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The benefits of climate tech: Do institutional investors affect these impacts?

Beatriz Aibar-Guzmán [a], Cristina Aibar-Guzmán [a], Juan-Ramón Piñeiro-Chousa [b,*], Nazim Hussain [c], Isabel-María García-Sánchez [d]

[a] Facultad de Ciencias Económicas y Empresariales, Universidad de Santiago Compostela, Av. Burgo, s/n, 15782 Santiago Compostela, Spain
[b] Facultad de Administración de Empresas, Universidad de Santiago Compostela, Av. Alfonso X el Sabio, s/n, 27002 Lugo, Spain
[c] Faculty of Economics and Business, University of Groningen, Universiteitscomplex, Nettelbosje 2, 9747 AE Groningen, the Netherlands
[d] Instituto Multidisciplinar de Empresa, Campus Miguel de Unamuno. Edificio FES, 37007 Salamanca, Spain

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ABSTRACT

This study analyses the impact of investment in climate change mitigation innovations and technologies on companies, both from a financial and reputational viewpoint, as well as in terms of their environmental performance. We also investigate the moderating effect of institutional investors on the relationship between climate change mitigation investments and firm performance, considering their presence in shareholdings and their typology. We argue that the time horizon and objectives of their investments determine the approach to the integration of environmental criteria in the companies in which they invest. The results obtained for an international sample of 38,666 observations for the period 2010–2020, indicate that investment in climate-change mitigation technologies shows an increasing evolution, focusing especially on clean technologies and, to a lesser extent, on green building. The presence of shareholding by institutional investors with a long-term time horizon and strategic objectives enhances the impact of these projects on the company's image, market value, and profitability. At the environmental level, their effects are particularly associated with the responsible management of resources, and has a limited effect on emissions. The results are robust to different methodological specifications, validating the theoretical and practical implications of this research.

1. Introduction

Due to the negative effects of global warming on the environment, economy, and society (Karl & Treberth, 2003), the fight against climate change and the reduction of greenhouse gas (GHG) emissions have become a societal imperative (Wang, 2017; Wu et al., 2021; Rashidi-Sabet et al., 2022), which require the coordinated action of various actors (Piñeiro-Chousa et al., 2020; Busch et al., 2022; Puertas et al., 2022). Social welfare demands innovative solutions for climate change mitigation, and firms, as major emitters of GHG, are required to play a key role in the transition to a sustainable economy (Cucchiella et al., 2017; Cadez et al., 2019; Caby et al., 2022; Holzner and Wagner, 2022). In this sense, the United Nations Environment Programme calls on companies to adopt climate change mitigation technologies (hereafter, climate tech) to address their environmental impacts and reduce their GHG emissions (Wang et al., 2018). Likewise, the measures introduced by environmental regulations to reduce emissions have boosted environmental innovation (Romero-Castro et al., 2022).

Investment in climate tech is growing strongly, as reveals the study 'State of Climate Tech 2021' carried out by the consulting firm PwC. Between the second half of 2020 and the first half of 2021, climate tech mobilized $87.5 billion, an increase of 210 % over the previous year's figures, although financial returns are not high. The average transaction size has increased from $27 to $96 million (PwC, 2021).

Although climate tech is a key instrument in the fight against climate change, its adoption requires large investments (Iyer et al., 2015; Li et al., 2022). According to Backman et al. (2017), companies decide to invest resources in climate change impact mitigation projects (such as climate tech) based on corporate investment analyses in which their effects on firm performance are considered (Shahzad et al., 2022). However, despite the increasing interest of researchers in studying climate change mitigation strategies (Damert et al., 2017; Velte et al., 2020; Holzner and Wagner, 2022; Rashidi-Sabet et al., 2022), how companies' efforts to reduce carbon emissions affect their financial and

* Corresponding author.
E-mail addresses: beatriz.aibar@usc.es (B. Aibar-Guzmán), cristina.aibar@usc.es (C. Aibar-Guzmán), j.pineiro@usc.es (J.-R. Piñeiro-Chousa), n.hussain@rug.nl (N. Hussain), lajefa@usal.es (I.-M. García-Sánchez).

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non-financial performance remains unclear and requires further study (Lee et al., 2015; Damert et al., 2017). Moreover, as Velte et al. (2020) indicated, moderator analysis is not frequently employed in climate change research, with studies on governance-related factors moderating the relationship between environmental proactivity and firm performance clearly lacking. Therefore, given that management myopia may hinder investments in climate tech (García-Sánchez et al., 2020), it is crucial to understand how climate change strategies impact firm performance and how corporate governance characteristics affect this impact.

Motivated by the gaps in the investigation indicated above, this study contributes to the literature by analysing the impact that investments in climate tech have on firm performance, both from a financial and reputational viewpoint, as well as with respect to companies' environmental performance. We also investigate the circumstances under which climate tech investments lead to higher financial and non-financial performance by studying the moderating effect of institutional ownership and type of institutional investors on the relationship between environmental proactivity and firm performance.

The results obtained for an international sample of 38,666 observations for the period 2010–2020, indicate that climate tech investment shows an increasing evolution, focusing especially on clean technologies and, to a lesser extent, on green building. These decisions are driven by companies in which institutional investors' participation in capital has a long-term time horizon, and is associated with strategic objectives. The presence of this type of investor enhances the impact of these projects on the company's image, market value, and profitability. At the environmental level, the moderating effect of institutional ownership and type of institutional investors are particularly associated with responsible resource management, with a limited effect on emissions.

This study's findings contribute to the literature by bringing a novel perspective to the debate on whether 'it pays to be green' (Hart & Ahuja, 1996) by analysing 'when it pays to be green' (King & Lenox, 2002) and showing under what conditions environmental proactivity in the fight against climate change brings financial and non-financial benefits to companies. We show how the presence of institutional investors in shareholdings and their investment horizons and objectives affect the effects of climate tech investments on financial and non-financial performance. Thus, this study enhances the current understanding of the role of institutional ownership in the financial and non-financial implications of environmental proactivity. In this sense, we complement the findings and conclusions of García-Sánchez et al. (2020) by showing that institutional investors' characteristics that affect companies' environmental proactivity and its impact on financial and non-financial performance go beyond their investment horizon. We also supplement the findings and conclusions of Bueno-García et al. (2022) by demonstrating that institutional investors' investment objectives and closeness to firm management influence their impact on the development of a proactive strategy that provides financial and non-financial returns to firms.

The rest of the paper proceeds as follows. The next section briefly outlines the types of technologies related to the fight against climate change. The third section presents the theoretical framework and the development of the research hypotheses. The fourth section sets out the empirical framework of the study. The fifth section summarizes the main results of this study. The sixth section displays the results of the complementary analyses. In the seventh section, the study's findings are discussed and their theoretical and practical implications are explored. Finally, the last section presents the main conclusions of the study, as well as its limitations and scope for future research.

2. Climate change mitigation technologies

Climate tech is defined as technologies that explicitly focus on addressing climate change impacts and reducing GHG emissions (PwC, 2021). They encompass both high-tech and low-tech solutions, including new energy-saving techniques, carbon capture technologies, biomass processing, pollution prevention, and waste recycling (Hötte and Jee, 2022; Li et al., 2022). According to Wang et al. (2018), companies use a mix of different climate technologies to make up a portfolio.

Depending on its tangible and intangible resources and the nature of its climate change impact, a company will choose from different types of climate tech (Backman et al., 2017). An overall classification of climate tech distinguishes five categories, each with different economic and environmental effects: eco-efficiency technologies, green design technologies, low-carbon energy technologies, pollution control technologies, and management system technologies (Wang et al., 2018). The first three categories (i.e., eco-efficiency technologies, green design technologies, and low-carbon energy technologies) are preventive in nature, seeking to reduce the generation of environmental impacts by acting at the source of those impacts, which usually implies structural changes in processes and/or products and their effects usually take time to materialise (Wang et al., 2018).

Eco-efficiency technologies consist of those technologies that aim to reduce the consumption of materials and energy used in the process of manufacturing products or providing services (Kang and Lee, 2016). Green design technologies seek to reduce a product's GHG footprint throughout its life cycle by introducing changes in its design (Aibar-Guzmán and Somohano-Rodríguez, 2021), for example, by replacing GHG-intensive inputs with sustainable ones (Jeswani et al., 2008). Low-carbon energy technologies substitute traditional energy sources (e.g., oil and coal) for 'clean' energy sources, such as wind, solar, and biofuel (Wang, 2017). Pollution control technologies, also known as 'end-of-pipe technologies', focus on controlling emissions by acting at the end of current processes (Frondel et al., 2007). Last, management system technologies focus on operations management through monitoring and reporting GHG emissions and employee training (Jira and Toffel, 2013).

3. Theoretical framework and hypotheses development

3.1. Climate tech and firm performance

According to the resource-based view (RBV), each company has idiosyncratic resources and capabilities, both tangible and intangible, which determine the competitive strategies the company develops to obtain competitive advantages (Barney, 1991). From this perspective, investments in climate tech are determined by a firm's resources and capabilities, including technological competencies, financial constraints, management factors, and ownership structure (García-Sánchez et al., 2020). As each type of technology has different environmental and economic effects (Wang et al., 2018), the decision to invest in climate tech is based on an investment analysis that considers its effects on the firm's environmental and financial performance (Backman et al., 2017).

Although investments in environmental technologies were initially considered costly for companies and, consequently, detrimental to their financial performance, it is now widely accepted that these investments can provide competitive advantages, such as cost savings and risk reduction or improvement of the firm's reputation and image (Cucchiella et al., 2017; Wang, 2018; Xie et al., 2019), with a positive impact on the company's financial performance. This view corresponds to the 'win-win argument' posed by Porter and Van der Linde (1995) according to which environmental performance and financial performance are compatible, so that companies that invest in climate tech can simultaneously reduce their negative environmental impacts and improve their financial performance (Lee et al., 2015).

From an environmental viewpoint to the extent that climate tech allows companies to reduce their GHG emissions and other negative environmental impacts from processes and products, investments in climate tech are expected to be associated with improved environmental performance. Previous studies document a positive relationship between GHG reduction investments and environmental performance (Boiral et al., 2012; Böttcher and Müller, 2015; Cadez et al., 2019; da Silva et al., 2021). However, Wang (2018) found that low-carbon and pollution control technologies were effective in mitigating companies' GHG emissions, whereas other types of climate tech did not have significant effects on environmental performance. Likewise, Damert et al. (2017) failed to find a significant association between companies' climate change mitigation initiatives and their environmental performance.

In terms of financial performance, according to Wang (2017), while in addition to their positive effect on companies' environmental performance, climate tech can provide cost savings, productivity gains, and other operational and reputational benefits (da Silva et al., 2021), the adoption of these technologies is often associated with significant investments or disruptions in business operations that in the short term outweigh the benefits they provide (Slawinski and Bansal, 2012; Busch et al., 2022). In this regard, previous studies document a negative impact of climate change mitigation investments on firm performance in the short run (Ramanathan et al., 2010; García-Sánchez et al., 2020; Aibar-Guzmán and Frías-Aceituno, 2021). However, from a long-term perspective, the reduction of costs and risks (Cucchiella et al., 2017) and the improvement of a firm's reputation and image (Zeng et al., 2010; Xia et al., 2015; Xie et al., 2019) associated with climate tech offset the initial costs. Thus, climate tech is positively related to financial performance (Clemens, 2006; Damert et al., 2017). Furthermore, the stock market rewards environmental proactivity in fighting climate warnings (Aggarwal and Dow, 2012; Lee et al., 2015; da Silva et al., 2021).

Based on the previous discussion, we propose the following hypothesis:

H1. Climate tech is positively associated with firms' financial and non-financial performance.

3.2. The moderating effect of institutional ownership

Because of the importance of institutional investors in capital markets worldwide, they play an important role in corporate governance (Velte et al., 2020; Aguilera et al., 2021) influencing firms' strategies and decisions (Oh et al., 2011; Bena et al., 2017). This influence extends to corporate sustainability, encouraging the adoption of environmentally and socially responsible practices and investments (Berrone et al., 2013; Dyck et al., 2019; García-Sánchez et al., 2020). To the extent that institutional investors prefer environmentally and socially responsible firms (Aguilera et al., 2006; Petersen and Vredenburg, 2009; Amel-Zadeh and Serafeim, 2018), they directly or indirectly pressure firms to enhance their environmental, social, and governance (ESG) performance by adopting behaviours aligned with sustainable development (Ferreira and Matos, 2008; Aggarwal and Dow, 2012; Lee et al., 2015).

Investors have shown a growing interest in climate change issues (Eccles and Klimenko, 2019; Piñeiro-Chousa et al., 2020; Aguilera et al., 2021; Busch et al., 2022). In particular, an increasing number of institutional investors are considering climate change issues in their investment decisions. (Andersson et al., 2016; Krueger et al., 2020; Ameli et al., 2020). As their investment portfolios are exposed to risks from business externalities, they seek to diminish the potential costs driving companies to reduce their carbon emissions (Dimson et al., 2015). Thus, institutional investors 'are increasingly viewed as catalysts in driving firms to reduce their carbon emissions and to prepare for a low-carbon economy' (Krueger et al., 2020, p. 1069).

On the one hand, from the standpoint of agency theory, monitoring by institutional investors can reduce managerial entrenchment and, consequently, the possibility of management prioritising its own objectives at the risk of jeopardising the owners' interests. In this regard, information asymmetries and agency costs associated with climate change mitigation investments lead institutional investors to monitor management in order to safeguard their interests. Thus, investors may exert a disciplinary role over management by mitigating 'managerial myopia' (Dimson et al., 2015) and encouraging climate change mitigation investments (Nishitani and Kokubu, 2012) or, conversely, by opposing such investments if they believe they may threaten firm performance.

On the other hand, ownership structure constitutes a key mechanism by which companies can obtain and allocate resources to strategies and projects (Chen et al., 2014), affecting both their financial and environmental performance (Earnhart and Lizal, 2006). As noted by Bueno-García et al. (2022), from the perspective of the RBV, some ownership structures favour the development of the green resources and capabilities necessary to implement a proactive environmental strategy. Previous research shows that the presence of institutional investors in a company's equity drives environmental proactivity (Lee et al., 2015; Dyck et al., 2019; Kim et al., 2019; Aguilera et al., 2021). García-Sánchez et al. (2020) found that institutional ownership is positively associated with eco-innovation investments, while in the US context, Aggarwal and Dow (2012) document a positive but no significant effect of institutional ownership on this type of investment.

Based on the previous discussion, we propose the following hypothesis:

H2. The effect of climate tech on firms' financial and non-financial performance is moderated by the presence of institutional investors.

However, institutional investors do not constitute a homogeneous group but diverge in terms of their closeness to the company, risk preferences, and investment horizon (Brossard et al., 2013), which affects their interest in corporate sustainability (Oh et al., 2011) and, therefore, their influence on companies in this regard (García-Sánchez et al., 2020). The literature broadly classifies institutional investors according to the time frame within which they consider investment returns (Cox et al., 2004). Previous studies have found that long-term institutional investors tend to be more supportive of environmental and social investments than short-term institutional investors (Oh et al., 2011; García-Sánchez et al., 2020).

According to a survey conducted by Krueger et al. (2020), long-term investors consider climate risks to be significantly more financially material than short-term investors, and accordingly, they are more prone to promote climate change mitigation strategies and investments. Furthermore, to the extent that long-term institutional investors seek investment viability over time (Barroso Casado et al., 2016), they are more concerned about firm image (Walls et al., 2012). Conversely, short-term institutional investors are 'inpatient' investors who are more concerned about short-term profits and liquidity (Brossard et al., 2013). Thus, because of their 'myopic' focus, short-term institutional investors would prevent the adoption of proactive environmental strategies and investments (García-Sánchez et al., 2020).

In sum, as the returns from climate change mitigation strategies and investments are expected to be realised mostly over the long run, long-term institutional investors are more likely to support them, as they are likely to benefit from their results, while short-term institutional investors will be less supportive or even opposed to them. Therefore, it can be assumed that the moderating effect of institutional ownership on the relationship between climate tech investments and firm performance may be affected by the type of institutional investor considered. Hence, we propose the following hypothesis:

H3. The effect of climate tech on firms' financial and non-financial performance is strengthened (reduced or unaffected) by the presence of long-term (short-term) institutional investors.

Fig. 1 illustrates the research model.

4. Method

4.1. Sample

The sample used in the analysis is obtained from an original population made up of the companies included in Thomson Reuters EIKON

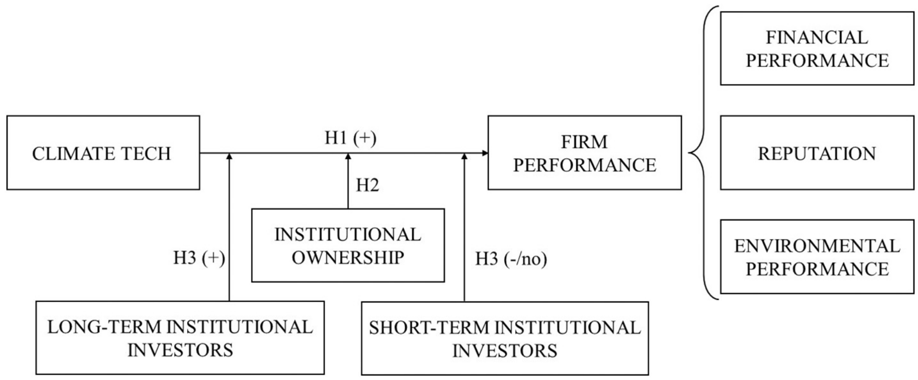

Fig. 1. Research model.

and Compustat, for which the financial and non-financial (ESG) information required for the estimation of the analysis models proposed in the following section was available. The period from 2010 to 2020 was selected with the objective of analysing the impact that the investment in climate tech that companies have made in the last decade on financial and environmental performance, and on their reputation. The unbalanced data panel comprises 38,666 observations corresponding to 4822 companies with information available for at least three of the 11 years analysed. In addition, information on the institutional environment is incorporated from macroeconomic indicators of different organizations.

The sample firms are located in 61 countries across five continents, characterised by different institutional and economic settings, and operate in ten activity sectors. There is a bias in favour of USA companies as well as those belonging to the financial and real estate, industrial, and consumer services sectors.

4.2. Empirical models and methodology

Models 1 and 2 were designed to test our hypotheses. Specifically, the testing of research hypotheses H1 and H2 will be determined by the effect and significance of β_1 and β_3 in Model 1. Thus, the moderating impact of the presence of institutional investors in the shareholding will require that $\beta_3 > 0$, confirming that the effect of Climate Tech ($\beta_1 > 0$) is enhanced by their presence. The testing of hypothesis H3, concerning the moderating impact of the type of institutional investors, by analysing δ_4 and δ_5 in Model 2. In this case, it is expected that $\delta_4 > 0$ and $\delta_5 \leq 0$.

$$\begin{aligned}\mathbf{Impact}_{i,t} =\ & \beta_0 + \boldsymbol{\beta_1}\mathbf{ClimateTech}_{i,t} + \boldsymbol{\beta_2}\mathbf{InstInv}_{i,t} + \boldsymbol{\beta_3}\mathbf{ClimateTech{*}InstInv}_{i,t} \\ & + \beta_4 \text{logAge}_{i,t} + \beta_5 \text{logSize}_{i,t} + \beta_6 \text{ROA}_{i,t} + \beta_7 \text{ForeingSales}_{i,t} \\ & + \beta_8 \text{R\&DInv}_{i,t} + \beta_9 \text{Adverstaising}_{i,t} + \beta_{10} \text{Capex}_{i,t} + \beta_{11} \text{Dividend}_{i,t} \\ & + \beta_{12} \text{Leverage}_{i,t} + \beta_{13} \text{Analysts}_{i,t} + \beta_{14} \text{Governance}_{i,t} + \beta_{15} \text{StkEng}_{i,t} \\ & + \beta_{16} \text{ERRI}_{i,t} + \beta_{17} \text{EPI}_{i,t} + \beta_{18} \text{EU}_{i,t} + \beta_{19} \text{Covid}_{i,t} + \beta_{20} \text{Country}_i \\ & + \beta_{21} \text{Industry}_i + \beta_{22} \text{Year}_t + \varepsilon_{it} + \eta_i\end{aligned} \qquad \text{[Model 1]}$$

$$\begin{aligned}\mathbf{Impact}_{i,t} =\ & \delta_0 + \boldsymbol{\delta_1}\mathbf{ClimateTech}_{i,t} + \boldsymbol{\delta_2}\mathbf{LTInstInv}_{i,t} + \boldsymbol{\delta_3}\mathbf{STInstInv}_{i,t} \\ & + \boldsymbol{\delta_4}\mathbf{ClimateTech{*}LTInstInv}_{i,t} + \boldsymbol{\delta_5}\mathbf{ClimateTech{*}STInstInv}_{i,t} \\ & + \delta_6 \text{logAge}_{i,t} + \delta_7 \text{logSize}_{i,t} + \delta_8 \text{ROA}_{i,t} + \delta_9 \text{ForeingSales}_{i,t} \\ & + \delta_{10} \text{R\&DInv}_{i,t} + \delta_{11} \text{Adverstaising}_{i,t} + \delta_{12} \text{Capex}_{i,t} + \delta_{13} \text{Dividend}_{i,t} \\ & + \delta_{14} \text{Leverage}_{i,t} + \delta_{15} \text{Analysts}_{i,t} + \delta_{16} \text{Governance}_{i,t} + \delta_{17} \text{StkEng}_{i,t} \\ & + \delta_{18} \text{ERRI}_{i,t} + \delta_{19} \text{EPI}_{i,t} + \delta_{20} \text{EU}_{i,t} + \delta_{21} \text{Covid}_{i,t} + \delta_{22} \text{Country}_i \\ & + \delta_{23} \text{Industry}_i + \delta_{24} \text{Year}_t + \varepsilon_{it} + \eta_i\end{aligned} \qquad \text{[Model 2]}$$

Impact is a term that refers to six dependent variables: Reputation, TobinQ, ROA, EnvPerf, ResourcesUse and Emissions. These variables are dichotomous (Reputation), numerical (TobinQ and ROA), and numerical with censoring (EnvPerf, ResourcesUse and Emissions). Owing to the numerical nature of the variables, the models were estimated using STATA 17.0, using linear regressions for panel data with random effects, according to the Hausman test. For the Reputation variable, a logit regression model for panel data was used.

To obtain robust results, the models are also estimated with fixed effects, and Tobit regressions with random effects are used for the censored variables. Endogeneity is controlled using a lag on independent and control variables. In Model 2, multicollinearity introduced by the interaction of variables is limited by using centred variables.

4.3. Variables

The dependent variables to which the term Impact refers correspond to a measure of intangible benefits (Reputation), two measures of financial performance (TobinQ and ROA), and three measures of environmental performance (EnvPerf, ResourcesUse, and Emissions). Following García-Sánchez et al. (2022b, 2022c), the variable Reputation has been constructed as a dichotomous variable that takes a value of one for those companies in the sample that have been included in any of these rankings: Forbes World's Best Regarded Companies, Fortune World's Admired Companies, and Global RepTrack Most Reputable Companies Worldwide, and zero otherwise.

In relation to financial performance, we consider a market measure (Tobin's Q) and an accounting measure (ROA). The first variable is calculated based on the ratio of market value to the replacement value of the company's assets, making it possible to determine whether the specialised agents operating in market value climate tech projects. The ROA variable is calculated by dividing net profit by total assets, and measures the impact of climate tech projects on economic profitability (Holzner and Wagner, 2022).

With regard to the variables representing environmental performance (EnvPerf, ResourceUses and Emissions) correspond to the three main EIKON environmental scores linked to the impacts of climate tech projects. These scores aggregate different items, selecting those that are more closely related to climate change using two sub-scores. The first (ResourceUses) reflects a company's capacity and performance in reducing the use of energy, materials, and water. The second (Emission) identifies the company's effectiveness in reducing emissions in different phases of its activity.

The independent variable (ClimateTech) is configured as a score formed by the sum of four items that identify the inclusion of innovations and technologies against climate change in the different phases of business activity. In this regard, this score was created by aggregating the following dichotomous variables that identify that the company has made innovations or invested in (i) green building, including pollution-control equipment, (ii) resource use with the aim of reducing resource and energy consumption and improving energy efficiency of resources, (iii) clean technology in the processes of planning and production planning, and (iv) waste management technology with the aim of using recycling techniques and recycled materials.

The InstInv variable identifies the presence of institutional investors based on voting rights held by significant shareholders with a stake in the capital of >5 %. Moreover, in accordance with Brossard et al. (2013) and García-Sánchez et al. (2020, 2022a), we determine the nature of these investors according to the time horizon of their short- or long-term investments. Thus, LTInstInv refers to long-term investors (government institutions, family firms, and pension or endowment funds), whereas STInstInv refers to short-term institutional investors (financial institutions, cross holdings, and other holdings).

To reduce bias in the estimations, different control variables that have been tested in previous literature (Wang, 2018; García-Sánchez et al., 2020) will be incorporated, such as age (logAge) and company size (logSize), measured as the logarithm of age and total assets, respectively; economic profitability (ROA), except in the model that considers ROA as a dependent variable; the percentage of the company's sales abroad (ForeingSales), tangible (CAPEX) and intangible investments (R&DInv) and spending on advertising (Advertising); the annual dividend distribution policy (Dividend); the level of indebtedness (Leverage), the number of financial analysts who follow the company (Analysts); the level of good corporate governance using the EIKON governance score (Governance); and the existence of a stakeholder engagement policy (StkEng) that favours the active participation of stakeholders in management processes (García-Sánchez et al., 2022c). Institutional environmental pressures at the country level are identified by including the Environmental Regulatory Regime Index (ERRI), the Environmental Performance Index (EPI), and a dummy coded one for EU countries from 2019 to 2020 (EU), the period in which the European Action Plan to ensure sustainable growth is approved (Puertas et al., 2022). Additionally, we controlled for the sector (Industry), country (Country), and period (Year), as well as the effect of the COVID-19 pandemic in 2020 (Covid).

Table 1 shows the description and source of the independent, moderating, and control variables included in the research models, as well as some references to prior studies that have used them.

5. Results

5.1. Descriptive analysis

Table 2 presents the descriptive statistics of the variables designed to estimate Models 1 and 2.

As can be seen, on average, companies have invested in two of the

Table 1
Variable Description.

Acronym	Variable	Description	Source	References
Independent and moderating variables				
ClimateTech	Investment in innovations and technologies against climate change	Score formed by the sum of four items related to climate tech projects	EIKON	Own design
InstInv	Institutional ownership	Institutional investors with a stake >5 % in the firm's stock capital	Compustat	Barroso Casado et al. (2016)
LTInstInv	Long-term institutional investors	Government institutions, family firms, and pension or endowment funds	Compustat	Brossard et al. (2013), García-Sánchez et al. (2020, 2022a)
STInstInv	Short-term institutional investors	Financial institutions, cross holdings, and other holdings	Compusta	
Control variables				
logAge	Firm age	Logarithm of the age of the firm	Compustat	Holzner and Wagner (2022)
logSize	Firm size	Logarithm of the total assets	Compustat	Aggarwal and Dow (2012); Xie et al. (2019); Zhang et al. (2019);
ForeingSales	Internationalization	Percentage of the firm's sales abroad	Compustat	Horbach (2008); Aibar-Guzmán and Somohano-Rodríguez (2021)
CAPEX	Investment in tangible assets	Capital intensity (statistics in value)	Compustat	García-Sánchez et al. (2020); Aibar-Guzmán et al. (2022)
R&DInv	Investment in intangible assets	R&D intensity (statistics in value)	Compustat	Demirel & Kesidou (2019); Lee et al. (2015); Wang (2018)
Advertising	Spending on advertising	Advertising intensity (statistics in value)	Compustat	Wang (2017); Wang et al. (2018)
Dividend	Dividend Policy	The firm's annual dividend distribution policy	Compustat	Aibar-Guzmán and Somohano-Rodríguez (2021); Aibar-Guzmán et al. (2022)
Leverage	Level of indebtedness	Total ratio of external funds between the total assets	Compustat	Aggarwal and Dow (2012); Lee et al. (2015); Xie et al. (2022)
Analysts	Analyst monitoring	The number of financial analysts following the firm	Compustat	García-Sánchez et al. (2022a, 2022c)
Governance	Level of good corporate governance	The EIKON governance score	EIKON	Bueno-García et al. (2022); Aibar-Guzmán and Somohano-Rodríguez (2021)
StkEng	Stakeholder engagement policy	Dummy coded 1 if the firm has a policy of active stakeholder engagement and 0 otherwise	EIKON	Bueno-García et al. (2022); García-Sánchez et al. (2022c)
ERRI		The Environmental Regulatory Regime Index	Esty and Porter (2002)	Aibar-Guzmán and Frías-Aceituno (2021)
EPI	Institutional environmental pressures at the country level	The Environmental Performance Index	Yale Center for Environmental Law and Policy (Yale University)	das Neves Almeida and García-Sánchez (2016)
EU		Dummy that coded 1 for EU countries from 2019 to 2020 the period when the European Action Plan is approved, and 0 otherwise	–	Own design
Covid	The effect of the COVID-19 pandemic in 2020	Dummy coded by 1 for 2020 to control the pandemic effect, 0 otherwise	–	Own design

Table 2
Descriptives.

	Mean	Std. dev.		Mean	Std. dev.
TobinQ	0.80	0.10	CAPEX	59.80	64.70
ROA	2.69	3.13	Dividend	28.10	36.10
EnvPerf	34.91	29.44	Leverage	51.85	46.08
ResourceUse	38.43	33.71	Analysts	13.29	8.83
Emmisions	23.62	8.33	Governance	39.02	31.97
ClimateTech	1.40	0.97	ERRI	0.87	0.67
InstInv	23.67	23.84	EPI	58.77	7.20
LTInstInv	8.33	15.05			%
STInstInv	15.34	20.73	Reputation		37.84
StrategicInstInv	17.71	24.02	StkEng		39.32
FinancialInstInv	5.96	5.69	EU		14.18
logAge	3.20	0.90	Covid		9.83
logSize	15.44	1.82	Green Bulding Innovation		47.61
ForeignSales	25.90	36.20	Resources Innovation		54.80
R&Dinv	11.30	26.90	Clean Technology		72.20
Advertising	102.00	103.00	Waste Technology		57.61

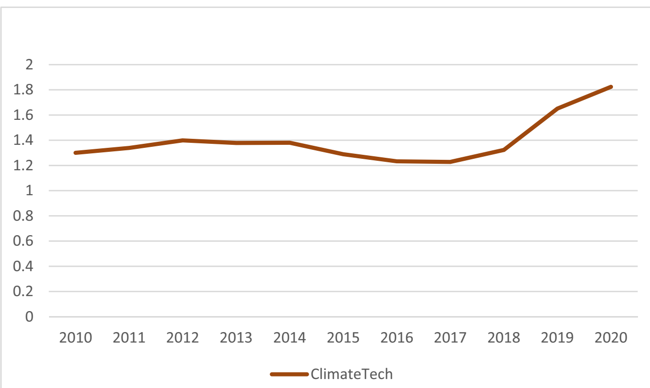

Fig. 2. ClimateTech dinamic evolution.

innovations and technologies associated with the four climate tech dimensions considered in this study, with these investments experiencing considerable growth since 2018 (Fig. 2). The innovations and technologies in which companies invest the most are mainly associated with clean technology (72.20 %). In contrast, innovations in green building are less widespread among the companies analysed (47.61 %).

Tobin's Q has an average value of 1.08 over the analysis period and ROA is approximately 3 %. The environmental performance score is 34.91, and its breakdown shows that t companies' efforts regarding the efficient use of resources (ResourceUse: mean = 38.43) are higher than those aimed at reducing emissions (Emmisions: mean = 23.62). The presence of institutional investors in shareholdings is associated with 23.67 % of the votes.

The bivariate correlations in Table 3 suggest the absence of serious multicollinearity problems in the analysis models.

5.2. Results of the estimation of the basic models

Table 4 shows the results obtained from the estimation of Models 1 and 2 designed to test the hypotheses using linear regressions with random effects, except for the reputation variable, whose dichotomous nature requires a logistic regression.

According to the results reflected in the first four columns, innovations and investments in climate tech positively affect both the market value and profitability of companies. In relation to Model 1, the impact of ClimateTech on TobinQ ($\beta_1 = 9.58\text{e-}05$) and ROA ($\beta_1 = 1.812$) is positive and significant for 99 % and 95 % confidence level, respectively. Results that allow us to accept hypothesis H1 regarding the impact of Climate Tech on the financial performance of companies.

The impact of climate tech on financial performance is greater in companies with institutional investors as shareholders, thus confirming the moderating effect proposed in hypothesis H2. In this sense, in addition to the positive impact of ClimateTech discussed above, it is observed that the interaction ClimateTech *InstInv positively affects Tobin's Q ($\beta_3 = 1.28\text{e-}06$) for a confidence level of 99 %. However, in the case of economic profitability or ROA, the moderating effect of institutional ownership ($\beta_1 = 0.0108$) is econometrically irrelevant.

Regarding the results of Model 2, we confirm the robustness of the impact of ClimateTech and hypothesis H3, showing that the long-term nature of institutional investors conditions the moderating effect they have. In this regard, the interaction ClimateTech *LTInstInv positively affects Tobin's Q ($\beta_4 = 2.96\text{e-}06$) and ROA ($\beta_4 = 0.0686$) for a 99 % confidence level. Thus, the results confirm that the moderating impact that ClimateTech has on financial performance only occurs for long-term institutional investors.

With regard to the results obtained for the intangible benefits associated with Climate Tech, the next two columns of Table 4 show that its impact on the Reputation variable is similar to the effect observed for ROA. The ClimateTech variable positively affects the inclusion of companies in rankings of reputable and admired companies (Model 1: $\beta_1 = 0.768$; Model 2: $\beta_1 = 0.\ 979$). Furthermore, this positive effect being enhanced by the presence of long-term institutional investors (ClimateTech *LTInstInv: $\beta_4 = 0.00580$). Both effects are significant for a 99 % confidence level. In contrast, the presence of short-term institutional investors is econometrically irrelevant (ClimateTech *STInstInv: $\beta_5 = 0.00386$). Therefore, as regards the intangible effects of business investments against climate change, we can accept hypotheses H1 and H3.

Regarding the impact of ClimateTech on environmental performance, the seventh and eighth columns in Table 4 reflect its effect on the overall score of companies' environmental performance. As can be seen, these projects positively affect the EnvPerf variable (Model 1: $\beta_1 = 8.907$; Model 2: $\beta_1 = 9.486$) for a 99 % confidence level. Though, when we closely analyse the subcomponents of the environmental performance score, we observe that this impact only leads to better practices in terms of resource management and use (variable ResourcesUse [Model 1: $\beta_1 = 12.\ 52$; Model 2: $\beta_1 = 12.01$]), but it does not entail improvements in emissions (variable Emissions [Model 1: $\beta_1 = 4.12\text{e-}05$; Model 2: $\beta_1 = 0.000224$]).

Regarding the moderating effect of institutional ownership, it is only significant for the variable ResourcesUse, confirming that the presence of institutional investors in the shareholding (ClimateTech *InstInv: $\beta_3 = 0.00970$) and their long-term nature (ClimateTech *LTInstInv: $\beta_4 = 0.0194$) enhance the impact of corporate investments against climate change. In sum, in the case of the environmental effects of business investments in climate tech, we can partially accept hypotheses H1, H2, and H3.

Regarding the direct impact that institutional investors have on the financial, reputational, and environmental performance of a company, there is no generalisable pattern either for their presence or for their type. With respect to the control variables, it is worth noting the relevant role played by financial analysts and good corporate governance in practically all the models estimated.

5.3. Robust models estimation results

To confirm the robustness of our results, we made changes to the methodological specifications. Table 5 shows the results of the estimation of Models 1 and 2 using different methodologies and approximations. Specifically, linear regressions with fixed effects were used for the TobinQ and ROA variables. Logit regression with fixed effects for the Reputation variable. Given the censored nature of the environmental performance scores, the models for the EnvPerf, ResourceUses, and Emmisions variables were estimated using Tobit regression with random effects. The results in Table 5 confirm those obtained from the initial estimations discussed in the previous section.

Table 3
Correlation matrix (Significance level at: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	TobinQ	1													
2	ROA	0.01***	1												
3	EnvPerf	0.10***	0.00	1											
4	ResourceUse	0.08***	0.00	0.91***	1										
5	Emmisions	0.00	0.00	0.01	0.01*	1									
6	Reputation	0.08***	0.01	0.51***	0.50***	0.01	1								
7	ClimateTech	0.08***	0.00	0.74***	0.73***	0.01***	0.43***	1	1						
8	InstInv	0.01***	0.02***	−0.01***	−0.03***	0.00	0.02***	0.00	0.13***	1					
9	StrategicInstInv	0.03***	0.05***	0.05***	0.05***	0.01***	0.12***	0.08***	−0.45***	−0.15***	1				
10	FinancialInstInv	0.03***	−0.01***	−0.09***	−0.08***	0.00	−0.07***	−0.07***	0.03***	0.51***	−0.04***	1			
11	LTInstInv	0.04***	0.03***	0.04***	0.05***	0.00	0.04***	0.03***	0.00	0.74***	0.13***	−0.14***	1		
12	STInstInv	0.01	0.03***	0.01**	0.01	0.02***	0.09***	0.05***	0.03***	−0.03***	−0.07***	−0.02***	−0.04***	1	
13	logAge	0.05***	0.02***	0.26***	0.24***	0.01	0.15***	0.24***	−0.05***	0.09***	−0.10***	0.09***	0.02***	0.16***	1
14	logSize	0.30***	0.01	0.46***	0.44***	0.00	0.38***	0.34***	0.02***	0.05***	−0.01***	0.03***	0.03***	0.02***	0.01
15	ForeignSales	0.02***	0.10***	0.08***	0.06***	0.00	0.06***	0.05***	0.02***	0.03***	−0.02***	0.00	0.03***	0.03***	0.07***
16	R&DInv	0.01	0.07***	0.06***	0.04***	0.00	0.04***	0.04***	0.02***	0.00	−0.01***	−0.01**	0.01	0.02***	0.05***
17	Advertising	0.01	0.10***	0.07***	0.05***	0.00	0.07***	0.05***	0.03***	0.06***	−0.03***	0.01	0.06***	0.04***	0.08***
18	CAPEX	0.02***	0.12***	0.07***	0.05***	0.00	0.08***	0.05***	0.03***	0.08***	−0.02***	0.05***	0.05***	0.03***	0.08***
19	Dividend	0.01	0.13***	0.03***	0.03***	0.00	0.07***	0.03***	0.00	0.11***	−0.02***	0.09***	0.06***	0.02***	0.06***
20	Leverage	0.00	0.16***	0.01**	0.01	0.00	0.08***	0.03***	0.01***	0.13***	−0.03***	0.04***	0.11***	0.03***	−0.01
21	Analysts	0.05***	0.06***	0.38***	0.38***	0.00	0.32***	0.27***	−0.03***	0.04***	−0.04***	0.04***	0.01	0.04***	0.47***
22	Governance	0.05***	0.00	0.23***	0.23***	0.00	0.16***	0.19***	−0.05***	−0.14***	0.00	−0.07***	−0.12***	0.06***	0.16***
23	StkEng	0.08***	0.02***	0.63***	0.62***	0.01**	0.42***	0.53***	0.00	0.16***	−0.08***	0.08***	0.11***	0.15***	0.32***
24	ERRI	0.02***	−0.10***	0.00	0.01**	0.01*	−0.17***	−0.08***	−0.06***	−0.48***	0.09***	−0.18***	−0.40***	0.00	−0.11***
25	EPI	0.04***	−0.01**	0.19***	0.17***	0.00	0.01	0.12***	0.00	−0.11***	−0.04***	−0.04***	−0.11***	0.03***	0.10***
26	EU	0.04***	−0.03***	0.28***	0.28***	−0.01	0.06***	0.20***	0.00	0.12***	−0.06***	0.18***	0.00	0.03***	0.16***
27	Covid	0.03***	−0.01***	0.05***	0.04***	0.06***	0.02***	0.14***	−0.01	−0.01	0.01***	−0.01***	0.01	0.03***	−0.02***

		15	16	17	18	19	20	21	22	23	24	25	26	27
15	ForeignSales	1												
16	R&DInv	0.90***	1											
17	Advertising	0.86***	0.84***	1										
18	CAPEX	0.75***	0.74***	0.82***	1									
19	Dividend	0.29***	0.25***	0.43***	0.52***	1								
20	Leverage	0.13***	0.03***	0.30***	0.32***	0.28***	1							
21	Analysts	0.12***	0.09***	0.12***	0.11***	0.05***	0.03***	1						
22	Governance	0.06***	0.05***	0.05***	0.04***	0.02***	−0.02***	0.14***	1					
23	StkEng	0.06***	0.04***	0.05***	0.06***	0.04***	0.02***	0.25***	0.16***	1				
24	ERRI	−0.10***	−0.05***	−0.14***	−0.15***	−0.16***	−0.22***	−0.13***	0.04***	−0.16***	1			
25	EPI	−0.01***	0.00	−0.02***	−0.03***	−0.04***	−0.07***	0.00	0.01***	0.02***	0.53***	1		
26	EU	−0.03***	−0.02***	−0.04***	−0.04***	−0.03***	−0.04***	0.16***	0.01***	0.21***	0.19***	0.46***	1	
27	Covid	−0.01	0.00	−0.01	−0.01*	0.00	−0.01*	−0.07***	0.02***	0.09***	0.01	−0.01**	0.00	1

Table 4
Basic results of random effect models (Significance level at: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

	TobinQ		ROA		Reputation		EnvPerf		ResourceUse		Emmisions	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.
	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)
Direct effects												
ClimateTech	9.58e-05***	3.33e-05*	1.812**	0.0376**	0.768***	0.979***	8.907***	9.486***	12.52***	12.01***	4.12e-05	0.000224
	(3.50e-05)	(1.72e-05)	(0.913)	(0.0190)	(0.113)	(0.0577)	(0.337)	(0.167)	(0.433)	(0.216)	(0.000270)	(0.000140)
InstInv	2.38e-06**		0.0102		0.00519**		0.0235***		0.0141		5.79e-06	
	(9.96e-07)		(0.0165)		(0.00246)		(0.00798)		(0.00981)		(4.81e-06)	
LTInstInv		1.59e-06		0.156***		0.0146***		0.0259		0.0291*		1.85e-05
		(1.90e-06)		(0.0462)		(0.00417)		(0.0178)		(0.0161)		(1.38e-05)
STInstInv		1.36e-06		0.0488		0.00791		0.00409		0.0137		9.59e-06
		(1.32e-06)		(0.0340)		(0.00597)		(0.0126)		(0.0227)		(1.02e-05)
Moderating effects												
ClimateTech *InstInv	1.28e-06***		0.0108		0.00147		0.00525		0.00970**		1.58e-06	
	(3.84e-07)		(0.00980)		(0.00125)		(0.00369)		(0.00473)		(2.88e-06)	
ClimateTech *LTInstInv		2.96e-06***		0.0686***		0.00580***		0.0141		0.0194**		1.19e-05
		(9.54e-07)		(0.0265)		(0.00212)		(0.00930)		(0.00815)		(7.94e-06)
ClimateTech *STInstInv		8.60e-07		0.185		0.00386		0.00717		0.0184		7.87e-06
		(6.41e-07)		(0.470)		(0.00311)		(0.00630)		(0.0120)		(5.76e-06)
Control variables												
logAge	4.37e-05*	4.38e-05*	0.507	0.493	0.172***	0.175***	4.198***	4.194***	3.899***	3.878***	0.000113	0.000101
	(2.51e-05)	(2.51e-05)	(0.365)	(0.365)	(0.0543)	(0.0544)	(0.205)	(0.205)	(0.251)	(0.251)	(0.000102)	(0.000102)
logSize	−0.000497***	−0.000499***	−0.887***	−0.927***	0.685***	0.683***	5.077***	5.070***	5.019***	5.020***	−0.000217***	−0.000221***
	(1.65e-05)	(1.65e-05)	(0.257)	(0.256)	(0.0412)	(0.0412)	(0.137)	(0.137)	(0.169)	(0.169)	(7.18e-05)	(7.19e-05)
ROA	1.03e-07	1.07e-07			0.000111	0.000115	0.00118	0.00129	0.00125	0.00123	−2.47e-07	−3.09e-07
	(1.73e-07)	(1.73e-07)			(0.000720)	(0.000730)	(0.00175)	(0.00175)	(0.00228)	(0.00228)	(2.12e-06)	(2.12e-06)
ForeingSales	0.000	0.000	−5.09e-10*	−4.66e-10*	0.000	0.000	1.07e-10	1.10e-10	2.58e-10**	2.59e-10**	0.000	0.000
	(0.000)	(0.000)	(2.71e-10)	(2.71e-10)	(0.000)	(0.000)	(1.00e-10)	(1.00e-10)	(1.28e-10)	(1.28e-10)	(0.000)	(0.000)
R&Dinv	0.000	0.000	−3.79e-09	−3.67e-09	2.01e-10	1.98e-10	5.37e-10	5.31e-10	2.08e-09	2.01e-09	0.000	0.000
	(0.000)	(0.000)	(3.22e-09)	(3.22e-09)	(4.70e-10)	(4.70e-10)	(1.03e-09)	(1.03e-09)	(1.34e-09)	(1.34e-09)	(0.000)	(0.000)
Advertising	0.000	0.000	3.06e-09***	2.89e-09**	−2.50e-10*	−2.54e-10*	−2.52e-10	−2.65e−10	−1.50e-09**	-1.50e-09**	0.000	0.000
	(0.000)	(0.000)	(1.16e-09)	(1.16e-09)	(1.48e-10)	(1.47e-10)	(4.59e-10)	(4.60e-10)	(5.88e-10)	(5.89e-10)	(0.000)	(0.000)
CAPEX	0.000	0.000	3.16e-09***	3.13e-09***	0.000	0.0.000	2.68e-10	2.62e-10	2.27e-10	2.27e-10	0.000	0.000
	(0.000)	(0.000)	(9.63e-10)	(9.63e-10)	(1.32e-10)	(1.32e-10)	(3.49e-10)	(3.49e-10)	(4.48e-10)	(4.49e-10)	(0.000)	(0.000)
Dividend	0.000	0.000	−8.58e-10	−8.37e-10	0.000	0.000	−6.65e-10	−6.38e-10	−6.72e-10	−6.20e-10	0.000	0.000
	(0.000)	(0.000)	(1.82e-09)	(1.82e-09)	(2.72e-10)	(2.72e-10)	(5.66e-10)	(5.67e-10)	(7.34e-10)	(7.35e-10)	(0.000)	(0.000)
Leverage	−5.17e-07***	−5.13e-07***	0.0410***	0.0410***	−0.000129	−0.000128	0.00262*	0.00269*	0.00248	0.00246	−2.46e-07	−2.70e-07
	(1.68e-07)	(1.68e-07)	(0.00306)	(0.00305)	(0.000341)	(0.000340)	(0.00137)	(0.00137)	(0.00169)	(0.00169)	(8.12e-07)	(8.13e-07)
Analysts	2.78e-05***	2.76e-05***	0.300***	0.299***	0.0609***	0.0614***	0.111***	0.111***	0.224***	0.225***	4.02e-06	4.03e-06
	(2.11e-06)	(2.11e-06)	(0.0442)	(0.0441)	(0.00568)	(0.00569)	(0.0196)	(0.0196)	(0.0248)	(0.0248)	(1.25e-05)	(1.25e-05)
Governance	1.32e-07***	1.35e-07***	0.00149	0.00145	0.00031***	0.00033***	0.00295***	0.00296***	0.00301***	0.00301***	1.62e-08	2.24e-08
	(3.31e-08)	(3.32e-08)	(0.000960)	(0.000964)	(0.000103)	(0.000104)	(0.000325)	(0.000326)	(0.000421)	(0.000422)	(2.87e-07)	(2.89e-07)
StkEng	5.88e-06	1.10e-05	−0.0957	−0.0466	0.760***	0.766***	9.028***	9.057***	10.59***	10.64***	0.000233	0.000253
	(2.50e-05)	(2.50e-05)	(0.744)	(0.746)	(0.0738)	(0.0738)	(0.246)	(0.247)	(0.319)	(0.319)	(0.000223)	(0.000224)
ERRI	−8.77e-05	−9.21e-05	−5.687***	−5.638***	−0.887***	−0.791***	0.225	0.261	1.696***	1.805***	−7.01e-05	−8.46e-05
	(7.31e-05)	(7.44e-05)	(0.767)	(0.815)	(0.116)	(0.121)	(0.514)	(0.530)	(0.611)	(0.632)	(0.000208)	(0.000223)
EPI	−1.24e-06	−2.10e-06	0.318***	0.317***	0.0247**	0.0216**	0.295***	0.290***	0.157***	0.142***	2.85e-05	2.66e-05
	(6.52e-06)	(6.51e-06)	(0.0654)	(0.0653)	(0.0100)	(0.0100)	(0.0453)	(0.0454)	(0.0537)	(0.0538)	(1.76e-05)	(1.76e-05)
EU	3.31e-05	7.42e-05	−3.050**	−3.297***	−0.286	−0.310	6.932***	6.969***	8.487***	8.705***	−0.000451	−0.000404

(*continued on next page*)

Table 4 (*continued*)

	TobinQ		ROA		Reputation		EnvPerf		ResourceUse		Emmisions	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.
	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)
	(0.000120)	(0.000122)	−1.213	−1.254	(0.186)	(0.191)	(0.838)	(0.853)	(0.993)	−1.013	(0.000326)	(0.000340)
Covid	0.000236***	0.000236***	−0.302	−0.227	0.217***	0.223***	1.183***	1.196***	1.284***	1.310***	0.00145***	0.00147***
	(2.16e-05)	(2.16e-05)	(0.812)	(0.812)	(0.0774)	(0.0773)	(0.216)	(0.216)	(0.282)	(0.282)	(0.000271)	(0.000271)
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.00886***	0.00872***	1.249	−0.0908	−15.02***	−15.60***	−84.48***	−86.20***	−80.74***	−81.56***	0.00152	0.00109
	(0.000420)	(0.000414)	−4.930	−4.784	(0.818)	(0.801)	−3.060	−3.016	−3.670	−3.615	(0.00136)	(0.00132)
R-square	0.186	0.187	0.123	0.128			0.704	0.704	0.687	0.687	0.004	0.004
Log likelihood					−9094.771	−9090.7196						
rho	0.814	0.814	0.110	0.108	0.663	0.663	0.658	0.659	0.606	0.606	0.032	0.032
p-value	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.05

6. Complementary analyses

To further explore the impact of the type of institutional investor on the adoption of climate change mitigation initiatives, following Bueno-García et al. (2022), an alternative categorisation of institutional investors was adopted, which considers whether the interest of institutional investors is focused on managing their investment portfolio to obtain a higher return (financial purposes) or pursue other strategic purposes. Thus, we group institutional investors' voting rights according to whether they can be considered strategic (government institutions, cross-holdings, and family firms) or financial investors (pension or endowment funds, financial institutions, and other holdings).

The results obtained for Model 2 with this categorisation of institutional investors are summarized in Table 6. In the first column, the estimates are made in accordance with the methodologies and specifications of the basic models, whereas the second column shows the results obtained in accordance with the specifications of the robust models in the previous section. In this respect, the impact of the ClimateTech variable on financial and non-financial performance is confirmed, verifying that the presence of strategic investors has a positive moderating effect, enhancing this effect, except in the case of the Emissions variable. On the contrary, the presence of financial investors in companies' equity has an opposite moderating effect, because their interest is mainly oriented toward improving returns, standing at 3 % for the sample and period analysed. These results suggest that the categorisation of investors according to their time horizon should be complemented by considering the objectives pursued by the different types of institutional investors, as regarding environmental issues they may differ, as evidenced by García-Sánchez et al. (2020) for eco-innovation projects. These differences could be a consequence of the volume of resources required by these investments and the generation of positive cash flows in the long term (Aibar-Guzmán and Frías-Aceituno, 2021).

Additionally, it seems relevant to confirm the previous results by analysing the role of institutional investors in climate tech investments. For this purpose, Model 3 has been estimated, as well as a variant in which the nature of institutional investors is considered according to the time horizon of their investment and the objectives pursued (strategic versus financial). This implies a breakdown of the InstInv variable into LTInstInv, STInstInv, StrategicInstInv, and FinancialInstInv.

$$\begin{aligned}\mathbf{ClimateTech_{i,t}} = & \propto_0 + \propto_1 \mathbf{InstInv_{i,t}} + \propto_2 \mathrm{logAge}_{i,t} + \propto_3 \mathrm{logSize}_{i,t} \\ & + \propto_4 \mathrm{ROA}_{i,t} + \propto_5 \mathrm{ForeingSales}_{i,t} + \propto_6 \mathrm{R\&DInv}_{i,t} \\ & + \propto_7 \mathrm{Adverstaising}_{i,t} + \propto_8 \mathrm{Capex}_{i,t} + \propto_9 \mathrm{Dividend}_{i,t} \\ & + \propto_{10} \mathrm{Leverage}_{i,t} + \propto_{11} \mathrm{Analysts}_{i,t} + \propto_{12} \mathrm{Governance}_{i,t} \\ & + \propto_{13} \mathrm{StkEng}_{i,t} + \propto_{14} \mathrm{ERRI}_{i,t} + \propto_{15} \mathrm{EPI}_{i,t} + \propto_{16} \mathrm{EU}_{i,t} \\ & + \propto_{17} \mathrm{Covid}_{i,t} + \propto_{18} \mathrm{Country}_i + \propto_{19} \mathrm{Industry}_i + \propto_{20} \mathrm{Year}_t \\ & + \varepsilon_{it} + \eta_i\end{aligned}$$

[Model 3]

Table 7 shows that only the variables LTInstInv and StrategicInstInv are significant from an econometric point of view. Specifically, institutional investors with a long-term time horizon promote Climate Tech projects in the companies in which they invest, with an impact of $\propto_1 = 0.00160$, significant at a 95 % confidence level. The impact of strategic investors is smaller, $\propto_1 = 0.000711$, for a 90 % confidence level.

7. Discussion and implications

7.1. Summary of findings

Regarding the financial impact that investments in climate tech have on companies, the findings indicate that these investments positively affect both companies' market value (Tobin's Q) and profitability (ROA). These findings indicate that the stock market rewards environmental proactivity in response to climate change. Furthermore, these

Table 5
Robust results of fixed effects and Tobit models (Significance level at: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

	TobinQ		ROA		Reputation		EnvPerf		ResourceUse		Emmisions	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.
	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)
Direct effects												
ClimateTech	0.00011***	3.16e-05*	0.483**	0.776**	0.399***	0.575***	8.627***	9.171***	12.20***	11.67***	7.87e-05	0.000223*
	(3.68e-05)	(1.80e-05)	(0.190)	(0.526)	(0.133)	(0.0674)	(0.339)	(0.170)	(0.437)	(0.220)	(0.000253)	(0.000132)
InstInv	4.39e-06**		0.0134		−0.00469		0.0248***		0.0143		6.23e-06	
	(1.77e-06)		(0.0715)		(0.00624)		(0.00850)		(0.0104)		(4.51e-06)	
LTInstInv		2.37e-06		0.298***		0.00847		0.0269		0.0273*		1.80e-05
		(2.09e-06)		(0.0837)		(0.00785)		(0.0180)		(0.0162)		(1.31e-05)
STInstInv		3.83e-07		0.0845		0.00495		0.00124		0.0135		1.00e-05
		(1.42e-06)		(0.0574)		(0.00514)		(0.0127)		(0.0230)		(9.66e-06)
Moderating effects												
ClimateTech *InstInv	1.39e-06***		0.00461		0.00178**		0.00488		0.00990**		2.07e-06	
	(4.05e-07)		(0.0164)		(0.00047)		(0.00370)		(0.00476)		(2.70e-06)	
ClimateTech *LTInstInv		3.46e-06***		0.0540**		0.000227**		0.0140		0.0183**		1.14e-05
		(9.91e-07)		(0.0267)		(0.00048)		(0.00927)		(0.00813)		(7.48e-06)
ClimateTech *STInstInv		4.28e-07		0.0450		0.00210		0.00668		0.0187		7.74e-06
		(6.61e-07)		(0.0402)		(0.00232)		(0.00626)		(0.0120)		(5.46e-06)
Control variables												
logAge	4.89e-05	4.89e-05	−0.711	−1.082	−0.0689	−0.0545	4.660***	4.655***	4.356***	4.337***	0.000117	0.000106
	(3.50e-05)	(3.51e-05)	−1.414	−1.416	(0.131)	(0.131)	(0.224)	(0.224)	(0.272)	(0.273)	(9.34e-05)	(9.37e-05)
logSize	−0.000394***	−0.000396***	−0.532	−0.707	0.730***	0.728***	5.165***	5.159***	5.149***	5.150***	−0.000210***	−0.000214***
	(2.30e-05)	(2.30e-05)	(0.928)	(0.928)	(0.0947)	(0.0948)	(0.145)	(0.145)	(0.178)	(0.178)	(6.56e-05)	(6.57e-05)
ROA	1.21e-07	1.32e-07			0.000431	0.000431	0.00141	0.00153	0.00156	0.00155	−2.76e-07	−3.47e-07
	(1.74e-07)	(1.74e-07)			(0.000849)	(0.000884)	(0.00171)	(0.00172)	(0.00225)	(0.00225)	(2.10e-06)	(2.10e-06)
ForeingSales	0.000	0.000	−2.24e-09***	−2.22e-09***	5.86e-11	5.97e-11	1.08e-10	1.11e-10	2.60e-10**	2.62e-10**	0.000	0.000
	(0.000)	(0.000)	(4.72e-10)	(4.71e-10)	(0.000)	(0.000)	(1.00e-10)	(1.00e-10)	(1.29e-10)	(1.29e-10)	(0.000)	(0.000)
R&Dinv	0.000	0.000	3.82e-09	3.66e-09	−4.34e-10	−4.11e-10	5.06e-10	5.01e-10	2.08e-09	2.01e-09	0.000	0.000
	(0.000)	(0.000)	(4.33e-09)	(4.33e-09)	(6.81e-10)	(6.80e-10)	(1.02e-09)	(1.02e-09)	(1.33e-09)	(1.33e-09)	(0.000)	(0.000)
Advertising	0.000	0.000	4.71e-09**	4.74e-09**	−6.76e-10***	−6.79e-10***	−2.47e-10	−2.60e-10	−1.45e-09**	−1.45e-09**	0.000	0.000
	(0.000)	(0.000)	(2.08e-09)	(2.08e-09)	(2.43e−10)	(2.43e-10)	(4.61e-10)	(4.62e-10)	(5.93e-10)	(5.93e-10)	(0.000)	(0.000)
CAPEX	0.000	0.000	2.08e-09	2.13e-09	(0.000)	(0.000)	2.55e-10	2.48e-10	1.71e-10	1.71e-10	0.000	0.000
	(0.000)	(0.000)	(1.56e-09)	(1.56e-09)	(1.74e-10)	(1.74e-10)	(3.49e-10)	(3.49e-10)	(4.50e-10)	(4.50e-10)	(0.000)	(0.000)
Dividend	0.000	0.000	-1.02e-08***	-1.01e-08***	1.97e-10	1.96e-10	−6.61e-10	−6.34e-10	−7.48e-10	−6.98e-10	0.000	0.000
	(0.000)	(0.000)	(2.47e-09)	(2.47e-09)	(3.10e-10)	(3.10e-10)	(5.62e-10)	(5.62e-10)	(7.30e-10)	(7.31e-10)	(0.000)	(0.000)
Leverage	−4.73e-07*	−4.75e-07*	0.146***	0.145***	0.00167*	0.00169*	0.00284*	0.00291**	0.00286	0.00285	−2.47e-07	−2.72e-07
	(2.45e-07)	(2.46e-07)	(0.01000)	(0.01000)	(0.000936)	(0.000935)	(0.00146)	(0.00146)	(0.00178)	(0.00178)	(7.59e-07)	(7.60e-07)
Analysts	1.33e-05***	1.30e-05***	0.631***	0.620***	0.0382***	0.0390***	0.0901***	0.0895***	0.199***	0.200***	3.08e-06	3.14e-06
	(2.32e-06)	(2.33e-06)	(0.0939)	(0.0941)	(0.00820)	(0.00822)	(0.0200)	(0.0201)	(0.0255)	(0.0255)	(1.14e-05)	(1.14e-05)
Governance	1.30e-07***	1.32e-07***	0.00260*	0.00281**	0.000131	0.000138	0.00283***	0.00283***	0.00288***	0.00288***	1.38e-08	9.40e-09
	(3.42e-08)	(3.42e-08)	(0.00138)	(0.00138)	(0.000118)	(0.000118)	(0.000324)	(0.000324)	(0.000420)	(0.000421)	(2.70e-07)	(2.72e-07)
StkEng	−7.66e-06	−2.53e-06	−0.248	−0.0558	0.296***	0.299***	8.605***	8.634***	10.13***	10.18***	0.000204	0.000221
	(2.57e-05)	(2.58e-05)	(1.041)	(1.042)	(0.0818)	(0.0820)	(0.248)	(0.248)	(0.322)	(0.322)	(0.000210)	(0.000211)
ERRI	0.000	0.000	0.000	0.000	0.000	0.000	0.0925	0.120	1.586**	1.699**	−6.71e-05	−7.63e-05
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.572)	(0.587)	(0.669)	(0.690)	(0.000188)	(0.000201)
EPI	0.000	0.000	0.000	0.000	0.000	0.000	0.297***	0.291***	0.157***	0.142**	2.66e-05*	2.48e-05

(*continued on next page*)

Table 5 (*continued*)

	TobinQ		ROA		Reputation		EnvPerf		ResourceUse		Emmisions	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.
	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.0506)	(0.0506)	(0.0590)	(0.0591)	(1.58e-05)	(1.59e-05)
EU	0.000	0.000	0.000	0.000	0.000	0.000	7.255***	7.286***	8.823***	9.047***	−0.000415	−0.000374
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.936)	(0.949)	−1.092	−1.111	(0.000292)	(0.000305)
Covid	0.000200***	0.000199***	−0.278	−0.348	0.594***	0.595***	1.278***	1.290***	1.384***	1.407***	0.00145***	0.00147***
	(2.22e-05)	(2.22e-05)	(0.900)	(0.899)	(0.0858)	(0.0858)	(0.213)	(0.213)	(0.279)	(0.279)	(0.000272)	(0.000272)
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.00720**	0.00682**	−1.563	4.682			−86.31***	−88.10***	−83.10***	−83.92***	0.00154	0.00104
	(0.00287)	(0.00285)	(116.2)	(115.4)			−3.367	−3.320	−3.989	−3.932	(0.00124)	(0.00120)
R-square	0.147	0.147	0.084	0.074								
Log likelihood					−4152.441	−4151.8912	−92,124.465	−92,126.476	−98,284.749	−98,288.052	70,163.114	70,164.034
rho	0.835	0.835	0.354	0.361			0.720	0.720	0.664	0.664	0.001	0.001
p-value	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.05

results are consistent with those obtained by Lee et al. (2015) and Damert et al. (2017). However, our findings contradict those of Wang (2018), who found that low-carbon technologies and pollution control technologies negatively affect financial performance, while other types of climate tech have no significant effects, and Böttcher and Müller (2015), who found no statistically significant effect of climate change proactivity on financial performance.

Investments in climate tech also provide intangible benefits for companies, positively affecting their inclusion in the rankings of reputable and admired companies. In this case, our findings are in line with those obtained by Zeng et al. (2010), Xia et al. (2015), and Xie et al. (2019), who also find a positive impact of environmental proactivity on firm reputation.

The findings show an overall positive impact of investments in climate tech on environmental performance. This finding was consistent with the results obtained by Xie et al. (2022). However, when the subcomponents of the environmental performance score were closely analysed, we observed that investments in climate change only led to better practices in terms of resource management and use, but did not entail significant improvements in emissions. In the former case, our findings are in line with those obtained by da Silva et al. (2021), while in the case of the variable Emissions, our findings contradict the results obtained by Wang (2018), Cadez et al. (2019), and da Silva et al. (2021).

We also find that the impact of climate tech on financial and non-financial performance differs in the presence of institutional investors in their shareholding. Regarding financial performance, ownership by institutional investors positively affects Tobin's Q, but its effect on economic profitability (ROA) is econometrically irrelevant. This suggests that market discipline imposed by institutional investors leads companies to invest in climate tech, which in turn provides them with a higher market value. Nevertheless, this moderating effect is affected by the nature of these shareholders, and specifically, it only occurs for long-term institutional investors. The effect of climate tech on firm reputation is also enhanced by the presence of long-term institutional investors in company's equity. In both cases (financial performance and reputation) the presence of short-term institutional investors does not affect the contribution of climate tech to firm performance. Likewise, the presence of institutional investors in shareholdings and their long-term nature enhances the environmental performance of corporate investments against climate change, favouring better practices in terms of resource management and use.

Finally, we show that institutional investors' characteristics that affect companies' environmental proactivity and its impact on financial and non-financial performance go beyond their investment horizon; specifically, institutional investors' investment objectives and closeness to firm management influence their impact on the development of a proactive strategy that provides financial and non-financial returns to firms.

7.2. *Research implications*

This study extends existing research on the effects of firms' environmental proactivity on their financial and non-financial performance (Wang, 2017, 2018; Aibar-Guzmán and Frías-Aceituno, 2021; da Silva et al., 2021; Holzner and Wagner, 2022) by analysing the moderating role of the presence of institutional investors in shareholdings, as well as their investment horizon and objectives, on the relationship between investments in climate tech and firm performance.

First, we show that investing in climate tech companies can reap financial and non-financial benefits while improving their environmental performance. In this sense, our findings provide empirical support to the 'win-win' argument put forward by Porter and Van der Linde (1995) in the context of environmental proactivity against climate change. Furthermore, we provide additional empirical evidence on the link between investments in climate tech and firm performance in both financial (Tobin's Q and ROA) and non-financial (business image and

Table 6
Robust results of institutional investors categories: random effects, fixed effects and Tobit models (Significance level at: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

	Tobin		ROA		Reputation		EnvPerf		ResourceUse		Emmisions	
	Model 2a	Model 2a	Model 2a	Model 2a	Model 2a	Model 2a	Model 2a	Model 2a	Model 2a	Model 2a	Model 2a	Model 2a
	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.
	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)
Direct effects												
ClimateTech	3.88e-05**	3.61e-05**	0.0838***	0.330***	0.996***	0.585***	9.435***	9.111***	11.84***	11.50***	0.000229	0.000228*
	(1.74e-05)	(1.81e-05)	(0.0300)	(0.125)	(0.0586)	(0.0682)	(0.169)	(0.171)	(0.218)	(0.222)	(0.000142)	(0.000133)
StregicInstInv	1.87e-06	1.06e-06	0.180	0.0741	0.0126***	0.00598	0.0166	0.0148	0.0295**	0.0281*	8.84e-06	8.32e-06
	(1.22e-06)	(1.33e-06)	(0.477)	(0.0539)	(0.00377)	(0.00481)	(0.0115)	(0.0116)	(0.0147)	(0.0148)	(8.95e-06)	(8.45e-06)
FinancialInstInv	1.40e-06	−2.85e-07	0.0936	0.822	0.0192*	0.00964	−0.0409	−0.0452*	−0.0529	−0.0559	3.84e-05*	4.36e-05**
	(2.88e-06)	(3.10e-06)	(0.0720)	(0.733)	(0.0101)	(0.0133)	(0.0272)	(0.0275)	(0.0347)	(0.0351)	(2.17e-05)	(2.07e-05)
Moderating effects												
ClimateTech *StregicInstInv	1.25e-06**	1.12e-06*	0.0485***	0.0393*	0.00469**	0.00117**	0.0280*	0.0323**	0.0834***	0.0859***	1.63e-05	1.73e-05
	(5.70e-07)	(5.89e-07)	(0.0165)	(0.0239)	(0.00189)	(0.00029)	(0.0163)	(0.0162)	(0.0210)	(0.0210)	(1.51e-05)	(1.44e-05)
ClimateTech *FinancialInstInv	−4.78e-06***	−4.01e-06**	−0.0478	−0.143**	−0.0148***	−0.00806	−0.0124**	−0.0122**	−0.0261***	−0.0255***	7.91e-06	7.40e-06
	(1.66e-06)	(1.71e-06)	(0.0495)	(0.0692)	(0.00574)	(0.00657)	(0.00559)	(0.00556)	(0.00722)	(0.00721)	(4.97e-06)	(4.70e-06)
Control variables												
logAge	4.59e-05*	5.36e-05	0.502	−0.995	0.175***	−0.0487	4.186***	4.649***	3.867***	4.324***	0.000104	0.000109
	(2.51e-05)	(3.51e-05)	(0.366)	−1.418	(0.0544)	(0.132)	(0.205)	(0.224)	(0.251)	(0.272)	(0.000102)	(9.37e-05)
logSize	−0.000500***	−0.000397***	−0.914***	−0.529	0.681***	0.724***	5.060***	5.149***	5.024***	5.154***	−0.000212***	−0.000204***
	(1.66e-05)	(2.30e-05)	(0.257)	(0.928)	(0.0412)	(0.0948)	(0.137)	(0.145)	(0.169)	(0.179)	(7.20e-05)	(6.58e-05)
ROA	1.12e-07	1.33e-07			0.000116	0.000431	0.00126	0.00150	0.00129	0.00162	−2.71e-07	−2.93e-07
	(1.73e-07)	(1.74e-07)			(0.000730)	(0.000870)	(0.00175)	(0.00171)	(0.00228)	(0.00225)	(2.12e-06)	(2.10e-06)
ForeingSales	0.000	0.000	−4.79e-10*	−2.24e-09***	0.000	5.96e-11	1.10e-10	1.10e-10	2.62e-10**	2.64e-10**	0.000	0.000
	(0.000)	(0.000)	(2.71e-10)	(4.72e-10)	(0.000)	0.000	(1.00e-10)	(1.00e-10)	(1.28e-10)	(1.29e-10)	(0.000)	(0.000)
R&Dinv	0.000	0.000	−3.87e-09	3.75e-09	2.09e-10	−4.21e-10	5.29e-10	4.99e-10	2.04e-09	2.04e-09	0.000	0.000
	(0.000)	(0.000)	(3.22e-09)	(4.33e-09)	(4.69e-10)	(6.81e-10)	(1.03e-09)	(1.02e-09)	(1.34e-09)	(1.33e-09)	(0.000)	(0.000)
Advertising	0.000	0.000	2.94e-09**	4.72e-09**	−2.55e-10*	−6.82e-10***	−2.65e-10	−2.58e−10	−1.52e-09***	-1.46e-09**	0.000	0.000
	(0.000)	(0.000)	(1.16e-09)	(2.08e-09)	(1.47e-10)	(2.43e-10)	(4.59e-10)	(4.61e-10)	(5.88e-10)	(5.93e-10)	(0.000)	(0.000)
CAPEX	0.000	0.000	3.22e-09***	2.09e-09	0.000	0.000	2.71e-10	2.58e-10	2.33e-10	1.76e-10	0.000	0.000
	(0.000)	(0.000)	(9.62e-10)	(1.56e-09)	(1.32e-10)	(1.74e-10)	(3.49e-10)	(3.49e-10)	(4.48e-10)	(4.50e-10)	(0.000)	(0.000)
Dividend	0.000	0.000	−7.60e−10	-1.01e-08***	0.000	1.97e-10	−6.35e-10	−6.30e-10	−6.15e-10	−6.93e-10	0.000	0.000
	(0.000)	(0.000)	(1.82e-09)	(2.47e-09)	(2.72e-10)	(3.11e-10)	(5.66e-10)	(5.62e-10)	(7.34e-10)	(7.30e-10)	(0.000)	(0.000)
Leverage	−5.01e-07***	−4.52e-07*	0.0410***	0.146***	−0.000113	0.00171*	0.00266*	0.00288**	0.00240	0.00280	−2.60e-07	−2.58e-07
	(1.68e-07)	(2.45e-07)	(0.00306)	(0.0100)	(0.000340)	(0.000936)	(0.00137)	(0.00146)	(0.00169)	(0.00178)	(8.12e-07)	(7.59e-07)
Analysts	2.78e-05***	1.33e-05***	0.299***	0.611***	0.0615***	0.0392***	0.111***	0.0894***	0.223***	0.198***	3.58e-06	2.60e-06
	(2.11e-06)	(2.33e-06)	(0.0442)	(0.0942)	(0.00569)	(0.00822)	(0.0196)	(0.0201)	(0.0248)	(0.0255)	(1.25e-05)	(1.14e-05)
Governance	1.32e-07***	1.30e-07***	0.00151	0.00283**	0.000334***	0.000141	0.00295***	0.00282***	0.00298***	0.00285***	−3.97e-08	−1.21e-08
	(3.32e-08)	(3.42e-08)	(0.000965)	(0.00139)	(0.000104)	(0.000118)	(0.000326)	(0.000324)	(0.000422)	(0.000421)	(2.89e-07)	(2.73e-07)
StkEng	8.66e-06	−4.96e-06	−0.0586	−0.187	0.761***	0.297***	9.084***	8.659***	10.70***	10.24***	0.000254	0.000225
	(2.50e-05)	(2.58e-05)	(0.746)	−1.043	(0.0739)	(0.0821)	(0.247)	(0.248)	(0.320)	(0.322)	(0.000224)	(0.000211)
ERRI	−7.62e-05	0.000	−5.626***	0.000	−0.770***	0.000	0.291	0.140	1.607**	1.490**	−0.000134	−0.000133
	(7.49e-05)	(0.000)	(0.827)	(0.000)	(0.122)	(0.000)	(0.535)	(0.592)	(0.639)	(0.697)	(0.000225)	(0.000203)
EPI	−2.20e-06	0.000	0.310***	0.000	0.0215**	0.000	0.288***	0.289***	0.149***	0.149**	2.77e-05	2.62e-05*
	(6.52e-06)	(0.000)	(0.0654)	(0.000)	(0.0100)	(0.000)	(0.0453)	(0.0507)	(0.0538)	(0.0591)	(1.76e-05)	(1.59e-05)
EU	3.78e-05	0.000	−2.942**	0.000	−0.348*	0.000	7.023***	7.373***	8.776***	9.120***	−0.000369	−0.000337

(*continued on next page*)

Table 6 (*continued*)

	Tobin		ROA		Reputation		EnvPerf		ResourceUse		Emmisions	
	Model 2a	Model 2a	Model 2a	Model 2a	Model 2a	Model 2a	Model 2a	Model 2a	Model 2a	Model 2a	Model 2a	Model 2a
	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.	coeff.
	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)	(std.error)
	(0.000121)	(0.000)	−1.241	(0.000)	(0.189)	(0.000)	(0.848)	(0.946)	−1.008	−1.106	(0.000335)	(0.000300)
Covid	0.000237***	0.000200***	−0.237	−0.280	0.226***	0.595***	1.193***	1.286***	1.304***	1.401***	0.00146***	0.00145***
	(2.16e-05)	(2.22e-05)	(0.813)	(0.900)	(0.0774)	(0.0858)	(0.216)	(0.213)	(0.282)	(0.279)	(0.000271)	(0.000273)
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.00872***	0.00680**	−0.125	16.74	−15.59***		−85.92***	−87.81***	−81.54***	−83.87***	0.000925	0.000845
	(0.000414)	(0.00285)	−4.805	(115.5)	(0.803)		−3.015	−3.322	−3.617	−3.934	(0.00133)	(0.00121)
R-square	0.187	0.148	0.125	0.076			0.704		0.687		0.005	
Log likelihood					−9089.197	−4151.634		−92,123.524		−98,273.525		70,165.548
rho	0.814	0.835	0.109	0.362	0.662		0.658	0.720	0.606	0.664	0.031	0.001
p-value	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.05

Table 7
Complementary results for random effects models.
(Significance level at: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$)

	Model 3: ClimateTech		
	coeff.	coeff.	coeff.
	(std.error)	(std.error)	(std.error)
Direct effects			
InstInv	0.000352		
	(0.000322)		
LTInstInv		0.00160**	
		(0.000628)	
STInstInv		−0.000482	
		(0.000434)	
StregicInstInv			0.000711*
			(0.000411)
FinancialInstInv			−0.00139
			(0.000995)
Control variables			
logAge	0.235***	0.234***	0.234***
	(0.0102)	(0.0102)	(0.0102)
logSize	0.199***	0.199***	0.199***
	(0.00664)	(0.00663)	(0.00664)
ROA	8.39e-06	3.70e-06	7.30e-06
	(8.56e-05)	(8.56e-05)	(8.56e-05)
ForeingSales	0.001**	0.001*	0.001*
	(0.000)	(0.000)	(0.000)
R&Dinv	9.59e-11*	9.35e-11*	9.52e-11*
	(5.06e-11)	(5.06e-11)	(5.06e-11)
Advertising	−5.36e-11**	−5.31e-11**	−5.35e-11**
	(0.000)	(0.000)	(0.000)
CAPEX	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Dividend	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Leverage	−9.09e-05	−9.14e-05	−8.97e-05
	(6.73e-05)	(6.73e-05)	(6.73e-05)
Analysts	−0.000412	−0.000504	−0.000502
	(0.000964)	(0.000965)	(0.000965)
Governance	0.000148***	0.000146***	0.000146***
	(1.59e-05)	(1.60e-05)	(1.60e-05)
StkEng	0.346***	0.347***	0.347***
	(0.0119)	(0.0119)	(0.0119)
ERRI	−0.200***	−0.210***	−0.208***
	(0.0252)	(0.0259)	(0.0262)
EPI	0.0162***	0.0160***	0.0161***
	(0.00222)	(0.00222)	(0.00222)
EU	0.156***	0.174***	0.166***
	(0.0411)	(0.0417)	(0.0415)
Covid	0.441***	0.441***	0.441***
	(0.0104)	(0.0104)	(0.0104)
Industry	Yes	Yes	Yes
Country	Yes	Yes	Yes
Year	Yes	Yes	Yes
Constant	−3.045***	−3.040***	−3.042***
	(0.148)	(0.147)	(0.147)
Log likelihood	−19,994.751	−19,991.905	−19,993.01
rho	0.658	0.653	0.658
p-value	<0.01	<0.01	<0.01

reputation) dimensions.

Second, we contribute to the understanding of how institutional ownership affects corporate environmental proactivity (García-Sánchez et al., 2020; Aibar-Guzmán et al., 2022). Our findings confirm that institutional ownership influences the relationship between climate tech investments and firm performance and that institutional investors with different investment horizons and objectives value environmental proactivity against climate change differently. Our findings suggest that institutional investors with a long-term investment horizon have incentives to encourage investments in climate tech, as they can benefit from stock market rewards and reputational benefits from such investments. Furthermore, to the extent that institutional investors' objectives involve not only financial returns but also management purposes (Bueno-García et al., 2022), differences in investment objectives (strategic versus financial) also affect institutional investors' involvement in firms' environmental proactivity and the effect of institutional ownership on the contribution of climate tech to companies' financial and non-financial performance.

From a theoretical perspective, we contribute to the RBV by showing that some ownership structures favour the development of green resources and capabilities necessary to implement a proactive environmental strategy (Piñeiro-Chousa et al., 2020; Bueno-García et al., 2022), strengthening the effect of such a strategy on firm performance. Specifically, our results indicate that the contribution of climate tech to financial and non-financial performance is greater in companies with a greater presence of long-term and strategic institutional investors in their shareholding. We also contribute to agency theory by considering the effect of principals with different objectives and investment horizons on corporate climate strategy and its impact on firm performance (Secinaro et al., 2020). We show that different types of institutional investors do not exert the same disciplinary role over management regarding investments in climate tech thereby affecting the relationship between investments in climate tech and firm performance.

7.3. Practical implications

The findings of this study have several managerial, policy, and social implications. From a managerial perspective, by showing that investments in climate tech have a positive impact on both financial and non-financial performance, this study provides an incentive to invest resources in these technologies and helps overcome management's resistance to this kind of investment. Furthermore, our findings suggest that management should consider the influence of ownership structure on the relationship between environmental proactivity and firm performance when deciding to invest in climate tech. Thus, based on this study's findings, companies can design an ownership structure that favours the achievement of 'win-win' situations, such as fostering the presence of long-term and strategic institutional investors in their shareholding.

With regard to policy implications, our findings may help policymakers design effective policies to fight climate change and, specifically, to promote business investment in climate tech (Romero-Castro et al., 2022). Thus, besides financial incentives and technical support, such policies may encourage ownership by long-term and strategic institutional investors. Finally, from a social viewpoint, this study's findings highlight that firm performance is compatible with combating climate change and reducing emissions and that, to the extent that institutional investors act as catalysts in this regard, they play a key social and economic role.

8. Concluding remarks

Combating climate change and reducing emissions has become a societal imperative that requires the coordinated actions of various actors, including the business sector. The number of companies investing in climate change mitigation technologies has shown a pattern of continued growth from 2013 to 2018 (PwC, 2021). This study analysed the impact of investment in innovations and technologies against climate change on firm performance, both from a financial and reputational viewpoint, as well as with respect to companies' environmental performance. We also investigate the moderating effect of institutional investors by considering both their presence in a company's shareholding and the type of institutional investors. In this regard, we argue that the time horizon and the objectives of their investment determine the approach to the integration of environmental, social, and governance (ESG) criteria in the companies in which they invest, and reflect on the relationship between investments in climate tech and firm performance.

Despite the significance and usefulness of the results, some limitations should be addressed in future research. First, we only analysed the sign (positive or negative) of the association between climate tech investments and firm performance without differentiating the effects of different types of climate tech and eco-innovations. As demonstrated by Wang (2018), different types of climate tech have different effects on financial and environmental performance. Future studies could complement our analysis by considering each type of climate technology separately. Second, we did not account for the causes behind the moderating impact of institutional ownership on the relationship between climate tech investments and firm performance; therefore, our findings do not allow us to discriminate whether the moderating impact of long-term/strategic institutional ownership is due to their active engagement or, on the contrary, is due to the choice to selectively invest in firms that are more environmentally proactive. Future studies should delve into this issue by analysing how and under what conditions institutional investors exercise their influence.

Future research could also analyse whether the recent energy crisis has influenced institutional investors' expectations regarding the low-carbon transition and the effect this may have had on the influence that institutional investors can exert on companies in this regard. In addition, future studies could analyse the influence of other types of institutional investors (e.g., foreign investors) or the effect of each type of institutional investor separately. Likewise, future research could consider interactions that may occur between institutional investors belonging to the same category (long-term/short-term, or strategic/financial).

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Declaration of competing interest

None.

Data availability

Data will be made available on request.

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Beatriz Aibar-Guzmán. Associate Professor at the Departamento de Economía Financiera y Contabilidad. Universidad de Santiago de Compostela (Spain)

Brief professional biography: She is PhD. in Economics and Business Administration by the University of Santiago de Compostela (Spain). She writes for interdisciplinary indexed journals. Her research interests include corporate social responsibility, corporate governance, environmental innovation, greenwashing, assurance, and management accounting.

Cristina Aibar-Guzmán. Associate Professor at the Departamento de Economía Financiera y Contabilidad. Universidad de Santiago de Compostela (Spain)

Brief professional biography: She is PhD. in Economics and Business Administration by the University of Santiago de Compostela (Spain). She writes for interdisciplinary indexed journals. Her research interests include corporate social responsibility, corporate governance, environmental innovation, greenwashing, assurance, and management accounting.

Juan Piñeiro-Chousa. Associate Professor at the Departamento de Economía Financiera y Contabilidad. Universidad de Santiago de Compostela (Spain)

Brief professional biography: He is PhD. in Economics and Business Administration by the University of Santiago de Compostela (Spain). He writes for interdisciplinary indexed journals. His research interests include corporate social responsibility, behavioural finance, and environmental innovation.

Nazim Hussain. Assistant Professor at the Department of Accounting – Management of the University of Groningen (The Netherlands)

Brief professional biography: He is PhD. in business administration at Ca' Foscari University of Venice (Italy). He writes for interdisciplinary indexed journals. His research interests include financial accounting, corporate governance, corporate social responsibility, corporate sustainability, environmental innovation, and greenwashing.

Isabel María García-Sánchez. Full Professor at the Departamento de Administración y Economía de la Empresa. Instituto Multidisciplinar de Empresa. Universidad de Salamanca (Spain).

Brief professional biography: She is PhD. in Economics and Business Administration by the University of Salamanca (Spain). She writes for interdisciplinary indexed journals. Her research interests include financial accounting, corporate governance, corporate social responsibility, corporate sustainability, environmental innovation, greenwashing, and assurance.