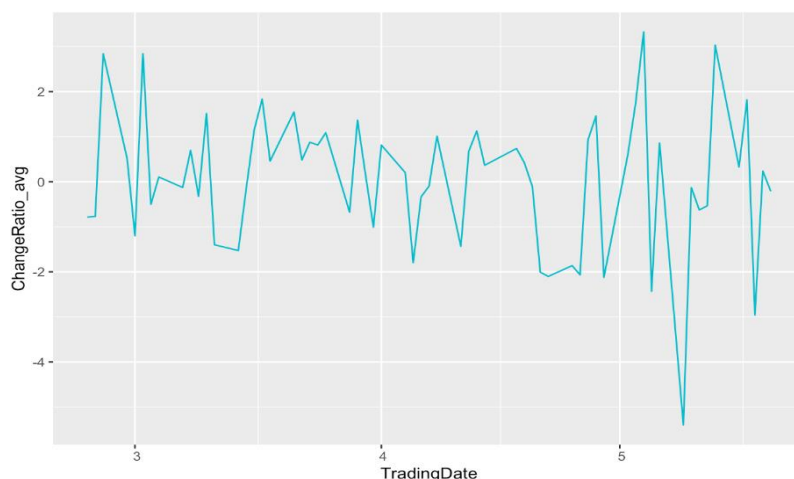


Fig 9. The Average Rate of Return of 18 Energy Stocks after the Event (90 days period)

6. Conclusion

The Russian-Ukrainian war had a profound impact on the volatility and the rate of return of the market. These effects became a new research field focused by many researchers who are dedicating to find the outcome that caused by this conflict. In this paper, we propose two related hypotheses. And the investigation results can be summarized as follows. First, the volatility of S&P500 index

changed significantly before and after the Russia-Ukraine war. This proves that the war had a great impact on the price of the energy market and interfered with the stability of the market. As an industry index with a relatively long correlation, the return rate of SP500 index and domestic large consumption index did not change significantly in the same period, which indicates that the change of SP500 index is not special which further prove our finding. Second, the S&P500 index return rate did not change significantly before and after the event, it proves that there was no significant gap in the supply and production of the energy industry. Subsequently, we verify that the changes in return of 18 well-known US stocks in the energy sector were also not significant. Finally, through the specific analysis of the K-line daily value of 18 famous US stocks, it is found that the war event is good for the traditional oil and gas enterprises in the US stocks. But at the same time, the downstream energy machinery industry and secondary energy enterprises suffered drops in stock price due to fluctuation of energy price during and after the event.

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