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JEL Classification: E3, G14, G01, Q54

Keywords: Climate transition risk, Energy, Esg, Event studies, inflation, Resilience, Russia-ukraine war, Stock returns

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The Net-Zero Transition and Firm Value: Insights from the Russia-Ukraine War, REPowerEU, and the US Inflation Reduction Act*

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October 4, 2022

Abstract

In response to the Russia-Ukraine war, stocks more exposed to the regulatory risks of the transition to a low-carbon economy performed better, suggesting that investors expect an overall slowdown in this transition. These stock price effects were particularly strong in the US. In Europe, the effects were less pronounced or even opposite. Arguably, market participants initially expected stronger policy responses supporting European renewable energy sources. Investors perceived both the REPowerEU plan and the US Inflation Reduction Act to boost the value of firms with opportunities in the realm of renewable energies, but they also anticipated an increased value of US firms that benefit from a slowdown in the regulation of polluting technologies. Overall, the findings highlight an expected international divergence in the pace of the energy transition, with geopolitical tensions thus threatening the gains made so far in combating the global problem of climate change.

Keywords: Climate transition risk, energy, ESG, event study, inflation, Inflation Reduction Act, resilience, regulation, REPowerEU, Russia-Ukraine war, stock returns
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1 Introduction

Climate change is a global challenge. Therefore, the widely discussed "net-zero" transition inherently requires international policy coordination. While such international coordination has always been difficult, the outbreak of the Russia-Ukraine war has added another layer of complexity (besides leading to an enormous direct human toll). Yet, it is not obvious whether the war will accelerate or retard the transition to a lower-carbon economy. The war presumably leads to endogenous policy responses (beyond sanctions) and changes in individual behavior. The implications of these geopolitical events for addressing the long-term and global problem of climate change, therefore, require careful analysis.

This paper first utilizes the stock price reactions of firms around the globe to the Russia-Ukraine war to shed light on what investors expect for the net-zero transition. It uses the insight that asset price changes capture current expectations; the researcher does not need to trace all the future changes to cash flows and discount rates separately (Schwert, 1981). A comparison of stock price reactions of firms to the outbreak of the war, particularly those more or less exposed to the transition to the low-carbon economy, offers a preview of the expected impact of the war. Moreover, the nature of the conflict provides a sad but unique situation to obtain insights into corporate resilience against crises and into the firm value implications of a wide range of factors.

The paper also studies two policy developments that followed, the announcement of the REPowerEU plan and the passage of the US Inflation Reduction Act (IRA). The analysis of these events provides additional complementary evidence on the market's expectations regarding the energy transition (and on the importance of climate policies for firm value).

After a brief review of country-average and industry-average returns drawing on roughly 13,500 stocks (above a minimum firm size), our primary focus is on the cross-section of roughly 4,500 global stocks for which we have a wide variety of firm characteristics. While the Russian invasion of Ukraine on February 24, 2022, had been visibly prepared in the prior months, many observers were still surprised that President Vladimir Putin took this step. Specifically, we consider three phases: *Build-up* (from the time NATO put its troops on stand-by on January 24 through February 23), *Outbreak* (from February 24, the day of the invasion, through March 8, the day the US announced to ban Russian oil, gas, and coal), and *Continuation* (from March 9 through April 29).

We find that firms more exposed to climate transition risk performed better. We establish this result using two different measures of transition risk, that is, the set of corporate risks deriving from regulation supporting the transition from a fossil-fuel-reliant economy to a lower-carbon economy. One measure is based on corporate conference calls (Sautner et al., 2022a), the other on dedicated corporate risk disclosures (Kölbel et al., 2022). These results suggest that investors generally expect the transition to a low-carbon economy to slow down. In fact, financial analysts increased their earnings estimates for high transition-risk stocks for the years 2022 through 2025. We also find a short-term boost to firms with exposure to climate opportunities late in the Outbreak period, but this effect reversed in the Continuation period (and indeed, analysts tended to reduce their forecasts for these stocks).

These global results hold in an even more pronounced fashion in the US. Strikingly, European stocks with high transition risk did not exhibit such noticeable outperformance, whereas stocks with pronounced climate change opportunities outperformed in a sustained manner. This result may be due to stronger expected policy responses supporting renewable energy sources, which, given Europe's relatively pronounced dependency on Russian oil and gas, is arguably the only way for Europe to enhance its energy security. In short, investors expect the speed of transition to a low-carbon economy to diverge between the US and Europe.

Our analysis controls for a range of potentially important factors that, if left uncontrolled, could confound the inferences. For example, they hold with (and without) controls for exposure to oil and gas prices, and they are not driven by the energy sector. The findings for several controls are also interesting in their own right. First, the results for a variety of Environmental, Social, and Governance (ESG) measures are mixed, which is perhaps not too surprising given the "aggregate confusion" surrounding them (Berg, Kölbel, and Rigobon, 2022). It appears that investors cannot easily rely on such scores for their investment decisions in the face of a disaster like war.

Moreover, firms for which a textual measure suggests strong exposure to inflation risks performed worse. In recent times, in the absence of noteworthy inflation shocks, it has been difficult for researchers to examine the relevance of inflation for firm value. Thus, this analysis contributes by quantifying the importance of inflation as a concern for investors.

Finally, the data also point to investors' concerns regarding the international exposure of companies in general, adding to the current discussion on (de)globalization. Companies with a higher share of international sales underperformed. For US companies, we employ a text-based proxy for exposure to China, and we find that China-oriented companies strongly underperformed (net of all other effects) during the Outbreak period. While this may be partly due to the recent outbreak of COVID-19 in China (and corresponding supply-chain difficulties and risks of international sales funnels), it may also point to wider-ranging geopolitical consequences of the Russia-Ukraine war, particularly to a further increased tension between the US and China.

In the final section of the paper, we investigate two consequential policy events: the announcement of the REPowerEU plan in Europe and the passage of the US Inflation Reduction Act (IRA). While the REPowerEU act was not a very surprising announcement, firms with opportunities in the renewable energy space benefited modestly. The IRA did come as a major surprise, and the stock price moves were substantial. Here, too, firms with opportunities in renewable energies benefited, as would be expected given the positive incentives the Act provides for the use of these sources of energy. However, firms with large transition risks also received a boost, consistent with the IRA opening up additional oil drilling opportunities, for example.

Overall, this analysis of how investors navigate a unique amalgam of geopolitical, macroeconomic, and (environmental) policy developments provides two broad insights. First, our analysis highlights a major concern for policymakers in the form of the expected divergence between the US and Europe in the pace of the energy transition, with geopolitical tensions threatening the gains made so far in combating climate change. This divergence has not been diminished by the two recent major policy developments, the REPowerEU plan and the Inflation Reduction Act. While Europe and the US appear aligned in the positive incentives for renewable energies, there is a sustained divergence in the expected regulations reducing carbon emissions. Second, the paper provides a systematic analysis of a wide range of factors driving firm value in a situation not witnessed for a long time, namely, a war in Europe.

Our paper makes three contributions. First, it advances the literature that exploits capital markets to understand the economic implications of climate change. One focal point of that literature has been the study of the "carbon premium" over longer time periods. Some studies find that stocks of firms with higher carbon emissions earn higher returns (e.g., Bolton and Kacperczyk, 2021), while others find the opposite (e.g. In, Park, and Monk, 2019; Cheema-Fox et al., 2021).[1] A challenge in interpreting these results is that associations of stock returns with carbon intensity depend on whether

[1]Both results can occur theoretically, depending on factors such as preference shifts, unexpected climate news, and underreaction to predictability of fundamentals (Pástor, Stambaugh, and Taylor, 2021; Pástor, Stambaugh, and Taylor, 2022; Pedersen, Fitzgibbons, and Pomorski, 2021).

only disclosed or also estimated carbon emissions are included in the analysis (Aswani, Raghunandan, and Rajgopal, 2022). Sautner et al. (2022b) show that their measures of firm-level climate change exposure (rather than carbon emissions) do not on average earn risk premiums, but do so in certain times. They find that the priced part of the risk premium primarily originates from climate-related opportunity shocks rather than downside physical or regulatory shocks.[2] Contributing to this body of work, our study exploits geopolitical disruptions to deliver strong evidence on the relevance of transition risk for firm value. The findings provide an important reference point for assessing the impact of climate policy changes on the economy.

Our work is also related, second, to the literature on corporate resilience to crises. Important insights on this topic come from the study of the Global Financial Crisis (GFC) and the analysis of COVID-19. In those crises, financial strength (low leverage and high cash holdings) have proved important, and ESG has also been shown to play a role.[3] By contrast, we obtain mixed findings for the role of corporate financial strength and ESG scores in the Russia-Ukraine crisis.

Finally, this analysis contributes by studying the impact of war on financial markets.[4] Brune et al. (2015) find that an increase in the war likelihood tends to decrease stock

[2]Other recent studies exploring the interconnections between climate change and financial markets include Addoum, Ng, and Ortiz-Bobea (2020) and Addoum, Ng, and Ortiz-Bobea (2021), Andersson, Bolton, and Samama (2016), Baldauf, Garlappi, and Yannelis (2020), Bansal, Kiku, and Ochoa (2016), Bartram, Hou, and Kim (2022), Berkman, Jona, and Soderstrom (2019), Bernstein, Gustafson, and Lewis (2019), Ceccarelli, Ramelli, and Wagner (2022), Choi, Gao, and Jiang (2020), Delis et al. (2021), Duan, Li, and Wen (2022), Engle et al. (2020), Hong, Li, and Xu (2019), Ilhan, Sautner, and Vilkov (2021), Pankratz and Schiller (2021), and Ramelli et al. (2021), among others.

[3]On financial strength, see, for example, Duchin, Ozbas, and Sensoy (2010), Campello et al. (2011), Giroud and Mueller (2017), and Gilchrist et al. (2017), for work on the Great Recession and Ding et al. (2021), Fahlenbrach, Rageth, and Stulz (2021), and Ramelli and Wagner (2020) for work on COVID-19. During the GFC, high-ESG firms did well (Lins, Servaes, and Tamayo, 2017). There is also some evidence that these firms did better in the COVID-19 crisis (Albuquerque et al., 2020; Garel and Petit-Romec, 2021), though this result has been debated (Demers et al., 2021).

[4]See, e.g., Frey and Kucher (2000), Frey and Kucher (2001), Frey and Waldenström (2004), Choudhry (2010), and Hudson and Urquhart (2015) for studies on World War II. Schneider and Troeger (2006) analyze three recent international conflicts, i.e., the Gulf War, the conflict between Israel and Palestine, and the Civil War in Ex-Yugoslavia.

prices, but the ultimate outbreak of war increases them. However, when a war starts unexpectedly, the outbreak of war decreases stock prices. Hence, through the lens of Brune et al. (2015), the Russian invasion took equity markets by surprise. The current war will probably also spur intense scrutiny by researchers. We believe our paper is the first to conduct a comprehensive firm-level analysis.[5] Our focus is on energy transition and climate change risks, although our systematic analysis of control variables will hopefully help researchers select firm characteristics that may be important for understanding investor responses to war and its broader economic consequences.

The remainder of the paper is structured as follows. Section 2 presents the timeline and summarizes how attention of investors developed around the Russian invasion of Ukraine. Section 3 presents the data sources. Section 4 summarizes the main results for the Russia-Ukraine war. Section 5 reports on the analysis of the REPowerEU plan and the US Inflation Reduction Act. Section 6 concludes.

2 Dates of Key Events and Investor Attention in the Russia-Ukraine war

There have been tensions between Russia and Ukraine for a long time, not least since the annexation of Crimea in 2014. In spring 2021, Russia began amassing a large number of troops and equipment. A second build-up began in October 2021. Despite these rising tensions, we restrict our event study to the beginning of 2022. In particular, we explore three different periods, which we label *Build-up* (Monday, January 24 to Wednesday, February 23), *Outbreak* (Thursday, February 24 to Tuesday, March 8), and *Continuation* (Wednesday, March 9 through Friday, April 29).

[5] Contemporaneous work includes the following studies. Boungou and Yatié (2022) and Federle et al. (2022) provide evidence on the role of geographic proximity to the war and international trade. Huang and Lu (2022) find that equity markets of countries imposing sanctions lose more value. Several studies compare the performance of firms leaving Russia with remaining firms, obtaining somewhat mixed findings (Balyuk and Fedyk, 2022; Basnet, Blomkvist, and Galariotis, 2022; Berninger, Kiesel, and Kolaric, 2022; Huang and Lu, 2022; Lu and Huang, 2022; Pajuste and Toniolo, 2022; Sonnenfeld et al., 2022; Tosun and Eshraghi, 2022).

First, on January 24, NATO put its troops on standby, and on January 25, Russian exercises involving 6,000 troops and 60 jets took place in Russia near Ukraine and Crimea. Moreover, on January 25, White House officials stated the US, alongside allies and partners, was prepared to implement sanctions with "massive consequences that were not considered in 2014" (the Crimea crisis), including financial sanctions and export controls on US software and technology. They added, "the gradualism of the past is out, and this time we'll start at the top of the escalation ladder and stay there."[6]

Second, on February 24, Russia invaded Ukraine. The United Nations (UN) convened the General Assembly during an emergency special session on February 28 and concluded the session on March 2. While several countries were putting increasingly severe sanctions against Russia, arguably a particularly strong signal, at least diplomatically, was the March 8 announcement by President Joe Biden that his administration would ban Russian oil, natural gas, and coal imports to the US.

Third, the "*Continuation*" period lasts from March 9 through April 29. This cutoff date is admittedly somewhat arbitrary. We chose it because it is about two weeks before the REPowerEU plan was announced (see Section 5).

As a rationale for the choice of these three periods, we rely on observations gleaned from the development of proxies for investor attention, summarized in Figure 1. We consider corporate earnings calls as an indicator of professional investor (and managerial) attention, and Google search volume as an indicator of retail investor attention. Specifically, in all earnings conference call transcripts obtained from Refinitiv Company Events Coverage (formerly Thomson Reuters StreetEvents), we search for the keywords "RUSSIA","UKRAINE","RUSSIAN", "UKRAINIAN", "WAR". As can be seen in Figure 1, the fraction of conference calls mentioning these keywords remains relatively stable

[6]See `https://www.piie.com/blogs/realtime-economic-issues-watch/russias-war-ukraine-sanctions-timeline`.

through February 24, when it jumps up and remains elevated through the end of April.[7] Thus, while Russian troop movements have been a concern since October 2021, and US intelligence agencies had warned of an imminent invasion as early as mid-February, corporate managers and analysts do not appear to have focused explicitly on this issue until the invasion actually occurred.

– Figure 1 here –

With regards to the proxy for retail investor attention, we observe that the Google search volume for "Russia" and "Ukraine" ticks up briefly on January 24, 2022, which marks the beginning of the "Build-up" period. It then jumps dramatically on February 24, the start of "Outbreak". It then fairly quickly subsides, though it remains substantially above the level prior to the invasion even towards the end of March.[8]

3 Data and Sample Construction

We employ data from Compustat North America and Compustat Global (obtained via WRDS). We select all stocks with valid prices since January 01, 2022. We only keep stocks with a market capitalization larger than USD 10 million and stock prices larger than USD 1 by the end of 2021 to avoid results being driven by penny stocks. We have around 13,500 stocks from 63 countries/regions in the sample with valid returns. Further merging with additional data leaves us with a sample of around 4,500 stocks that has a complete set of firm characteristics. Some countries drop from the final sample in particular because conference call data are not available, but also because ESG score

[7] The fact that the absolute number of conference calls on February 24 is high is a coincidence. In prior years, too, the highest number of conference calls in February occurred on the last Thursday of that month.

[8] The geopolitical risk index computed by Caldara and Iacoviello (2022) from newspaper coverage also points to an overall similar pattern. A similar picture emerges when considering coverage of the war on television. See `https://blog.gdeltproject.org/how-is-ukraine-being-covered-on-television-news-3/`.

coverage is minimal. For details on the sample composition and variable definitions, we refer to Tables A2 and A1 in the Appendix.

3.1 Stock returns and firm characteristics

For stock returns, we collect daily stock price information from Compustat. We calculate the total returns of the three periods (Build-up, Outbreak, and Continuation), respectively. We adjust prices for dividends through the daily multiplication factor and the price adjustment factors provided by Compustat.

We employ the Fama-French five-factor model plus momentum to measure the market beta (Carhart, 1997; Fama and French, 2015). The factors are obtained from the Kenneth R. French Data Library. We use the Fama/French North America factors to match the stocks from Compustat North America and the Fama/French Developed ex US Factors to match the stocks from Compustat Global. We use one year of daily data before January 1, 2022 for the calculation.

In our analysis, it is potentially important to account for the effect of exposure to energy prices. To calculate the sensitivity of the stock return to oil price changes (β^{Oil}), we follow the literature (see, e.g., Sadorsky, 2001; Jin and Jorion, 2006; Mohanty et al., 2013, and the survey by Degiannakis, Filis, and Arora, 2018) and extend a CAPM model by adding the oil price change as an additional explanatory variable and calculating its coefficient. In particular, for each firm, we regress its daily excess return on the market return and the return of the NYMEX West Texas Intermediate (WTI) crude oil 1-month future with one year of data in 2021. The WTI crude oil price data comes from Refinitiv Datastream.

We then merge the price information with the accounting variables also obtained from Compustat. We use accounting data from the latest 2021 quarterly results referring to periods ending before January 1, 2022. All accounting variables in our analyses are, therefore, predetermined to stock returns. For non-US firms which have dual listing stocks in the US and their home country, we first take the data available from their home countries.

Firm size is measured as the natural logarithm of the market capitalization (in millions). BTM is defined as the natural logarithm of the book-to-market ratio (book equity divided by market capitalization). Cash is defined as the cash and short-term investments divided by total assets. Leverage is calculated as the long-term debt plus debt in current liabilities divided by total assets. Profitability is proxied by the return on assets (ROA), defined as income before extraordinary items divided by total assets. All non-ratio values are transformed to dollar values with the exchange rate at the end of 2021 provided by Compustat.

3.2 Analyst earnings forecast revisions

We follow Landier and Thesmar (2020) to calculate analyst earnings forecast revisions. We obtain daily consensus estimate data from S&P Global Capital IQ. Then, for each firm i and for estimation horizon h, we calculate the change of analysts' consensus estimates, expressed in percent, between January 23 and April 29 (the entire period of our analysis of the immediate impact of the Russia-Ukraine war), i.e. $Rev = (\frac{F_{T_1}EPS_{i,h}}{F_{T_0}EPS_{i,h}} - 1) * 100$, where $F_tEPS_{i,h}$ is the consensus estimate for earnings per share for firm i on date t with estimation horizon h. T_0 is set at January 23 and T_1 is set at April 29. We follow Landier and Thesmar (2020) to require $F_{T_0}EPS_{i,h}$ to be positive. The revision is calculated for eight different estimation horizons, including four quarterly estimates 2022Q1, 2022Q2, 2022Q3, 2022Q4 and four yearly estimates 2022, 2023, 2024, 2025. Each of the resulting eight variables is winsorized at the 1 percent and 99 percent levels.

3.3 Transition risk, physical risk, and opportunity

We use two different data sources based on textual analysis to determine firms' exposure to climate risks and opportunities. As for risks, we distinguish between transition risks and physical climate risks. Physical risks arise from extreme weather events, whereas transition risks arise from regulatory reforms designed to support the transition from a fossil fuel-based to a low-carbon economy. Unlike exposure to physical climate risks, corporate exposure to transition risks includes exposure to changes in governments and geopolitical developments. In addition, we employ a measure of opportunities from the transition to a low-carbon economy. Because these measures feature prominently in our analysis, we describe them in some detail to ensure the paper is self-contained.

Sautner et al. (2022a) utilize quarterly earnings conference calls from a global sample. Based on an initial bigram set, they first uncover, through machine learning algorithms, a set of bigrams relevant to climate change topics. Second, they construct climate change exposure measures based on the number of occurrences of the specified bigrams. Specifically, they generate four different topic bigrams (climate change, climate change opportunity, climate change regulatory, and physical climate change) and three measures for each bigram (exposure, sentiment, and risk).[9] Finally, they show that the text-based measure captures firm-level climate exposure variation better than other measures such as carbon intensities or ESG performance and risk scores. In this paper, we use the regulatory (transition) exposure ($Trans^{ECC}$), physical exposure (Phy^{ECC}), and opportunity exposure (Opp^{ECC}) scores provided by Sautner et al. (2022a) to proxy the transition/physical risk and climate change opportunity of individual firms, where ECC stands for earnings conference calls.[10] $Trans^{ECC}$ and Opp^{ECC} are correlated with 0.42.

[9] Examples of initial bigrams for regulatory (transition) exposure are: carbon price, carbon tax, emission trade, greenhouse gas, EPA regulation, energy regulatory, etc. Examples for physical exposure are: coastal area, natural hazard, global warm, heavy snow, sea level. Examples for opportunity are: renewable energy, solar energy, clean energy, wind power, electric vehicle.

[10] Sautner et al. (2022a) also provide risk measures by counting the relative frequencies of climate

Phy^{ECC} is effectively uncorrelated with both $Trans^{ECC}$ and Opp^{ECC}.

Kölbel et al. (2022) use a contextual natural language processing approach based on BERT[11] to extract transition and physical risk information from 10-Ks. Specifically, Kölbel et al. (2022) focus on Item 1.A of the 10-K report, where firms are obliged to report relevant risk factors.[12] Therefore, this measure is only available for US firms (and for a few firms with headquarters that still file in the US). It focuses on risks (and, therefore, does not include a proxy for climate change opportunities). Kölbel et al. (2022) implement a multi-classification algorithm based on BERT to learn whether each sentence is relevant to transition or physical risk, further aggregated on a document level to measure firm-specific exposure to transition and physical risk. The measure is economically validated on CDS market data and shows that transition risks increased CDS spreads in the wake of the Paris Agreement in 2015 and decreased after the Trump election. By contrast, the disclosure of physical risks decreases CSD spreads for companies materially exposed to physical climate risks through an uncertainty reduction mechanism. We use their regulatory exposure ($Trans^{10K}$) and physical exposure (Phy^{10K}) scores in this paper. $Trans^{10K}$, which has less than 25% of zero values, and $Trans^{ECC}$ are correlated with 0.53, indicating that they pick up related but different dimensions of the concept of interest.

change bigrams when they explicitly co-occur with terms indicating risks such as "uncertainty" and "risk". However, the risk scores are zero for most firms. For example, for the transition risk score in earnings conference calls, only about 3% observations in the global sample have a non-zero value, in comparison to 32% non-zero observations for the transition exposure score. To ensure that our main results are not driven by a small number of observations in the sample, we use the more general climate change regulatory (physical) exposure measure to proxy transition (physical) risk. Additional tests show that the explanatory power of the risk score is absorbed by the exposure score when both are included as explanatory variables.

[11] BERT is the acronym for Bidirectional Encoder Representations from Transformers. It is a deep neural network-based machine learning technique used for natural language processing (Devlin et al., 2018).

[12] Lopez-Lira (2021) show theoretically why the design of Regulation S-K and the prevailing legal doctrine lead managers to disclose the firm's risks accurately in the 10-K filings.

3.4 ESG measures

We control for ESG scores in our analysis. For the main analysis, we employ the overall ESG score from Refinitiv (formerly known as Asset 4), obtained as of the end of the calendar year 2021. With these data we maximize the sample size. These data have been used in several other recent studies, e.g., Albuquerque et al. (2020), Dyck et al. (2019), and Ferrell, Liang, and Renneboog (2016). For robustness checks, we also employ a series of other ESG measures, namely, MSCI ESG KLD STATS, MSCI ESG rating, S&P Global ESG rank, Sustainalytics ESG risk score, and RepRisk ESG reputational risk score.

The ESG measures from Refinitiv, MSCI, and S&P Global are performance measures. The ESG measures from Sustainalytics and RepRisk are risk measures, i.e., they capture firms' risk exposure to ESG-related topics.[13] To facilitate comparability, we flip the signs for the risk measures from Sustainalytics and RepRisk.

3.5 Inflation exposure

We construct a simple proxy of inflation exposure ($\%INF$) using the earnings conference call data. First, we count the total number of occurrences of three keywords (INFLATION, CPI, PPI) and normalize by the total number of words in the call. Next, we compute the variable for each conference call during 2021 and compute the average by

[13]MSCI KLD does not provide an aggregated score to indicate ESG-related performances or risks. Instead, it provides a list of ESG-related topics and the strengths and concerns within each topic. We follow previous literature (Deng, Kang, and Low, 2013; Servaes and Tamayo, 2013; Lins, Servaes, and Tamayo, 2017; Albuquerque, Koskinen, and Zhang, 2019) and focus on the following seven topics: community, diversity, employee relations, environment, human rights, product, and corporate governance. For each topic, we divide the sum of strength (concerns) within that topic for each firm-year by the maximum possible number of strengths (concerns) for that topic in that year. The MSCI KLD ESG measure then is constructed by summing up all the scaled strengths and subtracting all the scaled concerns across all seven topics. Data for this measure are available through 2018. For the S&P Global, MSCI, and Sustainalytics measures, we use data downloaded from Bloomberg on March 30, 2022. As only the most recent data, not historical scores, are available without limitation in our subscription, it is possible that some data were updated just as the war started to develop. For the RepRisk measure, we use year-end 2020 data downloaded from WRDS. The most recent data update there was done on October 4, 2021.

firm.

3.6 Geopolitical and international exposure

A first, straightforward measure of exposure to the war derives from how much corporate managers and analysts refer to the involved countries and the (possibility of) war. Specifically, in each earnings conference call transcript, we count the total number of occurrences of five terms relevant to the current war situation (RUSSIA, RUSSIAN, UKRAINIAN, UKRAINE, WAR) and normalize that count by the total number of words in the call. Then, for each firm, a variable ($\%War$) is constructed by taking the mean of the war relevant keywords counting ratio from all the earnings conference calls during the period January 1, 2021, through February 23, 2022 (that is, just before the Outbreak period starts).

The second approach uses a measure in the spirit of Hoberg and Moon (2017). These authors construct a text-based variable from 10-K filings to capture the offshore activities (offshore sale of output, purchase of input, and ownership of assets) of firms. The number of times a country is mentioned constitutes a proxy for the firm's exposure to that country. Ramelli and Wagner (2020) apply these data to study international exposure during the COVID-19 crisis. We focus on the two countries, Russia and Ukraine, which are at the center of the conflicts, and China, which plays an essential role in the global supply chain and international relations. Hoberg and Moon (2017) provide their data until 2017. To update the data to the most recent filing before the war started, we have replicated their measure as closely as possible. We compute the number of times each of these three countries is mentioned, #Russia, #Ukraine, and #China. Our measure and the corresponding measure from the original paper yield an average correlation of 0.75 for the common historical sample.

Third, we obtain the percentage of revenues generated from international sales, measured at the end of calendar year 2021, from S&P Global Capital IQ.

4 The Russia-Ukraine War

The Russia-Ukraine war affects firm values in many dimensions. We begin by laying out descriptive evidence on the average stock's performance across countries and industries. Then, we turn to the firm-level evidence, beginning with our main results on climate exposure. For that analysis, we offer a basic specification including only a core set of controls, followed by an expanded analysis including a wide range of potential value drivers.

4.1 Country- and industry-level results

Figure 2 shows that while in almost all countries, average equity returns were negative in the Build-up and, in particular, in the Outbreak period, in many countries the average firm delivered strongly positive returns in the Continuation period.[14] Relatively positive performers in the Outbreak period were stocks in Canada and the US (in addition to several other smaller countries). By contrast, Russian, French, German, and Italian companies and companies closely connected to Russia economically (the Baltic countries and Austria, for example) suffered. Companies in these countries also saw their volatility rise dramatically.

– Figures 2 and 3 here –

Not surprisingly, as visible in Figure 3 energy stocks and utilities were the two major sectors where the average returns were positive in the Outbreak period.[15] Automobiles,

[14]To maximize the numbers of observations for this plot, we retain observations even if some of the accounting variables are missing.

[15]Throughout the paper, we adopt the GICS industry classification, mostly because of its broad popularity among practitioners, which fits well with our empirical goal of studying how investors reacted to the Russia-Ukraine war. Bhojraj, Lee, and Oler (2003) provides evidence on the superior performance of the GICS classification in explaining stock return comovements and other financial similarities.

consumer services and consumer durables were the worst performers. By contrast, most industries delivered positive returns on average in the Continuation period.

4.2 Climate transition risk

Can the war be considered a negative shock to the transition to a low-carbon economy? Or does the war energize economies to speed up the weaning from fossil fuels due to the perceived need to become independent in particular from Russian energy? The baseline results that provide an answer to this question are summarized in Table 2.

For our global sample of firms, columns (1) and (4) of Table 2 show that already in the Build-up period as well as in the Outbreak period, stocks with high transition risk performed better than their peers. Stocks with a one standard deviation higher transition risk had about 11% of a standard deviation (1.34/12.18) higher Outbreak returns.[16] The Continuation period exhibited further drift, as seen in column (7).[17] Thus, the market overall priced a considerably protracted slowdown in the transition to a low-carbon economy.

Stock prices of firms with high opportunities from the climate transition briefly performed well in the Outbreak period, but these temporary positive effects in Outbreak reversed during the Continuation period. (The results for transition risk do not depend on the inclusion of the opportunities variable in the regressions.)

These global results mask striking heterogeneity across regions, in particular the US and Europe. Columns (2), (5), and (8) of Table 2 show the results for the US. Here, we use the 10-K-based transition and physical risk measures, but Appendix Table A4 shows that similar findings obtain with the earnings calls-based measure.

[16] During the Outbreak period, firms with above-median transition risk on average had positive returns while firms with below-median transition risk had negative returns.

[17] Notice that in the Outbreak period regressions, we control for returns in the Build-up period; in the Continuation period regressions, we control for returns in the Outbreak period. This approach mitigates concerns that in highly volatile market phases, we merely pick up reversal as we move from one phase to the next. However, the results also hold without these controls.

– Table 2 here –

The regressions show that the positive effect for transition risk is much more pronounced in the US than in the combined global sample. In the US, a one standard deviation higher transition risk resulted in one third of a standard deviation higher Outbreak returns (3.62/11.93). In Europe, the effect of transition risk is economically and statistically weaker. Diverging findings for the US and Europe also obtain for climate change opportunities. Whereas in the US, the effect for climate change opportunities is only briefly positive in the Outbreak period and then reverts and actually turns negative in the Continuation period, the positive impact in Europe in the Outbreak period is sustained throughout Continuation.

These results arguably reflect not only potentially less stringent regulation in the US, but also higher demand for US fossil fuels from Europe.[18] Thus, stock market participants anticipated that the war would slow down the transition to a low-carbon economy in the US, but not noticeably in Europe. Overall, this reaction appears consistent with the different policy stances.[19]

– Figures 4 and 5 here –

Figure 4 illustrates the development and magnitude of the impact of transition risk on cumulative stock returns over the sample period for the global sample. Clearly, the transition risk score becomes significant starting in mid-February. At the same time, there is no discernible effect from physical risk exposure. This is as expected: The current war is not affecting the climate itself. Firms with high opportunity-scores receive a noticeable positive boost late in the Outbreak period, but this effect dissipates and reverse over the course of the Continuation period.

[18]The price of the EU carbon permits dropped significantly on Feb 24 but then stabilized in the following days. See `https://tradingeconomics.com/commodity/carbon`.

[19]Financial Times, "EU to step up push for clean power as Ukraine conflict escalates", March 7, 2022

The top two panels of Figure 5 contrast the US and Europe. In the left panel, we observe the stark positive effects for transition risk for the US. By contrast, in Europe, shown in the right panel, there is no noticeable effect of the transition risk score, but a small and sustained positive effect for opportunity.

Consistent with the findings for stock returns, financial analysts also adjusted their forecasts. In Table 3, we find that, by and large, analysts upgraded their forecasts for companies with high transition risk. For example, for a company with a one standard deviation higher transition risk, analysts increased their consensus forecast for full-year earnings 2022 by around 18% of an interquartile range (2.34/12.98) by end of April 2022.[20] Comparing Panel A and Panel B suggests that the effect is more pronounced in the 10-K sample, that is, for US firms, than in the global sample. Interestingly, in the US sample, analysts even reduced their earnings forecasts for firms with large climate change opportunities. Further results available on request reveal that this negative effect comes from analyst forecast changes made during the Continuation period, in line with the particularly poor stock-price performance of these firms in that time period.

– Table 3 here –

Overall, these results show the dramatic consequences of the sanctions and the threats to energy security for many countries as they try to wean themselves off Russian fossil fuels. Investors globally appear to expect the energy transition to slow down, in particular in the US.

The results presented so far are derived controlling for a set of baseline controls. Naturally, firms exposed more to market moves (higher beta) performed poorly.[21] Firms

[20] We use the interquartile range for this quantitative statement because revisions have a large standard deviation as for some companies with earnings expectations close to zero even a small absolute change implies a large percentage change.

[21] As a robustness check, we also use cumulative abnormal returns, where abnormal returns are computed relative to expected returns following the Capital Asset Pricing Model (CAPM), Fama-French 3-factor model plus momentum, and the Fama-French 5-factor model plus momentum. Results available on request show that the overall findings are very similar.

more robust to rising oil prices did better (though the results for transition risk do not depend on the inclusion of this control variable). The results also do not change when exposure to gas prices is added as a further control (not shown). Contrary to the situation during the COVID-19 pandemic, financial strength (leverage and cash holdings) did not affect resilience in the three periods overall. Looking more closely at the development over time shows that high-cash companies performed well in the early part of the Continuation period. However, as fears of rising inflation took hold especially in the course of April, the attractiveness of holding cash was diminished strongly.

Despite these controls, it is possible that some of the results on transition risk are confounded by other factors. Next, we therefore add further controls. While the findings for these additional variables, described in what follows, are interesting in their own right, it is worth noting already now that the findings for transition risk remain robust. The bottom two panels of Figure 5 plot the results again comparing US and Europe. Even when including many controls and industry fixed effects, US firms with higher transition risk did significantly better after the Russian invasion, and a divergence in expected transition speed between the US and Europe is clearly visible.

4.3 Industry fixed effects

Transition risk is obviously correlated with industry. Therefore, in Table 4, we add industry fixed effects. Although the economic size of the effects is reduced, the results continue to hold. In fact, that divergence between the US and Europe becomes even more pronounced. Specifically, looking with industry, European firms with low transition risk outperformed.

Note also that all main results hold excluding the energy sector or excluding the financials and utilities sectors (see Table A5 in the Appendix). In results available on request, we find that the transition risk effect in the Outbreak period is particularly pronounced for financial companies, an interesting finding in light of the potential importance of the financial sector in the energy transition.

– Table 4 here –

4.4 ESG

It is possible that some of the results on transition risk reflect broader corporate environmental responsibility or even wider aspects of social responsibility or corporate governance. Therefore, throughout, we also control for ESG scores. The analysis of the role of ESG scores is of interest in its own right because prior work has yielded some indications that some of these scores predict higher resilience to crises such as the GFC and COVID-19. At the same time, there is widespread disagreement about what to measure and how to measure it (Berg, Kölbel, and Rigobon, 2022). In the regressions in Table 4, we begin by using Asset 4 data because the coverage is the widest of the data providers we have access to. The results show that Asset 4 ESG scores were largely unrelated with stock returns. Similar results hold also when focusing on the ES scores (leaving out the G component).

In Table A6 in the Appendix, we conduct checks using other ESG scores, namely, those provided by MSCI KLD, S&P Global, MSCI, Sustainalytics, and RepRisk. These scores have somewhat varying purposes (some emphasizing ESG performance, some risk), and they are available for different (sometimes substantially smaller) samples. Similar to the results for Asset 4, most of the coefficients of the ESG scores are not significant.

The top panel of Figure 6 illustrates this finding of the pricing of ESG fluctuating quite strongly within the three periods under consideration. Most importantly for our purposes, the findings for transition risk hold throughout when controlling for different types of ESG scores.

– Figure 6 here –

4.5 Inflation concerns

Even before the war started, inflation concerns had gripped the market. The shortage of energy supplies from Russia and fear of food shortage (e.g., wheat supplies from Ukraine) present a supply shock that can potentially lead to at least temporary inflation (and corresponding monetary policy responses). Controlling for differences in corporate inflation exposure also is important because one explanation for the differential performance of firms with high and low climate transition risk is that these firms differ along dimensions other than those related to their environmental and social performance. One prime candidate is, in fact, inflation risk and the risk of rising interest rates. After all, energy and other assets typically benefit from rising commodity prices. Controlling for corporate inflation talk ameliorates this concern.

The regression results in Table 4 show that firms that had talked about inflation more frequently on their earnings conference calls during year 2021 did far more poorly during the Outbreak period. A one standard deviation more frequent mention of inflation predicted a performance reduction by around one percentage point. Strikingly, this effect continued during the Continuation period. The bottom panel of Figure 6 illustrates this finding.

The underperformance of these stocks persists into the Continuation period, especially for European companies. (The persistence is even stronger, and also pronounced for the US, when not controlling for exposure to the oil price.) This result resonates well with a statement made by European Central Bank's Christine Lagarde. In a news conference on March 10, 2022, she stated that the "Russia-Ukraine war will have a material impact on economic activity and inflation through higher energy and commodity prices, the disruption of international commerce and weaker confidence."[22]

[22]See `https://www.ecb.europa.eu/press/pressconf/2022/html/ecb.is220310~1bc8c1b1ca.en.html`.

4.6 International exposure, sanctions, and exposure to the war

In Table 4, we also add measures of companies' international exposure (some of which are available only for US companies). First, as might be expected, firms that more frequently talked about Russia, Ukraine, or the (possibility of) war in their conference calls during 2021 and in early 2022 (before the Outbreak period) turned out to have significantly worse performance in the Outbreak period, as can be seen from the negative coefficient on %War. Interestingly, this effect reversed for US companies, but not for European companies, in the Continuation period.

Second, during the first month of the war in Ukraine, nearly 500 foreign firms had left the Russian market.[23] Clearly, only firms that were active in Russia in the first place can leave.[24] We construct a binary indicator $\mathbb{1}_{Action}$ that picks up these (partial or complete leavers), and another binary indicator, $\mathbb{1}_{Active}$ identifies firms that remain active in Russia. Therefore, the omitted category includes firms that either are not active in Russia or whose actions are unknown at this time. Table 4 shows that those who took action to leave performed significantly worse in the Outbreak period. Causality can run both ways: First, shareholders may expect leaving to be bad for long-term business, or it may signify that these firms will be expected to take other decisions based on moral assessments that some shareholders may consider to run counter to immediate business interests. Second, it is conceivable that when the management of a company engaged in Russia observes a particularly negative stock price effect early on, it interprets this as a critical vote of its shareholders on its Russia activities and then chooses to exit Russia.

Third, the number of times a US firm mentioned Russia or Ukraine in its 10-K disclosures is not significantly related to stock returns (whether or not we control for %War).

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[23] https://som.yale.edu/story/2022/almost-500-companies-have-withdrawn-russia-some-remain. We thank Jeffrey Sonnenfeld for making these data available on his website.

[24] Stocks with higher ESG scores tend to have had more Russia exposure in the first place, see https://corpgov.law.harvard.edu/2022/03/16/the-false-promise-of-esg/.

However, interestingly, exposure to China was negative in the Outbreak phase and beyond. Table 4 suggests that US companies mentioning supply chain or product market exposure to China by one standard deviation more frequently experienced more than one percentage point lower returns in the Outbreak period, an effect that was sustained into the Continuation period. This effect may be partly due to the recent outbreak of COVID-19 in China (and corresponding supply-chain difficulties and greater risks of international sales funnels). It may also reflect that investors worried that given that China did not condemn the Russian invasion, there is a possibility of a further trade or economic conflict between the US and China, which would hurt these firms. The bottom panel of Figure 6 illustrates these findings and makes it clear how sustained these effects are.

Finally, in additional results, reported in Table A7, we also control for the percent international sales. This variable is missing for a sizable part of the sample, which is why we do not include it in the main regressions. We set missing values of international sales equal to zero and include an indicator variable equal to 1 for missing values. International sales enter strongly negatively (and the missing values indicator is mostly insignificant), consistent with the interpretation that investors anticipate this war to have broader geopolitical repercussions that complicate business for internationally oriented firms.

Our main results, especially those relating to transition risk, hold controlling for all these variables.

5 The REPowerEU plan and the US Inflation Reduction Act

Policymakers in both Europe and the US have taken drastic measures to address the issues of energy security and the transition to a low-carbon economy that have come to the fore even more forcefully due to the Russia-Ukraine war. On May 18, the European Commission presented a detailed plan named REPowerEU to reduce the EU's energy dependence on Russia and to accelerate the net-zero transition.[25] In addition to promoting saving energy and diversifying the energy supply, one of the most important measures is accelerating the rollout of renewable energies. The plan contains various targets for the different renewable energy sectors, including introducing a legal obligation to install solar panels on new buildings, accelerating the deployment rate of heat pumps, increasing the production of hydrogen and biomethane, and simplifying the permitting processes for renewable energy projects. Overall, the goal is to increase the share of renewables in total energy consumption to 45% in 2030, up from 40% in an earlier EU energy plan (the Renewable Energy Directive).

As for the US, on August 16, President Joe Biden signed the Inflation Reduction Act of 2022 (IRA), i.e., the Climate, Tax, and Health Care bill, into law. The IRA can be seen as a continuation of an earlier version, the Build Back Better Act, which failed in the Senate in December 2021. It was a major surprise when in the late afternoon of July 27 Senator Joe Machin, whose vote played a crucial role in the failure of the Build Back Better Act in the Senate, expressed support for climate and tax measures in the new Inflation Reduction Act.[26] The climate section of IRA foresees investments of $369 billion in energy security and climate change. It weaves together a vast array of tax credits, loan guarantees, and grants, seeking to encourage people to make low-carbon purchases, such as electric cars, and to encourage businesses to invest in green technologies. However, it also contains provisions that will likely lead to more drilling for oil and gas; therefore, it does not shut down the carbon-emitting part of the US economy. Overall, at least some policy and research groups expect that the IRA will help the US move closer than

[25]Discussions of REPowerEU first surfaced in English-language searches for the term in the Factiva database on March 8, but the details did not come out until two months later. According to Google trends, the term "REPowerEU" reached the highest search volume on May 18 between January and August.

[26]While the IRA is arguably not as direct a consequence of the war as the REPowerEU proposal, it is likely that the heightened concerns about energy security in Europe and the energy transition disrupted by the war played an important role.

the prior policies to the latest US carbon emission reduction target of 50%-52% below 2005 levels by 2030, announced by President Biden at the Leaders Summit on Climate in 2021. For example, Jenkins et al. (2022) estimate that the Act will help reduce carbon emissions in the US to 42% below 2005 levels by 2030, compared to a 27% reduction with prior policies. A preliminary assessment from the US Department of Energy also estimates a reduction to 40% below 2005 levels.[27]

These policy initiatives provide an ideal opportunity to further test the conjecture that expected climate policy matters greatly for firm value. We regress the stock returns both at the event days (May 18, the day the European Commission released the REPowerEU plan, and July 28, the first trading day after Senator Manchin pledged support for the IRA, drastically improving the chances of its passage) on the climate exposure measures with all the control variables defined in the previous section.[28] Moreover, we consider a longer time period (one week from May 18, and the period from July 28 through August 16, the day when the IRA was signed by President Biden, respectively).[29] Besides addressing issues of energy, the IRA also stipulates that companies with more than $1 billion in adjusted financial statement income (AFSI) in the past three years are subject to a minimum corporate tax of 15%. This means that companies paying less than 15% of the AFSI are subject to a book alternative minimum tax (AMT) liability equal to the difference between 15% of the AFSI and the tax under the regular tax rule. Hoopes and Kindt (2022) perform a detailed estimate of this liability using publicly available data. They provide a list of 78 firms that would be affected, assuming the law had been in

[27] https://www.energy.gov/sites/default/files/2022-08/8.18%20InflationReductionAct_Factsheet_Final.pdf

[28] According to various news outlets, the support by Senator Manchin became widely known around 5:00 p.m. ET, after the market closed. For example, the earliest valid search of the Factiva database shows Dow Jones Newswires reporting the news at 5:03 p.m. ET on July 27. The press release from Joe Manchin's official website on IRA shows only the date, not the exact time. We checked the Internet Archive WayBack Machine, which maintains a historical archive of Internet sites, and find that Manchin's press release was first recorded at 8:54 p.m. GMT (4:54 p.m. ET).

[29] For the IRA period analysis, we updated the climate measures generated from the 10K for all firms that published 10K reports between the beginning of January 2022 and the end of June 2022.

force in 2021. From this list, we construct a binary indicator variable $\mathbb{1}_{Tax}$ to proxy for whether a firm will be affected by the tax law in IRA.[30]

Columns (1) and (2) of Table 5 report the results for the REPowerEU period, naturally focusing on the European sample. Column (1) regresses the return on the day of the announcement (May 18), and Column (2) the return one week after the announcement (May 18 through May 24). The positive coefficients for the climate opportunity measure (*Opp*) imply that the market expects firms with higher climate opportunities to benefit from the REPowerEU plan. Comparing Columns (1) and (2), it seems that the effect on the European firms further accumulates in the week after. However, the economic magnitudes are much smaller compared to the effects in the Outbreak period.

– Table 5 and Figure 7 here –

The top panel of Figure 7 displays these results graphically. The figure also includes results for US firms. Notably, the positive effects occur not only in Europe, where the plan has direct effects; apparently, the market expected a spillover also to US firms. There do not seem to be any dramatic changes on May 18, but rather a small upward trend for the European companies that began a week before the plan was unveiled. This is not surprising, given that the plan had been under discussion since the beginning of the war. The overall small effect is consistent with the relatively long period of discussion; part of the effect may have been priced in at an early stage.

Columns (3) and (4) present the results for the IRA period. Column (3) shows that already on the day the passage of the IRA became very likely, US firms with higher *Opp* significantly outperformed, consistent with the strong boost the Act would provide to firms engaged in the renewable energy business. At the same time, we also observe

[30] As discussed by Hoopes and Kindt (2022), there are various reasons why the actual future AMT liabilities might differ from the 2021 levels. Even whether or not a firm is affected at all might change. We note that the IRA also contains other tax-related provisions, in particular, an excise tax on repurchases, that we are not controlling for here.

a statistically significant positive coefficient for the transition risk measure from 10Ks ($Trans^{10K}$), consistent with the fact that the IRA also contains provisions that benefit fossil fuel firms. Policies promoting the transition to a lower-carbon economy can go two ways: supporting innovation and new technologies for clean energy or putting tighter regulations on polluting technologies. The market appears to expect that the current geopolitical tensions, especially the energy security concerns, make the latter approach relatively unattractive at the moment. The positive effects for both Opp and $Trans$ further accumulate during the entire IRA period, as displayed in Column (4).

The bottom panel of Figure 7 displays the effect of the climate exposure measures graphically. Clearly, the passage of the IRA was much more surprising and consequential than the REPowerEU plan. Notably, the coefficients on the climate exposure measures were around zero until July 27, the last trading day before the news that Senator Manchin had agreed to support the IRA came out, and then jumped on July 28 for the opportunity measure and the transition risk measure. A drift occurred in the following days when the bill was voted in the Senate and the House and finally signed into law on August 16.[31]

Although we only use the tax exposure variable ($\mathbb{1}_{Tax}$) as a control in this analysis, the effect is interesting in its own right. The results in Table 5 suggest that, on the day when the passage of the IRA became much more likely, the market expected firms subject to book AMT liability to lose from the bill.[32]

[31] In Appendix Table A8, we tabulate regression results for the US firms with more granular event windows. In particular, we also consider the first trading day after Senator Kyrsten Sinema, the last holdout in the Democratic Party, agreed to the bill (August 5), the day the bill passed in the Senate (August 8), the day the bill passed in the House (August 12), and the day the bill was signed by President Biden (August 16). Consistent with Figure 7, most of the significant market moves in terms of the climate measures occur at the beginning of the event. For example, the positive effect of $Trans$ began on July 28 and continues until the day Senator Sinema agreed to the bill.

[32] Appendix Table A8 shows that when Senator Sinema agreed to the IRA on August 5, there was another negative move for these firms, but in between the Manchin and Sinema agreements these firms outperformed, resulting in overall insignificant effects in the period until the IRA became law. In contemporaneous work, Gaertner et al. (2022) find overall similar stock price effects for the exposure to the book minimum tax. They point out that this exposure correlates with firm size, and they therefore do not control for size. Our findings regarding the climate exposure variables do not depend on whether or not we include the size control. The results for transition risk and opportunities are also not affected when

Returning to the issue of climate change exposure, Figure 7 also shows (and regressions available on request confirm) that for European firms, we observe a modest positive spillover effect for climate opportunity but not for transition risk. Such different effects between US and European firms for the *Trans* and *Opp* measures resemble those during the REPowerEU and the Outbreak periods. That is, while US firms with either high transition risk or climate opportunity both benefited, mainly European firms with high climate opportunities outperformed. In sum, there seems to be a consistent divergent market expectation between US and European firms regarding the transition to a lower-carbon economy throughout the analysis across different war-related episodes.

6 Conclusion

Even before war broke out in Ukraine, investors worldwide were facing a unique, challenging mix of events: restart of economic activity after COVID-19, fear of new virus strains, surging inflation, and new monetary policy and central bank frameworks, among others. The tragedy of war in Europe and the prospect of far-reaching geopolitical repercussions added another black swan to the flock.

Anecdotal evidence and market commentary abound on what factors influenced stock returns during the Russia-Ukraine crisis. However, such typically univariate analyses face the challenge that many relevant firm characteristics (like sustainability, international activities, sensitivity to interest rates, financial performance, among others) are correlated. Regressions controlling for a variety of factors can help distinguish which factors remain important after considering these common traits.

Our analysis reveals that regulatory climate risks, in particular, play an essential

we employ variations of the proxy for the tax effects. For example, we replace $\mathbb{1}_{tax}$ with the estimated book AMT liability, adjusted for either total assets or market capitalization. This scaled variable is not significantly related to returns. Finally, recall that the tax effects are based on a proxy on the as-if 2021 liability. A more detailed analysis of the tax effects would require estimates of how the market expects firms' tax positions to develop in future years.

role. Russia's invasion of Ukraine has put the issue of energy security back at the top of the political agenda and brought the planned energy transition to a crossroads. Many countries are (considering) turning to coal or liquefied natural gas as alternatives to Russian imports. At the same time, accelerating the fight against the climate crisis would seem to need increased and globally coordinated regulation. Some hope and indeed demand that such coordination results in a faster move towards renewable energy.[33] The REPowerEU plan and the US Inflation Reduction Act hold some promise in this respect. However, equity markets point to a nuanced story as investors appear to expect that the pace of transition to a low-carbon economy will be different in the US and Europe.

[33]For example, on March 21, 2022, United Nations secretary-general Antonio Guterres said "Instead of hitting the brakes on the decarbonisation of the global economy, now is the time to put the pedal to the metal towards a renewable energy future."

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Figure 1: Attention to the Russia-Ukraine War: Earnings Conference Calls and Google Trends

This figure plots the attention to the Russian-Ukrainian war measured from earnings conference calls and Google trends. The bar chart with the vertical axis on the left shows the number of earnings conference calls (blue bar) and the number of earnings conference calls with the keywords “RUSSIA”,” UKRAINE”,” RUSSIAN”, “UKRAINIAN”, ”WAR” (red bar). The line chart with the vertical axis on the right shows the percentage of the calls which have mentioned the keywords (red line), the global Google Search Volume Index (SVI) for “Russia” (green line), and the global SVI for “Ukraine” (blue line).

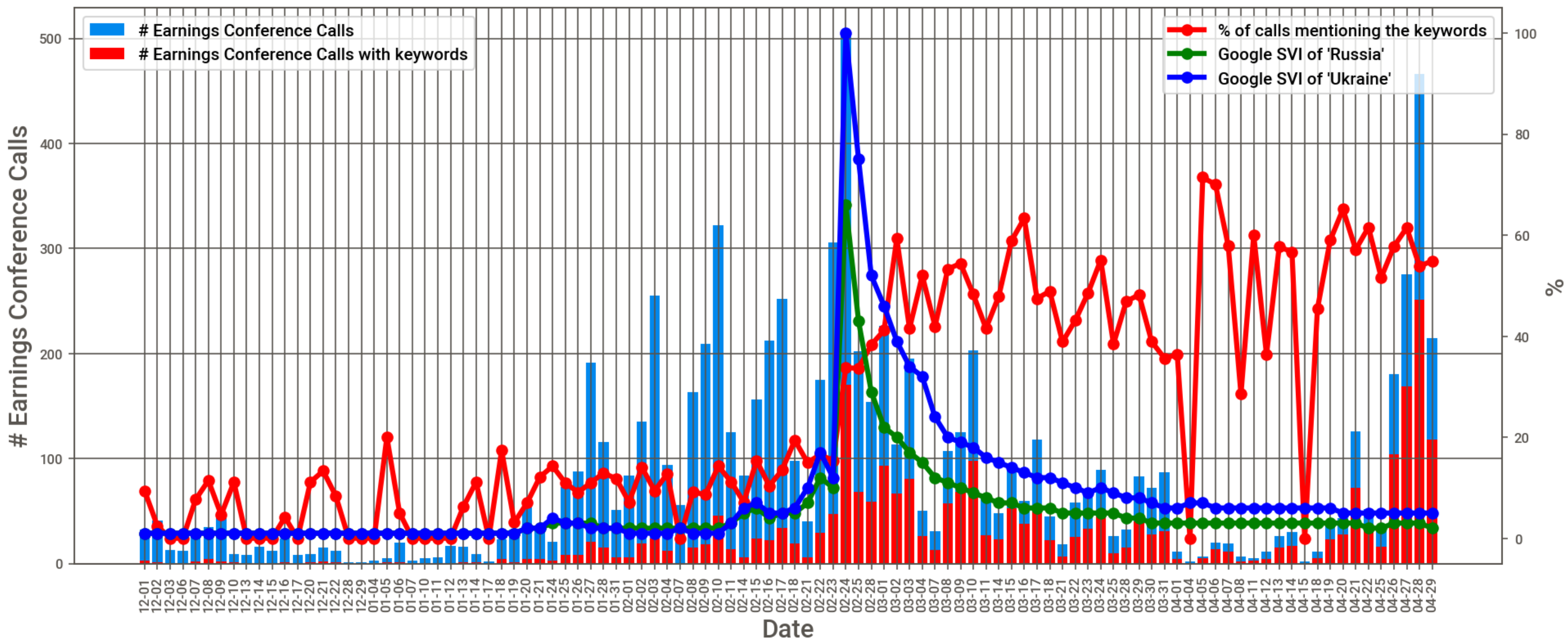


Figure 2: Stock Market Reactions to the Russia-Ukraine War Across Countries

This figure plots the stock market reactions of different countries for three periods: Build-up (January 24 - February 23), Outbreak (February 24 - March 08), and Continuation (March 09 - April 29). The left figure shows the equally weighted cumulative stock returns. The right figure shows the average standard deviation of daily stock returns. The country classification is based on firms' headquarter locations provided by Compustat.

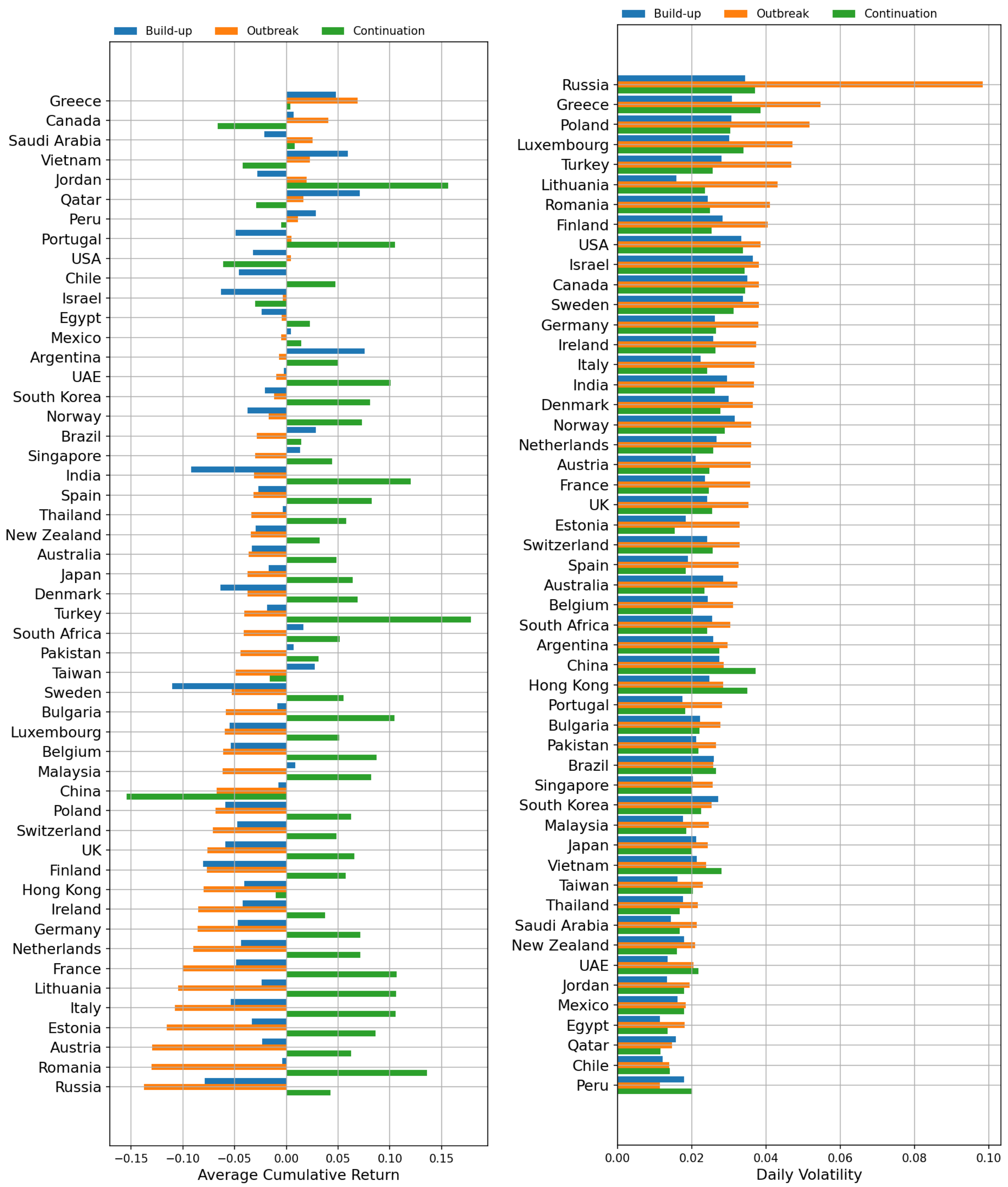
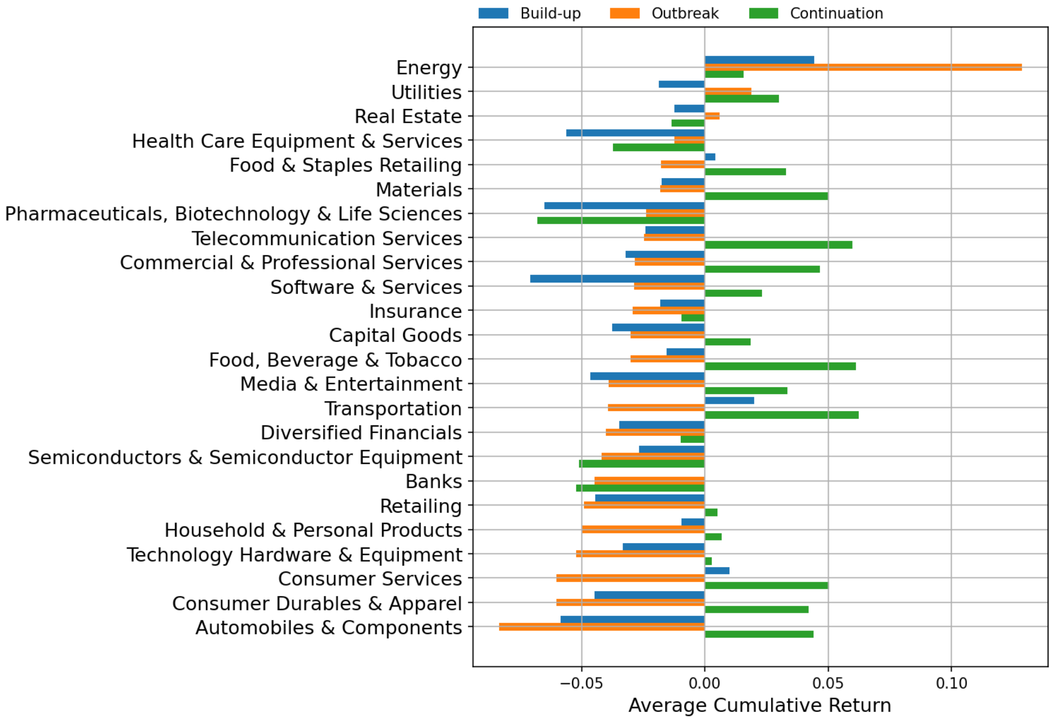


Figure 3: Stock Market Reactions Across Industries

This figure plots the stock market reactions of different GICS industries for three periods: Build-up (January 24 - February 23), Outbreak (February 24 - March 08), and Continuation (March 09 - April 29). The upper figure shows the equally weighted cumulative stock returns. The lower figure shows the average standard deviation of daily stock returns.



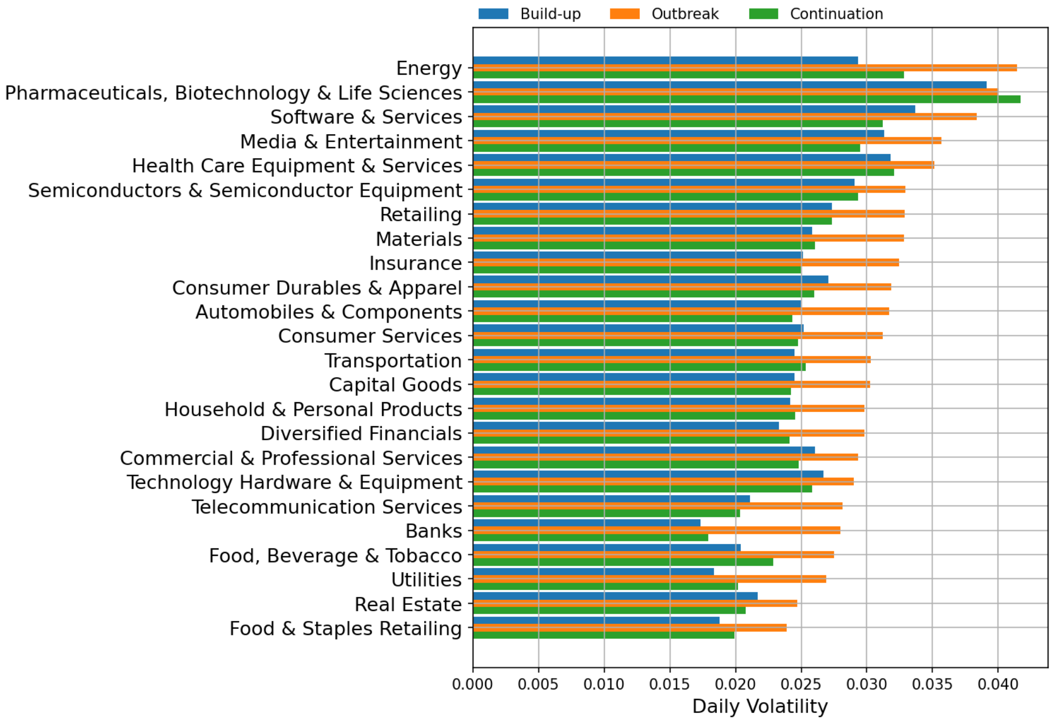


Figure 4: Evolution of Coefficients for Climate Change Exposure in the Russia-Ukraine War: Baseline Results

This figure plots the evolution of coefficients with 90% confidence intervals for transition risk, physical risk, and climate change opportunity from cross-sectional regressions, where the dependent variable is the cumulative return starting from January 24 through each trading day on the horizontal axis. The sample is a global sample of around 4500 firms. The control variables include the full set of controls from Table 2, except prior-period returns, including country fixed effects.

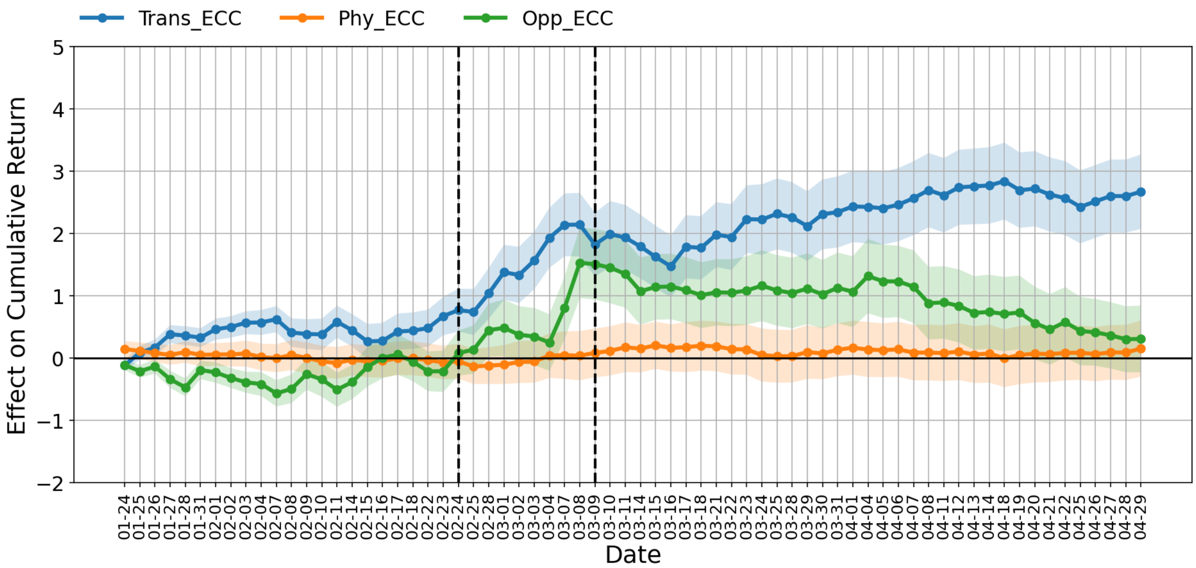


Figure 5: Evolution of Coefficients for Climate Change Exposure in the Russia-Ukraine War: US vs. Europe

This figure plots the evolution of coefficients with 90% confidence intervals for firms' climate change exposure (transition risk, physical risk, and opportunity) from cross-sectional regressions, where the dependent variable is the cumulative return starting from January 24 through each trading day on the horizontal axis. The two panels on the left use the US sample, the two panels on the right the European sample. For the US, we have proxies for transition and physical risk from earnings conference calls (ECC) and 10-Ks. A proxy for opportunity is available only from ECCs. We denote with Opp_{10K} the coefficient obtained when including the ECC-based proxy of opportunity in the regressions with transition and physical risk measured from 10-Ks. The upper panels display the results with the baseline controls from Table 2, except prior-period returns, including country fixed effects. The lower panels display the results with the full set of controls from Table 4, including country and industry fixed effects.

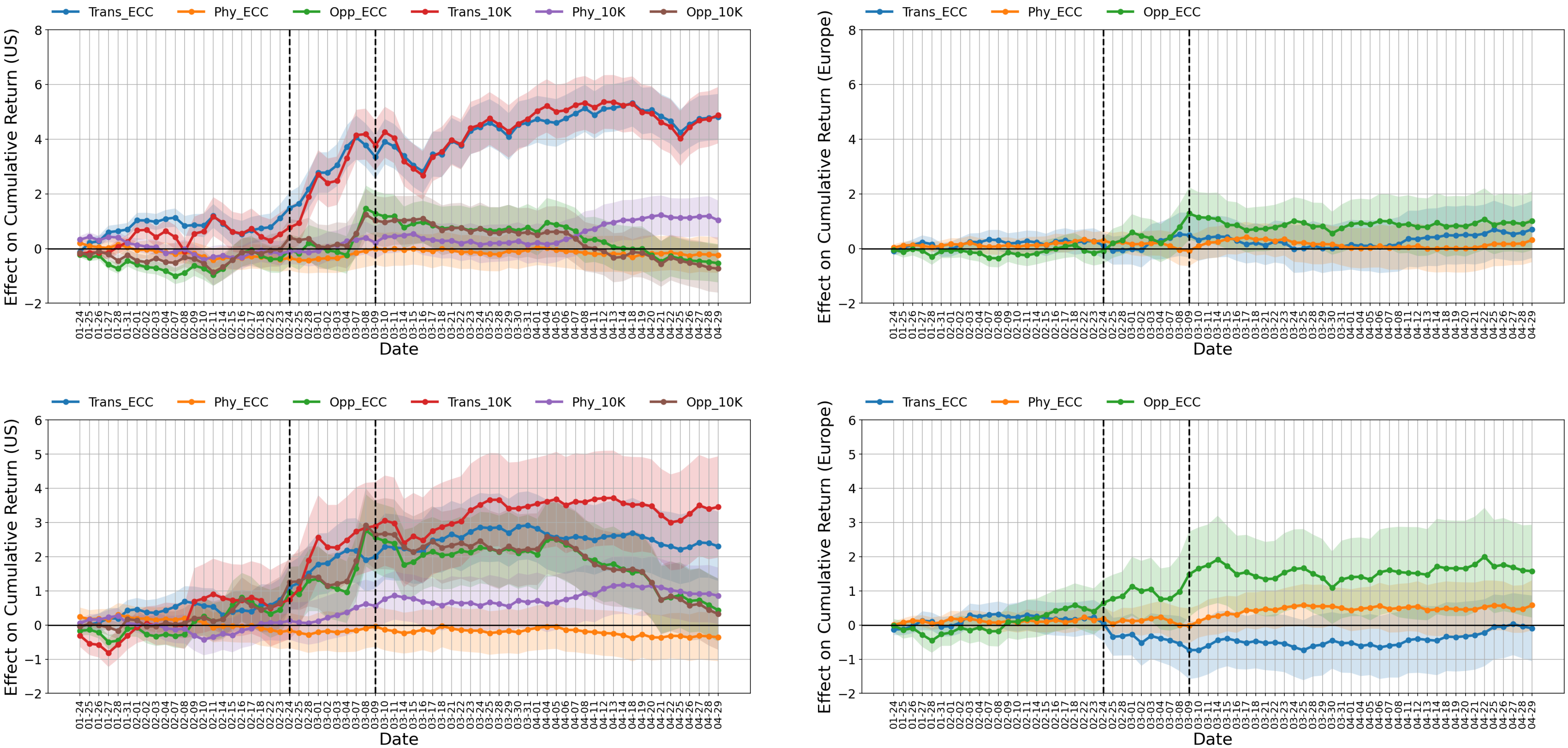


Figure 6: Evolution of Coefficients for ESG Scores, Inflation and International Exposure in the Russia-Ukraine War

The top panel of this figure plots the evolution of coefficients for different ESG scores from cross-sectional regressions, where the dependent variable is the cumulative return starting from January 24 through each trading day on the horizontal axis. The ESG measures from Refinitiv, KLD, MSCI, and S&P Global are performance measures. The original ESG measures from Sustainalytics and RepRisk are risk measures, i.e., they capture firms' risk exposure to ESG-related topics. We flip the signs of the risk measures so that their plots are comparable with the performance measures. Because confidence bands are partially very wide, they are not plotted. The bottom panel plots the evolution of coefficients for $\%INF$, $\%War$, and $\#China$ with 90% confidence intervals. The control variables include the full set of controls from Table 4, except prior-period returns, including country and industry fixed effects.

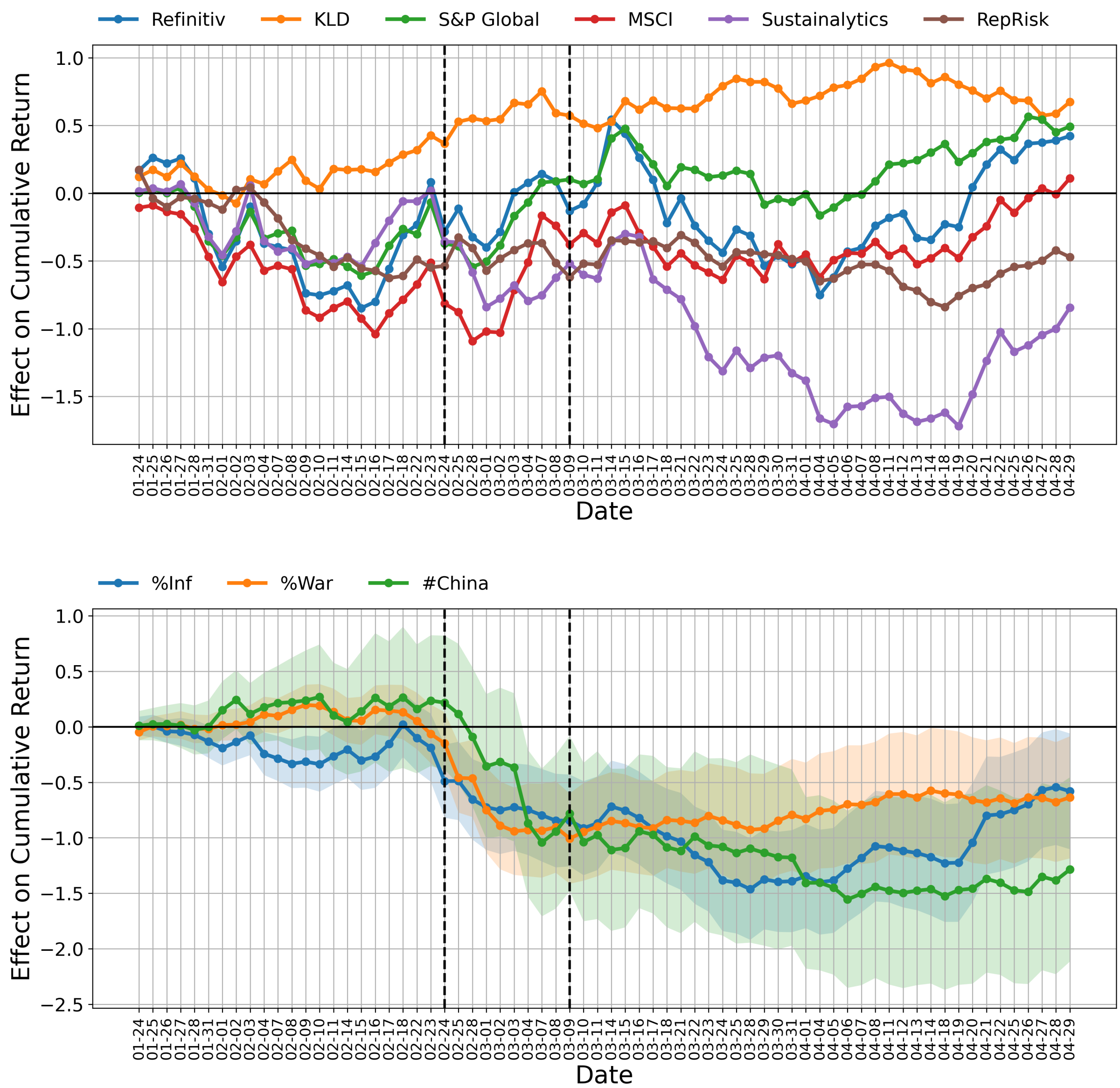


Figure 7: Evolution of Coefficients for Climate Change Exposure: REPowerEU and IRA Periods

This figure plots the evolution of coefficients with 90% confidence intervals for firms' transition risk and opportunity from cross-sectional regressions, where the dependent variable is the cumulative return starting from the first date on the horizontal axis through each of the following trading days. The top panel displays the period around May 18 when the REPowerEU was detailed by the European Commission. The bottom panel displays the period when the Inflation Reduction Act was voted into the law. For the US companies, we have proxies for transition risk measures from 10-Ks and opportunity measure from ECCs. For the European companies, we have both measures from ECCs. The results are with the controls from Table 5, including country and industry fixed effects.

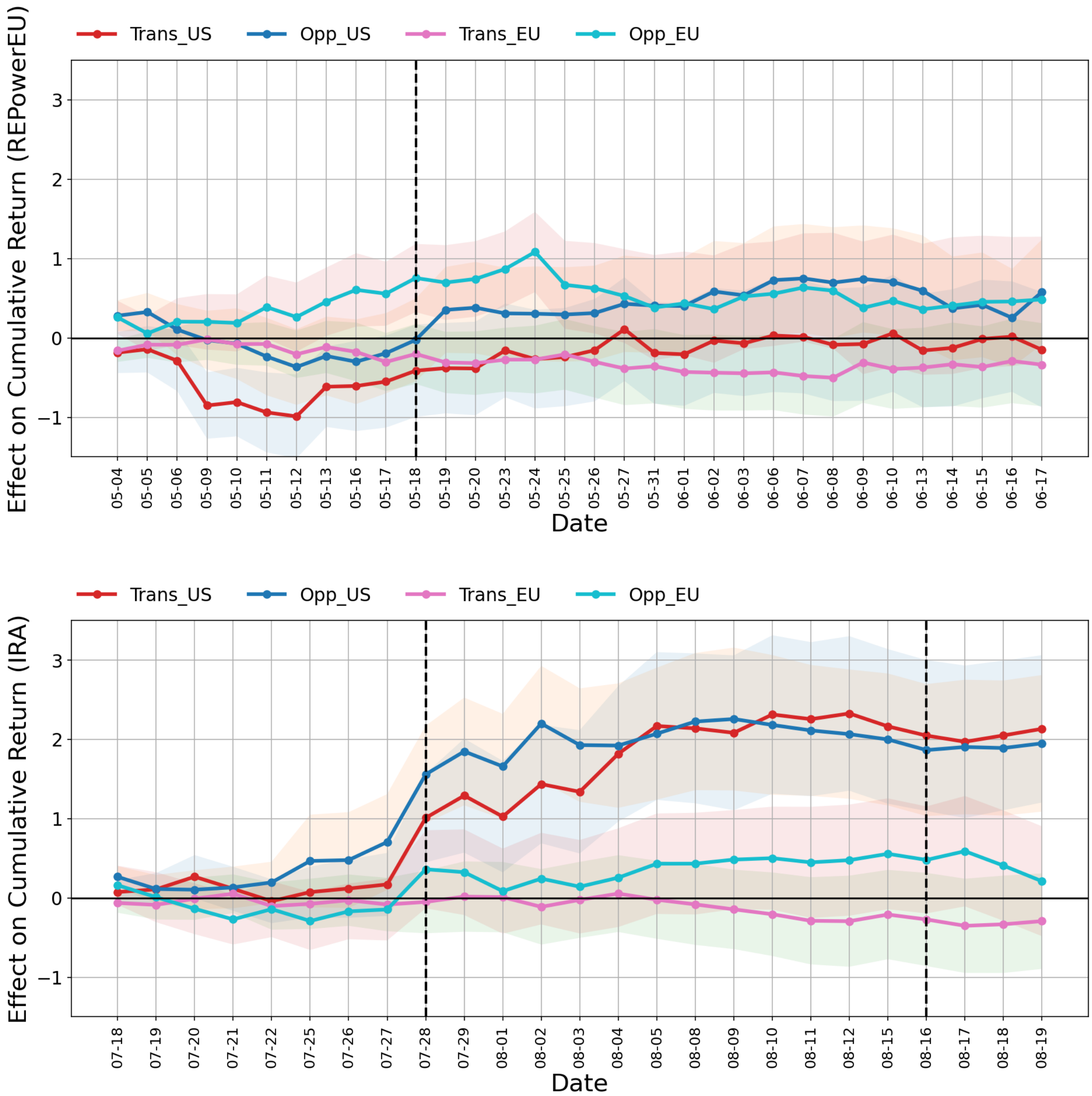


Table 1: Summary Statistics

This table reports the summary statistics (number of observations, mean, standard deviation, minimum, 25%, 50%, 75% percentiles, and maximum) for the main variables used in the paper. In the regressions, all continuous explanatory variables are standardized to have zero mean and unit variance. The definitions of variables can be found in Table A1.

	N	Mean	Std	Min	25%	50%	75%	Max
Stock Returns								
$Ret^{Buildup}$	4601	-2.962	11.707	-36.483	-9.309	-2.974	3.030	34.954
$Ret^{Outbreak}$	4601	-1.352	12.186	-29.467	-8.603	-2.280	3.943	44.253
$Ret^{Continuation}$	4601	-1.687	15.948	-46.686	-10.690	-1.211	7.905	42.938
Ret^{May18}	4539	-2.551	3.210	-11.953	-4.368	-2.390	-0.495	5.970
$Ret^{REPowerEU}$	4539	-3.423	6.401	-23.077	-6.660	-2.655	0.443	13.775
Ret^{July28}	4441	1.080	3.021	-8.719	-0.297	0.943	2.419	13.007
Ret^{IRA}	4441	8.292	13.714	-20.887	0.782	6.093	12.392	67.220
Earnings Forecast Revisions								
$RevQ1$	1479	-10.599	59.695	-378.571	-14.341	-2.323	5.340	175.298
$RevQ2$	1642	-2.572	45.799	-248.148	-11.174	-1.384	6.881	166.600
$RevQ3$	1764	1.110	36.796	-160.484	-7.141	0.165	8.098	154.123
$RevQ4$	1837	3.194	41.546	-200.000	-5.814	1.754	11.254	173.513
$Rev2022$	2693	-1.177	31.790	-159.322	-6.525	0.148	6.455	114.610
$Rev2023$	2729	-0.922	29.284	-159.211	-6.251	0.193	5.762	122.222
$Rev2024$	1670	-1.363	40.697	-218.129	-7.141	-0.168	5.596	193.103
$Rev2025$	978	-6.220	47.294	-273.333	-10.731	-0.692	5.239	173.077
Basic Firm Characteristics								
β^{MKT}	4601	0.906	0.419	-0.320	0.645	0.924	1.179	1.927
β^{Oil}	4601	0.027	0.155	-0.381	-0.052	0.022	0.096	0.663
$Size$	4601	7.722	1.929	3.277	6.429	7.767	9.017	12.175
BTM	4601	-1.044	1.003	-4.300	-1.622	-0.918	-0.316	0.898
ROA	4601	0.003	0.075	-0.326	-0.008	0.010	0.034	0.205
$Cash$	4601	0.217	0.243	0.002	0.049	0.121	0.280	0.955
$Leverage$	4601	0.267	0.201	0.000	0.088	0.247	0.404	0.809
Climate Risk Exposure								
$Trans^{ECC}$	4419	2.287	5.260	0.000	0.000	0.000	1.877	30.180
Phy^{ECC}	4419	0.122	0.484	0.000	0.000	0.000	0.000	3.205
Opp^{ECC}	4419	7.669	17.858	0.000	0.000	1.229	5.411	103.926
$Trans^{10K}$	1985	0.044	0.072	0.000	0.003	0.016	0.050	0.386
Phy^{10K}	1985	0.027	0.027	0.000	0.007	0.019	0.039	0.136
ESG Scores								
$ESG^{Refinitiv}$	3763	45.409	19.196	8.960	30.125	44.430	60.105	86.110
ESG^{KLD}	2081	0.483	0.658	-0.857	0.000	0.500	0.722	2.794
ESG^{MSCI}	1066	6.399	1.824	2.143	5.000	6.429	7.857	9.285
$ESG^{S\&P}$	3022	48.565	27.260	5.000	24.000	46.000	71.000	100.000
ESG^{SA}	1143	-21.795	6.818	-40.329	-26.598	-21.188	-16.742	-9.394
$ESG^{RepRisk}$	2568	-12.659	12.432	-54.000	-22.000	-13.000	0.000	0.000
Inflation and Tax Exposure								
$\%INF$	4146	1.629	3.239	0.000	0.000	0.259	1.666	18.000
$\mathbb{1}_{Tax}$	4601	0.015	0.122	0.000	0.000	0.000	0.000	1.000
International Exposure								
$\%War$	4150	0.190	0.604	0.000	0.000	0.000	0.000	4.223
$\#Russia$	1982	1.238	3.787	0.000	0.000	0.000	0.000	23.000
$\#Ukraine$	1982	0.664	2.419	0.000	0.000	0.000	0.000	15.000
$\#China$	1982	7.246	15.067	0.000	0.000	0.000	7.000	90.000
$\mathbb{1}_{Action}$	4601	0.052	0.222	0.000	0.000	0.000	0.000	1.000
$\mathbb{1}_{Active}$	4601	0.003	0.055	0.000	0.000	0.000	0.000	1.000
$IntSale$	4601	0.275	0.369	0.000	0.000	0.000	0.534	1.000
$\mathbb{1}_{IntSale}$	4601	0.506	0.500	0.000	0.000	1.000	1.000	1.000

Table 2: Cross-sectional Regressions of Cumulative Returns in the Russia-Ukraine War

This table summarizes the results of cross-sectional regressions of cumulative stock returns. The dependent variables are the total returns in the three periods Build-up, Outbreak, and Continuation. The explanatory variables include proxies for firms' climate change exposure (transition risk, physical risk, and opportunity) and various firm characteristics. In the global and European samples, the three climate change exposure measures are constructed from earnings conference calls. In the US sample, the transition risk and physical risk measures are constructed from 10-Ks, the opportunity measure is constructed from earnings conference calls. Country fixed effects are included as control variables for the global and European samples. All continuous explanatory variables are winsorized at the 1 percent and 99 percent levels and standardized to have zero mean and unit variance. All variables are defined in the main text and in greater detail in Appendix Table A1. The t-statistics (based on robust standard errors) are reported in parentheses below the coefficient estimates. *,**, and *** indicate statistical significance at the 10%, 5%, and 1% level respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variable:	$Ret^{Buildup}$			$Ret^{Outbreak}$			$Ret^{Continuation}$		
Sample:	Global	US	Europe	Global	US	Europe	Global	US	Europe
Trans	0.643***	0.201	0.143	1.341***	3.625***	0.226	0.998***	0.998**	0.748
	(3.48)	(0.58)	(0.50)	(5.70)	(9.90)	(0.59)	(4.07)	(2.18)	(1.49)
Phy	-0.054	0.060	0.308	0.085	0.311	-0.375	0.265	1.135***	0.402
	(-0.35)	(0.23)	(1.42)	(0.52)	(1.15)	(-1.42)	(1.35)	(3.47)	(0.92)
Opp	-0.209	0.102	-0.092	1.897***	1.498***	1.596***	-0.685***	-1.328***	-0.112
	(-1.07)	(0.33)	(-0.32)	(6.95)	(3.77)	(3.01)	(-2.90)	(-3.98)	(-0.24)
β^{MKT}	-0.019	-0.607*	-0.706*	-0.795***	-0.916***	-1.308**	-0.293	-1.096**	-0.228
	(-0.09)	(-1.68)	(-1.69)	(-3.73)	(-2.70)	(-2.57)	(-1.11)	(-2.48)	(-0.37)
β^{Oil}	2.560***	3.754***	2.807***	1.440***	0.693*	1.580*	1.816***	2.069***	1.598*
	(10.80)	(9.18)	(5.11)	(5.48)	(1.71)	(1.78)	(6.11)	(4.11)	(1.84)
Size	-0.420**	-0.573	0.710*	-1.264***	-2.101***	-0.550	1.748***	2.622***	0.841
	(-2.02)	(-1.62)	(1.87)	(-6.11)	(-6.27)	(-1.17)	(6.48)	(5.95)	(1.44)
BTM	0.824***	0.007	1.980***	-0.107	-0.546	-0.019	0.386	0.149	0.504
	(3.73)	(0.02)	(4.90)	(-0.47)	(-1.64)	(-0.03)	(1.33)	(0.34)	(0.76)
ROA	1.977***	2.634***	2.036***	0.352	0.345	-0.147	2.102***	3.281***	1.305**
	(7.43)	(4.49)	(5.57)	(1.41)	(0.82)	(-0.30)	(6.11)	(4.74)	(2.08)
Cash	0.292	0.784*	0.910	-0.139	0.438	0.121	-0.563	-0.306	0.197
	(1.05)	(1.67)	(1.45)	(-0.54)	(1.17)	(0.16)	(-1.57)	(-0.53)	(0.18)
Leverage	0.472**	0.446	1.753***	-0.156	-0.121	-1.275**	1.193***	0.984***	0.742
	(2.37)	(1.58)	(4.22)	(-0.78)	(-0.46)	(-2.36)	(4.75)	(2.80)	(1.15)
$Ret^{Buildup}$				0.284	-0.174	0.715			
				(1.33)	(-0.54)	(1.36)			
$Ret^{Outbreak}$							-1.945***	-1.332***	-2.512***
							(-6.42)	(-2.58)	(-4.63)
Constant	0.964	-2.278***	-6.025***	7.400	1.423***	-13.699***	6.651***	-4.617***	0.989
	(0.09)	(-7.60)	(-2.60)	(0.81)	(5.20)	(-11.79)	(7.23)	(-12.57)	(0.44)
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Country FE	YES	NO	YES	YES	NO	YES	YES	NO	YES
Observations	4419	1756	918	4419	1756	918	4419	1756	918
R-squared	0.142	0.135	0.241	0.184	0.183	0.150	0.233	0.151	0.094

Table 3: Cross-sectional Regressions of Analyst Earnings Forecast Revisions in the Russia-Ukraine War

This table summarizes the results of cross-sectional regressions of analyst earnings forecast revisions. The dependent variables are the changes of analysts' consensus earnings per share (EPS) estimates (expressed in percent) between January 23 and April 29 for eight different estimation horizons (including four quarterly estimates 2022Q1, 2022Q2, 2022Q3, 2022Q4 and four yearly estimates 2022, 2023, 2024, 2025). Following Landier and Thesmar (2020), we require the EPS forecast outstanding on January 23 to be positive. The main explanatory variables are the proxies for firms' climate change exposure (transition risk, physical risk, and opportunity) and firms' return sensitivity to oil price changes (β^{Oil}). Additional control variables, for which coefficients are not displayed to conserve space, include β^{MKT}, $Size$, BTM, ROA, $Cash$, and $Leverage$. Country fixed effects are also included. All continuous explanatory variables are winsorized at the 1 percent and 99 percent levels and standardized to have zero mean and unit variance. All variables are defined in the main text and in greater detail in Appendix Table A1. The t-statistics (based on robust standard errors) are reported in parentheses below the coefficient estimates. *,**, and *** indicate statistical significance at the 10%, 5%, and 1% level respectively.

Panel A ECC Sample

Dependent variable:	(1) $RevQ1$	(2) $RevQ2$	(3) $RevQ3$	(4) $RevQ4$	(5) $Rev2022$	(6) $Rev2023$	(7) $Rev2024$	(8) $Rev2025$
$Trans^{ECC}$	2.344	3.957***	3.677***	3.718***	2.341***	0.967*	1.406*	2.668**
	(1.33)	(2.73)	(3.28)	(2.70)	(3.47)	(1.79)	(1.75)	(2.34)
Phy^{ECC}	1.104	1.951*	1.005	0.869	0.964	0.693	0.613	1.535*
	(0.80)	(1.83)	(1.04)	(0.72)	(1.54)	(1.45)	(0.92)	(1.76)
Opp^{ECC}	-1.153	-1.843*	-0.507	0.101	-0.661	0.037	-0.235	-1.439
	(-0.60)	(-1.91)	(-0.41)	(0.09)	(-1.15)	(0.06)	(-0.21)	(-1.10)
β^{Oil}	1.127	8.760***	6.708***	7.593***	6.875***	8.438***	9.107***	4.585*
	(0.40)	(4.96)	(4.34)	(4.38)	(6.61)	(8.16)	(4.83)	(1.92)
Controls	YES	YES	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES	YES	YES
Observations	1426	1585	1701	1772	2624	2666	1663	966
R-Squared	0.110	0.183	0.180	0.147	0.119	0.191	0.167	0.178

Panel B 10K Sample

Dependent variable:	(1) $RevQ1$	(2) $RevQ2$	(3) $RevQ3$	(4) $RevQ4$	(5) $Rev2022$	(6) $Rev2023$	(7) $Rev2024$	(8) $Rev2025$
$Trans^{10K}$	0.364	4.135**	5.474***	5.089***	3.696***	3.059**	4.966**	4.265*
	(0.10)	(2.51)	(3.28)	(2.72)	(2.75)	(2.32)	(2.41)	(1.82)
Phy^{10K}	3.182	1.559	0.087	0.409	1.128	1.617**	0.313	0.318
	(1.19)	(1.18)	(0.09)	(0.37)	(1.10)	(2.01)	(0.23)	(0.21)
Opp^{ECC}	-1.895	-1.979*	-0.225	-1.011	-1.429**	-2.019**	0.302	-0.679
	(-0.81)	(-1.96)	(-0.17)	(-0.83)	(-2.10)	(-2.55)	(0.23)	(-0.52)
β^{Oil}	0.613	8.886***	6.405***	7.122***	5.557***	7.967***	5.450	3.732
	(0.14)	(3.57)	(2.74)	(2.60)	(3.22)	(4.85)	(1.63)	(1.28)
Controls	YES	YES	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES	YES	YES
Observations	858	968	1050	1124	1199	1217	707	441
R-Squared	0.087	0.171	0.168	0.137	0.119	0.227	0.221	0.217

Table 4: Cross-sectional Regressions of Cumulative Returns in the Russia-Ukraine War: Adding ESG, Inflation Concerns, and International Exposure as Controls

This table summarizes the results of cross-sectional regressions of cumulative stock returns for three different samples, i.e., global firms, US firms, and European firms. The dependent variables are the total returns for the three periods Build-up, Outbreak, and Continuation. The main explanatory variables include proxies for firms' climate change exposure (transition risk, physical risk, and opportunity), environmental, social, and governance (ESG) scores, inflation exposure, and international exposure. The opportunity measure is constructed from earnings conference calls, and the transition and physical measures are constructed from 10Ks (earnings conference calls) for US (Global/European) samples. Additional control variables, for which coefficients are not displayed to conserve space, include β^{Oil}, β^{MKT}, $Size$, BTM, ROA, $Cash$, and $Leverage$. Regressions with Outbreak (Continuation) returns include Buildup (Outbreak) returns as control variables. Country and industry fixed effects are included as control variables. All continuous variables are winsorized at the 1 percent and 99 percent levels and standardized to have zero mean and unit variance. All variables are defined in the main text and in greater detail in Appendix Table A1. The t-statistics (based on robust standard errors) are reported in parentheses below the coefficient estimates. *,**, and *** indicate statistical significance at the 10%, 5%, and 1% level respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variable:		$Ret^{Buildup}$			$Ret^{Outbreak}$			$Ret^{Continuation}$	
Sample:	Global	US	Europe	Global	US	Europe	Global	US	Europe
$Trans$	0.411*	0.159	0.113	-0.042	2.236***	-0.951**	0.515*	0.791	0.764*
	(1.96)	(0.34)	(0.38)	(-0.16)	(4.28)	(-2.31)	(1.94)	(1.43)	(1.68)
Phy	0.007	0.165	0.187	-0.002	0.487	-0.170	0.226	0.776**	0.526
	(0.05)	(0.53)	(0.94)	(-0.01)	(1.62)	(-0.72)	(1.11)	(2.15)	(1.43)
Opp	0.340	0.860**	0.628	1.955***	2.420***	1.017	-0.641**	-1.573***	0.172
	(1.23)	(2.14)	(1.50)	(5.83)	(4.98)	(1.54)	(-2.20)	(-3.85)	(0.28)
$ESG^{Refinitiv}$	0.147	-0.299	0.133	-0.071	0.104	-0.997**	0.578*	0.580	0.418
	(0.60)	(-0.81)	(0.31)	(-0.30)	(0.32)	(-1.99)	(1.87)	(1.34)	(0.62)
$\%INF$	-0.158	-0.165	-0.447	-0.793***	-0.981***	-0.578*	0.179	0.563*	-0.820*
	(-0.85)	(-0.65)	(-1.31)	(-4.43)	(-3.97)	(-1.76)	(0.76)	(1.79)	(-1.77)
$\%War$	-0.059	0.370	-0.078	-0.865***	-0.737**	-1.262***	0.500**	1.211**	0.204
	(-0.36)	(1.35)	(-0.37)	(-4.33)	(-1.99)	(-4.82)	(2.03)	(2.32)	(0.64)
$\mathbb{1}_{Action}$	-0.462	-0.559	-2.187**	-3.106***	-1.611*	-4.200***	-1.317	-2.029*	-0.363
	(-0.64)	(-0.54)	(-2.00)	(-4.78)	(-1.85)	(-3.52)	(-1.51)	(-1.65)	(-0.24)
$\mathbb{1}_{Active}$	1.423	2.621	-0.188	-1.780	-0.348	-0.498	0.041	-2.622	5.086**
	(0.69)	(0.79)	(-0.07)	(-0.71)	(-0.15)	(-0.08)	(0.01)	(-0.52)	(2.16)
$\#Russia$		-0.550			0.034			0.385	
		(-1.39)			(0.09)			(0.79)	
$\#Ukraine$		0.308			0.082			-0.584	
		(0.80)			(0.23)			(-1.24)	
$\#China$		0.157			-1.076***			-0.434	
		(0.44)			(-3.67)			(-1.04)	
Constant	6.423	-9.284***	-7.255**	-10.970***	-9.388***	-26.628***	6.904**	-4.818*	-5.137
	(0.65)	(-3.09)	(-2.14)	(-3.59)	(-3.14)	(-9.17)	(2.12)	(-1.77)	(-1.21)
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	3397	1598	727	3397	1598	727	3397	1598	727
R-squared	0.180	0.169	0.296	0.328	0.309	0.394	0.291	0.218	0.175

Table 5: REPowerEU and Inflation Reduction Act

This table summarizes the results of cross-sectional regressions. The dependent variables are the returns on the event date of REPowerEU (May 18) and IRA (July 28), the total returns for the REPowerEU period (May 18 through May 24) and the IRA period (July 28 through August 16). The main explanatory variables include proxies for firms' climate change exposure (transition risk, physical risk, and opportunity). The opportunity measure is constructed from earnings conference calls, and the transition and physical measures are constructed from 10Ks (earnings conference calls) for US (European) samples. In addition to the standard set of controls, regressions for the US also include a tax effect indicator ($\mathbb{1}_{Tax}$). The regressions also include returns of the prior month of the REPowerEU/IRA periods as control variables. Country and industry fixed effects are included as control variables. All continuous variables are winsorized at the 1 percent and 99 percent levels and standardized to have zero mean and unit variance. All variables are defined in the main text and in greater detail in Appendix Table A1. The t-statistics (based on robust standard errors) are reported in parentheses below the coefficient estimates. *,**, and *** indicate statistical significance at the 10%, 5%, and 1% level respectively.

	(1)	(2)	(3)	(4)
Dependent variable:	Ret^{May18}	$Ret^{REPowerEU}$	Ret^{July28}	Ret^{IRA}
Sample:	Europe	Europe	US	US
$Trans$	0.110	0.034	0.500***	2.116***
	(1.55)	(0.23)	(3.36)	(3.85)
Phy	0.074	0.130	-0.131	-0.894**
	(1.13)	(1.00)	(-1.51)	(-2.48)
Opp	0.194*	0.531***	0.588***	1.227**
	(1.65)	(2.94)	(4.52)	(2.45)
$\mathbb{1}_{Tax}$			-1.143***	0.074
			(-2.65)	(0.06)
β^{MKT}	-0.198	-0.228	0.116	1.104**
	(-1.20)	(-0.91)	(1.08)	(2.02)
β^{Oil}	0.219	-0.046	-0.380***	-1.959***
	(0.96)	(-0.13)	(-3.07)	(-2.91)
$Size$	-0.298*	-0.378	0.135	-1.448**
	(-1.93)	(-1.44)	(1.04)	(-2.56)
BTM	0.214	0.279	-0.360***	-1.575***
	(1.56)	(1.02)	(-2.95)	(-2.99)
ROA	-0.119	-0.340	-0.238	-3.655***
	(-0.70)	(-1.39)	(-1.28)	(-4.69)
$Cash$	-0.101	-0.302	-0.240*	1.167*
	(-0.42)	(-0.75)	(-1.80)	(1.65)
$Leverage$	-0.144	-0.264	0.114	1.651***
	(-0.94)	(-1.00)	(1.17)	(3.43)
$ESG^{Refinitiv}$	-0.137	-0.287	-0.017	0.131
	(-1.14)	(-1.29)	(-0.17)	(0.30)
$\%INF$	-0.107	0.107	-0.033	-0.513
	(-1.40)	(0.68)	(-0.53)	(-1.64)
$\%War$	0.012	-0.098	-0.039	-0.335
	(0.22)	(-0.90)	(-0.43)	(-0.63)
$\mathbb{1}_{Action}$	0.326	-0.454	0.156	0.097
	(1.17)	(-0.84)	(0.64)	(0.09)
$\mathbb{1}_{Active}$	0.769	3.516***	0.546	3.142
	(1.06)	(2.84)	(0.55)	(0.50)
$\#Russia$			-0.097	-0.162
			(-0.90)	(-0.30)
$\#Ukraine$			0.010	-0.103
			(0.10)	(-0.18)
$\#China$			0.149*	0.636
			(1.79)	(1.36)
Ret^{preREP}	0.373**	-0.001		
	(2.44)	(-0.00)		
Ret^{preIRA}			0.137	-1.798***
			(1.31)	(-3.09)
Constant	-2.086***	-1.625	1.673***	16.593***
	(-3.09)	(-1.10)	(2.62)	(4.61)
Country FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Observations	725	725	1520	1520
R-squared	0.245	0.284	0.196	0.204

Table A1: Variable Definitions

Variable	Definition	Source
$\mathbb{1}_{Action}$	A dummy variable indicating whether a firm has taken any of the following action regarding their business in Russia: holding off new investments/development, reducing current operations, suspension, withdraw.	Jeffrey Sonnenfeld and Yale Research Team
$\mathbb{1}_{Active}$	A dummy variable indicating whether a firm has not been taking any action regarding their business in Russia.	Jeffrey Sonnenfeld and Yale Research Team
β^{MKT}	The coefficient of the market return calculated from the Fama-French five-factor model plus momentum factor (Carhart, 1997; Fama and French, 2015) with prior one year daily data, by the end of calendar year 2021. We use the Fama-French North America factors to match the stocks from Compustat North America and the Fama-French Developed ex US Factors to match the stocks from Compustat Global.	Compustat, Kenneth R. French Data Library, own calculations
β^{Oil}	The coefficient on the oil return, calculated from an augmented CAPM model with oil returns as an additional explanatory variable. The oil price is the NYMEX West Texas Intermediate (WTI) crude oil 1-month future price, obtained from Refinitiv Datastream with Rueters Instrument Code (RIC) CLc1. The estimation uses prior one year daily data, by the end of calendar year 2021.	Compustat, Kenneth R. French Data Library, Refinitiv Datastream, own calculations
BTM	The natural logarithm of the firm's book-to-market ratio (book equity divided by market capitalization), measured by the end of calendar year 2021.	Compustat
$Cash$	Cash and short-term investments divided by total assets, measured by the end of calendar year 2021.	Compustat
$\#Country$	$\#Russia$, $\#Ukraine$, $\#China$ The number of times a firm mentions Russia, Ukraine, or China in their 10-K regarding offshore activities.	10-K, Hoberg and Moon (2017), own calculations
ESG^{KLD}	ESG measure from MSCI KLD STATS. We follow previous literature (Deng, Kang, and Low, 2013; Servaes and Tamayo, 2013; Lins, Servaes, and Tamayo, 2017; Albuquerque, Koskinen, and Zhang, 2019) and focus on MSCI KLD ESG data on seven topics: community, diversity, employee relations, environment, human rights, product, and corporate governance. For each topic, the sum of strengths (concerns) within that topic for each firm-year is scaled by the maximum possible number of strengths (concerns) for that topic in that year. Then the ESG measure is constructed by summing up all the scaled strengths and subtracting all the scaled concerns across all seven topics. Data on WRDS is available through the year 2018. We use the most updated data for each firm.	WRDS

Table A1 Continued

ESG^{MSCI}	ESG measure from MSCI, an ESG rating categorized in letters from best (AAA) to worst (CCC). We transform the letter rating into numerical value based on the rating methodology provided by MSCI. We take the average of the range of the final industy-adjusted company score of each letter rating category as the numerical value for that category. We use the value current on the day of the data download, March 30, 2022.	Bloomberg Terminal
$ESG^{Refinitiv}$	ESG measure from Refinitiv, an overall company score based on the reported information in the environmental, social and corporate governance pillars (ESG Score) with an ESG Controversies overlay. We use data applicable by the end of calendar year 2021.	Refinitiv Eikon and Datastream
$ESG^{RepRisk}$	ESG measure from RepRisk. The original measure is an index that captures a firm's exposure to reputational risks related to ESG. The value ranges from zero (lowest) to 100 (highest). The higher the value, the higher the risk exposure. We flip the sign of the original measure so that a higher value indicates less ESG risk to make it comparable with other ESG performance measures. We use year-end 2020 data. The most recent data update on WRDS was done on October 4, 2021.	WRDS
$ESG^{S\&P}$	ESG measure from S&P Global, a sustainability percentile rank converted from a total sustainability score which ranges from 0-100. We use the value current on the day of the data download, March 30, 2022.	Bloomberg Terminal
ESG^{SA}	ESG measure from Sustainalytics. The original measure captures the company's overall score in the ESG Risk Rating. The score ranges from 0 and 100, with 0 indicating the risks have been fully managed and 100 indicating the highest level of unmanaged risk. We flip the sign of the original score so that a higher value indicates less ESG risk to make it comparable with other ESG performance measures. We use the value current on the day of the data download, March 30, 2022.	Bloomberg Terminal
$E/S/G$	The environment/social/governance pillar score from Refinitiv, which is the weighted average relative performance of a company based on the reported environment/social/governance information and the resulting environment/social/governance category scores, measured by the end of calendar year 2021.	Refinitiv Eikon
$\%INF$	The total number of keywords (INFLATION, CPI, PPI) divided by the total number of words in earnings conference calls, then averaged for each firm for the calendar year 2021.	Refinitiv Company Events Coverage
$IntSale$	The percentage of revenues generated from international sales, measured at the end of calendar year 2021.	S&P Global Capital IQ
$\mathbb{1}_{IntSaleNA}$	A dummy variable indicating whether a firm is missing international revenues information.	S&P Global Capital IQ
$Leverage$	Long-term debt plus debt in current liabilities divided by total assets, measured at the end of calendar year 2021.	Compustat

Table A1 Continued

Opp^{ECC}	The climate change exposure related to opportunity generated from earnings conference call transcripts using a machine learning and bigram matching approach. The variable name in the original data file provided by the authors is *op_expo_ew*.	Sautner et al. (2022a)
Phy^{10K}	The physical risk score generated from 10-K using a machine learning approach based on BERT.	10-K, Kölbel et al. (2022)
Phy^{ECC}	The physical risk score generated from earnings conference call transcripts using a machine learning and bigram matching approach. The variable name in the original data file provided by the authors is *ph_expo_ew*.	Sautner et al. (2022a)
Ret	$Ret^{Buildup}$, $Ret^{Outbreak}$, $Ret^{Continuation}$, $Ret^{REPowerEU}$, Ret^{IRA}, Ret^{May18}, Ret^{July28}. The total return in percentage for the Buildup (January 24 through February 23), Outbreak (February 24 through March 08), Continuation (March 09 through April 29), REPowerEU (May 18 through 24), IRA (July 28 through August 16) periods, and the returns on May 18 and July 28, respectively.	Compustat
Rev	$RevQ1$, $RevQ2$, $RevQ3$, $RevQ4$, $Rev2022$, $Rev2023$, $Rev2024$, $Rev2025$. The change, expressed in percent, of analyst consensus estimates for earnings per share between January 24 and April 29 for eight different estimation horizons (four quarterly estimates 2022Q1, 2022Q2, 2022Q3, 2022Q4 and four yearly estimates 2022, 2023, 2024, 2025).	S&P Global Capital IQ
ROA	Return on assets, calculated as income before extraordinary items divided by total assets, measured by the end of calendar year 2021.	Compustat
$Size$	The natural logarithm of the firm's market capitalization (in millions), measured at the end of calendar year 2021.	Compustat
$\mathbb{1}_{Tax}$	A binary variable indicating whether a firm is likely to be affected by the minimum book tax due to the Inflation Reduction Act.	Hoopes and Kindt (2022)
$Trans^{10K}$	The transition risk score generated from 10-Ks using a machine learning approach based on BERT.	10-K, Kölbel et al. (2022)
$Trans^{ECC}$	The transition risk score generated from earnings conference call transcripts using a machine learning and bigram matching approach. The variable name in the original data file provided by the authors is *rg_expo_ew*.	Sautner et al. (2022a)
$\%War$	The total number of war-relevant keywords (RUSSIA, RUSSIAN, UKRAINE, UKRAINIAN, WAR) divided by the total number of words in an earnings conference call, then averaged for each firm during the period of January 01, 2021 through February 23, 2022.[34]	Refinitiv Company Events Coverage

[34]The measures generated from earnings conference calls ($\%INF$, $\%War$, $Trans^{ECC}$, Phy^{ECC}) are relatively small because of the scaling method. Due to the precision limit of the value in the summary statistics table, we have adjusted the original variable of $\%INF$ by a factor of 100 and $Trans^{ECC}$, Phy^{ECC}, $\%War$ by a factor of 10,000 for better presentation of the variation. The regressions use standardized values for all explanatory variables.

Table A2: Country/Region Distribution

This table reports the country/region distribution of the samples used for figures and regressions in this paper. A company's country is determined by its headquarters' location obtained through Compustat. The "Return Sample" has the largest number of stocks. We use this sample to plot Figure 2 and Figure 3 and only require the availability of stock returns but no other firm characteristics. We require a country to have a minimum of 10 stocks to enter the sample. The "Global Sample" and the "European Sample" are used for the regression analysis and are required to have additional firm characteristics besides stock returns.

Name	Return Sample	Global Sample	European Sample
Argentina	18	3	0
Australia	306	175	0
Austria	22	18	18
Bahamas	0	1	0
Belgium	41	22	22
Bermuda	0	26	0
Brazil	94	6	0
Bulgaria	27	0	0
Canada	190	129	0
Cayman Islands	0	6	0
Chile	24	0	0
China	842	19	0
Colombia	0	1	0
Costa Rica	0	1	0
Czech Republic	0	1	1
Denmark	69	40	40
Egypt	28	0	0
Estonia	11	0	0
Finland	126	44	44
France	192	83	83
Germany	117	70	70
Greece	28	12	12
Hong Kong	64	24	0
India	1307	3	0
Ireland	44	33	33
Israel	96	39	0
Italy	73	27	27
Japan	2921	218	0
Jersey	0	1	0
Jordan	12	0	0
Kazakhstan	0	1	0
Lithuania	10	0	0
Luxembourg	28	21	21
Malaysia	54	2	0
Malta	0	3	3
Mexico	51	0	0
Monaco	0	5	5
Netherlands	68	47	47
New Zealand	58	38	0
Norway	132	56	56
Pakistan	51	0	0
Peru	21	0	0
Poland	63	0	0
Portugal	12	5	5
Qatar	10	0	0
Romania	11	0	0
Russia	18	1	0
Saudi Arabia	69	0	0
Singapore	51	17	0
South Africa	68	1	0
South Korea	458	1	0
Spain	79	40	40
Sweden	403	106	106
Switzerland	122	71	71
Taiwan	458	2	0
Thailand	71	0	0
Turkey	131	0	0
United Arab Emirates	18	0	0
United Kingdom	444	223	223
United States of America	3959	3038	0
Uruguay	0	2	0
Vietnam	152	0	0
Virgin Islands, US	0	1	0
Total	13722	4683	927

Table A3: Industry Distribution

This table reports the industry distribution of the samples used for figures and regressions in this paper. A company's country is determined by its headquarters' location obtained through Compustat. The "Return Sample" has the largest number of stocks. We use this sample to plot Figure 2 and Figure 3 and only require the availability of stock returns but no other firm characteristics. We require a country to have a minimum of 10 stocks to enter the sample. The "Global Sample" and the "European Sample" are used for the regression analysis and are required to have additional firm characteristics besides stock returns.

Industry	Return Sample	Global Sample	European Sample
Automobiles & Components	367	75	22
Banks	325	232	6
Capital Goods	1859	486	155
Commercial & Professional Services	522	175	48
Consumer Durables & Apparel	619	161	44
Consumer Services	490	159	32
Diversified Financials	270	164	5
Energy	404	231	40
Food & Staples Retailing	188	43	13
Food, Beverage & Tobacco	631	151	45
Health Care Equipment & Services	634	319	45
Household & Personal Products	140	41	9
Insurance	99	65	3
Materials	1500	312	87
Media & Entertainment	533	186	47
Pharmaceuticals, Biotechnology & Life Sciences	1175	503	73
Real Estate	249	166	2
Retailing	575	210	48
Semiconductors & Semiconductor Equipment	362	95	15
Software & Services	1006	372	50
Technology Hardware & Equipment	821	201	33
Telecommunication Services	132	53	21
Transportation	412	134	51
Utilities	287	123	29
Total	13600	4657	923

Table A4: Cross-sectional Regressions of Cumulative Returns (ECC measures)

This table summarizes the results of cross-sectional regressions of cumulative stock returns. The dependent variables are the total returns in the three periods (Build-up, Outbreak, and Continuation). The explanatory variables include proxies for firms' climate change exposure (transition risk, physical risk, and opportunity) and various firm characteristics. All three climate change exposure measures are constructed from earnings conference calls. Country fixed effects are included as control variables for the global and European samples. All continuous explanatory variables are winsorized at the 1 percent and 99 percent levels and standardized to have zero mean and unit variance. All variables are defined in Table A1. The t-statistics (based on robust standard errors) are reported in parentheses below the coefficient estimates. *,**, and *** indicate statistical significance at the 10%, 5%, and 1% level respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variable:		$Ret^{Buildup}$			$Ret^{Outbreak}$			$Ret^{Continuation}$	
Sample:	Global	US	Europe	Global	US	Europe	Global	US	Europe
Trans	0.643***	1.211***	0.143	1.341***	2.481***	0.226	0.998***	1.401***	0.748
	(3.48)	(4.11)	(0.50)	(5.70)	(7.20)	(0.59)	(4.07)	(4.03)	(1.49)
Phy	-0.054	-0.436*	0.308	0.085	0.340	-0.375	0.265	0.010	0.402
	(-0.35)	(-1.79)	(1.42)	(0.52)	(1.41)	(-1.42)	(1.35)	(0.04)	(0.92)
Opp	-0.209	-0.442	-0.092	1.897***	1.839***	1.596***	-0.685***	-1.237***	-0.112
	(-1.07)	(-1.49)	(-0.32)	(6.95)	(5.00)	(3.01)	(-2.90)	(-3.90)	(-0.24)
β^{MKT}	-0.019	0.059	-0.706*	-0.795***	-0.582**	-1.308**	-0.293	-0.510	-0.228
	(-0.09)	(0.21)	(-1.69)	(-3.73)	(-2.24)	(-2.57)	(-1.11)	(-1.54)	(-0.37)
β^{Oil}	2.560***	2.474***	2.807***	1.440***	1.250***	1.580*	1.816***	1.810***	1.598*
	(10.80)	(8.62)	(5.11)	(5.48)	(4.17)	(1.78)	(6.11)	(5.21)	(1.84)
Size	-0.420**	-0.975***	0.710*	-1.264***	-1.614***	-0.550	1.748***	1.775***	0.841
	(-2.02)	(-3.69)	(1.87)	(-6.11)	(-6.28)	(-1.17)	(6.48)	(5.14)	(1.44)
BTM	0.824***	-0.009	1.980***	-0.107	-0.182	-0.019	0.386	-0.043	0.504
	(3.73)	(-0.03)	(4.90)	(-0.47)	(-0.64)	(-0.03)	(1.33)	(-0.12)	(0.76)
ROA	1.977***	2.739***	2.036***	0.352	0.305	-0.147	2.102***	3.499***	1.305**
	(7.43)	(6.53)	(5.57)	(1.41)	(0.84)	(-0.30)	(6.11)	(6.99)	(2.08)
Cash	0.292	0.374	0.910	-0.139	0.016	0.121	-0.563	-0.414	0.197
	(1.05)	(1.12)	(1.45)	(-0.54)	(0.05)	(0.16)	(-1.57)	(-0.99)	(0.18)
Leverage	0.472**	-0.015	1.753***	-0.156	0.166	-1.275**	1.193***	1.092***	0.742
	(2.37)	(-0.06)	(4.22)	(-0.78)	(0.72)	(-2.36)	(4.75)	(3.69)	(1.15)
$Ret^{Buildup}$				0.284	0.147	0.715			
				(1.33)	(0.57)	(1.36)			
$Ret^{Outbreak}$							-1.945***	-1.419***	-2.512***
							(-6.42)	(-3.60)	(-4.63)
Constant	0.964	-2.211***	-6.025***	7.400	1.231***	-13.699***	6.651***	-4.310***	0.989
	(0.09)	(-10.23)	(-2.60)	(0.81)	(5.86)	(-11.79)	(7.23)	(-15.49)	(0.44)
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Country FE	YES	NO	YES	YES	NO	YES	YES	NO	YES
Observations	4419	2797	918	4419	2797	918	4419	2797	918
R-squared	0.142	0.107	0.241	0.184	0.120	0.150	0.233	0.137	0.094

Table A5: Robustness: Excluding Energy, Financials, and Utilities Companies

This table summarizes the results of cross-sectional regressions of cumulative stock returns on the firms' climate change exposure (transition risk, physical risk, and opportunity) after excluding certain sectors. Panel A presents the results without the energy sector. Panel B presents the results without the financials and utilities sectors. The dependent variables are the total returns for the three periods (Build-up, Outbreak, and Continuation). The explanatory variables include firms' climate change exposure (transition risk, physical risk, and opportunity) and the same set of full controls as in Table 4, but only the coefficients for climate change exposure, β^{Oil} and ESG are displayed. Country and industry fixed effects are included as control variables. All continuous variables are winsorized at the 1 percent and 99 percent levels and standardized to have zero mean and unit variance. All variables are defined in Table A1. The t-statistics (based on robust standard errors) are reported in parentheses below the coefficient estimates. *,**, and *** indicate statistical significance at the 10%, 5%, and 1% level respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variable:		$Ret^{Buildup}$			$Ret^{Outbreak}$			$Ret^{Continuation}$	
Sample:	ECC	ECC+10K	10K	ECC	ECC+10K	10K	ECC	ECC+10K	10K
Climate risk measure:	Var^{ECC}	Var^{ECC}	Var^{10K}	Var^{ECC}	Var^{ECC}	Var^{10K}	Var^{ECC}	Var^{ECC}	Var^{10K}
Panel A: Excluding Energy									
$Trans$	0.534**	0.682	0.144	0.133	1.560***	3.004***	0.564*	0.555	0.304
	(2.33)	(1.39)	(0.31)	(0.46)	(2.65)	(5.30)	(1.93)	(1.12)	(0.56)
Phy	-0.021	-0.473*	0.112	-0.008	-0.061	0.163	0.229	0.023	0.727**
	(-0.13)	(-1.82)	(0.38)	(-0.05)	(-0.22)	(0.55)	(1.10)	(0.07)	(2.02)
Opp	0.345	0.665	0.863**	2.040***	2.284***	2.065***	-0.639**	-1.570***	-1.420***
	(1.19)	(1.54)	(2.08)	(5.80)	(4.01)	(4.15)	(-2.11)	(-3.68)	(-3.59)
β^{Oil}	2.849***	3.702***	3.785***	-0.730**	-0.602	-0.594	2.632***	3.085***	3.079***
	(7.38)	(6.69)	(6.90)	(-2.07)	(-1.30)	(-1.30)	(5.99)	(4.78)	(4.84)
$ESG^{Refinitiv}$	0.139	-0.303	-0.309	-0.071	0.019	0.107	0.628**	0.423	0.450
	(0.56)	(-0.83)	(-0.84)	(-0.29)	(0.06)	(0.33)	(1.98)	(0.98)	(1.05)
Controls and FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	3227	1574	1573	3227	1574	1573	3227	1574	1573
R-squared	0.142	0.136	0.134	0.250	0.213	0.230	0.303	0.229	0.231
Panel B: Excluding Financial and Utility									
$Trans$	0.434*	0.372	0.453	0.035	0.993*	2.221***	0.270	0.221	0.761
	(1.78)	(0.69)	(0.90)	(0.12)	(1.70)	(4.23)	(0.92)	(0.38)	(1.28)
Phy	0.029	-0.428	-0.126	-0.133	-0.121	0.497	0.401*	0.211	0.869**
	(0.17)	(-1.33)	(-0.35)	(-0.80)	(-0.39)	(1.49)	(1.84)	(0.56)	(2.13)
Opp	0.439	0.955*	0.935*	2.073***	3.192***	2.889***	-0.594*	-1.787***	-1.897***
	(1.31)	(1.85)	(1.90)	(5.17)	(4.64)	(4.72)	(-1.78)	(-3.42)	(-3.75)
β^{Oil}	2.754***	3.889***	3.903***	0.142	0.071	-0.079	1.991***	2.553***	2.434***
	(7.86)	(7.19)	(7.20)	(0.43)	(0.15)	(-0.17)	(4.83)	(3.85)	(3.67)
$ESG^{Refinitiv}$	0.094	-0.429	-0.408	-0.125	-0.214	-0.069	0.556	0.566	0.630
	(0.35)	(-1.03)	(-0.98)	(-0.48)	(-0.59)	(-0.19)	(1.64)	(1.16)	(1.30)
Controls and FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	2993	1401	1400	2993	1401	1400	2993	1401	1400
R-squared	0.188	0.183	0.182	0.322	0.303	0.315	0.292	0.220	0.223

Table A6: Robustness: Different ESG Measures

This table summarizes the results of cross-sectional regressions of cumulative stock returns on different ESG measures. The dependent variables are the total returns for the three periods (Build-up, Outbreak, and Continuation). The explanatory variables include firms' climate change exposure (transition risk, physical risk, and opportunity) and the same set of full controls as in Table 4, but only the coefficients for ESG and climate change exposure are displayed. The ESG measures from Refinitiv, MSCI, and S&P Global are performance measures. The ESG measures from Sustainalytics and RepRisk are risk measures, i.e., they capture firms' risk exposure to ESG-related topics. To facilitate comparability, we flip the signs for the risk measures from Sustainalytics and RepRisk. Country and industry fixed effects are included as control variables. All continuous variables are winsorized at the 1 percent and 99 percent levels and standardized to have zero mean and unit variance. All variables are defined in Table A1. The t-statistics (based on robust standard errors) are reported in parentheses below the coefficient estimates. *,**, and *** indicate statistical significance at the 10%, 5%, and 1% level respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variable:		$Ret^{Buildup}$			$Ret^{Outbreak}$			$Ret^{Continuation}$	
Sample:	ECC	ECC+10K	10K	ECC	ECC+10K	10K	ECC	ECC+10K	10K
Climate risk measure:	Var^{ECC}	Var^{ECC}	Var^{10K}	Var^{ECC}	Var^{ECC}	Var^{10K}	Var^{ECC}	Var^{ECC}	Var^{10K}
Panel A: MSCI KLD									
$Trans$	0.793**	0.665	0.320	0.866**	1.382***	1.833***	0.395	0.562	0.622
	(2.36)	(1.57)	(0.73)	(2.13)	(2.86)	(3.84)	(1.04)	(1.20)	(1.23)
Phy	-0.200	-0.354	0.158	0.154	0.085	0.542*	-0.092	-0.059	0.612*
	(-0.77)	(-1.23)	(0.53)	(0.65)	(0.31)	(1.91)	(-0.31)	(-0.16)	(1.70)
Opp	0.072	0.549	0.708*	1.713***	2.112***	2.187***	-0.651*	-1.125***	-1.051***
	(0.18)	(1.30)	(1.75)	(3.62)	(3.76)	(4.42)	(-1.68)	(-2.76)	(-2.69)
ESG^{KLD}	0.424*	0.299	0.313	0.240	0.282	0.327	0.196	0.475	0.503
	(1.73)	(1.04)	(1.08)	(0.97)	(1.02)	(1.19)	(0.64)	(1.29)	(1.36)
Controls and FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	1945	1523	1523	1945	1523	1523	1945	1523	1523
Panel B: S&P Global									
$Trans$	0.371*	0.488	0.500	0.008	0.961**	2.191***	0.536*	0.605	0.750
	(1.72)	(1.14)	(1.19)	(0.03)	(2.01)	(4.34)	(1.96)	(1.23)	(1.37)
Phy	0.025	-0.389	0.087	0.070	0.016	0.391	0.256	-0.019	0.614*
	(0.15)	(-1.46)	(0.30)	(0.42)	(0.05)	(1.31)	(1.13)	(-0.05)	(1.68)
Opp	0.319	0.573	0.593	1.260***	2.148***	1.934***	-0.547*	-1.356***	-1.310***
	(1.13)	(1.43)	(1.52)	(3.66)	(3.97)	(4.08)	(-1.72)	(-3.21)	(-3.22)
$ESG^{S\&P}$	-0.012	-0.399	-0.351	0.170	0.205	0.320	0.357	0.645	0.714
	(-0.04)	(-0.95)	(-0.84)	(0.62)	(0.55)	(0.87)	(1.04)	(1.34)	(1.49)
Controls and FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	2761	1532	1531	2761	1532	1531	2761	1532	1531
Panel C: MSCI									
$Trans$	0.043	0.691	1.026*	-0.080	0.190	1.905***	0.929***	1.337**	1.050
	(0.17)	(1.13)	(1.79)	(-0.30)	(0.29)	(2.84)	(2.93)	(2.26)	(1.64)
Phy	0.224	-0.442	0.311	0.107	-0.195	0.601	0.257	0.185	0.574
	(1.04)	(-1.30)	(0.78)	(0.50)	(-0.40)	(1.62)	(1.03)	(0.39)	(1.11)
Opp	0.339	0.054	0.079	1.126**	2.113*	1.608*	-0.381	-0.513	-0.316
	(0.94)	(0.09)	(0.14)	(2.15)	(1.73)	(1.85)	(-0.96)	(-0.68)	(-0.46)
ESG^{MSCI}	-0.524*	-0.867*	-0.891*	0.306	0.969**	0.942**	0.576	0.542	0.536
	(-1.70)	(-1.88)	(-1.95)	(1.06)	(2.36)	(2.31)	(1.62)	(1.10)	(1.08)
Controls and FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	991	428	428	991	428	428	991	428	428
Panel D: Sustainalytics									
$Trans$	0.171	0.615	0.932*	0.240	0.807	1.390**	0.846***	0.661	1.307*
	(0.68)	(1.10)	(1.82)	(0.81)	(1.50)	(2.38)	(2.73)	(0.91)	(1.87)
Phy	0.264	-0.303	0.126	0.124	-0.384	0.462	0.359	0.058	0.699
	(1.28)	(-0.91)	(0.34)	(0.58)	(-0.85)	(1.31)	(1.48)	(0.13)	(1.46)
Opp	0.488	0.372	0.494	0.584	1.421	1.547**	-0.259	-0.359	-0.326
	(1.52)	(0.78)	(1.05)	(1.53)	(1.64)	(2.14)	(-0.68)	(-0.49)	(-0.47)
ESG^{SA}	0.109	-0.138	-0.070	-0.490	-0.507	-0.405	-0.315	-0.287	-0.187
	(0.35)	(-0.26)	(-0.13)	(-1.46)	(-1.01)	(-0.85)	(-0.87)	(-0.53)	(-0.35)
Controls and FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	1073	502	502	1073	502	502	1073	502	502
Panel E: RepRisk									
$Trans$	0.377*	0.334	0.280	0.004	0.854	2.156***	0.190	0.440	0.336
	(1.69)	(0.68)	(0.57)	(0.01)	(1.41)	(3.84)	(0.61)	(0.81)	(0.62)
Phy	-0.159	-0.744**	0.312	-0.193	-0.220	0.680*	0.188	0.195	0.741*
	(-0.86)	(-2.08)	(0.90)	(-1.06)	(-0.62)	(1.85)	(0.74)	(0.47)	(1.82)
Opp	0.401	0.564	0.643	1.185***	2.414***	2.281***	-0.143	-0.860*	-0.725
	(1.40)	(1.13)	(1.39)	(3.32)	(3.81)	(4.06)	(-0.44)	(-1.77)	(-1.59)
$ESG^{RepRisk}$	-0.492**	-0.525	-0.481	-0.141	-0.039	0.063	0.137	0.405	0.435
	(-2.09)	(-1.44)	(-1.31)	(-0.54)	(-0.10)	(0.17)	(0.43)	(0.93)	(1.00)
Controls and FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	2365	1068	1067	2365	1068	1067	2365	1068	1067

Table A7: International Sales

This table summarizes the results of cross-sectional regressions of cumulative stock returns with the information of international sales as additional controls. The dependent variables are the total returns in the three periods (Build-up, Outbreak, and Continuation). The explanatory variables include proxies for firms' climate change exposure (transition risk, physical risk, and opportunity), environmental, social, and governance (ESG) scores, inflation exposure, international exposure, and various firm characteristics. Country and industry fixed effects are included as control variables. All continuous explanatory variables are winsorized at the 1 percent and 99 percent levels and standardized to have zero mean and unit variance. All variables are defined in Table A1. The t-statistics (based on robust standard errors) are reported in parentheses below the coefficient estimates. *,**, and *** indicate statistical significance at the 10%, 5%, and 1% level respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		$Ret^{Buildup}$			$Ret^{Outbreak}$			$Ret^{Continuation}$	
$Trans^{ECC}$	0.404*	0.459		-0.054	0.913*		0.516*	0.513	
	(1.93)	(1.05)		(-0.20)	(1.84)		(1.94)	(1.08)	
Phy^{ECC}	0.009	-0.361		0.000	-0.004		0.225	-0.019	
	(0.05)	(-1.27)		(0.00)	(-0.01)		(1.11)	(-0.06)	
Opp^{ECC}	0.347	0.656	0.776*	1.998***	2.651***	2.453***	-0.639**	-1.584***	-1.522***
	(1.25)	(1.55)	(1.93)	(5.99)	(4.85)	(5.01)	(-2.20)	(-3.69)	(-3.75)
$Trans^{10K}$			0.152			2.140***			0.655
			(0.33)			(4.19)			(1.20)
Phy^{10K}			0.084			0.463			0.756**
			(0.27)			(1.54)			(2.09)
$ESG^{Refinitiv}$	0.180	-0.187	-0.188	-0.030	-0.051	0.052	0.574*	0.471	0.511
	(0.73)	(-0.50)	(-0.51)	(-0.13)	(-0.16)	(0.16)	(1.84)	(1.08)	(1.18)
$\%INF$	-0.167	-0.155	-0.191	-0.836***	-0.900***	-1.010***	0.178	0.574*	0.512
	(-0.89)	(-0.62)	(-0.76)	(-4.70)	(-3.79)	(-4.15)	(0.76)	(1.82)	(1.64)
$\%War$	-0.035	0.388	0.402	-0.766***	-0.751**	-0.681*	0.501**	1.177**	1.214**
	(-0.22)	(1.39)	(1.43)	(-3.82)	(-2.00)	(-1.86)	(2.03)	(2.24)	(2.31)
$\#Russia$		-0.526	-0.534		0.089	0.013		0.512	0.452
		(-1.35)	(-1.36)		(0.23)	(0.03)		(1.05)	(0.93)
$\#Ukraine$		0.281	0.299		0.047	0.071		-0.691	-0.653
		(0.73)	(0.78)		(0.13)	(0.20)		(-1.47)	(-1.38)
$\#China$		0.286	0.271		-0.932***	-0.945***		-0.311	-0.329
		(0.78)	(0.73)		(-3.00)	(-3.22)		(-0.72)	(-0.77)
$\mathbb{1}_{Action}$	-0.414	-0.375	-0.293	-2.746***	-1.308	-1.043	-1.306	-1.871	-1.663
	(-0.57)	(-0.35)	(-0.27)	(-4.16)	(-1.49)	(-1.20)	(-1.49)	(-1.51)	(-1.35)
$\mathbb{1}_{Active}$	1.571	2.873	2.832	-1.653	-0.250	-0.610	0.017	-2.668	-2.810
	(0.76)	(0.86)	(0.85)	(-0.67)	(-0.10)	(-0.25)	(0.01)	(-0.51)	(-0.55)
$IntSale$	0.072	-0.124	-0.109	-1.305***	-1.422***	-1.336***	-0.096	-0.721	-0.737
	(0.26)	(-0.28)	(-0.25)	(-4.55)	(-3.39)	(-3.21)	(-0.26)	(-1.18)	(-1.21)
$\mathbb{1}_{IntSale}$	0.977*	1.184	1.171	-0.361	-0.481	-0.666	-0.223	0.505	0.294
	(1.68)	(1.40)	(1.38)	(-0.65)	(-0.62)	(-0.87)	(-0.30)	(0.47)	(0.27)
β^{MKT}	-0.288	-0.482	-0.462	-0.672***	-1.105***	-1.048***	-0.503	-1.095**	-1.104**
	(-1.02)	(-1.13)	(-1.09)	(-2.60)	(-2.90)	(-2.73)	(-1.50)	(-2.11)	(-2.14)
β^{Oil}	2.767***	3.769***	3.810***	-0.089	-0.147	-0.286	2.038***	2.514***	2.452***
	(8.15)	(7.21)	(7.26)	(-0.28)	(-0.33)	(-0.64)	(5.10)	(3.98)	(3.89)
$Size$	-0.329	-0.420	-0.370	-0.466	-1.343***	-1.494***	2.079***	2.820***	2.717***
	(-1.11)	(-0.90)	(-0.80)	(-1.64)	(-3.28)	(-3.67)	(5.67)	(5.12)	(4.99)
BTM	0.363	-0.258	-0.235	0.014	-0.206	-0.208	0.709**	0.700	0.724
	(1.35)	(-0.63)	(-0.57)	(0.05)	(-0.56)	(-0.56)	(2.13)	(1.47)	(1.52)
ROA	2.294***	2.902***	2.871***	0.391	1.023**	0.942*	2.449***	3.318***	3.316***
	(6.89)	(4.40)	(4.35)	(1.18)	(2.05)	(1.90)	(6.02)	(4.45)	(4.45)
$Cash$	-0.123	0.485	0.525	-0.447	-0.505	-0.338	-0.158	0.574	0.715
	(-0.35)	(0.92)	(0.99)	(-1.37)	(-1.22)	(-0.82)	(-0.38)	(0.90)	(1.12)
$Leverage$	0.335	0.226	0.241	-0.276	-0.220	-0.209	1.130***	0.369	0.375
	(1.33)	(0.65)	(0.69)	(-1.18)	(-0.73)	(-0.70)	(3.62)	(0.85)	(0.86)
$Ret^{Buildup}$				-0.012	-0.411	-0.413			
				(-0.05)	(-1.30)	(-1.33)			
$Ret^{Outbreak}$							-1.682***	-0.970*	-1.072*
							(-4.73)	(-1.69)	(-1.86)
Constant	6.124	-11.189***	-11.296***	-9.721**	-5.919*	-5.683*	7.040**	9.365***	10.116***
	(0.64)	(-3.33)	(-3.35)	(-2.57)	(-1.79)	(-1.74)	(2.15)	(2.65)	(2.86)
Country FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	3397	1639	1638	3397	1639	1638	3397	1639	1638
R-squared	0.181	0.178	0.177	0.334	0.323	0.334	0.291	0.220	0.223

Table A8: Inflation Reduction Act: US Sample With Detailed Event Windows

This table summarizes the results of cross-sectional regressions of stock returns. The dependent variables are the US stock returns during different time windows of the passage of the Inflation Reduction Act. The main explanatory variables include proxies for firms' climate change exposure (transition risk, physical risk, and opportunity), tax effect indicator ($\mathbb{1}_{Tax}$), basic firm characteristics (β^{MKT}, β^{Oil}, *Size*, *BTM*, *ROA*, *Cash*, and *Leverage*), environmental, social, and governance (ESG) scores, inflation exposure, and international exposure. The opportunity measure is constructed from earnings conference calls, and the transition and physical measures are constructed from 10Ks (earnings conference calls) for US (Global/European) samples. The regressions also include returns of the prior month of the IRA period as control variables. Country and industry fixed effects are included as control variables. All continuous variables are winsorized at the 1 percent and 99 percent levels and standardized to have zero mean and unit variance. All variables are defined in the main text and in greater detail in Appendix Table A1. The t-statistics (based on robust standard errors) are reported in parentheses below the coefficient estimates. *,**, and *** indicate statistical significance at the 10%, 5%, and 1% level respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Time period/event:	IRA announcement (Jul 27)	First trading day (Jul 28)	Jul 29 through Aug 4	Sinema agreement (Aug 5)	Senate vote passed (Aug 8)	Aug 9 through Aug 11	House vote passed (Aug 12)	Aug 13 through Aug 15	Signed into law (Aug 16)
Trans	0.071	0.500***	0.651**	0.339***	0.074	0.246	0.092	-0.131*	-0.138
	(0.80)	(3.36)	(2.29)	(2.98)	(0.68)	(1.53)	(1.37)	(-1.88)	(-1.35)
Phy	-0.031	-0.131	-0.109	-0.207**	-0.134*	-0.089	0.026	-0.083	0.014
	(-0.49)	(-1.51)	(-0.56)	(-2.42)	(-1.79)	(-0.66)	(0.46)	(-1.56)	(0.22)
Opp	0.173*	0.588***	0.302	0.080	0.171	0.069	0.033	-0.133*	-0.244***
	(1.92)	(4.52)	(1.12)	(0.64)	(1.56)	(0.41)	(0.43)	(-1.89)	(-2.93)
$\mathbb{1}_{Tax}$	0.364	-1.143***	2.699***	-0.659**	-0.296	0.070	-0.017	-0.071	-0.168
	(1.17)	(-2.65)	(2.81)	(-2.21)	(-1.33)	(0.14)	(-0.08)	(-0.43)	(-0.78)
β^{MKT}	0.530***	0.116	0.254	-0.061	0.157	0.360	0.282**	-0.177*	-0.167*
	(6.31)	(1.08)	(0.94)	(-0.43)	(1.30)	(1.56)	(2.49)	(-1.88)	(-1.90)
β^{Oil}	-0.339***	-0.380***	-1.151***	0.094	-0.125	0.122	-0.195	-0.183*	0.432***
	(-3.48)	(-3.07)	(-3.38)	(0.60)	(-0.80)	(0.45)	(-1.44)	(-1.70)	(3.90)
Size	0.033	0.135	-0.511*	-0.133	-0.290**	0.090	0.051	-0.260***	0.026
	(0.35)	(1.04)	(-1.72)	(-0.90)	(-2.41)	(0.42)	(0.48)	(-2.66)	(0.26)
BTM	-0.205**	-0.360***	-0.402	-0.368***	-0.107	0.014	0.031	-0.165**	-0.024
	(-2.45)	(-2.95)	(-1.57)	(-2.82)	(-1.01)	(0.07)	(0.35)	(-2.13)	(-0.29)
ROA	0.213*	-0.238	-1.793***	-0.327	-0.593***	-0.472	-0.275	0.126	0.241*
	(1.68)	(-1.28)	(-4.13)	(-1.36)	(-3.28)	(-1.37)	(-1.51)	(0.91)	(1.71)
Cash	0.318***	-0.240*	1.096***	0.295*	-0.249*	-0.157	0.412***	-0.146	-0.078
	(3.10)	(-1.80)	(3.09)	(1.69)	(-1.79)	(-0.58)	(3.03)	(-1.35)	(-0.69)
Leverage	0.088	0.114	0.536**	0.147	0.030	0.357*	0.111	-0.111	0.086
	(1.13)	(1.17)	(2.19)	(1.19)	(0.32)	(1.88)	(1.33)	(-1.60)	(1.19)
$ESG^{Refinitiv}$	-0.157**	-0.017	-0.258	-0.024	-0.096	0.236	-0.132	-0.002	0.199***
	(-2.08)	(-0.17)	(-1.16)	(-0.20)	(-1.00)	(1.36)	(-1.62)	(-0.03)	(3.01)
%INF	-0.053	-0.033	-0.109	-0.077	0.026	-0.105	-0.122***	0.064	-0.073*
	(-1.09)	(-0.53)	(-0.69)	(-0.86)	(0.45)	(-1.02)	(-2.96)	(1.59)	(-1.74)
%War	-0.074	-0.039	-0.245	0.005	0.075	0.015	-0.077	0.127*	0.001
	(-1.05)	(-0.43)	(-0.83)	(0.05)	(0.95)	(0.08)	(-1.40)	(1.92)	(0.02)
$\mathbb{1}_{Action}$	-0.314	0.156	-0.291	-0.297	-0.378*	0.434	0.032	0.083	0.127
	(-1.28)	(0.64)	(-0.45)	(-1.21)	(-1.92)	(0.97)	(0.17)	(0.54)	(0.78)
$\mathbb{1}_{Active}$	0.469	0.546	-1.436	2.429	-0.351	-0.250	-0.081	-0.558	0.017
	(1.07)	(0.55)	(-0.61)	(1.22)	(-0.88)	(-0.43)	(-0.26)	(-1.48)	(0.02)
#Russia	-0.006	-0.097	0.140	-0.110	-0.098	-0.050	-0.025	-0.086	-0.048
	(-0.07)	(-0.90)	(0.40)	(-0.85)	(-0.96)	(-0.24)	(-0.34)	(-1.29)	(-0.81)
#Ukraine	0.081	0.010	-0.070	0.182	0.152	-0.237	0.063	0.099	0.010
	(1.05)	(0.10)	(-0.22)	(1.38)	(1.37)	(-1.11)	(0.75)	(1.40)	(0.14)
#China	0.068	0.149*	0.458**	0.035	0.056	0.059	-0.073	0.074	-0.033
	(1.01)	(1.79)	(2.01)	(0.31)	(0.57)	(0.28)	(-0.73)	(0.84)	(-0.42)
Ret^{preIRA}	-0.297***	0.137	-0.404	-0.087	-0.533***	-0.201	-0.138	0.065	-0.018
	(-3.58)	(1.31)	(-1.38)	(-0.59)	(-4.60)	(-0.90)	(-1.14)	(0.66)	(-0.20)
Constant	3.284***	1.673***	1.803	1.101	2.785***	2.602**	3.096***	0.896**	0.999***
	(9.19)	(2.62)	(1.03)	(0.86)	(5.56)	(2.23)	(5.47)	(2.05)	(3.10)
Country FE	NO	NO	NO	NO	NO	NO	NO	NO	NO
Industry FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	1520	1520	1520	1520	1520	1520	1520	1520	1520
R-squared	0.248	0.196	0.219	0.127	0.221	0.111	0.098	0.169	0.397