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On the protective effects of European sustainable stocks during the Russian invasion of Ukraine

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Abstract

Sustainable investments remain popular, attracting investors and researchers alike. Especially the tail-risk properties seem to differ between sustainable stocks and common stocks. Empirically, this can be observed in particular during extreme events. On February 24, 2022 Russian forces invaded Ukraine, thereby marking the beginning of a major historical event. Using standard event study methodology, we analyze if and how Refinitiv's environmental, social, and governance (ESG) ratings, as well as carbon dioxide (CO_2) intensity, influence cumulative abnormal returns during different event windows. We find that the abnormal returns of companies with high ecological scores exhibit a protective effect in the pre- and post-event windows. However, this effect did not materialize in all observed event windows. Therefore, our results do not fully support the hypothesis of an 'ESG hedge' against such extreme events.

Key words: abnormal returns, war, Ukraine, ESG, Russia
JEL Codes: G11, G14, M14

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1. Introduction

Investments considering ventures' environmental, social, and governance aspects (ESG) have become increasingly popular in recent years. There is an ongoing debate within the literature regarding 'green' stocks' return expectations and risk properties. In the general approach of Pedersen, Fitzgibbons, and Pomorski (2021), sustainable companies are expected to generate higher future profits. The expected returns of these firms depend on the dominant investor type in the market. Investors aware of ESG scores use this information to re-evaluate their expectations regarding the risk-return patterns of stocks.[1] To achieve this, it is essential to gain a deeper understanding of the risk-return patterns, with particular attention to tail-risks and their interconnection with ESG. In the equilibrium model of Pástor, Stambaugh, and Taylor (2021) 'greener' firms are expected to have lower returns due to nonpecuniary benefits of investors with a taste in ecologically aligned investments. In return, the authors attribute a climate-risk hedge property to such funds. There is a large body of empirical literature, suggesting that companies with a high reputation in environmental and social aspects provide an insurance-like protection against downside risks. E.g. Fombrun, Gardberg, and Barnett (2000), Godfrey (2005), Godfrey, Merrill, and Hansen (2009), Utz (2018), as well as Shiu and Yang (2017) contend, that firms engaged in sustained and trustworthy initiatives related to corporate social responsibility (CSR) offer investors such a form of protection. Given the strong interconnection between CSR and ESG[2], it is unsurprising that similar effects can be empirically demonstrated through the utilization of ESG scores.

Engle et al. (2020) document in their US-sample that mimicking portfolios based on environmental scores from MSCI and Sustainalytics can hedge against bad climate news. Additionally, Choi, Gao, and Jiang (2020) show in their international sample

1. Pedersen, Fitzgibbons, and Pomorski (2021) describe three types of investors. ESG-aware investors have preferences concerning mean-variance and utilize ESG scores to update their views on risk and expected returns. ESG-motivated investors, on the other hand, have a preference for high ESG scores. They make use of ESG information by selecting the portfolio with the highest Sharpe ratio for their preferred ESG score. In contrast, unaware investors do not incorporate ESG information into their decision-making.

2. Gillan, Koch, and Starks (2021) characterize ESG as broader in scope, as it explicitly encompasses governance, whereas in CSR, governance is only indirectly addressed through its connection to environmental and social considerations.

that firms with low carbon emissions perform better when temperatures are abnormally high. Furthermore, Ilhan, Sautner, and Vilkov (2021) find that options of S&P 500 firms which provide a protection against downside risks, are more expensive for carbon-intense companies due to uncertainties vis-à-vis future climate policies. Lins, Servaes, and Tamayo (2017) provide evidence, that companies with high CSR ratings (from the MSCI ESG Stats Database) outperformed firms with lower ratings during the global financial crisis, from August 2008 to March 2009. Engelhardt, Ekkenga, and Posch (2021) note that European firms with high Refinitiv ESG scores generated higher abnormal returns when the COVID-19 pandemic hit the financial markets, between February 3 and March 23, 2020. They observe that this effect was mainly driven by the social aspect of ESG. This is in line with the study of Albuquerque et al. (2020), who find in their US sample that firms with higher Refinitiv E and S ratings performed better in the first quarter of 2020. Conversely, Bae et al. (2021) find no evidence of a downside-risk protection for companies with high ESG ratings (according to Refinitiv or MSCI) during the stock market crash from February 18 to March 20, 2020, which was triggered by the pandemic. Their findings are in line with those of Demers et al. (2021), who document in their US sample that, after controlling for industry affiliation and other accounting- and market-based stock characteristics, the aforementioned downside-risk protection during the COVID-19 pandemic vanishes.

The Russian invasion of Ukraine on February 24, 2022 represents another recent crisis. In this event study, we analyze the European stock market's response to this war, offering fresh empirical insights into the ongoing discussion about the risk mitigation effect of companies with high ESG ratings during periods of crisis. This bears significant relevance for investors in sustainable stocks and for those who aim to diversify (tail) risks. There is a growing body of literature examining the economic implications of this war, particularly concerning the European market, although not exclusively. As noted by Ahmed, Hasan, and Kamal (2022), the onset of this war significantly impacted the European stock market. Using the daily stock prices of STOXX Europe 600 firms, they found negative and significant abnormal returns around February 24, 2022. Federle et al. (2022) observed in their international sample, covering firms from

54 countries, that the proximity to the conflict zone was a crucial factor influencing the market's response, when it comes to explaining cumulative returns in a 4-week event window around that date.

However, in the course of escalating sanctions against Russia from Western countries, a growing number of firms decided to leave the Russian market. Despite the adverse effects of ceasing business operations in Russia, companies that made a definitive decision to withdraw, outperformed those that either remained in Russia or withdrew reluctantly, as demonstrated by Sonnenfeld et al. (2022). This is especially interesting, since Basnet, Blomkvist, and Galariotis (2022) find, that companies with higher ESG scores were more likely to leave Russia. This seems to justify the high ethical standards attributed to such stocks, leading to the aforementioned protective effect.

So did the described insurance-like protection against downside-risks also prove robust at the Russian invasion of Ukraine? To evaluate this, we use the market model proposed by MacKinlay (1997). Our sample covers 1,608 firms from 30 European countries. As a measure of companies' environmental, social, and governance aspects we utilize Refinitiv's ESG scores, which consist of the total (TSC), environmental (ESC), social (SSC) and governance (GSC) scores. Furthermore, as another proxy for the environmental dimension, we make use of the companies' CO_2-intensity (C2R).

The results show that, in the pre- and post-event windows, higher ESC lead to positive cumulative abnormal returns (CAR), thus demonstrating the expected insurance-like effect. However, in the days closely surrounding the event, no such effect can be observed. Therefore, an omnipresent downside-risk protection cannot be ascribed to stocks with high Refinitiv ESG ratings. Our results regarding CO_2-intensity as well as robustness checks with cumulative raw returns (CRR) and different event windows largely support these findings.

The remainder of this paper is structured as follows. Section 2 describes the data and the asset pricing tests. Next, we present the results in Section 3. Finally, Section 4 concludes this paper.

2. Data and Methodology

We use daily total return data as well as accounting and ESG data from Datastream and Worldscope in €. The data is collected for all stocks originating from the European Union, as well as Norway, Switzerland, and the United Kingdom.[3] It is common practice to use accounting data of the year t_{-1} from June onwards, to avoid a lookahead bias. Since the event of interest occurred in February, we use accounting data from t_{-2}. According to Datastream documentation (Thomson Reuters (2017)), ESG data provisioning depends on the companies' fiscal year ends and the records are refreshed in two-week intervals. However, even for companies with a fiscal year end in September, no ESG data were yet provided by the end of March 2022. Therefore, we use data of t_{-2} for accounting data, as well as for ESG data including the ecological proxy C2R.

We use several static filters, as recommended by Schmidt et al. (2011) and Ince and Porter (2006), to clean our data. Furthermore, we control for illiquid companies and public holidays by setting zero returns to NA. Moreover, we exclude penny stocks.[4] All applied filters are summarized in Tables B1 and B2 in Appendix B. In addition to those filters, firms have to be covered by Refinitiv's ESG rating. The country composition of the sample is presented in Figure A1 in Appendix A.

The estimation window over 250 (normal) trading days spans from January 15 to December 30, 2021. Regarding the present event study's context, political tensions between Russia and Ukraine escalated following the annexation of Crimea in 2014, and were further aggravated in July 2021 with the publication of the article 'On the Historical Unity of Russians and Ukrainians' (Vladimir Putin (2021)). Despite even clearer indications of a possible conflict, appearing by the end of the year, defining the year 2021 as 'normal' seems reasonable. By the beginning of January 2022, leading stock indices such as the MSCI World, the Dow Jones Industrial Average, and the German DAX reached all-time highs. This suggests, that investors were not expecting a war at that time. The day of the invasion (February 24, 2022) was chosen as event

3. All countries and the corresponding country lists are presented in Table A1 in Appendix A.
4. We define penny stocks as stocks with an unadjusted price below 1€ on December 31, 2021.

date t_0. The term 'event window' refers to the date of the studied event and the three business days both before and after it. Therefore, this period also encompasses the recognition of the People's Republics of Donetsk and Luhansk on February 21, 2022.

For the calculation of abnormal returns during the event period, we start by regressing the daily returns in our estimation window on the MSCI Europe Index returns using equation (1):

$$R_{i,t} = \alpha_i + \beta_i MSEU_t + \epsilon_i, \tag{1}$$

where $R_{i,t}$ are the stock-specific realized returns during the estimation period and $MSEU_t$ are the realized returns of the MSCI Europe Index. We require each stock to have a coverage of cleaned returns data of at least 70%.

The expected returns during the event period are calculated as in equation (2):

$$E(R_{i,t}) = \alpha_i + \beta_i MSEU_t \tag{2}$$

Abnormal returns (AR) are defined as in equation (3):

$$AR_{i,t} = R_{i,t} - E(R_{i,t}) \tag{3}$$

We calculate cumulative abnormal returns (CAR) as in equation (4):

$$CAR_i = \sum_{t_0+d_1}^{t_0+d_2} (AR_{i,t}), \tag{4}$$

where d_1 and d_2 are the borders of the defined event windows (in days) and may be negative or positive.

We regress those CARs on ESG scores from Refinitiv as well as on C2R. We do this, because the CO_2-intensity can be considered another proxy for the E dimension, which is independent of an artificial scoring mechanism. It is hard to find useful proxies for the environmental pillar of ESG which are available for a broad range of companies.

It is even more difficult to find useful variables for the social and governance pillars. Therefore, no results on other characteristics related to those ESG dimensions can be reported.[5]

We use a variety of control variables. We follow Demers et al. (2021) and use the first two digits of the Standard Industrial Classification (SIC) codes as industry controls. However, SIC does not provide a sector code to identify defense companies. To account for the special nature of the event, we therefore use the Industry Classification Benchmark (ICB) subsectors to exclude companies in the defense sector.[6] Figure 1 shows the average (non-cumulative) abnormal returns of the 11 excluded companies from the beginning of January to March 10, 2022. As suspected, initially, we observe random fluctuations around zero well into February. However, with the start of the war an extreme increase in abnormal returns becomes evident. This can be seen as an indication, that the majority of investors did not expect the Russian invasion of Ukraine, supporting our choice of February 24, 2022 as event date.[7]

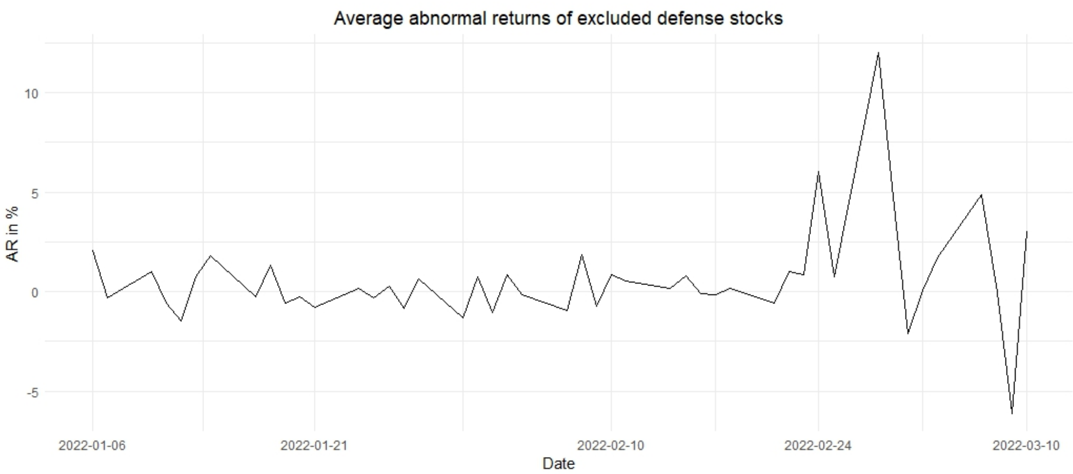

Figure 1. Average abnormal returns of excluded defense stocks.

Given the special nature of the event, controlling for the economic ties to Russia and Ukraine has to be considered. After all, the degree of economic dependency to Russia

5. When using characteristics that are related to the social pillar of ESG, such as the rate of employee turnover or the injuries per million working hours, the sample size drops to 454, which is less than 1/3 of the available sample when using Refinitiv scores. Data availability in the governance pillar is even worse.

6. Our main results are robust to the direct usage of the ICB subsectors as industry control variables.

7. Furthermore, it is also reflected by the losses of major stock indices on February 24, 2022. E.g. the German DAX lost ∼5% in the course of the day, UK's FTSE100 about 3.8% and the Polish WIG more than 10%.

may yield for a significant portion of the observed stock price movements. We rely on the combination of industry and country fixed effects in this respect. Additionally, as another proxy variable for the economic interconnection, we utilize the distance to Moscow (DTM), as distance has a negative effect on the trade volume, as demonstrated by Head and Mayer (2014). Federle et al. (2022) and Boungou and Yatié (2022) show, that such proximity measures are indeed an important factor to be considered, when trying to explain the stock market reactions in the light of war. To do so, we obtain the addresses of each stock's headquarters from Datastream. Using ArcGIS, we convert them into GPS coordinates, and use them to calculate DTM (in 1,000 kilometers).[8] The inclusion of Russia-specific βs[9] as an additional control for the ties to Russia is problematic in our setting, since we calculate normal returns, using βs to the MSCI Europe Index (see equation (3)). This index, as well as the MSCI Russia Index, are influenced by global market sentiment, which affects the beta estimates. Since we use CARs as dependent variable, that rely on those betas, the inclusion of Russia-specific βs as control variable introduces major endogeneity problems. When working with raw returns, instead of abnormal returns, no such problem arises, especially since the beta estimates are performed, using data from 2021.[10] So we do both and present our results based on CARs, controlling for the described distance measures. We further show how these results are reflected in the models using CRRs, controlling for βs on the MSCI Russia Index and DTM.[11] CRRs are calculated (similarly to CARs) as of equation (5):

$$CRR_i = \sum_{t_0+d_1}^{t_0+d_2} (R_{i,t}). \tag{5}$$

As outlined by Cakici and Zaremba (2022), it is especially important to control for

8. Additionally we also calculate the distance to Kiev (DTK). Given their high correlation (as of table 2), the choice between these two distance measures has minimal impact on the regression results.

9. Which were also utilized by Federle et al. (2022) as control variables.

10. Federle et al. (2022) and Biermann and Leromain (2023) also employ raw returns and are therefore able to include Russia related beta estimates in their analysis.

11. The approach is similar to equation (1), replacing the MSCI Europe Index with the MSCI Russia Index, again using daily returns within the estimation period. The results of our raw return estimates can be found in Appendix section C.

size, because larger companies tend to have better ESG scores.[12] As additional variables, we include the natural logarithm of the book-to-market (BM) ratio, profitability (PRO), as defined by Novy-Marx (2013) and investment (INV) following Fama and French (2015). Furthermore, we follow Bae et al. (2021) and control for the cash and debt rates (CR and DR).[13]

Table 1. Descriptive statistics. This table shows the descriptive statistics for our dependent and independent variables. The CARs cover the indicated days before, during, and after the event in %. We obtain the total (TSC), environmental (ESC), social (SSC), and governance (GSC) ESG scores from Refinitiv. ln(C2R) is the natural logarithm of the CO_2-intensity, calculated from the total CO_2 and CO_2-equivalent emissions in tonnes, divided by total assets. PRO is calculated as described in Novy-Marx (2013). For INV, the approach of Fama and French (2015) is used. As a size proxy, the natural logarithm of the market value on December 31, 2021, is used. ln(BM) is the book value of t_{-2} divided by the market value of t_{-2} ultimo. CR and DR are the cash and debt rate, while DTM (DTK) is the distance from the company's address (as listed in Datastream) to Moscow (Kiev) in 1,000 kilometers.

	N	Mean	St. Dev.	Min.	Median	Max
CAR [-10,+10]	1,608	-2.41	12.83	-104.83	-2.84	53.06
CAR [-10,-4]	1,608	-1.66	5.85	-33.62	-1.08	19.91
CAR [-3,3]	1,608	-0.36	8.25	-61.02	-0.65	30.61
CAR [4,10]	1,608	-0.39	6.86	-25.55	-0.32	35.37
TSC	1,608	51.57	21.23	1.74	53.01	95.09
ESC	1,607	44.28	27.32	0.00	43.64	99.22
SSC	1,607	54.14	23.99	0.57	55.66	97.36
GSC	1,607	53.45	22.32	1.26	54.48	98.05
ln(C2R)	1,197	-4.18	2.20	-12.34	-4.17	3.01
PRO	1,608	0.31	0.24	-0.21	0.26	2.05
IVT	1,608	0.13	0.48	-0.85	0.03	7.15
ln(MV)	1,608	7.37	1.73	2.69	7.27	12.81
ln(BM)	1,608	-0.96	0.97	-6.63	-0.87	3.86
CR	1,608	0.14	0.13	0.00	0.11	0.95
DR	1,608	0.27	0.17	0.00	0.27	0.86
DTK	1,608	1.77	0.60	0.54	1.67	10.84
DTM	1,608	2.10	0.69	0.82	2.20	10.74

Table 1 shows the descriptive statistics for our variables. There is a decline in the number of observations when considering C2R. This decline is attributed to the absence of CO_2 data for 410 stocks in our sample, despite the availability of Refinitiv ESG scores. However, from an availability point of view, this is still the best directly observable variable to proxy for the ESC. Table 2 shows the cross-correlations. It may be noted that the scores, as provided by Refinitiv, are correlated. Furthermore, they also have a correlation of $35\% - 56\%$ with firm size, supporting the aforementioned observation of Cakici and Zaremba (2022) in our sample. Conversely, C2R shows low correlations with all other variables.

12. They even argue that ESG premiums may be the 'small firm effect in disguise' (p. 4).

13. All variables used, are defined and described in detail in table A2 in Appendix A. The used Datastream items are presented in table A3.

Table 2. Correlation matrix in %. This table shows the cross-correlations for our dependent and independent variables. The CARs cover the indicated days before, during, and after the event in %. We obtain the total (TSC), environmental (ESC), social (SSC), and governance (GSC) ESG scores from Refinitiv. C2R indicates CO_2-intensity, calculated from the total CO_2 and CO_2-equivalent emissions in tonnes, divided by total assets. PRO is calculated as described in Novy-Marx (2013). For INV, the approach of Fama and French (2015) is used. As a size proxy, the natural logarithm of the market value on December 31, 2021, is used. ln(BM) is the book value of t_{-2} divided by the market value of t_{-2} ultimo. CR and DR are the cash and debt rate, while DTM (DTK) is the distance from the company's address (as listed in Datastream) to Moscow (Kiev) in 1,000 kilometers.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	
(1) CAR [-10,10]	100%																
(2) CAR [-10,-4]	46%	100%															
(3) CAR [-3,3]	73%	4%	100%														
(4) CAR [4,10]	64%	4%	13%	100%													
(5) TSC	11%	13%	1%	8%	100%												
(6) ESC	13%	17%	1%	10%	85%	100%											
(7) SSC	9%	12%	2%	6%	90%	71%	100%										
(8) GSC	6%	6%	1%	5%	72%	41%	48%	100%									
(9) ln(C2R)	4%	13%	-4%	4%	9%	12%	11%	3%	100%								
(10) GPN	-15%	-14%	0%	-17%	-14%	-14%	-13%	-9%	0%	100%							
(11) IVT	-7%	-12%	7%	-11%	-13%	-11%	-13%	-9%	-16%	8%	100%						
(12) ln(MV)	13%	7%	11%	4%	65%	57%	59%	46%	2%	-15%	2%	100%					
(13) ln(BM)	3%	17%	-17%	13%	1%	7%	-2%	-1%	17%	-40%	-23%	-23%	100%				
(14) CR	-7%	-6%	0%	-9%	-10%	-10%	-9%	-8%	-10%	29%	14%	-12%	-35%	100%			
(15) DR	-2%	5%	-5%	-2%	15%	18%	15%	6%	9%	-16%	5%	4%	5%	-23%	100%		
(16) DTK	8%	18%	6%	-8%	-2%	-1%	-1%	-1%	-2%	-7%	3%	2%	0%	4%	2%	100%	
(17) DTM	6%	24%	3%	-11%	2%	2%	3%	-2%	1%	-9%	1%	5%	2%	6%	3%	94%	100%

3. Results & Discussion

In table 3 we report the results of the cross-sectional regressions of the CARs on Refinitiv's ESG scores.[14] Models 1 – 4 show the results for the total ESG score (TSC). In the [-10,10] overall event window (model 1) we find, that the CARs are positively influenced by this variable with a t-value of 2.2935 and a magnitude of 0.05%. A brief discussion on the magnitude of the observed effect is needed. Given a standard deviation of 21.23, as outlined in table 1, this would lead to a protective effect of 1.06% of stocks whose TSC are one standard deviation above mean. Given, that the MSCI Europe Index has generated a cumulative return of -9.40% during this period, the protective effect is not negligible. The three sub-windows as presented in models 2 – 4 reveal, that this effect arises from the pre- and post-event window as of models 2 and 4. Especially the [-10,-4] period shows a high level of significance with a t-value beyond 4 and a magnitude of 0.04%. After all, the war may not have been a completely unanticipated event, as stated by Biermann and Leromain (2023), so that the insurance-like protection of sustainable stocks was already effective before the start of the war. This is also reflected by the highly significant negative regression coefficient on the MSCI Russia-β in our regression using CRRs as dependent variable from [-10,-4] as of models 2 and 6 of table C5 in Appendix section C.[15] In the narrow time window, directly around the day of the invasion, as presented in model 3, no such protective effect can be observed. This may have been the result of the general confusion, caused by the outbreak of the war.

14. We winsorize CARs at the 1% and 99% levels. Additional results, using unwinsorized CARs, are available upon request.

15. The reported coefficients on the MSCI Russia-β may seem to outweigh other reported effects, yet the standard deviation is also only 0.16 as of table C4 compared to 21.23 for TSC. Therefore, both effects are to be interpreted in the same order of magnitude.

Table 3. Cross sectional regressions of cumulative abnormal returns in % on Refinitiv ESG scores. This table reports the results of cross sectional regressions. The event date t_0 is February 24, 2022. The reported windows are located before, during, and after this event. TSC, ESC, SSC, and GSC are Refinitiv's total, environmental, social, and governance ESG scores. PRO is calculated as described in Novy-Marx (2013). For INV the approach of Fama and French (2015) is used. As a size proxy, we use the natural logarithm of the market value on December 31, 2021. For the calculation of ln(BM), the 2020 book values and the MV on the 2020 ultimo are used. CR and DR are the cash and debt rate, while DTM is the distance from the company's address (as listed in Datastream) to Moscow in 1,000 kilometers. We report absolute t-values between parentheses, based on robust standard errors (White (1980)). We control for firm and industry fixed effects. ***, **, and * indicate a significance level of 1%, 5%, and 10%, respectively.

	(1) [-10,10]	(2) [-10,-4]	(3) [-3,3]	(4) [4,10]	(5) [-10,10]	(6) [-10,-4]	(7) [-3,3]	(8) [4,10]
Intercept	13.13**	4.96***	-0.63	8.81***	14.40**	5.16***	-0.39	9.63***
	(2.0897)	(2.9004)	(0.1567)	(2.9868)	(2.2853)	(2.9851)	(0.0958)	(3.2323)
TSC	0.05**	0.04***	-0.01	0.02**				
	(2.2935)	(4.0601)	(0.9134)	(2.0440)				
ESC					0.06***	0.02**	0.00	0.04***
					(3.2246)	(2.4808)	(0.3881)	(3.4879)
SSC					-0.02	0.01	-0.01	-0.02
					(0.9520)	(0.9671)	(0.9026)	(1.5480)
GSC					0.01	0.01	0.00	0.00
					(0.4496)	(1.1637)	(0.4248)	(0.3858)
PRO	-5.31***	0.01	-2.05*	-3.26***	-5.57***	-0.06	-2.07*	-3.44***
	(3.0076)	(0.0073)	(1.8913)	(3.9342)	(3.1543)	(0.0762)	(1.9055)	(4.1192)
ln(BM)	-0.90*	0.55***	-1.31***	-0.15	-0.95**	0.54***	-1.31***	-0.18
	(1.9592)	(2.6763)	(4.6158)	(0.6198)	(2.0480)	(2.6162)	(4.6173)	(0.7422)
ln(MV)	0.31	-0.06	0.47***	-0.10	0.28	-0.07	0.48***	-0.12
	(1.2248)	(0.5146)	(2.8465)	(0.6907)	(1.0859)	(0.5978)	(2.8333)	(0.8480)
INV	-0.91	-1.01***	1.32***	-1.22**	-0.93	-1.02***	1.32***	-1.23**
	(1.1933)	(2.7462)	(3.5966)	(2.4591)	(1.2228)	(2.7916)	(3.5884)	(2.4728)
DR	-3.63*	-0.74	-2.78**	-0.11	-3.69*	-0.78	-2.77**	-0.15
	(1.6873)	(0.8507)	(2.1024)	(0.0962)	(1.7065)	(0.8935)	(2.0864)	(0.1260)
CR	-0.26	-2.15*	0.29	1.60	-0.19	-2.06	0.23	1.63
	(0.0823)	(1.6621)	(0.1569)	(1.0007)	(0.0611)	(1.5852)	(0.1254)	(1.0238)
DTM	-0.38	0.16	-0.14	-0.39	-0.43	0.16	-0.17	-0.42
	(0.5181)	(0.4392)	(0.3838)	(1.2047)	(0.5673)	(0.4369)	(0.4348)	(1.2560)
Industry FE	yes	yes	yes	yes	yes	yes	yes	yes
Country FE	yes	yes	yes	yes	yes	yes	yes	yes
Winsorized	yes	yes	yes	yes	yes	yes	yes	yes
R^2	0.2461	0.3323	0.256	0.2215	0.2491	0.3332	0.2572	0.2259
Adj. R^2	0.2003	0.2917	0.2108	0.2108	0.2024	0.2917	0.211	0.1778
N	1608	1608	1608	1608	1607	1607	1607	1607

When dissecting Refinitiv's total ESG score into its sub-components, model 5 shows, that during the overspanning [-10,10] event window, the protective effect is mainly driven by the environmental score (ESC) with a magnitude of 0.06% and a t-value of 3.2246.[16] Unreported regressions, using the three ESG pillars solely, support those results. However, with a variance inflation factor (vif) of 3.41 at most, a joint estimation seems appropriate.[17] A closer look at the different event phases reveals, that the observed effect on ESC is attributable to the pre- and post-event windows [-10,-4] and [4,10], while being insignificant in the narrow [-3,3] window (models 6 – 8).[18] The ap-

16. According to table C5, the effect diminishes to a statistically significant 0.03% when employing CRRs.

17. Standard econometric books such as Greene (2020) assume problematic multicollinearity only at a vif above 20.

18. This is also reflected in the regression of cumulative raw returns in the robustness check as of table C5.

parent contradiction between TSC and ESC which shows a higher (lower) magnitude for TSC in the pre-(post-)event periods, can be attributed to the calculation procedure of TSC and the underlying sub-elements. As documented in Refinitiv (2022), SSC and GSC account for ∼31% and ∼26% respectively. In the pre-event window, the coefficients for these two scores are positive but statistically insignificant. However, in the post-event window, the coefficient for SSC is still insignificant, yet negative with a magnitude of -0.02%. This has an impact on the results of TSC and leads to the observed contradiction.

Table 4. Cross sectional regressions of cumulative abnormal returns in % on carbon intensity. This table reports the results of cross sectional regressions. The event date t_0 is February 24, 2022. The reported windows are located before, during, and after this event. For C2R the total CO_2 and CO_2-equivalent emissions in tonnes, divided by total assets are used. PRO is calculated as described in Novy-Marx (2013). For INV the approach of Fama and French (2015) is used. As a size proxy, we use the natural logarithm of the market value on December 31, 2021. For the calculation of ln(BM), the 2020 book values and the MV on the 2020 ultimo are used. CR and DR are the cash and debt rate, while DTM is the distance from the company's address (as listed in Datastream) to Moscow in 1,000 kilometers. We report absolute t-values between parentheses, based on robust standard errors (White (1980)). We control for firm and industry fixed effects. ***, **, and * indicate a significance level of 1%, 5%, and 10%, respectively.

	(1) [-10,10]	(2) [-10,-4]	(3) [-3,3]	(4) [4,10]
Intercept	19.82***	6.72***	2.51	10.59***
	(2.8844)	(3.5074)	(0.5638)	(3.1069)
ln(C2R)	-0.44*	0.03	-0.17	-0.30**
	(1.6992)	(0.2991)	(1.1164)	(2.3232)
PRO	-5.46***	-0.79	-1.67	-3.01***
	(2.7008)	(0.7878)	(1.3649)	(3.0099)
ln(BM)	-0.69	0.56**	-1.33***	0.08
	(1.4591)	(2.4884)	(4.5083)	(0.2961)
ln(MV)	0.52**	0.11	0.28*	0.13
	(2.2566)	(1.1839)	(1.9582)	(1.0125)
INV	-1.14	-1.46**	1.48	-1.17
	(0.7605)	(2.2506)	(1.5362)	(1.5149)
DR	-5.04**	0.33	-4.49***	-0.88
	(1.9800)	(0.3530)	(2.8379)	(0.6529)
CR	-2.62	0.46	-1.05	-2.02
	(0.6015)	(0.2520)	(0.4062)	(0.8641)
DTM	-0.53	-0.05	0.05	-0.53
	(0.5717)	(0.1182)	(0.1397)	(1.4117)
Industry FE	yes	yes	yes	yes
Country FE	yes	yes	yes	yes
Winsorized	yes	yes	yes	yes
R^2	0.2800	0.2783	0.2891	0.2542
Adj. R^2	0.2200	0.2181	0.2299	0.1920
N	1197	1197	1197	1197

In table 4 we use C2R as a proxy for the environmental pillar of ESG. Model 1 shows an abnormal underperformance for companies with a high CO_2-intensity in the [-10,10] window, which is in line and adds further robustness to our observations regarding ESC, as just described. An increase in C2R by one percent leads to a loss of -0.44% in terms of cumulative abnormal returns, however only on a low level of significance with a t-value of 1.6992. This effect is mainly attributable to the post-event window as of model 4 with a magnitude of -0.30% and a t-value of 2.3232 and is compliant to the results on ESC in the regressions above, using the three ESG pillars. This result could have been expected, since Russia is one of the largest providers of fossil energies in Europe, while the war raised skepticism regarding the security of energy supplies. These results support the findings of Deng et al. (2022), who find that investors expect policymakers to become much more ambitious concerning the transition to a low-carbon economy in Europe as a result of the war.[19] Therefore companies that are more exposed to the transition risk were outperformed by stocks associated with climate change opportunities.

Looking briefly at the control variables in models 1 – 8 as of table 3, companies with higher profitability (PRO) perform significantly worse in the [-10,10] overall event window (models 1 and 5). A deeper look reveals, that this effect mainly stems from the [4,10] window (models 4 and 8) and is even present in the longer [4,20] windows, as of table C1 (models 3 and 6). This downstream effect is present in all our analysis. Following the invasion and the sanctions imposed by Western-oriented governments, the impact on established business models was not assessable for investors. The uncertainty caused, may have motivated investors to sell stocks with well-established, profitable business models. This is also indicated by the significant negative regression coefficients of ln(BM) in the [-3,3] window (models 3 and 7), indicating a preference for growth over value stocks, when the risk of war materialized. Before the outbreak of the war, as of models 2 and 6, the preference was opposite. This change in preferences due to the Russian invasion of Ukraine persists also in the longer post-event window [4,20] as of model 3 in table C1. Again, the more flexible business model of growth stocks with less capital tied up (relying on cheap energy supplies from Russia) might be a possible explanation for this observation. Additionally, we observe a considerable size effect, as indicated by the positive regression coefficient on ln(MV), in our models

19. Deng et al. (2022) also use the total Refinitiv ESG score as a control variable in their analysis of cumulative stock returns. Their results for Europe are consistent with ours reported in table C5. Since their study has a different focus, they do not report results for ESC, SSC and GSC separately.

utilizing ESG scores in the [-3,3] window. This indicates, in addition to the flexibility aspect, a preference for bigger companies, as they seem to be more stable in times of uncertainty.

For INV we observe significant positive values within the [-3,3] window (models 3 and 7), with a considerable magnitude. Interestingly, the coefficient of INV is significantly negative before the event and again in the post-event window. This observation is stable for our estimations using the TSC (models 2 – 4) and the three ESG pillars seperately (models 6 – 8), as well as for our results using CRRs as of table C5. When using C2R as dependent variable, as of tables 4 and C6, there is no significance in the [-3,3] and [4,10] windows, yet the signs are still in the described pattern. A possible explanation for this switching behaviour might be, that investors in companies with an aggressive investment style may have disliked the uncertainty in the days before the war. Therefore, the positive sign on INV during the [-3,3] window might be explained by the manifestation of the risk, with an expectation of the Russian Federation's victory within a few days. When it became clearer that the conflict would last longer, uncertainty regarding existing and expanding business models returned to the markets.

Another significant and stable effect can be observed for indebted companies, as indicated by the negative regression coefficient of DR in the overall event windows [-10,10]. This effect primarily stems from the narrow [-3,3] window and persists across all analysis conducted, irrespective of the used ESG-variables or the usage of CARs or CRRs. This is not surprising, since higher levels of debt reduce the resilience against economic disturbances, which naturally arise in the light of a war.

As stated above, we use DTM to further control for the economic ties to Russia in addition to the country and industry fixed effects in our (CAR)models. As long as we use country fixed effects, it remains insignificant throughout our analysis. However, when not controlling for country fixed effects as of table C3, we find significant positive effects in the [-10,-4] event window and negative effects in the [4,10] window. Their disappearance indicates, that the inclusion of country and industry fixed effects already accounts for a substantial portion of the distance effect, along with other effects such as culture or (economic) history vis-à-vis Russia and Ukraine.

In tables C5 and C6 we use CRRs instead of CARs. This enables us to additionally include the MSCI Russia-β as another variable to control for the economic ties of companies with Russia. We find significant negative effects in the [-10,-4] and the [-3,3] event windows as of models 2 and 3 in both tables and models 6 and 7 in table C5. However, in the downstream event window [4,10] (model 4 in both tables and model 8 in table C5) we observe a strong rebound for stocks with high MSCI Russia-βs, analogous to the mentioned negative effect on DTM in this window. At this point we can not offer an economic interpretation for this observation. Nevertheless, the overall effect in the overspanning [-10,10] event window (models 1 in both tables and 5 in table C5) stays negative.

4. Conclusion

In this paper, we analyze the (raw and abnormal) returns of European stocks in different event windows around February 24, 2022 – the day when Russian forces invaded Ukraine. Following standard event study methodology, we assess the effects of Refinitiv ESG ratings and CO_2-intensity on CARs and CRRs to contribute to the literature on the tail-risk properties of sustainable stocks.

We find that stocks with high Refinitiv ESG scores provide a significant insurance-like effect on (cumulative) abnormal stock returns in light of the Russian invasion of Ukraine. This effect can be especially attributed to the ecological dimension of the rating and materializes in our pre- and post-event windows. It remains robust when using cumulative raw returns and additionally controlling for the MSCI Russia-β. Furthermore, using the CO_2-intensity as a proxy variable for the ecological performance of companies supports our findings. However, no effect is observable for the narrow event window itself ([-3,3]). Amidst the general confusion in the days surrounding the event, other characteristics that are associated with flexibility, stability, and defensiveness appear to gain importance for investors. Therefore, we can not conclude that the described insurance-like effect of sustainable stocks is omnipresent in the course of such an extreme event and it may also depend on the event's nature and phase.

This study is constrained by the availability of ESG data. For example, it would have been interesting to see if the observed effects also hold for stocks of Eastern European countries. Unfortunately, ESG data are scarce, particularly for stocks of European countries bordering Ukraine or Russia (except for Finland). Another point to be considered is the disagreement of rating agencies in their ESG scores.[20] Using ESG-related factors (such as the CO_2-intensity we used) could help mitigate problems associated with using ESG scores of rating agencies. Nevertheless, this approach is not feasible for further ESG-related factors due to the limited data availability. Another aspect to be acknowledged is the choice of the event windows and the event date itself. It could be questionable to regard the Russian invasion on February 24, 2022 as 'unexpected'. Unlike natural disasters, there were signs and warnings before the event. Some market participants may have already formed expectations in this regard. However, as outlined above, major stock indices experienced high losses on February 24, 2022, while the excluded stocks from the defense sector gained considerable abnormal returns as visualized in figure 1. This suggests that the event was at least partially unexpected for the market participants.

For investors seeking protection against such events, relying on ESG scores is, from our point of view, only partially recommendable. Generally speaking, an insurance-like effect is present but does not materialize during each phase of our observed event. However, retail investors have only recently begun to develop preferences regarding sustainable stocks. This will continue due to the regulatory efforts on transparency and advisory – particularly within the European markets. The regulation on sustainability-related disclosures EU (2019) came into effect on March 10, 2021. Further (delegated) regulations on financial and insurance advisors (EU (2021a) and EU (2021b)) were adopted on August 2, 2022 and implement a compulsory assessment of clients' sustainability preferences. These regulations empower investors to formulate sustainability preferences more efficiently and could influence the distribution of investor types described by Pedersen, Fitzgibbons, and Pomorski (2021). Therefore, it is important

20. As extensively discussed in Berg, Kölbel, and Rigobon (2022).

to further investigate the behaviour of ESG investments in future crises, which could enable us to understand if and how investors value ESG properties in terms of a potential downside-risk protection and also if this behaviour changes over time.

Disclosure statement

No potential conflict of interest is reported by the author(s).

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Appendix A. Data items

Table A1. Countries and Datastream lists per country. The correct mapping of companies per country is ensured by the data screens, as described in Appendix section B.

Country	Country code	Lists
Austria	AT	WSCOPEOE, ALLAS, FOST
Belgium	BE	WSCOPEBG, FBEL
Bulgaria	BG	WSCOPEBL, DEADBG, FBGALL
Croatia	HR	WSCOPECT, DEADHR, CTALL
Cyprus	CY	WSCOPECP, DEADCY, FCYALL
Czech Republic	CZ	WSCOPECZ, DEADCZ, CZALL
Denmark	DK	WSCOPEDK, DKALL
Estinia	EE	WSCOPEEO, DEADEE, FEEALL
Finland	FI	WSCOPEFN, FFIN
France	FR	WSCOPEFR, FFRA
Germany	DE	WSCOPEBD, FGERDOM, FGERIBIS, FGER1, FGER2, FDEALLP1, FDEALLP2
Greece	GR	WSCOPEGR, GRALL, DEADGR, FGREE, FGRMM, FGRPM, FNEX A
Hungary	HU	WSCOPEHN, DEADHU, HNALL
Ireland	IE	WSCOPEIR, FIRL
Italy	IT	WSCOPEIT, FITA
Latvia	LV	WSCOPELV, DEADLV, LVALL
Lithuania	LT	WSCOPELN, DEADLT
Luxembourg	LU	WSCOPELX, LXALL
Malta	MT	WSCOPEMA, MAALL, DEADML
Netherlands	NL	WSCOPENL, FHOL
Norway	NO	WSCOPENW
Poland	PL	WSCOPEPO, DEADPL, POALL
Portugal	PT	WSCOPEPT, FPOR
Romania	RO	WSCOPERM, DEADRO, RMALL
Slovakia	SK	WSCOPESX, DEADSLO, ALLSLOV, SXALL
Slovenia	SI	WSCOPESJ, DEADSV, SJALL
Spain	ES	WSCOPEES, FSPDOM, FSPN, FSPNQ
Sweden	SE	WSCOPESD, SDALL
Switzerland	SW	WSCOPESW, FSWA, FSWS
United Kingdom	UK	WSCOPEUK, FBRIT

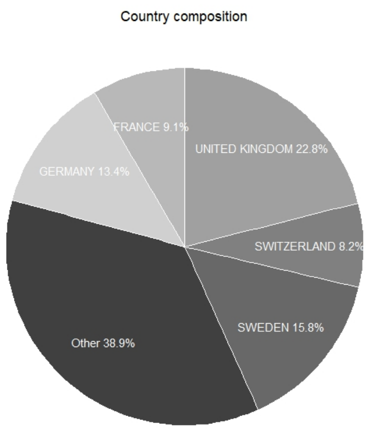

Figure A1. Country composition of the sample.

Table A2. Variable definition. This table describes the variables used.

# Variable Name	Description
AR_i	Stock-specific abnormal returns: Calculated as of equation (3).
BM	Bootk-to-market ratio: The book values (WC03501) as of 2020 are divided by the market value as of 2020-12-31.
C2R	CO_2 ratio (intensity): Relative CO_2 consumption per firm. Calculated by dividing CO_2 by total assets (Datastream Mnemonic WC02999) as of 2020.
CAR[d_1, d_2]	Cumulative abnormal returns: Calculated as of equation (4). d_1 and d_2 are the borders of the defined event windows (in days) and may be negative or positive.
CRR[d_1, d_2]	Cumulative raw returns. d_1 and d_2 are the borders of the defined event windows (in days) and may be negative or positive.
CO_2	CO_2 and CO_2-equivalent emissions (scope 1 + 2) per firm as of 2020.
CR	Cash rate: Cash holdings (WC02003) divided by total assets (WC02999). All values are as of 2020.
DTK	Distance to Kiev: Distance from the company's address (as listed in Datastream) to Kiev in 1,000 kilometers. The coordinates for each firm were determined using ArcGIS.
DTM	Distance to Moscow: Distance from the company's address (as listed in Datastream) to Moscow in 1,000 kilometers. The coordinates for each firm were determined using ArcGIS.
ESC	Environmental score of Refinitiv's ESG rating as of 2020.
GSC	Governancel score of Refinitiv's ESG rating as of 2020.
IVT	Investment as described in Fama and French (2015). Calculated as (Total assets $(WC02999)_{2020}$ - Total assets $(WC02999)_{2019}$) / Total assets $(WC02999)_{2019}$.
MSCI $Russia - \beta$	Measurement of sensitivity to the Russian stock market. Calculated using equation (1), but replacing $MSEU_t$ with the MSCI Russia Index. The MSCI $Russia - \beta$ is calculated using the estimation window over 250 trading days from January 15 to December 30, 2021.
MSEU	Realized returns of the MSCI Europe Index, using Datastream item RI.
MV	Market value.
PRO	Profitability as described in Novy-Marx (2013), which is (Sales (WC01001) - Cost of goods sold (WC01051)) / Total assets (WC02999). All values are as of 2020.
R_i	Stock-specific realized returns during the estimation period, calculated from Datastream item RI.
SSC	Social score of Refinitiv's ESG rating as of 2020.
TA	Total assets (WC02999) as of 2020.
DR	Debt rate: Total debt (WC03255) divided by total assets (WC02999). All values are as of 2020.
TSC	Total score of Refinitiv's ESG rating as of 2020.

Table A3. Datastream and Worldscope items used. This table shows the Datastream and Worldscope items and their usage in our analysis. The periodicity indicates how the data were retrieved.

# Mnemonic	Usage	Periodicity
WC02999	ASSETS (TOTAL): - Calculate carbon dioxide intensity - Calculate cash rate - Calculate debt rate - Calculate investment factor - Calculate profitability	y
WC02003	CASH HOLDINGS: - Calculate cash rate	y
WC03501	COMMON SHAREHOLDERS EQUITY: - Calculate book value	y
WC01051	COST OF GOODS SOLD: - Calculate profitability	y
GEOGN	COUNTRY OF COMPANY: - Data screens	static
GEOLN	COUNTRY OF SECURITY: - Data screens	static
PCUR	CURRENCY SHORTCUT: - Data screens	static
ENERDP023	CO_2 AND CO_2-EQUIVALENT EMISSIONS (TOTAL): - Calculate carbon dioxide intensity	y
WC03255	DEBT (TOTAL): - Calculate debt rate	y
ENSCORE	ENVIRONMENTAL SCORE (ESG): - Independent regression variable	y
ECNAME	EXPANDED COMAPY NAME: - Data screens	static
ENAME	EXPANDED NAME: - Data screens	static
NAME	EXTENDED NAME: - Data screens	static
CGSCORE	GOVERNANCEL SCORE (ESG): - Independent regression variable	y
WC07015	INACTIVE DATE: - Data cleaning	static
ISINID	ISIN CODE - PRIMARY/SECONDARY FLAG: - Data screens	static
GGISN	ISIN ISSUER COUNTRY: - Data screens	static
MAJOR	MAJOR FLAG: - data screens	static
MV	MARKET VALUE: - Size control variable	d
WC01001	SALES: - Calculate profitability	y
WC07021	SIC1: - 2-digit SIC as industry control variable	static
SOSCORE	SOCIAL SCORE (ESG): - Independent regression variable	y
TYPE	STOCK TYPE: - Data screens	static
RI	TOTAL RETURN INDEX: - Calculate daily stock returns	d
TRESGS	TOTAL SCORE ESG: - Independent regression variable	y
UP	UNADJUSTED PRICE: - Exclude penny stocks	d

Appendix B. Applied data screens

Table B1. Static screens. This table shows the filters applied based on equities' static data, as obtained via Datastream.

#	Items involved	Description	Reference
1	Major = Y	We require the Major Flag to be 'Y,' thereby excluding all securities not listed as major shares.	e.g., Schmidt et al. (2011), Hanauer and Huber (2018)
2	Stock Type = EQ	We require the Stock Type flag to be 'EQ,' excluding all non-equities.	e.g., Ince and Porter (2006)
3	ISINID = P	We require the ISINID flag to be 'P,' only considering primary listings.	e.g., Hanauer and Huber (2018)
4	NAME, ENAME, ECNAME	We filter for 'illegal symbols' in the names specifications of the stocks to exclude duplicates, warrants, ETFs, unit trusts, etc. A complete list of 'illegal symbols' can be found in Table B3.	e.g., Ince and Porter (2006), Griffin, Kelly, and Nardari (2010), Annaert, Ceuster, and Verstegen (2013)
5	GEOGN, GEOLN, ISINCC, GGISN	Stocks with a county indication different from the country composition to be analyzed are removed.	e.g., Ince and Porter (2006), Griffin, Kelly, and Nardari (2010), Annaert, Ceuster, and Verstegen (2013)
6	PCUR	Stocks with a currency indication different from those of the sample countries are removed.	e.g., Griffin, Kelly, and Nardari (2010), Hanauer and Huber (2018)

Table B2. Dynamic screens. This table shows the applied filters based on individual stocks to eliminate abnormal data structures, which could potentially influence our analysis, as provided by Datastream and Worldscope.

#	Items	Description	Reference
1	RI	We delete zero returns to prevent illiquid stocks and public holidays from distorting our results.	
2	UP	We exclude so-called penny stocks in our analyses. We define penny stocks as stocks with an unadjusted price below 1€ on December 31, 2021.	Ince and Porter (2006)
3	RI	We follow Ince and Porter (2006) and set abnormal returns to NA when R_t or $R_{t-1} > 300\%$ and $(1 + R_t)(1 + R_{t-1}) < 50\%$.	e.g., Ince and Porter (2006)
4	RI	We set returns to NA when $R_t > 990\%$.	e.g., Schmidt et al. (2011)

Table B3. Illegal symbols. This table lists the illegal symbols used to exclude stocks with unwanted properties globally or per country. The list is mainly taken from Hanauer and Huber (2018).

County	Items involved
All	1000DUPL, DULP, DUP, DUPE, DUPL, DUPLI, DUPLICATE, XSQ, XETa, ADR, GDR, PF, PF, PFD, PREF, PREFERRED, PRF, WARR, WARRANT, WARRANTS, WARRT, WT, WTS, WTS2, %, DB, DCB, DEB, DEBENTURE, DEBENTURES, DEBT, .IT, .ITb, INV, INV TST, INVESTMENT TRUST, RLST IT, TRUST, TRUST UNIT, TRUST UNITS, TST, TST UNIT, TST UNITS, UNIT, UNIT TRUST, UNITS, UNT, UNT TST, UT, AMUNDI, ETF, INAV, ISHARES, JUNGE, LYXOR, X-TR,EXPD, EXPIRED, EXPIRY, EXPY, ADS, BOND, CAP.SHS, CONV, CV, CVT, DEFER, DEP, DEPY, ELKS, FD, FUND, GW.FD, HI.YIELD, HIGH INCOME, IDX, INC.&GROWTH, INC.&GW, INDEX, LP, MIPS, MITS, MITT, MPS, NIKKEI, NOTE, OPCVM, ORTF, PARTNER, PERQS, PFC, PFCL, PINES, PRTF, PTNS, PTSHP, QUIBS, QUIDS, RATE, RCPTS, REAL EST, RECEIPTS, REIT, RESPT, RETUR, RIGHTS, RST, RTN.INC, RTS, SBVTG, SCORE, SPDR, STRYPES, TOPRS, UTS, VCT, VTG.SAS, XXXXX, YIELD, YLD
AT	PC, PARTICIPATION CERTIFICATE, GENUSSSCHEINE, GENUSSCHEINE
BE	VVPR, CONVERSION, STRIP
FI	USE
FR	ADP, CI, SICAV, "")SICAV""), SICAV-
DE	GENUSSCHEINE
IT	RNC, RP, PRIVILEGES
NL	CERTIFICATE, CERTIFICATES, CERTIFICATES""), CERT, CERTS, STK"".
UK	PAID, CONVERSION TO, NON-VOTING, CONVERSION A
CH	CONVERTED INTO, CONVERSION, CONVERSION SEE

Appendix C. Additional results

Table C1. Cross sectional regressions of cumulative abnormal returns in % on Refinitiv ESG scores, with longer pre- and post-event windows. This table reports the results of cross sectional regressions. The event date t_0 is February 24, 2022. The reported windows are located before, during, and after this event. TSC, ESC, SSC, and GSC are Refinitiv's total, environmental, social, and governance ESG scores. PRO is calculated as described in Novy-Marx (2013). For INV the approach of Fama and French (2015) is used. As a size proxy, we use the natural logarithm of the market value on December 31, 2021. For the calculation of ln(BM), the 2020 book values and the MV on the 2020 ultimo are used. CR and DR are the cash and debt rate, while DTM is the distance from the company's address (as listed in Datastream) to Moscow in 1,000 kilometers. We report absolute t-values between parentheses, based on robust standard errors (White (1980)). We control for firm and industry fixed effects. ***, **, and * indicate a significance level of 1%, 5%, and 10%, respectively.

	(1) [-20,20]	(2) [-20,-4]	(3) [4,20]	(4) [-20,20]	(5) [-20,-4]	(6) [4,20]
Intercept	21.58***	11.83***	10.39***	22.31***	11.92***	10.78***
	(3.2811)	(4.4150)	(2.8106)	(3.3377)	(4.4639)	(2.8653)
TSC	0.04*	0.05***	0.01			
	(1.8572)	(3.8604)	(0.3497)			
ESC				0.04*	0.02	0.02
				(1.7476)	(1.5980)	(1.2150)
SSC				-0.01	0.01	-0.01
				(0.5030)	(0.8706)	(0.7590)
GSC				0.02	0.02*	0.00
				(0.9577)	(1.9443)	(0.0982)
PRO	-6.18***	-0.88	-3.24***	-6.32***	-0.92	-3.32***
	(3.0429)	(0.8030)	(3.2674)	(3.1163)	(0.8366)	(3.3499)
ln(BM)	-1.04*	0.84***	-0.58*	-1.07**	0.83***	-0.59*
	(1.9408)	(2.8653)	(1.8750)	(1.9808)	(2.8335)	(1.9075)
ln(MV)	-0.21	-0.29*	-0.39**	-0.21	-0.29*	-0.40**
	(0.6759)	(1.6823)	(2.0965)	(0.6620)	(1.6537)	(2.1150)
INV	-0.61	-0.87**	-1.06	-0.62	-0.88**	-1.07*
	(0.7621)	(1.9734)	(1.6408)	(0.7807)	(1.9784)	(1.6475)
DR	-5.09**	-1.47	-0.85	-5.07**	-1.46	-0.84
	(2.1056)	(1.1282)	(0.6361)	(2.0854)	(1.1194)	(0.6332)
CR	1.77	-1.26	2.74	1.74	-1.24	2.75
	(0.4929)	(0.6362)	(1.2456)	(0.4853)	(0.6270)	(1.2467)
DTM	0.11	0.21	0.05	0.07	0.21	0.04
	(0.2483)	(0.4049)	(0.1422)	(0.1650)	(0.3939)	(0.1089)
Industry FE	yes	yes	yes	yes	yes	yes
Country FE	yes	yes	yes	yes	yes	yes
Winsorized	yes	yes	yes	yes	yes	yes
R^2	0.2107	0.1972	0.1670	0.2116	0.1974	0.1675
Adj. R^2	0.1628	0.1484	0.1165	0.1626	0.1475	0.1157
N	1608	1608	1608	1607	1607	1607

Table C2. Cross sectional regressions of cumulative abnormal returns in % on carbon intensity, with longer pre- and post-event windows. This table reports the results of cross sectional regressions. The event date t_0 is February 24, 2022. The reported windows are located before, during, and after this event. For C2R the total CO_2 and CO_2-equivalent emissions in tonnes, divided by total assets are used. PRO is calculated as described in Novy-Marx (2013). For INV the approach of Fama and French (2015) is used. As a size proxy, we use the natural logarithm of the market value on December 31, 2021. For the calculation of ln(BM), the 2020 book values and the MV on the 2020 ultimo are used. CR and DR are the cash and debt rate, while DTM is the distance from the company's address (as listed in Datastream) to Moscow in 1,000 kilometers. We report absolute t-values between parentheses, based on robust standard errors (White (1980)). We control for firm and industry fixed effects. ***, **, and * indicate a significance level of 1%, 5%, and 10%, respectively.

	(1) [-20,20]	(2) [-20,-4]	(3) [4,20]
Intercept	27.75***	14.87***	10.37***
	(4.4399)	(5.0821)	(2.6041)
ln(C2R)	-0.47	0.10	-0.40**
	(1.5483)	(0.7664)	(2.4883)
PRO	-5.47**	-1.59	-2.22*
	(2.3359)	(1.2209)	(1.8308)
ln(BM)	-0.76	0.92***	-0.35
	(1.2933)	(2.7946)	(1.0523)
ln(MV)	0.11	-0.04	-0.13
	(0.3935)	(0.2797)	(0.7877)
INV	-0.70	-1.19*	-0.98
	(0.4186)	(1.7517)	(1.0054)
DR	-4.77*	-0.25	-0.03
	(1.6774)	(0.1722)	(0.0232)
CR	-4.02	0.00	-2.97
	(0.8322)	(0.0014)	(1.0533)
DTM	-0.26	-0.12	-0.19
	(0.3850)	(0.1982)	(0.4651)
Industry FE	yes	yes	yes
Country FE	yes	yes	yes
Winsorized	yes	yes	yes
R^2	0.2645	0.2196	0.1983
Adj. R^2	0.2033	0.1546	0.1315
N	1197	1197	1197

Table C3. Cross sectional regressions of cumulative abnormal returns in % on Refinitiv ESG scores, without country fixed effects. This table reports the results of cross sectional regressions. The event date t_0 is February 24, 2022. The reported windows are located before, during, and after this event. TSC, ESC, SSC, and GSC are Refinitiv's total, environmental, social, and governance ESG scores. PRO is calculated as described in Novy-Marx (2013). For INV the approach of Fama and French (2015) is used. As a size proxy, we use the natural logarithm of the market value on December 31, 2021. For the calculation of ln(BM), the 2020 book values and the MV on the 2020 ultimo are used. CR and DR are the cash and debt rate, while DTM is the distance from the company's address (as listed in Datastream) to Moscow in 1,000 kilometers. We report absolute t-values between parentheses, based on robust standard errors (White (1980)). We control for firm and industry fixed effects. ***, **, and * indicate a significance level of 1%, 5%, and 10%, respectively.

	(1) [-10,10]	(2) [-10,-4]	(3) [-3,3]	(4) [4,10]	(5) [-10,10]	(6) [-10,-4]	(7) [-3,3]	(8) [4,10]
Intercept	14.19***	-1.33	3.20	12.33***	15.19***	-1.14	3.19	13.13***
	(2.7253)	(0.7369)	(0.8938)	(5.0471)	(2.9198)	(0.6347)	(0.8934)	(5.3256)
TSC	0.03*	0.03***	-0.02	0.02**				
	(1.6462)	(3.3215)	(1.5042)	(2.0505)				
ESC					0.05***	0.02*	0.00	0.04***
					(2.8244)	(1.9384)	(0.1355)	(3.6590)
SSC					-0.03	0.01	-0.02	-0.02
					(1.2526)	(0.9512)	(1.3225)	(1.6044)
GSC					0.01	0.01	0.00	0.00
					(0.4757)	(0.7650)	(0.0862)	(0.1287)
PRO	-5.12***	0.83	-2.35**	-3.60***	-5.32***	0.78	-2.35**	-3.75***
	(2.8821)	(0.9810)	(2.2265)	(4.3611)	(3.0029)	(0.9164)	(2.2185)	(4.5387)
ln(BM)	-1.16**	0.79***	-1.68***	-0.26	-1.21***	0.77***	-1.68***	-0.30
	(2.5447)	(3.6177)	(5.9604)	(1.0615)	(2.6284)	(3.5547)	(5.9187)	(1.2028)
ln(MV)	0.49**	0.14	0.47***	-0.12	0.46*	0.12	0.48***	-0.15
	(1.9851)	(1.1370)	(2.8921)	(0.8680)	(1.8155)	(1.0276)	(2.8882)	(1.0556)
INV	-1.54**	-1.45***	1.09***	-1.18**	-1.55**	-1.46***	1.09***	-1.19**
	(2.1495)	(4.2332)	(2.9511)	(2.4029)	(2.1623)	(4.2818)	(2.9438)	(2.4010)
DR	-3.36	-0.03	-2.93**	-0.39	-3.36	-0.09	-2.84**	-0.44
	(1.5478)	(0.0396)	(2.1701)	(0.3245)	(1.5334)	(0.1007)	(2.0822)	(0.3596)
CR	-1.20	-2.29*	-0.57	1.66	-1.20	-2.20	-0.68	1.69
	(0.3848)	(1.7165)	(0.3108)	(1.0312)	(0.3843)	(1.6436)	(0.3745)	(1.0511)
DTM	0.60	2.10***	-0.03	-1.47***	0.55	2.09***	-0.03	-1.51***
	(1.3081)	(6.3649)	(0.0911)	(5.2509)	(1.2022)	(6.3137)	(0.0924)	(5.3510)
Industry FE	yes	yes	yes	yes	yes	yes	yes	yes
Country FE	no	no	no	no	no	no	no	no
Winsorized	yes	yes	yes	yes	yes	yes	yes	yes
R^2	0.1886	0.2412	0.1774	0.1945	0.1913	0.2422	0.1785	0.1995
Adj. R^2	0.1495	0.2045	0.1377	0.1377	0.1512	0.2045	0.1377	0.1598
N	1608	1608	1608	1608	1607	1607	1607	1607

Table C4. Descriptive statistics. This table shows additional descriptive statistics for cumulative raw returns (CRR) and the MSCI Russia-β.

	N	Mean	St. Dev.	Min.	Median	Max
CRR [-10,+10]	1,606	-9.94	12.48	-107.93	-9.87	35.73
CRR [-10,-4]	1,606	-3.62	5.95	-31.11	-2.90	20.07
CRR [-3,3]	1,606	-3.42	8.15	-60.91	-3.44	26.57
CRR [4,10]	1,606	-2.90	6.65	-30.40	-2.70	34.14
MSCI Russia-β	1,606	0.26	0.16	-0.45	0.25	1.02

Table C5. Cross sectional regressions of cumulative raw returns in % on Refinitiv ESG scores. This table reports the results of cross sectional regressions. The event date t_0 is February 24, 2022. The reported windows are located before, during, and after this event. TSC, ESC, SSC, and GSC are Refinitiv's total, environmental, social, and governance ESG scores. PRO is calculated as described in Novy-Marx (2013). For INV the approach of Fama and French (2015) is used. As a size proxy, we use the natural logarithm of the market value on December 31, 2021. For the calculation of ln(BM), the 2020 book values and the MV on the 2020 ultimo are used. CR and DR are the cash and debt rate, while DTM is the distance from the company's address (as listed in Datastream) to Moscow in 1,000 kilometers. The MSCI Russia-β is calculated similarly to equation (1), but replacing $MSEU_t$ with the MSCI Russia Index. We report absolute t-values between parentheses, based on robust standard errors (White (1980)). We control for firm and industry fixed effects. ***, **, and * indicate a significance level of 1%, 5%, and 10%, respectively.

	(1) [-10,10]	(2) [-10,-4]	(3) [-3,3]	(4) [4,10]	(5) [-10,10]	(6) [-10,-4]	(7) [-3,3]	(8) [4,10]
Intercept	106.97***	104.52***	97.90***	104.54***	108.03***	104.69***	98.08***	105.27***
	(19.1490)	(64.0638)	(25.2063)	(37.2242)	(19.3569)	(63.4695)	(25.3157)	(37.2624)
TSC	-0.01	0.02**	-0.03***	0.00				
	(0.7019)	(2.1503)	(2.6400)	(0.0849)				
ESC					0.03*	0.01*	0.00	0.03***
					(1.9212)	(1.7079)	(0.3635)	(2.5844)
SSC					-0.03	0.01	-0.02	-0.02*
					(1.3625)	(0.5833)	(1.1570)	(1.6980)
GSC					-0.02	0.00	-0.01	-0.01
					(1.2996)	(0.1475)	(1.3935)	(0.9127)
PRO	-2.39	0.80	-1.17	-2.02**	-2.60	0.75	-1.17	-2.17***
	(1.4205)	(1.0705)	(1.0978)	(2.5312)	(1.5428)	(0.9970)	(1.0945)	(2.7113)
ln(BM)	-0.44	0.77***	-1.14***	-0.07	-0.47	0.76***	-1.14***	-0.09
	(1.0018)	(3.6948)	(4.0576)	(0.3020)	(1.0600)	(3.6626)	(4.0380)	(0.4014)
ln(MV)	0.18	-0.03	0.43**	-0.21	0.15	-0.04	0.43**	-0.24*
	(0.7145)	(0.2922)	(2.5502)	(1.5274)	(0.5789)	(0.3704)	(2.5437)	(1.6979)
INV	-1.60**	-1.20***	1.10***	-1.49***	-1.61**	-1.21***	1.09***	-1.50***
	(1.9708)	(3.3387)	(3.1226)	(2.8248)	(1.9915)	(3.3832)	(3.1243)	(2.8266)
DR	-3.52*	-0.27	-2.71**	-0.54	-3.60*	-0.31	-2.70**	-0.59
	(1.7299)	(0.3215)	(2.0756)	(0.4726)	(1.7621)	(0.3688)	(2.0657)	(0.5131)
CR	-4.48	-2.71**	-0.83	-0.94	-4.38	-2.62**	-0.88	-0.88
	(1.469)	(2.0762)	(0.4636)	(0.5998)	(1.4353)	(1.9952)	(0.4942)	(0.5602)
MSCI Russia-β	-3.88	-4.77***	-3.72**	4.61***	-3.96*	-4.77***	-3.72**	4.54***
	(1.6118)	(4.9749)	(2.3634)	(3.5504)	(1.6478)	(4.9947)	(2.3603)	(3.5070)
DTM	-0.20	0.16	-0.11	-0.25	-0.23	0.17	-0.13	-0.27
	(0.2677)	(0.4461)	(0.2945)	(0.7686)	(0.3054)	(0.4464)	(0.3394)	(0.8008)
Industry FE	yes	yes	yes	yes	yes	yes	yes	yes
Country FE	yes	yes	yes	yes	yes	yes	yes	yes
Winsorized	yes	yes	yes	yes	yes	yes	yes	yes
R^2	0.2642	0.3755	0.2530	0.2271	0.2667	0.3763	0.2545	0.2305
Adj. R^2	0.2189	0.3371	0.2071	0.2071	0.2206	0.3370	0.2075	0.1821
N	1606	1606	1606	1606	1605	1605	1605	1605

Table C6. Cross sectional regressions of cumulative raw returns in % on carbon intensity. This table reports the results of cross sectional regressions. The event date t_0 is February 24, 2022. The reported windows are located before, during, and after this event. For C2R the total CO_2 and CO_2-equivalent emissions in tonnes, divided by total assets are used. $\ln(CO_2)$ is the natural log of the total CO_2 and CO_2-equivalent emissions in tonnes. PRO is calculated as described in Novy-Marx (2013). For INV the approach of Fama and French (2015) is used. As a size proxy, we use the natural logarithm of the market value on December 31, 2021. For the calculation of ln(BM), the 2020 book values and the MV on the 2020 ultimo are used. CR and DR are the cash and debt rate, while DTM is the distance from the company's address (as listed in Datastream) to Moscow in 1,000 kilometers. The MSCI Russia-β is calculated similarly to equation (1), but replacing $MSEU_t$ with the MSCI Russia Index. We report absolute t-values between parentheses, based on robust standard errors (White (1980)). We control for firm and industry fixed effects. ***, **, and * indicate a significance level of 1%, 5%, and 10%, respectively.

	(1) [-10,10]	(2) [-10,-4]	(3) [-3,3]	(4) [4,10]
Intercept	112.45***	106.64	101.62***	104.20***
	(16.5043)	(53.7351)	(23.6199)	(29.8124)
ln(C2R)	-0.55**	0.04	-0.19	-0.40***
	(2.1750)	(0.4232)	(1.2711)	(3.2765)
PRO	-2.50	-0.17	-0.84	-1.49
	(1.2929)	(0.1786)	(0.6976)	(1.5792)
ln(BM)	-0.47	0.73***	-1.21***	0.02
	(1.0237)	(3.1526)	(4.1504)	(0.0651)
ln(MV)	-0.01	0.01	0.10	-0.12
	(0.0596)	(0.0920)	(0.6844)	(1.0224)
INV	-1.34	-1.45**	1.47	-1.36*
	(0.9307)	(2.1893)	(1.5713)	(1.9074)
DR	-6.02**	0.44	-4.75***	-1.71
	(2.4917)	(0.4815)	(3.0594)	(1.3363)
CR	-4.91	0.96	-1.16	-4.71**
	(1.1745)	(0.5150)	(0.4499)	(2.1409)
MSCI Russia-β	-6.04**	-5.42***	-5.54***	4.93***
	(2.1050)	(4.8288)	(2.9526)	(3.2570)
DTM	-0.47	-0.13	-0.01	-0.33
	(0.4892)	(0.2802)	(0.0363)	(0.8363)
Industry FE	yes	yes	yes	yes
Country FE	yes	yes	yes	yes
Winsorized	yes	yes	yes	yes
R^2	0.2935	0.3092	0.2937	0.2674
Adj. R^2	0.2339	0.2508	0.2340	0.2055
N	1195	1195	1195	1195

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