The impact of climate transition risk on firms' value – evidence from select Indian-listed companies

Amitava Mondal and Somnath Bauri
Department of Commerce, Sidho-Kanho-Birsha University, Purulia, India

Received 19 September 2023
Revised 17 January 2024
Accepted 10 June 2024

Abstract

Purpose – Transitioning to a low-carbon economy requires a positive response by society, including business organizations, towards the green concept and also requires the implementation of long-term green strategies. These requirements could impose various transition risks on the sustainable development of the firms; hence, the present study aims to examine the impact of climate transition risk on a firm's financial performance and market value creation from the Indian perspective.

Design/methodology/approach – We have considered the firm-level environmental risk score (ERS) to evaluate the sensitivity of a firm's profitability (measured by ROA & ROE) and market value (measured by Tobin's Q) towards the climate transition risk. The present study used multiple regression analysis to examine the impact of climate transition risk on the firm's financial performance and market value creation, as evidenced by Nifty 50 companies.

Findings – The empirical results suggested that corporate climate transition risks have been positively associated with the firm's financial performance indicators but negatively impacted the firm's market value creation in the case of select Indian-listed firms. Hence, our results indicate that with the increase of firm-level climate transition risk, the firm's financial performance increases but negatively affects the firm's market value creation. The robustness tests have also confirmed the same results and supported our analysis.

Originality/value – The present paper contributes to the existing literature on climate risks and firms' performance by providing insights about firms' sensitivity towards climate transition risk from the Indian perspective.

Keywords Climate risk, Transition risk, Regulatory risk, Firm's performance, Indian firms

Paper type Research paper

1. Introduction

Climate change has been recognized as one of the most challenging and complex issues the world is currently facing (TCFD, 2021). It accelerated the severe consequences of extreme weather events (IPCC, 2014). As per the recent IPCC Report, 2022, over the last few decades, the world has faced more extreme weather events in terms of frequency and vulnerability than their expectations. According to the Global Risk Report (2022), among the top ten most severe risks, "Climate Action Failure" is the top most severe risk on a global scale. Thus, to cope with this emerging "Climate Action Failure" issue, society, including business organizations (major GHG emitters), must agree to take substantial actions towards the mitigation and adaptation of climate change-related risks.

Climate change refers to "a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere, and that is in addition to

Authors are thankful to the editor and anonymous reviewers for their valuable advises and suggestions to improve the paper.

Asian Journal of Accounting Research
Vol. 9 No. 3, 2024
pp. 257-274
Emerald Publishing Limited
e-ISSN: 2443-4175
p-ISSN: 2459-9700
DOI 10.1108/AJAR-08-2023-0264

natural climate variability observed over comparable periods" (UNFCCC, 1992, p. 3). Excessive emissions of greenhouse gases (GHGs) due to rapid industrialization have been considered the main contributor for human-induced global climate change (IPCC, 2014). Rapid urbanization has also been recognized as one major source of carbon dioxide emissions (Sufyanullah *et al.*, 2022). Among the GHGs, carbon dioxide (CO_2) emissions have been largely associated with global climate change (Rahman and Kashem, 2017). Thus, to limit GHG emissions, people worldwide have realized that human interventions are needed. Hence, to discuss these emerging issues, people from different parts of the world met at the "United Nations Conference on Environment and Development" (UNCED) in 1992, and under this conference, the "United Nations Framework Convention on Climate Change" (UNFCCC) came into presence. Under this framework, world leaders meet every year to formulate policies that could help in the mitigation and adaptation of climate change-related emerging risks; this meeting is called the Conference of Parties (CoPs); till now, 27 CoPs have been held in different countries of the world. However, CoP 3, also known as the "Kyoto Protocol", which was held in Kyoto, Japan, made several efforts to limit GHG emissions. In this regard, another one of the most essential CoPs is CoP 21, also known as the *Paris Agreement*, which aims to reduce the earth's temperature below 2 °C and also encourages making necessary efforts to reduce the global temperature to 1.5 °C above preindustrial levels. These targets set in the international agreements could potentially impose various risks on the firm's financial and operational activities. Thus, investors and other stakeholders are interested in knowing how companies are affected by climate-related risks and how they have addressed these issues (Caby *et al.*, 2020).

Climate change has also been recognized as an emerging risk for the sustainable development of firms. Worldwide, researchers have found that climate risk is one of the major considerations for investors and other stakeholders in their decision-making process (Reboredo and Otero, 2021). Kouloukoui *et al.* (2018) have found that climate change is an emerging threat to firms' profitability. Climate change mainly possessed two types of risks to the firm's activities: (1) *Physical risk*: by damaging the infrastructures, properties and assets of the firms through extreme weather events and (2) *Transition risk:* by imposing various regulations and reputational risks on the firm's operational and financial activities on the way to the net zero emission goal (TCFD, 2017). Climate change-related physical risk can be expressed based on a firm's exposure to direct damages from extreme weather events, while the transitional risks are more influential as these risks depend on a firm's strategy towards a net zero emission target and sustainability, which is associated with substantial cost and could influence the firms over a long period (Reboredo and Ugolini, 2022). The sensitivity of a firm's value towards climate change-related transition risks has been derived from three main sources: (1) policy and legal compliance: compliance of policies for limiting carbon emissions and transition to a greener economy; (2) technological upgradation: changes in the technology for more efficient and environment-friendly production to limit the earth's temperature and (3) shifts in consumer preference: environmentally concerned consumers increasingly preferred more environment-friendly and sustained products.

The present study attempted to examine whether climate change-related transition risk affected the firm's financial performance and market value. To measure climate change-related transition risks at the firm level, we have used the individual companies' ratings on environmental risk provided by Sustainalytics. Morningstar Sustainalytics is the world's leading rating, research and data provider on environmental, social and governance (ESG)-related issues. The individual firm-level environmental risk scores (ERS) provided by Sustainalytics measure a company's climate change-related transition risk driven by the transition to a greener economy. The ESG risk score of a firm is computed annually based on a company's exposure and its risk-managing strategy. This individual firm's level rating is spread between 0 and 100. A firm rated between 0 and 9.99 is termed as negligible risk,

10–19.99 is termed as low risk, 20–29.99 is termed as medium risk and 30–39.99 termed as high risk, whereas more than 40 rated firms are termed as severe risky firms. To measure the climate transition risks, we have taken the environmental risk score (ERS) provided under the overall ESG score. As a proxy of climate transition risks, ERS could bring deeper insights as this metric incorporates the cost of carbon externalities after considering the firm-level unmanaged risks. More specifically, the present paper has examined how the annually reported ERS impacted the financial performance and market value creation indicators of the selected Indian-listed companies for 2021–22. Our empirical results suggested that climate change-related transition risk scores are negatively associated with the firm's market value creation and positively related to financial performance indicators in terms of return on assets and return on equity in the short run. We have outlined the rest of the paper as follows: The next section of this paper has included the literature review and development of the hypothesis part; the third section discusses the methodology; the fourth section presents the empirical results and major findings part and the last section has contained concluding remarks.

2. Literature review and hypothesis development

As per the Task Force on Climate-Related Financial Disclosures (TCFD) Final Report (2017), climate change-related transition risks could potentially impact the operating and financial activities of the companies by influencing the revenue generation ability and expenditure of the company as the investors and other stakeholders increasingly incorporated climate transition risks in their decision-making process, especially after the nation's nationally determined contributions (NDCs) submission requirement by the Paris Agreement, 2015. Climate transition risks include policy and legal risks, technology risks, market risks and reputation risks. Climate change-related policy and legal risks could influence a company's operating costs and revenue by increasing compliance costs and retaining existing carbon-intensive assets due to policy change. On the other hand, transition risks could also increase the market risks by influencing the demand for more eco-friendly products and services. These emerging risks could also impose potential reputational risks on a company for firms that are less responsive to the green concept and are not able to meet societal expectations on climate change-related management activities. Thus, in this current scenario where investors, governments, policymakers and other stakeholders are very much concerned about a low-carbon economy, the business organizations' role in mitigating and adapting to climate change-related material risks and sustainable development of the business is very significant and crucial. Thus, researchers across the world increasingly explore the different aspects of corporate climate risks and their impacts on the sustainable development of firms.

2.1 Relevant past literature

In the era of the current environment-concerned world, investors and other stakeholders are very concerned about climate change-related issues and also consider these issues to make more informative and efficient decisions. Over the last few decades, the issue of climate change-related financial risks has had great momentum. Researchers have increasingly conducted their research to understand and give a deeper insight into climate risk and how these risks could influence a firm's performance and sustainability.

In the way of a net zero economy by 2050, the oil and gas sector is facing various transition risks like increased social pressure and market and legal risks (UNEP, 2023). Cruz and Krausmann (2013) have revealed that climate risk imposes a greater threat on the performance and growth of the oil and gas sector. They also found that the vulnerability and intensity of the climate risk in this particular sector depends on the risk exposure of the firm's geographical location from where it is operating. They have suggested that the emerging

threats from climate risks are to be considered an emergency issue by the oil and gas sector and proactive measures should be taken to minimize the negative consequences of climate risk. Jianfei *et al.* (2014) found that without affecting environmental health, sustainable energy supply is one of the emerging issues in China. Thus, the top power generation companies in China have increasingly made several efforts to limit carbon emissions with a sufficient energy supply. Delmas *et al.* (2015) investigated the relationship between climate change-related risks and the financial performance evidence from US corporations. They found a decrease in GHG emissions, which positively impacted the companies' financial performance. Morfeldt *et al.* (2015) estimated that the binding obligations related to the low-carbon economy shifted the price of crude steel up to approximately $500 per tonne in 2050. According to a report by the Carbon Disclosure Project (2019), due to an increase in carbon pricing, an average of 14% of steel companies' value is at a greater risk. Huang *et al.* (2018) investigated the impact of climate change-related physical risk on the financial performance of the firms. They have taken the Climate Risk Index (CRI) scores to measure climate change-related physical risks. Whereas, return on assets and cash flow from operations have been taken as a proxy of the financial performance indicators of the firms. They have found that climate change-related physical risk has negatively influenced the firm's financial performance. They have also revealed that physical climate risk also potentially alters the financial policies of firms. Boadi and Owusu (2017) found that climate change-related variability in rainfall has created major issues in Ghana's hydropower sector. The automobile industry is also very much exposed to climate risk; for instance, Andersson *et al.* (2016) emphasized that "Automobile manufacturers would largely be preserved because most of the carbon emissions for a car-maker are scope 3 emissions". Gerlak *et al.* (2018) found in their review paper in the area of climate risk management and the electricity sector that researchers have given "significant emphasis on the identification of potential climate change impacts and opportunities for adaption, but less attention paid to the assessment of risk, stakeholder engagement, and cross-sectoral collaboration in climate risk management." Researchers have investigated the relationship between corporate emissions and a firm's performance. In this regard, Garvey *et al.* (2018) found that low carbon emissions reduce the risk associated with regulation related to GHG emissions, which is ultimately positively associated with a firm's future profitability. Cui *et al.* (2018) show that Chinese banks are improving their nonperforming loan rates by lending money to less polluting firms. Kumar and Firoz (2018) examined the impact of carbon intensity on the firm's financial performance for the period of 2009–2016 from the Indian context. Using the panel data regression analysis, they found that the corporate carbon emissions negatively impacted the companies' return on net worth and earnings per share. Sudha (2020) examined the impact of corporate environmental performance in terms of energy and water intensity and pollution prevention proactive strategies on a firm's financial performance for the period of 2002–2011 evidenced by S&P 500 Indian companies. They have found that corporate environmental performance was positively associated with the firm's return on assets, return on equity and return on sales. Kumar *et al.* (2020) investigated the connection between the issuance of certified emissions reductions and corporate financial performance in terms of ROE in the case of 44 Indian companies for the period of 2011–2015. They have found issuance of certified emissions reductions is positively associated with return on equity (ROE). Kumar and Dua (2021) investigated the impact of environmental management practices on corporate financial performance and market value creation. They found that environmental management practices have a positive impact on corporate financial performance and market value creation. Engels *et al.* (2020) have highlighted that climate transition risks impose various potential challenges on conventional companies in the form of low-carbon adaptation strategies for long-run survival. Recently, Abreu *et al.* (2021) revealed that external parties like the government, suppliers, competitors and others create potential pressure and increase

the likelihood of the adoption of low-carbon strategies by the firms in the case of the Canadian oil and gas sector. Climate change also potentially imposed greater threats on the non-energy mineral sector, including the iron and steel industry. Arnell *et al.* (2021) revealed that risks associated with climate change could be reduced with the reduction of GHG emissions in the long run. Reboredo and Otero (2021) found that investors take into consideration the climate change-related transition risks in their decision-making process and allocate their money to investments with lower transition risks. Miah *et al.* (2021) found that a firm's market value creation (Tobin's Q) and portability (ROE) have been negatively associated with higher carbon emissions. They have also found an inverse relationship between Credit Rating and Z score with higher GHG emissions. Ferrat (2021) found that carbon emission performance negatively impacted the firm's financial performance in the short term. Reboredo and Ugolini (2022) examined the relationship between climate transition risks in terms of the low-carbon risk score provided by Sustainalytics and the financial performance of European and US firms. They have found that climate transition risks are negatively associated with the financial performance of US and European firms. The past literature suggested that climate change-related transition risk has evolved as an emerging threat to the firm's financial performance and market value creation. Few studies have explored the impact of corporate carbon emissions and environmental performance on financial performance from the Indian perspective, but the studies have failed to reflect the recent evidence, specifically when the Paris Agreement came into the picture, and India entered into the NDCs of the UNFCCC. However, studies that examine whether climate transition risks have been reflected in the financial performance and market value creation in the case of Indian companies remain scarce. Thus, to meet this research gap, the present study aims to examine the impact of climate transition risk on the financial performance and market value creation of Indian companies.

Hypothesis conjecture: Climate transition risk leads to higher cost production, decreasing the value of assets involved in the production of GHGs and could also decrease a firm's repayment ability. Corporate climate transition risks could impose potential reputation risks, policy compliance risks, technology risks and others; thus, market value creation could be negatively affected by climate transition risks (TCFD, 2017). Along with the market value creation of a firm, the study also attempted to examine whether climate transition risks also negatively affected the firm's financial performance of the Indian listed companies. Some evidence shows that climate change-related transition risk is inversely related to a firm's market value creation. For instance, Beatty and Shimshack (2010) examined the relationship between GHG emissions and stock return evidence from selected US firms. However, they found that some investors have negatively reacted to the news of corporate GHG emissions, which led to a substantial reduction in the firm's market value. Recently, Miah *et al.* (2021) found that a firm's market value creation has been negatively associated with higher carbon emissions, evidence from 22 emerging economies. Reboredo and Ugolini (2022) found that stocks that are less exposed to climate change-related transition risks financially performed better and also gave a better return to the investors than those that are exposed higher to transition risks.

Based on previous studies, we have constructed the following hypothesis that higher transition risk could hamper the performance of the firms exposed to greater transition risks.

H1. There is an inverse relationship between climate change-related transition risk and a firm's financial performance and market value creation.

We test this hypothesis with the help of multiple regression analysis; here ROA, ROE and Tobin's Q are the proxies of the firm's performance (dependent variable) and climate transition risks (ERS as independent variable). However, if H1 holds that means climate change-related transition risks have already started impacting the performance of the firms.

3. Data and methodology

In response to the emerging climate risks, the firm-specific ESG issues consider the climate risks as a central pillar of its structure and also incorporated as the core area of its efforts. It makes various efforts on the assessment of materiality of climate change-related issues, e.g. accounting for GHG emissions at the firm level is an emerging material issue of the firm across the various industries. Li *et al.* (2021) highlighted some core factors (like GHG emissions, energy consumption and efficiency, air pollutants, innovation in environmentally friendly products and services and others) of the Environmental issues under the aegis of ESG issues. All of these factors are closely associated with climate transition risk exposure and management. Thus, to assess the climate transition risks of each firm, we have used the environmental risk score (ERS) assigned by Sustainalytics under ESG risk scores. Morningstar Sustainalytics rated each firm from 0 to 100 based on their ESG risks; here we considered lower scores of ERS to indicate lower transition risk and higher scores of ERS mean higher transition risk. The risk scores are assigned based on to what extent each firm is exposed to ESG risks and how the firm manages these risks. The exposure of each firm is evaluated by assessing the level of exposure of the firm's supply chain, operational activities, and its products and services to environmental, social and governance risks. Whereas, management refers to the strategy through which a firm tries to manage carbon emissions and other related issues through the implementation of various policies and programs. The unmanaged risk refers to the risk over which the firm has no control or the manageable risks that have not yet been addressed by the firm. Based on this assigned risk score the firms have been classified with five stages of transition risks: A firm rated between 0 and 9.99 termed as negligible risk, 10–19.99 termed as low risk, 20–29.99 termed as medium risky, 30–39.99 termed as high risky, whereas more than 40 rated firms are termed as severe risky firms. See Figure 1.

These risk scores are readily available on the *Yahoo Finance* website for individual firms for investors and other stakeholders. However, we have considered the environmental risk score only of each firm, so that we can evaluate whether climate transition risk in terms of ERS impacted the financial performance of the selected firms.

We have considered the Nifty 50 companies as the sample for the present study because this index represents a benchmark of the Indian Stock Market Index, constructed with the weighted average of the 50 largest companies listed on the National Stock Exchange (NSE). The largest companies have the potential to adopt different activities to manage climate-related risk, and they may set an example for the small and medium-sized companies as an early adopter in India. The Nifty 50 covers 12 sectors of the Indian economy, among which we have selected 11 sectors, excluding the financial sector, as the activities and nature are different from the rest of the selected sectors. Our sample gives weightage to the Energy Sector 18%, Consumer Goods 18%, Auto Mobile 15%, IT 13%, Pharmaceutical 10%, Iron and Steel 8%, Cement 8%, Telecommunication 3%, Agrochemical 3%, Integrated Ports and Logistics 2% and Construction 2%. However, the present paper has considered the 32 largest companies (based on availability of data and after excluding financial companies from the Nifty 50) listed on the Nifty 50 Index as of 7th July 2021. Annual reports of each firm are the sources for the financial data, whereas the transition risk-related scores have been collected from the *Yahoo Finance* website for each company from 2021 to 2022.

Source(s): Sustainalytics

Figure 1.
Classification of ESG risk including environmental risk score

3.1 Variables description and their justification for selection

The financial performance of a business deals with the evaluation of its operational efficiency, management capacity, competitiveness in the market and future growth ability. The financial performance of a company is a subjective indicator of how successfully it makes use of the available resources in its main business operations and earns profits. The most common financial performance indicators for measuring profitability are return on assets (ROA), return on equity (ROE), return on capital employed (ROCE), gross profit margin and net profit margin. On the other hand, the most widely used evaluation indicators for the market performance of a company are Tobin's Q, market-to-book ratio (Mondal and Ghosh, 2012; Kumar and Dua, 2021; Zhang *et al.*, 2023).

In the present study, a firm's financial performance and market value creation (dependent variables) are measured by the widely acceptable proxies used in the past literature, ROA, ROE and Tobin's Q, respectively (Kumar, 2016). ROA measures how efficiently a firm uses its assets to generate revenue in a particular time period. As per Zhang *et al.* (2023), a higher ROA indicates an efficient utilization of resources and a better financial performance of a company. Though ROA indicates the efficient use of a company's total assets in generating revenue and earning profits, it fails to provide a clear picture of a firm's financial health as it does not reveal the use of debt capital in generating revenue for the particular period. However, ROE could provide us with a better picture of a company's financial performance as it indicates how efficiently a company uses its shareholders' funds to generate profits (Kumar and Dua, 2021). Tobin's Q represents the wealth created in the market by the companies for their shareholders. It is a measure of a company's market performance as it shows the relation between the market value of a company's existing equity share capital with its replacement cost of total physical assets (Ishaq *et al.*, 2021).

The independent variable is climate transition risk, measured by the rating score of environmental risk of the individual firm provided by Sustainalytics, as the main objective of this study is to understand whether and how this risk impacted the financial performance and market value of the firms. The market-to-book ratio could affect the market value of the firms; hence, we have selected the market-to-book ratio as a control variable for Model I. The asset turnover ratio could influence the performance of the firm and help understand how efficiently the firm uses its assets to generate a handsome volume of sales. Researchers (like Seema *et al.*, 2011, Ding and Sha, 2011) also found a positive relationship between the asset turnover ratio and firms' performance. The asset turnover ratio could also affect market value creation in the long term. Hence, we have taken the assets turnover ratio as a control variable for the current study. Leverage is another aspect that could significantly affect the financial performance and market value of firms. In these regards, researchers have produced both positive (e.g. Humera *et al.*, 2011) and negative (e.g. Al-Jafari and Al Samman, 2015) relationships between leverage and financial performance of the firms. As per the NI approach, we know that leverage could positively impact the firm's market value. In this regard, we have taken the debt-equity ratio to measure the leverage. Here we have considered the debt-equity ratio as a proxy of leverage. Liquidity could play a significant role in the way of sustainability of a firm, as repeatedly failing to meet its obligation within the stipulated time leads to a low credit rating in the market, which also leads to a reduction in the growth of the firm in the market and also reduces the capacity of availing further credit in the market in the near future. Liquidity has also a strong and significant impact on a firm's financial performance (Seema *et al.*, 2011) and also on a firm's value creation. Here, we have taken the current ratio, a measure of liquidity, as another control variable for the current study. A firm's size could affect the firm's financial performance (Lopez-Valeiras *et al.*, 2016) and its market value, as larger firms have larger resources and a bigger customer base and could influence their investors and other stakeholders in a better manner. Researchers have found both positive (e.g. Ayele, 2012) and negative (e.g. Salman and Yazdanfar, 2012) relationships between a firm's size and its financial performance.

Empirical model: Using multiple regression analysis, the present study examines the impact of climate transition risk on a firm's performance.

$$\text{Tobin's Q} = \beta_0 + \beta_1 \text{ERS} + \beta_2 \text{M/B} + \beta_3 \text{S/TA} + \beta_4 \text{D/E} + \beta_5 \text{CR} + \beta_6 \text{SIZE} + \text{e} \quad (1)$$

$$\text{ROA} = \beta_0 + \beta_1 \text{ERS} + \beta_2 \text{S/TA} + \beta_3 \text{D/E} + \beta_4 \text{CR} + \beta_5 \text{SIZE} + \text{e} \quad (2)$$

$$\text{ROE} = \beta_0 + \beta_1 \text{ERS} + \beta_2 \text{S/TA} + \beta_3 \text{D/E} + \beta_4 \text{CR} + \beta_5 \text{SIZE} + \text{e} \quad (3)$$

For assessing the impact of climate transition risks in terms of ERS on the performance of the firms, we have considered ROA and ROE (profitability indicators) and Tobin's Q (market value creation indicator) to measure the financial performance and value of the firms. Return on assets (ROA) – measured by net profit/loss of the year divided by total assets, returned on equity – measured by net profit divided by shareholder's equity; Tobin's Q – measured by the sum of the market value of equity and the value of debt capital divided by total assets. We have taken some widely recognized variables as the control variables in this regard: price-to-book ratio (M/B) – market value per share divided by book value per share; Sales *et al.* (S/TA) – measured by annual sales divided by total assets; Debt to equity ratio (D/E) – measured by debt divided by total shareholder equity; Current ratio (CR): company's current assets divided by its current liabilities and Firm's size (SIZE) – measured by the natural logarithm value of the firm's total assets.

4. Empirical results and interpretations

4.1 Descriptive statistics

Table 1 includes the entire variables taken into consideration in the present study and represents their summary statistics for the study period.

Interpretation: The above table shows the descriptive statistics of the variables taken into consideration in the present study. The average value of environmental risk score (ERS) is 9.256250, the maximum value is 24.80000, the minimum value is 0.500000 and the standard deviation is 7.461079, which indicates that there is quite a difference between the values of ERS in the entire sample of the data. The mean value of Tobin's Q is 4.057347, the maximum value is 22.31321, the minimum value is 0.451603 and the standard deviation is 4.508173, which indicates that there are also quite differences between the values of Tobin's Q in the entire sample of the study. The mean values of ROA and ROE are 0.110762 and 0.190641, while their minimum and maximum values are −0.021766, −0.069700 and 0.499147 and 1.028900, respectively. The standard deviations of ROA and ROE are 0.104520 and 0.208385 respectively. This information indicates that the difference between the values of these two variables is not too large. The average value of Firm Size is 11.19299, the maximum and minimum values are 9.013100 and 13.68617 and the value of standard deviation is 1.118776, which indicates that the differences between values of the firm size in our entire sample are not very heterogeneous.

Figure 2 shows that the distribution of ERS values among the various sectors taken into consideration in the present study is not too unstable during the period of the study. Here, we can see that in the case of the energy industry, the climate transition risk poses the highest risk, and in the case of the IT industry, the risks are at the lowest.

Figure 3 shows the distribution of the firm's financial performance and value creation indicator along with the distribution of the firm's climate transition risks (ERS values) in the case of the sample companies of the current study. However, from Figure 2, it is clear that with the increase of ERS values, Tobin's Q decreases. The same relationship can also be noticed in the case of ERS and market over book value ratio and ERS.

	ERS	Tobin's Q	ROA	ROE	M/B	S/TA	D/E	CR	SIZE
Mean	9.256250	4.057347	0.110762	0.190641	7.770938	0.782813	0.414688	1.853750	11.19299
Median	7.400000	2.673308	0.095074	0.145150	4.090000	0.735000	0.130000	1.35000	11.17804
Maximum	24.80000	22.31321	0.499147	1.028900	76.84000	2.490000	4.160000	7.260000	13.68617
Minimum	0.500000	0.451603	−0.021766	−0.069700	0.870000	0.050000	0.000000	0.510000	9.013100
Std. dev	7.461079	4.508173	0.104520	0.208385	13.36440	0.523673	0.800564	1.352834	1.118776
Skewness	0.588071	2.501723	1.803398	2.485355	4.546153	1.287575	3.441636	2.313968	0.304934
Kurtosis	2.162817	9.884489	7.302447	10.12019	23.82387	5.235241	16.15278	9.270151	2.595918

Source(s): Authors' own work

Table 1.
Summary statistics of the variables taken into the present study

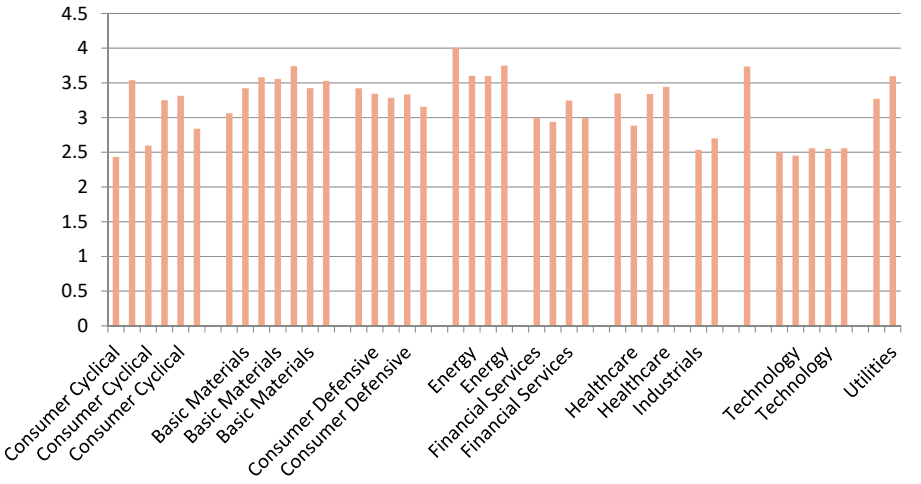

Figure 2.
Industry-wise distribution of climate risks

Source(s): Authors' own work

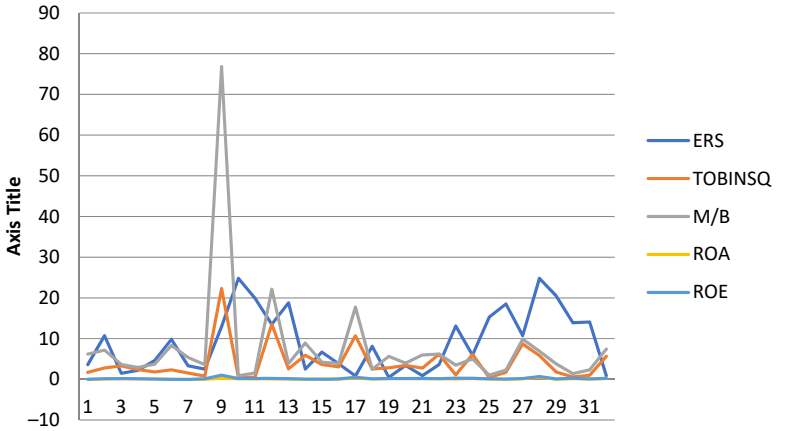

Figure 3.
Distribution of firm's financial performance with the distribution of corporate climate risks

Source(s): Authors' own work

4.2 Correlation analysis

In this section, we have analysed the correlation between ERS and the firm's financial and market performance indicators along with the control variables taken into consideration in the present study.

Table 2 reveals the correlation analysis among the variables for the present study. The result shows that Tobin's Q is inversely related to the coefficient of environmental risk scores (ERS). In addition, the correlation coefficient between ERS and ROA is 0.159326, and between ERS and ROE is 0.211489. We have found a positive correlation between ERS and ROA and also between ERS and ROE. The correlation coefficient between asset turnover and ERS is −0.013194, which means there is a negative relationship. We have also found a negative

	ERS	Tobin's Q	ROA	ROE	S/TA	D/E	SIZE	M/B	CR
ERS	1								
Tobin's Q	−0.063481	1							
ROA	0.159326	0.514131	1						
ROE	0.211489	0.733470	0.822438	1					
S/TA	−0.013194	0.443469	0.162467	0.379952	1				
D/E	−0.097531	−0.325026	−0.394846	−0.254336	−0.363645	1			
SIZE	0.239739	−0.559692	0.363967	−0.369164	−0.339418	0.555163	1		
M/B	0.014918	0.898741	0.350753	0.757055	0.451262	−0.144883	−0.441900	1	
CR	−0.080747	0.127801	0.688410	0.387588	−0.240839	0.025843	−0.265664	−0.037417	1

Source(s): Authors' own work

Table 2.
Correlation matrix

relation between ERS and debt-equity ratio, and the same relationship was also found between ERS and current ratio. The correlation coefficient of ERS is positively correlated with firm size for the study period.

4.3 Regression results

In this section, we have examined the impact of climate transition risks on the firm's financial performance and market value creation with the help of multiple regression analyses.

Interpretation: Table 3 presented the regression results of the climate transition risk indicator in terms of ERS on Tobin's Q. The adjusted R2 of this model is 0.657758, which indicates that the degree of explanation of Tobin's Q through ERS, the proxy of climate transition risk with other independent variables present in the model, is 65.78%. The *F*-Statistic is 10.92988, and the *p*-value of the model is 0.000006, which indicates that the model is significant. The coefficient of ERS (climate transition risk) is −0.197022 with a *p*-value of 0.0546, which is negative and also passed the significance test. Therefore, the H1 hypothesis is accepted. This implies that climate change-related transition risk is negatively related to the market value creation of firms in terms of Tobin's Q. The coefficient of market-to-book ratio is 0.038966 with a *p*-value of 0.0004, which implies that market-to-book value ratio is positively associated with Tobin's Q, and this association is also statistically significant. We have found a significantly negative relationship between the debt equity ratio and Tobin's Q. We have also used the variance inflation factor (VIF) to check the multicollinearity issue in the model and found that all VIF values are less than 5, which is considered the cut-off value for the present study. Thus, there is no multicollinearity issue present in the present analysis.

Interpretation: Table 4 demonstrates the regression results of model II, i.e. the impact of climate transition risk (proxied by ERS) on return on assets (ROA). The coefficient of ERS is 0.208634 with a *p*-value of 0.0091, which indicates that ERS is positively associated with the firm's performance indicator in terms of return of assets (ROA), and its association is also statistically significant. In this model, the relationship between the assets turnover ratio and ROA is also positive and significant. Here is the coefficient of the debt equity ratio −0.163041 with a *p*-value of 0.0143, which implies that the association between the debt equity ratio and ROA is negative and significant. The current ratio is also positively related to ROA, and their relationship is also statistically significant. The value of adjusted *R*-squared is 0.683841, which indicates that the model explains 68.63% variance in the dependent variables (ROA). The model is significant as the suggested value of *F*-Statistic is 14.41041 and the probability value (*F*-Statistics) is 0.000001, which means Model II is statistically significant at a 1% level. We have also checked whether the multicollinearity issue is present in the analysis model or

Variable	Coefficient	Std. error	*t*-stat	Prob	VIF values
ERS	−0.197022	0.097688	−2.016845	0.0546	1.129640
M/B	0.038966	0.009527	4.090112	0.0004	1.562442
S/TA	−0.265000	0.242052	−1.094807	0.2840	1.548580
D/E	−0.397263	0.165678	−2.397806	0.0243	1.695576
SIZE	−0.209888	0.135941	−1.543963	0.1352	2.229376
CR	0.112371	0.086533	1.298596	0.2059	1.320834
C	3.509388	1.593128	2.202828	0.0370	NA
R-squared			0.723999		
Adjusted *R*-squared			0.657758		
F-statistic			10.92988		
Prob. (*F*-statistics)			0.000006		

Source(s): Authors' own work

Table 3. Regression results of Model 1: Dependent variable – Tobin's Q

not with the help of the variance inflation factor (VIF). Here, we have found that all the VIF values for each variable included in the model do not exceed the cut-off value of 5, which indicates that the regression results are not severely affected by the multicollinearity issue.

Interpretation: Table 5 shows the regression results of Model III, which represents the empirical results of the impact of climate transition risks on return on equity (ROE). In this model, the coefficient of ERS is 0.278222 and the *p*-value is 0.006, which indicates that ERS is positively associated with the return on equity (ROE) and their association is also statistically significant. In this model, the relationship between the assets turnover ratio and ROE is positive and significant. The debt equity ratio is negatively related to ROE, but their association is not statistically significant. The current ratio is positively related to ROE, and their relationship is also significant at the 1% level. However, the adjusted R2 is 0.510580, which indicates that the independent variables with the control variables are able to explain 51.06% of the variance in the dependent variable (ROE). The value of *F*-statistics is 7.468060 with a probability value of 0.000185, which means the model is significant at a 1% level of significance. Here, all the VIF values have not exceeded the cut-off value, i.e. 5; this indicates that a severe multicollinearity issue is not present in the analysis.

4.4 Diagnostic test for autocorrelation, heteroskedasticity and endogeneity and their results

Here we have used the Breusch–Godfrey serial correlation LM test to detect the autocorrelation issue in the empirical analysis. In this test, all the probability values of *F*-Statistics are greater than 0.05. Therefore, the serial correlation LM test confirms that there is no autocorrelation issue present in our analysis.

Variable	Coefficient	Std. error	*t*-stat	Prob	VIF values
ERS	0.208634	0.074031	2.818188	0.0091	1.279026
S/TA	0.259875	0.108529	2.394517	0.0241	1.793596
D/E	−0.163041	0.062063	−2.627008	0.0143	2.796906
SIZE	0.125474	0.084802	1.479613	0.1510	1.710358
CR	0.824273	0.191459	4.305215	0.0002	2.417276
C	−4.494503	1.029909	−4.363979	0.0002	NA
R-squared			0.734835		
Adjusted *R*-squared			0.683841		
F-statistic			14.41041		
Prob. (*F*-statistics)			0.000001		

Source(s): Authors' own work

Table 4. Regression results of Model 2: Dependent variable – return on assets (ROA)

Variable	Coefficient	Std. error	*t*-stat	Prob	VIF values
ERS	0.278222	0.093247	2.983719	0.0061	1.279026
S/TA	0.372815	0.136699	2.727264	0.0113	1.793596
D/E	−0.046065	0.078173	−0.589276	0.5608	2.796906
SIZE	0.082550	0.106813	0.772846	0.4466	1.710358
CR	0.990782	0.241154	4.108494	0.0004	2.417276
C	−3.292351	1.297234	−2.537979	0.0175	NA
R-squared			0.589519		
Adjusted *R*-squared			0.510580		
F-statistic			7.468060		
Prob. (*F*-statistics)			0.000185		

Source(s): Authors' own work

Table 5. Regression results of Model 3: Dependent variable – return on equity (ROE)

We have used the Breusch–Pagan–Godfrey test for the checking of heteroskedasticity in the models. Here also all the probability values of the F-Stats for all three models are greater than 0.05, which indicates that there are heteroskedasticity issues in the models.

We have also run the Durbin–Wu–Hausman test to check the endogeneity issue in the models. We have found that for all three cases, the probability value of the Durbin (score) Chi2 and the Wu–Hausman F Stats is more than 0.05. Thus, we can accept the H0 of the test and conclude that the variables are exogenous for all three models.

4.5 Robustness test

In this section, we have used an alternative proxy of climate transition risk to confirm the consistency of regression results obtained from models 1, 2 and 3. Here, we have replaced the previously selected proxy of climate transition risk *ERS* with *Scope 1 and Scope 2 emission of CO2e* (here represented as Trans Risk). The selection of Scope 1 and Scope 2 emissions as a proxy of climate risks is also supported by the recent study conducted by Reboredo and Ugolini (2022). Here, we have examined the impact of climate transition risk (Scope 1 and Scope 2 emissions) on the firm's market value creation (Tobin's Q) and its operating performance (ROA and ROE).

With the alternative measure of climate transition risks (Trans risk), we have run regression analysis with the same dependent variables (Tobin's Q, ROA and ROE) and previously considered control variables to test the robustness of the empirical results got from the regression analysis (Models 1, 2 & 3). The regression results have been presented in Tables 6–8. Here, we have found similar results, i.e. Trans risk is negatively associated with Tobin's Q, and the association is also statistically significant. On the other hand, climate transition risks (Trans risk) are positively associated with the financial performance indicators (ROA and ROE); here also, their relationship is statistically significant.

5. Conclusion

The adaptation of climate change-related negative effects leads to a transition to a greener economy. This transition needs to implement policies and legal bindings to limit GHG emissions, which in turn leads to technological advancement and changes in consumer preferences. These activities ultimately impose various risks on the firms' operational as well as financial activities and also lead to hampering the profitability and market value of the firms. This paper has explored whether the transition risks impacted the market value creation and financial performance of Indian-listed firms or not. For this purpose, climate change-related transition risks need to be measured, so we have obtained the ERS from the ESG risk rating

Variable	Coefficient	Std. error	*t*-stat	Prob
Trans risk	−0.197022	0.097688	−2.016845	0.0546
M/B	0.038966	0.009527	4.090112	0.0004
S/TA	−0.265000	0.242052	−1.094807	0.2840
D/E	−0.397263	0.165678	−2.397806	0.0243
Size	−0.209888	0.135941	−1.543963	0.1352
CR	0.112371	0.086533	1.298596	0.2059
C	3.509388	1.593128	2.202828	0.0370
R-squared		0.723999		
Adjusted *R*-squared		0.657758		
F-statistic		10.92988		
Prob. (*F*-statistics)		0.000006		

Source(s): Authors' own work

Table 6.
Model IV: Dependent variable – TOBIN'S Q

Variable	Coefficient	Std. error	*t*-stat	Prob
Trans risk	0.123763	0.030678	4.034289	0.0004
S/TA	0.241037	0.095485	2.524346	0.0180
D/E	−0.203996	0.055596	−3.669262	0.0011
Size	0.758828	0.161469	4.699521	0.0001
CR	0.130894	0.075971	1.722962	0.0968
C	−5.965547	1.019706	−5.850259	0.0000
R-squared		0.787104		
Adjusted *R*-squared		0.746162		
F-statistic		19.22505		
Prob. (*F*-statistics)		0.000000		

Source(s): Authors' own work

Table 7. Model V: Dependent variable – return on assets (ROA)

Variable	Coefficient	Std. error	*t*-stat	Prob
Trans risk	0.147029	0.040804	3.603264	0.0013
S/TA	0.340154	0.127004	2.678305	0.0127
D/E	−0.097368	0.073948	−1.316720	1.1994
Size	0.881393	0.214769	4.103912	0.0004
CR	0.089683	0.101048	0.887528	0.3829
C	−4.992007	1.356304	−3.680597	0.0011
R-squared		0.632489		
Adjusted *R*-squared		0.561814		
F-statistic		8.949255		
Prob. (*F*-statistics)		0.000048		

Source(s): Authors' own work

Table 8. Model VI: Dependent variable – return on equity (ROE)

provided by Sustainalytics. Morningstar Sustainalytics rated the transition risks of individual firms based on their exposure and management ability and classified the firms among four categories, i.e. "Negligible Risk", "Low Risk", "Medium Risk" "High Risk" and "Severe Risk". We have tested the impact of ERS on the accounting as well as the market performance of the firms in terms of ROA, ROE and Tobin's Q. The empirical results of the study suggest that there is a negative relationship between climate change-related transition risks and Tobin's Q. The empirical results suggested that climate transition risks have negatively impacted the market value creation of the Indian listed companies. The results also suggested that climate transition risks are positively related to the firm's return on assets and return on equity. However, it is clear that climate change-related transition risks adversely impacted the market value creation of the Indian-listed firms. On the other hand, climate transition risks (in terms of GHG emissions, energy consumption and others) are positively associated with the firm's financial performance in the case of Indian-listed companies.

6. Contributions, limitations and future research

The present study has certain contributions to the existing literature related to climate risk and the nexus between climate transition risk and a firm's performance. First, the present study has tried to fill-up the gap in existing literature, as very limited research has been conducted on the nexus between climate transition risk and financial performance and market value creation from an Indian perspective. Second, this research may also help in the promotion of empirical research in the area of corporate climate transition risk and provide deeper insights into the status of climate transition risk and its impact on the firm's financial performance. As the present study selected Nifty 50 companies, which are very much a

concern of the public, and the present study has some significance in this regard, the firms could enhance their financial health by improving their risk management strategies and policies in this concern and on the other hand, as the climate transition risk is an emerging threat, investors and other stakeholders could make more informed decisions by considering the climate transition risks and their financial impacts.

However, the present study is not free from limitations; the present study is limited to NIFTY 50 companies. Thus, the inferences drawn from the study are not valid for all the companies across the world, as the sample size of this study is very small. Another major limitation is that the study explored the relationship between climate transition risks and their impact on a firm's market value creation and the financial performance of Indian-listed companies by concentrating on only one study period. Hence, to generalize the results and policy implementations, further study is needed.

References

Abreu, M.C.S.de, Webb, K., Araújo, F.S.M. and Cavalcante, J.P.L. (2021), "From 'business as usual' to tackling climate change: exploring factors affecting low-carbon decision-making in the Canadian oil and gas sector", *Energy Policy*, Vol. 148, 111932, doi: 10.1016/j.enpol.2020.111932.

Al-Jafari, M.K. and Al Samman, H. (2015), "Determinants of profitability: evidence from industrial companies listed on Muscat Securities Market", *Review of European Studies*, Vol. 7 No. 11, pp. 303-311, doi: 10.5539/res.v7n11p303.

Andersson, M., Bolton, P. and Samama, F. (2016), "Hedging climate risk", *Financial Analysts Journal*, Vol. 72 No. 3, pp. 13-32, doi: 10.2469/faj.v72.n3.4.

Arnell, N.W., Kay, A.L., Freeman, A., Rudd, A.C. and Lowe, J.A. (2021), "Changing climate risk in the UK: a multi-sectoral analysis using policy-relevant indicators", *Climate Risk Management*, Vol. 31, 100265, doi: 10.1016/j.crm.2020.100265.

Ayele, G.A. (2012), *Factors Affecting Profitability of Insurance Companies in Ethiopia: Panel Evidence*, Addis Ababa University, Ethiopia.

Beatty, T. and Shimshack, J. (2010), "The impact of climate change information: new evidence from the stock market", *The BE Journal of Economic Analysis and Policy*, Vol. 10 No. 1, pp. 1-29, doi: 10.2202/1935-1682.2374.

Boadi, S.A. and Owusu, K. (2017), "Impact of climate change and variability on hydropower in Ghana", *African Geographical Review*, Vol. 38 No. 1, pp. 19-31, doi: 10.1080/19376812.2017.1284598.

Caby, J., Ziane, Y. and Lamarque, E. (2020), "The determinants of voluntary climate change disclosure commitment and quality in the banking industry", *Technological Forecasting and Social Change*, Vol. 161, 120282, doi: 10.1016/j.techfore.2020.120282.

Cruz, A.M. and Krausmann, E. (2013), "Vulnerability of the oil and gas sector to climate change and extreme weather events", *Climatic Change*, Vol. 121 No. 1, pp. 41-53, doi: 10.1007/s10584-013-0891-4.

Cui, Y., Geobey, S., Weber, O. and Lin, H. (2018), "The impact of green lending on credit risk in China", *Sustainability*, Vol. 10 No. 6, pp. 1-16, doi: 10.3390/su10062008.

Delmas, M.A., Nairn-Birch, N. and Lim, J. (2015), "Dynamics of environmental and financial performance", *Organization and Environment*, Vol. 28 No. 4, pp. 374-393, doi: 10.1177/1086026615620238.

Ding, H. and Sha, R. (2011), "Empirical analysis of the impact of capital structure on performance in Jilin Forest Industry Co., Ltd", *Issues of Forestry Economics*, Vol. 31 No. 2, pp. 141-144.

Engels, P.D.A., Kunkis, M. and Altstaedt, S. (2020), "A new energy world in the making: imaginary business futures in a dramatically changing world of decarbonized energy production", *Energy Research and Social Science*, Vol. 60, 101321, doi: 10.1016/j.erss.2019.101321.

Ferrat, Y. (2021), "Carbon emissions and firm performance: a matter of horizon, materiality and regional specificities", *Journal of Cleaner Production*, Vol. 329, 129743, doi: 10.1016/j.jclepro.2021.129743.

Garvey, G.T., Iyer, M. and Nash, J. (2018), "Carbon footprint and productivity: does the 'E' in ESG capture efficiency as well as environment?", *Journal of Investment Management*, Vol. 16 No. 1, pp. 59-69.

Gerlak, A.K., Weston, J., McMahan, B., Rachel, L., Murray, R.L. and Mills-Novoa, M. (2018), "Climate risk management and the electricity sector", *Climate Risk Management*, Vol. 19, pp. 12-22, doi: 10.1016/j.crm.2017.12.003.

Global Risk Report (2022), available at: https://www3.weforum.org/docs/WEF_The_Global_Risks_Report_2022.pdf

Huang, H.He, Kerstein, J. and Wang, C. (2018), "The impact of climate risk on firm performance and financing choices: an international comparison", *Journal of International Business Studies*, Vol. 49 No. 5, pp. 633-656, doi: 10.1057/s41267-017-0125-5.

Humera, K., Maryam, M., Khalid, Z., Sundas, S. and Bilal, S. (2011), "Corporate governance and firm performance: case study of karachi stock market", *International Journal of Trade Economic and Finance*, Vol. 2, pp. 39-43, available at: https://www.unepfi.org/themes/climate-change/climate-risks-in-the-oil-and-gas-sector/

IPCC (2014), "Climate change 2014: synthesis report", Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.

IPCC (2022), "Climate change 2022: impacts, adaptation, and vulnerability", Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.

Ishaq, M., Islam, Y. and Ghouse, G. (2021), "Tobin's Q as an indicator of firm performance: empirical evidence from manufacturing sector firms of Pakistan", *International Journal of Economics and Business Administration*, Vol. 9 No. 1, pp. 425-441, doi: 10.35808/ijeba/683.

Jianfei, S., Song, X., Ming, Z., Yi, W., Yuejin, W., Xiaoli, L. and Zhijie, W. (2014), "Low-carbon development strategies for the top five power generation groups during China′s 12th Five-Year Plan period", *Renewable and Sustainable Energy Reviews*, Vol. 34, pp. 350-360, doi: 10.1016/j.rser.2014.03.029.

Kouloukoui, D., Gomes, S.M.S., Marinho, M.M.O., Torres, E.A., Kiperstok, A. and Jong, P. (2018), "Disclosure of climate risk information by world's largest companies", *Mitigation and Adaption Strategies for Global Change*, Vol. 23 No. 8, pp. 1251-1279, doi: 10.1007/s11027-018-9783-2.

Kumar, R. (2016), "Perspectives on value and valuation", *Valuation*, pp. 3-46, doi: 10.1016/b978-0-12-802303-7.00001-2.

Kumar, S. and Dua, P. (2021), "Environmental management practices and financial performance: evidence from large listed Indian enterprises", *Journal of Environmental Planning and Management*, Vol. 65 No. 1, pp. 1-27, doi: 10.1080/09640568.2021.1877641.

Kumar, P. and Firoz, M. (2018), "Corporate carbon intensity matter: predicting firms' financial performance", *SCMS Journal of Indian Management*, Vol. 15 No. 4, pp. 74-84.

Kumar, P., Mittal, A. and Firoz, M. (2020), "Carbon credit issuance: accounting based financial performance", *SCMS Journal of Indian Management*, Vol. 17 No. 2, pp. 111-119.

Li, T.T., Wang, K., Sueyoshi, T. and Wang, D.D. (2021), "ESG: research progress and future prospects", *Sustainability*, Vol. 13 No. 21, 11663, doi: 10.3390/su132111663.

Lopez-Valeiras, E., Gomez-Conde, J. and Fernandez-Rodriguez, T. (2016), "Firm size and financial performance: intermediate effects of indebtedness", *Agribusiness*, Vol. 32 No. 4, pp. 454-465, doi: 10.1002/agr.21458.

Miah, M.D., Hasan, R. and Usman, M. (2021), "Carbon emissions and firm performance: evidence from financial and non-financial firms from selected emerging economies", *Sustainability*, Vol. 13 No. 23, 13281, doi: 10.3390/su132313281.

Mondal and Ghosh (2012), "Intellectual capital and financial performance of Indian Banks", *Journal of Intellectual Capital*, Vol. 13 No. 4, pp. 515-530, doi: 10.1108/14691931211276115.

Morfeldt, J., Nijs, W. and Silveira, S. (2015), "The impact of climate targets on future steel production–an analysis based on a global energy system model", *Journal of Cleaner Production*, Vol. 103, pp. 469-482, doi: 10.1016/j.jclepro.2014.04.045.

Rahman, M.M. and Kashem, M.A. (2017), "Carbon emissions, energy consumption and industrial growth in Bangladesh: empirical evidence from ARDL cointegration and Granger causality analysis", *Energy Policy*, Vol. 110 C, pp. 600-608, doi: 10.1016/j.enpol.2017.09.006.

Reboredo, J.C. and Otero, L.A. (2021), "Are investors aware of climate-related transition risks? Evidence from mutual fund flows", *Ecological Economics*, Vol. 189, 107148, doi: 10.1016/j.ecolecon.2021.107148.

Reboredo, J.C. and Ugolini, A. (2022), "Climate transition risk, profitability and stock prices", *International Review of Financial Analysis*, Vol. 83, 102271, doi: 10.1016/j.irfa.2022.102271.

Salman, A.K. and Yazdanfar, D. (2012), "Profitability in Swedish SME firms: a quantile regression approach", *International Business Research*, Vol. 5 No. 80, pp. 94-106, doi: 10.5539/ibr.v5n8p94.

Seema, G., Jain, P.K. and Yadav, S.S. (2011), "Impact of MoU on financial performance of public sector enterprises in India", *Journal of Advances in Management Research*, Vol. 8 No. 2, pp. 263-284, doi: 10.1108/09727981111175984.

Sudha, S. (2020), "Corporate environmental performance–financial performance relationship in India using eco-efficiency metrics", *Management of Environmental Quality: An International Journal*, Vol. 31 No. 6, pp. 1497-1514, doi: 10.1108/meq-01-2020-0011.

Sufyanullah, K., Ahmad, K.A. and Ali, M.A.S. (2022), "Does emission of carbon dioxide is impacted by urbanization? An empirical study of urbanization, energy consumption, economic growth and carbon emissions-Using ARDL bound testing approach", *Energy Policy*, Vol. 164, 112908, doi: 10.1016/j.enpol.2022.112908.

TCFD (2017), "Recommendations of the task force on climate-related financial disclosure", available at: https://assets.bbhub.io/company/sites/60/2020/10/FINAL-2017-TCFD-Report-11052018.pdf

TCFD (2021), "Task force on climate-related financial disclosures: 2020 status report", available at: https://assets.bbhub.io/company/sites/60/2022/03/GPP_TCFD_Status_Report_2021_Book_v17.pdf

UNEP, (2023), "Climate risks in the oil and gas sector", available at: https://www.unepfi.org/themes/climate-change/climate-risks-in-the-oil-and-gas-sector/#:~:text=As%20the%20world%20moves%20towards,to%20rapidly%20lose%20market%20value

UNFCCC (1992), "United Nations framework convention on climate change", United Nations, FCCC/INFORMAL/84 GE. 05-62220 (E) 200705, Secretariat of the United Nations Framework Convention on Climate Change, Bonn, Germany, p. 24, available at: unfccc.int/resource/docs/convkp/conveng.pdf

Zhang, X., Zhang, M. and Fang, Z. (2023), "Impact of climate risk on the financial performance and financial policies of enterprises", *Sustainability*, Vol. 15 No. 20, 14833, doi: 10.3390/su152014833.

Further reading

TCFD (2020), "Task force on climate-related financial disclosures: 2020 status report", available at: www.fsb.org/wp-content/uploads/P291020-1.pdf

Corresponding author
Amitava Mondal can be contacted at: amitavakalna@gmail.com