

From crisis to climate: Geopolitical turbulence, climate change exposure, and managerial ownership

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Abstract

We explore how geopolitical risk shapes firm-specific exposure to climate change, utilizing innovative text-based measures for both variables. Our analysis reveals that elevated geopolitical risk leads to a significant reduction in firms' climate change exposure, suggesting that external shocks can spur organizational adaptation. The robustness of these findings is confirmed through a range of empirical checks, including propensity score matching, entropy balancing, and instrumental variable analysis. Further, we show that firms with larger cash reserves or greater R&D intensity tend to be less responsive to increases in geopolitical risk. Crucially, the reduction in climate change exposure is also less pronounced in firms with higher managerial ownership, underscoring the pivotal role of governance in guiding corporate responses to global risks.

JEL Classification: G32, G34, Q54, D22, D84

Keywords: Geopolitical risk, climate change exposure, managerial ownership, corporate governance, firm-level risk, textual analysis, adaptation

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Acknowledgement: This project is funded by National Research Council of Thailand (NRCT): N42A680640

Declaration: No competing interests.

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1. Introduction

Climate change and geopolitical risk have emerged as two of the most pressing challenges facing the global economy. Both pose significant threats to financial stability, corporate performance, and long-term value creation, compelling firms and investors to reassess their risk management and strategic priorities (Caldara & Iacoviello, 2022; Giglio et al., 2021). Understanding how these risks interact is crucial, as global disruptions—ranging from climate-induced disasters to geopolitical shocks—now routinely reshape business environments and investor expectations (Krueger et al., 2020; Sautner et al., 2023).⁵

Despite their significance, the effect of geopolitical risk on firm-specific exposure to climate change remains underexplored. As climate risk becomes a central factor in investment decisions and regulatory agendas, it is essential to understand whether—and how—geopolitical tensions influence how vulnerable firms are to climate-related shocks (Abdullah et al., 2024; Kolasa & Sautner, 2024; Nguyen et al., 2025; Roy et al., 2024). Geopolitical events can rapidly alter the priorities of firms and governments, potentially accelerating or delaying climate adaptation and resilience strategies (Caldara & Iacoviello, 2022).

This paper addresses this gap by investigating the effect of geopolitical risk on firm-level climate change exposure, highlighting why this connection is increasingly relevant for risk managers, boards, and policymakers. A key innovation of our study is the use of new, text-based measures for both climate change exposure and geopolitical risk. The geopolitical risk (GPR) index

⁵ Geopolitical risk encompasses the potential for events such as wars, terrorism, and international crises to disrupt global stability and international relations. For corporations, these risks can influence supply chains, investment strategies, and overall business operations (Caldara & Iacoviello, 2022). Climate change exposure reflects the extent to which a firm is susceptible to risks and opportunities brought about by climate change. This includes vulnerabilities related to physical climate impacts, evolving regulations, and the emergence of new business opportunities, as evidenced in firms' own disclosures and communications (Sautner et al., 2023).

from Caldara & Iacoviello (2022) and the firm-level exposure metric from Sautner et al. (2023) represent major methodological advances, enabling more precise and consistent empirical analysis than traditional approaches, which have long struggled to capture these elusive risks.

Our main results show that increases in geopolitical risk bring about a significant decrease in firm-specific climate change exposure, supporting the view that geopolitical shocks can serve as catalysts for organizational adaptation. This finding is consistent with the dynamic capabilities perspective, which argues that external shocks can prompt firms to reconfigure their resources and strategies in ways that improve long-term resilience (Nadeem et al., 2024; Qiu et al., 2022; Teece et al., 1997). When confronted with heightened geopolitical risk—such as wars, terrorist attacks, or diplomatic tensions—firms may accelerate efforts to strengthen their operational robustness and diversify supply chains, often aligning these efforts with broader climate adaptation and sustainability goals.

Our results thus support the “catalyst for change” hypothesis, showing that geopolitical risk can act as a wake-up call for firms, prompting meaningful adjustments in climate risk management. Rather than crowding out climate concerns, geopolitical shocks appear to drive firms to become less exposed to climate-related vulnerabilities by updating risk mitigation strategies and investing in resilience. Our findings are robust to a comprehensive suite of robustness checks, including propensity score matching, entropy balancing, and instrumental variable analysis using the exogenous shock of September 11, 2001, as an instrument for geopolitical risk. Our results are also supported by Oster's (2019) test for coefficient stability.

We further examine how this effect varies with key firm-specific attributes. Our evidence indicates that firms with larger cash reserves or higher R&D intensity exhibit a weaker reduction in climate change exposure in response to rising geopolitical risk. These results suggest that more

financially flexible or innovation-driven firms may have different approaches to risk management or may already be actively managing their climate exposures.

Finally, we investigate the moderating effect of managerial ownership, a crucial governance mechanism (Jensen & Meckling, 1976; Shleifer & Vishny, 1989). Our analysis reveals that the reduction in climate change exposure linked to greater geopolitical risk is significantly less pronounced in firms with higher managerial ownership. This suggests that agency conflicts and managerial entrenchment may dampen the willingness of firms to adjust to external shocks, emphasizing the importance of aligning managerial incentives with long-term risk mitigation.

This paper makes several significant contributions to the literature on risk, corporate governance, and climate finance by integrating theoretical insights with advanced empirical tools. First, by borrowing and applying recently developed, text-based measures for geopolitical risk and firm-specific climate change exposure, we address a core empirical challenge in the literature—the difficulty of systematically quantifying these risks (Caldara & Iacoviello, 2022; Sautner et al., 2023). The GPR index and the firm-level climate exposure metric operationalize two previously elusive constructs, thus directly advancing empirical tests of resource allocation theory and the attention-based view of the firm (Ocasio, 1997; Temmes & Välikangas, 2019). These theories posit that managers' resource allocation and risk responses depend on the salience and measurability of external threats. By employing these measures, we contribute to a significant and rapidly growing area of the literature that utilizes textual analysis to capture qualities that would otherwise be difficult to quantify (Chatjuthamard, Chintrakarn, Papangkorn, et al., 2024; Loughran & McDonald, 2011, 2014, 2016, 2020; Ongsakul, Jiraporn, et al., 2025; Wongsinhirun et al., 2023).

Second, our focus on the intersection of geopolitical risk and climate change exposure is rooted in calls for research on how complex, overlapping risks shape firm behavior (Giglio et al.,

2021; Kolasa & Sautner, 2024). The findings engage directly with the dynamic capabilities framework (Teece et al., 1997) and institutional theory (DiMaggio & Powell, 2004), examining whether external shocks serve as “forcing functions” that prompt firms to adapt, innovate, and build resilience, or conversely, lead to managerial distraction and inaction, as predicted by the attention-based view and real options theory (Dixit & Pindyck, 1994).

Finally, our findings on managerial ownership contribute to the agency theory literature (Jensen & Meckling, 1976; Morck et al., 1988). By showing that higher managerial ownership dampens the reduction in climate change exposure triggered by geopolitical risk, we highlight how entrenched managers, even when incentivized through ownership, may resist adaptation to exogenous threats—reflecting classic agency conflicts and the limits of incentive alignment under uncertainty.

2. Pertinent research

2.1. Geopolitical risk

Geopolitical risk (GPR) occupies a central position in the analysis of macroeconomic outcomes and global financial stability. Caldara & Iacoviello (2022) define geopolitical risk as the threat, realization, or escalation of events such as wars, terrorism, and international crises that disrupt the peaceful course of international relations. They construct a widely used news-based GPR index that tracks the intensity of global geopolitical tensions as perceived by the press, investors, and policymakers.

Empirical evidence shows that increases in geopolitical risk consistently foreshadow negative macroeconomic consequences. Caldara & Iacoviello (2022) demonstrate that when the GPR index rises, investment, employment, and stock prices tend to decline at the aggregate level.

They find that both the anticipation (threat) and realization of geopolitical events drive these effects, amplifying downside risks for economic activity and raising the probability of severe economic downturns.

Geopolitical risk also affects global financial markets and international economic linkages. Studies find that spikes in GPR disrupt cross-border capital flows and trade, increase financial market volatility, and trigger precautionary behavior by firms and households (Caldara & Iacoviello, 2022; Hoque et al., 2024; Pan et al., 2023; Schlosky et al., 2024). High GPR can lead to sudden shifts in investor sentiment, risk repricing, and increased demand for safe assets (Böyükaslan et al., 2024; Demiralay et al., 2024).

Further research highlights the global dimension of geopolitical risk. Caldara & Iacoviello (2022) show that their GPR index captures major international crises—including wars, terrorist attacks, and diplomatic standoffs—across multiple decades. The macroeconomic effects of these events are not limited to the countries directly involved, as elevated GPR can transmit shocks across borders, affecting the world economy.

Recent policy discussions reinforce the importance of monitoring geopolitical risk. International organizations such as the International Monetary Fund (IMF) warn that persistent or escalating geopolitical tensions threaten global growth and complicate policy coordination. Overall, current research affirms that geopolitical risk is a powerful, independent driver of macroeconomic and financial outcomes, making it an essential variable in contemporary economic analysis and forecasting (Jawadi et al., 2024; Lai et al., 2023; Nguyen & Thuy, 2023; Zhu et al., 2025).⁶

⁶ Additional recent research on geopolitical risk can be found in the following studies (Alam et al., 2023; El Ghouli et al., 2024; Le & Tran, 2021; Pringpong et al., 2023; Shrestha et al., 2024).

2.2. Climate change

Climate change stands as one of the most significant threats facing the global economy, with consequences that ripple far beyond the environment to influence financial markets and asset values worldwide (Giglio et al., 2021). An expanding literature documents how climate risk shapes the pricing of stocks, bonds, and real estate (Bernstein et al., 2019; Ginglinger & Moreau, 2019; Painter, 2020; Seltzer et al., 2022). Institutional investors increasingly treat climate exposure as a central consideration in portfolio management (Krueger et al., 2020).

Empirical evidence highlights the substantial impact of climate risk on firms. Many studies link greater climate vulnerability to weaker firm value, negative market responses, and higher financing costs. For example, Choi et al. (2020) find that carbon-intensive firms experience lower returns during unusually warm periods, while Bolton & Kacperczyk (2021) show that stocks with higher CO₂ emissions offer higher returns, reflecting a risk premium. Beyond equities, Painter (2020) reports that municipal bonds issued by coastal cities exposed to rising sea levels carry wider credit spreads. Heo (2021) observes that companies facing climate risk often increase cash holdings to buffer against uncertainty.

Together, these findings underscore how climate change disrupts traditional business and investment paradigms. Innovative research using machine-learning-based metrics, such as those developed by Sautner et al. (2023), shows that political shocks—like the 2016 Trump election—can significantly harm climate-exposed firms (Chatjuthamard, Mook Lee, et al., 2024). Likewise, new textual-analysis-based measures indicate that elevated climate policy uncertainty raises firm-level climate vulnerability and reduces firm value (Ongsakul et al., 2023).

3. Hypothesis development

3.1. *The crowded-out hypothesis*

This hypothesis draws from the *attention-based view of the firm* (Ocasio, 1997) and *resource allocation theory*. According to the attention-based view, organizations are boundedly rational and allocate their finite attention and resources to issues perceived as most urgent or threatening. In the presence of acute geopolitical risk—wars, sanctions, terrorism, or diplomatic crises—corporate and governmental priorities often shift rapidly toward immediate survival and operational continuity, crowding out less immediate but critical challenges like climate change adaptation (Ocasio, 1997; Hirshleifer & Teoh, 2003).

When geopolitical risk spikes, firms typically adopt precautionary behaviors: cutting investment, hoarding cash, and postponing strategic initiatives. This reallocation of resources is well explained by *real options theory*, which posits that under uncertainty, firms delay or suspend investments—especially those with long and uncertain payback, like sustainability and climate adaptation projects (Dixit & Pindyck, 1994). As a result, the organization’s ability to mitigate its climate exposure weakens, while vulnerabilities to physical, regulatory, and transition risks accumulate (Kolasa & Sautner, 2024).

Moreover, the *salience theory* (Bordalo et al., 2012) suggests that immediate, high-visibility threats (e.g., war, sanctions) capture disproportionate attention, while “slow-burn” risks like climate change become less salient and are systematically underweighted in decision-making. As a consequence, periods of high geopolitical risk not only overshadow climate risks in the near term but can inadvertently increase firm-specific exposure by stalling decarbonization investments, undermining risk management, and eroding preparedness for climate-related shocks

Recent empirical work underscores this mechanism: industries most exposed to GPR see the greatest declines in investment (Caldara & Iacoviello, 2022). The firm-level variation in climate change exposure is largely driven by managerial attention and organizational action, which are highly susceptible to external shocks that redirect attention (Sautner et al., 2023). Thus, if geopolitical crises crowd out climate priorities, exposure intensifies, compounding future risk.

3.2. The catalyst for change hypothesis

In contrast, the *dynamic capabilities* framework (Teece et al., 1997) and *institutional theory* argue that external shocks—including geopolitical disruptions—can trigger transformational change within organizations. According to these theories, when faced with heightened external threats, adaptive firms redeploy resources, reconfigure operations, and innovate to ensure survival and long-term competitiveness. Geopolitical risk, in this sense, can act as a “forcing function” that accelerates climate action, especially when energy security and supply chain resilience become intertwined with decarbonization and adaptation.

Geopolitical shocks often expose the vulnerabilities of fossil-fuel dependency and fragile global supply chains. Institutional theory predicts that such moments create “windows of opportunity” for new norms and practices to take root, especially as policymakers, investors, and civil society demand greater resilience (DiMaggio & Powell, 1983). In this context, *stakeholder theory* (Freeman, 1984) comes into play: institutional investors, governments, and consumers push firms toward sustainable business models not just for ethical reasons, but as a rational response to external threats.

Institutional investors leverage periods of uncertainty to pressure portfolio firms for better climate disclosure, governance, and rapid decarbonization (Kolasa & Sautner (2024); Stroebel &

Wurgler (2021). Sautner et al. (2023) show that firms with higher climate change exposure—as measured by attention in earnings calls—respond with more green hiring, green innovation, and investment in climate solutions. Here, geopolitical risk and climate risk become intertwined, with the former amplifying the perceived and real cost of inaction on the latter.

Thus, instead of overshadowing climate concerns, geopolitical risk can act as a catalyst, spurring firms to future-proof their operations, invest in green technologies, and build strategic resilience—ultimately reducing long-term climate change exposure.

4. Sample selection and data description

4.1. Sample selection

Building on recent research, we measure geopolitical risk using the index developed by Caldara & Iacoviello (2022). Firm-specific climate change exposure is captured with a distinctive metric from Sautner et al. (2023), which leverages advanced textual analysis. Data on board characteristics come from Institutional Shareholder Services (ISS), while information on managerial ownership is drawn from EXECUCOMP, which reports the percentage of total equity held by the top five executives. Our final sample comprises 60,167 firm-year observations spanning 2001 to 2020.⁷

4.2. Measuring geopolitical risk

While the concept of geopolitical risk is intuitive, its empirical operationalization has long been challenging due to difficulties in measurement. To address this gap, this study employs the

⁷ Our sample period ends in 2020 due to data availability. Even if additional data were accessible for subsequent years, it may not be advisable to include them because the onset of the COVID-19 pandemic represents an extraordinary shock to the global economy and corporate behavior. The pandemic introduced unique disruptions that could confound the analysis, making it difficult to isolate the effects of geopolitical risk and climate change exposure during this period.

Geopolitical Risk (GPR) index developed by Caldara & Iacoviello (2022). The GPR index is a news-based measure designed to capture both the threat and realization of adverse geopolitical events—including wars, military tensions, terrorist acts, and diplomatic crises—that could disrupt international relations or economic stability.

The index is constructed by systematically searching the archives of ten leading English-language newspapers. Caldara & Iacoviello (2022) implement a dictionary-based approach, identifying articles that contain keywords and phrases associated with a broad set of geopolitical risks. These keywords span categories such as war, military buildup, terrorism, and nuclear threats, as well as words linked to the onset or escalation of conflict (e.g., "invasion," "attack," "crisis," "threat"). The GPR index is calculated as the share of news articles referencing these risk-related terms relative to the total number of articles published during the same period.

The resulting index is normalized so that the average value for the 1985–2020 period is set to 100. Notably, spikes in the GPR index align closely with major geopolitical events such as the Gulf War, the September 11 attacks, the Iraq War, and more recent crises, reflecting heightened perceptions of geopolitical risk as they unfold. This systematic, text-based methodology provides a consistent and real-time indicator of global geopolitical tensions, facilitating empirical analysis of their economic consequences. For more detailed information about the construction of this index, please refer to Caldara & Iacoviello (2022).

4.3. Measuring climate change exposure

To assess firm-specific climate change exposure, we rely on the innovative dataset introduced by Sautner et al. (2023), which generates dynamic, company-level measures of climate risk based on the textual analysis of earnings conference call transcripts. Leveraging sophisticated

machine learning techniques, Sautner et al. (2023) extract climate-related bigrams—two-word phrases—found within the transcripts, and compute exposure as the ratio of climate change-related bigrams to the total bigrams present in each transcript. This metric is designed to reflect how frequently climate-related developments or disruptions affect individual firms (Heo, 2021; Chatjuthamard, Chintrakarn, Jiraporn, et al., 2024; Chindasombatcharoen et al., 2024; Likitapiwat et al., 2023; Ongsakul, Jiraporn, et al., 2025; Treepongkaruna et al., 2025). Further methodological specifics can be found in Sautner et al. (2023).

Earnings conference calls have become a key venue for firms to communicate with analysts, investors, and other stakeholders, providing updates on recent performance and addressing emerging issues (Hossain et al., 2022). During these calls, managers not only highlight positive developments but also seek to reassure or clarify during turbulent periods. Because these discussions often touch on operational risks and strategic challenges, they offer a rich resource for capturing a company's climate risk exposure in real time. Research by Hossain et al. (2022) affirms the value of this approach, noting its strong associations with important economic variables, including public sentiment and awareness around climate change (Sautner et al., 2023; Hossain et al., 2022).

Unlike conventional climate risk measures—such as reported emissions or records of environmental incidents—which tend to cover only firms that disclose such data, the method developed by Sautner et al. (2023) applies across a much broader spectrum of companies. This inclusiveness overcomes the limitations of voluntary reporting and enhances the representativeness of the dataset (Hossain et al., 2022). The approach's robustness and wide applicability have led to its rapid adoption in recent empirical work investigating climate risk and financial outcomes (Hossain et al., 2022; Heo, 2021; Chindasombatcharoen et al., 2024). By

drawing on earnings call transcripts, this methodology provides a more holistic view of climate change exposure, capturing dimensions often missed by traditional metrics and establishing itself as a benchmark in climate finance research.

4.4. Empirical strategy and other variables

To investigate the effect of geopolitical risk on firm-specific exposure to climate change, we estimate a panel data model with several key control variables. Our dependent variable is firm-specific climate change exposure, which captures how susceptible each firm is to climate-related risks.⁸

$$\begin{aligned} \text{Climate Change Exposure}_{it} = & \alpha + \beta_1 (\text{Geopolitical Risk})_t + \beta_2 (\text{Controls})_{it} \\ & + \text{Firm Fixed Effects} + \varepsilon_{it} \end{aligned} \quad (1)$$

where i indexes firms and t indexes years

The main explanatory variable is the Geopolitical Risk (GPR) index, which measures the level of global geopolitical tensions for each year. Since the GPR index is the same for all firms in a given year, we include a time trend variable to help account for any gradual changes in climate awareness or disclosure practices that might occur over time. The time trend increases by one each year and helps to separate the effect of GPR from broader temporal patterns.⁹

To ensure that our findings are not simply capturing general economic risk or uncertainty, we also control for the Economic Policy Uncertainty (EPU) index developed by Baker et al.

⁸ For easier interpretation, the original metrics by Sautner et al. (2023) are scaled by multiplying them by 10,000.

⁹ Year fixed effects cannot be included in this context because the Geopolitical Risk (GPR) index is constant across all firms within a given year. If year fixed effects were added, they would absorb all the variation in the GPR index, making it impossible to identify or estimate the separate effect of geopolitical risk on firm-specific climate change exposure. In other words, the model would not be able to distinguish the impact of GPR from any other factors that change uniformly across all firms each year. Therefore, to preserve the ability to assess the influence of GPR, year fixed effects are not included in the analysis.

(2016). Including the EPU index allows us to distinguish the unique influence of geopolitical risk from that of broader economic and policy-related uncertainties.

The model includes a range of firm-level control variables that might also influence climate change exposure, according to prior research (Chatjuthamard, Mook Lee, et al., 2024; Chindasombatcharoen et al., 2024; Likitapiwat et al., 2023; Ongsakul, Jiraporn, et al., 2025; Treepongkaruna et al., 2024). These controls include firm size, leverage, profitability, capital expenditures, advertising intensity, R&D intensity, dividends, discretionary spending, asset tangibility, and cash reserves. Each variable is chosen to account for differences in financial resources, risk management, investment in innovation, and corporate governance, all of which could affect a firm's vulnerability to climate risks.

Firm fixed effects are included to control for any unobserved, time-invariant characteristics of individual firms—such as industry, business model, or management culture—that could bias the results. By accounting for these firm-specific traits, we ensure that the analysis focuses on within-firm changes over time rather than on differences between firms. Finally, we cluster standard errors by both firm and year. This approach corrects for possible correlations in the data within firms over time and across firms within the same year, providing more reliable inference.

Detailed variable definitions are shown in Table A1 in the Appendix, while the summary statistics are in Table 1. Figure 1 shows geopolitical risk and climate change exposure over time.¹⁰ Based on this preliminary visual inspection, geopolitical risk shows high values in the early 2000s and generally declines over time, while climate change exposure steadily rises, especially after the

¹⁰ We standardize both variables so that each has a mean of zero and a standard deviation of one over the sample period. Standardization makes it possible to directly compare the movement and relative changes of the two series on the same scale, even though they originally have different units and magnitudes. This is especially useful for visually assessing trends and relationships over time.

mid-2000s. These contrasting trends suggest an evolving relationship between the two risks, motivating further analysis.

[Insert Table 1 about here]

[Insert Figure 1 about here]

5. Results

5.1. Regression results

Table 2 presents the main regression results examining the effect of geopolitical risk on firm-specific climate change exposure. The findings show that the coefficient on geopolitical risk is negative and highly significant in both model specifications. This suggests that higher geopolitical risk is linked to a decrease in firm-specific climate change exposure, supporting the “catalyst for change” hypothesis rather than the “crowded-out” hypothesis. In other words, rather than overshadowing or increasing climate vulnerability, heightened geopolitical risk appears to drive firms to become less exposed to climate change—possibly because geopolitical shocks prompt firms to strengthen resilience and accelerate climate-related strategies.

[Insert Table 2 about here]

An intriguing aspect of Table 2 is the contrast between the results for the GPR index and those for the Economic Policy Uncertainty (EPU) index. While the coefficient on GPR is negative, the coefficient on EPU is positive and significant.¹¹ This difference highlights that general economic uncertainty and geopolitical risk affect climate change exposure in distinct ways.

¹¹ The effect of EPU on firm-specific climate change exposure documented here is consistent with the findings in (Ongsakul, Chatjuthamard, Chintrakarn, & Jiraporn, 2025), who show that greater economic policy uncertainty exacerbates firm-specific exposure to climate change.

Specifically, while economic policy uncertainty tends to increase firms' climate risk exposure, geopolitical risk appears to have the opposite effect, suggesting that the nature of the external shock matters for how firms adjust to climate threats.

An important implication of these results is that the negative coefficient on geopolitical risk and the positive coefficient on economic policy uncertainty should not be interpreted as contradictory, but rather as evidence that different types of uncertainty operate through distinct channels. Although both variables capture elevated uncertainty, their content and effects differ qualitatively.

Geopolitical risk arises from exogenous shocks such as wars, terrorism, and international crises (Caldara & Iacoviello, 2022). These events are existential in nature, forcing firms to adapt rapidly to ensure survival and continuity. The dynamic capabilities perspective (Teece et al., 1997) suggests that such shocks act as “forcing functions” that compel organizations to reconfigure resources, diversify supply chains, and invest in resilience. In this sense, geopolitical risk can accelerate climate-related adaptation and reduce firm-specific climate exposure, consistent with the catalyst-for-change hypothesis.

In contrast, economic policy uncertainty reflects ambiguity about government actions, regulatory direction, and macroeconomic policy (Baker et al., 2016). Unlike geopolitical shocks, which trigger immediate adaptation, economic uncertainty encourages delay and caution. Real options theory predicts that when policy signals are unclear, firms postpone long-term commitments—such as climate disclosure or decarbonization investments—until greater clarity emerges (Dixit & Pindyck, 1994). This explains why EPU is positively associated with climate change exposure in our results.

Taken together, the contrasting signs on GPR and EPU coefficients highlight that the mechanism is not “uncertainty” in a generic sense, but rather the specific nature of the uncertainty. Geopolitical risk uniquely catalyzes organizational change and resilience, whereas economic policy uncertainty prompts managerial caution and delay. Recognizing this distinction strengthens the interpretation of our findings and contributes to the broader literature on overlapping global risks.

5.2. Propensity score matching and entropy balancing

Our baseline results are already less susceptible to endogeneity concerns because geopolitical risk, by its very nature, is determined by large-scale global or national events and is entirely outside the control of individual firms. This makes geopolitical risk fundamentally exogenous to firm-level decision-making, reducing the risk that our estimates are biased by reverse causality or omitted variables specific to firms. Nevertheless, to provide even greater confidence in our findings and to rule out any remaining concerns about endogeneity, we conduct additional robustness analyses using instrumental variables. Table 3 presents additional robustness tests using propensity score matching (PSM) and entropy balancing to ensure that the effect of geopolitical risk on climate change exposure is not driven by systematic differences between firms.

[Insert Table 3 about here]

In the propensity score matching analysis, observations are classified into a treatment group if they fall within the top quartile of the geopolitical risk index. For each treatment observation, a matched control is selected from the remainder of the sample based on the closest similarity across ten firm-specific characteristics—these are the ten control variables used in the main regression. This approach aims to create a balanced sample where the only systematic difference between the

treatment and control groups is the level of geopolitical risk. The advantage of PSM is that it helps to mimic the conditions of a randomized experiment, reducing bias from observable firm characteristics and allowing for a clearer interpretation of the causal effect of geopolitical risk (Lennox et al., 2012; Rosenbaum & Rubin, 1983).

Entropy balancing, similarly, uses the same treatment group classification (top quartile of GPR). However, rather than matching individual observations, entropy balancing adjusts the weights of control group observations so that the distributions of the ten firm-specific characteristics are exactly balanced between the treatment and control groups. This method ensures that the treatment and control groups are statistically equivalent with respect to all observed covariates, providing even stronger control for confounding influences (Hainmueller, 2012; Hainmueller & Xu, 2013; Tübbicke, 2022).

In Table 3, both methods yield highly consistent results: the negative and statistically significant coefficient for geopolitical risk persists, indicating that firms exposed to higher geopolitical risk tend to have lower climate change exposure. Notably, the coefficient on the EPU index remains positive and significant, reinforcing the finding that economic policy uncertainty has a distinctly different effect from geopolitical risk. These results provide robust support for the main findings and reinforce the interpretation that geopolitical risk and economic policy uncertainty influence climate risk exposure through different channels.

Overall, the use of PSM and entropy balancing addresses potential selection bias and strengthens the credibility of the empirical results, confirming that the main findings are not simply artifacts of the underlying firm characteristics or sample composition.

5.3. Instrumental-variable analysis (IV)

Table 4 reports the results of the instrumental-variable (IV) analysis, which addresses potential endogeneity concerns in the relationship between geopolitical risk and firm-specific climate change exposure. Endogeneity may arise if unobserved factors affect both geopolitical risk and climate exposure, leading to biased estimates in standard regressions. The IV approach helps resolve this by using an external shock—one that is plausibly unrelated to firm-level characteristics—to isolate exogenous variation in geopolitical risk (Angrist & Krueger, 2001; Larcker & Rusticus, 2010).

[Insert Table 4 about here]

In this study, we exploit the unprecedented and unexpected terrorist attacks on September 11, 2001, as our instrumental variable. This tragic event sharply raised global geopolitical risk and was entirely outside the control of individual firms, making it an exogenous shock.¹² To capture this effect, we define a binary instrument equal to one for the years 2001 and 2002, and zero otherwise. This specification leverages the immediate and widely recognized surge in geopolitical risk following September 11, providing a strong and credible source of exogenous variation.

The results in Table 4 demonstrate that when geopolitical risk is instrumented using the September 11 event, the negative effect of geopolitical risk on firm-specific climate change exposure remains statistically significant. This finding holds across the full sample, as well as in

¹² We also consider alternative geopolitical events, such as the Iraq War, the Crimea invasion, and the escalation of U.S.-China trade tensions, as potential instruments. While these shocks increase geopolitical tensions, their effects on the Geopolitical Risk Index are smaller and less globally pervasive compared to the unprecedented surge triggered by the terrorist attacks of September 11, 2001. Multiple studies document that 9/11 produces one of the largest and most persistent spikes in the GPR index across decades, dwarfing other geopolitical events in both magnitude and global reach (Dong et al., 2019; Khraiche et al., 2023; Schlosky et al., 2024). The 9/11 attacks represent a unique, exogenous shock with broad and immediate implications for global security, policy, and financial markets, which makes them especially well-suited for our identification strategy. Accordingly, we clarify that our IV analysis identifies a local average treatment effect concentrated in the early 2000s. This focus enhances credibility, though it also implies that the interpretation of the IV results should be understood within the historical context of that period.

propensity score matching and entropy balancing specifications, indicating the robustness of the result. The instrumental variable estimates confirm that higher geopolitical risk—when triggered by an exogenous shock—reduces firm-specific climate change exposure. This supports the interpretation that the observed relationship is not simply due to omitted variables or reverse causality but reflects a causal effect.

Overall, the IV analysis in Table 4 strengthens the empirical evidence that geopolitical risk, particularly when driven by unexpected global events, encourages firms to lower their exposure to climate change. This result aligns with the “catalyst for change” hypothesis, suggesting that major geopolitical shocks may prompt firms to adapt and become more resilient to climate-related risks.

5.4. Oster's (2019) test for coefficient stability

Oster's (2019) coefficient stability test is designed to assess how robust an estimated relationship is to potential omitted variable bias. The key idea is to examine whether the inclusion of additional control variables significantly alters the coefficient of interest. If the coefficient remains stable—even as more controls are added—it suggests that unobserved factors would need to be extremely influential to overturn the main result.

The logic behind Oster's method is to compare how much the coefficient and the model's explanatory power (R-squared) change as observable controls are introduced. Using these changes, the test projects how strong the influence of omitted variables would have to be, relative to the observed controls, in order to reduce the estimated effect to zero. If the required strength is much higher than what is observed in the data, it provides reassurance that omitted variable bias is unlikely to drive the results.

In our case, the test reveals that any unobserved variables would need to be 1.64 times stronger than our observed controls to fully explain away the estimated effect. This finding offers strong evidence that our results are robust to concerns about omitted variable bias.

Additionally, using the impact threshold of confounding variables, we find that for our main result to be invalidated, 83.45% of the estimated effect would have to be explained entirely by bias from unobserved confounders. In other words, over 83% of our observed association would need to be attributable to omitted variables, rather than a true effect. Put differently, it would require replacing 83.45% of the sample (or 50,209 cases) with hypothetical cases showing no effect, in order to overturn our inference. This high threshold provides strong evidence that our findings are robust and not easily explained away by unobserved bias

5.5. Different dimensions of climate change exposure

So far, our analysis has concentrated on firms' overall exposure to climate change. However, Sautner et al. (2023) further decompose climate change exposure into three distinct dimensions: physical risk, regulatory risk, and new business opportunities. Physical risk captures a firm's vulnerability to the direct impacts of climate change, such as extreme weather events or rising sea levels. Regulatory risk reflects exposure to changes in climate-related policies and regulations that could affect business operations. New business opportunities represent the potential for firms to benefit from climate-related shifts, such as increased demand for green products or services.

Table 5 explores how geopolitical risk influences each of these dimensions. The results show that the effect of geopolitical risk is negative and statistically significant for both regulatory risk and new business opportunities, and weakly negative for physical risk. This suggests that

higher geopolitical risk is associated with lower exposure to both regulatory risk and new business opportunities linked to climate change, and a slight reduction in physical climate risk as well.

[Insert Table 5 about here]

These findings provide strong support for the “catalyst for change” hypothesis. The negative relationship between geopolitical risk and both regulatory risk and new business opportunities suggests that, in the face of heightened geopolitical tensions, firms may take proactive steps to reduce their exposure across multiple dimensions of climate risk. Specifically, as geopolitical risk rises, firms appear to strengthen their resilience to both regulatory changes and shifting market opportunities related to climate change, potentially by accelerating adaptation, streamlining operations, or investing in strategies that make them less vulnerable to external shocks. The weakly negative effect on physical risk also fits this narrative, indicating that firms may enhance their preparations for direct climate impacts as part of broader efforts to bolster overall resilience. Altogether, the results in Table 5 support the idea that geopolitical shocks can serve as a wake-up call, prompting firms to adapt and become more robust to climate-related challenges—consistent with the predictions of the “catalyst for change” hypothesis.

5.6. Interactions with firm-specific characteristics

Table 6 explores how the impact of geopolitical risk on firm-specific climate change exposure is shaped by certain firm-level attributes. Investigating these moderating roles is important because firms differ in their ability and willingness to respond to external shocks based on their financial resources, innovation strategies, and capital structure. By focusing on characteristics such as profitability, leverage, cash reserves, and R&D intensity, we gain insights into which types of firms are more or less responsive to changes in geopolitical risk.

[Insert Table 6 about here]

In the table, each model adds an interaction between geopolitical risk and a specific firm attribute. For profitability and leverage, the interaction terms are not statistically significant, suggesting that the negative relationship between geopolitical risk and climate change exposure does not vary systematically with these attributes.

However, the findings are different for cash reserves and R&D intensity. The interaction between geopolitical risk and cash reserves is positive and significant, meaning that firms with larger cash reserves experience a smaller reduction in climate change exposure in response to geopolitical risk. Similarly, the positive and significant interaction with R&D intensity indicates that firms with greater R&D investment also see a less pronounced decline in climate change exposure when geopolitical risk increases. In other words, while most firms reduce their climate change exposure as geopolitical risk rises, this response is weaker among firms that are highly liquid or invest heavily in R&D.

One plausible interpretation is that firms with ample cash reserves or advanced innovation capacity may already be managing climate risks proactively, or they may have more complex exposure that is not as easily reduced in the face of geopolitical shocks. These results highlight that the “catalyst for change” effect of geopolitical risk is not uniform across all firms, but is moderated by firm-specific characteristics, with the strongest reductions in climate exposure observed among firms with less liquidity and lower R&D intensity.

5.7. The role of managerial ownership

In Table 7, we seek to explore the motivation behind the observed reduction in climate change exposure when geopolitical risk increases. Specifically, we investigate whether agency

conflicts—misalignments between managers’ interests and those of shareholders—might play a role in shaping how firms respond to heightened geopolitical risk. Managerial ownership, where a company's leadership holds a substantial stake in its equity, serves as a pivotal mechanism in corporate governance. This alignment of interests directly addresses agency conflicts, which invariably arise when the objectives of a firm's managers diverge from those of its external shareholders. When managers' personal wealth is significantly tied to the company's performance through their ownership, their decision-making naturally converges with the goal of maximizing shareholder value (Jensen & Meckling, 1976; Morck et al., 1988; La Porta et al., 1999; Ongsakul, Chatjuthamard, Chintrakarn, Jiraporn, et al., 2025; Wongsinhirun et al., 2024).

[Insert Table 7 about here]

Table 7 analyzes how managerial ownership influences the relationship between geopolitical risk and climate change exposure. The main finding is that the interaction between geopolitical risk and managerial ownership is positive and statistically significant for overall climate change exposure, regulatory risk, and new business opportunities. This pattern indicates that as managerial ownership increases, the reduction in climate change exposure in response to geopolitical risk becomes weaker. In other words, firms with higher managerial ownership are less likely to reduce their exposure to climate change when geopolitical tensions rise.

Disaggregating by climate risk dimensions, the interaction term is positive and significant for regulatory risk and new business opportunities, but not for physical risk. This suggests that managerial ownership most strongly moderates the response to external factors—such as evolving regulations or opportunities to pursue green innovation—rather than direct physical impacts. One possible interpretation is that managers with large ownership stakes may be more reluctant to pursue strategic adaptation in response to geopolitical risk, prioritizing the protection of their own

wealth or status quo policies over aggressive climate risk management. This reluctance could reflect classic agency problems, where entrenched managers resist costly or disruptive changes even when external shocks, like rising geopolitical risk, would otherwise prompt broader adaptation.

Taken together, the results in Table 7 suggest that the reduction in climate change exposure in response to greater geopolitical risk may be motivated, at least in part, by agency conflicts. Firms with higher managerial ownership are less responsive to geopolitical shocks, highlighting the crucial role of governance in determining how organizations adjust to external risks.

5.8. Firm-level geopolitical risk

In addition to analyzing aggregate geopolitical risk, we also examine firm-specific geopolitical risk using the data provided by Caldara & Iacoviello (2022). However, the results using firm-specific geopolitical risk are not statistically significant. One possible explanation is that firm-level disclosures may underreport or inadequately capture the true extent of geopolitical threats, either due to limited managerial awareness or because such risks are often perceived as external and uncontrollable.

Furthermore, aggregate geopolitical shocks—such as wars or diplomatic crises—typically affect the entire market environment, influencing all firms simultaneously through broad economic and policy channels (Caldara & Iacoviello, 2022). In contrast, variations in firm-specific references to geopolitical risk may be too subtle, inconsistent, or idiosyncratic to drive meaningful differences in climate change exposure. This suggests that macro-level geopolitical risk is more relevant for understanding broad shifts in firm behavior and adaptation, whereas firm-level measures may lack the power or precision to capture these systematic effects.

5.9. Environmental performance (Refinitiv): Contextual evidence

To shed additional light on how geopolitical risk (GPR) relates to firms' environmental orientation, we examine the Refinitiv environment score as an outcome. Before turning to the estimates, it is important to clarify scope. The Refinitiv environment score is a broad, third-party composite that reflects overall environmental practices and disclosure (e.g., emissions management, resource use, waste/pollution control, policies/targets, supply-chain systems, and reporting quality). Our primary outcome elsewhere in the paper—firm-level climate change exposure—captures the salience of climate topics in earnings-call dialogue and is constructed from transcript bigrams following Sautner et al. (2023).

These two metrics therefore speak to different constructs: a disclosure-weighted, multi-dimensional environmental responsibility rating versus a climate-specific salience measure derived from calls. Because of this scope and construct mismatch, we treat the Refinitiv analysis as contextual rather than commensurate evidence, and we interpret it with appropriate caution. We continue to employ the global GPR index of Caldara & Iacoviello (2022) as our macro shock, consistent with our main design.

Table A2 in the Appendix reports regressions where the Refinitiv environment score is the dependent variable. Across the full sample and two balancing designs (PSM and entropy balancing), the coefficient on GPR is negative and statistically significant: -0.152 (t statistic = -5.376) in the full sample, -0.117 (t statistic = -4.370) with PSM, and -0.127 (t statistic = -4.269) with entropy balancing. In sum, higher geopolitical risk is associated with lower third-party environmental scores even after conditioning on the same covariates used in our main analyses.

How should we interpret these results alongside our core finding that higher GPR reduces climate-exposure salience on earnings calls? Because Refinitiv's score aggregates many non-climate dimensions and places weight on documented policies, targets, management systems, and disclosure quality, a decline in the score under heightened GPR is best interpreted as lower outward environmental commitment and reporting rather than a direct movement in climate exposure per se. Earnings-call salience, by contrast, moves quickly with events and captures what is front-of-mind in managerial discourse (Hossain et al., 2022; Sautner et al., 2023). The joint pattern—less climate talk on calls and lower broad environmental scores—aligns with a macro-shock mechanism in which geopolitical turbulence reorders managerial attention and reporting bandwidth toward near-term resilience and risk hardening.

This interpretation is consistent with our broader “catalyst for change” perspective and related theory on dynamic capabilities: external shocks can trigger resource redeployment and operational adaptation (e.g., supply-chain diversification, footprint reconfiguration) even as firms temporarily scale back disclosure-heavy environmental programs that ratings reward (Teece et al., 1997). Finally, the negative association between GPR and ESG-type outcomes we document echoes work linking geopolitical shocks to weaker firm-level ESG performance (Jiang et al., 2024; Yang et al., 2024), reinforcing that the channel we identify is economy-wide and not merely firm-idiosyncratic.

In conclusion, the Refinitiv analysis offers a complementary lens: when geopolitical risk rises, firms both talk less about climate on earnings calls and receive lower broad environmental scores from an external rater. The former aligns with our central result on reduced climate-exposure salience; the latter indicates a contemporaneous de-emphasis on outward environmental programs and disclosure. Because the Refinitiv score is broader than climate and disclosure-

weighted, we explicitly avoid one-for-one comparisons and treat these estimates as contextual corroboration of a macro-shock-induced reordering of priorities, not as a direct measure of climate exposure itself. This section therefore strengthens our main conclusion while stressing the need for care when relating broad ESG ratings to climate-specific text-based exposure measures.

5.10. Practical implications

The results of this study offer several important lessons for a wide array of stakeholders. For corporate managers and boards, our findings underscore the value of building organizational agility and integrating both climate and geopolitical risks into risk management and strategic planning processes. Geopolitical shocks can serve as wake-up calls, prompting firms to reassess their exposure and invest in greater climate resilience. However, the results also suggest that firms with ample cash reserves or high R&D intensity may be slower to reduce their climate change exposure in response to geopolitical risk, highlighting the importance of regular, not just reactive, reassessment of risk mitigation strategies, even among financially strong or innovative firms.

For investors—especially institutional investors who increasingly factor climate risk into their portfolio strategies—these findings emphasize the need to evaluate how firms manage climate exposure in turbulent geopolitical environments. Since firms generally reduce their climate risk exposure as geopolitical risk rises, investors may view such adaptive behaviors as a positive signal. Yet, our results also show that higher managerial ownership can weaken this response, suggesting that investors should carefully scrutinize governance structures and engage with firms to ensure that managerial incentives are properly aligned with long-term resilience and proactive risk management.

Regulators and policymakers can also draw valuable insights from our results. Given that the effects of geopolitical risk and economic policy uncertainty on firms are not interchangeable, regulations and guidance should be tailored to recognize these distinct influences. Policymakers can play a role in encouraging greater transparency and consistency in climate risk disclosure and may consider frameworks that promote climate adaptation, particularly in firms with entrenched management or weaker governance.

Finally, for employees, customers, and supply chain partners, the findings highlight the broader value of organizational resilience. Firms that are responsive to both climate and geopolitical risks are likely to provide greater stability and reliability, even during periods of significant disruption. Across all stakeholder groups, the main message is clear: building robust, forward-looking, and well-governed organizations is essential for navigating the interconnected threats posed by climate change and geopolitical risk.

6. Conclusions

Climate change and geopolitical risk are rapidly emerging as two of the most critical challenges confronting firms worldwide. Both risks now shape the global financial system and corporate strategy, compelling managers and investors to adapt in real time to an evolving landscape (Giglio et al., 2021; Caldara & Iacoviello, 2022). For companies, successfully navigating these uncertainties is no longer optional but essential for long-term survival and competitiveness (Krueger et al., 2020; Sautner et al., 2023).

A key contribution of this study is the use of novel, text-based measures for both climate change exposure and geopolitical risk. The Geopolitical Risk (GPR) index by Caldara & Iacoviello (2022) and the firm-level climate exposure metric by Sautner et al. (2023) allow for a much more

precise and comprehensive analysis than was previously possible. This methodological advance overcomes the longstanding difficulty of reliably quantifying these risks.

In this paper, we examine how geopolitical risk affects firm-specific exposure to climate change, drawing on a large panel of U.S. firms from 2001 to 2020. We also explore how this relationship is moderated by important firm characteristics and managerial ownership. Our findings show that greater geopolitical risk leads to a significant reduction in firm-specific climate change exposure. This effect is robust across a wide range of empirical checks, including propensity score matching, entropy balancing, and instrumental variable analysis. These results suggest that geopolitical shocks may act as a catalyst, prompting firms to adapt and strengthen their climate resilience.

When examining interactions with firm-specific characteristics, we find that firms with higher cash reserves or greater R&D intensity experience a smaller reduction in climate change exposure in response to geopolitical risk. This suggests that more liquid or innovation-focused firms may already be actively managing climate risk, or face more complex challenges that are less easily reduced. Importantly, we also find that managerial ownership plays a key role. Firms with higher managerial ownership are less likely to reduce climate change exposure when geopolitical risk rises, pointing to the influence of agency problems and the potential reluctance of entrenched managers to embrace strategic adaptation.

For managers and policymakers, these results emphasize the importance of actively integrating both climate and geopolitical risks into decision-making frameworks. Firms should assess their financial flexibility and governance structures to ensure they remain agile in the face of shocks. Promoting alignment between managerial incentives and firm resilience is essential for meeting the dual challenges of climate change and global uncertainty.

Finally, while our study focuses on climate change exposure, future research could extend the analysis to real environmental outcomes, such as firm-level green investment (Wang et al., 2026) or pollutant emissions (Akey & Appel, 2021). Exploring these variables would provide a more comprehensive view of how geopolitical shocks influence not only disclosure and discourse but also firms' tangible environmental commitments and actions.

Figure 1: Geopolitical risk and climate change exposure over time

We standardize both variables so that each has a mean of zero and a standard deviation of one over the sample period. Standardization makes it possible to directly compare the movement and relative changes of the two series on the same scale, even though they originally have different units and magnitudes.

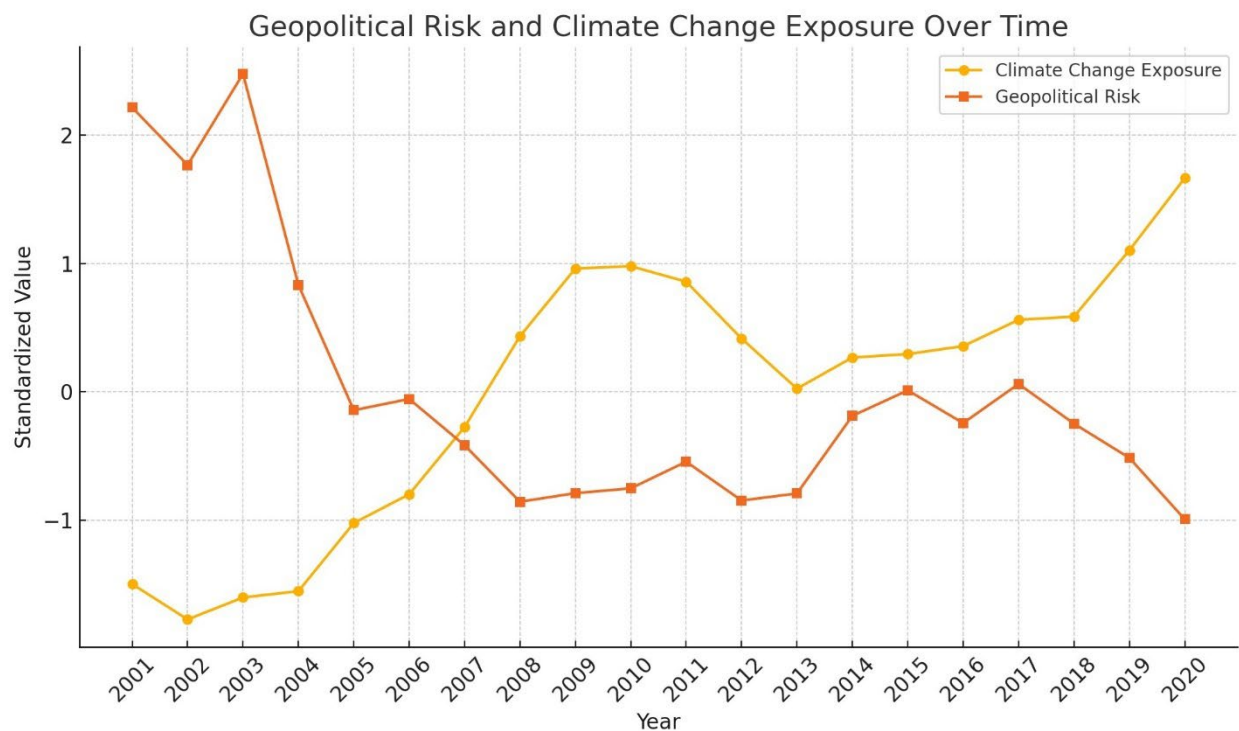


Table 1: Descriptive statistics

This table provides summary statistics for the sample. Climate change metrics are sourced from Sautner et al. (2023), and the geopolitical risk index is from Caldara & Iacoviello (2022). Variable definitions can be found in Table A1 in the Appendix.

Variable	Obs.	Mean	SD	25 th	Median	75 th
<u>Climate Change</u>						
Climate Change Exposure	60,167	9.890	20.964	1.080	3.183	8.127
Physical Risk	60,167	0.136	1.072	0.000	0.000	0.000
Regulatory Risk	60,167	0.558	2.842	0.000	0.000	0.000
New Business Opportunities	60,167	4.038	13.511	0.000	0.700	2.505
<u>Geopolitical Risk</u>						
Geopolitical Risk Index	60,167	100.480	23.448	83.102	98.553	104.035
<u>Economic Policy Uncertainty</u>						
Economic Policy Uncertainty (EPU)	60,167	120.463	39.632	94.678	110.751	138.468
<u>Firm-specific Attributes</u>						
Firm Size	60,167	6.968	2.125	5.527	6.918	8.366
Leverage	60,167	0.311	0.805	0.045	0.226	0.389
Profitability	60,167	0.018	0.203	0.005	0.061	0.109
Capital Expenditures	60,167	0.049	0.055	0.015	0.031	0.062
Advertising Intensity	60,167	0.011	0.029	0.000	0.000	0.006
R&D Investments	60,167	0.052	0.107	0.000	0.000	0.057
Dividends	60,167	0.019	0.064	0.000	0.000	0.017
Discretionary Spending	60,167	0.238	0.260	0.049	0.163	0.335
Asset Tangibility	60,167	0.516	0.435	0.168	0.388	0.790
Cash Reserves	60,167	0.198	0.219	0.037	0.112	0.281
<u>Managerial Ownership</u>						
% Managerial Ownership	60,167	2.468	5.242	0.123	0.588	1.930

Table 2: The effect of geopolitical risk on climate change exposure

This table provides the baseline regression results. Climate change metrics are sourced from Sautner et al. (2023), and the geopolitical risk index is from Caldara & Iacoviello (2022). Variable definitions can be found in Table A1 in the Appendix.

	(1)	(2)
	Climate Change Exposure	Climate Change Exposure
Geopolitical Risk	-0.051***	-0.025***
	(-5.252)	(-3.611)
EPU		0.012***
		(3.964)
Firm Size		-0.153
		(-0.726)
Leverage		-0.093*
		(-1.743)
Profitability		0.535
		(0.706)
Capital Expenditures		3.311
		(1.188)
Advertising Intensity		0.381
		(0.122)
R&D Intensity		2.025
		(1.671)
Dividends		-0.946
		(-0.843)
Discretionary Spending		-0.246
		(-0.433)
Asset Tangibility		-0.496
		(-1.080)
Cash Reserves		1.297*
		(1.917)
Time Trend		0.201***
		(4.524)
Constant	14.993***	9.649***
	(14.610)	(5.462)
Firm Fixed Effects	Yes	Yes
Observations	59,648	59,648
Adjusted R-squared	0.792	0.794

Robust t-statistics in parentheses

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

Table 3: Propensity score matching (PSM) and entropy balancing

This table provides the regression results with propensity score matching and entropy balancing. Climate change metrics are sourced from Sautner et al. (2023), and the geopolitical risk index is from Caldara & Iacoviello (2022). Variable definitions can be found in Table A1 in the Appendix.

	PSM	Entropy Balancing
	(1)	(2)
	Climate Change Exposure	Climate Change Exposure
Geopolitical Risk	-0.025***	-0.023***
	(-3.545)	(-3.565)
EPU	0.013***	0.012***
	(4.444)	(4.294)
Firm Size	-0.307	-0.227
	(-1.487)	(-1.093)
Leverage	-0.035	-0.075
	(-0.732)	(-1.589)
Profitability	1.043	1.039
	(1.260)	(1.460)
Capital Expenditures	6.256**	5.918**
	(2.448)	(2.343)
Advertising Intensity	-2.565	0.178
	(-0.857)	(0.062)
R&D Intensity	4.019***	2.643**
	(3.572)	(2.225)
Dividends	-1.345	-1.651
	(-0.878)	(-1.352)
Discretionary Spending	-0.302	-0.314
	(-0.668)	(-0.584)
Asset Tangibility	-0.870*	-0.666
	(-1.790)	(-1.380)
Cash Reserves	1.024	1.513**
	(1.416)	(2.253)
Time Trend	0.207***	0.230***
	(4.581)	(5.158)
Constant	10.246***	9.326***
	(5.345)	(5.314)
Firm Fixed Effects	Yes	Yes
Observations	34,573	59,648
Adjusted R-squared	0.797	0.785

Robust t-statistics in parentheses

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

Table 4: Instrumental-variable analysis (IV)

This table provides the regression results with instrumental variable analysis. Climate change metrics are sourced from Sautner et al. (2023), and the geopolitical risk index is from Caldara & Iacoviello (2022). Variable definitions can be found in Table A1 in the Appendix.

	Full Sample	Full Sample	PSM	Entropy Balancing
	(1)	(2)	(3)	(4)
	Geopolitical Risk	Climate Change Exposure	Climate Change Exposure	Climate Change Exposure
September 11	41.700**			
	(2.547)			
Geopolitical Risk (Instrumented)		-0.037**	-0.030**	-0.028**
		(-2.768)	(-2.357)	(-2.231)
EPU	-0.154**	0.011***	0.013***	0.011***
	(-2.531)	(3.713)	(4.302)	(3.857)
Firm Size	-1.382*	-0.168	-0.304	-0.222
	(-1.862)	(-0.805)	(-1.487)	(-1.086)
Leverage	0.176	-0.090	-0.032	-0.076
	(1.185)	(-1.673)	(-0.678)	(-1.610)
Profitability	-4.684	0.432	1.032	1.012
	(-1.079)	(0.564)	(1.260)	(1.436)
Capital Expenditures	-29.583	2.992	6.514**	6.078**
	(-1.661)	(0.976)	(2.403)	(2.173)
Advertising Intensity	-28.421	-0.078	-2.683	0.102
	(-1.393)	(-0.025)	(-0.911)	(0.036)
R&D Intensity	-14.370*	1.849	4.076***	2.663**
	(-1.897)	(1.508)	(3.663)	(2.302)
Dividends	0.096	-0.952	-1.329	-1.669
	(0.039)	(-0.856)	(-0.865)	(-1.379)
Discretionary Spending	-7.203*	-0.343	-0.373	-0.339
	(-2.035)	(-0.598)	(-0.809)	(-0.622)
Asset Tangibility	5.490	-0.416	-0.876	-0.669
	(1.706)	(-0.835)	(-1.653)	(-1.291)
Cash Reserves	0.891	1.284*	1.003	1.495**
	(0.337)	(1.889)	(1.352)	(2.192)
Time Trend	-1.244	0.178**	0.210***	0.231***
	(-0.968)	(2.583)	(3.181)	(3.483)
Constant	142.210***	11.383***	10.728***	9.748***
	(7.475)	(4.279)	(4.055)	(3.858)
Firm Fixed Effects	Yes	Yes	Yes	Yes
Observations	59,648	59,648	34,573	59,648
Adjusted R-squared	0.429	0.794	0.796	0.785

Robust t-statistics in
parentheses

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

Table 5: The effect of geopolitical risk on various dimensions of climate change exposure

This table provides the regression results for different dimensions of climate change exposure. Climate change metrics are sourced from Sautner et al. (2023), and the geopolitical risk index is from Caldara & Iacoviello (2022). Variable definitions can be found in Table A1 in the Appendix.

	(1)	(2)	(3)
	Physical Risk	Regulatory Risk	New Business Opportunities
Geopolitical Risk	-0.000*	-0.003**	-0.009**
	(-1.790)	(-2.567)	(-2.375)
EPU	-0.000***	0.002*	0.006***
	(-2.894)	(2.023)	(3.662)
Firm Size	-0.007	-0.019	-0.320*
	(-0.682)	(-0.618)	(-1.996)
Leverage	0.005	-0.023**	-0.058**
	(1.028)	(-2.306)	(-2.107)
Profitability	0.035	0.041	0.685
	(1.653)	(0.287)	(1.686)
Capital Expenditures	0.007	0.050	2.150
	(0.048)	(0.080)	(1.183)
Advertising Intensity	-0.276	-0.554	1.503
	(-1.394)	(-0.899)	(0.821)
R&D Intensity	0.125	0.214	-0.406
	(1.162)	(0.595)	(-0.461)
Dividends	-0.063	-0.010	-0.566
	(-1.142)	(-0.032)	(-0.816)
Discretionary Spending	0.006	0.251	-0.310
	(0.183)	(1.329)	(-0.659)
Asset Tangibility	-0.023	0.032	-0.503
	(-1.058)	(0.332)	(-1.341)
Cash Reserves	0.017	0.102	0.223
	(1.037)	(0.738)	(0.416)
Time Trend	0.000	0.010	0.172***
	(0.152)	(1.338)	(5.185)
Constant	0.271***	0.517*	4.723***
	(3.153)	(1.948)	(3.949)
Firm Fixed Effects	Yes	Yes	Yes
Observations	59,648	59,648	59,648
Adjusted R-squared	0.526	0.509	0.722

Robust t-statistics in parentheses

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

Table 6: Interactions with firm-specific attributes

This table provides the regression results with interaction effects. Climate change metrics are sourced from Sautner et al. (2023), and the geopolitical risk index is from Caldara & Iacoviello (2022). Variable definitions can be found in Table A1 in the Appendix.

	(1)	(2)	(3)	(4)
	Climate Change Exposure	Climate Change Exposure	Climate Change Exposure	Climate Change Exposure
Geopolitical Risk × Profitability	0.005			
	(0.293)			
Geopolitical Risk × Leverage		-0.002		
		(-1.074)		
Geopolitical Risk × Cash Reserves			0.077***	
			(4.343)	
Geopolitical Risk × R&D Intensity				0.122***
				(3.869)
Geopolitical Risk	-0.026***	-0.025***	-0.041***	-0.032***
	(-3.538)	(-3.485)	(-4.491)	(-3.987)
EPU	0.012***	0.012***	0.012***	0.012***
	(3.962)	(3.951)	(3.898)	(3.909)
Firm Size	-0.149	-0.152	-0.174	-0.193
	(-0.697)	(-0.720)	(-0.814)	(-0.892)
Leverage	-0.093*	0.150	-0.092*	-0.085
	(-1.754)	(0.650)	(-1.764)	(-1.603)
Profitability	0.072	0.532	0.735	0.663
	(0.042)	(0.702)	(1.013)	(0.907)
Capital Expenditures	3.316	3.305	3.028	3.070
	(1.190)	(1.187)	(1.111)	(1.117)
Advertising Intensity	0.426	0.371	0.493	0.152
	(0.137)	(0.119)	(0.160)	(0.049)
R&D Intensity	2.028	2.028	2.070	-10.072***
	(1.674)	(1.676)	(1.721)	(-2.920)
Dividends	-0.933	-0.951	-0.853	-0.998
	(-0.825)	(-0.849)	(-0.769)	(-0.892)
Discretionary Spending	-0.247	-0.246	-0.162	-0.210
	(-0.435)	(-0.433)	(-0.285)	(-0.372)
Asset Tangibility	-0.496	-0.497	-0.496	-0.534
	(-1.081)	(-1.081)	(-1.073)	(-1.150)
Cash Reserves	1.308*	1.295*	-6.889***	1.107
	(1.949)	(1.911)	(-3.768)	(1.660)
Time Trend	0.201***	0.201***	0.197***	0.201***
	(4.515)	(4.524)	(4.594)	(4.576)
Constant	9.630***	9.577***	11.463***	10.604***
	(5.474)	(5.433)	(5.987)	(5.704)
Firm Fixed Effects	Yes	Yes	Yes	Yes
Observations	59,648	59,648	59,648	59,648
Adjusted R-squared	0.794	0.794	0.794	0.794

Robust t-statistics in parentheses

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

Table 7: The role of managerial ownership

This table provides the regression results with an interaction with managerial ownership. Climate change metrics are sourced from Sautner et al. (2023), and the geopolitical risk index is from Caldara & Iacoviello (2022). Variable definitions can be found in Table A1 in the Appendix.

	(1)	(2)	(3)	(4)
	Climate Change Exposure	Physical Risk	Regulatory Risk	New Business Opportunities
Geopolitical Risk × Managerial Ownership	0.002*** (3.370)	-0.000 (-0.156)	0.000*** (3.094)	0.001** (2.264)
Managerial Ownership	-0.193*** (-2.952)	0.000 (0.016)	-0.032*** (-3.222)	-0.070 (-1.511)
Geopolitical Risk	-0.034*** (-3.505)	-0.000 (-1.058)	-0.004*** (-2.882)	-0.008 (-1.415)
EPU	0.016*** (4.353)	-0.000** (-2.575)	0.003** (2.453)	0.010*** (4.395)
Firm Size	-0.613** (-2.111)	0.010 (0.650)	-0.045 (-1.353)	-0.267 (-1.443)
Leverage	-0.148** (-2.247)	-0.001 (-0.170)	-0.012** (-2.179)	-0.079* (-1.970)
Profitability	0.196 (0.159)	0.062 (1.342)	0.035 (0.167)	0.064 (0.117)
Capital Expenditures	12.768** (2.524)	-0.006 (-0.036)	0.632 (0.813)	9.472** (2.510)
Advertising Intensity	-0.787 (-0.221)	-0.735* (-1.876)	0.319 (0.569)	0.653 (0.306)
R&D Intensity	-0.403 (-0.187)	0.330 (1.087)	-0.179 (-0.786)	-0.450 (-0.375)
Dividends	-2.337 (-1.312)	0.091 (1.232)	0.745 (0.766)	-1.092 (-0.675)
Discretionary Spending	0.123 (0.095)	0.014 (0.151)	-0.104 (-0.904)	0.648 (0.755)
Asset Tangibility	-0.847 (-1.103)	0.013 (0.532)	0.192 (1.698)	-0.478 (-1.062)
Cash Reserves	1.120 (1.232)	0.042 (0.904)	0.146 (1.637)	0.684 (1.169)
Time Trend	0.235*** (4.498)	-0.001 (-0.233)	0.012 (1.622)	0.202*** (4.869)
Constant	12.942*** (4.152)	0.134 (0.990)	0.662* (1.972)	2.686 (1.312)
Firm Fixed Effects	Yes	Yes	Yes	Yes
Observations	25,020	25,020	25,020	25,020
Adjusted R-squared	0.773	0.314	0.438	0.647

Robust t-statistics in
parentheses

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

Appendix

Table A1: Variable definitions

The metrics for climate change exposure are from Sautner et al. (2023), while geopolitical risk index is from (Caldara & Iacoviello, 2022).

Variable	Definition
<u>Geopolitical Risk</u>	
Geopolitical Risk Index	The geopolitical risk index developed by (Caldara & Iacoviello, 2022).
<u>Managerial Ownership</u>	
Managerial Ownership	Percentage of managerial ownership held by the top five executives
<u>Climate Change</u>	
Climate Change Exposure	Overall text-based measure of firm-specific exposure developed by Sautner et al. (2023)
Physical Risk	Text-based measure of physical risk
Regulatory Risk	Text-based measure of regulatory risk
New Business Opportunities	Text-based measure of new business opportunities
<u>Time Trend</u>	
Time Trend	Variable that increments by one unit for each successive year
<u>Firm-specific Characteristics</u>	
Firm Size	Total Assets
Profitability	EBIT/Total Assets
Leverage	Total Debt/Total Assets
Capital Expenditures	Capital Expenditures/Total Assets
Advertising Intensity	Advertising Expense/Total Assets
R&D Investments	R&D Expense/Total Assets
Cash Reserves	Cash Holdings/Total Assets
Dividends	Dividends/Total Assets
Discretionary Spending	SG&A Expense/Total Assets
Asset Tangibility	Fixed Assets/Total Assets
<u>Macroeconomic Uncertainty</u>	
Economic Policy Uncertainty Index	Text-based measure of economic policy uncertainty developed by Baker et al. (2016).

Table A2: The effect of geopolitical risk on environmental performance (Refinitiv)

This table provides the regression results, where the dependent variable is the environmental score reported by Refinitiv. Climate change metrics are sourced from Sautner et al. (2023), and the geopolitical risk index is from Caldara & Iacoviello (2022). Variable definitions can be found in Table A1 in the Appendix.

	(1)	(2)	(3)
	Full Sample	PSM	Entropy Balancing
	Environment Score	Environment Score	Environment Score
Geopolitical Risk	-0.152*** (-5.376)	-0.117*** (-4.370)	-0.127*** (-4.269)
EPU	0.031 (1.226)	0.066** (2.625)	0.042 (1.445)
Firm Size	5.090*** (4.676)	4.771*** (3.927)	4.407*** (3.974)
Leverage	0.301 (1.242)	0.689*** (3.573)	0.417* (2.006)
Profitability	5.479 (1.500)	3.260 (0.758)	4.362 (1.215)
Capital Expenditures	1.441 (0.156)	1.749 (0.120)	3.010 (0.280)
Advertising Intensity	6.350 (0.202)	39.665 (0.886)	5.137 (0.147)
R&D Intensity	8.455 (0.735)	15.475 (0.899)	5.916 (0.488)
Dividends	3.795 (0.760)	16.289 (1.506)	6.226 (0.973)
Discretionary Spending	6.147 (1.116)	-0.095 (-0.012)	4.616 (0.764)
Asset Tangibility	4.782 (1.685)	4.338 (1.270)	4.426 (1.548)
Cash Reserves	9.145** (2.302)	8.193 (1.724)	8.846* (2.099)
Time Trend	2.300*** (14.439)	2.431*** (14.989)	2.451*** (15.453)
Constant	-35.098*** (-3.289)	-40.225*** (-3.415)	-33.739*** (-3.053)
Firm Fixed Effects	Yes	Yes	Yes
Observations	10,802	5,802	10,802
Adjusted R-squared	0.778	0.775	0.766

Robust t-statistics in parentheses

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

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