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Corporate awareness and readiness to climate change: Evidence from the GRINS project on Piedmont data

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Abstract
This study employs unique firm-level survey data from the GRINS research project to map climate strategies of companies operating in the Piedmont region and their associated governance factors. Drawing on a sample of 2,121 companies, mainly SMEs, we categorized firms' responses to climate risks into different clusters based on climate-related investments made and planned ("Wait-and-see", "Planners", "Foresighted", and "Proactive"), and assessed their prevalence. Our findings indicate that most Piedmont companies adopt a "wait-and-see" approach to climate investments, while approximately 20% exhibit a "proactive" climate profile. More proactive climate strategies appear to be positively associated with corporate literacy on sustainability issues, active participation in training activities, the presence of a sustainability manager, and the preparation of a sustainability report. These findings provide valuable guidance for policymakers in supporting firms' commitment to aligning with EU climate objectives.

Keywords: climate change, climate risks, climate strategies, corporate sustainability, SMEs

1. INTRODUCTION

Climate change is undoubtedly one of the most urgent challenges facing our society. It is widely acknowledged by the scientific community that addressing the negative effects of climate change requires drastic global reductions in greenhouse gas (GHG) emissions. The Intergovernmental Panel on Climate Change (IPCC) warns that a rise in temperatures of 1.5°C by 2040 will cause unavoidable increases in climate hazards resulting in severe risks to ecosystems and humans (IPCC, 2022).

The issue has been reflected in political agendas. In 2015, during the United Nations (UN) Conference of Parties (COP21) in Paris, 195 countries adopted a legally binding agreement to combat climate change. The Paris Agreement set the goal of limiting global warming to well below 2°C above pre-industrial levels, with an ambition to cap it at 1.5°C. Accordingly, Europe has committed to reducing carbon emissions by at least 55% by 2030 (EC, 2021) and achieve climate neutrality by 2050 as part of the EU Green Deal (EC, 2019).

The ever-increasing incidence of climate risks poses a major threat to business organizations, especially small and medium enterprises (SMEs), which are equipped with fewer resources and capacity to face climate challenges (Johnson and Schaltegger, 2016). Climate risks can have severe financial impacts on firms, undermining their performance and increasing the uncertainty surrounding their prospects (Cadez *et al.*, 2019; Palea and Drogo, 2020; Palea and Santhia, 2022; Zhang, 2022). On the other hand, businesses have a pivotal role in fighting climate change. Companies are responsible for a large portion of GHG emissions (IPCC, 2022), and they can significantly contribute to the shift toward a low-carbon economy through the adoption of cleaner production processes and investments in green technologies (EC, 2022; Stern and Valero, 2021).

But *are firms actually addressing climate risks*? *Are they prepared to navigate the challenges brough about by climate change*? And *what factors can promote their investments toward climate actions*? These questions are relevant to policymakers in devising effective climate policies and to corporate managers facing the imminent threats of climate change.

In this work, we tackle these issues by examining the level of climate action among Italian firms operating in the Piedmont region and the factors affecting their propensity to invest for reducing climate risks. Based on data collected from a survey of 2.121 companies, we categorized firms' responses to climate risks into different clusters based on climate-related investments made and planned ("Wait-and-see", "Planners", "Foresighted", and "Proactive"), and we assessed their prevalence. Subsequently, we examined organizational features associated with the adoption of a more proactive approach to climate risk management. In particular, we focused on the role of corporate governance mechanisms that can facilitate the integration of sustainability issues in corporate investment decisions (i.e. sustainability-oriented governance mechanisms). These include a firm's legal status as a benefit corporation, the possession of sustainability-related competences, the presence of a sustainability manager, the implementation of incentive mechanisms in the form of sustainable compensations, the adoption of sustainability reporting, and participation in multistakeholder initiatives, such as the UN Global Compact and the Science-based Targets Initiative.

The results highlight that most companies in Piedmont adopt a "wait-and-see" approach to climate-related investments, while approximately 20% of companies exhibit a "proactive" climate profile. Furthermore, we support that the implementation of sustainability-oriented governance mechanisms can foster more advanced climate strategies. In particular, a firm's literacy on sustainability issues, active participation in training activities, the presence of a sustainability manager, and the preparation of a sustainability report are positively associated with climate proactiveness.

The paper is organized as follows. Section 2 presents the literature review and conceptual framework. The sample and variable measurement are presented in Section 3. The empirical results are reported in Section 4, while Section 5 draws the conclusions and policy implications.

2. LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

2.1. Firms' exposure to climate risks and strategic responses

Climate risks are generally examined under two components: physical and transition risks (EIB, 2021; TCFD, 2017). *Physical risks* are associated with potential economic losses resulting from acute climate events, such as hurricanes, cyclones, floods (*acute physical risk*), or from chronic climate events, such as sea level rise and chronic heat waves (*chronic physical risk*). These risks directly affect firms, particularly those operating in vulnerable regions, by exposing them to asset damage, reduced productive capacity, supply chain disruptions, and increased relocation and insurance costs. *Transition risks*, on the other hand, arise from changes associated with the transition to a low-carbon economy. These include policy and regulatory risks (e.g., carbon pricing, emission reduction targets, litigation), technological risks (e.g. costly technological advancements), market and reputation risks (e.g., shift in consumer preferences toward sustainable products), which can lead to increased business costs, stranded assets, market contraction, and reduced market capitalization.

Accordingly, climate actions can be broadly distinguished into two categories: adaptation and mitigation. *Adaptation* refers to "any adjustment that takes place in natural or human systems in response to actual or expected impacts of climate change, aimed at moderating harm or exploiting

beneficial opportunities" (Klein *et al.*, 2005, p. 580). Instead, *mitigation* refers to all human activities aimed at reducing or stabilizing GHG emissions to prevent further climate change (Klein *et al.*, 2005).

Therefore, in response to climate risks, companies can implement adaptation measures to adjust to physical impacts, such as product and geographic diversification (Linnenluecke *et al.*, 2013), and mitigation actions to reduce GHG emissions, such as setting emission reduction targets (Cadez and Czerny, 2016; Palea and Drogo, 2020). Some prior literature has also categorized climate-related strategic responses based on a firm's awareness and vulnerability to risks (Gasbarro and Pinkse, 2016), timing of actions (Smit *et al.*, 2000), risk/opportunity dual approach (Bui and De Villiers, 2017), and internal/external focus (Cadez and Czerny, 2016).

In this work, we develop a framework based on climate-related investments made and planned by companies. We indeed assume that firms' climate investment decisions are integral to their overarching climate strategy (EIB, 2022). Therefore, we identify four distinct climate strategies (**Fig. 1**) depending on whether a company carried out mitigation and/or adaptation investments in the recent past (2021-2023 period), and whether it planned to undertake mitigation and/or adaptation investments in the near future (2024-2026 period). The strategic groups are set as follows:

- **Wait-and-see**: companies that have not invested in the past and do not intend to invest in the future. These companies adopt a passive approach to climate risks.
- **Planners**: companies that have not invested in the past but plan to do so in the future. This group has not yet taken steps to mitigate climate risks but intends to start investing in the coming years.
- **Foresighted**: companies that have invested in the past, but do not intend to do so in the future. These firms adopt a cautious approach, preferring to wait before making further investments.
- **Proactive**: companies that have invested in the past and will continue to do so. These firms recognize the importance of undertaking climate investments and maintain a forward-looking approach in their climate strategy.

	INVESTMENTS PLANNED (2024-26)	
INVESTMENTS MADE (2021-23)	NO	YES
NO	***Wait-and-see***	***Planners***
YES	***Foresighted***	***Proactive***

Fig. 1. Climate change strategy framework

Despite growing concerns about the impacts of climate change, some evidence suggests that companies' commitment to global challenges is still in its infancy (Yunus *et al.*, 2016; Palea *et al.*, 2025). There is, therefore, a compelling need to draw a picture of corporate actions on climate change.

Furthermore, it is essential to examine the influencing factors of firms' climate commitment to effectively accelerate corporate action and improve business resilience to climate risks.

2.2. Sustainability-oriented governance and corporate climate strategies

Empirical research exploring key factors of business climate strategies is quite scarce (Yunus *et al.*, 2016). Extant studies indicate that the adoption of climate strategies is affected by internal organizational factors. For instance, managerial awareness of climate change and the perception of risk exposure are triggers of climate action (EIB, 2021, 2022) (Hoffmann *et al.*, 2009; Pinkse and Gasbarro, 2019). Furthermore, there is consensus that larger companies tend to be better equipped to implement climate measures (Unger and Nippa, 2024; Weinhofer and Hoffmann, 2010).

Some studies also suggest that corporate governance factors, including board structure (e.g. board size and independence), can influence the implementation of climate change practices (Galbreath, 2010). Nonetheless, traditional governance mechanisms may not be sufficient to address climate issues, emphasizing the need for *sustainability-oriented governance* (Naciti *et al.*, 2022). Sustainability governance entails establishing governance mechanisms, management systems, and organizational structures that facilitate the integration of climate-related issues into decision-making and business operations (Aibar-Guzmán *et al.*, 2024; García-Sánchez *et al.*, 2024). In particular, drawing upon the broader literature on the governance for sustainability (Flammer *et al.*, 2019; Haque, 2017; Peters *et al.*, 2019; Velte, 2024), various governance tools emerge as means for companies to embed sustainability related actions in business practices.

Benefit corporation legal status. The transition toward a more sustainable economy has gone hand in hand with changes in corporate law, leading to the emergence of new legal structures designed to foster sustainable business practices. These include benefit corporations. A *benefit corporation* is a legally recognized for-profit entity that embeds social and environmental responsibilities into its establishment act, thereby combining the pursuit of profit with a commitment to creating a positive societal impact (Hiller, 2013). The ultimate goal of benefit corporation legislation is indeed to redefine corporate identity by embedding social and environmental considerations at the core of corporate governance. Hence, among their responsibilities, directors of a benefit corporation must consider the impacts of their decisions on the environment and society. The model, first promoted and proposed by B Lab nonprofit organization, was introduced in Italy under Law No. 208/2015 and, by the end of 2024, the number of Italian benefit corporations has reached 4,593[1].

Sustainability-related competences. A fundamental prerequisite for companies to engage in sustainable practices is the development of sustainability-related expertise among managers and organizational staff (Schaltegger *et al.*, 2024). This expertise can be fostered, for instance, through professional experience in sustainability-related fields, technical and scientific knowledge, or training in socio-environmental issues. Possessing sustainability-related competencies by managers is crucial for making informed daily decisions and driving meaningful change within governance and management structures (Baumgartner and Winter, 2014). Research indeed indicates that the lack of knowledge and expertise is a critical barrier to SMEs' engagement with environmental and social issues, often leading to a reactive, rather than proactive, approach to sustainability management (Johnson and Schaltegger, 2016). Furthermore, providing organization's members with sustainability training is suggested to boost employees' motivation and skills, ultimately fostering green innovation behaviors and enhancing process efficiency (Xie and Zhu, 2020).

[1] Available at: https://www.renewablematter.eu.

Sustainability professionals. The implementation of a sustainability-oriented governance requires changes in corporate organizational roles. As traditional CEOs may lack the appropriate understanding or expertise to address specific sustainability opportunities, companies may decide to appoint sustainability professionals, commonly referred to as s*ustainability managers/officers*. Sustainability mangers are responsible for designing, implementing, monitoring, and continuously refining a firm's strategic sustainability plan. Their objective is to maximize long-term benefits for all stakeholders, while fostering valuable engagement with them (Borglund *et al.*, 2023). Indeed, there is evidence that the appointment of a sustainability manager can drive corporate sustainability performance improvements (Peters *et al.*, 2019).

Sustainability incentive mechanisms. The effectiveness of a corporate governance system in managing social and environmental issues is closely tied to the presence of incentive systems that integrate social and environmental factors, aligning the behavior of organizational administrative structures with corporate sustainability policies. Hence, the alignment between management actions and stakeholder-oriented policies may be facilitated by managerial *remuneration schemes* that include not only economic and financial objectives but also social and environmental goals (Velte, 2024). Sustainable compensation policies can foster a long-term strategic focus and spur the adoption of environmental initiatives (Flammer *et al.*, 2019; Haque, 2017).

Sustainability reporting. Well-informed decision-making on sustainability issues undoubtedly necessitates the integration of sustainability accounting and reporting into a firm's planning, performance management, and risk management operations (Tang and Higgins, 2022). The collection of relevant data for sustainability reporting is critical in supporting long-term planning and strategy development (Massa *et al.*, 2015), leading to the adoption of more advanced environmental strategies (Palea *et al.*, 2023). Hence, sustainability reporting can provide valuable data for assessing climate risks and thus support climate actions. Nonetheless, research suggests that accounting information is often overlooked in the decision-making process (Schaltegger and Burritt, 2017).

Multi-stakeholder initiatives. Multi-stakeholder initiatives, by fostering collaboration among businesses, governments, NGOs, and other organizations, can effectively provide companies with frameworks and platforms to help them navigate sustainability challenges. Among them, the UN *Global Compact*, launched in 2000, is probably the world's largest corporate sustainability initiative. It is designed to guide businesses in aligning their strategies and operations with universal principles on human rights, labor, environment, and anti-corruption. As such, it can serve as a voluntary governance mechanism that fosters ethical business practices and sustainable development (Birindelli and Palea, 2022). Similarly, the Science Based Targets initiative (SBTi) – a joint collaboration among Carbon Disclosure Project (CDP), Global Compact, World Resources Institute (WRI), and WWF – can support companies in setting emission reduction targets. In particular, the initiative assists businesses in aligning their targets to the Paris Agreement with scientific rigor, which can lead to a higher firm commitment to reduce GHG emissions (Romito *et al.*, 2024).

The adoption of the aforementioned governance mechanisms oriented towards sustainability can positively affect corporate strategic responses to climate risks. Business strategies, indeed, are shaped by a firm's unique set of organizational resources (Barney, 1991). As such, effective corporate governance can provide firms with strategic and organizational capabilities that foster environmental proactiveness (Backman *et al.*, 2017; Buysse and Verbeke, 2003). Hence, sustainability governance can lead to integrating climate risks and opportunities into strategy, risk management, and decision-making (Bui and De Villiers, 2017). There is indeed evidence that the implementation of different

sustainability-oriented governance mechanisms can be conducive to corporate environmental commitment (Palea *et al.*, 2023), such as climate change management (García-Sánchez *et al.*, 2024). Based on this, we formulate the following hypothesis:

HP: *The adoption of a more proactive strategic approach to climate risks is positively associated with the presence of sustainability-oriented corporate governance mechanisms.*

Fig. 2 portrays our research conceptual framework.

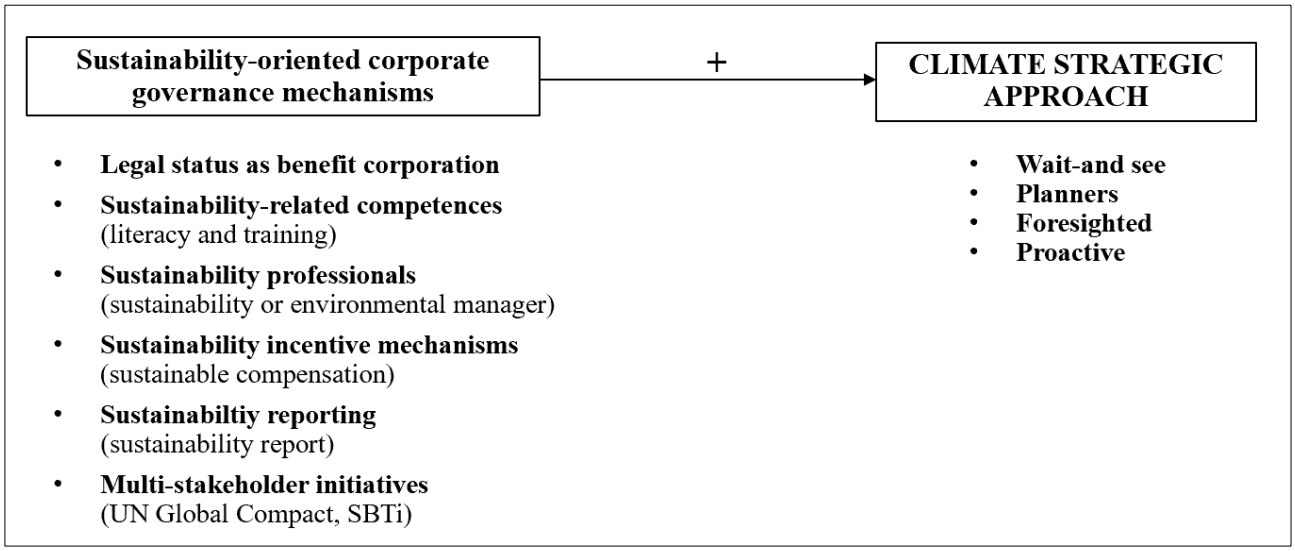

Fig. 2. Research conceptual framework

3. METHODOLOGY

3.1. Sample and Data

The analysis is part of a broader project carried forward by the GRINS (Growing Resilient, Inclusive and Sustainable) Foundation and financed by the (Italian) National Recovery and Resilience Plan (PNRR). Specifically, the work pertains to the outputs of Work Package (WP) 1.4 ("Improving territories' value creation by supporting business sustainability"), whose primary objective is to map the sustainability of SMEs operating in various Italian regions, including Piedmont, Veneto, Emilia-Romagna, Tuscany, Lazio and Southern Italy (Sicily, Sardinia, Abruzzo, Molise, Campania, Apulia, Calabria and Basilicata). For each surveyed region, sample companies were selected using a stratified sampling methodology. The population of active companies as of 2021 was divided into distinct strata based on the province where they operate, number of employees (10-49, 50-249, or more than 250), and sector. Sectors were identified by reclassifying ATECO 2007 codes according to the EU Taxonomy of sustainable activities (EC, 2019). Therefore, they comprise *eligible* sectors, including food and beverage, other manufacturing sectors, energy, water supply and waste management, construction and real estate, transport, information and communication, and professional activities, and *not eligible* sectors. Subsequently, a sample was drawn from each subgroup, ensuring that it was adequately represented in the overall sample. This method allows for statistical relevance of the sample and the ability to detect potential differences among groups in the observed phenomena.

The present study focuses on the Piedmont sample. The data collected come from the "Survey among Italian firms on sustainability strategies and their determinants"[2] administered to Piedmont companies by the institute Noto Sondaggi, with data received in December 2024. The survey included questions on the investments made (2021-2023 period), as well as planned investments for the next three years (2024-2026), to address the impact of climate physical risks and reduce carbon emissions for the same objectives. Furthermore, it comprised questions on firms' perception of climate risks, drivers and barriers to investments, and organizational features, including corporate governance characteristics. A total of 2,121 responses were gathered. Table 1 shows the distribution of respondents by number of employees, sector, and province.

Table 1. Sample distribution

Panel A. Distribution by number of employees

Class of employees	N	%
10-49 employees	1.619	76,33
50-249 employees	440	20,74
More than 250 employees	62	2,92
Total	2.121	100,00

Panel B. Distribution by sector

Sector	N	%
Eligible	*1,420*	*66,95*
Other manufacturing industries	717	33,80
Construction and real estate	347	16,36
Information and communication	116	5,47
Food and beverage	111	5,23
Professional activities	45	2,12
Transport	43	2,03
Water supply and waste management	33	1,56
Energy	8	0,38
Not eligible	*701*	*33,05*
Total	2.121	100,00

Panel C. Distribution by province

Province	N	%
Torino	868	40,92
Cuneo	403	19,00
Alessandria	239	11,27
Novara	216	10,18
Biella	124	5,85
Asti	108	5,09
Vercelli	82	3,87
Verbano-Cusio-Ossola	81	3,82
Total	2.121	100,00

[2] Available at: https://grins.it/output/survey-among-italian-firms-sustainability-strategies-and-their-determinants-background.

3.2. Variable measurement

3.2.1. Dependent variable

The dependent variable is a categorical variable that indicates the climate strategic profile adopted by companies. Climate strategies are identified based on survey questions related to investments made and planned to reduce acute physical risk, chronic physical risk, and transition risk.

We first built a measure for the strategic profile in the adaptation to physical risks (*StrategyAdaptation*). We categorized firms as "Wait-and-see" if they did not make any investments in the period 2021-2023 and stated that they have not planned any investments for the period 2024-2026 to reduce acute *or* chronic physical risk. We defined firms as "Planners" if they did not make any investments for acute and chronic risks but plan to make investments for either acute *or* chronic risks in the future. We classified as "Foresighted" those firms that made investments for either acute *or* chronic risk, but they stated that would not make investments for both acute and chronic risks in the future. Finally, we categorized firms as "Proactive" if they made investments for either acute *or* chronic risk and they plan to make further investments for either acute *or* chronic risk. Following the same logic, we categorized firms' strategic profile in the mitigation of transitions risks (*StrategyMitigation*) in the four clusters based on investments made and planned to reduce the transition risk. Subsequently, we developed a categorization that jointly considers the strategic profile of companies in adaptation and mitigation (*ClimateStrategy*). Specifically, firms are classified as "Wait and see" (*ClimateStrategy*=0) if they show a wait-and-see approach to both adaptation *and* mitigation strategies. Firms were considered as "Planners" (*ClimateStrategy*=1) if they are planners on either adaptation *or* mitigation. We categorized firms as "Foresighted" (*ClimateStrategy*=2) if they are foresighted about one of the two type of actions. Finally, firms were considered "Proactive" (*ClimateStrategy*=3) if they adopted a proactive approach to either adaptation *or* mitigation.

3.2.2. Independent variables

Our explanatory variables are sustainability-oriented corporate governance mechanisms. Governance mechanisms are measured by eight dummy variables taking the value of 1 if the specific governance mechanisms is adopted by the firm, and 0 otherwise. The measurement of the eight variables is based on answers by respondents to the survey. In particular, we considered the following governance mechanisms: 1) legal status as a benefit corporation; 2) possession of sustainability competences, as measured by a firm's literacy in sustainable finance and participation in training activities; 3) presence of sustainability professionals, such as an environmental or sustainability manager; 4) implementation of incentive mechanisms in the form of sustainable compensations linked to climate targets; 5) adoption of sustainability reporting; and 6) participation in multi-stakeholder initiatives, measured by the firm's adherence to the UN Global Compat and the SBTi. Variables used and related survey questions are reported in Table 2.

Table 2. Description of explanatory variables.

Sustainability-oriented governance mechanisms	Variable label	Survey questions
Legal status as benefit corporation	*BenefitCorporation*	"Is your company legally constituted as a Benefit Corporation?"
Sustainability-related competences	*SustainableLiteracy*	"Is your company aware of the recent legislative developments in sustainable finance (i.e., considering environmental, social, and governance factors in investment decisions) adopted by the European Union (CSRD, CSDDD, European taxonomy, etc.)?"
	SustainableTraning	"And, specifically, have you participated in training activities related to sustainable finance?"
Sustainability professionals	*SustainabilityManager*	"Does your company have a person or body responsible for the environmental/sustainability strategy?"
Sustainability incentive mechanisms	*SustainableComp*	"Does your company have a remuneration system for employees linked to achieving climate targets?"
Sustainability reporting	*SustainabilityReport*	"Does your company prepare a sustainability report?"
Multi-stakeholder initiatives	*GlobalCompact*	"Has your company joined the UN Global Compact?"
	SBTi	"Has your company joined the Science Based Targets Initiative (SBTi) (the scientifically supported emissions reduction program)?"

3.2.3. Control variables

We controlled for several factors that could affect the adoption of different climate strategies by companies. We controlled for a firm's perception of climate risks (*RiskPerception*), measured as a dummy variable that equals 1 if a firm perceives climate change as a factor that significantly impacts its business activity (quite a lot or very much), and 0 if a firm perceives climate risks as either non-existent or having little impact. We controlled for firm size (*Size*), measured as a categorical variable, with three classes: 10-49 employees, 50-249 employees, and more than 250 employees. Furthermore, we controlled for a firm's profitability, as measured by return on assets (*ROA*) for the 2021 financial year (the first year of the time period over which the dependent variable is calculated, i.e. 2021-2026). Data for this variable wretrieved from Bureau van Dijk AIDA database. Furthermore, we controlled for a firm's ownership structure. Specifically, we considered whether a firm is a family-owned business (*FamilyBusiness*), by looking at whether more than 20% of shares or participations are hold by family members, also through companies. Finally, we included sector and province dummies in our model.

4. EMPIRICAL RESULTS

4.1. Descriptive statistics

Table 3 shows descriptive statistics for investments made in adaptation and mitigation in the triennium 2021-2023 and 2024-26, used for the determination of firms' climate profile. The data indicate that approximately 15% (N=323) of the sampled companies have made investments to mitigate physical risks (i.e. adaptation), while 25% (N=539) have invested to reduce transition risks (i.e. mitigation). Additionally, about 17% (N=358) of companies plan to invest in measures to address physical risks in the future, and 27% (N=569) are planning investments to reduce transition risks.

Table 3. Frequency of investments in adaptation and mitigation by sample companies

Investments	**N**	**%**
Investments in adaptation 2021-23	323	15,23
Investments in adaptation 2024-26	358	16,88
Investments in mitigation 2021-23	539	25,41
Investments in mitigation 2024-26	569	26,83

The table shows the number (N) and percentage (%) of companies in the sample that made investments in adaptation and mitigation in the triennium 2021-23, as well as the number and percentage of companies that planned to make investments in adaptation and mitigation for the triennium 2024-26. Percentages are calculated on the total sample of 2,121 companies.

Table 4 reports the frequency of climate strategies adopted by sample companies (*ClimateStrategy*), as described in paragraph 3.2.1. Most companies (55,12%) belong to the "Wait-and-see" cluster, indicating that most firms have chosen not to make climate-related investments by 2026. Approximately 12% of companies fall under the "Planners" cluster, which means that one out of eight firms on average has not yet made climate investments but has plans to do so in the 2024-26 period. This group is likely in the early stages of integrating climate considerations into their business plans. A similar proportion of companies is found in the "Foresighted" group, consisting of firms that are adopting a cautious approach to climate investments, waiting for further developments before committing to additional investments. Finally, around 20% of companies in sample exhibit a proactive approach, indicating they have been actively engaging in climate-related investments since 2021. In Table 5, the frequency of climate strategies by size and sector is presented. Most companies adopting a wait-and-see approach (83,75%) are small businesses (10-49 employees), while proactive firms include also a notable portion (33,26%) of medium-sized companies. This underlines that small business have higher barriers to investment. Additionally, the wait-and-see approach is more prevalent among companies operating in eligible sectors, suggesting the urgent need to promote a shift in the investment behavior of firms that are eligible to the EU taxonomy.

Table 6 presents the summary statistics of independent variables used in empirical analysis. The data show that, while nearly half of Piedmont companies in sample possess some knowledge on sustainability issues (43%), only a small portion of them have implemented other sustainability-oriented governance mechanisms. The most common mechanisms include the appointment of a sustainability manager (16,55%), the adoption of sustainability reporting (11,46%), and participation in sustainability training activities (11,13%).

Table 4. Frequency of climate strategies adopted by sample companies

Climate strategies	**N**	**%**
Wait-and-see	1,169	55,12
Planners	262	12,35
Foresighted	254	11,98
Proactive	436	20,56
Total	2,121	100,00

The table shows the number (N) and percentage (%) of companies in the sample, broken down by the four strategies identified (*ClimateStrategy*) (see paragraph 3.2.1).

Table 5. Frequency of climate strategies by size and sector

Panel A. Frequency of climate strategies by size (class of employees)

Climate strategies	**10-49 emps.**	**50-249 emps.**	**<250 emps.**	Total
Wait-and-see	979 (83,75%)	179 (15,31%)	14 (1,20%)	1,169
Planners	198 (75,57%)	58 (22,14%)	6 (2,29%)	262
Foresighted	187 (73,62%)	61 (24,02%)	6 (2,36%)	254
Proactive	255 (58,49%)	145 (33,26%)	36 (8,26%)	436

Panel B. Frequency of climate strategies by sector (eligible, not eligible)

Climate strategies	**Eligible**	**Not eligible**	Total
Wait-and-see	785 (67,15%)	384 (32,85%)	1,169
Planners	179 (68,32%)	83 (31,68%)	262
Foresighted	175 (68,90%)	79 (31,10%)	254
Proactive	281 (64,45%)	155 (35,55%)	436

The table shows the distribution of companies in the four strategies identified (*ClimateStrategy*) (see paragraph 3.2.1), by size (number of employees) and sector (eligible, not eligible, see paragraph 3.1).

Table 6. Summary statistics of independent variables

Panel A. Summary statistics of categorical variables

Variables	**N**	**%**
BenefitCorporation (dummy=1)	51	2,40
SustainabilityLiteracy (dummy=1)	912	43,00
SustainabilityTraining (dummy=1)	236	11,13
SustainabilityManager (dummy=1)	351	16,55
SustainableComp (dummy=1)	26	1,23
SustainabilityReport (dummy=1)	243	11,46
GlobalCompact (dummy=1)	20	0,94
SBTi (dummy=1)	8	0,38
RiskPerception		
Not at all/A little	1,159	54,64
Quite a bit/A lot	962	45,36
FamilyBusiness (dummy=1)	1,454	68,55

Panel B. Summary statistics of continuous variables

Variables	**N**	**Mean**	**Min**	**Max**
ROA2021	2,086	6,76	-86,64	74,81

The table shows the summary statistics of categorical and continuous independent variables, as defined in paragraph 3.2.2. and 3.2.3.

4.2. Results of the empirical model

To test our hypothesis that corporate climate proactiveness is positively associated with sustainability-oriented governance mechanisms, we performed a nominal (unordered) multinomial regression analysis. After controlling for financial variables, 2,086 observations remained in the sample for hypothesis testing. “Wait-and-see” cluster was chosen as the baseline, against which the other categories are compared. Results are presented in Table 7. Findings overall support our HP on the positive association between climate proactiveness and the presence of sustainability-oriented governance mechanisms. In particular, *SustainabilityLiteracy* has a positive and statistically significant relationship across all three outcomes (Planners, Foresighted, Proactive). This supports that higher awareness of sustainability issues and knowledge about regulatory interventions in the sustainability field can promote corporate climate engagement by facilitating the adoption of a planner, foresighted or proactive approach. Furthermore, *SustainabilityTraining* has a positive association with the “Proactive” outcome (odds ratio 2.226***), thus supporting that training in sustainability issues may be conducive to climate proactiveness. It also found that *SustainabiltiyManager* is positively associated with a proactive profile of firms (odds ratio 1.908***), and shows a slightly significant positive association with the “Foresighted” cluster (odds ratio 1.419*). This suggests that the presence of a sustainability or environmental manager increases the likelihood that companies adopt forward-looking strategies, or at the very least, encourages corporate

engagement in climate-related investments in the short-term. Similarly, *SustainabilityReport* is positively related to both "Proactive" and "Foresighted" outcomes. However, we did not find any significant effect of *BenefitCorporation*, *SustainableComp*, *GlobalCompact*, and *SBTi*. This could be motivated by the lack of a sufficient number of observations adopting these corporate governance mechanisms. In line with prior research (e.g. Pinkse and Gasbarro, 2019; Weinhofer and Hoffmann, 2010), control variables indicate that a larger firm size and higher perception of climate risks are positively associated with the adoption of proactive strategies.

Table 7. Results of multinomial regression

Wait-and-see base outcome (N=1,146)	Outcome		
Independent variables	**Planners**	**Foresighted**	**Proactive**
BenefitCorporation	0.840	1.318	1.140
	(0.467)	(0.631)	(0.476)
SustainabilityLiteracy	1.670***	1.638***	1.584***
	(0.259)	(0.256)	(0.225)
SustainabiltiyTraining	1.265	1.196	2.226***
	(0.327)	(0.307)	(0.461)
SustainabilityManager	1.176	1.419*	1.908***
	(0.275)	(0.300)	(0.350)
SustainabilityReport	1.375	1.944***	2.011***
	(0.382)	(0.474)	(0.423)
SustainableComp	2.678	1.688	2.326
	(2.006)	(1.413)	(1.652)
GlobalCompact	1.174	1.032	1.700
	(1.048)	(0.929)	(1.121)
SBTi	0.642	0.538	0.331
	(0.937)	(0.685)	(0.327)
RiskPerception	1.942***	1.847***	3.473***
	(0.281)	(0.266)	(0.459)
Size: 50-249 emps.	1.292	1.356*	2.224***
	(0.236)	(0.247)	(0.350)
> 250 emps.	1.478	1.566	4.666***
	(0.785)	(0.835)	(1.704)
ROA2021	0.999	1.007	1.002
	(0.009)	(0.008)	(0.007)
FamilyBusiness	1.082	1.436**	1.268
	(0.171)	(0.237)	(0.185)
Sector dummies	YES	YES	YES
Province dummies	YES	YES	YES
Observations by clusters	258	253	429
Total observations		2,086	
Pseudo R-squared		0.100	

Robust standard errors in parantheses; *** p<0.01, **p<0.05, * p<0.1. Coefficients are odds ratios. The table shows the results of multinomial regression. Dependent variable: ClimateStrategy.

5. DISCUSSION AND CONCLUSION

Climate change will continue to exert significant impacts on businesses. Addressing climate risks is therefore fundamental for corporate sustainability and global sustainable development.

In this study, we examined the climate profile of a sample of 2,121 Italian companies operating in the Piedmont region and the influencing factors at the organizational level of a more proactive approach to climate action. To this aim, we first clustered climate strategies based on investments made in the period 2021-23 and those planned for the period 2024-26 to reduce climate risks. We then examined, in multinomial regression analysis, the associated organizational features of the identified climate profiles, focusing on sustainability-oriented governance mechanisms, i.e. governance mechanisms for integrating sustainability issues in business decisions and operations.

We found that most companies in Piedmont (about 55%), especially small businesses, adopt a "wait-and-see" approach to climate-related investments, while approximately 20% of companies exhibit a "proactive" climate profile. Our econometric analysis also shows that the presence of sustainability-oriented governance mechanisms increases companies' likelihood of adopting more sophisticated climate strategies. Specifically, we found that a firm's literacy on sustainability issues, active participation in training activities, the presence of a sustainability manager and the preparation of a sustainability report are positively associated with greater climate proactiveness. These results align with prior evidence on the positive impact of effective governance on corporate environmental sustainability (e.g. García-Sánchez *et al*., 2024; Palea *et al.*, 2023), and further support its association with more proactive climate strategies.

Our findings offer valuable insights for policymakers to foster more proactive climate actions among businesses. First, we found that a significant portion of firms is neither in the process of implementing nor planning climate investments. This highlights an urgent need for stronger incentives to drive climate investments in both adaptation and mitigation by SMEs. Second, while we acknowledge that our study demonstrates correlation rather than causality, our evidence supports the critical role of sustainability governance to promote climate proactiveness. Because companies with higher sustainability awareness are more likely to implement advanced climate strategies, there is room for policymaking to support education and training initiatives aimed at enhancing sustainability knowledge among managers and organizational staff. This could be achieved through public-private partnerships, funding for training programs, or incorporating sustainability literacy into broader business education curricula. By fostering a culture of sustainability within organizations, these initiatives can help businesses to address climate risks. Additionally, the presence of a sustainability professional and the preparation of a sustainability report were identified as key factors. Hence, policymakers should consider incentivizing companies to appoint dedicated sustainability officers. In addition, our findings on sustainability reporting underscore the potential benefits of broadening the scope and depth of sustainability disclosures, as outlined by the EU Corporate Sustainability Reporting Directive (CSRD) (EC, 2022). Overall, the results suggest that promoting robust governance structures can better equip businesses to manage climate risks across their operations and supply chains, in alignment with the objectives of the EU Due Diligence Directive (EC, 2022).

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