The impact of the Russia-Ukraine war on European energy stock prices

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Abstract. The world economy is developing to a new level with more challenges and more opportunities. However, the war between Russia and Ukraine has brought the world's energy resources into a tough situation. In this essay, we are going to set UK's stock market as an example, to discuss since the war began in February 2022, the influence that brought to the European energy stock prices. We found two empirical results from the model. First, the positive correlation is existed between the excess return of energy stocks and the excess return of the market portfolio and the return of oil prices; Second, the Industrial production index and energy price CPI have no conspicuous influence on the returns of energy stocks. The results in this paper may benefit some relevant investors in the financial markets.

Keywords: Russia; Ukraine; UK; Stock market

1. Introduction

By 2017, Russia has 1,688 trillion cubic feet of proven natural gas reserves, the biggest in the world. Which is about 24% share of the world. Russia's proven oil reserves are equivalent to 102.3 times its annual consumption [1]. The huge reserves of energy resources have let Russia became a major supplier to the European Union for crude oil, natural gas and solid fossil fuels [2]. The extent European countries rely on Russia's energy is shown in the Figure 1 below.

From these data, it clarifies that most European countries have a huge dependency on Russia's energy resources, most European countries are highly dependent on Russian energy, importing almost half of their natural gas use from Russia. As we can see, Russia plays a big role in supplying European energy.

From the perspective of differences in member countries' dependence on Russian gas, the dependence of Slovakia and Bulgaria is more than 75%, Finland and Hungary are more than 95%, while the Czech Republic is 100%, and other countries such as Germany, Italy, Greece, Poland, Sweden and so on have also maintained a long-term dependence of more than 50%. Considering of the influence of the Russia and Ukraine war, to apart from Russia, Europe is imposing economic and energy sanctions on Russia again. As a result, until the sixth sanctions, energy prices in Europe increased because of a sudden decreasing energy supply from Russia, leading to energy shortages in Europe. Therefore, in the context of the Russia-Ukraine war, due to the shortage of energy and the increase in energy prices, the price of energy stocks may also be affected, and the entire energy stock market fluctuated under the influence of the Russia-Ukraine war [3-4].

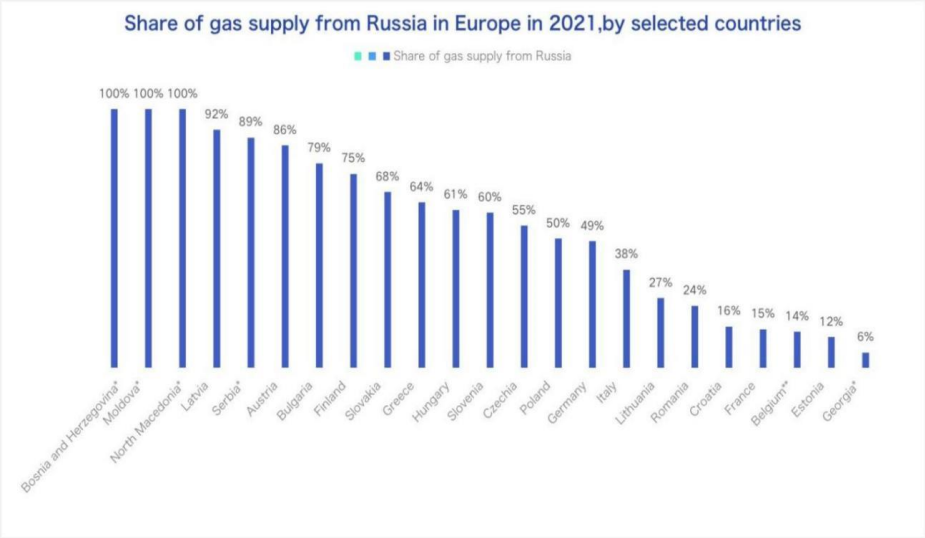

Fig 1. Russia's share of European gas supplies in 2021

Existing investigation shows that energy sector and stock price are closely connected [4-6]. Besides, Yang Zhe and Chen Bo accept that modern local wars have a wide range, short duration, and varying magnitude of impact on international financial markets [7]. Considering the war between Russia and Ukraine, we think wars will affect the stock market in some extent.

In this essay, we will explain how this war can affected the energy prices, especially the reason that caused the high stock prices. Here is the summarized results of the empirical research of this paper: We use two multi-factor models to explore whether the impact of energy prices, market portfolio excess returns, and economic activity on energy stock prices changes before and after the Russia-Ukraine war. The research in our essay may be helpful to investors in the related fields.

2. Empirical Analysis

2.1 Analysis for Model 1

$$R_{it} = \alpha + \beta_0 R_{ot} + \beta_m R_{mt} + \beta_w war + \varepsilon \quad (1)$$

This is a multiple linear regression model. It is obvious that Rot, Rmt and war are the independent variables and Rit is the dependent variable. where α is the constant term and ε is the residual. The parameters of the oil and gas sector index beta, the market beta and the war index beta are β0, βm and βw, respectively, and the random error term is ε t. In order to study the impact of war on energy stocks, war represents whether war has occurred or not, and war is denoted as 0 when war has not yet occurred and 1 when it has occurred. Rit means the return on day t of the UK Oil and Gas sector Index [8] subtracts the yield on the 1-month UK Treasury bill which is obtained from the TradeWeb [9]. The daily return on the oil price on day t refers to Rot; the oil price used is the spot barrel price in US dollars of the London Brent Crude Oil Index [10]. The daily market portfolio excess return on day t refers to the Rmt, measured in terms of the return on the FTSE All Share Index subtracting the return on the 1-month UK Treasury bill. The FTSE All Share Index data is obtained from Financial Times [11]. Details of descriptive statistics are shown below.

Table 1. Descriptive statistics

Variable	Obs	Mean	Std.Dev.	Min	Max
Rit	857	-.758	2.646	-19.235	21.565
Rot	857	.111	3.093	-24.404	21.019
Rmt	857	-.749	1.534	-10.749	8.867

Table 2. Rit Details

Variables	Mean	Std.Dev.	Min	Max	p1	p99	Skew.	Kurt.
Rit	-.758	2.645	-19.235	21.565	-6.57	6.568	.465	13.391

The kurtosis of the data from table 2 is large and there are extreme values, so, 1% tail is reduced.

Table 3. Rit after reduction in tail

Variables	Mean	Std.Dev.	Min	Max	p1	p99	Skew.	Kurt.
Rit	-.749	2.332	-6.57	6.568	-6.57	6.568	.396	3.665

Table 3 represents Rit data after reduction in tail, the kurtosis and skewness of data are improved.

Performing an ADF test on all variables verifies the stationarity of the data. The results represent that each data rejects the original hypothesis, has no unit root and is a smooth time series data.

Table 4. ADF test of Rit, Rmt, Rot

	Test Statistics	p-value	Dickey-Fuller critical value		
			1%	5%	10%
Rit	-23.594	0.0000	-3.430	-2.860	-2.570
Rmt	-18.879	0.0000	-3.430	-2.860	-2.570
Rot	-25.866	0.0000	-3.430	-2.860	-2.570

Correlation analyses were then done on the data and the results were as follows.

Table 5. Pairwise correlations

Variables	(1)	(2)	(3)	(4)
(1) Rit	1.000			
(2) Rmt	0.755	1.000		
(3) Rot	0.453	0.254	1.000	
(4) war	0.021	0.012	0.018	1.000

The correlation analysis shows a weak negative positive relationship between Rit, Rmt, Rot and war, while Rit has a stronger positive relationship with Rmt, Rot. After basically analyze the data, the regression results are shown below.

Table 6. Overall regression results

Rit	Coef.	St.Err	t-value	p-value	Sig.
Rmt	1.225	0.066	17.36	0.000	***
Rot	0.229	0.034	6.67	0.000	***
war	0.025	0.171	0.15	0.882	
_cons	0.132	0.089	1.47	0.141	
Mean dependent var	-0.749		SD dependent var		2.332
Number of obs	857.000		F-test		188.27

*** p<0.01, ** p<0.05, * p<0.1

To compare the impact of the Russia-Ukraine war, a regression was made on the data before and after the war.

Table 7. Pre-war

Rit	Coef.	St.Err	t-value	p-value	Sig.
Rmt	1.253	0.07	17.46	0.000	***
Rot	0.205	0.038	5.32	0.000	***
_cons	0.154	0.092	1.68	0.094	*
Mean dependent var	-0.766	SD dependent var		2.309	
Number of obs	758.000	F-test		238.41	

*** p<0.01, ** p<0.05, * p<0.1

Table 8. During the war

Rit	Coef.	St.Err	t-value	p-value	Sig.
Rmt	1.070	0.118	9.07	0.000	***
Rot	0.338	0.048	7.05	0.000	***
_cons	0.0276	0.166	0.17	0.869	
Mean dependent var	-0.616	SD dependent var		2.515	
Number of obs	99.000	F-test		62.78	

*** p<0.01, ** p<0.05, * p<0.1

Prior to the war, the outcome indicate that Brent crude oil returns have a weak positive correlation with energy stock excess returns, while the beta of the market portfolio excess returns was 1.25, a significant positive correlation with energy stock excess returns. During the war, the beta of Rot was 0.33, which was higher than before the war, and the beta of Rmt dropped to 1.07, so the relationship between market portfolio excess returns and energy excess returns became weaker .In addition, the results of the chow test in the Table 9 show that the critical value 0.05 is greater than p-value of 0.0179, so the results are significant and there is a structural change in the impact of Rmt and Rot on Rit before and after the Russia-Ukraine war.

Table 9. Chow test

Chow's Structural Change Test		
Ho: no Structural Change		
Chow Test =	3.38	P-Value > F(3 , 777) = 0.0179

2.2 Analysis for Model 2

$$re_{stp} = \theta_0 + \theta_1 Pt + \theta_3 Gt + \theta_4 War + \varepsilon \quad (2)$$

All data in model 2 are selected from 22 February 2019 to 29 April 2022. Where re_stp is UK energy stock returns from the Wind financial terminal and Pt is the index of industrial production gained from the OECD Statistics Portal [12] representing real economic activity. Gt is the UK energy price CPI, data from the UK government website [13]. war represents the Russia-Ukraine war, when war=0, the Russia-Ukraine war has not yet started, when war=1, it is during the Russia-Ukraine war. Table 10 shows the descriptive statistics of these data. Details of descriptive statistics are shown below.

Table 10. Descriptive statistics

Variable	Obs	Mean	Std.Dev.	Min	Max
re_stp	783	-.007	1.511	-13.445	10.707
Pt	783	.008	4.251	-20.708	11.083
Gt	783	123.192	5.493	1	134.228

As shown in Table 11, we performed a ADF test on these data. The results show that the energy stock returns, and the industrial production index are stationary time series, while the energy price CPI has a unit root and is not a stationary time series. Therefore, we perform a first-order differencing of the energy price CPI to improve its smoothness, and the first-order differenced energy price CPI is denoted as dGt.

Table 11. ADF test

	Test Statistic	p-value	Dickey-Fulller critical value 1%	5%	10%
re_stp	-27.052	0	-3.430	-2.860	-2.570
Gt	2.717	0.9991	-3.430	-2.860	-2.570
Pt	-3.985	0.0015	-3.430	-2.860	-2.570
dGt	-3.338	0.0133	-3.430	-2.860	-2.570

The correlation analysis of the data is shown in table 12. There is a weak negative relationship between dGt, Pt, war and re_stp, and a weak negative relationship between Pt and war; however, there is a slightly stronger positive relationship between dGt and war.

Table 12. Pairwise correlations

Variables	(1)	(2)	(3)	(4)
(1) re_stp	1.000			
(2) Pt	-0.005	1.000		
(3) dGt	-0.027	0.006	1.000	
(4) war	0.032	-0.023	0.496	1.000

After basically analyze the data, the regression results are shown below.

Table 13. Overall regression

re_stp	Coef.	St.Err	t-value	p-value	Sig.
dGt	-0.180	0.111	-1.63	0.104	*
Pt	-0.001	0.022	-0.05	0.962	
war	0.386	0.214	1.80	0.072	*
_cons	0.038	0.069	0.55	0.583	
Mean dependent var	-0.007		SD dependent var	1.511	
Number of obs	783.000		F-test	1.349	

*** p<0.01, ** p<0.05, * p<0.1

Table 14. Pre-war

re_stp	Coef.	St.Err	t-value	p-value	Sig.
dGt	-0.195	0.111	-1.75	0.080	*
Pt	-0.001	0.022	-0.05	0.961	
_cons	0.043	0.070	0.62	0.537	
Mean dependent var	-0.019		SD dependent var	1.526	
Number of obs	736.000		F-test	1.537	

*** p<0.01, ** p<0.05, * p<0.1

Table 15. During war

re_stp	Coef.	St.Err	t-value	p-value	Sig.
dGt	1.861	1.249	1.49	0.143	
Pt	-0.927	1.102	-0.84	0.405	
_cons	-2.636	1.947	-1.35	0.183	
Mean dependent var	0.186		SD dependent var	1.245	
Number of obs	47.000		F-test	1.118	

*** p<0.01, ** p<0.05, * p<0.1

Table 16. Chow test

Chow's Structural Change Test Ho: no Structural Change		
Chow Test =	1.25	P-Value > F(3 , 777) = 0.2906

Both Table 14 and Table 15shows that the p-values for these data are all greater than five percent, so there is no significant result. The results of the chow test in Table.16 accept the original hypothesis, so there is no structural change in the return on energy stocks during the Russia-Ukraine war as a result of the industrial production index and the CPI.

The results of the first model indicate that energy stock returns and London Brent crude oil returns have been positively correlated with market portfolio excess returns, with the beta of market portfolio excess returns decreasing and the beta of London Brent crude oil returns increasing compared to the period before the war.

The industry production indices all have a non-significant effect on energy share prices. The second model shows that both the Energy CPI and the Industrial Production Index have a non-significant effect on energy share prices.

3. Conclusion

Linear regression models are applied in this paper to research the impact of the Russia-Ukraine war on stock prices of European energy. The Russia-Ukraine war has directly affected European countries that have long relied on Russian energy imports, resulting in energy shortages and rising energy prices in European countries. The results show that, before and after the Russia-Ukraine war, the positive correlation between the Brent crude oil yield and the excess return of energy stocks strengthened, and there is a decline in a positive correlation between the excess return of the market portfolio and the excess return of energy stocks. From the second model, the industrial production index and energy price CPI have little significant impact on energy stock prices before and after the Russia-Ukraine war.

In addition, there are still shortcomings in the article. When using data analysis, only the data of energy prices and stock prices in the UK are used, and no in-depth research has been carried out on other European countries, so the results are relatively one-sided. However, before this, there were very few studies on the stock price issue under the Russia-Ukraine war. We chose to supplement and develop some articles in this area, and also provide references for later scholars.

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