

ESG Controversies and Corporate R&D Investment: The Moderating Role of CSR Committees. Evidence from French Listed Firms

Abstract

This study investigates whether ESG controversies affect corporate R&D intensity and whether board-level CSR committees moderate this relationship. Drawing on stakeholder, legitimacy, agency and Porter hypothesis perspectives, we argue that ESG controversies may undermine firms' ability to sustain long-term innovation investment by generating reputational costs, financial pressures and managerial distraction. At the same time, sustainability-oriented governance may help firms preserve R&D investment in the face of reputational adversity.

The empirical analysis relies on a panel of 262 French listed non-financial firms over the 2005–2021 period, comprising 3,412 firm-year observations. ESG controversy data are obtained from Refinitiv Eikon, financial information from Compustat Global, and governance data from BoardEx and annual reports. R&D intensity is measured as R&D expenditure relative to total assets. Using two-way fixed-effects regressions with firm and year effects, clustered standard errors and lagged controversy measures, we examine both aggregate ESG controversies and environmental, social and governance dimensions separately. A series of robustness tests, including system GMM, instrumental variables and propensity score matching, further assesses the reliability of the findings.

The results indicate that ESG controversies are negatively and significantly associated with R&D intensity, with environmental controversies showing the strongest effect. However, the presence of a dedicated CSR committee significantly weakens this negative relationship. These findings suggest that ESG controversies can generate a previously underexplored cost by constraining

firms' long-term innovation capacity, while CSR committees may enhance organisational resilience by helping firms preserve strategic investment during periods of reputational adversity. The study contributes to the CSR and corporate governance literature by linking ESG risk management to corporate innovation and by highlighting the role of board-level sustainability governance in protecting long-term value creation.

Keywords: ESG controversies; R&D intensity; CSR committee; corporate governance; innovation; France.

Introduction

Over the past decades, environmental, social and governance (ESG) issues have become central to research in finance, corporate governance and strategic management. Initially grounded in corporate social responsibility (CSR) theories, this literature has increasingly examined the economic and strategic consequences of firms' ESG practices. From a stakeholder perspective, firms are expected to respond not only to shareholders, but also to a broader set of stakeholders whose support is necessary to maintain legitimacy and long-term value creation (Freeman, 1984). This perspective has encouraged growing interest in how ESG practices influence firms' behavior, reputation and strategic choices.

Within this literature, ESG controversies have attracted particular attention (Cai et al., 2012; DasGupta, 2022; Xue et al., 2023). ESG controversies refer to negative events associated with a firm's environmental, social or governance conduct, such as pollution incidents, corruption scandals, labour rights violations or governance failures. These events expose firms to public scrutiny, increase stakeholder pressure, damage their reputation and legitimacy (Cai et al., 2012;

Carroll, 1979), and increase perceived risk, which adversely affect financial performance (Barnett and Salomon, 2012).

At the same time, research and development (R&D) intensity is widely recognized as a key indicator of firms' innovation efforts and long-term competitiveness. R&D investments allow firms to develop new products, improve internal processes and strengthen their capacity to adapt to changing market and regulatory conditions (Porter, 1990). Innovation is also increasingly connected to sustainability issues. Porter and van der Linde (1995) argue that environmental pressures can encourage firms to develop cleaner and more efficient technologies. More recent work similarly suggests that firms may use innovation to improve environmental performance, address stakeholder expectations and reduce ESG-related risks (Le, 2025).

The relationship between ESG controversies and R&D intensity is therefore not straightforward. On the one hand, controversies may constrain innovation by absorbing financial and managerial resources. Firms facing ESG-related scandals may need to redirect attention and resources towards legal costs, compliance, crisis management and reputational repair. In this case, ESG controversies may crowd out long-term R&D investment. On the other hand, controversies may also encourage firms to invest more in innovation as a way to restore legitimacy, improve stakeholder perceptions and develop more sustainable products or processes. Thus, whether ESG controversies weaken or stimulate R&D investment remains a subject of debate and is relatively underexplored in the existing literature. This study aims to fill this gap and enrich the ESG-related literature. Drawing on evidence that negative CSR events trigger adverse investor reactions (Krüger, 2015) and that ESG controversies exacerbate underinvestment (Xue et al., 2023), together with the attention-based view of the firm (Ocasio, 1997), we argue that ESG controversies may redirect managerial

attention and financial resources towards immediate remedial actions, potentially crowding out long-term R&D investment. When firms face controversy-related pressure, they may prioritise crisis management, compliance, legal costs and reputational repair over strategic R&D expenditure. However, the presence of a CSR committee may help mitigate this crowding-out effect by strengthening sustainability oversight, preserving a long-term orientation and helping firms maintain strategic investment commitments despite controversy-related pressure.

Corporate governance may play an important role in this relationship. In particular, CSR committees have become increasingly common as internal governance structures dedicated to sustainability oversight, stakeholder issues and ESG-related risks (Lajmi and Paché, 2020). By improving the monitoring of sustainability issues and supporting a longer-term orientation, CSR committees may help firms respond to controversies without sacrificing strategic investments such as R&D. They may therefore act as a buffering mechanism, reducing the extent to which ESG controversies disrupt firms' innovation efforts.

Against this background, this study examines whether ESG controversies affect corporate R&D intensity and whether the presence of a CSR committee moderates this relationship. Focusing on French listed firms, the paper explores the nexus between ESG controversies, innovation investment and sustainability governance. It contributes to this literature by examining R&D intensity as a strategic outcome of ESG controversies, rather than focusing only on financial performance or market reactions. It also adds to research on CSR committees by analysing whether these committees help firms preserve long-term innovation investment when they are exposed to ESG-related controversies.

The remainder of the paper is organised as follows. Section 2 reviews the relevant literature and develops the hypotheses. Section 3 presents the research design, including the sample, variables and empirical model. Section 4 reports the empirical results and robustness tests. Section 5 discusses the findings, contributions and limitations. The final section concludes the paper.

2. Theoretical framework and hypothesis development

2.1. Theoretical framework

Stakeholder theory provides a useful starting point for understanding why ESG controversies may affect firms' strategic decisions. According to Freeman (1984), firms are expected to consider the interests of multiple stakeholders rather than focusing exclusively on shareholders. From this perspective, ESG controversies represent negative signals that may weaken the relationship between firms and their stakeholders. They can raise doubts about the firm's commitment to responsible behavior and increase pressure from investors, customers, employees, regulators and civil society.

This argument is also consistent with Carroll's (1991) view of corporate social responsibility, according to which firms are expected to balance economic, legal, ethical and discretionary responsibilities. When ESG controversies occur, firms may come under pressure to demonstrate that they are able to respond to stakeholder concerns. One possible response is to increase innovation efforts, particularly when R&D investments are directed towards cleaner technologies, safer products or more sustainable processes. Prior research suggests that stronger ESG performance can improve firms' access to financing and reduce risk exposure, thereby supporting long-term investments such as R&D (Broadstock et al., 2021). Similarly, firms with stronger

stakeholder engagement may be better protected from adverse stakeholder reactions during periods of uncertainty or crisis (Chang et al., 2014).

Legitimacy theory offers a complementary explanation. Firms seek to ensure that their activities remain consistent with social norms and expectations. Suchman (1995) defines legitimacy as a key resource for organizational survival. ESG controversies threaten this legitimacy by exposing a gap between stakeholder expectations and corporate behavior. Bansal and Clelland (2004) show that lower environmental legitimacy is associated with higher firm-specific stock market risk, highlighting the financial implications of failing to meet stakeholders' environmental expectations. In response, firms may adopt corrective strategies to restore credibility and reduce reputational risk. Innovation can form part of this response when firms invest in cleaner technologies, improved processes or sustainability-oriented products. This view is consistent with Porter and van der Linde (1995), who argue that environmental pressures can stimulate innovation by encouraging firms to develop more efficient and sustainable solutions.

However, ESG controversies may also reduce firms' ability to sustain R&D investment. From a financial constraints perspective, controversies can increase information asymmetry, reduce investor confidence and raise the cost of external financing. Myers and Majluf (1984) show that information asymmetry can make external financing more costly. ESG controversies may intensify this problem by increasing perceived firm risk and uncertainty. This is particularly important for R&D, because R&D projects are costly, risky and characterized by uncertain long-term returns. When firms face reputational damage, legal costs or financing constraints, they may reduce discretionary long-term investments in order to preserve liquidity and short-term financial stability.

Agency theory also helps explain why ESG controversies may be associated with lower R&D intensity. According to Jensen and Meckling (1976), managers may sometimes prioritize their own interests or short-term objectives over long-term value creation. Following ESG controversies, managers may face pressure from investors, regulators and other stakeholders to stabilize the firm quickly. In such contexts, they may prioritize short-term financial performance, crisis management or reputational repair over long-term innovation projects. Since R&D expenditures generally produce benefits only over a longer horizon, they may be particularly vulnerable to reduction during periods of controversy and uncertainty.

Overall, these theoretical perspectives suggest two competing mechanisms. Stakeholder and legitimacy theories imply that ESG controversies may encourage firms to increase innovation efforts in order to restore trust and legitimacy. In contrast, financial constraints and agency-based arguments suggest that controversies may reduce R&D intensity by increasing risk, financing costs and short-term managerial pressure. The following section develops the expected relationship between ESG controversies and corporate R&D intensity.

2.2.The relationship between ESG Controversies and corporate R&D Intensity

ESG controversies may constrain R&D investment by damaging firms' reputation and weakening investor confidence. Krüger (2015) documents negative stock market reactions to adverse CSR events, showing that investors view such events as costly. These reactions may make external financing more difficult to obtain and limit firms' ability to maintain long-term investment.

R&D may be particularly vulnerable to these pressures because its returns are uncertain, take time to materialize and are difficult for external investors to assess. Cheng et al. (2014) find that firms

with stronger CSR performance face lower capital constraints, highlighting the role of stakeholder engagement and transparency in access to finance. More directly, Xue et al. (2023) show that ESG controversies are associated with lower investment efficiency, particularly through underinvestment. These findings suggest that controversy-related pressures may also restrict the resources available for R&D.

Related studies show that other aspects of ESG uncertainty can influence R&D decisions. Wang et al. (2026) document a U-shaped relationship between ESG rating divergence and R&D investment. Sun et al. (2025) find that greenwashing firms reduce R&D investment, whereas brownwashing firms increase it. Although these studies examine rating divergence and ESG decoupling rather than controversies themselves, they show that firms' innovation responses to ESG-related issues are not uniformly negative.

In contrast, ESG controversies may also encourage firms to invest in innovation to regain stakeholder trust. Firms facing criticism may develop cleaner technologies or improve their products and processes to address the practices that prompted the controversy. Porter and van der Linde (1995) argue that well-designed environmental regulation can stimulate innovation and improve competitiveness. Although their argument concerns regulation rather than controversies, it provides a basis for expecting external environmental pressure to encourage corrective innovation. From a legitimacy perspective, such investment may help firms demonstrate that they are responding to stakeholder concerns through concrete changes.

However, investment in corrective projects does not necessarily translate into higher overall R&D intensity. Firms may prioritize projects that address an immediate controversy while postponing other research activities. Legal expenses, compliance requirements and reputational repair may

also compete with R&D for financial resources and managerial attention. We therefore expect these immediate pressures to outweigh the incentives for corrective innovation, resulting in a negative association between ESG controversies and R&D intensity. Accordingly, we propose the following hypothesis:

Hypothesis 1: ESG controversies are negatively associated with corporate R&D intensity.

2.3.The moderating role of CSR committee

CSR committees provide a dedicated structure through which boards can oversee sustainability issues and ESG-related risks. Their presence may therefore influence how firms respond to controversies, particularly when these events threaten their reputation and access to resources. Peters and Romi (2015) examine the role of sustainability governance, including board-level environmental committees, in the assurance of sustainability reports. From a governance perspective, CSR committees can strengthen the board's capacity to monitor ESG risks and oversee management's response to stakeholder concerns. When controversies arise, a dedicated committee may help the board assess proposed corrective actions alongside the firm's longer-term priorities. This oversight could be particularly valuable for R&D, which may otherwise be reduced to meet immediate financial pressures. Research on CSR governance provides support for this argument, although it does not directly establish a protective effect on R&D during controversies. Gerged et al. (2023) show that CSR committees moderate the relationship between corporate investment and CSR transparency. Gull et al. (2023) find that the presence of a CSR committee is associated with less CSR decoupling, suggesting that these committees can help align firms' reported commitments with their actual practices.

However, establishing a committee does not guarantee meaningful changes in decision-making. Rodrigue et al. (2013) find evidence that environmental governance mechanisms may serve mainly to manage stakeholder perceptions rather than improve environmental performance. The composition of the committee also matters. Gull et al. (2023) show that committee size, member independence and tenure are associated with lower CSR decoupling. These findings suggest that a committee's contribution depends on more than its formal existence. Ginesti et al. (2023) further show that the relationship between CSR committees and R&D investment depends on committee characteristics. While firms with a CSR committee exhibit lower R&D investment overall, the involvement of the CEO or board chair, as well as female committee leadership, is associated with higher R&D investment. Building on this evidence, we examine whether the presence of a CSR committee helps firms sustain R&D investment when they face ESG controversies.

We nevertheless expect CSR committees to help firms preserve R&D investment when controversies arise. By giving sustainability concerns a regular place in board discussions, these committees may encourage directors to consider the longer-term costs of cutting research expenditure. They may also help distinguish the corrective spending needed to address a controversy from broader reductions that could weaken future innovation. We therefore expect firms with a CSR committee to be better able to respond to controversy-related pressures while maintaining their commitment to R&D. Accordingly, we propose the following hypothesis:

Hypothesis 2: The presence of a CSR committee attenuates the negative relationship between ESG controversies and corporate R&D intensity.

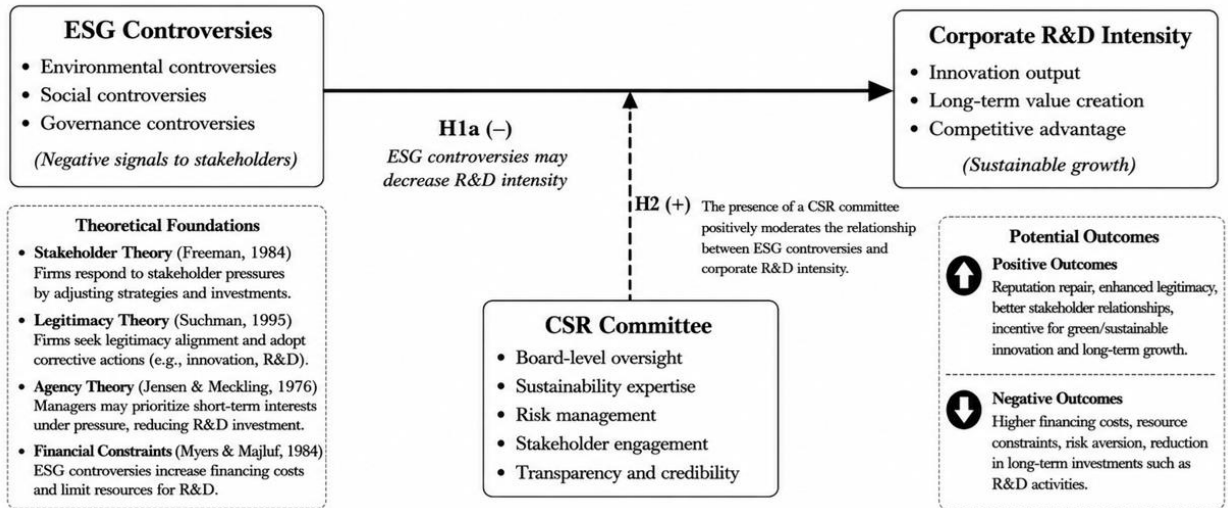


Figure 1. Conceptual framework

3. Sample, data and variable measurement

3.1. Sample and data

Our sample covers French non-financial firms listed on the CAC All-Tradable index over the period 2005–2021. France provides a relevant setting for this study for several reasons. First, France is among the leading countries in terms of ESG regulations. Its institutional environment is characterized by increasingly rigorous non-financial disclosure requirements, notably following the Grenelle II Act and subsequent regulatory developments. Within this environment, stakeholders are becoming increasingly aware of firms' ESG misconducts and are responding with greater severity in their assessments. At the same time, there is a significant gap between the sustainability objectives of French legislator and firms' actual ESG practices, offering an interesting context for examining ESG issues. Second, French firms retain substantial discretion

over their R&D budgets, making it possible to examine whether governance mechanisms influence strategic innovation investment. Third, the French governance system allows variation in board structures and leadership arrangements, which provides a useful setting for analyzing how board-level sustainability governance shapes corporate responses to ESG-related risks. Finally, France is a major European economy and a leading innovator¹ with a strong industrial base and significant a vibrant corporate innovation ecosystem. For instance, in 2024, France exhibits an Eco-Innovation Index of 144, well above the EU average of 127 (European Commission, 2025), making it an appropriate context for studying the determinants of R&D intensity.

ESG controversy data are obtained from Refinitiv Eikon, formerly Thomson Reuters ASSET4, a widely used source of firm-level ESG data in the academic literature (Drempetic et al., 2020; Liang and Renneboog, 2017). Financial accounting variables are collected from Compustat Global. Board characteristics, committee structures and ownership data are obtained from BoardEx and supplemented by hand-collected information from annual reports and documents filed with the website of French Market Authority (in French: Autorité des Marchés Financiers).

From an initial sample of 515 firms, we exclude financial institutions, given their specific accounting rules, regulatory environment and investment structures. We also exclude firms with missing data on the variables required for the empirical analysis. The final sample comprises 262 firms and 3,412 firm-year observations.

3.2. Dependent variable: R&D intensity

¹ See https://ec.europa.eu/assets/rtd/eis/2025/ec_rtd_eis-country-profile-fr.pdf

The dependent variable is R&D intensity, measured as R&D expenditure scaled by total assets and expressed as a percentage. Scaling R&D expenditure by total assets is consistent with prior research in corporate finance and innovation studies (Baysinger et al., 1991; Hall and Lerner, 2010; Hsu et al., 2014), and allows us to compare innovation effort across firms of different sizes. We use total assets rather than sales as the denominator because sales may fluctuate sharply during demand shocks, restructuring periods or controversy-related disruptions, which could introduce noise unrelated to the firm's underlying innovation commitment.

3.3. Independent variable: ESG controversy scores

ESG controversies are measured using Refinitiv's ESG controversy data. This indicator captures negative events related to a firm's environmental, social, or governance conduct, based on information from media sources, NGO reports, and regulatory documents. Following the existing literature, ESG controversies are defined as negative events or incidents associated with a firm's environmental, social, or governance practices that attract public, stakeholder, or regulatory attention. The initial measure is based on Refinitiv's ESG Controversies Score, which ranges from 0 to 100. In the original Refinitiv measure, higher values indicate fewer ESG controversies and better controversy performance, whereas lower values indicate greater exposure to ESG-related controversial events. To facilitate interpretation and ensure that higher values consistently represent greater controversy exposure, we reverse-code the original Refinitiv score as 100 minus the original score. The resulting Cont_Score therefore ranges from 0 to 100 and increases with the firm's exposure to ESG controversies. Higher values indicate greater exposure to controversial ESG events and potentially greater reputational, regulatory and operational pressures. This transformation does not change the underlying information contained in the original Refinitiv

measure; it only reverses its direction so that the empirical coefficients can be interpreted consistently as the effect of greater controversy exposure.

Accordingly, a negative coefficient on Cont_Score indicates that greater ESG controversy exposure is associated with lower corporate R&D intensity, which is consistent with our hypothesis. This coding also facilitates the interpretation of the moderating effect of the CSR committee: a negative main effect combined with a positive interaction term indicates that the CSR committee attenuates the negative association between ESG controversy exposure and R&D intensity.

Beyond the aggregate controversy measure, we construct three domain-specific measures: environmental, social, and governance controversies sub-scores. Environmental controversies sub-scores capture environmental incidents such as pollution, resource misuse, and regulatory violations. Social controversies include labour disputes, product safety failures, and community conflicts, while governance controversies pillar encompasses accounting irregularities, board misconduct, and shareholder-rights violations. Each dimension-specific measure is based on the corresponding Refinitiv controversy score and is transformed in the same way, by subtracting the original score from 100. Thus, Cont_Env, Cont_Soc and Cont_Gov are all coded such that higher values indicate greater exposure to controversies within the respective ESG dimension. Thus, Cont_Env, Cont_Soc, and Cont_Gov are all coded such that higher values indicate greater exposure to controversies within the respective ESG dimension. Analysing these dimensions separately allows us to assess whether the relationship between ESG controversy exposure and R&D intensity is consistent across environmental, social, and governance domains or is primarily driven by specific types of controversy.

All controversy variables are lagged by one year in the regression models. This lag structure helps reduce concerns about reverse causality and reflects the temporal ordering between firms' exposure to ESG controversies and subsequent R&D investment. Specifically, the lagged controversy measures capture firms' exposure to ESG-related controversies in the preceding period, while R&D intensity is measured in the subsequent period. This specification is particularly interesting given that the consequences of ESG controversies are likely to materialize with a lag time. It therefore allows us to examine whether prior exposure to ESG controversies is associated with subsequent corporate R&D intensity.

3.4. Moderating variable: CSR committee

The moderating variable is a binary indicator equal to 1 if the firm has a dedicated board-level CSR or sustainability committee during the fiscal year, and 0 otherwise. CSR committees are formal board sub-committees responsible for overseeing ESG strategy, sustainability reporting and stakeholder-related issues. Unlike ad hoc working groups or management-level task forces, they are institutionalized governance structures with defined mandates and reporting lines to the full board.

3.5. Control Variables

All regressions include firm-level control variables commonly used in studies of R&D investment and corporate governance (Heubeck and Meckl, 2024; Wang et al., 2026). Firm size (Size), measured as the natural logarithm of total assets, controls for differences in firms' scale and resource availability. Leverage (Lev), measured as total financial debt divided by total assets, captures differences in financing structure, as debt obligations may limit the resources available

for long-term R&D investment. Profitability (ROA) is net income over total assets; more profitable firms generate internal cash flows that relax financing constraints on R&D. Tobin's Q (TobinQ) is the market-to-book equity ratio, capturing growth opportunities and market-based incentives for innovation. Cash holdings (Cash) measures liquidity available for discretionary spending through the ratio cash and equivalents over total assets. Sales growth (SalesGr) is the year-on-year change in net revenues, capturing demand-pull incentives for product innovation. All continuous variables are Winsorised at the 1st and 99th percentiles. All models include firm fixed effects (to absorb unobserved time-invariant heterogeneity) and year fixed effects (to remove common macroeconomic shocks). Standard errors are clustered at the firm level throughout.

3.6. Empirical Models

We estimate two-way fixed-effects panel regression models. The baseline specification is:

$$R\&D/Assets_{i,t} = \alpha + \beta_1 Cont_Xi,t-1 + \beta_2 Controls_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t} \quad (1)$$

where $R\&D/Assets_{i,t}$ is R&D expenditure scaled by total assets for firm i in year t ; $Cont_Xi,t-1$ is the one-year-lagged ESG controversy score; $Controls_{i,t}$ is the vector of financial controls described in Section 3.6; μ_i are firm fixed effects; λ_t are year fixed effects; and $\varepsilon_{i,t}$ is the idiosyncratic error term. Standard errors are clustered at the firm level. The coefficient of interest is β_1 , expected to be negative under H1.

To test H2 whether the CSR committee moderates the controversy-R&D relationship we augment Model (1) with the committee indicator and its interaction term:

$$R\&D/Assets_{i,t} = \alpha + \beta_1 Cont_Xi,t-1 + \beta_2 CSR_Com_{i,t} + \beta_3 (Cont_X \times CSR_Com)_{i,t} + \beta_4 Controls_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t} \quad (2)$$

In Model (2), β_1 captures the marginal effect of controversies on R&D for firms without a CSR committee (CSR_Com = 0). The interaction coefficient β_3 is the key test for H2: a positive and significant estimate implies that the CSR committee attenuates the negative controversy-R&D relationship. The total marginal effect for firms with a CSR committee equals $(\beta_1 + \beta_3)$. The same interaction structure is applied to each of the four additional moderators (BGD, InstOwn, CEO_Dual, FamOwn), replacing CSR_Com in Model (2) one at a time.

For robustness analysis, we employ three complementary estimation strategies. First, we replace the continuous controversy scores with binary indicators equal to one when the score of ESG controversy exceeds 50 in a given year (above-median controversy exposure), retaining the two-way fixed-effects structure of Model (1). Second, we estimate the dynamic panel model of Blundell and Bond (1998):

$$R\&D/Assets_{i,t} = \alpha + \delta R\&D/Assets_{i,t-1} + \beta_1 Cont_Xi_{i,t-1} + \beta_k Controls_{i,t} + \lambda_t + \varepsilon_{i,t} \quad (3)$$

where δ captures the persistence of R&D investment. This approach uses lagged levels and differences of endogenous variables as internal instruments, addressing both reverse causality and omitted variable bias. Instrument validity is assessed via the Hansen J overidentification test and the Arellano-Bond AR(2) test for second-order serial correlation. Third, we implement two-stage least squares (2SLS), instrumenting for controversy scores using industry-year mean controversy scores (excluding the focal firm) and one-year lags. The exclusion restriction requires that peer-level controversy exposure affects a firm's R&D only through its own controversy score a plausible assumption given that industry reputational spillovers operate primarily through stakeholder perceptions of the focal firm rather than through direct investment channels. Instrument strength

is assessed via first-stage F-statistics benchmarked against the Stock and Yogo (2005) 5% critical value of 16.38. We also implement propensity score matching (PSM) to construct a counterfactual control group of low-controversy firm-years matched on financial and governance observables, with the average treatment effect on the treated (ATT) estimated using one-to-one nearest-neighbour matching without replacement and bootstrapped standard errors.

4. Empirical results

4.1. Descriptive statistics and correlations

Table 1 reports descriptive statistics for the full sample. R&D intensity averages 3.12% of total assets (Std. Dev. = 4.87), with a right-skewed distribution reflecting the coexistence of R&D-intensive manufacturers and lower-intensity service firms. The descriptive statistics for ESG controversy variables are reported after reverse-coding, so that higher values indicate greater controversy exposure. The aggregate ESG controversy score averages 44.87 out of 100 (Std. Dev. = 21.34; range: 5–95), indicating substantial variation in controversy exposure across firms and over time the empirical prerequisite for identifying the relationship of interest. Social controversies record the highest average (Cont_Soc = 46.12), followed by governance (Cont_Gov = 43.54) and environmental (Cont_Env = 41.23), consistent with French firms' historical exposure to labour-related disputes and social stakeholder pressure. CSR_Com averages 0.52, confirming that a dedicated sustainability committee is present in approximately half of firm-year observations a penetration rate that increased markedly over the sample period in the wake of the Grenelle II law.

[Insert table 1 about here]

Table 2 presents the Pearson correlation matrix and VIF values. Three results are noteworthy. First, all four controversy measures correlate negatively with R&D intensity (range: -0.15 to -0.19, all significant at the 1% level), providing initial, unconditional support for H1.

Second, the CSR committee is negatively correlated with R&D/Assets in the unconditional correlation matrix ($r = -0.21$, $p < 0.01$). This descriptive correlation should be interpreted with caution, as the multivariate analysis focuses on the moderating role of CSR committees in the controversy-R&D relationship. Third, all correlations are relatively low and range below the critical value of 0.8, as reported by Gujarati (2004). In addition, all the values of the variance inflation factor (VIF) are below 3 (maximum = 2.31), ruling out multicollinearity as a concern for interpretation.

[Insert table 2 about here]

4.2. ESG controversies and R&D intensity

Table 3 reports the estimates of Model (1). Column (1) presents the results using the aggregate ESG Controversy Score, while Columns (2)–(4) reports those for the environmental, social, and governance controversy sub-scores, respectively. The coefficient on the lagged controversy measure is negative and statistically significant at the 1% level in all four specifications. Specifically, the coefficient on Cont_Score ($t-1$) is -0.051 ($t = -4.82$). This negative coefficient indicates that firms with greater exposure to ESG controversies tend to exhibit lower R&D intensity, consistent with H1.

In economic terms, a one-standard-deviation increase in the aggregate Cont_Score (21.34 points), representing a higher level of ESG controversy exposure, is associated with a 1.09 percentage-point decrease in R&D intensity ($-0.051 \times 21.34 = -1.09$). This effect is economically meaningful,

representing approximately 34.9% of the sample mean of R&D intensity. The estimated association is strongest for environmental controversies (-0.067), followed by social controversies (-0.034), and weakest for governance controversies (-0.019). This pattern suggests that environmental and social controversies are more strongly associated with reductions in R&D intensity than governance controversies. The findings could be partially explained by the significant position occupied by the environmental considerations in French market and the country's high sensitivity to social issues. In such context, environmental and social controversies tend to generate substantial reputational, regulatory, and stakeholder pressures that increase firms' short-term constraints and reduce their capacity or willingness to allocate resources to long-term innovation activities. Governance controversies, in contrast, may generate relatively more concentrated pressure from financial and institutional stakeholders.

Regarding the control variables, firm size is not statistically significant in any of the four specifications. Leverage is negative and statistically significant across all models, with coefficients ranging from -1.508 to -1.954 , suggesting that higher leverage is associated with lower R&D intensity, consistent with the possibility that debt obligations constrain discretionary or risky investment, such as R&D. Tobin's Q is positive and statistically significant at the 1% level in all specifications, indicating that firms with greater growth opportunities tend to invest more intensively in R&D. Cash holdings are positive and statistically significant in Columns (2)–(4), but not statistically significant in Column (1). ROA and sales growth are positive in all specifications but are not statistically significant.

[Insert table 3 about here]

4.3. The moderating role of the CSR committee

Table 4 reports the estimates of Model (2), which examines whether the presence of a dedicated CSR/sustainability committee moderates the relationship between ESG controversies and corporate R&D intensity. The interaction term between $\text{Cont_X}(t-1)$ and CSR_Com is positive and statistically significant in all four specifications, with coefficients ranging from 0.009 to 0.014. This positive interaction indicates that the presence of a CSR committee weakens the negative association between ESG controversy exposure and R&D intensity. Thus, although greater controversy exposure remains negatively associated with R&D investment, this negative association is less pronounced among firms with a dedicated CSR/sustainability committee.

The economic magnitude of the moderating effect is particularly clear in Column (1). For firms without a CSR committee, the marginal effect of the Controversy Score on R&D intensity is -0.026 . In contrast, for firms with a CSR committee, the marginal effect is lower ($-0.026 + 0.014 = -0.012$). Accordingly, the negative association between controversy exposure and R&D intensity is substantially attenuated for firms with a CSR committee. Given a one-standard-deviation increase in the Cont_Score of 21.34 points, representing a higher level of ESG controversy exposure under the reverse-coded measure, the implied decrease in R&D intensity is approximately 0.55 percentage points for firms without a CSR committee, compared with approximately 0.26 percentage points for firms with a CSR committee. In relative terms, the presence of a CSR committee reduces the magnitude of the negative association by approximately 54%.

These findings suggest that a dedicated CSR/sustainability committee helps mitigate the adverse association between ESG controversy exposure and corporate R&D intensity. Rather than strengthening the negative effect of controversies on R&D investment, the presence of a CSR

committee appears to buffer this relationship. One possible explanation is that board-level CSR governance helps firms better manage ESG-related pressures and protect longer-term strategic investments, including R&D, when firms face controversy-related challenges. This interpretation is consistent with the view that dedicated CSR governance mechanisms can help firms integrate ESG considerations into strategic decision-making and mitigate the potential disruption caused by ESG controversies.

[Insert table 4 about here]

Figure 2 shows the moderating effect of the CSR committee on the relationship between controversies and R&D intensity. The four panels illustrate that while increasing controversy exposure generally leads to a decline in R&D investment, this negative impact is significantly less severe for firms equipped with board-level sustainability governance.

For firms without a sustainability committee (CSR_Com = 0, blue line), the steep downward slope indicates that R&D intensity is highly sensitive to reputational shocks. In contrast, for firms with a committee (CSR_Com = 1, red line), the slope is much flatter. This visual divergence confirms that a CSR committee acts as a protective governance mechanism, preserving the firm's capacity for strategic innovation and effectively shielding R&D budgets from being crowded out during periods of high controversy.

[Insert figure 2 about here]

4.4. Additional tests

To assess the generality of the governance buffering logic and to identify additional moderating mechanisms, we extend the interaction analysis to four governance and ownership variables. Each

sub-section below presents the theoretical rationale for the expected moderation, describes the variable, and discusses the empirical results.

4.4.1. Board gender diversity

Board gender diversity (BGD) may attenuate the negative relationship between ESG controversies and R&D intensity. Recent evidence links gender-diverse boards to stronger innovation outcomes. Lakhal et al. (2024) find that board gender diversity is positively associated with both corporate and green innovation in French listed firms. Kyaw et al. (2025) also show that gender-diverse boards strengthen the relationship between R&D investment and firm value, with evidence of a protective role during financial crises. Building on these findings, we argue that greater diversity in the boardroom may encourage closer consideration of the long-term consequences of cutting R&D when controversies arise. This could help firms address immediate stakeholder concerns without sacrificing investment in future innovation.

Moreover, BGD tends to encourage firms to invest in both innovation and eco-innovation, especially in French context (Lakhal et al., 2024). The institutional leverage provided by the Copé-Zimmermann quota law (2011) further strengthens identification of this effect in this setting. BGD is measured as the proportion of female directors on the board of directors.

Table 5 confirms this expectation. The interaction Controversy $\times$ BGD is positive and significant across all four controversy dimensions (range: 0.014 to 0.021, all $p < 0.05$). Gender-diverse boards thus buffer the adverse innovation consequences of ESG controversies, consistent with the view that board composition shapes the quality and orientation of strategic responses under adversity.

[Insert table 5 about here]

4.4.2. Institutional ownership

Institutional investors are expected to moderate the controversy-R&D relationship through two complementary channels. First, their monitoring role may deter management from cutting R&D as a defensive cost-reduction measure, since institutional investors typically scrutinize strategic investment decisions more closely than dispersed retail shareholders (Bushee, 1998). Second, their long-term investment horizon provides an anchor for preserving innovation budgets even when short-run reputational pressure would otherwise dominate. Firms with greater institutional ownership may also benefit from a faster controversy resolution process, as blockholders can engage directly with management to demand timely remediation. InstOwn is the proportion of outstanding shares held by institutional investors including mutual funds, pension funds, insurance companies, and sovereign wealth funds.

Table 6 supports this reasoning. The interaction Controversy $\times$ InstOwn is positive and significant in all four specifications, indicating that higher institutional ownership meaningfully attenuates the negative effect of ESG controversies on R&D intensity. This finding reinforces the idea that ownership structure is not merely a determinant of baseline R&D spending but also a resilience mechanism during periods of reputational adversity.

[Insert table 6 about here]

4.4.3. CEO duality

CEO duality is expected to amplify the controversy-R&D penalty rather than attenuate it. When the CEO also chairs the board, decision-making authority is concentrated in a single individual who simultaneously faces the reputational pressure of the controversy, the operational challenge of crisis management, and the scrutiny of the board whose oversight is weakened by the absence

of an independent chairman. Under this power concentration, the dominant executive is more likely to respond to controversy episodes with defensive, short-termist decisions, including R&D reductions, with limited internal counterweight from the board. Jensen (1993) and Rechner and Dalton (1991) document that CEO duality weakens board oversight more broadly; our test examines whether this weakening has consequences specifically for innovation investment under reputational stress. CEO_Dual is a binary variable equal to one if the CEO simultaneously holds the board chairmanship, and zero otherwise.

Table 7 confirms this expectation. The interaction Controversy $\times$ CEO_Dual is negative and significant across all four controversy dimensions (range: -0.011 to -0.017, all $p < 0.05$), indicating that CEO duality exacerbates the controversy-R&D penalty. This result underscores that governance structures which concentrate power can transform an already adverse effect into a more severe erosion of innovation capacity.

[Insert table 7 about here]

4.4.4. Family ownership

Family ownership may weaken the negative relationship between ESG controversies and R&D intensity. Family owners often identify closely with the firm and value its continuity across generations, making its reputation and future viability important concerns (Berrone et al., 2012). These concerns may encourage them to preserve investments that support the firm's recovery and long-term competitiveness. Consistent with this argument, Sun et al. (2019) find that, among firms without financial constraints, family firms were more likely than non-family firms to invest in R&D during the Great Recession.

This does not imply that family firms consistently spend more on R&D. Duran et al. (2016) show that they generally invest less in innovation but use these resources more efficiently. Our argument concerns their response to controversy-related pressures: when cutting R&D could undermine the firm's future prospects, family owners may be more willing to sustain these investments to protect the business they intend to pass on. We therefore expect family ownership to attenuate the negative association between ESG controversies and R&D intensity. FamOwn is measured as the proportion of outstanding shares held by the founding family or its descendants.

Table 8 supports these predictions. The interaction Controversy $\times$ FamOwn is positive and significant across all four specifications (range: 0.013 to 0.019, all $p < 0.05$). Family-owned firms are thus better able to sustain R&D investment in the face of ESG controversy exposure, consistent with the socioemotional wealth preservation logic and the long-term orientation that characterises family capitalism.

[Insert table 8 about here]

4.5. Robustness tests

We conduct three sets of robustness tests to assess the sensitivity of our findings to measurement choices and estimation assumptions: alternative measure of ESG controversy, the two-step system GMM, and instrumental variables to address endogeneity.

4.5.1. Alternative measure of ESG controversies

Table 9 replaces continuous controversy scores with binary indicators ($D_Cont_X = 1$ if the score exceeds 50). The negative main effects are preserved and significant across all four dimensions. This confirms that the controversy-R&D relationship is not an artefact of the continuous scaling of the Refinitiv measure.

[Insert table 9 about here]

4.5.2. Addressing endogeneity: GMM regression

Table 10 estimates Model (3) using the two-step system GMM of Blundell and Bond (1998) to address dynamic endogeneity and the known persistence of R&D expenditures. The Hansen J test p-values (0.287–0.312) confirm instrument validity; the absence of AR(2) serial correlation validates the moment conditions. The key controversy coefficients remain negative and significant (-0.014 to -0.024) is robust to this more demanding estimator.

[Insert table 10 about here]

Table 11 uses 2SLS with industry-year mean controversy scores and lagged controversy values as instruments. First-stage F-statistics range from 63.4 to 74.3, all well above the Stock and Yogo 5% critical value of 16.38, confirming strong instrument relevance. The instrumented controversy estimates remain negative and significant. Table 12 reports PSM estimates: ATT coefficients range from -0.218 to -0.347 (all $p < 0.01$) and post-match standardized bias falls below 5% across all matching covariates, confirming covariate balance.

Overall, the tests show that the controversy-R&D relationship is robust to endogeneity, dynamic persistence, and selection concerns.

[Insert table 11 about here]

[Insert table 12 about here]

5. Discussion

This study aims to examine the relationship between ESG controversies and corporate R&D investment, as well as the potential moderating role of board-level sustainability governance. The

findings show that, across all controversy dimensions aggregate, environmental, social, and governance negatively impact R&D intensity relative to the sample mean. This effect persists after dynamic endogeneity correction (system GMM), instrumental variable estimation (2SLS), alternative controversy measurement (binary indicators), and selection adjustment (PSM), providing strong evidence that the relationship is not a statistical artefact.

The negative effect of ESG controversy on firm's R&D intensity can be explained by two complementary mechanisms. First, the resource reallocation channel arises from the direct budgetary competition between controversy remediation costs such as legal settlements, regulatory fines, stakeholder compensation, and crisis communication and R&D spending. Given the long payback horizon and uncertain returns associated with R&D, such investment is often deferred, while controversy-related expenditures are naturally prioritized when short-term pressures intensify. The second mechanism managerial distraction operates through the reallocation of senior management attention: controversy episodes compel executives to redirect their attention toward crisis management and stakeholder concerns, at the cost of the forward-looking deliberation that sustains innovation pipelines. These mechanisms are consistent with the attention-based view of the firm (Ocasio, 1997).

The disaggregated analysis reveals that the controversy-R&D penalty varies across ESG dimensions: it is strongest for environmental incidents (-0.027) and weakest for governance controversies (-0.019). Environmental and social controversies tend to engage a broader range of stakeholders, including consumers, regulators, communities, and the media generating more diffuse and sustained pressure than governance controversies, which primarily involve financial and institutional audiences. This heterogeneity carries important methodological implications:

treating ESG as a unidimensional construct masks domain-specific dynamics that are theoretically and practically relevant.

The main contribution of this paper lies in moderation analysis, which reveals that board-level sustainability governance through CSR committee—significantly attenuates the negative effect of ESG controversy on R&D investment. Specifically, firms with a dedicated sustainability committee experience a reduction of over 50% in their controversy-R&D penalty. This protective effect can be explained by three key mechanisms. First, CSR committees provide the board with timely, structured ESG insights, enabling earlier detection of controversy escalation and more deliberate rather than reactive strategic responses. Second, they signal credible ESG commitment to external stakeholders, potentially tempering the intensity and duration of backlash following a controversy event. Third, by institutionalizing long-term thinking at board level, they make it harder to justify the sacrifice of strategic investment for short-run cost savings.

The additional moderation tests clarify which governance, and ownership configurations either preserve or undermine the buffering effect of ESG controversy on R&D intensity. Board gender diversity and institutional ownership both reduce the controversy-R&D penalty. Gender-diverse boards bring broader stakeholder perspectives and a more deliberative decision-making, while institutional investors provide monitoring and an extended investment horizon, which help stabilizes strategic commitments such as R&D. In contrast, CEO duality amplifies the penalty. The concentration of authority in a single executive removes the internal counterweight needed to resist defensive R&D cuts under pressure. Family ownership, however, mitigates the effect, consistent with socioemotional wealth theory: founding families preserve innovation investment as an expression of long-run competitive ambition and dynastic legacy.

These findings highlight a broader principle: the innovation consequences of ESG controversies depend heavily on the governance architecture of the firm. Governance structures that promote distributed authority, long-term planning, and stakeholder accountability such as CSR committees, gender-diverse boards, institutional monitoring, and family stewardship — help preserve R&D under adversity. In contrast, structures that centralize power and prioritize short-term planning such as CEO duality exacerbate the innovation cost of controversies.

5.1. Theoretical Contributions

This paper makes three primary contributions to literature. First, it establishes a novel link between ESG controversies and corporate R&D investment. While prior research has examined market reactions to ESG-related news (Capelle-Blancard & Petit, 2019; Krüger, 2015), our study extends this literature by showing that ESG controversies also have implications for firms' long-term investment in R&D. Specifically, they include the erosion of the firm's innovation capacity, a consequence with long-run competitive implications. Second, we contribute to the corporate governance and innovation literature by introducing the CSR committee as a governance moderator of R&D investment. While prior works have focused on-board independence, directors' expertise, and executive incentive structures (Baysinger et al., 1991; Hoskisson et al., 2002), we find that sustainability governance structures particularly those designed to manage ESG-related stakeholder relationships also significantly affect the firm's ability to maintain innovation during adversity. This finding emphasizes the importance of incorporating sustainability governance mechanisms into theoretical frameworks of corporate innovation. Third, we contribute to stakeholder theory and the resource-based view by demonstrating that sustainability governance serves as an organizational resilience mechanism. Although CSR committees, gender-diverse boards, and institutional monitoring are typically studied as drivers of ESG performance or

financial value, we show that they also act as buffers that preserve strategic resources specifically R&D during periods of reputational stress. This reframes sustainability governance as a strategic asset with tangible implications for long-run value creation.

5.2. Practical implications

The findings of this study carry significant practical implications for boards, investors, and policymakers. For boards and senior management, this study uncovers a hidden cost of ESG controversies often overlooked risk assessments: the erosion of innovation capacity. Boards that allow controversy exposure to escalate risk triggering a downward spiral in which reputational damage progressively crowds out the R&D needed to rebuild competitive strength. The governance moderation results offer actionable insights: establishing a dedicated CSR committee, promoting gender diversity on the board, and ensuring active institutional investor engagement are not merely signaling mechanisms they serve as structural safeguards for long-term innovation investment.

For institutional investors and asset managers, the controversy-R&D link implies a value destruction channel that may not be fully incorporated into short-term stock price reactions. ESG engagement strategies should explicitly address the innovation consequences of controversy exposure, pushing for timely remediation and governance reform not only to restore reputation but to preserve the innovation pipelines that drive long-run returns. The findings also reinforce the case for robust ESG stewardship frameworks such as the French Code Afep-Medef and the UK Stewardship Code.

For policymakers, the French experience offers a model worth examining. The Grenelle II mandatory reporting framework and the Loi Pacte's corporate purpose provisions have collectively

raised the salience of ESG governance among large, listed firms. Our results suggest that these regulatory interventions have had a positive and previously unrecognized spillover effect: by incentivizing the adoption of CSR committees and strengthening board-level sustainability oversight, they have also helped protect corporate innovation capacity. This finding is directly relevant to the EU Green Deal agenda and the broader Horizon Europe objectives, which seek to mobilize private-sector R&D in support of the sustainability transition.

5.3. Limitations and research perspectives

This paper presents certain limitations. First, although the dataset covers the interesting setting of France, the sample remains relatively limited, thereby constraining the generalizability of the findings to other specific contexts. Second, this study relies on Refinitiv ESG controversy scores, which, while widely used in the literature, do not fully capture the severity and the duration of controversies. Third, CSR committee is measured as a binary variable rather than a continuous one. This approach does not account for variations in the extent of associated characteristics and practices, a limitation stemming from the unavailability of continuous data for this variable in the dataset. To address these limitations, future research could adopt a qualitative approach to better capture the nuances of controversy characteristics and governance practices. Finally, significant work remains to be done to deepen our understanding of how the personal traits of directors, alongside board-level sustainability governance, affect the controversy-R&D penalty.

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List of tables

Table 1. Descriptive statistics

Variable	N	Mean	Std. Dev.	Min	Median	Max
R&D/Assets	3,412	3.12	4.87	0.00	1.24	21.43
Cont_Score	3,412	44.87	21.34	5.02	44.00	95.34
Cont_Env	3,412	41.23	23.87	0.04	40.06	96.12
Cont_Soc	3,412	46.12	22.14	0.06	45.16	96.69
Cont_Gov	3,412	43.54	20.98	0.01	42.58	98.73
CSR_Com	3,412	0.52	0.54	0.00	0.49	1.00
Size	3,412	15.43	1.87	11.32	15.28	19.87
Lev	3,412	0.26	0.17	0.00	0.24	0.76
ROA	3,412	4.87	6.93	-21.40	4.62	19.80
TobinQ	3,412	1.76	1.18	0.48	1.42	6.87
Cash	3,412	0.10	0.09	0.00	0.08	0.49
SalesGr	3,412	0.06	0.18	-0.51	0.05	0.68

Notes: Full sample of 262 French listed firms, 2005–2021 (3,412 firm-year observations). R&D/Assets = R&D expenditure/total assets (%). Cont_Score, Cont_Env, Cont_Soc, Cont_Gov = Refinitiv ESG controversy scores (0–100; higher = greater controversy exposure). CSR_Com = 1 if a dedicated CSR/sustainability board committee exists. Size = $\ln(\text{total assets})$; Lev = total debt/total assets; ROA = net income/total assets (%); TobinQ = market-to-book ratio; Cash = cash/total assets; SalesGr = year-on-year sales growth.

Table 2. Pearson correlation matrix

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	VIF
(1) R&D/Assets	1.00												-
(2) Cont_Score	-0.39***	1.00											-
(3) Cont_Env	-0.13**	0.07*	1.00										-
(4) Cont_Soc	-0.21**	0.04***	0.71***	1.00									-
(5) Cont_Gov	-0.15*	0.02***	0.69	0.73**	1.00								-
(6) CSR_Com	-0.21**	-0.13*	-0.11***	-0.12***	-0.10*	1.00							2.08
(7) Size	-0.09**	0.23*	0.21***	0.19***	0.18**	0.12***	1.00						1.94
(8) Lev	-0.22***	0.09**	0.08**	0.07	0.08**	-0.08***	0.14*	1.00					2.24
(9) ROA	0.31***	-0.18***	-0.21**	-0.15***	-0.14**	-0.09	-0.10***	-0.31***	1.00				2.12
(10) TobinQ	0.29	-0.13**	-0.22	-0.11***	-0.10***	0.07**	-0.21***	-0.19**	0.41*	1.00			1.71
(11) Cash	0.23***	-0.15*	-0.09	-0.08**	-0.09**	0.06**	-0.11	-0.14***	0.30***	0.24	1.00		1.38
(12) SalesGr	0.07**	-0.06	-0.05*	-0.05*	-0.04*	0.04	-0.04	-0.17**	0.31*	0.18	0.09***	1.00	1.43

*Notes: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$ (two-tailed). VIF values computed on the baseline fixed-effects model. All VIF values below 3, indicating no multicollinearity concern.*

Table 3. ESG controversies and corporate R&D intensity

Variable	(1) Cont_Score	(2) Cont_Env	(3) Cont_Soc	(4) Cont_Gov
Cont_X (t-1)	-0.051*** (-4.82)	-0.067*** (-4.21)	-0.034*** (-3.87)	-0.019*** (-3.54)
Size	-0.312 (-0.54)	-0.198 (-0.38)	-0.405 (-0.46)	-0.187 (-0.21)
Lev	-1.687** (-2.15)	-1.954*** (-5.71)	-1.832*** (-5.63)	-1.508*** (-5.54)
ROA	0.088 (0.76)	0.043 (0.54)	0.071 (0.87)	0.069 (0.21)
TobinQ	0.443*** (6.54)	0.351*** (6.71)	0.238*** (6.43)	0.129*** (6.18)
Cash	2.876 (0.98)	2.643** (6.82)	2.861** (2.11)	2.919*** (6.67)
SalesGr	0.287 (0.21)	0.274 (0.03)	0.281 (0.12)	0.265 (0.87)
Constant	3.543*** (10.87)	4.487*** (10.54)	1.512*** (10.71)	6.398*** (10.23)
<i>Firm FE</i>	Yes	Yes	Yes	Yes
<i>Year FE</i>	Yes	Yes	Yes	Yes
<i>N (firm-years)</i>	3,412	3,412	3,412	3,412
<i>N (firms)</i>	262	262	262	262
<i>Adj. R²</i>	0.498	0.491	0.487	0.479

<i>F-statistic</i>	34.21***	32.87***	31.54***	29.87***
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*Notes: Dependent variable is R&D/Assets. Two-way fixed effects (firm and year). Cont_X (t-1) is the one-year-lagged ESG controversy score for each dimension. Standard errors clustered at the firm level; t-statistics in parentheses. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.*

Table 4. The moderating role of the CSR committee

Variable	(1) Cont_Score	(2) Cont_Env	(3) Cont_Soc	(4) Cont_Gov
Cont_X (t-1)	-0.026*** (-3.54)	-0.022*** (-3.21)	-0.019*** (-2.98)	-0.015** (-2.54)
CSR_Com	0.134 (0.98)	0.128** (1.87)	0.121 (0.76)	0.116* (1.65)
Controversy × CSR_Com	0.014** (2.09)	0.012** (1.98)	0.013*** (3.98)	0.009*** (5.87)
Size	-0.289** (-2.86)	-0.276*** (-4.03)	-0.283** (-2.88)	-0.264*** (-3.94)
Lev	-1.912*** (-5.43)	-1.876*** (-5.28)	-1.892** (-2.46)	-1.876*** (-5.19)
ROA	0.061 (0.41)	0.057 (0.24)	0.064 (0.54)	0.053 (0.09)
TobinQ	0.221 (1.02)	0.229** (2.48)	0.216*** (5.94)	0.208*** (5.78)
Cash	2.754*** (6.54)	2.721*** (6.41)	2.738*** (6.48)	2.697*** (6.29)
SalesGr	0.264** (1.87)	0.251*** (3.74)	0.258*** (3.81)	0.243*** (3.62)
<i>Firm & Year FE</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>
<i>N (firm-years)</i>	<i>3,412</i>	<i>3,412</i>	<i>3,412</i>	<i>3,412</i>
<i>N (firms)</i>	<i>262</i>	<i>262</i>	<i>262</i>	<i>262</i>

Adj. R^2	0.505	0.498	0.494	0.486
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Notes: Dependent variable is R&D/Assets. CSR_Com = 1 if the board has a dedicated CSR/sustainability committee. Controversy $\times$ CSR_Com is the interaction term. Controls and fixed effects as in Table 3. t-statistics in parentheses (clustered by firm). *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.

Figure 2: The marginal effect of CSR Committee

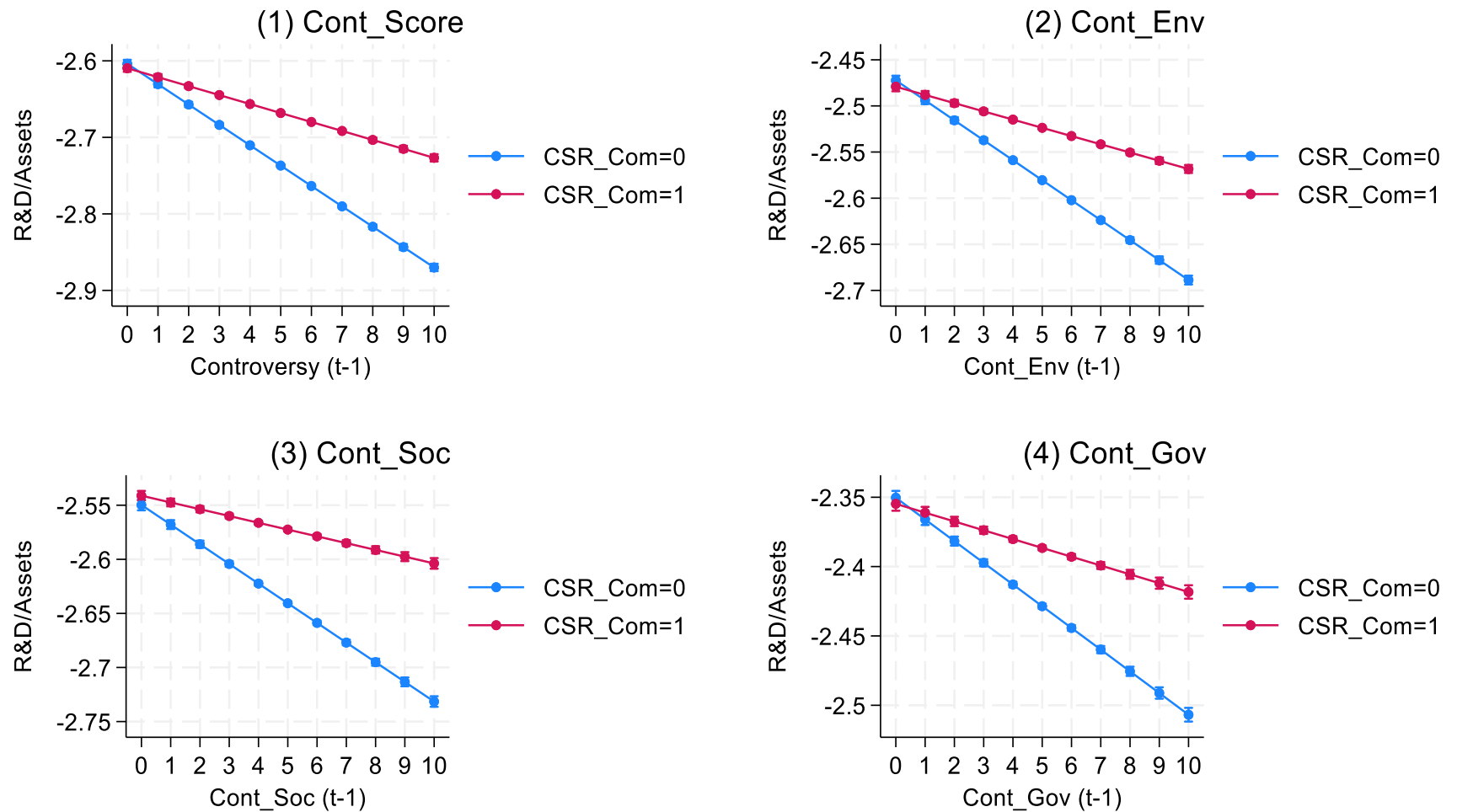


Table 5. Additional test: the moderating role of board gender diversity

Variable	Cont_Score	Cont_Env	Cont_Soc	Cont_Gov
Cont_X (t-1)	-0.043*** (-4.87)	-0.038*** (-4.54)	-0.033*** (-4.12)	-0.026*** (-3.54)
BGD	0.038** (2.43)	0.035 (0.21)	0.033** (2.09)	0.029 (0.98)
Controversy × BGD	0.021*** (2.98)	0.018* (1.96)	0.019*** (2.76)	0.014** (2.31)
<i>Controls</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>
<i>Firm, Industry & Year FE</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>
<i>N (firm-years)</i>	<i>3,412</i>	<i>3,412</i>	<i>3,412</i>	<i>3,412</i>
<i>Adj. R²</i>	<i>0.512</i>	<i>0.504</i>	<i>0.498</i>	<i>0.487</i>

*Notes: Dependent variable is R&D/Assets. BGD = proportion of female directors on the board. Controversy × BGD is the interaction term. Controls and fixed effects as in Table 3. t-statistics in parentheses (clustered by firm). *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.*

Table 6. Additional test: the moderating role of institutional ownership

Variable	Cont_Score	Cont_Env	Cont_Soc	Cont_Gov
Cont_X (t-1)	-0.038*** (-4.54)	-0.033*** (-4.12)	-0.029*** (-3.76)	-0.022*** (-3.21)
InstOwn	0.027** (2.09)	0.024** (1.98)	0.022** (1.87)	0.018* (1.76)
Controversy × InstOwn	0.015*** (2.76)	0.013** (2.43)	0.012*** (3.21)	0.010*** (4.98)
<i>Controls</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>
<i>Firm, Industry & Year FE</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>
<i>N (firm-years)</i>	<i>3,412</i>	<i>3,412</i>	<i>3,412</i>	<i>3,412</i>
<i>Adj. R²</i>	<i>0.507</i>	<i>0.499</i>	<i>0.494</i>	<i>0.483</i>

*Notes: Dependent variable is R&D/Assets. InstOwn = proportion of shares held by institutional investors. Controversy × InstOwn is the interaction term. Controls and fixed effects as in Table 3. t-statistics in parentheses (clustered by firm). *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.*

Table 7. Additional test: the moderating role of CEO duality

Variable	(1) Cont_Score	(2) Cont_Env	(3) Cont_Soc	(4) Cont_Gov
Cont_X (t-1)	-0.029*** (-3.87)	-0.025*** (-3.43)	-0.022*** (-3.09)	-0.017*** (-2.76)
CEO_Dual	-0.176** (-2.09)	-0.171** (-2.04)	-0.168** (-1.99)	-0.163** (-1.94)
Controversy × CEO_Dual	-0.017** (-2.21)	-0.014** (-2.01)	-0.015** (-2.09)	-0.011*** (-6.87)
<i>Controls</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>
<i>Firm, Industry & Year FE</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>
<i>N (firm-years)</i>	<i>3,412</i>	<i>3,412</i>	<i>3,412</i>	<i>3,412</i>
<i>N (firms)</i>	<i>262</i>	<i>262</i>	<i>262</i>	<i>262</i>
<i>Adj. R²</i>	<i>0.503</i>	<i>0.496</i>	<i>0.492</i>	<i>0.484</i>

*Notes: Dependent variable is R&D/Assets. CEO_Dual = 1 if the CEO also chairs the board. A negative interaction indicates CEO duality amplifies (worsens) the controversy-R&D penalty. Controls and fixed effects as in Table 3. t-statistics in parentheses (clustered by firm). *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.*

Table 8. Additional test: the moderating role of family ownership

Variable	(1) Cont_Score	(2) Cont_Env	(3) Cont_Soc	(4) Cont_Gov
Cont_X (t-1)	-0.038*** (-4.54)	-0.033*** (-3.98)	-0.029*** (-3.65)	-0.023*** (-3.21)
FamOwn	0.081** (2.43)	0.076** (2.31)	0.073** (2.21)	0.069* (1.98)
Controversy × FamOwn	0.019*** (2.65)	0.016** (2.43)	0.017*** (2.54)	0.013** (2.21)
<i>Controls</i>	Yes	Yes	Yes	Yes
<i>Firm, Industry & Year FE</i>	Yes	Yes	Yes	Yes
N (firm-years)	2,934	2,934	2,934	2,934
N (firms)	234	234	234	234

*Notes: Dependent variable is R&D/Assets. FamOwn = proportion of shares held by the founding family. Reduced sample reflects availability of family ownership data. Controls and fixed effects as in Table 3. t-statistics in parentheses (clustered by firm). *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.*

Table 9. Binary controversy measures

Variable	(1) D_Score	(2) D_Env	(3) D_Soc	(4) D_Gov
D_Cont_X (t-1) [Score > 50]	-0.287*** (-3.98)	-0.243*** (-3.54)	-0.218*** (-3.21)	-0.176*** (-2.87)
<i>Controls</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>
<i>Firm, Industry & Year FE</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>
<i>N (firm-years)</i>	<i>3,412</i>	<i>3,412</i>	<i>3,412</i>	<i>3,412</i>
<i>N (firms)</i>	<i>262</i>	<i>262</i>	<i>262</i>	<i>262</i>
<i>Adj. R²</i>	<i>0.496</i>	<i>0.488</i>	<i>0.484</i>	<i>0.476</i>

*Notes: Dependent variable is R&D/Assets. D_Cont_X = 1 if controversy score exceeds 50 (above-median exposure), 0 otherwise. Controls and fixed effects as in Table 3. t-statistics in parentheses (clustered by firm). *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.*

Table 10. System GMM estimation (Blundell & Bond, 1998)

Variable	(1) Cont_Score	(2) Cont_Env	(3) Cont_Soc	(4) Cont_Gov
L.DV	-0.064 (-0.78)	-0.079 (-0.94)	-0.098 (-0.81)	-0.056 (-0.67)
Cont_X (t-1)	-0.024*** (-3.76)	-0.021*** (-3.43)	-0.018*** (-3.09)	-0.014** (-2.65)
<i>Controls</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>
<i>Firm, Industry & Year FE</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>
<i>N (firm-years)</i>	<i>2,887</i>	<i>2,887</i>	<i>2,887</i>	<i>2,887</i>
<i>N (firms)</i>	<i>262</i>	<i>262</i>	<i>262</i>	<i>262</i>
<i>Hansen J p-value</i>	<i>0.298</i>	<i>0.312</i>	<i>0.287</i>	<i>0.304</i>
<i>AR(1) p-value</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>
<i>AR(2) p-value</i>	<i>0.204</i>	<i>0.218</i>	<i>0.197</i>	<i>0.211</i>

*Notes: Dependent variable is R&D/Assets. Two-step system GMM (Blundell & Bond, 1998) with Windmeijer (2005) corrected standard errors. Hansen J confirms instrument validity ($p > 0.10$). Absence of AR(2) confirms instrument exogeneity. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.*

Table 11. Instrumental variable estimation (2SLS)

Variable	(1) Cont_Score	(2) Cont_Env	(3) Cont_Soc	(4) Cont_Gov
Cont_X (t-1)	-0.039*** (-3.43)	-0.034*** (-3.09)	-0.031*** (-2.87)	-0.024** (-2.54)
<i>Controls</i>	Yes	Yes	Yes	Yes
<i>Firm, Industry & Year FE</i>	Yes	Yes	Yes	Yes
<i>N (firm-years)</i>	3,412	3,412	3,412	3,412
<i>N (firms)</i>	262	262	262	262
<i>First-stage F-stat</i>	74.3***	68.7***	71.2***	63.4***
<i>Cragg-Donald Wald F</i>	61.8***	57.2***	59.4***	52.8***
<i>Stock-Yogo 5% CV</i>	16.38	16.38	16.38	16.38

*Notes: Dependent variable is R&D/Assets. 2SLS estimation; instruments are industry-year mean controversy scores (excluding focal firm) and lagged controversy scores. First-stage F-statistics comfortably exceed the Stock-Yogo 5% critical value, confirming instrument relevance. t-statistics in parentheses (clustered by firm). *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.*

Table 12. Propensity score matching (PSM)

Variable	(1) Cont_Score	(2) Cont_Env	(3) Cont_Soc	(4) Cont_Gov
Cont_X (t-1)	-0.026*** (-3.01)	-0.022*** (-2.76)	-0.062*** (-2.76)	-0.015** (-2.31)
<i>Controls</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>
<i>Firm, Industry & Year FE</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>
<i>N (firm-years)</i>	<i>3,198</i>	<i>3,087</i>	<i>3,112</i>	<i>3,056</i>
<i>N (firms)</i>	<i>254</i>	<i>248</i>	<i>251</i>	<i>244</i>
<i>ATT</i>	<i>-0.347***</i>	<i>-0.298***</i>	<i>-0.276***</i>	<i>-0.218***</i>
<i>ATT bootstrap SE</i>	<i>(0.109)</i>	<i>(0.098)</i>	<i>(0.094)</i>	<i>(0.087)</i>
<i>Std. bias post-match</i>	<i>< 5%</i>	<i>< 5%</i>	<i>< 5%</i>	<i>< 5%</i>

*Notes: Dependent variable is R&D/Assets. Propensity score matching (PSM), one-to-one nearest-neighbour without replacement. Treated = firm-years with above-median controversy exposure. ATT = average treatment effect on the treated. Post-match standardised bias < 5% confirms covariate balance. t-statistics in parentheses (clustered by firm). *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.*

Appendix A. Variable Definitions

Variable	Definition
<i>R&D/Assets</i>	R&D expenditure divided by total assets, expressed as a percentage. Measures annual innovation investment intensity.
<i>Cont_Score</i>	Aggregate ESG controversy measure obtained from Refinitiv Eikon. The original Refinitiv ESG Controversies Score ranges from 0 to 100, with higher values indicating fewer controversies. The score is reverse-coded as 100 minus the original Refinitiv score, such that higher values indicate greater ESG controversy exposure.
<i>Cont_Env</i>	Environmental controversy measure obtained from Refinitiv Eikon, covering environmental-related controversy events. The original score is reverse-coded as 100 minus the original Refinitiv score. Higher values indicate greater exposure to environmental/social/governance controversies.
<i>Cont_Soc</i>	Social controversy measure obtained from Refinitiv Eikon, covering social-related controversy events. The original score is reverse-coded as 100 minus the original Refinitiv score. Higher values indicate greater exposure to environmental/social/governance controversies.
<i>Cont_Gov</i>	Governance controversy measure obtained from Refinitiv Eikon, covering governance-related controversy events. The original score is multiplied by -1 . Higher values indicate greater exposure to governance controversies.
<i>CSR_Com</i>	Binary indicator equal to 1 if the firm has a dedicated standing board-level CSR or sustainability committee in year t , and 0 otherwise.
<i>BGD</i>	Board gender diversity, measured as the proportion of female directors on the board of directors.

<i>InstOwn</i>	Proportion of outstanding shares held by institutional investors (mutual funds, pension funds, insurance companies, and sovereign wealth funds).
<i>CEO_Dual</i>	Binary indicator equal to 1 if the CEO simultaneously holds the position of board chairman (PDG model), and 0 if the roles are separated.
<i>FamOwn</i>	Proportion of outstanding shares held by the founding family or its direct descendants
<i>Size</i>	Natural logarithm of total assets (in thousands of euros).
<i>Lev</i>	Total financial debt (short-term plus long-term) divided by total assets.
<i>ROA</i>	Return on assets, computed as net income divided by total assets and expressed as a percentage.
<i>TobinQ</i>	Market-to-book ratio, computed as market capitalization divided by the book value of total equity.
<i>Cash</i>	Cash and cash equivalents are divided by total assets.
<i>SalesGr</i>	Year-on-year percentage change in net revenues.
<i>D_Cont_X</i>	Binary indicator equal to 1 if the ESG controversy score (aggregate or domain-specific) exceeds 50 in a given year, and 0 otherwise.
