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Research article

Climate change and geopolitical conflicts: The role of ESG readiness

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ABSTRACT

This study examines the relationship between climate change vulnerability and geopolitical risk using data on 42 countries from 1995 to 2021. Utilising two distinct indices, the climate vulnerability index (CVI) and the country-specific geopolitical risk (CGPR) indices, we find that countries with high vulnerability to climate change are more likely to experience geopolitical conflicts. Further analysis reveals that country-level overall economic, social, and governance (ESG) readiness significantly mitigates this detrimental effect. This moderation is mainly attributed to the social and governance readiness measures. Additional tests indicate that the mitigating role of ESG is more pronounced for countries with high institutional governance. These results remain resilient through a set of endogeneity tests using matched samples of countries generated through propensity score matching (PSM) estimation. Our findings suggest that addressing climate vulnerability is crucial to promoting global peace and geopolitical stability.

1. Introduction

Climate change has become a pressing issue globally for communities, organisations, and countries. The Intergovernmental Panel on Climate Change (IPCC) has warned that human-induced pollution has intensified extreme weather events like heat waves, torrential rain, droughts, and tropical cyclones. Natural resource scarcity has led to geopolitical disputes between governments and regions, as many resources, such as oil, gas, minerals, and water, are essential to economic growth, national security, and livelihood. Emissions of greenhouse gases due to global economic activity have caused atmospheric CO_2 levels to rise by 50%, contributing to climate change vulnerability (Kaplan and Ramanna, 2021). Traditional climate indicators like temperature, rainfall loss, drought, and storms affect intergroup conflict risk by an average of 11% per standard deviation change (Burke et al., 2015). Climate change is being increasingly framed as a security issue (McDonald, 2018). The imbalance in the ecosystem and the scarcity of resources, including water, caused by climate change (Gosling and Arnell, 2016) has resulted in competition for scarce resources like water, food, and energy, leading to conflict between and within countries (Schilling et al., 2020; Alboghdady and El-Hendawy, 2016). Resource scarcity is likely to impact national security and increase military and defence efforts (Nightingale, 2017). Climate change can displace people, leading to migration and tensions between countries over border control, refugees, and resource allocation (Morelli et al., 2016; Brzoska and Fröhlich, 2016).

Environmental changes, such as rising sea levels and droughts, force migration, staining resources and contributing to social tension (Manning and Clayton, 2018). Social inequality caused by climate change also leads to geopolitical conflict (Islam and Winkel, 2017). Vulnerable communities disproportionately affected by climate change experience heightened inequalities, and foster conditions ripe for unrest and conflicts. Nations may engage in competition over strategic resources as climate-induced scarcity becomes more pronounced (Klare, 2020). In brief, climate change amplifies securities risks, economic challenges, and resource competition, creating intricate connections with geopolitical conflicts.

Although various strategies, policies, and regulations have been

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proposed and implemented by governments and policymakers, economic, social, and governance (ESG) readiness is increasingly becoming a corporate action for organisations, as highlighted by Gillan et al. (2021). Corporate entities, in particular, are navigating a dynamic landscape where consideration of climate change and ESG issues have gained prominence. This heightened awareness and commitment are not solely driven by regulatory compliance; rather, corporate managers and stakeholders are increasingly embracing sustainability as a core business principle. Furthermore, corporate managers and stakeholders are increasingly focusing on climate change and ESG issues, driven by pressure from international organisations, government regulations, and manufacturers in global supply chains (Chen et al., 2022). These multifaceted influences contribute to a paradigm shift, wherein organisations recognize the importance of aligning their operation with sustainable practices not only to meet regulatory requirements but also to foster resilience, build reputation, and ensure long-term viability in an interconnected and environmentally conscious global economy.

The ESG principle, introduced formally in 2004, has undergone 17 years of development and active implementation in Europe, Americas, and other developed regions and countries (Li et al., 2021). ESG, standing for Environmental, Social, and Governance, constitutes a comprehensive framework evaluating an organisation's or a nation's ethical, sustainable, and responsible practices. Each facet of ESG holds significance in understanding a country's global impact, encompassing both internal operations and external relationships. Environmental considerations in ESG involve managing resource use, waste, and emissions. Implementing eco-friendly practices, adopting renewables, and reducing the carbon footprint contribute to a positive ESG profile. This aspect assesses how a country handles natural resources, encompassing policies, conservation, carbon emissions, and environmental sustainability. Addressing social issues is vital for organisations, encompassing fair labor practices, diversity, employee well-being, and community engagement. Social responsibility extends beyond the workplace, with companies committed to enhancing their social responsibility strategies. The social component focuses on a country's approach to social issues, including equity, education, healthcare, and labor rights. Governance in organisations relates to decision-making, accountability, transparent communication, and ethical leadership. At the country level, governance involves institutional effectiveness, the rule of law, and political transparency. It considers government stability, corruption levels, adherence to the rule of law, and human rights protection.

Investing in ESG can expedite the transition to a low-carbon economy, resulting in a more sustainable economic system and lowering the risk of conflict over scarce resources, both of which are key in mitigating the effects of climate change (Louche et al., 2019). Moreover, ESG has evolved into corporate social responsibility, with companies taking an active role in addressing the root cause of climate change and decreasing the risk of conflict (Koller et al., 2019). Although governments, organisations, and policymakers have extensively discussed climate change, there are still numerous areas that require clarification, leading to our motivation to conduct a new study on the relationship between climate change and geopolitical conflicts, incorporating ESG into the equation to comprehend better the role that it can play.

This paper initiates a novel empirical investigation into the impact of climate change risk on geopolitical conflicts at a global level. Our study differs from previous research in several ways. Firstly, while previous research only focused on specific regions like North Africa, our study analyses 42 countries over a period from 1995 to 2021, providing a more comprehensive view of the relationship between climate change vulnerability and geopolitical conflicts. Secondly, prior research on geopolitical risk mostly focused on the overall (i.e., global) GPR index and its subindexes (i.e., geopolitical threats and acts). We use the country-specific geopolitical risk (CGPR) indices developed by Caldara and Iacoviello (2022) and the climate vulnerability index (CVI) developed by the Notre Dame Global Adaptation Initiative (ND-GAIN) to predict the association between the two while controlling for a range of country-level factors such as military expenses, arms imports, armed forces personnel, and energy imports, among others, that are likely to drive geopolitical conflicts. Prior studies have traditionally examined climate vulnerability via three lenses: a country's exposure to climate hazards, its sensitivity to these events, and its adaptive capacity to manage climate-induced impact. The widely used ND-GAIN's CVI encompasses these vulnerability components, along with six sectoral dimensions and readiness in economic, social, and governance aspects for adaptation (Kling et al., 2021; Chen et al., 2015). These indicators have been pivotal in examining the influence of climate vulnerability on various domains such as human migration, bond yields, equity distributions in global climate finance, a firm's cost of capital, and bank liquidity creation (Islam, 2022; Kling et al., 2021; Lee et al., 2022). However, empirical research into the relationship between climate vulnerability and geopolitical risk is still in its infancy. Thirdly, our study addresses the role of overall and categorical ESG readiness in moderating the dismantling effect of climate change vulnerability on geopolitical conflicts. Finally, we extend our investigation by examining how country heterogeneity based on ESG readiness and institutional governance quality may influence the mitigating role of ESG in the association between climate change vulnerability and geopolitical conflicts.

Using a sample of 42 countries from 1995 to 2021, our findings reveal that countries with high vulnerability to climate change face higher geopolitical conflicts. This association persists while using different empirical specifications and sub-samples based on different sets of controlling factors. Interestingly, country-level ESG readiness significantly moderates this effect. Further analyses indicate that the mitigating role of ESG readiness mainly stems from its social and governance dimensions. In addition, we find that the level of a country's institutional quality plays a significant role in this moderation. Our findings suggest that countries with high vulnerability to climate change could reduce their risk of geopolitical conflicts by strengthening their ESG readiness measures and improving their institutional governance mechanisms. Supplementary analyses show that while the mediating effects of ESG and its dimensions are valid for sub-samples excluding USA and MENA countries, the dismantling effect of climate vulnerability is less pronounced for NATO and G7 member countries. Our findings emphasise the importance of considering ESG factors in investment and regulatory decision-making and promoting sustainable and responsible business practices to minimise the adverse impact of climate change.

Our study highlights the crucial role of national-level ESG readiness in addressing the geopolitical implications of climate change. Also, our findings underscore the critical need to seamlessly integrate economic, social, and governance (ESG) considerations into the decision-making processes at the national level, recognising the intricate connections among climate change, socioeconomic factors, and geopolitical stability. This positioning of ESG as a pivotal component within governmental initiatives is essential for effectively mitigating the adverse effects of climate change. Our insights extend beyond governmental realms, reaching corporations and stakeholders across sectors. Encouraging a shift towards prioritising ESG factors, our study advocates for strategies promoting long-term sustainability and resilience, contributing significantly to understanding the interplay between climate change and geopolitical conflicts.

In contrast to previous research, our analysis adopts an exploratory approach, building upon established literature such as Koubi (2019) and introducing novel perspectives for a comprehensive understanding. Secondly, our research unveils patterns and dynamics through a comprehensive secondary data analysis, laying the groundwork for effective strategies. Thirdly, our study addresses the limitations of regionally focused research, contrasting with Schilling et al. (2020), which solely examined North Africa. Our global perspective enables a holistic understanding of the multifaceted factors influencing conflicts arising from climate change, adopting a more inclusive analysis across 42 countries. A pioneering aspect is the incorporation of ESG factors into the analysis. Unlike current studies, our research highlights the mediating role of ESG in the relationship between climate change and

geopolitical conflicts. Emphasising the significance of integrating these factors into governmental decision-making processes aims to minimise the adverse effects of climate change holistically.

Our research highlights the imperative role of governmental institutions in cultivating national ESG preparedness to address climate change's intricate geopolitical repercussions effectively. Policymakers are urged to intricately integrate ESG considerations into decision-making processes, utilising robust regulatory frameworks and offering incentives for the widespread adoption of sustainable practices. The expeditious alignment of national policies with overarching sustainability goals emerges as a critical imperative, forming the bedrock for not only efficacious climate change mitigation but also the prevention of geopolitical conflicts. This academic insight extends to non-governmental organisations (NGOs), offering them a nuanced understanding of their role in advocating for and collaborating with governmental bodies and corporations to devise comprehensive and inclusive strategies. Furthermore, investors are presented with a strategic imperative to prioritise companies demonstrating strong ESG practices in their portfolios, thereby aligning with sustainability and resilience objectives and contributing substantively to a global paradigm shift towards responsible and sustainable practices. This academic discourse advances the understanding of the symbiotic relationship between governmental action, non-governmental advocacy, and investor influence in shaping a holistic response to the multifaceted challenges posed by climate change on geopolitical stability.

The rest of the paper is organised as follows: section 2 briefly reviews the relevant literature; section 3 describes the data, variables, and model; section 4 documents and discusses the major empirical findings; Section 5 illustrates the robustness and supplementary analyses; finally, section 6 offers a brief conclusion and directions for further research.

2. Theory and hypothesis development

According to the theory of resource based view (RBV), an organisation achieves sustainable competitive advantage and higher firm performance if its resources are valuable, rare, inimitable, and non-substitutable (Barney, 1991; Wernerfelt, 1984). It means that a firm's resources and capabilities are key determinants of its success. This theory can be applied to the challenge of climate change, as natural resources are critical to both firms and individuals. The scarcity of natural resources due to climate change can lead to a range of economic, social, and political challenges, including increased competition for resources, rising prices, and migration (Burke et al., 2015; Brzoska and Frö;hlich, 2016; Rasul and Sharma, 2016; Rodríguez et al., 2019).

Scarcity and competition for natural resources can lead to disputes over access to resources such as water, food, and energy (Burke et al., 2015). These disputes could then influence state behavior and geopolitical rivalry. For example, the limitation and the shortage of natural resources may prompt states to take action and others to utilise their access to strategic water resources in order to gain competitiveness and express their influence in international relations (Arnell and Gosling, 2013). The evidence for this can be found in a study conducted by Chaney (2013), who discovered that Nile shocks boosted this authority's political power by increasing the likelihood that he could coordinate a revolt, which is consistent with historical data on political developments during Nile shocks. Chaney (2013) then discovers that the available data support this interpretation and compares it to some of the most plausible alternatives.

Schilling et al. (2020) reported on climate change vulnerability, water resources and social implications in North Africa. The sensitivity to climate change is highest in Algeria, Tunisia, and Egypt. Social unrest, such as the Arab Spring, is partly caused by the population's basic needs not being met. Climate change can be expected to undermine food security, economic stability, resilience, and overall livelihood prospects in the region. North Africa is often considered a 'climate change hotspot'. The largest uncertainties are related to projections of heavy rainfall events. However, it is argued that this study has some weaknesses as almost all the indicators used are only available at the national level. This means variations in the vulnerability within a country cannot be addressed. The researchers suggest that the degree to which climate change affects these conflicts is currently unclear. Violent conflict certainly undermines the adaptive capacity and resilience of a country, as demonstrated in the case of Libya.

Because of the scarcity and constraint of resources, people tend to relocate to another location that may provide greater resources (Rasul and Sharma, 2016). Climate change can cause many people to flee from their homes (Koubi et al., 2016). This has resulted in the migration problem (Brzoska and Frö;hlich, 2016). Migration is one response to climatic stress and shocks (Cattaneo et al., 2019). The influx of large numbers of environmental migrants is likely to burden economic and resource bases in the receiving areas, thus promoting contests over scarce resources (Brzoska & Frö;hlich, 2015; Reuveny, 2007). For example, migrants and residents may fight for land, jobs, health care, education, and social services. Furthermore, environmental migration may spark ethnic tensions when migrants and inhabitants belong to different ethnocultural groups, and the presence of newcomers disrupts the ethnopolitical balance. (Brzoska & Frö;hlich, 2015; Gaikwad and Nellis, 2017).

Abel et al. (2019) use bilateral data on asylum-seeking applications in 157 countries from 2006 to 2015, studying the causes of refugee flows by applying a gravity model that accounts for endogenous selection to investigate the causal relationship between climate, conflict, and forced migration. According to the study, climatic conditions played a substantial impact as an explanatory factor for asylum seeking in the years 2011–2015 by affecting drought severity and the possibility of armed conflict. Jessoe et al. (2017) documented that future climate change will increase the number of climate-induced migrants. To obtain insight into the possible labor market implications of climate change, the study examined the effects of annual weather changes on employment in rural Mexico. Using panel data on individual employment spanning over a 28 year period, they find that years with a high prevalence of heat exhibit declines in local employment, particularly for wage-based jobs and non-farm labor. Extreme heat also drives domestic migration from rural to urban areas and overseas migration to the United States. A medium emissions scenario implies that increases in extreme heat may decrease local employment by up to 1.4% and climate change may increase migration by 1.4%. It is criticised, nevertheless, that these findings should only be taken into account as potential migratory patterns rather than precise forecasts. This is because these studies frequently simulate short-term reactions to climate-related shocks, yet the disparity between short- and long-term responses gets larger as we look further into the future.

Climate change is predicted to increase both the frequency and intensity of extreme weather events such as storms, floods, landslides, and droughts (Sesana et al., 2021). Approximately 243 million people are thought to be impacted by natural disasters each year, which is a staggering statistic (Gröschl and Steinwachs, 2017). Climate change is predicted to make heatwaves, droughts, and wildfires more frequent and severe in many places. Similarly, it is anticipated to intensify and occur more frequently during periods of high rainfall, which may cause additional landslides and flooding. Except for drought, most natural disasters occur relatively abruptly and do not last for an extended period. Nevertheless, damaging public and private infrastructure, destroying crops, and killing livestock can cause or worsen scarcity, leading to conflict (Koubi, 2019). Climate change has been identified as one of the factors contributing to the severe drought that resulted in human conflict (Couttenier and Soubeyran, 2013). The Syrian civil war was exacerbated in part by human climate change, with climate change-related drought helping to fuel the early discontent in Syria, which degenerated into civil war (Obama, 2015; Malm, 2016).

Studies focusing on climate-depressed agricultural incomes show that drought increases the incidence of most crimes, including burglary, banditry, rape, riot, and murder in India (Blakeslee and Fishman, 2018). Gawande et al. (2017) find that rainfall shocks by reducing agricultural

output increase the intensity of conflict, measured as the number of killings, in the Maoist belt in India. Higher food prices due to adverse climatic conditions can also affect civil conflict. For instance, Raleigh et al. (2015), using disaggregated data for 113 African markets from January 1997 to April 2010, find that decreased rainfall increases the incidence of violent conflict through its effect on food prices. This can be supported by the study from Ghimire and Ferreira (2016), which found that natural disasters increase the duration of civil conflict. Mares and Moffett (2016) find that homicide rates increase as temperatures rise in a sample of 57 countries during the period 1995–2012. They also claim that this positive relationship will continue as global warming raises average temperatures around the world and predict that each degree Celsius increase in global temperature will increase homicide rates by 6%. Overall, these studies provide evidence suggesting that temperature immediately affects criminal activity.

Mach et al. (2019) have concluded that climate variability and change impact the possibility of organised armed conflict inside countries. Countries with high levels of poverty and high dependence on renewable resources, e.g., agriculture, are more susceptible to climate-related adverse economic conditions, which in turn are often associated with a higher likelihood of conflict (Ide et al., 2014). According to the previous literature, there are numerous debates and discussions about how climate change has affected geopolitical conflicts worldwide. Overall, the subject of the relationship between climate and conflict has been intensively and inconclusively argued in different fields for many years, primarily utilising qualitative or case-study methodologies (Burke et al., 2015). Based on the above discussion, we develop the following hypothesis:

H1. Climate change vulnerability is positively associated with geopolitical conflict.

ESG factors play a crucial role in assessing climate change risks and opportunities, as they provide insights into the ways that companies are managing their environmental impact, social responsibility, and governance practices (Armstrong, 2020). ESG has gained importance in recent years as companies face increasing pressure to address environmental and social issues, such as climate change, diversity and inclusion, and employee welfare, in addition to traditional financial metrics (Tettamanzi et al., 2022). Corporate ESG factors have been gaining increasing attention from investors as they seek to integrate sustainability and responsibility considerations into their investment decisions (Aouadi and Marsat, 2018; Cek and Eyupoglu, 2020). Investors nowadays recognize that 'climate risk is investment 'risk' (Battiston et al., 2021). Thus, engagement with environmental and social issues can reduce the risk of environmental incidents (Hoepner et al., 2018). ESG is currently one of the focus areas for policymakers worldwide as well (Bruno and Lagasio, 2021). A survey in 2013 from United Global Compact found that nearly 93% of chief executive officers (CEOs) viewed ESG policies as crucial to their company's success (Khan, 2022). Theoretical research shows that the involvement of significant players in environmental, social, and governance concerns has given stakeholders a different perspective (Atan et al., 20188). Investors react positively to positive news about companies with higher ESG scores but negatively to negative news about companies with lower ESG ratings (Chen and Yang, 2020).

ESG has become the subject of a large and varied collection of literature worldwide. Limited and inconsistent in its focus, techniques, and findings is empirical research on ESG performance, particularly regarding climate change (Aureli et al., 2020). Most of the time, ESG measures have only been used to quantify a firm's performance (Buallay, 2020; Landi and Sciarelli, 2019; Dalal and Thaker, 2019). Previous literature offers mixed evidence on ESG issues in business and finance, with some studies advocating the beneficial role of ESG while others indicate the downside of ESG-related investments. Using a sample of European banks operating in 21 countries between 2005 and 2017, Chiaramonte et al. (2022) discovered that the total ESG score, and its sub-pillars reduce bank fragility during times of financial difficulty. The impact of environmental, social, and governance performance on the economic success of Standard & Poor's 500 firms was assessed by Cek and Eyupoglu (2020). Using longitudinal data covering the years from 2010 to 2015, structural equation modelling and linear regression have been used to assess the overall and individual influence of environmental, social, and governance ratings on economic performance. The whole ESG approach and economic success were significantly correlated. Ting et al. (2019) looked at how ESG activities within businesses affected their financial performance. They also contrast how corporate social performance initiatives affect valuation in developed and emerging market enterprises. Using ESG ranking scores from the Thomson Reuters database and a sample of 1,317 emerging market firms and 3,569 developed market firms, their study found that ESG activities significantly impact firm performance. Fatemi et al. (2018) investigated how ESG actions, and their transparency affected firm value. Their research discovered that firm value is increased by ESG strengths and decreased by ESG shortcomings.

However, other researchers have discovered detrimental effects related to ESG. Buallay et al. (2020) examines 882 banks from developed and developing countries covering 11 years after the 2008 financial crisis. Using pooled regression and instrumental variable GMM estimation, the study finds that ESG weakens 'banks' performance in developed and developing countries. Ruan and Liu (2021) analysed samples of China's Shanghai and Shenzhen A-share listed companies using their ESG rating data from 2015 to 2019. They document that corporate ESG initiatives have a significant negative effect on firm performance. Studying a panel of listed Italian companies, Landi and Sciarelli (2019) discovered a negative and statistically significant impact of ESG in terms of market premium while engaging in socially responsible investing (SRI). In their comparative study of two rising nations, i.e., Malaysia and Denmark, Atan et al. (2018) found no correlation between ESG disclosure level and firm's financial success for the top 100 largest companies listed in each Bursa Malaysia and Nasdaq.

According to the prior literature, almost all extant ESG research focus on the positive and negative effects of ESG on performance, regardless of firm or institutional level. ESG factors are typically associated with positive impacts on climate change, as they encourage companies to prioritise environmental sustainability and social responsibility in their business practices. However, it is possible that implementing ESG policies could positively influence climate change issues if properly designed or executed. For example, some firms may engage in "greenwashing," where they promote their ESG practices to create a positive image without making substantive changes to their business practices (Yu et al., 2020). This can lead to a false sense of progress and impede true measures to reduce climate change, which can further affect geopolitical conflict. ESG practices may have unintended consequences that could contribute to climate change. For example, investing in renewable energy may lead to the displacement of communities and damage to natural habitats if not executed properly. Similarly, sustainable agriculture practices may require the use of synthetic fertilisers, which can contribute to greenhouse gas emissions (Dunlap and McCright, 2015). However, the scarcity of evidence on this link is imprecise and limited. No recent research has developed a study on the influence of ESG in moderating the effect of climate change on geopolitical conflicts. This has led us to a new assumption: there may be a moderating effect of ESG readiness on the relationship between climate change and geopolitics. Thus, we hypothesize that:

H2. ESG readiness moderates the detrimental impact of climate vulnerability on geopolitical conflicts.

3. Data and research design

3.1. Data and sample

Secondary data at the national level were obtained from multiple

sources. First, we collect the climate vulnerability index scores offered by the ND-GAIN to proxy for climate change vulnerability. This index has been used in many prior studies (e.g., Edmonds et al., 2020; Kling et al., 2021; Shear et al., 2023). This is a free, open-source, country-level index that determines a country's current vulnerability to climate change. ND-GAIN assesses a country's vulnerability by considering six critical sectors: food, water, health, environment, human habitat, and infrastructure. Six indicators represent each sector, each representing three cross-cutting components: the exposure to climate-related or climate-exacerbated hazards, the sensitivity to the impacts, and the adaptive capacity to cope with or adapt to these impacts.

Next, we utilise the country-specific GPR indices developed by Caldara and Iacoviello (2022) to measure geopolitical uncertainty at the country level. This index has been retrieved from the Economic Policy Uncertainty (EPU) website hosted by Baker, Bloom, and Davis. The GPR measure of Caldara and Iacoviello (2022) is based on a multitude of negative geopolitical events reported in major newspapers such as The New York Times, The Wall Street Journal, The Washington Post, USA Today, Chicago Tribune, The Daily Telegraph, Financial Times, The Guardian, The Globe and Mail, and The Los Angeles Times. The categories of GPR include war threats, peace threats, military build-ups, nuclear threats, terror threats, beginning of war, escalation of war, and terror acts. The GPR index has been provided on a monthly basis since 1985. However, following prior studies (Alam et al., 2023; Banna et al., 2023a), we converted the monthly GPR indices into a yearly frequency to ensure consistency with the CVI index.

We choose to use the country-level CVI scores of ND-GAIN as they are the most widely used proxy for climate vulnerability in the empirical literature (Kling et al., 2021). Moreover, the ND-GAIN CVI scores are constructed using a delicate technique that has been widely accepted by a range of users, including academics and practitioners (Hedlund et al., 2018). As far as the geopolitical risk measure is concerned, while prior studies in relevant literature mostly use the overall/global GPR index (e.g., Su et al., 2021; Lee et al., 2021; Gong and Xu, 2022, among others), the use of a country-level index fits more appropriately in the context of our econometric analysis.[1] These country-level GPR indices developed by Caldara and Iacoviello (2022) have been employed in many studies in previous literature (Hasan et al., 2020; Bouras et al., 2019; Iyke et al., 2022, among others).

To study the moderating role of ESG readiness, we obtain country-level overall and dimension-wise ESG readiness data from ND-GAIN. Furthermore, we collect the institutional quality data from the Worldwide Governance Indicators (WGI) database of the World Bank. WGI presents six institutional quality estimates for each country. These estimates include voice and accountability, political stability and absence of violence, regulatory quality, rule of law, control of corruption, and governance effectiveness. This data has been used in numerous studies in relevant literature (e.g., Zakaria and Bibi, 2019; Alam, 2022; Hussain and Dogan, 2021; Alam et al., 2022, among others). Following Alam et al. (2022), we generate a composite institutional quality index using the weighted average of the standard deviations (SD) of the six institutional quality estimates.

In order to control for country-specific macroeconomic factors, we collect several variables from the World Development Indicators (WDI) database of the World Bank. In particular, we obtain the growth rate of gross domestic product (GDP), inflation, real interest rate, and energy imports. Additionally, we obtain data on military expenditures, arms imports, and other indicators using the trend indicator value provided by the Stockholm International Peace Research Institute (SIPRI). Merging all these datasets, we obtain a final sample of 42 countries, spanning over the years from 1995 to 2021.

[1] To ensure consistency, we use the country-level GPR indices as the outcome variable since our main regressor (CVI scores) are also at the country-level.

3.2. Variables

Our study focuses on predicting the nexus between climate vulnerability, ESG readiness, and geopolitical risk at the country level. The country-level GPR index score (CGPR) developed by Caldara and Iacoviello (2022) is the predicted variable which measures the level of risk associated with geopolitics in each country. The main predictor variable is the climate vulnerability index score (CVI) obtained from ND-GAIN which captures a country's vulnerability to climate disruptions. Control variables include military expenses (Mil_Exp), arms imports (Arms_Imp), armed forces personnel (AFP), energy imports (Energy_Imp), GDP growth rate, inflation, and interest rate. Furthermore, we include INQ, which is the weighted average of the SDs of six WGI institutional quality estimates, as an additional control variable. To measure the moderating role of ESG, we use both overall and dimensional ESG readiness indices and run separate tests for each of them.

3.3. Model specification

Our main empirical model is based on the following equation:

$$CGPR_{c,t+1} = \zeta_0 + \zeta_1 * CVI_{c,t} + \zeta_2 * \varphi_{c,t} + \varepsilon_1 \quad (1)$$

Where, $CGPR_{c,t+1}$ represents the level of geopolitical risk for country c in year $t+1$. $CVI_{c,t}$ is the annual climate vulnerability index score for country c in year t. To accurately depict the impact of the climatic change vulnerability on the future geopolitical risk profiles of our sample countries, we employ the lagged CVI index scores.

$\Phi_{c,t}$ is a vector of country-specific macroeconomic variables for country c in year t. Table 1 provides definitions of our main variables. Full empirical specification includes year and region-fixed effects (FE) and robust standard errors (SE).

3.4. Summary statistics

Table 2 displays the descriptive statistics for the key variables. The average CVI index score over the sample period is negative 0.0540, with a standard deviation of 0.0437. The minimum and maximum values for CVI are −0.1389 and 0.0697, respectively. The mean value for CGPR is 0.2111, with a standard deviation of 0.4156. The mean ESG readiness index score is 0.0619, with a standard deviation of 0.0873.

4. Empirical results and discussion

Our empirical analyses are conducted in several steps. Firstly, we explore the effect of changes in CVI on the country-specific GPR to determine the baseline relationship between the two. Secondly, we

Table 1
Variable definitions.

Variable	Definition
CGPR	Country-level geopolitical risk index score
CVI	Country-level climate vulnerability index score
ESG	Country-level economic, social and governance (ESG) readiness index score
E	Country-level economic readiness index score
S	Country-level social readiness index score
G	Country-level governance readiness index score
Mil_Exp	Military expenditure as a percentage of gross domestic product (GDP)
Arms_Imp	Arms imports (SIPRI trend indicator values)
AFP	Total armed forces personnel
Energy_Imp	Net energy imports as a percentage of energy use
GDP	GDP growth rate
Inflation	Annual percentage change in consumer prices
Interest	Real interest rate
INQ	Country-level institutional quality (a weighted average index using the six country-level IQ estimates)
GPRH	Historical geopolitical risk index score

Table 2
Summary statistics.

Variable	Obs.	Mean	Std. Dev.	Min	Max
CGPR	1,053	0.2111	0.4156	0.0036	4.3497
CVI	1,053	−0.0540	0.0437	−0.1389	0.0697
ESG	1,053	0.0619	0.0873	−0.1915	0.2422
E	1,053	0.4931	0.1342	0.1705	0.8414
S	1,053	0.4325	0.1759	0.1327	0.7306
G	1,053	0.6127	0.1786	0.3144	0.8798
Mil_Exp	1,026	2.0604	1.6215	0.4428	12.4457
Arms_Imp	930	3.863e+08	5.975e+08	2,000,000.00	3.287e+09
AFP	950	414,244.58	686,904.02	17,000.00	3,640,000.00
Energy_Imp	783	−11.4744	133.1298	−680.4843	96.5269
GDP	1,022	2.8180	3.5405	−9.9432	12.7210
Inflation	999	5.2152	15.9348	−1.1250	376.7462
Interest	607	5.4612	8.9797	−35.2424	45.6378
INQ	874	0.6032	0.8516	−0.9524	1.9148
GPRH	1,026	77.5268	21.0571	39.6731	135.3242

Table 3
Impact of climate vulnerability on geopolitical risk.

Y = $CGPR_{c,t+1}$	(1)	(2)	(3)
CVI	**1.7414****	**1.7118****	**1.8643****
	(0.7961)	**(0.7946)**	**(0.7816)**
Mil_Exp	0.2575***	0.2574***	0.2645***
	(0.0288)	(0.0285)	(0.0286)
Arms_Imp	−0.0411	−0.0516	−0.0424
	(0.0575)	(0.0582)	(0.0560)
AFP	0.2365***	0.2446***	0.2402***
	(0.0569)	(0.0572)	(0.0554)
Energy_Imp	0.7973***	0.7977***	0.8558***
	(0.1514)	(0.1488)	(0.1572)
GDP	−5.7818	−6.5816	−7.4798
	(5.5562)	(5.7869)	(6.3756)
Inflation	2.1369	3.3196	6.2236
	(3.5723)	(3.4741)	(4.3518)
Interest	−2.1317	−2.0337	−1.9838
	(1.7350)	(1.7072)	(2.0495)
INQ	0.1155***	0.1209***	0.1206***
	(0.0358)	(0.0359)	(0.0361)
GPRH		0.0015	−0.0013
		(0.0014)	(0.0021)
Constant	−0.3207***	−0.4453***	−0.0884
	(0.0626)	(0.1255)	(0.2294)
Observations	341	341	341
R-squared	0.6104	0.6134	0.6388
Year FE	No	No	Yes
Region FE	Yes	Yes	Yes
Robust SE	Yes	Yes	Yes

Robust standard errors are in parentheses.
*** denotes significance at the 0.01 level.
** denotes significance at the 0.05 level.
* denotes significance at the 0.10 level.

reiterate this test by trying different empirical specifications and combinations of control variables. Thirdly, we introduce the idea of overall and dimensional ESG readiness and examine whether and how a country's readiness for ESG, both combined and pillar-wise, affects the baseline relationship between CVI and CGPR. Lastly, we reinvestigate the moderating role of ESG readiness using sub-samples generated based on countries with high versus low ESG readiness, as well as countries demonstrating high versus low institutional governance quality. All of these tests are based on fixed-effects panel OLS, whereas matched samples based on propensity score matching (PSM) estimation are used to confirm the empirical resilience of these tests and their findings.

4.1. Baseline multivariate analysis

In Table 3, we present the results of our baseline regressions based on Equation (1). Model 1 regresses CGPR on CVI along with all control variables, while including region FEs only. Model 2 is built upon model 1; however, it includes historical geopolitical risk index (GPRH) as an additional control variable. It is important to rule out if a country's geopolitical risk index is influenced by the historical exposure to geopolitical issues and conflicts. Finally, in Model 3, we repeat the specification in model 2 by incorporating both year and region fixed effects, which is our full empirical specification.

Our findings in all three models reveal a significant positive association between CGPR and CVI, supporting our first hypothesis. Specifically, holding all else unchanged, a 1-point increase in the country-level CVI score results in a 1.7118-units (1.8643-units) increase in the country-level geopolitical risk, as portrayed in model 2 (model 3). Findings from our baseline tests suggest that an increase in a country's climate change risk severely erodes its stability in the geopolitical landscape. These findings are consistent with previous studies by Schilling et al. (2020) and Mach et al. (2019). This convergence of evidence underscores the urgency of addressing climate change as not merely an environmental challenge but as a pivotal factor in shaping the geopolitical landscape.

4.2. Moderating role of ESG readiness

Next, we move on to the more interesting segment of our analysis, i.e., whether and how the country-level ESG readiness moderates the effect of CVI on GPR. Table 4 illustrates the results. Models 1–3 repeat the three models in Table 3, respectively, while including ESG and the interaction between ESG and CVI as additional regressors. In all models, CVI*ESG is our variable of interest. We observe that the estimated coefficients on CVI in all three models are positive and highly significant, confirming our baseline findings in Table 3. Interestingly, however, the coefficient estimates on CVI*ESG in all three models turn out to be negative and statistically significant at the 0.01 level. These results imply that ESG readiness significantly moderates the positive relationship between CVI and CGPR. In particular, countries with better economic, social, and governance readiness are less likely to suffer from increased CGPR when there is an increase in their vulnerability to climate change issues. Confirming the empirical validity of our second hypothesis H2, these findings are well aligned with those in previous literature (e.g., Sarkodie and Strezov, 2019; Wen et al., 2023; Sarkodie et al., 2022).

4.3. Moderating effects of ESG dimensions

We expand our analysis by examining the moderating effect of each ESG readiness dimension to determine if there are any changes to the earlier findings. The results are presented in Table 5. Columns 1–3 portray the results based on economic, social, and governance dimensions, respectively. We find that both social (S) and governance (G) readiness indices play significant moderating roles in the dismantling

Table 4
Does country-level ESG readiness matter?

Y = $CGPR_{c,t+1}$	(1)	(2)	(3)
CVI	**3.8991*** **	**3.8598*** **	**4.1326*** **
	(0.7023)	**(0.7114)**	**(0.7683)**
ESG	−0.2018	−0.1102	0.2431
	(0.3852)	(0.3833)	(0.3342)
CVI*ESG	**−18.4514*** **	**−18.2054*** **	**−18.3545*** **
	(6.8823)	**(6.9723)**	**(6.7967)**
Mil_Exp	0.2535***	0.2538***	0.2625***
	(0.0279)	(0.0276)	(0.0276)
Arms_Imp	−0.0329	−0.0437	−0.0283
	(0.0578)	(0.0582)	(0.0560)
AFP	0.2478***	0.2526***	0.2328***
	(0.0623)	(0.0622)	(0.0592)
Energy_Imp	0.8056***	0.8090***	0.8779***
	(0.1457)	(0.1434)	(0.1508)
GDP	−9.4776	−10.1482	−11.9219
	(6.1586)	(6.3277)	(7.2319)
Inflation	1.6601	2.8993	5.0936
	(3.8559)	(3.762)	(4.7395)
Interest	−1.2311	−1.0251	−0.6200
	(1.8211)	(1.7494)	(2.037)
INQ	0.0984*	0.0974*	0.0653
	(0.0556)	(0.0558)	(0.0525)
GPRH		0.0016	−0.0014
		(0.0014)	(0.0021)
Constant	−0.2767***	−0.4139***	−0.0291
	(0.0558)	(0.1214)	(0.2329)
Observations	341	341	341
R-squared	0.6187	0.6222	0.6507
Year FE	No	No	Yes
Region FE	Yes	Yes	Yes
Robust SE	Yes	Yes	Yes

Robust standard errors are in parentheses.
*** denotes significance at the 0.01 level.
** denotes significance at the 0.05 level.
* denotes significance at the 0.10 level.

impact of CVI on CGPR. In particular, a one-unit increase in the social (governance) readiness index reduces CGPR by 13.5379 (9.6319) units, given that there has been a unitary increase in the CVI index. We do not find any evidence of the moderating effect of the economic (E) readiness measure. Overall, these findings reaffirm that ESG readiness, especially the social and governance aspects, of a country plays a critical role in mitigating its geopolitical uncertainty stemming from high climate change vulnerability.

4.4. Additional tests on the impact of ESG readiness

We extend our analysis of the moderation (by ESG) by using sub-samples based on high vs low ESG readiness, as well as sub-samples based on high vs low country-level institutional governance quality. The results are reported in Table 6 and Table 7, respectively. Countries with above-median readiness scores are regarded as high-readiness countries. Sub-samples based on institutional quality are created using a similar approach. In Table 6, the results indicate that countries with high ESG readiness demonstrate significant moderating effects of their readiness (both overall and the social and governance dimensions) on the association between CVI and CGPR. For a country with high ESG readiness, a 1-unit increase in its social (governance) readiness score reduces its country-specific geopolitical risk score by 40.6203 units (18.1574 units) when there is a unitary increase in the country's CVI score as indicated in model 5 (model 7). Table 7 shows that both countries with high and low institutional governance exhibit significant mitigating effects of the overall and dimension-wise ESG readiness programs, although the effects are more substantial in cases of the high-INQ samples. This is likely because greater institutional quality leads to effective implementation and adoption of sustainable policies and practices. In addition, it helps build climate resilience and foster

Table 5
Moderating role of individual dimensions of ESG readiness.

Y = $CGPR_{c,t+1}$	(1)	(2)	(3)
CVI	2.9061*	8.1194***	7.5666***
	(1.5304)	(2.2019)	(2.5978)
E	0.5659***		
	(0.1639)		
CVI*E	**−2.0592**		
	(2.4967)		
S		−0.0123	
		(0.3288)	
CVI*S		**−13.5379*** **	
		(4.8589)	
G			−9.1266***
			(1.9169)
CVI*G			**−9.6319** **
			(4.2042)
Mil_Exp	0.2786***	0.2573***	0.2821***
	(0.0275)	(0.0282)	(0.0275)
Arms_Imp	−0.0140	−0.0306	−0.0657
	(0.0571)	(0.0531)	(0.0524)
AFP	0.1663***	0.2627***	0.4127***
	(0.0640)	(0.0612)	(0.0663)
Energy_Imp	1.0718***	0.9989***	0.7356***
	(0.1440)	(0.1795)	(0.1514)
GDP	−4.2359	−6.4752	−13.2714**
	(6.4022)	(7.6351)	(6.7362)
Inflation	4.3463	7.4741	6.1798
	(4.0657)	(4.6880)	(3.9166)
Interest	−0.8099	−1.6297	−1.9067
	(1.9026)	(2.0266)	(1.9154)
INQ	0.0677	0.1142**	2.0092***
	(0.0450)	(0.0578)	(0.4332)
GPRH	−0.0013	−0.0016	−0.0017
	(0.0021)	(0.0021)	(0.0021)
Constant	−0.3196	−0.0246	4.3528***
	(0.2589)	(0.2714)	(0.9861)
Observations	341	341	341
R-squared	0.6523	0.6578	0.6723
Year FE	Yes	Yes	Yes
Region FE	Yes	Yes	Yes
Robust SE	Yes	Yes	Yes

Robust standard errors are in parentheses.
*** denotes significance at the 0.01 level.
** denotes significance at the 0.05 level.
* denotes significance at the 0.10 level.

cooperation among countries through social trust when facing global challenges like climate change. These findings provide additional support to our previous discoveries.

5. Robustness and additional analyses

To address potential endogeneity associated with our empirical model, we have utilised a matched sample of countries generated through propensity score matching (PSM) estimation, which was introduced by Rosenbaum and Rubin (1983) and employed in numerous studies in existing literature (Banna et al., 2023b; Chiaramonte et al., 2022; Alam et al., 2023, among others).[2] The PSM estimation has been

[2] The Inverse Probability of Treatment Weighting (IPTW) is another popular technique in minimizing the effect of bias in observational studies. However, it's widely regarded that although both methods have similar accuracy, the PSM performs better than the IPTW in certain scenarios. In case of substantial confounding with a small number of observations, the IPTW gives fuzzy estimates of the treatment effect (Elze et al., 2017). As compared to the IPTW, the propensity scores are likely to produce estimators with smaller mean squared error (MSE) (Ertefaie and Stephens, 2010). Furthermore, Zhu (2012) argued that although the two methods generate similar treatment effect hazard ratio estimates, the PSM turn out to be more efficient than the IPTW. Based on these advantages of the PSM over the IPTW, we have employed the PSM estimation as our main approach to addressing potential endogeneity.

Table 6
Sub-sample analysis: High vs. low ESG readiness.

Y = $CGPR_{c,t+1}$	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	High	Low	High	Low	High	Low	High	Low
CVI	10.4686***	−1.6124***	−2.8123	1.6750	24.7830***	2.2013*	13.0727***	−5.8679***
	(3.3082)	(0.4949)	(5.5068)	(1.9230)	(5.8550)	(1.1676)	(4.3444)	(2.1652)
ESG	−4.3830***	0.7696*						
	(1.2458)	(0.4071)						
CVI*ESG	**−60.5405*** **	**−5.9726**						
	(21.3195)	**(9.1887)**						
E			0.8551	0.0778				
			(0.5893)	(0.1638)				
CVI*E			**8.2061**	**−8.0401**				
			(8.1930)	**(5.4691)**				
S					−2.5264***	−0.3548		
					(0.6242)	(0.2761)		
CVI*S					**−40.6203*** **	**−15.0735** **		
					(10.1156)	**(6.0316)**		
G							−19.7668***	0.2344
							(4.3525)	(0.3789)
CVI*G							**−18.1574*** **	**8.6682** **
							(5.7543)	**(3.5135)**
Constant	1.1447**	−0.0341	−0.0106	−0.0717	1.6791***	0.0915	10.0745***	−0.1328
	(0.5456)	(0.0601)	(0.6836)	(0.0902)	(0.6009)	(0.0742)	(2.2491)	(0.2110)
Observations	183	158	183	158	183	158	183	158
R-squared	0.7192	0.8145	0.7076	0.8257	0.7404	0.8279	0.7691	0.8073
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Robust SE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors are in parentheses.
*** denotes significance at the 0.01 level.
** denotes significance at the 0.05 level.
* denotes significance at the 0.10 level.

Table 7
Sub-sample analysis: High vs. low institutional governance quality.

Y = $CGPR_{c,t+1}$	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	High	Low	High	Low	High	Low	High	Low
CVI	4.7271***	−0.1316	13.9261***	1.4643*	4.7216**	3.5428***	17.3851***	−6.2044***
	(1.2658)	(0.2757)	(2.8469)	(0.8081)	(1.9399)	(0.8604)	(4.6232)	(1.6906)
ESG	0.4337	0.1733						
	(0.6602)	(0.1997)						
CVI*ESG	**−28.2635*** **	**−8.8173** **						
	(9.3178)	**(4.4388)**						
E			1.2863***	0.0946				
			(0.3853)	(0.0754)				
CVI*E			**−27.1951*** **	**−3.6879** **				
			(5.1445)	**(1.5273)**				
S					1.1895***	−0.4843**		
					(0.3944)	(0.2368)		
CVI*S					**−8.7359** **	**−15.6454*** **		
					(4.0513)	**(3.3846)**		
G							0.0303	−0.1809
							(0.4604)	(0.2132)
CVI*G							**−21.7151*** **	**10.0844*** **
							(6.2982)	**(3.5493)**
Constant	−1.0784***	−0.0129	−1.6552***	−0.0550	−1.4784***	0.1612**	−1.1733***	0.0907
	(0.3370)	(0.0440)	(0.3802)	(0.0625)	(0.3529)	(0.0620)	(0.4315)	(0.0847)
Observations	231	188	231	188	231	188	231	188
R-squared	0.7133	0.7827	0.7318	0.7943	0.7309	0.8069	0.7134	0.8030
Controls (exc. INQ)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Robust SE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors are in parentheses.
*** denotes significance at the 0.01 level.
** denotes significance at the 0.05 level.
* denotes significance at the 0.10 level.

Table 8
Robustness test: PSM estimation.

Panel A: Repeating baseline tests using matched sample.			
Y = $CGPR_{c,t+1}$	(1)	(2)	(3)
CVI	**1.7784****	**1.7571****	**1.9026****
	(0.7874)	**(0.7853)**	**(0.7753)**
Mil_Exp	0.3724***	0.3712***	0.3847***
	(0.0406)	(0.0403)	(0.0384)
Arms_Imp	−0.0393	−0.0483	−0.0401
	(0.0587)	(0.0598)	(0.0585)
AFP	0.2066***	0.2135***	0.2056***
	(0.0563)	(0.0572)	(0.0558)
Energy_Imp	0.9700***	0.9695***	1.0620***
	(0.1952)	(0.1936)	(0.1823)
GDP	3.8382	3.4706	5.3488
	(7.6836)	(7.8659)	(7.5801)
Inflation	0.8094	2.3407	10.6007
	(9.5656)	(9.4297)	(10.0284)
Interest	6.3061**	6.3807**	6.4661**
	(2.8017)	(2.8467)	(3.1254)
INQ	0.1749***	0.1797***	0.1878***
	(0.0447)	(0.0448)	(0.0435)
GPRH		0.0012	0.0038**
		(0.0015)	(0.0019)
Constant	−0.604***	−0.7008***	−1.1128***
	(0.0969)	(0.1532)	(0.2179)
Observations	288	288	288
R-squared	0.6597	0.6612	0.6916
Year FE	No	No	Yes
Region FE	Yes	Yes	Yes
Robust SE	Yes	Yes	Yes

Panel B: Moderating effects of ESG and its dimensions using matched sample.				
Y = $CGPR_{c,t+1}$	(1)	(2)	(3)	(4)
CVI	3.9077***	2.9036*	8.0232***	10.7696***
	(0.8183)	(1.6656)	(2.2388)	(3.2342)
ESG	−0.7816*			
	(0.4734)			
CVI*ESG	**−18.9886*****			
	(6.8447)			
E		0.0339		
		(0.2527)		
CVI*E		**−1.9330**		
		(2.5445)		
S			−0.0779	
			(0.3654)	
CVI*S			**−13.1077*****	
			(4.7259)	
G				−6.0072**
				(2.3825)
CVI*G				**−13.6246*****
				(4.8953)
Mil_Exp	0.3771***	0.3828***	0.3744***	0.3812***
	(0.0381)	(0.0399)	(0.0373)	(0.0373)
Arms_Imp	−0.0438	−0.0321	−0.0279	−0.0759
	(0.0618)	(0.0632)	(0.0577)	(0.0557)
AFP	0.2455***	0.1963***	0.2316***	0.3595***
	(0.0653)	(0.0725)	(0.0633)	(0.0675)
Energy_Imp	1.0887***	1.1082***	1.2122***	0.8263***
	(0.1906)	(0.1741)	(0.2225)	(0.1580)
GDP	−1.9270	4.6843	5.1960	−4.2169
	(8.1312)	(7.9442)	(9.5632)	(8.2950)
Inflation	13.0651	10.0816	13.7587	12.3821
	(10.5639)	(10.3754)	(9.5544)	(9.1652)
Interest	6.7893**	6.4414**	6.3767**	5.2057
	(3.1531)	(3.1334)	(2.9115)	(3.2779)
INQ	0.2155***	0.1829***	0.1900***	1.3479**
	(0.0694)	(0.0638)	(0.0668)	(0.5343)
GPRH	0.0040**	0.0038**	0.0035*	0.0038*
	(0.0019)	(0.0019)	(0.0018)	(0.0019)
Constant	−1.0755***	−1.1042***	−1.0250***	1.8783
	(0.2206)	(0.2171)	(0.2259)	(1.1812)
Observations	288	288	288	288
R-squared	0.6974	0.6921	0.7080	0.7103
Year FE	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes
Robust SE	Yes	Yes	Yes	Yes

Robust standard errors are in parentheses.
*** denotes significance at the 0.01 level.
** denotes significance at the 0.05 level.
* denotes significance at the 0.10 level.

performed in two stages. First, sample countries have been treated with a binary treatment variable, DCVI, which is equal to one if a country's CVI score is greater than the median score and zero otherwise. Similar treatment mechanism has been used in many prior studies (e.g., Chiaramonte et al., 2022; Trinh et al., 2023; Li et al., 2023, among others). The treated countries (DCVI = 1) are matched one-to-one without replacement with the controlled group of countries (DCVI = 0) using the entire set of control variables (i.e., military expenditure, arms import, number of armed forces personnel, energy import, GDP, inflation, interest rate, institutional governance, and historical GPR) as the matching criteria. Next, this newly generated matched sample of countries has been utilised to replicate the baseline panel regressions as well as the moderating role of ESG readiness to confirm the robustness of our earlier findings. The results of the PSM analysis are reported in Table 8. Panel A models repeat the three models, respectively, of Table 3. We observe that the estimated coefficients on CVI are positive and significant in all three models, confirming our baseline findings regarding the positive relationship between CVI and CGPR. Model 1 of Panel B replicates the last model of Table 4, whereas models 2–4 of panel B repeat the three models, respectively, of Table 5. The estimated coefficients on CVI (CVI*ESG, CVI*S, and CVI*G) is (are) positive (negative) and significant, confirming our previous findings regarding the moderating role of ESG and its dimensions in the CVI-CGPR relationship. Results in both panels reinforce the empirical resilience of our prior findings, concluding that the increase in a country's geopolitical risk stemming from escalated climate vulnerability at the country level is significantly moderated by its overall as well as social and governance readiness programs.

To further ensure the robustness of the ESG moderation, we repeat the last model in Table 4 as well as all three models in Table 5 using different sub-samples based on geographical/regional heterogeneity. In particular, we generate different sub-samples excluding specific countries or regions to test the persistence of our previous findings. First, we exclude USA from the sample and repeat the aforementioned models. USA is undeniably one of the greatest and most crucial players in the geopolitical arena and it will not be surprising to see the original results being strongly driven/biased by USA. The results based on the non-US sample are reported in panel A of Appendix table A1. In all four models, the estimated coefficients on the interaction terms are negative and highly significant, supporting our earlier results suggesting that ESG readiness strongly mitigates the impact of CVI. It is observed that the economic (E) readiness dimension, in addition to its social (S) and governance (G) counterparts, plays a significant role in mediating the detrimental impact of CVI on GPR for the non-US sample. Next, we generate another sub-sample by excluding the Middle Eastern and North African (MENA) countries and reiterate the models in panel A. Our sole intension was to exclude the Middle Eastern countries only; however, the dataset incorporates MENA as a separate region (including the North African countries) which is why we have created a sub-sample by omitting all countries belonging to this particular region. Since the tragic 9/11 event, there have been series of wars and geopolitical acts in the Middle East and it is necessary to rule out any bias created by the incorporation of these countries into our sample. Panel B of Appendix table A1presents the results based on the non-MENA sub-sample. Findings reveal that the moderating effect remains valid for the overall ESG readiness as well as its social (S) and governance (G) dimensions, reinforcing our previous claims. Finally, we investigate if countries with certain memberships, such as the North Atlantic Treaty Organization (NATO) and the Group of Seven (G7), are able to minimise their geopolitical risks and conflicts through such memberships. NATO is currently the largest geopolitical alliance ensuring security to its member countries through numerous political and military benefits. On the

other hand, G7 provides supportive avenues to its member nations in terms of solutions to vital global issues in the areas of economics/trade, security, and climate change. We generate two distinct binary variables, NATO and G7, where NATO (G7) is equal to one if a country belongs to NATO (G7) and zero otherwise, and include these dummy variables and their interactions with CVI separately in Appendix table A2. The results indicate that both membership to NATO and G7 provideinsurance against heightened GPR stemming from adverse climate-related issues. These findings reinforces the importance of such memberships in mitigating increased risks and uncertainties in the geopolitical landscape.

6. Conclusion & implications

The impact of climate change on geopolitical conflict has received little attention in literature. Only a few studies have explored the global impact of deteriorating climate change on geopolitical risk. Schilling et al. (2020) study climate change vulnerability, water resources, and socioeconomic ramifications. However, their study is limited by several issues, including the extension of other geopolitical risk factors, the use of a sample from North Africa only, a lack of analysis across varying country-level factors, and a lack of investigation based on other factors that play mitigating roles in the adverse impact of climate change on geopolitical conflicts. Our study sheds new light on the relationship between climate change and geopolitical conflict at the global level. Based on an extensive data set of 42 countries over the years from 1995 to 2021 and using the climate vulnerability index developed by the ND-GAIN and country-level GPR indices introduced by Caldara and Iacoviello (2022), we find that countries facing high vulnerability to climate change are more likely to experience geopolitical conflicts. Furthermore, a country's readiness for economic, social, and governance (ESG) issues significantly moderates this effect. This mitigation is mainly attributed to the rescuing role of the social and governance dimensions of ESG. Additional tests reveal that the mitigating impact of ESG is stronger in countries with higher institutional governance quality. Our primary results survive a set of endogeneity tests based on matched samples created through PSM estimation.

Our research findings suggest that the private sector has a significant opportunity to pivot towards more sustainable practices. Encouraging private sector companies to adopt measures that mitigate their carbon footprint and support climate adaptation initiatives becomes imperative. Moreover, incentivising private sector investments in climate-resilient infrastructure projects could substantially bolster stability and economic development in vulnerable areas. Our study provides distinctive empirical evidence on the significant impact of climate change on the risk of global geopolitical conflicts at the country level, thereby offering substantial implications for various stakeholders, encompassing governments, policymakers, investors, and business organisations. This is in line with previous studies conducted by Schilling et al. (2020), Abel et al. (2019), Koubi (2019), and Mach et al. (2019) that have explored the detrimental consequences of climate change on geopolitical conflicts.

Governments and policymakers can leverage our findings to address the intricate interplay between climate change, institutional quality, and geopolitical conflicts. Incorporating climate change considerations into policymaking and prioritising sustainable development goals can mitigate conflicts arising from environmental vulnerabilities. The study emphasises the critical role of ESG policies in reducing the risk of conflicts in countries that are highly vulnerable to climate change. For policymakers and governments, the discovery that high climate vulnerability correlates with increased geopolitical conflict necessitates a strategic recalibration. Integrating climate vulnerability assessments into national security and foreign policies becomes crucial, especially in regions prone to climate-induced conflicts. This integration empowers decision-makers to address potential conflict triggers and inform strategic decisions proactively.

Our research findings suggest that investors should take note of the implications of our study by acknowledging the interconnectedness of climate change, socioeconomic factors, and geopolitical stability. Integrating ESG considerations into decision-making processes becomes essential for firms as they navigate the challenges of climate change. By prioritising ESG factors and incorporating long-term sustainability and resilience strategies, firms can mitigate the adverse effects of climate change and align with stakeholder expectations.

While our study represents a significant step forward in understanding the relationship between climate change and geopolitical conflict, several limitations should be acknowledged. For example, our analysis is limited to a sample of 42 countries, which may not capture the full spectrum of global diversity and the myriad factors influencing the interplay between climate change and geopolitical conflict at the country level. It is possible that other nuanced variables, not included in our current analysis, could impact the observed relationship. Future research could explore these issues in more detail. In conclusion, our study provides crucial empirical evidence that helps to enrich our understanding of the complex relationship between climate change and geopolitical conflicts. Our findings are expected to inspire further research in this critical area and to be helpful to policymakers and other stakeholders as they work on addressing the challenges posed by climate change.

CRediT authorship contribution statement

Ashraful Alam: Writing – review & editing, Writing – original draft, Visualization, Project administration, Investigation, Formal analysis, Conceptualization. **Hasanul Banna:** Writing – review & editing, Writing – original draft, Visualization, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Ahmed W. Alam:** Writing – review & editing, Writing – original draft, Visualization, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Md. Borhan Uddin Bhuiyan:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Resources, Project administration. **Nur Badriya Mokhtar:** Writing – review & editing, Writing – original draft, Visualization, Validation, Resources.

Declaration of Competing interest

There is no conflict of interest.

Data availability

Data will be made available on request.

Appendix Table A1. Supplementary analyses

Panel A: Excluding USA				
Y = $CGPR_{c,t+1}$	(1)	(2)	(3)	(4)
CVI	0.3157	1.2050	3.7143**	4.3829**

(*continued on next page*)

(*continued*)

Panel A: Excluding USA				
Y = $CGPR_{c,t+1}$	(1)	(2)	(3)	(4)
	(0.4283)	(1.2285)	(1.5215)	(2.1268)
ESG	0.4330			
	(0.2683)			
CVI*ESG	**−20.8656*****			
	(6.0794)			
E		0.3415***		
		(0.1044)		
CVI*E		**−6.3675*****		
		(1.9771)		
S			0.0029	
			(0.2701)	
CVI*S			**−13.1864*****	
			(4.1864)	
G				−1.4532
				(0.9853)
CVI*G				**−9.8334****
				(3.7949)
Constant	0.0810	−0.1129	0.0778	0.7344
	(0.1214)	(0.1315)	(0.1501)	(0.4640)
Observations	324	324	324	324
R-squared	0.4839	0.4635	0.4861	0.4396
Controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes
Robust SE	Yes	Yes	Yes	Yes
Panel B: Excluding MENA countries				
Y = $CGPR_{c,t+1}$	(1)	(2)	(3)	(4)
CVI	4.1326***	2.9078*	8.1352***	7.5765***
	(0.7674)	(1.5282)	(2.2000)	(2.5950)
ESG	0.2445			
	(0.3343)			
CVI*ESG	**−18.4137*****			
	(6.7912)			
E		0.5663***		
		(0.1643)		
CVI*E		**−2.0735**		
		(2.4949)		
S			−0.0169	
			(0.3291)	
CVI*S			**−13.5879*****	
			(4.8549)	
G				−9.1398***
				(1.9152)
CVI*G				**−9.6608****
				(4.1990)
Constant	−0.0277	−0.3185	−0.0219	4.3606***
	(0.2327)	(0.2587)	(0.2712)	(0.9851)
Observations	338	338	338	338
R-squared	0.6509	0.6524	0.6579	0.6725
Controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes
Robust SE	Yes	Yes	Yes	Yes

Robust standard errors are in parentheses.
*** denotes significance at the 0.01 level.
** denotes significance at the 0.05 level.
* denotes significance at the 0.10 level.

Appendix Table A2. Moderating effects of NATO and G7 memberships

	(1)	(2)	(3)	(4)
CVI	**5.0856*****	**5.1841*****	**3.3936*****	**3.5391*****
	(0.8557)	**(0.9325)**	**(0.7015)**	**(0.7444)**
NATO	−0.3354***	−0.3465***		
	(0.1088)	(0.1089)		
CVI*NATO	**−7.2368*****	**−7.3932*****		
	(1.9514)	**(1.8347)**		
G7			0.0558	0.0483
			(0.0836)	(0.0809)
CVI*G7			**−4.2868****	**−4.5919*****

(*continued on next page*)

(*continued*)

	(1)	(2)	(3)	(4)
			(1.7986)	**(1.6401)**
Constant	−0.4363***	−0.1179	−0.4737***	−0.1701
	(0.1187)	(0.2185)	(0.1149)	(0.2177)
Observations	341	341	341	341
R-squared	0.6447	0.6701	0.6480	0.6747
Controls	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	Yes
Region FE	Yes	Yes	Yes	Yes
Robust SE	Yes	Yes	Yes	Yes

Robust standard errors are in parentheses.
*** denotes significance at the 0.01 level.
** denotes significance at the 0.05 level.
* denotes significance at the 0.10 level.

References

Abel, G.J., Brottrager, M., Crespo Cuaresma, J., Muttarak, R., 2019. Climate, conflict and forced migration. Global Environ. Change 54, 239–249.

Alam, A.W., 2022. ESG activities, political contributions, and firm performance. Uni of New Orleans Theses 2948.

Alam, A.W., Banna, H., Hassan, M.K., 2022. ESG activities and bank efficiency: are islamic banks better? J. Islam. Monetary Econ. Finance 8 (1), 65–88.

Alam, A.W., Houston, R., Farjana, A., 2023. Geopolitical risk and corporate investment: how do politically connected firms respond? Finance Res. Lett. 53, 103681.

Alboghdady, M., El-Hendawy, S.E., 2016. Economic impacts of climate change and variability on agricultural production in the Middle East and North Africa region. Int. J. Clim. Change Strat. Manag. 8 (3), 463–472.

Aouadi, A., Marsat, S., 2018. Do ESG controversies matter for firm value? Evidence from international data. J. Bus. Ethics 151, 1027–1047.

Armstrong, A., 2020. Ethics and ESG. Australas. Account. Bus. Financ. J. 14 (3), 6–17.

Arnell, N.W., Gosling, S.N., 2013. The impacts of climate change on river flow regimes at the global scale. J. Hydrol. 486, 351–364.

Atan, R., Alam, M.M., Said, J., Zamri, M., 2018. The impacts of environmental, social, and governance factors on firm performance: panel study of Malaysian companies. Manag. Environ. Qual. 29 (2), 182–194.

Aureli, S., Gigli, S., Medei, R., Supino, E., 2020. The value relevance of environmental, social, and governance disclosure: evidence from Dow Jones Sustainability World Index listed companies. Corp. Soc. Responsib. Environ. Manag. 27 (1), 43–52.

Banna, H., Alam, A., Alam, A.W., Chen, X.H., 2023a. Geopolitical uncertainty and banking risk: international evidence. Available at SSRN 4325966. https://doi.org/10.2139/ssrn.4325966.

Banna, H., Alam, A., Chen, X.H., Alam, A.W., 2023b. Energy security and economic stability: the role of inflation and war. Energy Econ. 126, 106949.

Barney, J., 1991. Firm resources and sustained competitive advantage. J. Manag. 17 (1), 99–120.

Battiston, S., Dafermos, Y., Monasterolo, I., 2021. Climate risks and financial stability. J. Financ. Stabil. 54, 100867.

Blakeslee, D.S., Fishman, R., 2018. Weather shocks, agriculture, and crime evidence from India. J. Hum. Resour. 53 (3), 750–782.

Bouras, C., Christou, C., Gupta, R., Suleman, T., 2019. Geopolitical risks, returns, and volatility in emerging stock markets: evidence from a panel GARCH model. Emerg. Mark. Finance Trade 55 (8), 1841–1856.

Bruno, M., Lagasio, V., 2021. An overview of the European policies on ESG in the banking sector. Sustainability 13 (22), 12641.

Brzoska, M., Fröhlich, C., 2016. Climate change, migration, and violent conflict: vulnerabilities, pathways and adaptation strategies. Migrat. Dev. 5 (2), 190–210.

Buallay, A., 2020. Sustainability reporting and firm's performance: comparative study between manufacturing and banking sectors. Int. J. Prod. Perform. Manag. 69 (3), 431–445.

Buallay, A.M., Wadi, R.M.A., Kukreja, G., Hassan, A.A., 2020. Evaluating ESG disclosures of islamic banks: evidence from the organization of islamic cooperation members. Int. J. Innovat. Sustain. Dev. 14 (3), 266.

Burke, M., Hsiang, S.M., Miguel, E., 2015. Climate and conflict. Annu. Rev. Econ. 7 (1), 577–617.

Caldara, D., Iacoviello, M., 2022. Measuring geopolitical risk. Am. Econ. Rev. 112 (4), 1194–1225.

Cattaneo, C., Beine, M., Fröhlich, C.J., Kniveton, D., Martinez-Zarzoso, I., Mastrorillo, M., Schraven, B., 2019. Human migration in the era of climate change. Rev. Environ. Econ. Pol. 13 (2), 189–206.

Cek, K., Eyupoglu, S., 2020. Does environmental, social and governance performance influence economic performance? J. Bus. Econ. Manag. 21 (4), 1165–1184.

Chaney, E., 2013. Revolt on the nile: economic shocks, religion, and political power. Econometrica 81 (5), 2033–2053.

Chen, C., Noble, I., Hellmann, J., Coffee, J., Murillo, M., Chawla, N., 2015. University of Notre Dame Global Adaptation Index. Uni. of Notre Dame.

Chen, H.M., Kuo, T.C., Chen, J.L., 2022. Impacts on the ESG and financial performances of companies in the manufacturing industry based on the climate change related risks. J. Clean. Prod. 380, 134951.

Chen, H.Y., Yang, S.S., 2020. Do investors exaggerate corporate ESG information? Evidence of the ESG momentum effect in the Taiwanese market. Pacific-Bas. Fin. J. 63, 101407.

Chiaramonte, L., Dreassi, A., Girardone, C., Piserà, S., 2022. Do ESG strategies enhance bank stability during financial turmoil? Evidence from Europe. Eur. J. Finance 28 (12), 1173–1211.

Couttenier, M., Soubeyran, R., 2013. Drought and civil war in sub-saharan Africa. Econ. J. 124 (575), 201–244.

Dalal, K.K., Thaker, N., 2019. ESG and corporate financial performance: a panel study of Indian companies. IUP J. Corp. Gov. 18 (1), 44–59.

Dunlap, R.E., McCright, A.M., 2015. Challenging climate change. Climate change and Society: Socio. Perspect. 300–332.

Edmonds, H.K., Lovell, J.E., Lovell, C.A.K., 2020. A new composite climate change vulnerability index. Ecol. Indicat. 117, 106529.

Elze, M.C., Gregson, J., Baber, U., Williamson, E., Sartori, S., Mehran, R., et al., 2017. Comparison of propensity score methods and covariate adjustment: evaluation in 4 cardiovascular studies. J. Am. Coll. Cardiol. 69 (3), 345–357.

Ertefaie, A., Stephens, D.A., 2010. Comparing approaches to causal inference for longitudinal data: Inverse probability weighting versus propensity scores. Int. J. Biostat. 6 (2), 14.

Fatemi, A., Glaum, M., Kaiser, S., 2018. ESG performance and firm value: the moderating role of disclosure. Global Finance J. 38, 45–64.

Gaikwad, N., Nellis, G., 2017. The majority-minority divide in attitudes toward internal migration: evidence from Mumbai. Am. J. Polit. Sci. 61 (2), 456–472.

Gawande, K., Kapur, D., Satyanath, S., 2017. Renewable natural resource shocks and conflict intensity: findings from ' 'India's ongoing Maoist insurgency. J. Conflict Resolut. 61 (1), 140–172.

Ghimire, R., Ferreira, S., 2016. Floods and armed conflict. Environ. Dev. Econ. 21 (1), 23–52.

Gillan, S.L., Koch, A., Starks, L.T., 2021. Firms and social responsibility: a review of ESG and CSR research in corporate finance. J. Corp. Finance 66, 101889.

Gong, X., Xu, J., 2022. Geopolitical risk and dynamic connectedness between commodity markets. Energy Econ. 110, 106028.

Gosling, S.N., Arnell, N.W., 2016. A global assessment of the impact of climate change on water scarcity. Clim. Change 134, 371–385.

Gröschl, J., Steinwachs, T., 2017. Do natural hazards cause international migration? CESifo Econ. Stud. 63 (4), 445–480.

Hasan, M., Naeem, M.A., Arif, M., Shahzad, S.J.H., Nor, S.M., 2020. Geopolitical risk and tourism stocks of emerging economies. Sustainability 12 (21), 9261.

Hedlund, J., Fick, S., Carlsen, H., Benzie, M., 2018. Quantifying transnational climate impact exposure: new perspectives on the global distribution of climate risk. Global Environ. Change 52, 75–85.

Hoepner, A.G., Oikonomou, I., Sautner, Z., Starks, L.T., Zhou, X., 2018. ESG Shareholder Engagement and Downside Risk. AFA, 2018 paper, European Corporate Governance Institute – Finance Working Paper No. 671/2020, Available at: SSRN: https://ssrn.com/abstract=2874252.

Hussain, M., Dogan, E., 2021. The role of institutional quality and environment-related technologies in environmental degradation for BRICS. J. Clean. Prod. 304, 127059.

Ide, T., Schilling, J., Link, J.S., Scheffran, J., Ngaruiya, G., Weinzierl, T., 2014. On exposure, vulnerability and violence: spatial distribution of risk factors for climate change and violent conflict across Kenya and Uganda. Polit. Geogr. 43, 68–81.

Islam, M.M., 2022. Distributive justice in global climate finance–Recipients' climate vulnerability and the allocation of climate funds. Global Environ. Change 73, 102475.

Islam, S.N., Winkel, J., 2017. Climate Change and Social Inequality. DESA Working Paper No. 152 ST/ESA/2017/DWP/152.

Iyke, B.N., Phan, D.H.B., Narayan, P.K., 2022. Exchange rate return predictability in times of geopolitical risk. Int. Rev. Financ. Anal. 81, 102099.

Jessoe, K., Manning, D.T., Taylor, J.E., 2017. Climate change and labour allocation in rural Mexico: evidence from annual fluctuations in weather. Econ. J. 128 (608), 230–261.

Kaplan, R.S., Ramanna, K., 2021. Accounting for climate change. Harv. Bus. Rev. 99 (6), 120–131.

Khan, M.A., 2022. ESG disclosure and firm performance: a bibliometric and meta-analysis. Res. Int. Bus. Finance, 101668.

Klare, M.T., 2020. Climate change, water scarcity, and the potential for interstate conflict in South Asia. J. Strat. Secur. 13 (4), 109–122.
Kling, G., Volz, U., Murinde, V., Ayas, S., 2021. The impact of climate vulnerability on firms' cost of capital and access to finance. World Dev. 137, 105131.
Koller, T., Nuttall, R., Henisz, W., 2019. Five ways that ESG creates value. The McKins. Quarter., New York. November 14.
Koubi, V., 2019. Climate change and conflict. Annu. Rev. Polit. Sci. 22, 343–360.
Koubi, V., Spilker, G., Schaffer, L., Böhmelt, T., 2016. The role of environmental perceptions in migration decision-making: evidence from both migrants and non-migrants in five developing countries. Popul. Environ. 38, 134–163.
Landi, G., Sciarelli, M., 2019. Towards a more ethical market: the impact of ESG rating on corporate financial performance. Soc. Responsib. J. 15 (1), 11–27.
Lee, C.C., Lee, C.C., Li, Y.Y., 2021. Oil price shocks, geopolitical risks, and green bond market dynamics. N. Am. J. Econ. Finance 55, 101309.
Lee, C.C., Wang, C.W., Thinh, B.T., Xu, Z.T., 2022. Climate risk and bank liquidity creation: international evidence. Int. Rev. Financ. Anal. 82, 102198.
Li, T.T., Wang, K., Sueyoshi, T., Wang, D.D., 2021. ESG: research progress and future prospects. Sustainability 13 (21), 11663.
Li, T., Trinh, V.Q., Elnahass, M., 2023. Drivers of global banking stability in times of crisis: the role of corporate social responsibility. Br. J. Manag. 34 (2), 595–622.
Louche, C., Busch, T., Crifo, P., Marcus, A., 2019. Financial markets and the transition to a low-carbon economy: challenging the dominant logics. Organ. Environ. 32 (1), 3–17.
Mach, K.J., Kraan, C.M., Adger, W.N., Buhaug, H., Burke, M., Fearon, J.D., Field, C.B., Hendrix, C.S., Maystadt, J.-F., O'Loughlin, J., Roessler, P., Scheffran, J., Schultz, K. A., von Uexkull, N., 2019. Climate as a risk factor for armed conflict. Nature 571 (7764), 193–197.
Malm, A., 2016. Who lit this fire? Approaching the history of the fossil economy. Crit. Hist. Stud. 3 (2), 215–248.
Manning, C., Clayton, S., 2018. Threats to mental health and wellbeing associated with climate change. In: Psychology and Climate Change. Academic Press, pp. 217–244.
Mares, D.M., Moffett, K.W., 2016. Climate change and interpersonal violence: a "global" estimate and regional inequities. Clim. Change 135, 297–310.
McDonald, M., 2018. Climate change and security: towards ecological security? Int. Theor. 10 (2), 153–180.
Morelli, T.L., Daly, C., Dobrowski, S.Z., Dulen, D.M., Ebersole, J.L., Jackson, S.T., et al., 2016. Managing climate change refugia for climate adaptation. PLoS One 11 (8), e0159909.
Nightingale, A.J., 2017. Power and politics in climate change adaptation efforts: struggles over authority and recognition in the context of political instability. Geoforum 84, 11–20.
Obama, Barack, 2015. Address at coast guard academy, New London, CT. May 20. https://www.whitehouse.gov/the-press-office/2015/05/20/remarks-president-united-states-coast-guard-academy-commencement. (Accessed 20 February 2023).
Raleigh, C., Choi, H.J., Kniveton, D., 2015. The devil is in the details: an investigation of the relationships between conflict, food price and climate across Africa. Global Environ. Change 32, 187–199.
Rasul, G., Sharma, B., 2016. The nexus approach to water–energy–food security: an option for adaptation to climate change. Clim. Pol. 16 (6), 682–702.
Reuveny, R., 2007. Climate change-induced migration and violent conflict. Politic. Geogr. 26 (6), 656–673.
Rodríguez, A., Pérez-López, D., Sánchez, E., Centeno, A., Gómara, I., Dosio, A., Ruiz Ramos, M., 2019. Chilling accumulation in fruit trees in Spain under climate change. Nat. Hazards Earth Syst. Sci. 19 (5), 1087–1103.
Rosenbaum, P.R., Rubin, D.B., 1983. The central role of the propensity score in observational studies for causal effects. Biometrika 70 (1), 41–55.
Ruan, L., Liu, H., 2021. Environmental, social, governance activities and firm performance: evidence from China. Sustainability 13 (2), 767.
Sarkodie, S.A., Strezov, V., 2019. Economic, social and governance adaptation readiness for mitigation of climate change vulnerability: evidence from 192 countries. Sci. Total Environ. 656, 150–164.
Sarkodie, S.A., Ahmed, M.Y., Owusu, P.A., 2022. Global adaptation readiness and income mitigate sectoral climate change vulnerabilities. Humanit. Soc. Sci. Commun. 9 (1).
Schilling, J., Hertig, E., Tramblay, Y., Scheffran, J., 2020. Climate change vulnerability, water resources and social implications in North Africa. Reg. Environ. Change 20 (15), 1–12.
Sesana, E., Gagnon, A.S., Ciantelli, C., Cassar, J., Hughes, J.J., 2021. Climate change impacts on cultural heritage: a literature review. Wiley Interdisciplinary Reviews: Clim. Change 12 (4), e710.
Shear, F., Ashraf, B.N., Butt, S., 2023. Sensing the heat: climate change vulnerability and foreign direct investment inflows. Res. Int. Bus. Finance, 102005.
Su, C.W., Khan, K., Umar, M., Zhang, W., 2021. Does renewable energy redefine geopolitical risks? Energy Pol. 158, 112566.
Tettamanzi, P., Venturini, G., Murgolo, M., 2022. Sustainability and financial accounting: a critical review on the ESG dynamics. Environ. Sci. Pollut. Control Ser. 29 (11), 16758–16761.
Ting, I.W.K., Azizan, N.A., Bhaskaran, R.K., Sukumaran, S.K., 2019. Corporate social performance and firm performance: comparative study among developed and emerging market firms. Sustainability 12 (1), 26.
Trinh, V.Q., Cao, N.D., Li, T., Elnahass, M., 2023. Social capital, trust, and bank tail risk: the value of ESG rating and the effects of crisis shocks. J. Int. Financ. Mark. Inst. Money 83, 101740.
Wen, J., Zhang, S., Chang, C.P., Anugrah, D.F., Affandi, Y., 2023. Does climate vulnerability promote green investment under energy supply restriction? Energy Econ., 106790
Wernerfelt, B., 1984. A resource-based view of the firm. Strat. Manag. J. 5 (2), 171–180.
Yu, E.P.Y., Van Luu, B., Chen, C.H., 2020. Greenwashing in environmental, social and governance disclosures. Res. Int. Bus. Finance 52, 101192.
Zakaria, M., Bibi, S., 2019. Financial development and environment in South Asia: the role of institutional quality. Environ. Sci. Pollut. Control Ser. 26, 7926–7937.
Zhu, Kejia, 2012. Comparing propensity score and inverse weighting methods in a longitudinal time-to-event study. Yale Uni., 1569087. Public Health Theses.