

# How Does The Russia-Ukraine War Affect Financial Markets

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**Abstract.** The war between Russia and Ukraine has become almost the most controversial topic in 2022. As Russia is a country with rich energy resources and the most sanctioned country in the world, the war influences global financial markets in various aspects. In this research, I investigate the gold, crude oil markets, military-industrial sector in the equity market, and investor sentiments to find the effect of the war. By comparing ex-post with ex-ante descriptive statistics and regressing asset prices on the VIX index, the research finds that the war increases all the three assets' prices and market uncertainty. Investor sentiments proxied by the VIX index have significantly positive impacts on gold price; positive but not significant impacts on crude oil price; significantly negative effects on military stocks.

**Keywords:** Gold, Crude Oil, The Russia-Ukraine War, Commodity Market, Investor Sentiment.

## 1. Introduction

The attack from Russia on the capital of Ukraine marked the beginning of a war between Russia and Ukraine. Since 24th February 2022, Russia has been financially sanctioned by the USA, Japan, and most European countries, as well as Ukraine. Although the aggregation of economies of Russia and Ukraine is less than 2% of the total global economy scale, the war and the consequential international financial and trading policies are able to create a volatile financial environment. For example, EU countries are going to stop purchasing oil from Russia after the end of 2022. Besides, the USA has banned imports of oil and natural gas from Russia. Furthermore, the USA provided military assistance to Ukraine against Russia. Overall, gold, crude oil, and stocks in military industries are the three types of assets that are most concerned during this wartime. At the same time, investors react to the sanctions and policies as well. Moreover, the war as an extreme event can significantly influence investor sentiments and then affect equity and commodity markets [1-3].

The recent works find that wars, especially wars involving oil-rich countries, can evidently push the oil price up. Moreover, wars do not directly increase oil prices but increase oil prices through affecting oil supply [4-6]. As Russia is one of the countries that have rich natural resources, those sanction policies in Russia are equivalent to decreasing the supply of energy resources in worldwide markets, while the total demand is not significantly varied. In other words, the demand for natural resources exceeds the supply. Therefore, the price of oil, gas, and other resources is expected to increase in the future. As well as disruptions in oil supply, investor sentiments can shift oil prices as well [7-8]. This article investigates the responses of the crude oil market to investor sentiments in an extreme shocked market [8]. They divided market shocks into extreme-positive-degree shocks, normal-degree shocks, and extreme-negative-degree shocks to investigate how these three different types of shocks influence investor sentiments and then crude oil returns. Finally, they prove that extreme shocks significantly Granger cause the crude oil future market, while the normal shocks including both normal positive shocks and normal negative shocks have few effects on crude oil futures. Furthermore, their empirical results also suggest that extreme-negative shocks are more powerful than extreme-positive shocks. Consequently, the hypothesis about the crude oil price is that the crude oil will be more expensive after the beginning of the war, than it before the war.

Gold has been proved to be a safe-haven asset in several periods and countries [10-15]. Therefore, in the volatile markets resulting from the Russia-Ukraine war, gold is still expected to be a safe-haven asset that is pursued by investors. And the rises in gold demand and market uncertainty probably will lead to an increase in gold future prices.

Stocks in military industries are affected in two opposite directions. One is the negative effect caused by overall depression in unstable equity markets. The other one is the positive effect that can push the prices of those stocks in the military-industrial sector because the demand for munitions and aerospace security increases during wartime. Investors sell stocks when they feel uncertain about the whole market, even if the stocks in the military-industrial sector perhaps get benefits during the war. Thus, the overall effect suggested on stocks in the military sector is valuable to be investigated.

Extreme events significantly influence investor sentiments [1-3]. Fluctuating investor sentiment not only reflects the increasing uncertainty of markets but also raises the market risks [16-21]. Investors' sentiments have a significant impact on asset returns [18-19].

However, few kinds of literature investigate the reactions of equity markets and commodity markets against the Russia-Ukraine war, because the war broke out in just two months. Besides, due to the insufficiency of data on asset prices, investment returns cannot be investigated in this research. Therefore, this research pays attention to asset prices and investor sentiments during the period of 2022 from February 24th to 2022 April 24th.

By suggesting the linear graphs and descriptive statistics, simple overviews of asset prices and the VIX index that represents investor passive sentiments are made. In the second part, regression analyses are manipulated to show if and how the prices of gold, crude oil, and stocks in the military-industrial sector are dominated by investors' sentiment in the case of the Russia-Ukraine war. Finally, figures and descriptive statistics indicate that prices of gold, crude oil, and military-industrial equities increased during wartime. Furthermore, the empirical results also suggest that the CBOES VIX index has a significantly positive influence on the gold price but not a significantly positive impact on crude oil future price military index. On the other hand, it has a significantly negative relationship with military stocks.

The rest parts of this research are as follows. Section2 describes the data types and sample periods used in this research. Section3 introduces the methodology that is applied. Section4 presents empirical results including figures and tables and interpretations. The final part is Section5; it gives the conclusion and discussion of this research.

## 2. Data

One-year daily data that started from April 24th, 2021 to April 24th, 2022 are gathered. To observe the reactions of commodity and financial markets to the Russia-Ukraine war, both status of markets before the war and after the war is needed to be suggested. Data in the range of 04/24/2021-02/23/2022 are allocated into the ex-ante group, as the control group, while the others in the period of 02/24/2022-04/24/2022 are used to indicate the influence of the war. The reason why February 24th, 2022 is a special point to break data is that although the conflicts between Russia and Ukraine have lasted for several years, the outbreak on February 24th, 2022 is the most severe in recent decades. Thereafter Russia has been subjected to a set of sanctions from other countries. Besides, the increasing demand for munitions and the interruption of international logistics inevitably affect both commodity and financial markets. Therefore, data involved in this research are collected based on this time range.

The Boeing Company, Raytheon Technologies Corporation, Rolls-Royce Holdings plc, Lockheed Martin Corporation, and BAE Systems plc are picked to represent the military-industrial sector since they are the five large and the most famous enterprises in aerospace, defense, and security industries. The stock codes of these five companies are BA, RTX, RRL, LMT, and BAESY, respectively. They constitute an equally weighted portfolio to represent stocks in the worldwide military-industrial sector. Daily stock prices of the five firms are downloaded from Yahoo Finance.

Prices of gold future and crude oil future are taken from the official website of NASDAQ.

The proxy for investor sentiment is the CBOE Volatility Index (^VIX) in this research. The volatility index depicts the 30-day expected market fluctuations, and it can describe the real-time investors' sentiments in the market. According to [20], VIX has been a traditional measure of investor sentiment. It is an estimate of short-term stock market volatility and daily ^VIX data are downloaded

from Yahoo Finance. Total 252 observations in the first research. 211 observations are ex-ante data and 41 are ex-post data.

In the second part of the research, the relationship between the VIX and gold, crude oil, and military sector stocks are respectively assessed. Since only the relationships in the circumstance of the war are studied, data in the period of 02/24/2022-04/24/2022 are used in the regression analysis. 41 observations for each variable are included in regression processes.

### 3. Methodology

#### 3.1 Reflect financial markets under the war

To study the effect of the Russia-Ukraine war on the military equity market, a military index is needed. However, there is no existing available military market index that can be applied in this research. Therefore, a complex military stock index containing the five military industry stocks (BA, RTX, RR.L, LMT, BAESY) which are the five largest-scale enterprises is constructed by allocating weights according to each equity's market capitalization. The constituents of the military index are as following:

Table1. Components of the novel military index

|                       | BA               | RTX               | RR.L            | LMT               | BAESY           |
|-----------------------|------------------|-------------------|-----------------|-------------------|-----------------|
| Market Capitalization | \$80.681 Billion | \$137.375 Billion | \$6.767 Billion | \$117.774 Billion | \$29.28 Billion |
| Weight in the index   | 21.70%           | 36.94%            | 1.82%           | 31.67%            | 7.87%           |

Then statistics such as mean and variance for the gold price, crude oil price, military index, and the implied volatility index (VIX) are worked out. Correlation coefficients among gold, crude oil, and the portfolio are calculated to indicate the strength of co-movements among the three variables. The hypothesis is that the variance of time series in 02/24/2022-04/24/2022 is higher than that of time series in the period 04/24/2021-04/24/2022. The correlation coefficient between gold and crude oil futures is expected to be positive. While the correlation between gold and stocks in the military-industrial sector is expected to be negative, due to the overall passive attitude in stock markets and the tendency of holding the safe-haven asset.

#### 3.2 Regression model

Univariate linear regression models are used to evaluate the relationship between investor sentiment which is measured by the VIX index and assets' returns. The regression model is suggested as below:

$$P_{i,t} = \alpha_i + \beta_i VIX_t + u_{i,t} \quad (1)$$

where  $P_{i,t}$  is prices of asset  $i$ , i.e. gold price, crude oil price or military index;  $VIX_t$  is the variable for CBOE implied volatility index. As we are investigating the effects of the VIX index on three assets, total three regressions are going to be made in this research.

The hypothesis for this part is that VIX has a positive impact on gold returns and crude oil returns, as when financial markets are in uncertainty, investors prefer to long safe haven assets to hedge the risks from fluctuations in stock markets. However, a negative effect of the VIX index on the military index is anticipated to be shown in empirical results.

## 4. Empirical Results

### 4.1 Data description

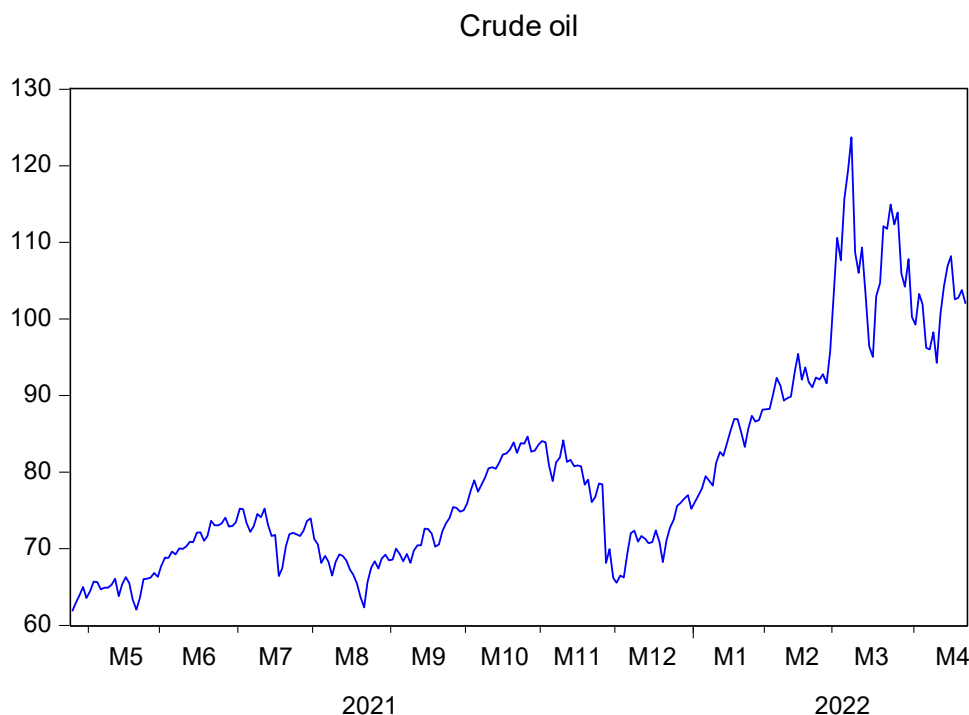


Figure 1. Crude oil price

Unlike the moving path of the VIX index, the price of crude oil has a significant upward tendency from April 2021 to April 2022. It proliferated at the end of February 2022. In the sample period, there is no slump after that proliferation. Although the price decreases for several times after that culmination, it is still much higher than any daily price in 2021. Thus, the outbreak of the war probably stimulates the crude oil price.

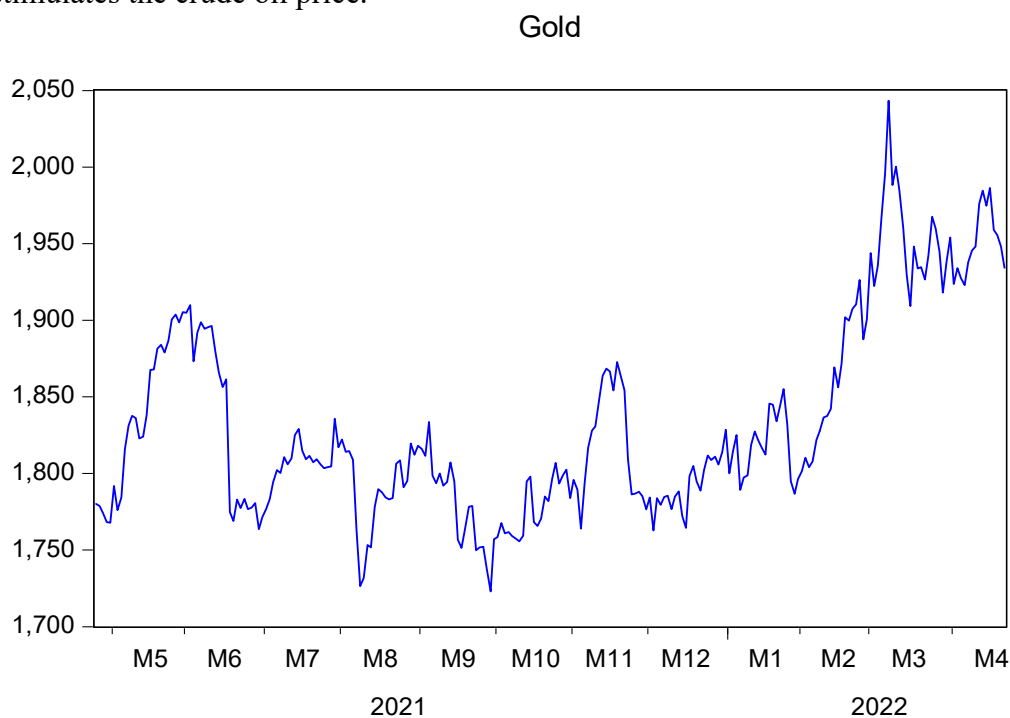


Figure 2. Gold price

The gold price has a similar process to the crude oil price. It started to grow at the end of 2021, and it kept moving in an almost continuous upward trend until reaching the top in March 2022. The

highest price of gold appears at the same time as crude oil price. The lowest ex-post price is higher than the highest price in May 2021. Perhaps I can conclude that the price increase reflects the investor preference for holding safe haven asset, i.e. gold, in wartime. Therefore, I assume there is a strong positive correlation between gold future price and crude oil price, and a positive relationship between the gold price and market panic on equity investments.



Figure 3. Military index

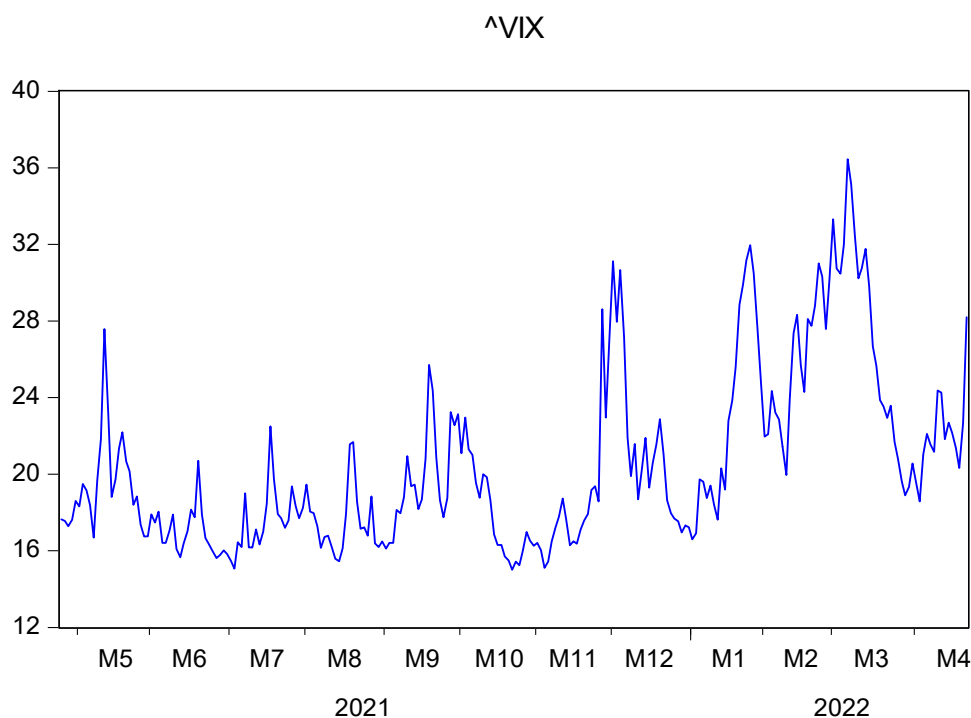


Figure 4. The implied volatility (VIX) index

VIX, the index for measuring market uncertainty and lost confidence of investors in financial markets, is presented in Figure4. Although the VIX index fluctuated severely during the whole year, there is no evident upward trend on the curve. What is noticeable is that the peak in March 2022 is higher than other peaks in the figure. It means that the highest level of market uncertainty was

triggered after the outbreak of the Russia-Ukraine war. Then the VIX decreased to a bottom, which is also higher than previous bottoms, at the beginning of April 2022, but it rebounded upward immediately. This is probably because lots of policies were made as sanctions on Russia government, and many Russian companies and foreign companies that cooperated with Russian companies would be negatively influenced. Therefore, increased pessimism of investors is indicated by the VIX index.

Table 2. Descriptive statistics for explained variables and explanatory variable

|         |                | Mean    | Variance | Median  | Maximum | Minimum | Spread |
|---------|----------------|---------|----------|---------|---------|---------|--------|
| Ex-ante | Gold           | 1809.95 | 1682.19  | 1803.40 | 1910.40 | 1722.90 | 187.50 |
|         | Crude Oil      | 74.68   | 61.08    | 72.76   | 95.46   | 61.91   | 33.55  |
|         | VIX            | 19.55   | 14.62    | 18.39   | 31.96   | 15.01   | 16.95  |
|         | Military Index | 197.96  | 60.67    | 198.76  | 212.91  | 177.65  | 35.26  |
| Ex-post | Gold           | 1949.37 | 868.54   | 1944.70 | 2043.30 | 1887.60 | 155.70 |
|         | Crude Oil      | 104.65  | 51.54    | 103.79  | 123.70  | 91.59   | 32.11  |
|         | VIX            | 25.37   | 24.66    | 23.57   | 36.45   | 18.57   | 17.88  |
|         | Military Index | 223.42  | 24.18    | 223.88  | 231.16  | 207.17  | 24.00  |

As Table 2 implies, the Russia-Ukraine war indeed stimulates the increase in investors' passive sentiment on financial investments. Every ex-post descriptive statistic for the VIX index is higher than the corresponding ex-ante statistic. The higher mean and median of ex-post VIX data show that the overall sample included in the ex-post group has a higher value than the ex-ante group. In other words, financial markets are more volatile than before. The ex-post variance is 24.66 which is approximately 1.69 times as much as the ex-ante variance. This indicates that the volatility of market uncertainty rises as well. In other words, the expectation of future market fluctuations becomes more ambiguous, and the VIX will be less instructive or predictable in this case. The ex-post spread, which is 17.88, also proves that investors are more uncertain about market movements in the future. In summary, markets become more uncertain after the outbreak of the Russia-Ukraine war.

In the gold futures market, the war creates benefits for gold investors. The average old price increases by around 140 dollars per ounce in two months, and it once reached the highest value at 2043.3 dollars per ounce. The increase in gold price is probably due to the rising demand for safe haven assets in unstable financial conditions, caused by war (e.g. [10], [11]). The range between the highest and the lowest historical gold price in the ex-post sample indicates that the gold price was more stable than that in the pre-war period. This expectation is proved by the approximately 50% lower variance of the ex-post sample of gold future prices than the one of the ex-ante sample. In other words, although the price of gold futures had a significant increase, the risk of purchasing gold futures decreased. Therefore, a leap in the gold price with a fall in risk makes the gold investors benefit since the war was triggered (Table 3-5).

Crude oil price is the most affected variable in this research, according to Table 2. The average price of crude oil rises from 74.68 dollars per barrel to 104.65 dollars per barrel. That means the price increased 40.13% on average since February 24th, 2022. The volatility of the crude oil future price declined 15.61%. Even though the spread did not significantly change, it got smaller than before the war as well. The minimum price in the ex-post group is almost equal to the highest in the ex-ante group.

Table 3. Correlation coefficients of all data

| Correlation<br>t-Statistic | Military<br>Index       | Gold                    | Crude oil               | VIX               |
|----------------------------|-------------------------|-------------------------|-------------------------|-------------------|
| Military Index             | 1.000000<br>-----       |                         |                         |                   |
| Gold                       | 0.793854***<br>20.64097 | 1.000000<br>-----       |                         |                   |
| Crude oil                  | 0.693593***<br>15.22373 | 0.713389***<br>16.09613 | 1.000000<br>-----       |                   |
| VIX                        | 0.305423***<br>5.071489 | 0.440325***<br>7.754335 | 0.529019***<br>9.856730 | 1.000000<br>----- |

Table 4. Correlation coefficients of ex-ante data

| Correlation<br>t-Statistic | Military Index          | Gold                 | Crude oil               | VIX               |
|----------------------------|-------------------------|----------------------|-------------------------|-------------------|
| Military Index             | 1.000000<br>-----       |                      |                         |                   |
| Gold                       | 0.468415***<br>7.664666 | 1.000000<br>-----    |                         |                   |
| Crude oil                  | 0.129694<br>1.890932    | 0.121756<br>1.773404 | 1.000000<br>-----       |                   |
| VIX                        | -0.092342<br>-1.340696  | 0.097439<br>1.415393 | 0.296355***<br>4.485870 | 1.000000<br>----- |

Table 5. Correlation coefficients of ex-post data

| t-Statistic    | Correlation<br>Military Index | Gold                    | Crude oil            | VIX               |
|----------------|-------------------------------|-------------------------|----------------------|-------------------|
| Military Index | 1.000000<br>-----             |                         |                      |                   |
| Gold           | 0.266847<br>1.729159          | 1.000000<br>-----       |                      |                   |
| Crude oil      | 0.230041<br>1.476199          | 0.623874***<br>4.985238 | 1.000000<br>-----    |                   |
| VIX            | -0.300231<br>-1.965621        | 0.294261<br>1.922794    | 0.244631<br>1.575594 | 1.000000<br>----- |

## 4.2 Regression Analysis

As the regression results suggested in Table 6, the gold future price is positively and significantly affected by the CBOE VIX index, at a 90% confidence level. When the VIX increases one unit, the gold futures price will rise by 1.75 dollars as the consequence. The result is consistent with previous hypothesis, and supports the common conclusion of [10], [11], [12], [13], [14] and [15]. In other words, investors are found to pursue more safe haven asset when they feel the stock market is in increasing uncertainty.

Table 6. Regression results (t-statistics of coefficients are suggested in parentheses).

|                | Intercept                 | $\Delta$ VIX              |
|----------------|---------------------------|---------------------------|
| Gold           | 1905.064***<br>(81.13536) | 1.746233*<br>(1.922794)   |
| Crude Oil      | 95.6772***<br>(16.48774)  | 0.35364<br>(1.575594)     |
| Military Index | 230.9635***<br>(59.06373) | -0.297298*<br>(-1.965621) |

However, although the average crude oil future price after the war significantly differs from it before the war, the statistical relationship between the crude oil future price is not significantly positive. Besides, the degree of the VIX's influence on the crude oil price is also light. The oil price will increase only 0.35 units if the VIX rises 1 unit. This is inconsistent with the expectation that the VIX index has statistically significant impacts on the oil price. It is probably because the driving force of the current urgent demand for crude oil is people's fears of insufficient supply in the future, rather than the desire to hedge risks from the equity market or get investment returns. As [4] and [6] illustrates, disruption of oil supplied by Russia due to the war is the main and direct cause of high crude oil price. On the contrary, gold is known as a safe haven asset that can help investors hedge risks embedded in their portfolios. Therefore, different regression results appear in the regressions for the gold price and oil price.

The market uncertainty has a significantly negative relationship with the novel military index. Although the higher ex-post mean of the military index indicates the short-term prosperity in the military industry, investor sentiment based on recent increasing uncertainty in the whole stock market makes them unavoidably have a pessimistic view of the military industry. Besides, this negative coefficient of the VIX index is consistent with the negative correlation coefficient which is suggested in Table 5 between the VIX and military index. Therefore, investor sentiment proxied by the VIX index leaves a negative impact on military stocks, even if the military-industrial industry may create profit during the war. The results also consistent with the correlation of different variables.

## 5. Conclusion

The outbreak of the Russia-Ukraine war on 24th February 2022 draws most of the attention in recent months. Subsequently, investors in financial markets react immediately. Eventually, lots of international stock markets suffer slumps, but proliferations appear in commodity markets at the same time. To wonder about the quantitative responses of stock markets and commodity markets, I make this research. I select gold, crude oil, and the military-industrial sector in the equity market as studied objects, because they are usually the most affected items in wartime, especially for a country with a strong military and rich natural resources like Russia. The CBOE VIX index is used to measure the investor pessimistic sentiments toward financial markets.

By showing the graph and descriptive statistics of variables, we find that VIX did increase from the period of February 24th, 2022 to April 24th, 2022. At the same time, future prices of gold and crude oil rise as well. Nonetheless, both the variances of the future prices of gold and oil are lower



than those in the pre-war period. By contrast, the variance of the VIX index increases after 24th February 2022. Regression results show that the VIX index is significantly positively related to the gold future price, and it is positive but not significantly positive with the crude oil price. By contrast, it delivers significant and negative effects on military-industrial stocks. Implication for the investor is that investing in gold and crude oil are good options in wartime, while the stock market including the military sector perhaps makes them lose money.

There are some limitations to this research. The primary one is the small sample size because the war was triggered just two months before the research. Besides, only prices are studied, rather than investment returns. That is also due to few data on asset monthly returns in the post-war period. Future researchers can study the influence of the Russia-Ukraine war by using more abundant samples.

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## References

- [1] Drakos K. Terrorism activity, investor sentiment, and stock returns. *Review of financial economics*. 2010;19(3):128-35.
- [2] Donadelli M, Kizys R, Riedel M. Dangerous infectious diseases: Bad news for Main Street, good news for Wall Street? *Journal of financial markets (Amsterdam, Netherlands)*. 2017;2016;35:84-103.
- [3] Da Z, Engelberg J, Gao P. The Sum of All FEARS Investor Sentiment and Asset Prices. *The Review of financial studies*. 2015;28(1):1-32.
- [4] Wang Q, Sun X. Crude oil price: Demand, supply, economic activity, economic policy uncertainty and wars – From the perspective of structural equation modelling (SEM). *Energy (Oxford)*. 2017;133:483-90.
- [5] Lieber RJ. Oil and Power after the Gulf War. *International security*. 1992;17(1):155-76.
- [6] Kilian L. Oil price volatility: Origins and effects[R]. WTO Staff Working Paper, 2010.
- [7] Zhang Y, Li S. The impact of investor sentiment on crude oil market risks: evidence from the wavelet approach. *Quantitative finance*. 2019;19(8):1357-71.
- [8] Wang L, Ma F, Niu T, Liang C. The importance of extreme shock: Examining the effect of investor sentiment on the crude oil futures market. *Energy economics*. 2021;99:105319.
- [9] Ji Q, Li J, Sun X. Measuring the interdependence between investor sentiment and crude oil returns: New evidence from the CFTC's disaggregated reports. *Finance research letters*. 2019;30:420-5.
- [10] Ji Q, Zhang D, Zhao Y. Searching for safe-haven assets during the COVID-19 pandemic. *International review of financial analysis*. 2020;71:101526.
- [11] Dutta A, Das D, Jana RK, Vo XV. COVID-19 and oil market crash: Revisiting the safe haven property of gold and Bitcoin. *Resources policy*. 2020;69:101816.
- [12] Huang W, Chang M. Gold and Government Bonds as Safe-Haven Assets Against Stock Market Turbulence in China. *SAGE open*. 2021;11(1):215824402199065.
- [13] Baur DG, McDermott TKJ. Why is gold a safe haven? *Journal of behavioral and experimental finance*. 2016;10:63-71.
- [14] Ciner C, Gurdgiev C, Lucey BM. Hedges and safe havens: An examination of stocks, bonds, gold, oil and exchange rates. *International review of financial analysis*. 2013;29:202-11.
- [15] Baur DG, Lucey BM. Is Gold a Hedge or a Safe Haven? An Analysis of Stocks, Bonds and Gold. *The Financial review (Buffalo, N.Y.)*. 2010;45(2):217-29.
- [16] Lee WY, Jiang CX, Indro DC. Stock market volatility, excess returns, and the role of investor sentiment. *Journal of banking & finance*. 2002;26(12):2277-99.
- [17] Sayim M, Rahman H. An examination of U.S. institutional and individual investor sentiment effect on the Turkish stock market. *Global finance journal*. 2015;26:1-17.
- [18] Gao L, Süß S. Market sentiment in commodity futures returns. *Journal of empirical finance*. 2015;33:84-103.

- [19] Bahloul W, Bouri A. The impact of investor sentiment on returns and conditional volatility in U.S. futures markets. *Journal of multinational financial management*. 2016;36:89-102.
- [20] Balcilar M, Bonato M, Demirer R, Gupta R. The effect of investor sentiment on gold market return dynamics: Evidence from a nonparametric causality-in-quantiles approach. *Resources policy*. 2017;51:77-84.[Link](#)
- [21] Shaikh I. On the relation between Pandemic Disease Outbreak News and Crude oil, Gold, Gold mining, Silver and Energy Markets. *Resources policy*. 2021;72:102025.