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Market Perceptions of ESG Reputational Risk in the US Pharmaceutical Industry

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ABSTRACT

Negative ESG-related reputational events generate significant corporate risks, particularly within sensitive sectors such as the pharmaceutical industry. Using novel reputational data, this research investigates investor perceptions of the consequences of experienced ESG breaches among US pharmaceutical firms. Specifically, we consider the magnitude, timing, and persistence of abnormal returns, testing whether firm-specific characteristics and event-related attributes moderate and account for identified market response differentials. Results indicate the presence of significant negative abnormal returns before the identified media release date, suggesting market anticipation or information leakage, followed by a pronounced negative shock upon formal announcement, with firm size the most robust mitigating factor. Market response shows substantial heterogeneity, while environmental incidents generate significant, delayed negative returns, whereas social and governance events show negligible investor response, indicating a lack of market concern. Companies experiencing recurring incidents experience further deterioration of returns than first-time offenders. Neither the initial news source's reach nor the assessed severity significantly affects the magnitude of market response. These findings highlight the context-dependent nature of ESG materiality in the pharmaceutical sector.

JEL Classification: G14, G32, L65, M14, Q56

1 | Introduction

The pharmaceutical industry operates under a distinct social expectation, where its commercial activities and pursuits intersect not only directly with public health standards but also ethical expectations. Consequently, perceived lapses in environmental standards, social responsibility, or governance integrity can inflict substantial damage to the corporate reputation, a critical asset built on public trust. This research explores the consequences of ESG-related reputational events affecting major US pharmaceutical corporations. Specifically, such work aims to understand how the societal assessment of corporate responsibility translates into tangible market outcomes, providing valuable information on the weight assigned to environmental, social, and governance (ESG) conduct in a sector focused directly on societal well-being.

The pharmaceutical industry provides an especially compelling context for examining ESG-related reputational risk due to its unique combination of high regulatory oversight, direct public health impacts, and persistent trust issues. Unlike other high-risk sectors such as energy or finance, pharmaceuticals face uniquely sensitive stakeholder scrutiny: Firms are routinely embroiled in ethical controversies over drug safety, pricing, and marketing practices. Indeed, survey evidence indicates that pharma ranks as the most poorly regarded industry, with 51% of Americans holding a negative view of the sector, the worst reputation among all business fields (Arnold

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et al. 2022). Such vulnerabilities suggest that ESG controversies in pharma could provoke particularly strong stakeholder and investor responses, as missteps directly threaten patient well-being and invite swift regulatory and public backlash. Focusing on pharmaceuticals thus allows us to investigate investor sensitivity to ESG events in a setting where the reputational stakes and human consequences of corporate behaviour are exceptionally high, arguably even higher than in energy or financial services.

Fundamentally, the pharmaceutical sector occupies a unique corporate position, in which many elements of related research and development remain obscured for operational reasons, placing a substantial premium on investor trust relative to other economic sectors. Breaches of ESG expectations send a negative signal to stakeholders, potentially reducing broader corporate trust and extending beyond associated financial characteristics. Issues such as environmental management in drug manufacturing, ethical conduct in clinical trials, product safety and efficacy, pricing strategies, and equitable access to medicines resonate deeply with public health concerns and societal expectations.

Understanding investor reactions to ESG incidents is not only a matter of financial analysis but also of strategic and normative significance. Market responses to a reputational event effectively signal stakeholders' approval or disapproval of a firm's conduct, thereby functioning as a form of informal governance or "market discipline" on corporate behaviour. For example, a sharp negative stock reaction to an ESG lapse sends a clear message to management and directors that certain practices are unacceptable, reinforcing incentives to strengthen ESG safeguards (Bansal and Clelland 2004; Krüger 2015). Conversely, if investors respond indifferently to ESG problems, it may indicate that market forces alone are insufficient to hold companies accountable, highlighting the potential need for regulatory intervention or stakeholder activism. Moreover, these market reactions reflect shifts in stakeholder trust and legitimacy: firms with greater social capital and credibility tend to fare better when trust in business is broadly shaken (Lins et al. 2017). Analysing how investors respond to ESG events, therefore, offers insights beyond short-term valuation effects, presents evidence on how reputational signals influence corporate strategy and stakeholder relations, and informs policymakers whether financial markets adequately penalise irresponsible behaviour or additional governance mechanisms are warranted.

Understanding the financial consequences of ESG-related reputational damage in the pharmaceutical industry is crucial to interpreting investors' responses to corporate misconduct, where reputational standing can vary significantly between contexts and stakeholder groups (Walsh et al. 2009). Fundamentally, expanding such understanding is particularly important when attempting to improve and tailor specific corporate risk management strategies that involve hedging and diversification. Motivations for managing reputation also vary; for instance, dominant principals in family firms may exhibit heightened sensitivity to potential reputational harm from unethical practices due to concerns about socio-emotional wealth, thereby influencing decisions such as earnings management (Martin et al. 2016). Theoretical frameworks posit that reputational capital, legal enforcement, and ethical norms serve as key mechanisms that deter opportunism, although their effectiveness may evolve with broader economic and technological shifts (Karpoff 2021). Empirical evidence confirms that reputational damage has tangible costs; following poor performance signals, such as borrower bankruptcies, financial intermediaries face adverse consequences in subsequent market activities, including retaining larger loan fractions and encountering difficulty attracting participants, indicating a direct financial penalty for perceived failures (Gopalan et al. 2011).

The pharmaceutical industry itself possesses a unique operating environment characterised by distinct levels of risk and regulation. For example, biotechnology R&D, characterised by high costs and significant failure rates (Vanderbyl and Kobelak 2008), necessitates sophisticated risk management approaches that may extend beyond the capacities of traditional audit committees (Brown et al. 2009). The broader sector has faced distinct ESG pressures, notably concerning access to medicines and environmental performance, which attract considerable attention from NGOs and investors, thereby influencing corporate transparency and response strategies (Lee and Kohler 2010; Steger et al. 2007). Strategic alliances often serve as a critical mechanism, particularly for smaller firms, for managing resources, mitigating risks, and pursuing internationalisation in this demanding environment (Veilleux et al. 2012).

Results indicate the existence of significant negative abnormal returns (AR) impacting US pharmaceutical firms prior to the formal announcement of ESG-related reputational incidents, indicating the presence of significant market anticipation, or information leakage, which culminates in a pronounced negative shock on the event date (t_0). While ARs exhibit rapid mean reversion in the days immediately following the event, the negative cumulative impact persists significantly over subsequent weeks. Firm size consistently emerges as the most substantial mitigating factor against these negative returns, particularly over longer horizons, with larger firms experiencing significantly less adverse impacts. Pre-event profitability (ROA) provides some short-term resilience around the event window. Crucially, market reactions are highly differentiated by event type, with environmental transgressions generating significant cumulative abnormal returns (CARs), whereas social and governance issues show no significant effects. Results further demonstrate that recurring ESG incidents are associated with more pronounced negative CARs than novel events, and incidents characterised by initial ambiguity regarding responsibility ultimately result in larger, delayed negative CARs compared to clearly attributed events. Conversely, neither the dissemination reach of the initial news source nor the assessed severity of the event demonstrably influences the magnitude of the financial repercussions, indicating that social media saturation has mitigated differentials between localised and global news releases.

The rest of this paper proceeds as follows: Section 2 provides a thorough review of the associated literature, providing a foundation for the presented research questions, specifically summarising the key interlinkages between reputational exposure and stock market response in the pharmaceutical industry. Section 3 presents a concise review of the data that was used to analyse the stated research questions, while Section 4 presents a concise review of the associated results. Section 5 provides several points of associated discussion, policy and regulatory implications, and directions for future research. Finally, Section 6 concludes.

2 | Previous Literature

Determining the exact financial consequences of CSR engagement is important, particularly considering sectors such as the pharmaceutical industry, where social impact and risk are fundamentally inherent (Leisinger 2005; Min et al. 2017). While direct interlinkages with financial performance contrast, evidence suggests that market perceptions and stakeholder management play crucial roles (Smith 2008). Within the pharmaceutical industry, professionals strongly believe that CSR initiatives contribute positively to long-term financial performance, primarily through enhanced reputation and stakeholder relations (Min et al. 2017). Market reactions to specific negative events, such as product recalls, further illustrate this materiality, with investor responses varying with the firm's perceived CSR standing and the specific market context (Cheah et al. 2007). Furthermore, the drive for transparency through benchmarking and the influence of socially responsible investing highlight how external assessments and reputational capital can create financial incentives for improved CSR (Lee and Kohler 2010). The sector's progression is also shaped by the perceived risks and benefits associated with core technological advancements, which influence regulation and public acceptance and thereby directly impact firm value (Stewart and Knight 2005).

Integrating non-traditional information streams, such as those related to ESG factors, presents distinct challenges to informational efficiency. While mandatory ESG disclosure aims to enhance price discovery (Zhang et al. 2023), the inherent characteristics of this information, including its qualitative nature and the divergence among rating agencies, influence its subsequent processing. Disagreement among ESG raters, rather than merely creating noise, can introduce diverse informational signals that may improve market efficiency by stimulating investor learning (Yin et al. 2025). However, ambiguity persists, as evidenced by divergent market reactions to disclosures from various ESG raters (Bachner 2025). While investors attempt to value ESG performance, this process can contribute to significant misvaluation relative to fundamental values (Bofinger et al. 2022; Khan et al. 2024). Furthermore, the processing of such non-financial information is not uniform; it is filtered through the characteristics and potential biases of market participants, including analysts' perceptions and technologically focused estimation of management tone (Ye et al. 2025) and the evaluation of board members whose educational backgrounds shape strategic responses (Wu et al. 2024), particularly under conditions of uncertainty (Rost and Osterloh 2010).

The expanding integration of non-financial criteria into investment decisions has generated a significant informationally-driven evolution across financial markets (Renneboog et al. 2008), underpinned by a growing network of ESG data and rating providers, yet hampered by substantial divergence in their assessments, raising questions about measurement validity and potential biases related to factors like firm size or disclosure integrity (Berg et al. 2022; Drempetic et al. 2020; Laufer 2003), which has been found to directly influence equilibrium asset pricing, potentially lowering required returns for 'green' assets and introducing complex trade-offs beyond traditional risk–return frontiers (Pedersen et al. 2021; Pástor et al. 2021). Such mechanisms influence the cost of capital through instruments such as green bonds (Zerbib 2019) or bank loans, in which perceived ESG risks can attract higher spreads (Goss and Roberts 2011). Moreover, the market's ability to fully incorporate the value derived from ESG factors, such as employee satisfaction, remains contested, suggesting potential under-valuation of key intangibles (Edmans 2011).

Prior research has extensively examined stock market reactions to ESG-related events across industries. A consistent finding is that negative ESG news, such as corporate social irresponsibility or environmental accidents, tends to trigger a decline in shareholder value, whereas positive ESG news yields more muted effects. For instance, an event study by Krüger (2015) found that investors respond strongly negatively to adverse CSR events but do not reward positive CSR announcements with commensurate gains. Similarly, Capelle-Blancard and Petit (2019), analysing approximately 33,000 ESG news items, report that firms facing negative ESG incidents experience an average AR of approximately −0.1%, whereas positive ESG events yield no significant market benefit. These patterns suggest an asymmetry in investor attention, with penalties for ESG failings far more pronounced than rewards for ESG achievements. Moreover, the magnitude of market sanctions is often modest. A recent meta-analysis of environmental event studies finds that the average immediate stock price penalty for harmful incidents is on the order of −2%, with a median around −0.6% (Capelle-Blancard et al. 2021). Such evidence implies that while investors do penalise ESG transgressions, these financial punishments may be limited relative to the high social and reputational costs of such events, a point that has led to the questioning of the sufficiency of market-driven incentives for corporate sustainability (Capelle-Blancard et al. 2021).

Despite the breadth of event-study evidence in the ESG domain, significant gaps remain in our understanding of industry-specific dynamics. Most prior studies have focused on environmental disasters in heavy industry (e.g., oil spills) or examined broad cross-industry samples, whereas the pharmaceutical sector's ESG risks have received comparatively little attention. This gap is notable given the distinctive nature of pharmaceutical controversies: unlike a typical industrial accident or a banking scandal, a pharmaceutical industry error (such as the release of an unsafe drug or a predatory pricing scheme) directly affects public health and can erode fundamental stakeholder trust. The industry's history of frequent misconduct, often tied to weak ethical cultures and 'profit-over-patients' behaviour, has caused substantial harm to consumers and reputational damage (Arnold et al. 2022), making pharma firms particularly vulnerable to public and investor backlash. Furthermore, pharmaceuticals operate under intense regulatory scrutiny (FDA oversight, patent regimes, etc.), so an ESG incident can swiftly translate into legal penalties or policy pressure (e.g., calls for stricter drug regulation or price controls) that investors must anticipate. Accordingly, it is plausible that investor reactions in the pharma sector differ in intensity or pattern from those observed in other high-risk industries. By concentrating on US pharmaceutical companies, our study addresses this gap. We extend the ESG event literature into a sector where the reputational stakes are especially high, examining whether and how shareholders penalise pharma firms for ESG-related reputational events, and what this implies for corporate ESG strategy in an industry so crucial to public well-being.

Information intermediaries are fundamentally important sources of ESG information, yet their influence introduces distinct market dynamics and potential biases. The opinions of ESG rating agencies are widely considered but exhibit significant divergence that subsequently complicates investor evaluation of corporate sustainability (Erhart 2022; Halbritter and Dorfleitner 2015; Wang, Ma, et al. 2023; Wang, Li, et al. 2023). This disagreement among raters has tangible consequences, often correlates negatively with excess stock returns, and influences investor behaviour, particularly in emerging markets (Wang, Ma, et al. 2023; Wang, Li, et al. 2023; Wang et al. 2024). Although ESG ratings can possess predictive power regarding future corporate ESG news, this ability diminishes substantially in the presence of elevated rating disagreement (Serafeim and Yoon 2023). Furthermore, ratings may be influenced by firm characteristics such as size, potentially reflecting resource availability for reporting rather than inherent sustainability performance (Drempetic et al. 2020), while corporations have been found to display heterogeneous strategic responses to these ratings, ranging from conformity to resistance, rather than uniform adoption (Clementino and Perkins 2021).

Further, we must consider the interaction between corporate governance structures and corporate ESG performance, recognising that directors fundamentally shape the ethical tone (Schwartz et al. 2005). Governance mechanisms, including board characteristics and compliance functions, have been found to significantly influence ESG performance and disclosure (Elshandidy et al. 2013; Holder-Webb et al. 2008; Khan 2022), though the integration of these aspects within sustainability reporting varies (Kolk 2008). Several studies have also investigated the influence of specific governance attributes, such as dedicated committees, director awareness (Rodrigue et al. 2013), the role of board diversity in enhancing ethical compliance (Isidro and Sobral 2015), and the impact of social ties on monitoring effectiveness (Hoitash 2011). Further, the use of formal ethical instruments is found to often correlate with firm size and strategy (Graafland et al. 2003), while stated commitments to ethics have been found to align with superior financial performance (Verschoor 1998), potentially creating positive feedback loops between social responsibility and financial results (Rodriguez-Fernandez 2016). However, compliance with governance codes does not always ensure linear performance improvements (Tariq and Abbas 2013), and reporting practices, while evolving (Belal et al. 2015), may still prioritise legitimacy over transparency (Chauvey et al. 2015).

3 | Data and Methodology Employed

The sample data used in this study are obtained from LSEG Workspace (formerly Refinitiv), which includes stock market data, sustainability metrics, and fundamentals used as control variables. Our sample consists primarily of firms based in the United States, and the study period spans 1 January 2007 through 31 December 2023, with each company's data aligned with the specific event being analysed. In total, we examine 3720 events across 116 companies. To ensure data integrity, we verify that all firms have complete return data within the event windows and exclude any firms or events with missing values as necessary. Consistent with established event-study practice, we use annual firm-level variables to capture underlying structural characteristics such as size, profitability, leverage, and valuation (Barrett et al. 2024; Delis et al. 2022; Pan et al. 2024; Piserà et al. 2025). These fundamentals change slowly relative to the short event windows examined, and therefore, annual measures appropriately reflect cross-sectional heterogeneity in firms' responses to the shocks studied. Alternative frequency metrics were unavailable for a substantial share of our sample, and restricting the analysis to firms with complete intra-year data would yield a significantly smaller, non-representative set of firms.

In our selection of control variables, we follow prior literature related to ARs methodologies Azevedo and Müller (2024), Shen et al. (2023), Yu et al. (2024). Our control variables include firm size, estimated as the natural logarithm of total assets; return on assets (ROA), calculated as total income divided by total assets; leverage, defined as total debt relative to total assets; and the market-to-book ratio (MV/BV), computed as the market value of the firm divided by its book value. We also control for time-fixed effects using the year in which the event happened because the control variables are yearly. All control variables are winsorised at the 1% and 99% level.

Data based on ESG-focused, negative reputational corporate events are obtained from the RepRisk database[1] which has been used in research to date that has focused on breaches of corporate social responsibility amongst several other areas (Akyildirim et al. 2020; Akyildirim et al. 2023; Akyildirim, Conlon, et al. 2025; Akyildirim, Corbet, et al. 2025). RepRisk's incident-level variables (severity, reach, novelty, and attribution sharpness) are produced using a transparent rule-based methodology. This broad sourcing reduces the likelihood of systematic coverage bias toward large or highly visible firms.[2] RepRisk's incident data have been used in a growing body of academic work examining ESG-related risks and market reactions (Harjoto et al. 2021; He and Li 2024; Park et al. 2025). In our setting, we additionally run placebo tests to further confirm that these classifications do not mechanically generate ARs, mitigating concerns regarding potential measurement bias. Data are obtained along with several related characteristics, enabling a specific analysis of the reputational event's severity, novelty, reach, and sharpness. Severity denotes the severity of a risk incident or criticism.[3] The reach of the information source indicates the influence of the reputational breach based on readership and circulation of the sources, as well as by its importance in a specific country.[4] The novelty (newness) of the issues addressed for the company and project, whether it is the first time a company/project is exposed to a specific ESG issue in a specific location. Unsharp risk incidents are defined as instances in which the entity is mentioned, but the criticism is complex or perhaps not precisely defined. Sharp incidents are, therefore, undoubtedly attributed to the company in focus.

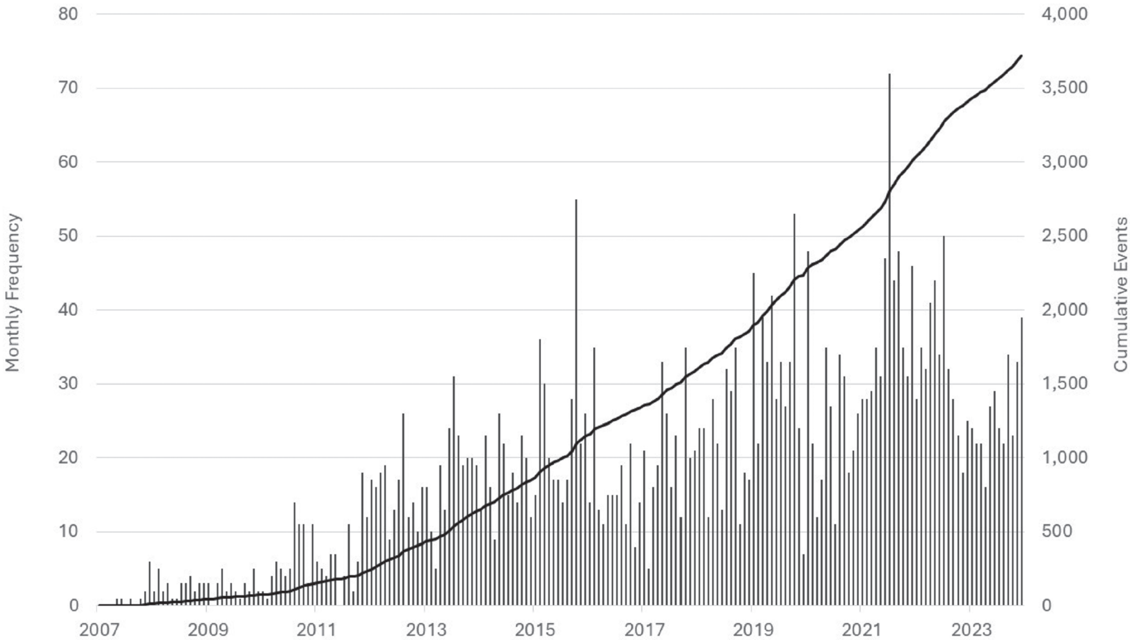

FIGURE 1 | Frequency of ESG-events relating to pharmaceutical companies analysed, Jan 2007 through Dec 2023. The timeline of the growth of RepRisk-identified ESG events between January 2007 and December 2023 as presented in the above figure. 757 valid US-based pharma ISIN codes are identified in the RepRisk database, representing 3720 distinct ESG-related issues between 1 January 2007 and 31 December 2023. Daily closing prices for each investigated firm are obtained for the same period, including 6 months before and 6 months after, to analyse the impact before and after the events.

Such categorisation has been used to identify the effects of several corporate effects regarding reputationally devastating events (Akyildirim, Conlon, et al. 2025; Akyildirim, Corbet, et al. 2025; Harjoto et al. 2022; Kim et al. 2024; Li and Wu 2020; Zhou and Wang 2020).

In total, our sample comprises 757 valid International Securities Identification Numbers (ISINs). These firms are identified from the RepRisk database for US-based pharmaceutical corporations. For the 757 firms, we collected 3720 distinct ESG-related events between January 1st 2007 and December 31st 2023.[5] Daily closing prices for each firm are obtained for the same period, where we use 250 days before each event for the estimation of the ARs.

The timeline of the growth of RepRisk-identified ESG events during the sample period analysed, from January 2007 to December 2023, is presented in Figure 1. Primarily, we observe an overall upward trend in the cumulative number of events, as depicted by the relatively smooth trajectory, suggesting a growing prevalence or recognition of such events over time. Concurrently, the bar graph presented simultaneously indicates the monthly event frequency, demonstrating significant month-to-month variability. The variability of the monthly events suggests that while the propensity for ESG-related reputational events has increased over time, they occur sporadically rather than following a predictable pattern. Such an observation is particularly pertinent when considering the broad-reaching influence of the COVID-19 pandemic and the intense media focus and scrutiny surrounding vaccine development (Corbet et al. 2020; Corbet et al. 2022; Lang et al. 2024). There is little to suggest differential behaviour from either a visual or statistical perspective, as evidence of sustained growth is observable far before the pandemic, most likely reflecting evolving societal values, regulatory environments, and global awareness of biodiversity issues, which have become increasingly salient in corporate governance and sustainability discourses.

Several studies utilise the market model, or the Fama–French three-factor model, to identify AR behaviour (Barrett et al. 2024; Sharma et al. 2020; Shen et al. 2023; Yi et al. 2021). We follow the Fama–French five-factor model, similar to Azevedo and Müller (2024), Pan et al. (2024), as our primary estimation method, while utilising other listed variants for robustness testing. We estimate the related CARs for the following event windows: [−20, −1], [−10, −1], [−5, −1], [−3, −1], [−2, −1], [−1, t_0], [t_0, +1], [t_0, +2], [t_0, +3], [t_0, +5], [t_0, +10] and [t_0, +20]. Our choice of event windows follows standard practice in event-study research (Forbes 2004; Shen et al. 2023; Sorescu et al. 2017). The short windows serve as our primary identification strategy, as they minimise confounding influences and capture the immediate market reaction. We also include longer windows, up to 20 days, to assess post-event price dynamics and to assess the robustness of our main results. Longer windows, therefore, allow us to observe whether initial market effects persist, attenuate, or reverse as information continues to diffuse. Further estimation windows inclusive of the period both before and after the selected events are estimated as: [−1, +1], [−2, +2], [−3, +3], [−5, +5], [−10, +10] and [−20, +20], where each of the even dates occurs at point t_0. For each event date analysed, we estimate the CAR and AR for all companies in our sample that traded on the event date, as denoted by the RepRisk database, and during the estimation window before the event date. When events occur on weekends or non-trading days, the next trading date is treated as the event date. To estimate AR, we first use Equation (1) with the estimation window [−260, −21], as in Corrado (2011). Building on Barrett et al. (2024), the number of days selected to represent the estimation period best is important so as not to contaminate the results.[6]

$$\left(R_{i,t}-R_{f,t}\right)=\alpha_i+\beta_1\left(R_{Mkt,t}-R_{f,t}\right)+\beta_2\mathrm{SMB}_t + \beta_3\mathrm{HML}_t+\beta_4\mathrm{RMW}_t+\beta_5\mathrm{CMA}_t+\epsilon_{i,t} \quad (1)$$

where $R_{i,t}$ represents the return of company i on date t, while $R_{f,t}$ incorporates the risk-free rate and $R_{Mkt,t}$ the return on the market on date t respectively. The factors are SMB for size, HML for the book-to-market ratio, RMW for profitability, and CMA represents the investment factor (Fama and French 2015), while ϵ is the error term. From the estimated parameters of the regression from Equation (1), we estimate the AR as follows:

$$\mathrm{AR}_{i,t}=\left(R_{i,t}-R_{f,t}\right)-[\widehat{\alpha}_i+\widehat{\beta}_1\left(R_{Mkt,t}-R_{F,t}\right)+\widehat{\beta}_2\mathrm{SMB}_t + \widehat{\beta}_3\mathrm{HML}_t+\widehat{\beta}_4\mathrm{RMW}_t+\widehat{\beta}_5\mathrm{CMA}_t] \quad (2)$$

where $\mathrm{AR}_{i,t}$ is the abnormal return of company i for the period t. From this estimated $\mathrm{AR}_{i,t}$, we can estimated CAR as:

$$\mathrm{CAR}_i\left[t_1,t_2\right]=\sum_{t=t_1}^{t_2}\mathrm{AR}_{i,t} \quad (3)$$

where $\mathrm{CAR}_i\left[t_1,t_2\right]$ is the sum of the estimated AR of company i for the period inclusive of $[t_1, t_2]$. We then repeat this process for each selected event window. Next, to measure the effect of each of the event dates, we regress the CAR against a set of variables, drawing on the work of Azevedo and Müller (2024) and using the following baseline methodological structure:

$$\mathrm{CAR}_{i,t}=\alpha_i+\beta_1\mathrm{Size}_{i,t-1}+\beta_2\mathrm{ROA}_{i,t-1}+\beta_3\mathrm{Leverage}_{i,t-1} + \beta_4\mathrm{MB}_{i,t-1}+\Sigma\mathrm{FE}+\epsilon_{i,t} \quad (4)$$

where CAR is defined as above, while the respective variables are collected and incorporated as size, return on assets (ROA), leverage, and market-to-book value (MV/BV). We also consider, where appropriate, fixed-effects (FE) testing for time-dependent fixed-effects as defined when accounting for the year in which the defined event occurred as indicated by the RepRisk database.[7]

Then, following the baseline model from Equation (5), we present the following model:

$$\mathrm{CAR}_{i,t}=\alpha_i+\beta_1\mathrm{RepR}_{i,t}+\beta_2\mathrm{Size}_{i,t-1}+\beta_3\mathrm{ROA}_{i,t-1} + \beta_4\mathrm{Leverage}_{i,t-1}+\beta_5\mathrm{MB}_{i,t-1}+\Sigma\mathrm{FE}+\epsilon_{i,t} \quad (5)$$

where in this final empirical structure, we add the variable $\mathrm{RepR}_{i,t}$, which, through separate analyses, utilises each respective reputational event's severity, novelty, reach and sharpness[8] respectively to identify whether particular characteristics surrounding each reputationally damaging event possesses further explanatory value with regard to estimated ARs and CARs.

4 | Empirical Results

Summary statistics relating to exposed US pharmaceutical companies' ARs during the periods surrounding negative ESG-related reputationally-damaging news events are presented in Table 1.[9] Results indicate the existence of several distinct patterns, such as that of significant anticipatory effects, specifically characterised by a discernible negative drift in mean ARs during the week preceding the event date (t_0), culminating in a pronounced −20 basis point (bps hereafter) impact on t_0 itself.[10] At a fundamental level, this pre-event decline strongly suggests the presence of information leakage or market anticipation, in which negative implications are partially incorporated into the respective pharmaceutical company's price before the formally identified news release. The event day itself is marked by substantial market volatility, with variance approximately doubling relative to surrounding periods, accompanied by pronounced negative skewness (−7.31) and significantly elevated kurtosis (134.37). Such observed results specifically indicate the presence of heightened uncertainty, associated with broad investor consensus regarding the downside nature of the released news, and a significantly elevated probability of extreme negative outcomes, exhibiting evidence of ESG-related investment conscience, or a readjustment of investor expectations of future corporate performance according to the news being released, fundamentally indicating that there is an initial expectation that ESG-related malpractice does possess negative effects for US pharmaceutical corporations. Following such a significant event-day reaction, the estimated mean ARs rapidly revert to zero over the subsequent trading days. This result implies that there exists relatively efficient processing of the core information after public dissemination, at least as captured by deviations from the Fama–French five-factor benchmark. Furthermore, the distribution of returns widens around the event, with minimum ARs deteriorating sharply before and at t_0, while maximum ARs show some elevation post-event, potentially reflecting increased perceived risk and hints of overreaction followed by corrective price movements.

A violin plot presenting clear evidence of the behaviour of ARs is presented in Figure 2, presenting evidence of persistent downside performance in the days before and during the announcement date t_0. Verifying the results presented in Table 1, we find that such negative ARs quickly revert to the mean estimates and, in the weeks thereafter, visually outperform outside of standard explanatory factors. Several distinct reasons explain why ARs behave in this manner. Primarily, ESG information can be rather ambiguous, and its financial materiality is often difficult to assess immediately. Fundamentally, this ambiguity explains the gradual pre-event drift as sophisticated news-monitoring investors, or those better informed, incorporate signals, resulting in high event-day variance and kurtosis as the broader market struggles to reach consensus on the precise financial implications upon news release. More specifically, such initial negative signals capture the attention of specialised ESG funds or short-sellers using naked short positions and put options, which can influence the identified pre-event drift, while the official news release triggers wider media and general investor attention, potentially leading to temporary overshooting (contributing to elevated maxima post-t_0) and subsequent reversion as

TABLE 1 | Estimated abnormal return summary statistics.

AR (day)	Mean	Var	Skew	Kurt	Min	Max	Percentile								
							1.0%	5.0%	10.0%	25.0%	50.0%	75.0%	90.0%	95.0%	99.0%
[−20]	−0.0003	0.0003	0.4468	35.1401	−0.2756	0.2013	−0.0573	−0.0220	−0.0143	−0.0068	−0.0003	0.0056	0.0143	0.0218	0.0503
[−15]	−0.0003	0.0004	1.2031	58.8535	−0.2808	0.3441	−0.0546	−0.0220	−0.0144	−0.0065	−0.0002	0.0059	0.0137	0.0205	0.0487
[−10]	−0.0002	0.0004	4.5884	122.9229	−0.1930	0.4707	−0.0470	−0.0221	−0.0147	−0.0065	−0.0004	0.0055	0.0137	0.0218	0.0468
[−5]	−0.0006	0.0004	−3.1530	94.7809	−0.3935	0.3202	−0.0599	−0.0224	−0.0149	−0.0064	−0.0003	0.0057	0.0134	0.0213	0.0514
[−3]	−0.0009	0.0004	−8.5457	205.4527	−0.5913	0.1103	−0.0582	−0.0232	−0.0148	−0.0067	−0.0002	0.0058	0.0142	0.0226	0.0467
[−1]	−0.0005	0.0004	−5.0305	249.7824	−0.6130	0.4086	−0.0519	−0.0217	−0.0146	−0.0065	−0.0003	0.0057	0.0140	0.0227	0.0455
[t_0]	−0.0020	0.0008	−7.3071	134.3691	−0.5559	0.3190	−0.0827	−0.0253	−0.0161	−0.0069	−0.0005	0.0057	0.0134	0.0203	0.0464
[+1]	−0.0003	0.0004	−0.2031	46.2561	−0.2893	0.2968	−0.0619	−0.0219	−0.0143	−0.0062	−0.0001	0.0061	0.0143	0.0228	0.0466
[+3]	0.0001	0.0004	3.6986	68.8476	−0.1740	0.3651	−0.0523	−0.0218	−0.0141	−0.0063	−0.0001	0.0058	0.0134	0.0211	0.0522
[+5]	−0.0002	0.0005	6.2004	214.2851	−0.3564	0.6388	−0.0563	−0.0238	−0.0149	−0.0065	−0.0001	0.0055	0.0137	0.0214	0.0563
[+10]	−0.0002	0.0005	3.2607	226.7419	−0.4167	0.6379	−0.0547	−0.0217	−0.0134	−0.0063	0.0001	0.0058	0.0136	0.0227	0.0524
[+15]	0.0002	0.0003	0.6583	48.5193	−0.2467	0.3238	−0.0505	−0.0211	−0.0139	−0.0063	−0.0001	0.0063	0.0150	0.0225	0.0541
[+20]	−0.0002	0.0004	8.8749	279.5157	−0.1739	0.6358	−0.0464	−0.0224	−0.0146	−0.0066	−0.0002	0.0058	0.0137	0.0211	0.0490

Note: The above Table presents the summary statistics of the estimated ARs based on the identified ESG-related reputational events for corporations in the pharmaceutical industry. ARs are estimated as $(R_{i,t} - R_{F,t}) = \alpha_i + \beta_1(R_{Mkt,t} - R_{F,t}) + \beta_2\text{SMB} + \beta_3\text{HML} + \beta_4\text{RMW} + \beta_5\text{CMA} + \epsilon_{i,t}$, where the number of days both before and after the event date t_0 is denoted.

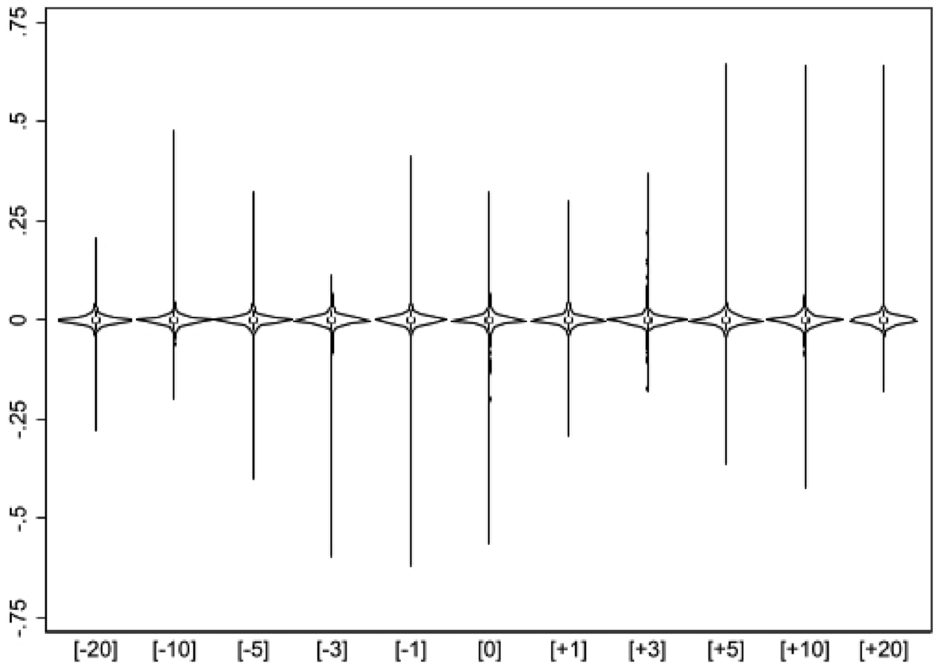

FIGURE 2 | Abnormal Return behaviour surrounding date t_0 (only significant results at the 10% level included). The above violin plot represents the behaviour of the estimated abnormal returns based on the identified ESG-related reputational events for corporations in the pharmaceutical industry. Abnormal returns are estimated as $\left(R_{i,t} - R_{F,t}\right) = \alpha_i + \beta_1\left(R_{Mkt,t} - R_{F,t}\right) + \beta_2\text{SMB} + \beta_3\text{HML} + \beta_4\text{RMW} + \beta_5\text{CMA} + \epsilon_{i,t}$, where the number of days both before and after the event date t_0 is denoted on the horizontal axis.

attention normalises. Heterogeneity in investor response arises from disagreement over the long-term cash-flow implications or the discount-rate adjustments associated with the examined ESG breach, which can lead to elevated liquidity conditions (Luo 2022; Wang, Ma, et al. 2023; Wang, Li, et al. 2023) and increases in variance and kurtosis around t_0. The negative skew suggests a prevailing, though not unanimous, view of downside risk, underpinned by broader perceptions of corporate governance weakness and a collapse of internal risk management in the aftermath of such events, with potential expectations of further negative news or recurring events elevating. Particularly, negative ESG events in the pharmaceutical sector (such as social irresponsibility, environmental breaches, and unethical corporate practice) are often intertwined with potential regulatory actions (such as those implemented by the FDA, EPA, etc.); therefore, the market reaction might incorporate anticipated regulatory fines, sanctions, or delays, which are often costly and uncertain. This elevates perceived risk, contributing to negative drift, sharp event-day impact, and negative skewness; however, some of this impact could be mitigated by effective corporate communications strategies (Pu et al. 2024). On day t_0, while attention might increase volume, heightened uncertainty could still widen spreads, contributing to variance. Long-term mean-reverting liquidity conditions in the period post-event facilitate smoother price reversion.

Summary statistics based on the associated CAR results located in Table 2 strongly reinforce the AR findings. The significant negative AR on day t_0 directly translates into negative CARs observed in windows that encompass t_0. Similarly, the cumulative effect of the persistent negative AR drift before t_0 is clearly captured by the negative CARs in pre-event windows (e.g., that of the window [−20, −1]). While daily ARs revert rapidly to zero after the event date t_0, the CAR analysis shows that this reversion is insufficient to immediately erase the negative impact. The fact that mean CARs in post-event windows such as [t_0, +10] and [t_0, +20] remain negative, and even decline further in the latter window, indicates that either the AR reversion is incomplete (i.e., average post-event ARs remain slightly negative) or that subsequent negative AR days occur frequently enough to maintain a negative cumulative trajectory.[11]

Beyond the direct accumulation of daily ARs, several other distinct factors contribute to the magnitude and persistence of the negative CARs, which are identified in Figure 3. While core news surrounding the respective negative ESG events might be incorporated into the price quite quickly, as identified in the AR reversion, the market may take longer to fully assess and evaluate the pricing effects of secondary implications such as the costs of reputational damage and the subsequent repair costs, along with damage to existing corporate relationships such as a loss of specific contracts, or broader stakeholder backlash. This slower processing of related, but less immediate, negative information leads to a continued, albeit potentially slower, decline in CARs over longer post-event windows ([t_0, +20]). It is also important to note that such a delayed response is related to the influence of an ESG reputational event and to the significant damage to intangible assets, such as brand value and stakeholder trust, which are hard to quantify immediately but have significant long-term cash-flow implications (Lins et al. 2017). Investors may gradually revise their valuation of these intangibles downward as evidence of damaged relationships emerges over time, contributing to CAR persistence. More specifically, the event could,

TABLE 2 | Estimated cumulative abnormal return summary statistics.

							Percentile								
CAR (days)	**Mean**	**Var**	**Skew**	**Kurt**	**Min**	**Max**	**1.0%**	**5.0%**	**10.0%**	**25.0%**	**50.0%**	**75.0%**	**90.0%**	**95.0%**	**99.0%**
[−20, −1]	−0.0038	0.0080	−0.9249	16.2695	−0.9747	0.7370	−0.3260	−0.1715	−0.0818	−0.0363	0.0013	0.0334	0.0720	0.1077	0.2294
[−10, −1]	−0.0031	0.0037	−1.3642	22.8844	−0.7512	0.5331	−0.1709	−0.1204	−0.0546	−0.0238	−0.0009	0.0217	0.0479	0.0710	0.1435
[−5, −1]	−0.0027	0.0021	−2.5566	43.0106	−0.6820	0.4691	−0.1498	−0.0880	−0.0367	−0.0160	−0.0005	0.0139	0.0332	0.0496	0.1020
[−3, −1]	−0.0015	0.0013	−4.3414	79.0081	−0.6880	0.4567	−0.0976	−0.0633	−0.0263	−0.0115	−0.0004	0.0109	0.0257	0.0397	0.0845
[−2, −1]	−0.0007	0.0009	−4.0901	112.0808	−0.6626	0.4519	−0.0852	−0.0484	−0.0205	−0.0090	−0.0006	0.0087	0.0208	0.0332	0.0672
[−1, t_0]	−0.0025	0.0012	−5.0505	84.9648	−0.6219	0.3269	−0.1055	−0.0556	−0.0223	−0.0098	−0.0008	0.0077	0.0194	0.0305	0.0662
[t_0, +1]	−0.0023	0.0013	−5.6688	101.1523	−0.6764	0.4038	−0.1048	−0.0549	−0.0225	−0.0096	−0.0003	0.0084	0.0198	0.0299	0.0704
[t_0, +2]	−0.0023	0.0016	−3.0653	70.3069	−0.6801	0.4729	−0.1075	−0.0706	−0.0287	−0.0130	−0.0004	0.0106	0.0257	0.0370	0.0904
[t_0, +3]	−0.0022	0.0021	−1.9780	49.0883	−0.6697	0.4699	−0.1452	−0.0780	−0.0319	−0.0150	−0.0009	0.0125	0.0294	0.0445	0.1063
[t_0, +5]	−0.0020	0.0033	−0.7094	38.2114	−0.7569	0.7391	−0.1742	−0.0975	−0.0419	−0.0182	−0.0008	0.0156	0.0381	0.0604	0.1631
[t_0, +10]	−0.0023	0.0054	−0.2349	23.6561	−0.6736	0.8256	−0.2263	−0.1265	−0.0581	−0.0261	−0.0007	0.0226	0.0517	0.0787	0.2109
[t_0, +20]	−0.0041	0.0093	−0.2710	22.6717	−1.0039	1.0567	−0.3244	−0.1743	−0.0825	−0.0377	−0.0005	0.0318	0.0685	0.1080	0.2675
[−1, +1]	−0.0028	0.0018	−4.7748	75.7628	−0.6872	0.4053	−0.1315	−0.0439	−0.0279	−0.0122	−0.0009	0.0101	0.0244	0.0379	0.0790
[−2, +2]	−0.0029	0.0026	−2.4637	43.2815	−0.6782	0.5393	−0.1470	−0.0584	−0.0367	−0.0169	−0.0014	0.0139	0.0324	0.0508	0.1278
[−3, +3]	−0.0037	0.0036	−2.2777	32.8211	−0.7399	0.4222	−0.2067	−0.0715	−0.0455	−0.0207	−0.0007	0.0169	0.0392	0.0603	0.1409
[−5, +5]	−0.0048	0.0055	−0.9680	22.4562	−0.6960	0.8305	−0.2651	−0.0930	−0.0595	−0.0275	−0.0007	0.0219	0.0504	0.0763	0.1898
[−10, +10]	−0.0054	0.0093	−0.5319	17.2342	−0.8852	1.0765	−0.3685	−0.1303	−0.0858	−0.0378	0.0003	0.0321	0.0689	0.1025	0.2615
[−20, +20]	−0.0079	0.0180	−0.5798	12.3746	−1.1003	0.9869	−0.5085	−0.1812	−0.1204	−0.0585	−0.0021	0.0460	0.1055	0.1569	0.3847

Note: The above Table presents the summary statistics of the estimated cumulative abnormal returns based on the identified ESG-related reputational events for corporations in the pharmaceutical industry. Cumulative abnormal returns are estimated as $\text{CAR}_i[t_1, t_2] = \sum_{t=t_1}^{t_2} \text{AR}_{i,t}$ for the following event windows: [−20, −1], [−10, −1], [−5, −1], [−3, −1], [−2, −1], [−1, t_0], [t_0, +1], [t_0, +2], [t_0, +3], [t_0, +5], [t_0, +10] and [t_0, +20]; and to focus on longer-term windows: [−1, +1], [−2, +2], [−3, +3], [−5, +5], [−10, +10] and [−20, +20].

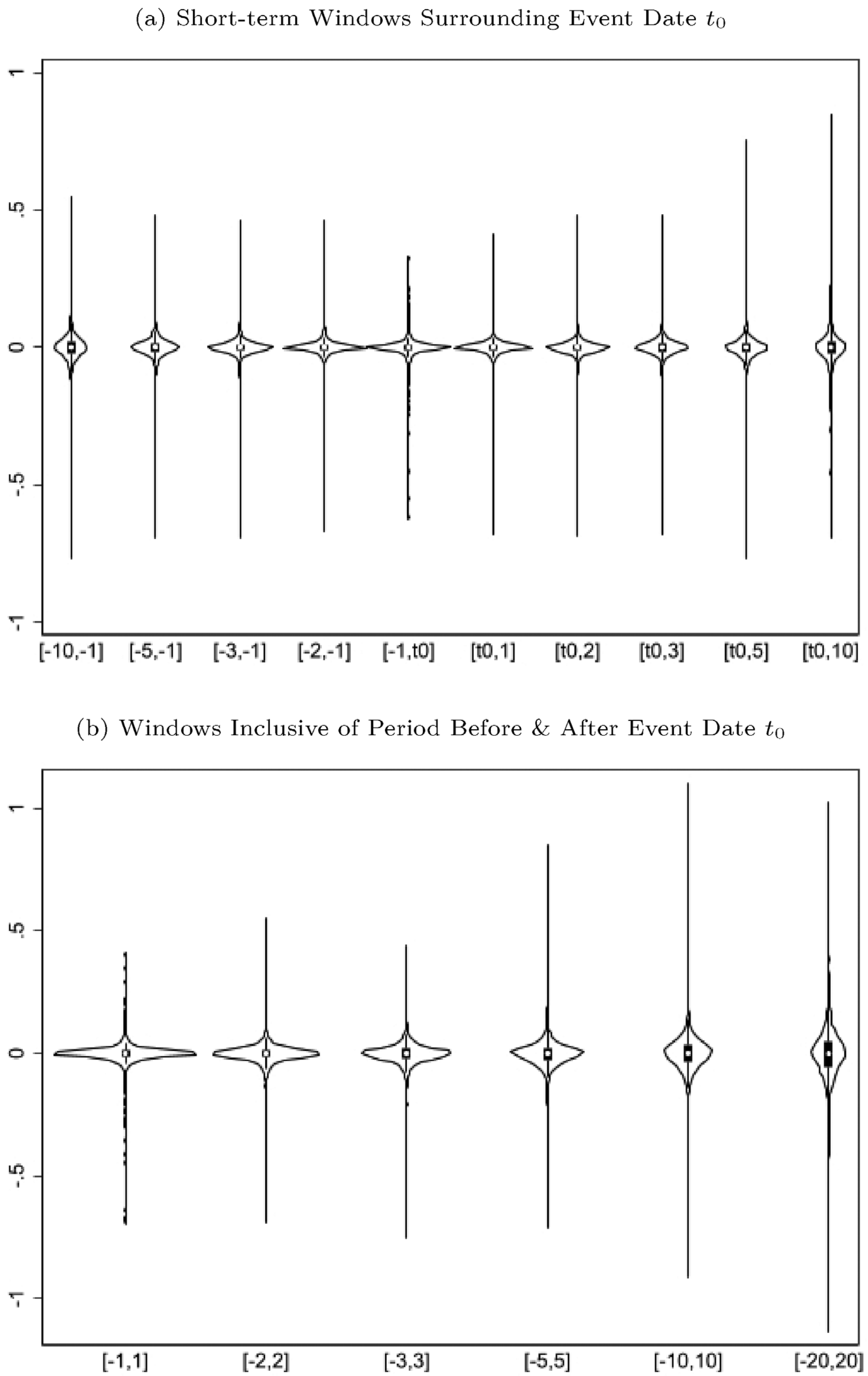

FIGURE 3 | Cumulative Abnormal return behaviour surrounding date t_0 (only significant results at the 10% level included). In the above violin plots, cumulative abnormal returns are estimated as $\text{CAR}_i\left[t_1, t_2\right] = \sum_{t=t_1}^{t_2} \text{AR}_{i,t}$ for the following short-term event windows: [−20, −1], [−10, −1], [−5, −1], [−3, −1], [−2, −1], [−1, t_0], [t_0, +1], [t_0, +2], [t_0, +3], [t_0, +5], [t_0, +10], and [t_0, +20]; and the following more long-term windows of focus containing dates both before and after the examined events on days [−1, +1], [−2, +2], [−3, +3], [−5, +5], [−10, +10] and [−20, +20]. The number of days both before and after the event date t_0 is denoted on the horizontal axis.

in some cases, be strong enough to trigger negative ESG rating downgrades or cause the firm to fail negative screening criteria used by increasingly influential ESG funds. Further, the ESG event is likely to cause investors to estimate associated costs of corrective actions, particularly surrounding the opportunity costs of diverted resources and diverting management attention from other distinct areas requiring their immediate input, which permanently, or more likely, semi-permanently increase their perception of the firm's systematic risk, even if not fully captured by the FF5 factors.[12]

When utilising corporate factors to further our understanding of CAR differentials due to ESG-related reputationally damaging events and persistent negative repercussions thereafter, baseline methodological results are presented in Table 3. Strong evidence is presented where investors incorporate such information into their respective price estimates in a negative manner, verifying AR and CAR results,[13] with information dilution observed well before the formally identified event date, reflected in statistically significant negative CARs accumulating to between −51.9 and −85.4 bp in the one to 2 weeks prior. This anticipatory phase of investor response is confirmed when considering corporate factors and is explained through information leakage (Kraft et al. 2014), where more sophisticated investors benefit from informational advantages, resulting in proactive short-selling, constrained perhaps for smaller firms, allowing share prices to partially adjust and begin to incorporate information ahead of the formal news release. While the CAR drift ceases immediately post-event relative to the Fama–French five-factor benchmark, as indicated by insignificant intercepts, investor focus quickly reverts to evaluating firm resilience. Pre-event profitability (as measured by ROA) appears to be a significant mitigating factor against the immediate shock, with coefficients ranging from +18.5 bp to +26.5 bp around the event date, suggesting that investors view financially healthier firms as better equipped to absorb initial costs and operational disruptions. Conversely, leverage shows only a limited, temporary positive association with CARs (+25.2 bp) in the week following the event, implying it is not a primary determinant of differential outcomes in this context.

Despite the rapid incorporation of the core news, the overall negative impact, including the identified anticipation, persists significantly over several weeks, resulting in negative CARs between −158.1 and −163.9 bp when considering the longer symmetric windows incorporating both the periods before and after the ESG events. This persistence likely reflects the slow recognition and realisation of secondary consequences, such as the gradual recognition of costs associated with reputational repair, litigation uncertainty, damage to intangible assets, such as brand value and stakeholder trust, operational adjustments, or potential ESG rating downgrades that trigger sustained selling pressure from specific funds. Firm size consistently emerges as the most robust factor differentiating performance, particularly over longer horizons. Larger firms experience significantly less negative CARs, with coefficients reaching +7.5 bp per unit of corporate size (as measured by the natural logarithm of market capitalisation[14]) in the longest examined window of analysis. This substantial size effect, which dominates ROA in the longer run, reflects the superior resources larger entities possess for comprehensive crisis management, including legal defense, public relations, potentially more effective lobbying, and the ability to navigate regulatory scrutiny, thereby presenting an ability to manage media narratives (Scrimgeour et al. 2024; Sharfman and Fernando 2008). As demonstrated by such significant corporate-size effects, factors such as pre-existing ESG reputation, event specifics (e.g., comparing core operations to peripheral operations), management credibility, and communication strategy also contribute significantly to the observed variation in CARs.

To mitigate problems of causality, we have extended our analysis by examining abnormal trading volume around the events (Campbell and Wasley 1996; Li et al. 2024). The results in Supporting Information: Table A4 present evidence of no statistically significant abnormal trading volume in the days preceding the event. In particular, the window [−2, −1] = 0.4935 and [−1, t_0] = 0.8412 are both not showing statistical significance. Even for the immediate event window, [t_0, 1] = 0.8057, again indicating no abnormal trading pressure around the event. Across all reported windows, the corresponding t-statistics are not significant, suggesting that the pre-event return movements documented in the paper are not accompanied by abnormal trading intensity. This pattern is consistent with gradual information diffusion, a phenomenon widely observed in ESG and reputational-risk research, rather than with insider trading activity. Importantly, the absence of abnormal volume in the pre-event window reinforces the validity of our identification strategy and supports our interpretation of return dynamics as market reactions to the evolving public information environment.

Methodological structures incorporating individual E, S, and G dimensions developed upon in Table 4 to advance our understanding of the key sources of additional corporate risk, and subsequently confirm the robustness of the baseline methodologies, particularly the significant mitigating role of firm size. Fundamentally, they reveal a striking heterogeneity in market responses specific to the pharmaceutical sector. Environmental malpractice triggers significant, albeit delayed, negative CARs, reaching −112 bp over the period [t_0, +10] and −158 bp over longer horizons such as [t_0, +20]. This delayed reaction suggests the market gradually incorporates the often substantial and tangible costs associated with E events in this industry, such as navigating complex regulations (e.g., hazardous waste disposal under RCRA, site remediation under CERCLA), facing potential operational disruptions, incurring direct fines, and managing long-tail liabilities that only become more evident in the longer-term period post-event. Furthermore, environmental damage can severely tarnish the reputations of firms that rely on public trust for health-related products. In contrast, social events, covering issues such as poor labour practices, product safety and access controversies, clinical trial ethics, or community relations, fail to elicit a significant market response. This indifference stems from several factors, particularly the inherent difficulty in quantifying the direct financial impact of many social issues; potentially supported by the perception that the pharmaceutical industry's core social contribution overshadows specific social harms; or that many social controversies (e.g., drug pricing debates) manifest more immediately as political or regulatory risk rather than direct, immediate market-repricing surrounding events (Jarrell and Peltzman 1985). Furthermore, the rapid and widespread dissemination capabilities of social media platforms can significantly accelerate the propagation of ESG news, potentially amplifying initial reactions or contributing to volatility as narratives spread rapidly outside traditional media cycles (Blankespoor et al. 2014). Governance-related events present another distinct pattern: they show no significant negative impact, suggesting that governance issues are often perceived as more readily addressable through standard corporate reforms or are already reflected in valuations due to their typically slower-moving nature relative

TABLE 3 | CARs as conditioned by corporate characteristics: baseline methodological structure.

Window	Intercept	Size	ROA	Leverage	MV/BV	Obs.	R^2	Ind. FE	Year FE
[−20, −1]	−0.0950	0.0045*	0.0025	−0.0092	−0.0001	1686	0.012	Yes	Yes
	(0.0662)	(0.0027)	(0.0257)	(0.0249)	(0.0001)				
[−10, −1]	−0.0854**	0.0035**	−0.0031	0.0020	−0.0001	1686	0.018	Yes	Yes
	(0.0430)	(0.0017)	(0.0171)	(0.0151)	(0.0001)				
[−5, −1]	−0.0519*	0.0022**	0.0017	−0.0010	0.0001	1686	0.015	Yes	Yes
	(0.0277)	(0.0011)	(0.0130)	(0.0104)	(0.0001)				
[−3, −1]	−0.0222	0.0009	0.0036	0.0043	−0.0001	1686	0.010	Yes	Yes
	(0.0224)	(0.0009)	(0.0108)	(0.0084)	(0.0001)				
[−2, −1]	−0.0167	0.0007	−0.0020	0.0056	0.0001	1686	0.013	Yes	Yes
	(0.0194)	(0.0008)	(0.0095)	(0.0063)	(0.0001)				
[−1, t_0]	−0.0201	0.0008	0.0185*	0.0028	−0.0001	1686	0.022	Yes	Yes
	(0.0229)	(0.0009)	(0.0096)	(0.0079)	(0.0001)				
[t_0, +1]	−0.0345	0.0013	0.0265**	0.0084	−0.0001	1686	0.037	Yes	Yes
	(0.0267)	(0.0011)	(0.0108)	(0.0072)	(0.0001)				
[t_0, +2]	−0.0295	0.0012	0.0149	0.0108	−0.0001	1686	0.020	Yes	Yes
	(0.0286)	(0.0012)	(0.0124)	(0.0083)	(0.0001)				
[t_0, +3]	−0.0378	0.0015	0.0143	0.0083	−0.0001	1686	0.016	Yes	Yes
	(0.0333)	(0.0013)	(0.0137)	(0.0116)	(0.0001)				
[t_0, +5]	−0.0207	0.0014	0.0038	0.0252*	−0.0001	1686	0.016	Yes	Yes
	(0.0413)	(0.0016)	(0.0167)	(0.0130)	(0.0001)				
[t_0, +10]	−0.0786	0.0037*	0.0225	0.0226	−0.0001	1686	0.022	Yes	Yes
	(0.0533)	(0.0020)	(0.0171)	(0.0204)	(0.0001)				
[t_0, +20]	−0.0631	0.0030	0.0083	0.0400	−0.0001	1686	0.014	Yes	Yes
	(0.0653)	(0.0026)	(0.0269)	(0.0253)	(0.0001)				
[−1, +1]	−0.0424	0.0016	0.0223*	0.0092	−0.0001	1686	0.031	Yes	Yes
	(0.0298)	(0.0012)	(0.0135)	(0.0083)	(0.0001)				
[−2, +2]	−0.0463	0.0019	0.0128	0.0164	−0.0001	1686	0.019	Yes	Yes
	(0.0325)	(0.0013)	(0.0135)	(0.0105)	(0.0001)				
[−3, +3]	−0.0600	0.0024	0.0179	0.0126	−0.0001	1686	0.017	Yes	Yes
	(0.0383)	(0.0015)	(0.0163)	(0.0157)	(0.0001)				
[−5, +5]	−0.0727	0.0036*	0.0055	0.0242	−0.0001	1686	0.019	Yes	Yes
	(0.0499)	(0.0020)	(0.0219)	(0.0173)	(0.0001)				
[−10, +10]	−0.1639**	0.0073***	0.0194	0.0246	−0.0001	1686	0.032	Yes	Yes
	(0.0705)	(0.0027)	(0.0286)	(0.0261)	(0.0001)				
[−20, +20]	−0.1581*	0.0075**	0.0107	0.0308	−0.0001	1686	0.018	Yes	Yes
	(0.0872)	(0.0035)	(0.0414)	(0.0398)	(0.0001)				

Note: Cumulative abnormal returns are estimated as $\text{CAR}_i[t_1, t_2] = \sum_{t=t_1}^{t_2} \text{AR}_{i,t}$ for the following event windows: [−20, −1], [−10, −1], [−5, −1], [−3, −1], [−2, −1], [−1, t_0], [t_0, +1], [t_0, +2], [t_0, +3], [t_0, +5], [t_0, +10], and [t_0, +20]; and to focus on longer-term windows: [−1, +1], [−2, +2], [−3, +3], [−5, +5], [−10, +10] and [−20, +20]. Such CARs are then developed in the methodological structure: $\text{CAR}_{i,t} = \alpha_i + \beta_1 \text{Size}_{i,t-1} + \beta_2 \text{ROA}_{i,t-1} + \beta_3 \text{Leverage}_{i,t-1} + \beta_4 \text{MB}_{i,t-1} + \Sigma\beta\text{FE} + \epsilon_{i,t}$, where CAR is again defined as above, while the respective control variables are collected and incorporated as size, which is measured as the natural logarithm of total assets; return on assets (ROA) estimated as the analysed company's net income divided by total assets; leverage defined as total corporate debt divided by total assets; market-to-book value (MB) measured as the end of period closing price multiplied by the number of common shares outstanding, which is subsequently divided by total equity. Standard errors are presented in parentheses. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

TABLE 4 | CARs as conditioned by ESG-segregation.

Window	Intercept	Envir.	Social	Gov.	Size	ROA	Leverage	MV/BV	Obs.	R^2	Ind. FE	Year FE
[−20, −1]	−0.1030	0.0065	0.0077	0.0063	0.0046*	0.0038	−0.0124	−0.0001	1686	0.015	Yes	Yes
	(0.0665)	(0.0076)	(0.0053)	(0.0046)	(0.0026)	(0.0254)	(0.0249)	(0.0001)				
[−10, −1]	−0.0907**	0.0058	0.0011	0.0052*	0.0037**	−0.0024	−0.0012	−0.0001	1686	0.020	Yes	Yes
	(0.0433)	(0.0048)	(0.0035)	(0.0031)	(0.0017)	(0.0170)	(0.0149)	(0.0001)				
[−5, −1]	−0.0550*	0.0040	0.0010	0.0021	0.0023**	0.0019	−0.0027	−0.0001	1686	0.016	Yes	Yes
	(0.0282)	(0.0029)	(0.0025)	(0.0021)	(0.0011)	(0.0129)	(0.0104)	(0.0001)				
[−3, −1]	−0.0246	0.0035	0.0010	0.0011	0.0010	0.0036	0.0031	−0.0001	1686	0.011	Yes	Yes
	(0.0226)	(0.0023)	(0.0020)	(0.0016)	(0.0009)	(0.0108)	(0.0084)	(0.0001)				
[−2, −1]	−0.0185	0.0025	0.0008	0.0009	0.0007	−0.0020	0.0047	0.0001	1686	0.013	Yes	Yes
	(0.0197)	(0.0020)	(0.0015)	(0.0013)	(0.0008)	(0.0095)	(0.0064)	(0.0001)				
[−1, t_0]	−0.0214	0.0033	0.0010	−0.0011	0.0008	0.0181*	0.0024	−0.0001	1686	0.024	Yes	Yes
	(0.0228)	(0.0026)	(0.0018)	(0.0016)	(0.0009)	(0.0096)	(0.0079)	(0.0001)				
[t_0, +1]	−0.0351	0.0014	0.0015	−0.0011	0.0013	0.0263**	0.0085	−0.0001	1686	0.038	Yes	Yes
	(0.0265)	(0.0028)	(0.0018)	(0.0017)	(0.0010)	(0.0108)	(0.0072)	(0.0001)				
[t_0, +2]	−0.0287	−0.0014	0.0005	−0.0007	0.0012	0.0148	0.0114	−0.0001	1686	0.020	Yes	Yes
	(0.0284)	(0.0032)	(0.0021)	(0.0019)	(0.0011)	(0.0123)	(0.0083)	(0.0001)				
[t_0, +3]	−0.0372	−0.0023	0.0021	−0.0004	0.0014	0.0145	0.0092	−0.0001*	1686	0.017	Yes	Yes
	(0.0330)	(0.0038)	(0.0026)	(0.0023)	(0.0013)	(0.0137)	(0.0117)	(0.0000)				
[t_0, +5]	−0.0184	−0.0051	0.0025	−0.0016	0.0013	0.0040	0.0273**	−0.0001*	1686	0.017	Yes	Yes
	(0.0407)	(0.0052)	(0.0032)	(0.0029)	(0.0016)	(0.0166)	(0.0129)	(0.0000)				
[t_0, +10]	−0.0731	−0.0112*	0.0007	−0.0010	0.0035*	0.0233	0.0259	−0.0001	1686	0.024	Yes	Yes
	(0.0531)	(0.0064)	(0.0044)	(0.0040)	(0.0020)	(0.0171)	(0.0210)	(0.0001)				
[t_0, +20]	−0.0552	−0.0158**	0.0047	−0.0042	0.0027	0.0090	0.0459*	−0.0001*	1686	0.017	Yes	Yes
	(0.0656)	(0.0079)	(0.0058)	(0.0053)	(0.0026)	(0.0270)	(0.0260)	(0.0000)				
[−1, +1]	−0.0445	0.0043	0.0009	−0.0003	0.0017	0.0220	0.0083	−0.0001	1686	0.032	Yes	Yes
	(0.0297)	(0.0032)	(0.0021)	(0.0018)	(0.0012)	(0.0134)	(0.0083)	(0.0001)				
[−2, +2]	−0.0472	0.0011	0.0012	0.0002	0.0019	0.0129	0.0161	−0.0001	1686	0.019	Yes	Yes
	(0.0325)	(0.0037)	(0.0026)	(0.0023)	(0.0013)	(0.0134)	(0.0104)	(0.0001)				

(Continues)

TABLE 4 | (Continued)

Window	Intercept	Envir.	Social	Gov.	Size	ROA	Leverage	MV/BV	Obs.	R^2	Ind. FE	Year FE
[−3, +3]	−0.0618	0.0012	0.0031	0.0007	0.0024	0.0181	0.0123	−0.0001	1686	0.018	Yes	Yes
	(0.0383)	(0.0043)	(0.0034)	(0.0029)	(0.0015)	(0.0162)	(0.0158)	(0.0001)				
[−5, +5]	−0.0733	−0.0012	0.0034	0.0005	0.0036*	0.0060	0.0246	−0.0001	1686	0.020	Yes	Yes
	(0.0496)	(0.0059)	(0.0041)	(0.0037)	(0.0019)	(0.0217)	(0.0172)	(0.0001)				
[−10, +10]	−0.1638**	−0.0054	0.0018	0.0042	0.0072***	0.0209	0.0247	−0.0001	1686	0.033	Yes	Yes
	(0.0709)	(0.0076)	(0.0058)	(0.0051)	(0.0027)	(0.0285)	(0.0265)	(0.0001)				
[−20, +20]	−0.1583*	−0.0093	0.0124	0.0021	0.0072**	0.0127	0.0335	−0.0001	1686	0.020	Yes	Yes
	(0.0888)	(0.0099)	(0.0085)	(0.0076)	(0.0035)	(0.0414)	(0.0410)	(0.0001)				

Note: Cumulative abnormal returns are estimated as $CAR_i[t_1, t_2] = \sum_{t=t_1}^{t_2} AR_{i,t}$ for the following event windows: [−1, +1], [−2, +2], [−3, +3], [−5, +5], [−10, +10] and [−20, +20]; and to focus on longer-term windows: [−1, +1], [−2, +2], [−3, +3], [−5, +5], [−10, +10] and [−20, +20]. Such CARs are then developed in the methodological structure: $CAR_{i,t} = \alpha_i + \beta_1 Size_{i,t-1} + \beta_2 ROA_{i,t-1} + \beta_3 Leverage_{i,t-1} + \beta_4 MB_{i,t-1} + \Sigma\beta FE + \epsilon_{i,t}$, where CAR is again defined as above, while the respective control variables are collected and incorporated as size, which is measured as the natural logarithm of total assets; return on assets (ROA) estimated as the analysed company's net income divided by total assets; leverage defined as total corporate debt divided by total assets; market-to-book value (MB) measured as the end of period closing price multiplied by the number of common shares outstanding, which is subsequently divided by total equity. Standard errors are presented in parentheses. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

to sudden environmental or social crises. Throughout these diverse reactions, the insulating effect of firm size persists, particularly pre-event for governance issues, underscoring larger firms' enhanced capacity, via legal resources, sophisticated communication strategies, and potentially diversified operations, to manage the distinct financial and reputational fallout associated with different types of ESG challenges. This differentiated response across E, S, and G underlines that ESG materiality is highly context-specific within the pharmaceutical sector, with investors primarily penalising environmental failures due to their perceived direct, enduring, and quantifiable financial consequences.

We next focus on differential behaviour as a result of event-specific dynamics in Table 5. We first focus on event novelty, which confirms a significant market distinction between first-time (novel) and recurring ESG reputational incidents among pharmaceutical firms. Consistent across pre-event, event-time, and post-event windows, novelty is associated with significantly less negative CARs relative to repeated events. Specifically, novel events exhibit a positive CAR differential of +9.9 bp pre-event ([−20, −1]), and significant post-event persistence at +7.1 bp ([t_0, +10]) and +11.5 bp ([t_0, +20]). This pattern strongly indicates that the market imposes a harsher penalty, or an additional discount, on firms that exhibit repeated ESG misconduct than on those facing such an issue for the first time. Such additional discounts stem from several interconnected factors that operate through market efficiency, risk premiums, and specific behavioural channels. From a market efficiency perspective, investors learn over time; a novel event carries inherent uncertainty regarding its long-term impact and management's ability to rectify it, potentially leading to a less severe initial reaction. However, a repeated event provides confirming evidence of systemic weakness or management failure, allowing for faster and more decisive negative repricing as the pattern becomes clear. This aligns with the risk-premium arguments, in which a repeat offender significantly increases the perceived operational, regulatory, and reputational risk associated with the firm. Investors likely demand a higher risk premium, discounting future cash flows more heavily, due to heightened concerns about management competence, the effectiveness of internal controls, and the potential for escalating sanctions or litigation, where regulators and courts often treat repeat offences more severely (Alexander 1999).

Specific channels further amplify this effect. Stakeholder trust erodes more sharply after repeated failures; key customers, partners, or influential stakeholders, who might offer latitude for a first mistake, are more likely to disengage after subsequent incidents. Reputation, a critical intangible asset, suffers disproportionately from patterns of misconduct than from isolated events (Rhee and Haunschild 2006). Furthermore, ESG rating agencies explicitly penalise recurring controversies more harshly (Chatterji et al. 2016), potentially triggering index exclusion or divestment by dedicated funds (Hartzmark and Sussman 2019). Management credibility is also severely undermined by repeat offences, signalling an inability or unwillingness to learn from past mistakes and implement effective corrective actions. Analysts may issue more punitive forecast revisions or downgrades following repeated ESG issues, reinforcing negative

TABLE 5 | CARs as conditioned by ESG-related event novelty.

Window	Intercept	Novelty	Size	ROA	Leverage	MV/BV	Obs.	R^2	Ind. FE	Year FE
[−20, −1]	−0.0900	0.0099**	0.0042	0.0041	−0.0081	−0.0001	1686	0.015	Yes	Yes
	(0.0662)	(0.0048)	(0.0027)	(0.0256)	(0.0251)	(0.0001)				
[−10, −1]	−0.0834*	0.0038	0.0034**	−0.0025	0.0025	−0.0001	1686	0.018	Yes	Yes
	(0.0427)	(0.0035)	(0.0016)	(0.0171)	(0.0152)	(0.0001)				
[−5, −1]	−0.0505*	0.0028	0.0021*	0.0022	−0.0007	0.0001	1686	0.016	Yes	Yes
	(0.0276)	(0.0023)	(0.0011)	(0.0130)	(0.0105)	(0.0001)				
[−3, −1]	−0.0214	0.0017	0.0009	0.0039	0.0045	−0.0001	1686	0.010	Yes	Yes
	(0.0222)	(0.0019)	(0.0009)	(0.0109)	(0.0085)	(0.0001)				
[−2, −1]	−0.0156	0.0022	0.0006	−0.0017	0.0059	0.0001	1686	0.014	Yes	Yes
	(0.0193)	(0.0015)	(0.0008)	(0.0096)	(0.0063)	(0.0001)				
[−1, t_0]	−0.0197	0.0008	0.0007	0.0186*	0.0029	−0.0001	1686	0.022	Yes	Yes
	(0.0230)	(0.0018)	(0.0009)	(0.0097)	(0.0080)	(0.0001)				
[t_0, +1]	−0.0330	0.0030*	0.0012	0.0270**	0.0087	−0.0001	1686	0.039	Yes	Yes
	(0.0269)	(0.0018)	(0.0011)	(0.0108)	(0.0072)	(0.0001)				
[t_0, +2]	−0.0284	0.0022	0.0012	0.0152	0.0110	−0.0001	1686	0.021	Yes	Yes
	(0.0287)	(0.0022)	(0.0012)	(0.0124)	(0.0084)	(0.0001)				
[t_0, +3]	−0.0366	0.0023	0.0014	0.0146	0.0085	−0.0001*	1686	0.017	Yes	Yes
	(0.0333)	(0.0026)	(0.0013)	(0.0137)	(0.0117)	(0.0000)				
[t_0, +5]	−0.0189	0.0037	0.0013	0.0044	0.0257**	−0.0001*	1686	0.017	Yes	Yes
	(0.0413)	(0.0032)	(0.0016)	(0.0167)	(0.0130)	(0.0000)				
[t_0, +10]	−0.0750	0.0071*	0.0035*	0.0237	0.0234	−0.0001	1686	0.024	Yes	Yes
	(0.0532)	(0.0040)	(0.0020)	(0.0172)	(0.0205)	(0.0001)				
[t_0, +20]	−0.0573	0.0115**	0.0026	0.0101	0.0413	−0.0001*	1686	0.017	Yes	Yes
	(0.0653)	(0.0053)	(0.0026)	(0.0269)	(0.0255)	(0.0000)				
[−1, +1]	−0.0407	0.0032	0.0015	0.0228*	0.0096	−0.0001	1686	0.032	Yes	Yes
	(0.0298)	(0.0021)	(0.0012)	(0.0134)	(0.0083)	(0.0001)				
[−2, +2]	−0.0440	0.0045*	0.0018	0.0136	0.0169	−0.0001	1686	0.021	Yes	Yes
	(0.0325)	(0.0027)	(0.0013)	(0.0134)	(0.0105)	(0.0001)				
[−3, +3]	−0.0580	0.0040	0.0023	0.0185	0.0130	−0.0001	1686	0.018	Yes	Yes
	(0.0382)	(0.0032)	(0.0015)	(0.0162)	(0.0158)	(0.0001)				
[−5, +5]	−0.0694	0.0065	0.0034*	0.0066	0.0249	−0.0001	1686	0.021	Yes	Yes
	(0.0499)	(0.0040)	(0.0020)	(0.0218)	(0.0173)	(0.0001)				
[−10, +10]	−0.1584**	0.0109*	0.0069***	0.0212	0.0259	−0.0001	1686	0.034	Yes	Yes
	(0.0698)	(0.0056)	(0.0027)	(0.0288)	(0.0263)	(0.0001)				
[−20, +20]	−0.1472*	0.0214***	0.0068*	0.0142	0.0333	−0.0001	1686	0.024	Yes	Yes
	(0.0871)	(0.0074)	(0.0035)	(0.0410)	(0.0401)	(0.0001)				

Note: In the above table, cumulative abnormal returns are estimated as $\text{CAR}_i\left[t_1, t_2\right] = \sum_{t=t_1}^{t_2} \text{AR}_{i,t}$ for the following event windows: [−20, −1], [−10, −1], [−5, −1], [−3, −1], [−2, −1], [−1, t_0], [t_0, +1], [t_0, +2], [t_0, +3], [t_0, +5], [t_0, +10], and [t_0, +20]; and to focus on longer-term windows: [−1, +1], [−2, +2], [−3, +3], [−5, +5], [−10, +10] and [−20, +20]. Such CARs are then developed in the methodological structure: $\text{CAR}_{i,t} = \alpha_i + \beta_1 \text{RepR}_{i,t} + \beta_2 \text{Size}_{i,t-1} + \beta_3 \text{ROA}_{i,t-1} + \beta_4 \text{Leverage}_{i,t-1} + \beta_5 \text{MB}_{i,t-1} + \Sigma\beta\text{FE} + \epsilon_{i,t}$, where CAR is again defined as above, while the respective control variables are collected and incorporated as size, which is measured as the natural logarithm of total assets; return on assets (ROA) estimated as the analysed company's net income divided by total assets; leverage defined as total corporate debt divided by total assets; market-to-book value (MB) measured as the end of period closing price multiplied by the number of common shares outstanding, which is subsequently divided by total equity. $\text{RepR}_{i,t}$, in this case, represents novelty, or the newness of the issues addressed for the criticised company, defined as one if the company is experiencing a recurring issue or two if the issue is new. Standard errors are presented in parentheses. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

sentiment. Investors may also infer that the true costs of remediation and addressing the root cause were underestimated after the first event, leading to a sharper downward revision upon recurrence.

Next, in Table 6 we focus on event sharpness, where RepRisk distinguishes between clearly attributed ('sharp') and complex or ambiguously linked ('unsharp') negative events. There are no significant differences in CARs based on sharpness either before or immediately at the event (t_0). However, in the post-event periods, specifically the two-week ([t_0, +10]) and four-week ([t_0, +20]) windows, sharp events exhibit significantly less negative CARs compared to unsharp events, indicated by positive coefficients of +76 and +159 bp, respectively. This indicates that events in which the company's responsibility is initially unclear ultimately incur a larger, albeit delayed, market penalty. This delayed, and more severe penalty for unsharp events likely reflects the market's process of resolving ambiguity over time. While sharp events enable relatively faster, clearer attribution and pricing of the immediate negative impact, unsharp events introduce prolonged uncertainty. An extended period of information discovery and digestion leads to a more gradual but ultimately more negative evaluation, which several factors can explain. Firstly, the ambiguity inherent in unsharp events signals potentially longer and more uncertain investigation periods, protracted litigation risks, or complex remediation efforts, elevating the perceived long-term risk profile and justifying a persistent discount. Secondly, the higher information-discovery costs of uncovering unsharp events slow the diffusion of information, delaying market consensus and the full pricing impact. Third, the initial ambiguity might allow management room to obfuscate or deny, but if clarity eventually emerges, confirming culpability, the resulting erosion of management credibility can trigger significant delayed selling pressure. Stakeholders, such as regulators or major customers, can also delay punitive actions or relationship changes until responsibility is clearly established, resulting in lagged negative effects on cash flow. Fundamentally, the lack of a sharp initial drop for unsharp events implies less potential for an immediate overreaction-reversal, allowing for a more sustained negative drift as the negative information solidifies. Such events, therefore, by their very nature, result in laboured or slow-moving dynamic response in the period thereafter, but reaffirm the presence of market efficiency and investor consideration of the facts surrounding the specific case.

Investigating the reach of such ESG-related news consistently presents evidence of statistically insignificant coefficients across each of the various event windows, indicating that, after controlling for firm characteristics and time effects, whether the negative ESG news originates from a low-reach (e.g., local media, blog), medium-reach (national media, NGOs), or high-reach (major international media) source does not significantly alter the magnitude of the CARs experienced by the pharmaceutical firms. While the overall negative market reaction to these events persists, as shown in Table 7, its severity is not demonstrably different across the breadth of the initial source's dissemination. The lack of significant reach is particularly intriguing because conventional wisdom might suggest that news disseminated through high-reach, globally recognised media outlets would trigger a faster and more severe market reaction due to greater visibility and perceived credibility. The observed indifference implies that the content and existence of the negative ESG information itself are the primary drivers of the market reaction, rather than the prestige or breadth of the initial reporting source. Further, the growth of social media and the immediacy of such news dissemination appear to have somewhat muddied traditional channels of release (Blankespoor et al. 2014). Several factors likely contribute to this phenomenon. Firstly, even if originating from a low-reach source, such news can rapidly propagate through specialised financial data vendors, social media, and investor networks, quickly reaching the relevant market participants who drive price discovery. This efficient aggregation and dissemination by intermediaries effectively neutralises the advantage of traditional high-reach media for sophisticated investors and algorithmic trading systems, which often react to keywords and data-feed updates regardless of the original publication source. Secondly, the core impact might be triggered by the first credible mention of the event; subsequent coverage, even in higher-reach outlets, may offer diminishing marginal informational value to a market already alerted. This aligns with the idea that localised news or specialised reports are sufficient to initiate the pricing process among informed investors. Furthermore, noise trading and the sheer volume of information flow could obscure any subtle differences attributable solely to source reach. Larger pharmaceutical companies deploy standardised crisis communication and media management strategies that effectively dampen or shape the narrative regardless of the initial source's scale.

In a particularly interesting result, as presented in Table 8, the severity of associated ESG events does not appear to result in any discernible differential of investor behaviour, thereby indicating that pharmaceutical corporations can be responsible for major ESG breaches, but investors do not perceive such responsibility to be of concern. This implies that, within this sample of US pharmaceutical firms, the market's negative reaction to an ESG reputational event does not vary significantly with the assessed harshness or scale of the incident, as defined by RepRisk's methodology. This observed indifference to event severity is somewhat counterintuitive, but could be a result of several distinct factors, where investors operate with a threshold expectation, where once any credible ESG breach crosses a certain threshold of concern, triggering a negative reassessment, the marginal impact of higher severity levels becomes negligible across the examined event windows. The primary signal might be the existence of a significant ESG failure, rather than its precise gradation. Investors might also be more attuned to the type of ESG violation (as observed with regard to the presented strong environmental effect) rather than its scale, perceiving certain categories of risk as inherently more damaging regardless of the specific severity level within that category. We must also consider that the already intense scrutiny faced by the pharmaceutical sector could mean that any significant ESG lapse is viewed as indicative of serious underlying risk, triggering a substantial baseline negative reaction that overwhelms severity differentials. Firms may also possess mitigation strategies (such as insurance, contingency funds, robust legal defences) that are particularly effective at capping the differential financial downside of higher-severity events.

Table 9 presents evidence of the selected robustness testing procedures to verify the baseline methodological structure.

TABLE 6 | CARs as conditioned by ESG-related event sharpness.

Window	Intercept	Sharp	Size	ROA	Leverage	MV/BV	Obs.	R^2	Ind. FE	Year FE
[−20, −1]	−0.0943	0.0085	0.0044*	0.0022	−0.0101	−0.0001	1686	0.013	Yes	Yes
	(0.0663)	(0.0065)	(0.0027)	(0.0257)	(0.0248)	(0.0001)				
[−10, −1]	−0.0853**	0.0010	0.0035**	−0.0031	0.0019	−0.0001	1686	0.018	Yes	Yes
	(0.0431)	(0.0053)	(0.0017)	(0.0171)	(0.0150)	(0.0001)				
[−5, −1]	−0.0516*	0.0041	0.0022**	0.0016	−0.0015	0.0001	1686	0.016	Yes	Yes
	(0.0277)	(0.0029)	(0.0011)	(0.0130)	(0.0104)	(0.0001)				
[−3, −1]	−0.0220	0.0028	0.0009	0.0035	0.0040	−0.0001	1686	0.010	Yes	Yes
	(0.0224)	(0.0023)	(0.0009)	(0.0108)	(0.0084)	(0.0001)				
[−2, −1]	−0.0167	0.0008	0.0007	−0.0020	0.0056	0.0001	1686	0.013	Yes	Yes
	(0.0195)	(0.0019)	(0.0008)	(0.0095)	(0.0063)	(0.0001)				
[−1, t_0]	−0.0201	−0.0003	0.0008	0.0185*	0.0028	−0.0001	1686	0.022	Yes	Yes
	(0.0229)	(0.0017)	(0.0009)	(0.0097)	(0.0079)	(0.0001)				
[t_0, +1]	−0.0346	−0.0014	0.0013	0.0266**	0.0085	−0.0001	1686	0.037	Yes	Yes
	(0.0267)	(0.0021)	(0.0011)	(0.0108)	(0.0072)	(0.0001)				
[t_0, +2]	−0.0297	−0.0016	0.0013	0.0149	0.0109	−0.0001	1686	0.020	Yes	Yes
	(0.0286)	(0.0024)	(0.0012)	(0.0124)	(0.0083)	(0.0001)				
[t_0, +3]	−0.0378	0.0001	0.0015	0.0143	0.0082	−0.0001*	1686	0.016	Yes	Yes
	(0.0333)	(0.0027)	(0.0013)	(0.0137)	(0.0116)	(0.0000)				
[t_0, +5]	−0.0209	−0.0022	0.0014	0.0039	0.0255*	−0.0001*	1686	0.016	Yes	Yes
	(0.0413)	(0.0031)	(0.0016)	(0.0167)	(0.0130)	(0.0000)				
[t_0, +10]	−0.0792	0.0076*	0.0038*	0.0228	0.0234	−0.0001	1686	0.023	Yes	Yes
	(0.0532)	(0.0043)	(0.0020)	(0.0171)	(0.0204)	(0.0001)				
[t_0, +20]	−0.0645	0.0159***	0.0031	0.0089	0.0417	−0.0001*	1686	0.017	Yes	Yes
	(0.0651)	(0.0056)	(0.0026)	(0.0269)	(0.0254)	(0.0000)				
[−1, +1]	−0.0425	−0.0017	0.0016	0.0224*	0.0094	−0.0001	1686	0.031	Yes	Yes
	(0.0298)	(0.0022)	(0.0012)	(0.0135)	(0.0083)	(0.0001)				
[−2, +2]	−0.0464	−0.0009	0.0019	0.0129	0.0165	−0.0001	1686	0.019	Yes	Yes
	(0.0325)	(0.0028)	(0.0013)	(0.0135)	(0.0105)	(0.0001)				
[−3, +3]	−0.0598	0.0029	0.0024	0.0178	0.0123	−0.0001	1686	0.018	Yes	Yes
	(0.0383)	(0.0036)	(0.0015)	(0.0163)	(0.0157)	(0.0001)				
[−5, +5]	−0.0725	0.0020	0.0036*	0.0055	0.0240	−0.0001	1686	0.019	Yes	Yes
	(0.0500)	(0.0043)	(0.0020)	(0.0219)	(0.0173)	(0.0001)				
[−10, +10]	−0.1645**	−0.0066	0.0073***	0.0197	0.0253	−0.0001	1686	0.032	Yes	Yes
	(0.0704)	(0.0076)	(0.0027)	(0.0287)	(0.0260)	(0.0001)				
[−20, +20]	−0.1587*	−0.0075	0.0075**	0.0110	0.0316	−0.0001	1686	0.018	Yes	Yes
	(0.0872)	(0.0092)	(0.0035)	(0.0415)	(0.0398)	(0.0001)				

Note: In the above table, cumulative abnormal returns are estimated as $\text{CAR}_i\left[t_1, t_2\right] = \sum_{t=t_1}^{t_2} \text{AR}_{i,t}$ for the following event windows: [−20, −1], [−10, −1], [−5, −1], [−3, −1], [−2, −1], [−1, t_0], [t_0, +1], [t_0, +2], [t_0, +3], [t_0, +5], [t_0, +10], and [t_0, +20]; and to focus on longer-term windows: [−1, +1], [−2, +2], [−3, +3], [−5, +5], [−10, +10] and [−20, +20]. Such CARs are then developed in the methodological structure: $\text{CAR}_{i,t} = \alpha_i + \beta_1 \text{RepR}_{i,t} + \beta_2 \text{Size}_{i,t-1} + \beta_3 \text{ROA}_{i,t-1} + \beta_4 \text{Leverage}_{i,t-1} + \beta_5 \text{MB}_{i,t-1} + \Sigma\beta\text{FE} + \epsilon_{i,t}$, where CAR is again defined as above, while the respective control variables are collected and incorporated as size, which is measured as the natural logarithm of total assets; return on assets (ROA) estimated as the analysed company's net income divided by total assets; leverage defined as total corporate debt divided by total assets; market-to-book value (MB) measured as the end of period closing price multiplied by the number of common shares outstanding, which is subsequently divided by total equity. $\text{RepR}_{i,t}$, in this case, unsharp events (defined to indicate whether a risk incident is sharp or unsharp, where more specifically, unsharp risk incidents are when the entity is mentioned, but the criticism is complex and/or not precisely defined). Standard errors are presented in parentheses. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

TABLE 7 | CARs as conditioned by ESG-related event reach.

Window	Intercept	Reach	Size	ROA	Leverage	MV/BV	Obs.	R^2	Ind. FE	Year FE
[−20, −1]	−0.0954	−0.0052	0.0046*	0.0027	−0.0084	−0.0001	1686	0.013	Yes	Yes
	(0.0663)	(0.0048)	(0.0027)	(0.0257)	(0.0248)	(0.0001)				
[−10, −1]	−0.0854**	−0.0006	0.0036**	−0.0031	0.0021	−0.0001	1686	0.018	Yes	Yes
	(0.0431)	(0.0035)	(0.0017)	(0.0171)	(0.0150)	(0.0001)				
[−5, −1]	−0.0519*	0.0007	0.0022**	0.0017	−0.0011	0.0001	1686	0.015	Yes	Yes
	(0.0277)	(0.0022)	(0.0011)	(0.0130)	(0.0104)	(0.0001)				
[−3, −1]	−0.0222	0.0004	0.0009	0.0036	0.0043	−0.0001	1686	0.010	Yes	Yes
	(0.0224)	(0.0018)	(0.0009)	(0.0108)	(0.0084)	(0.0001)				
[−2, −1]	−0.0166	0.0013	0.0006	−0.0021	0.0054	0.0001	1686	0.013	Yes	Yes
	(0.0195)	(0.0016)	(0.0008)	(0.0096)	(0.0063)	(0.0001)				
[−1, t_0]	−0.0200	0.0005	0.0008	0.0185*	0.0027	−0.0001	1686	0.022	Yes	Yes
	(0.0230)	(0.0018)	(0.0009)	(0.0097)	(0.0079)	(0.0001)				
[t_0, +1]	−0.0344	0.0011	0.0013	0.0265**	0.0082	−0.0001	1686	0.037	Yes	Yes
	(0.0268)	(0.0017)	(0.0011)	(0.0108)	(0.0071)	(0.0001)				
[t_0, +2]	−0.0294	0.0024	0.0012	0.0148	0.0104	−0.0001	1686	0.021	Yes	Yes
	(0.0286)	(0.0019)	(0.0012)	(0.0124)	(0.0083)	(0.0001)				
[t_0, +3]	−0.0376	0.0029	0.0014	0.0142	0.0078	−0.0001*	1686	0.017	Yes	Yes
	(0.0333)	(0.0022)	(0.0014)	(0.0137)	(0.0116)	(0.0000)				
[t_0, +5]	−0.0205	0.0038	0.0014	0.0036	0.0247*	−0.0001**	1686	0.017	Yes	Yes
	(0.0413)	(0.0026)	(0.0016)	(0.0166)	(0.0130)	(0.0000)				
[t_0, +10]	−0.0785	0.0008	0.0037*	0.0225	0.0225	−0.0001	1686	0.022	Yes	Yes
	(0.0533)	(0.0034)	(0.0020)	(0.0171)	(0.0204)	(0.0001)				
[t_0, +20]	−0.0636	−0.0061	0.0031	0.0085	0.0409	−0.0001*	1686	0.015	Yes	Yes
	(0.0654)	(0.0047)	(0.0026)	(0.0269)	(0.0253)	(0.0000)				
[−1, +1]	−0.0423	0.0009	0.0016	0.0223*	0.0091	−0.0001	1686	0.031	Yes	Yes
	(0.0299)	(0.0021)	(0.0012)	(0.0135)	(0.0083)	(0.0001)				
[−2, +2]	−0.0460	0.0037	0.0018	0.0127	0.0159	−0.0001	1686	0.020	Yes	Yes
	(0.0325)	(0.0024)	(0.0013)	(0.0136)	(0.0104)	(0.0001)				
[−3, +3]	−0.0598	0.0033	0.0023	0.0177	0.0121	−0.0001	1686	0.018	Yes	Yes
	(0.0383)	(0.0027)	(0.0016)	(0.0163)	(0.0156)	(0.0001)				
[−5, +5]	−0.0723	0.0045*	0.0035*	0.0053	0.0235	−0.0001	1686	0.020	Yes	Yes
	(0.0500)	(0.0034)	(0.0020)	(0.0219)	(0.0172)	(0.0001)				
[−10, +10]	−0.1639**	0.0002	0.0073***	0.0194	0.0246	−0.0001	1686	0.032	Yes	Yes
	(0.0706)	(0.0052)	(0.0027)	(0.0287)	(0.0261)	(0.0001)				
[−20, +20]	−0.1589*	−0.0112*	0.0077**	0.0112	0.0325	−0.0001	1686	0.020	Yes	Yes
	(0.0873)	(0.0067)	(0.0035)	(0.0414)	(0.0398)	(0.0001)				

Note: In the above table, cumulative abnormal returns are estimated as $\text{CAR}_i\left[t_1, t_2\right] = \sum_{t=t_1}^{t_2} \text{AR}_{i,t}$ for the following event windows: [−20, −1], [−10, −1], [−5, −1], [−3, −1], [−2, −1], [−1, t_0], [t_0, +1], [t_0, +2], [t_0, +3], [t_0, +5], [t_0, +10], and [t_0, +20]; and to focus on longer-term windows: [−1, +1], [−2, +2], [−3, +3], [−5, +5], [−10, +10] and [−20, +20]. Such CARs are then developed in the methodological structure: $\text{CAR}_{i,t} = \alpha_i + \beta_1 \text{RepR}_{i,t} + \beta_2 \text{Size}_{i,t-1} + \beta_3 \text{ROA}_{i,t-1} + \beta_4 \text{Leverage}_{i,t-1} + \beta_5 \text{MB}_{i,t-1} + \Sigma\beta\text{FE} + \epsilon_{i,t}$, where CAR is again defined as above, while the respective control variables are collected and incorporated as size, which is measured as the natural logarithm of total assets; return on assets (ROA) estimated as the analysed company's net income divided by total assets; leverage defined as total corporate debt divided by total assets; market-to-book value (MB) measured as the end of period closing price multiplied by the number of common shares outstanding, which is subsequently divided by total equity. $\text{RepR}_{i,t}$, in this case, reach is valued as either one, two, or three, which represents low reach (inclusive of local media smaller NGOs, local governmental bodies, blogs, internet sites, etc.), medium reach (including most national and regional media, international NGOs, and state, national, and international governmental bodies), and high reach events (denoted as the few international media, for example, the FT, NY Times, BBC, and others.) respectively as separated. Standard errors are presented in parentheses. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

TABLE 8 | CARs as conditioned by ESG-related event severity.

Window	Intercept	Severity	Size	ROA	Leverage	MV/BV	Obs.	R^2	Ind. FE	Year FE
[−20, −1]	−0.0915	−0.0032	0.0044*	0.0030	−0.0093	−0.0001	1686	0.013	Yes	Yes
	(0.0661)	(0.0042)	(0.0026)	(0.0256)	(0.0248)	(0.0001)				
[−10, −1]	−0.0844**	−0.0009	0.0035**	−0.0030	0.0020	−0.0001	1686	0.018	Yes	Yes
	(0.0428)	(0.0029)	(0.0017)	(0.0171)	(0.0151)	(0.0001)				
[−5, −1]	−0.0495*	−0.0022	0.0021*	0.0021	−0.0011	0.0001	1686	0.016	Yes	Yes
	(0.0274)	(0.0019)	(0.0011)	(0.0130)	(0.0104)	(0.0001)				
[−3, −1]	−0.0216	−0.0005	0.0009	0.0037	0.0043	−0.0001	1686	0.010	Yes	Yes
	(0.0221)	(0.0015)	(0.0009)	(0.0108)	(0.0084)	(0.0001)				
[−2, −1]	−0.0166	−0.0001	0.0007	−0.0020	0.0056	0.0001	1686	0.013	Yes	Yes
	(0.0194)	(0.0012)	(0.0008)	(0.0096)	(0.0063)	(0.0001)				
[−1, t_0]	−0.0209	0.0007	0.0008	0.0184*	0.0028	−0.0001	1686	0.022	Yes	Yes
	(0.0226)	(0.0013)	(0.0009)	(0.0096)	(0.0079)	(0.0001)				
[t_0, +1]	−0.0362	0.0015	0.0013	0.0263**	0.0084	−0.0001	1686	0.038	Yes	Yes
	(0.0263)	(0.0014)	(0.0011)	(0.0109)	(0.0071)	(0.0001)				
[t_0, +2]	−0.0311	0.0014	0.0013	0.0146	0.0108	−0.0001	1686	0.020	Yes	Yes
	(0.0284)	(0.0018)	(0.0011)	(0.0124)	(0.0083)	(0.0001)				
[t_0, +3]	−0.0397	0.0017	0.0015	0.0140	0.0083	−0.0001*	1686	0.016	Yes	Yes
	(0.0330)	(0.0020)	(0.0013)	(0.0138)	(0.0116)	(0.0000)				
[t_0, +5]	−0.0227	0.0017	0.0015	0.0035	0.0253*	−0.0001**	1686	0.016	Yes	Yes
	(0.0411)	(0.0025)	(0.0016)	(0.0168)	(0.0130)	(0.0000)				
[t_0, +10]	−0.0809	0.0021	0.0038*	0.0222	0.0227	−0.0001	1686	0.022	Yes	Yes
	(0.0531)	(0.0031)	(0.0020)	(0.0172)	(0.0204)	(0.0001)				
[t_0, +20]	−0.0624	−0.0006	0.0030	0.0084	0.0400	−0.0001*	1686	0.014	Yes	Yes
	(0.0648)	(0.0041)	(0.0026)	(0.0269)	(0.0253)	(0.0000)				
[−1, +1]	−0.0434	0.0009	0.0016	0.0222	0.0093	−0.0001	1686	0.031	Yes	Yes
	(0.0294)	(0.0016)	(0.0012)	(0.0135)	(0.0083)	(0.0001)				
[−2, +2]	−0.0477	0.0013	0.0020	0.0126	0.0164	−0.0001	1686	0.019	Yes	Yes
	(0.0325)	(0.0023)	(0.0013)	(0.0135)	(0.0104)	(0.0001)				
[−3, +3]	−0.0613	0.0012	0.0024	0.0177	0.0126	−0.0001	1686	0.017	Yes	Yes
	(0.0380)	(0.0025)	(0.0015)	(0.0163)	(0.0157)	(0.0001)				
[−5, +5]	−0.0721	−0.0005	0.0036*	0.0056	0.0242	−0.0001	1686	0.019	Yes	Yes
	(0.0499)	(0.0032)	(0.0020)	(0.0219)	(0.0173)	(0.0001)				
[−10, +10]	−0.1652**	0.0012	0.0073***	0.0192	0.0247	−0.0001	1686	0.032	Yes	Yes
	(0.0695)	(0.0041)	(0.0027)	(0.0287)	(0.0261)	(0.0001)				
[−20, +20]	−0.1539*	−0.0038	0.0073**	0.0113	0.0307	−0.0001	1686	0.018	Yes	Yes
	(0.0865)	(0.0059)	(0.0035)	(0.0413)	(0.0398)	(0.0001)				

Note: In the above table, cumulative abnormal returns are estimated as $\text{CAR}_i\left[t_1, t_2\right] = \sum_{t=t_1}^{t_2} \text{AR}_{i,t}$ for the following event windows: [−20, −1], [−10, −1], [−5, −1], [−3, −1], [−2, −1], [−1, t_0], [t_0, +1], [t_0, +2], [t_0, +3], [t_0, +5], [t_0, +10] and [t_0, +20]; and to focus on longer-term windows: [−1, +1], [−2, +2], [−3, +3], [−5, +5], [−10, +10] and [−20, +20]. Such CARs are then developed in the methodological structure: $\text{CAR}_{i,t} = \alpha_i + \beta_1 \text{RepR}_{i,t} + \beta_2 \text{Size}_{i,t-1} + \beta_3 \text{ROA}_{i,t-1} + \beta_4 \text{Leverage}_{i,t-1} + \beta_5 \text{MB}_{i,t-1} + \Sigma\beta\text{FE} + \epsilon_{i,t}$, where CAR is again defined as above, while the respective control variables are collected and incorporated as size, which is measured as the natural logarithm of total assets; return on assets (ROA) estimated as the analysed company's net income divided by total assets; leverage defined as total corporate debt divided by total assets; market-to-book value (MB) measured as the end of period closing price multiplied by the number of common shares outstanding, which is subsequently divided by total equity. $\text{RepR}_{i,t}$, in this case, severity is determined by RepRisk in a rule-based way as a function of the alleged violation of national laws and international standards along three dimensions (first, what are the consequences of the risk incident, secondly, what is the extent of the risk incident, and thirdly, was the risk incident caused by accident, by negligence, or intent, or even in a systematic way), which is scored as one for a low severity incident, two for a medium severity incident, and three for a high severity incident. Standard errors are presented in parentheses. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

TABLE 9 | Robustness testing procedure: CARs baseline methodology using placebo event dates.

Window	Intercept	Size	ROA	Leverage	MV/BV	Obs.	R^2	Ind. FE	Year FE
[−20, −1]	0.0532	−0.0008	0.0158	−0.0349	0.0001	1787	0.012	Yes	Yes
	(0.0642)	(0.0023)	(0.0255)	(0.0238)	(0.0001)				
[−10, −1]	0.0341	−0.0010	0.0276**	−0.0284*	−0.0001	1787	0.016	Yes	Yes
	(0.0365)	(0.0014)	(0.0138)	(0.0153)	(0.0001)				
[−5, −1]	0.0266	−0.0009	0.0058	−0.0124	−0.0001	1787	0.007	Yes	Yes
	(0.0323)	(0.0013)	(0.0130)	(0.0122)	(0.0001)				
[−3, −1]	−0.0019	0.0003	−0.0128	−0.0043	−0.0001	1787	0.009	Yes	Yes
	(0.0233)	(0.0009)	(0.0098)	(0.0085)	(0.0001)				
[−2, −1]	−0.0058	0.0005	−0.0166**	−0.0012	−0.0001	1787	0.013	Yes	Yes
	(0.0196)	(0.0008)	(0.0083)	(0.0071)	(0.0001)				
[−1, t_0]	0.0171	−0.0007	0.0079	−0.0041	0.0001	1787	0.008	Yes	Yes
	(0.0181)	(0.0007)	(0.0073)	(0.0073)	(0.0001)				
[t_0, +1]	0.0081	−0.0005	0.0127	0.0131**	−0.0001	1787	0.019	Yes	Yes
	(0.0157)	(0.0006)	(0.0078)	(0.0065)	(0.0001)				
[t_0, +2]	0.0069	−0.0004	0.0141	0.0129	0.0001	1787	0.013	Yes	Yes
	(0.0197)	(0.0008)	(0.0092)	(0.0090)	(0.0001)				
[t_0, +3]	0.0151	−0.0008	0.0179*	0.0168*	0.0001	1787	0.011	Yes	Yes
	(0.0225)	(0.0009)	(0.0093)	(0.0095)	(0.0001)				
[t_0, +5]	0.0108	−0.0006	0.0079	0.0159	0.0001	1787	0.006	Yes	Yes
	(0.0275)	(0.0011)	(0.0116)	(0.0124)	(0.0001)				
[t_0, +10]	−0.0328	0.0011	−0.0069	0.0283	−0.0001	1787	0.007	Yes	Yes
	(0.0386)	(0.0016)	(0.0152)	(0.0184)	(0.0001)				
[t_0, +20]	−0.0058	−0.0000	0.0120	0.0266	−0.0001	1787	0.008	Yes	Yes
	(0.0543)	(0.0022)	(0.0219)	(0.0220)	(0.0001)				
[−1, +1]	0.0168	−0.0009	0.0103	0.0080	0.0001	1787	0.012	Yes	Yes
	(0.0206)	(0.0008)	(0.0090)	(0.0083)	(0.0001)				
[−2, +2]	−0.0024	0.0001	−0.0025	0.0117	0.0001	1787	0.006	Yes	Yes
	(0.0311)	(0.0013)	(0.0129)	(0.0123)	(0.0001)				
[−3, +3]	0.0079	−0.0004	0.0051	0.0125	0.0001	1787	0.006	Yes	Yes
	(0.0358)	(0.0015)	(0.0142)	(0.0132)	(0.0001)				
[−5, +5]	0.0367	−0.0015	0.0137	0.0034	−0.0001	1787	0.006	Yes	Yes
	(0.0419)	(0.0017)	(0.0179)	(0.0167)	(0.0001)				
[−10, +10]	−0.0041	0.0001	0.0207	−0.0001	−0.0001	1787	0.006	Yes	Yes
	(0.0525)	(0.0021)	(0.0209)	(0.0242)	(0.0001)				
[−20, +20]	0.0200	−0.0008	0.0277	−0.0083	−0.0001	1787	0.009	Yes	Yes
	(0.0870)	(0.0035)	(0.0387)	(0.0356)	(0.0001)				

Note: Cumulative abnormal returns are estimated as $\mathrm{CAR}_i[t_1, t_2] = \sum_{t=t_1}^{t_2} \mathrm{AR}_{i,t}$ for the following event windows: [−20, −1], [−10, −1], [−5, −1], [−3, −1], [−2, −1], [−1, t_0], [t_0, +1], [t_0, +2], [t_0, +3], [t_0, +5], [t_0, +10], and [t_0, +20]; and to focus on longer-term windows: [−1, +1], [−2, +2], [−3, +3], [−5, +5], [−10, +10] and [−20, +20]. Such CARs are then developed in the methodological structure: $\mathrm{CAR}_{i,t} = \alpha_i + \beta_1 \mathrm{Size}_{i,t-1} + \beta_2 \mathrm{ROA}_{i,t-1} + \beta_3 \mathrm{Leverage}_{i,t-1} + \beta_4 \mathrm{MB}_{i,t-1} + \Sigma\beta \mathrm{FE} + \epsilon_{i,t}$, where CAR is again defined as above, while the respective control variables are collected and incorporated as size, which is measured as the natural logarithm of total assets; return on assets (ROA) estimated as the analysed company's net income divided by total assets; leverage defined as total corporate debt divided by total assets; market-to-book value (MB) measured as the end of period closing price multiplied by the number of common shares outstanding, which is subsequently divided by total equity. Standard errors are presented in parentheses. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

Specifically, the methodological structure is designed so that each identified event occurs 2 years in advance of the estimated real event date; therefore, there should be no significant difference beyond the factors designed to best inform. Results suggest no significant effects. In no examined case is the intercept found to be significant.

In Table 10, results further indicate that no E-S-G-related robustness testing event is found to significantly influence the estimated CARs outside of that explained by the examined factors. In a single case where significance is identified, the estimated influence on CARs is negligible. The placebo tests eliminate concerns surrounding methodological robustness and confirm that the market reaction is specifically tied to the timing and information content of the actual ESG reputational incidents. This is particularly important given the observed pre-event drift in the main analysis; the lack of a similar drift around placebo dates reinforces the view that the pre-t_0 negativity reflects genuine information leakage or anticipation, rather than merely a general tendency for these firms to underperform before negative news events. Furthermore, placebo testing confirms that these characteristics have explanatory power only when examined in conjunction with the true event occurrence, reinforcing the specificity of the main findings.

Table 11 presents the results of several placebo tests that provide significant methodological robustness based on additional explanatory elements, based on specific characteristics of the reputational event. The results indicate the existence of a minute influence. Where results are significant, the estimated differential is minimal and attributable to natural factors that can be explained by the methodological design and those proposed by Fama and French (2015). Fundamentally, there is no discernible pattern in the data, whereas in the main baseline results presented, evidence suggests that when results are positive or negative in scope, they remain persistently so.

5 | Associated Discussion, Policy Implications and Directions for Future Research

Several distinct areas surrounding the presented results warrant further discussion. An important distinction concerns the interpretation of the pre-event negative drift. Information leakage refers to the early release of news to a limited set of investors before the public announcement, and anticipation refers to rational pricing based on emerging signals that suggest an upcoming negative event, even when no explicit leak exists; our results cannot fully separate these mechanisms, but the absence of abnormal trading volume suggests gradual diffusion of public signals rather than illicit leakage. We therefore interpret the drift as a mix of informed monitoring and early signal processing rather than clear evidence of insider behaviour.

Primarily, a distinct area of research surrounds the separation of what elements of market movements constitute market anticipation and what should be considered a market movement as a result of information leakage. The consistent pre-event negative drift poses a critical challenge to the notion that the event date (t_0) is the primary information shock. The question of whether this drift stems from illicit information leakage, such as insider trading, is crucial to understanding what is arising from sophisticated market anticipation. If leakage dominates, it raises concerns about market integrity and the existence of disequilibrium in informational availability. If anticipation prevails, it suggests elevated market sophistication in ESG signal processing and an exceptional level of pharmaceutical-related investment speculation.

Results surrounding the influence of firm size, particularly where corporate size provides more substantial resilience against negative ESG events than other corporate characteristics, are particularly important. While ROA offers short-term resilience, the persistent size effect suggests large firms possess structural advantages that go beyond immediate financial health. This presents evidence of a superior capacity not only to absorb direct costs but also to actively manage the narrative surrounding ESG malpractice through sophisticated public relations, engaging legal teams to mitigate liabilities, leveraging established regulatory relationships, and potentially utilising greater market power or diversification to absorb operational shocks. Such potential manipulative ability raises questions about whether firms are exposed to ESG risks in the same way, or whether market structures allow larger corporations to neutralise such threats more effectively, potentially creating competitive disadvantages for smaller firms and dampening the disciplinary force of market reactions for the largest players in the pharmaceutical sector.

The pronounced market sensitivity to environmental issues, which is found to contrast significantly with the apparent investor indifference to social and governance events within pharmaceutical corporations, presents evidence of a highly contextual response. This sector-specificity likely arises from the tangible, often quantifiable, and long-tail nature of environmental liabilities in this industry, which directly threaten operational continuity and carry significant regulatory weight and potential sanctions. Furthermore, environmental harm can severely damage the core reputation of trust required for health-related companies. The lack of reaction to social and governance factors may indicate that investors perceive these issues as having less direct cash-flow impact, or they are simply more easily addressed through internal adjustments. The absence of significant CARs following negative social events in the pharmaceutical sector is particularly striking, as such indifference might not reflect a genuine lack of concern, but rather that the financial impacts of social issues manifest differently and might translate into longer-term reputational effects. Furthermore, the lack of a significant differential market reaction based on the initial news source's reach offers an interesting view of how information flows regarding ESG. It strongly suggests that the traditional hierarchy of media influence, where high-prestige outlets drive market opinion, has been significantly flattened by technology and specialised intermediaries.

The finding that unsharp events incur a greater long-term penalty than clearly attributed sharp events presents evidence of a complex dynamic regarding incentives. On the one hand, the delayed but ultimately deeper negative reaction to ambiguity could paradoxically incentivise firms to initially cloak, shroud, or delay clarification of negative events, hoping to avoid a sharp immediate hit and potentially manage the flow

TABLE 10 | Robustness testing procedure: CARs as separated by ESG category using placebo event dates.

Window	Intercept	Envir.	Social	Gov.	Size	ROA	Leverage	MV/BV	Obs.	R^2	Ind. FE	Year FE
[−20, −1]	0.0478	0.0061	−0.0064	0.0062	−0.0006	0.0160	−0.0381	0.0001	1787	0.013	Yes	Yes
	(0.0637)	(0.0070)	(0.0055)	(0.0056)	(0.0023)	(0.0254)	(0.0242)	(0.0001)				
[−10, −1]	0.0345	0.0009	−0.0016	−0.0006	−0.0010	0.0276**	−0.0286*	−0.0001	1787	0.016	Yes	Yes
	(0.0366)	(0.0050)	(0.0039)	(0.0033)	(0.0014)	(0.0139)	(0.0155)	(0.0001)				
[−5, −1]	0.0262	−0.0023	−0.0026	0.0014	−0.0009	0.0061	−0.0126	−0.0001	1787	0.008	Yes	Yes
	(0.0323)	(0.0041)	(0.0028)	(0.0026)	(0.0013)	(0.0130)	(0.0122)	(0.0001)				
[−3, −1]	−0.0019	−0.0011	−0.0021	0.0005	0.0003	−0.0127	−0.0044	−0.0001	1787	0.010	Yes	Yes
	(0.0232)	(0.0036)	(0.0021)	(0.0019)	(0.0009)	(0.0098)	(0.0087)	(0.0001)				
[−2, −1]	−0.0059	−0.0025	0.0009	0.0009	0.0005	−0.0164**	−0.0009	−0.0001	1787	0.014	Yes	Yes
	(0.0194)	(0.0031)	(0.0016)	(0.0015)	(0.0007)	(0.0083)	(0.0073)	(0.0001)				
[−1, t_0]	0.0183	−0.0052*	0.0005	−0.0002	−0.0008	0.0082	−0.0030	0.0001	1787	0.010	Yes	Yes
	(0.0180)	(0.0030)	(0.0018)	(0.0016)	(0.0007)	(0.0073)	(0.0073)	(0.0001)				
[t_0, +1]	0.0093	−0.0004	−0.0006	−0.0012	−0.0005	0.0126	0.0134**	−0.0001	1787	0.019	Yes	Yes
	(0.0160)	(0.0021)	(0.0016)	(0.0015)	(0.0006)	(0.0079)	(0.0065)	(0.0001)				
[t_0, +2]	0.0085	−0.0003	0.0001	−0.0025	−0.0004	0.0139	0.0136	0.0001	1787	0.014	Yes	Yes
	(0.0201)	(0.0026)	(0.0022)	(0.0020)	(0.0008)	(0.0093)	(0.0091)	(0.0001)				
[t_0, +3]	0.0152	0.0007	−0.0003	−0.0009	−0.0008	0.0178*	0.0169*	0.0001	1787	0.012	Yes	Yes
	(0.0227)	(0.0029)	(0.0025)	(0.0022)	(0.0009)	(0.0093)	(0.0096)	(0.0001)				
[t_0, +5]	0.0111	0.0007	−0.0011	−0.0007	−0.0006	0.0078	0.0159	0.0001	1787	0.006	Yes	Yes
	(0.0280)	(0.0034)	(0.0030)	(0.0027)	(0.0011)	(0.0116)	(0.0124)	(0.0001)				
[t_0, +10]	−0.0357	0.0047	−0.0005	−0.0007	0.0012	−0.0072	0.0276	−0.0001	1787	0.007	Yes	Yes
	(0.0396)	(0.0050)	(0.0039)	(0.0036)	(0.0016)	(0.0152)	(0.0187)	(0.0001)				
[t_0, +20]	−0.0131	0.0067	−0.0014	0.0056	0.0001	0.0120	0.0238	−0.0001	1787	0.009	Yes	Yes
	(0.0550)	(0.0066)	(0.0057)	(0.0050)	(0.0022)	(0.0219)	(0.0221)	(0.0001)				
[−1, +1]	0.0206	−0.0041	−0.0007	−0.0010	−0.0009	0.0104	0.0089	0.0001	1787	0.013	Yes	Yes
	(0.0207)	(0.0030)	(0.0019)	(0.0018)	(0.0008)	(0.0090)	(0.0084)	(0.0001)				
[−2, +2]	0.0001	−0.0029	0.0011	−0.0017	0.0000	−0.0025	0.0127	0.0001	1787	0.007	Yes	Yes
	(0.0314)	(0.0039)	(0.0026)	(0.0026)	(0.0013)	(0.0130)	(0.0125)	(0.0001)				

(Continues)

TABLE 10 | (Continued)

Window	Intercept	Envir.	Social	Gov.	Size	ROA	Leverage	MV/BV	Obs.	R^2	Ind. FE	Year FE
[−3, +3]	0.0094	−0.0004	−0.0024	−0.0004	−0.0004	0.0052	0.0125	0.0001	1787	0.006	Yes	Yes
	(0.0361)	(0.0044)	(0.0033)	(0.0029)	(0.0014)	(0.0143)	(0.0134)	(0.0001)				
[−5, +5]	0.0391	−0.0016	−0.0036	0.0007	−0.0015	0.0139	0.0033	0.0001	1787	0.007	Yes	Yes
	(0.0427)	(0.0051)	(0.0042)	(0.0038)	(0.0017)	(0.0179)	(0.0167)	(0.0001)				
[−10, +10]	−0.0066	0.0056	−0.0022	−0.0013	0.0001	0.0203	−0.0009	0.0001	1787	0.007	Yes	Yes
	(0.0536)	(0.0070)	(0.0058)	(0.0052)	(0.0022)	(0.0210)	(0.0244)	(0.0001)				
[−20, +20]	0.0078	0.0128	−0.0078	0.0118	−0.0005	0.0280	−0.0142	0.0001	1787	0.011	Yes	Yes
	(0.0876)	(0.0103)	(0.0085)	(0.0079)	(0.0035)	(0.0385)	(0.0360)	(0.0001)				

Note: Cumulative abnormal returns are estimated as $\mathrm{CAR}_i[t_1, t_2] = \sum_{t=t_1}^{t_2} \mathrm{AR}_{i,t}$ for the following event windows: [−1, +1], [−2, +2], [−3, +3], [−5, +5], [−10, +10] and [−20, +20]; and to focus on longer-term windows: [−1, +1], [−2, +2], [−3, +3], [−5, +5], [−10, +10] and [−20, +20]. Such CARs are then developed in the methodological structure: $\mathrm{CAR}_{i,t} = \alpha_i + \beta_1 \mathrm{Size}_{i,t-1} + \beta_2 \mathrm{ROA}_{i,t-1} + \beta_3 \mathrm{Leverage}_{i,t-1} + \beta_4 \mathrm{MB}_{i,t-1} + \Sigma\beta\mathrm{FE} + \epsilon_{i,t}$, where CAR is again defined as above, while the respective control variables are collected and incorporated as size, which is measured as the natural logarithm of total assets; return on assets (ROA) estimated as the analysed company's net income divided by total assets; leverage defined as total corporate debt divided by total assets; market-to-book value (MB) measured as the end of period closing price multiplied by the number of common shares outstanding, which is subsequently divided by total equity. Standard errors are presented in parentheses. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

of information over time. However, it is fair to assume that this is a high-risk strategy. If the firm is eventually found culpable after a period of perceived evasion, the damage to management credibility and overall corporate reputation could be far more severe than the impact of the initial event itself, potentially justifying the larger cumulative penalty observed. Therefore, while a short-term tactical incentive to obscure might exist, it likely conflicts with the long-term strategic imperative of maintaining stakeholder trust and credibility, especially for firms that rely on public confidence, such as those in pharmaceuticals.

5.1 | Policy and Regulatory Implications

These results offer several clear directions for regulatory practice. First, the pronounced market sensitivity to environmental breaches provides a strong rationale for targeted enforcement and risk disclosure mandates in environmental domains—particularly concerning waste disposal, emissions management, and compliance reporting. Agencies such as the FDA and EPA may consider expanding incident transparency frameworks to ensure the timely dissemination of ESG-relevant violations. Second, the documented investor indifference toward social and governance lapses suggests that market mechanisms may underdeter certain types of misconduct. Regulators could strengthen oversight through mandatory disclosures of clinical trial ethics, board diversity policies, and pricing strategies, especially in contexts with known reputational risk. Third, the sharp market penalties observed among repeat ESG offenders support the use of escalating enforcement schemes in which prior infractions increase the severity of sanctions or the required remediation commitments. Finally, the finding that larger firms experience less pronounced penalties for similar incidents raises the concern that ESG risk pricing is not size-neutral. This suggests a need for tailored regulatory approaches that ensure that large market actors face comparable accountability standards to smaller peers.

5.2 | Directions for Future Research

Several directions for future research extend from these results. A regional investigation would serve as a strong extension, testing whether US-focused results hold globally. Various regions possess vastly different regulatory regimes, cultural expectations and differentials, ESG regulations and expectations, and legal systems. It would be prudent to determine whether such regimes elicit different investor responses. Fundamentally, it is important to better understand why larger firms experience fewer negative impacts; therefore, future research should focus on the size premium. Further examination is required surrounding how firms' responses shape subsequent market performance. Such research would offer significant practical value to companies seeking to mitigate reputational damage and restore investor confidence following ESG controversies. The aggregate finding of market indifference towards social and governance events might mask significant heterogeneity within these broad categories. Future research should disaggregate social- and governance-related issues into more specific sub-themes relevant to the

TABLE 11 | Robustness testing procedure: CARs as separated by event characteristics using placebo event dates.

Window	Novelty	Sharp	Reach	Severity	Envir.	Social	Gover.
[−20, −1]	−0.0041	0.0087	−0.0011	0.0058	0.0026	−0.0069	0.0061
	(0.0055)	(0.0064)	(0.0056)	(0.0042)	(0.0065)	(0.0053)	(0.0052)
[−10, −1]	0.0015	0.0013	0.0016	0.0047*	0.0009	−0.0014	−0.0005
	(0.0034)	(0.0036)	(0.0032)	(0.0028)	(0.0047)	(0.0037)	(0.0031)
[−5, −1]	0.0017	−0.0004	0.0012	0.0040*	−0.0033	−0.0031	0.0021
	(0.0027)	(0.0028)	(0.0025)	(0.0020)	(0.0040)	(0.0026)	(0.0024)
[−3, −1]	−0.0017	−0.0001	−0.0004	0.0013	−0.0017	−0.0023	0.0009
	(0.0020)	(0.0023)	(0.0018)	(0.0015)	(0.0035)	(0.0020)	(0.0018)
[−2, −1]	−0.0006	−0.0010	−0.0000	0.0009	−0.0027	0.0005	0.0012
	(0.0016)	(0.0019)	(0.0016)	(0.0012)	(0.0030)	(0.0015)	(0.0015)
[−1, t_0]	−0.0012	−0.0011	−0.0003	0.0015	−0.0051*	0.0000	0.0005
	(0.0018)	(0.0020)	(0.0017)	(0.0013)	(0.0029)	(0.0017)	(0.0016)
[t_0, +1]	0.0020	−0.0001	0.0003	−0.0004	−0.0001	−0.0004	−0.0011
	(0.0016)	(0.0022)	(0.0015)	(0.0013)	(0.0019)	(0.0016)	(0.0014)
[t_0, +2]	0.0018	−0.0001	0.0001	0.0002	0.0006	0.0006	−0.0025
	(0.0021)	(0.0032)	(0.0019)	(0.0016)	(0.0025)	(0.0021)	(0.0019)
[t_0, +3]	0.0018	−0.0018	0.0035*	0.0002	0.0010	−0.0000	−0.0010
	(0.0022)	(0.0028)	(0.0020)	(0.0018)	(0.0028)	(0.0024)	(0.0021)
[t_0, +5]	0.0014	−0.0033	0.0028	0.0015	0.0008	−0.0009	−0.0007
	(0.0029)	(0.0040)	(0.0025)	(0.0023)	(0.0033)	(0.0029)	(0.0026)
[t_0, +10]	−0.0039	0.0040	0.0046	0.0037	0.0049	0.0001	−0.0013
	(0.0038)	(0.0063)	(0.0035)	(0.0031)	(0.0046)	(0.0038)	(0.0034)
[t_0, +20]	−0.0030	0.0072	0.0065	−0.0039	0.0044	−0.0018	0.0047
	(0.0051)	(0.0066)	(0.0046)	(0.0042)	(0.0062)	(0.0055)	(0.0046)
[−1, +1]	−0.0000	−0.0007	0.0005	0.0009	−0.0039	−0.0009	−0.0003
	(0.0019)	(0.0029)	(0.0019)	(0.0015)	(0.0029)	(0.0018)	(0.0017)
[−2, +2]	0.0012	−0.0011	0.0001	0.0012	−0.0021	0.0011	−0.0014
	(0.0027)	(0.0042)	(0.0026)	(0.0020)	(0.0038)	(0.0025)	(0.0025)
[−3, +3]	0.0001	−0.0018	0.0031	0.0016	−0.0006	−0.0023	−0.0000
	(0.0030)	(0.0039)	(0.0028)	(0.0023)	(0.0043)	(0.0032)	(0.0028)
[−5, +5]	0.0031	−0.0037	0.0040	0.0055*	−0.0025	−0.0039	0.0014
	(0.0039)	(0.0051)	(0.0036)	(0.0030)	(0.0049)	(0.0040)	(0.0036)
[−10, +10]	−0.0024	0.0052	0.0062	0.0008	0.0057	−0.0013	−0.0019
	(0.0052)	(0.0081)	(0.0049)	(0.0043)	(0.0066)	(0.0055)	(0.0048)
[−20, +20]	−0.0071	0.0016	0.0054	0.0019	0.0071	−0.0087	0.0109
	(0.0079)	(0.0094)	(0.0077)	(0.0063)	(0.0097)	(0.0082)	(0.0074)

Note: Cumulative abnormal returns are estimated as $\mathrm{CAR}_i\left[t_1, t_2\right] = \sum_{t=t_1}^{t_2} \mathrm{AR}_{i,t}$ for the following event windows: [−1, +1], [−2, +2], [−3, +3], [−5, +5], [−10, +10] and [−20, +20]. Such CARs are then developed in the methodological structure: $\mathrm{CAR}_{i,t} = \alpha_i + \beta_1 \mathrm{Size}_{i,t-1} + \beta_2 \mathrm{ROA}_{i,t-1} + \beta_3 \mathrm{Leverage}_{i,t-1} + \beta_4 \mathrm{MB}_{i,t-1} + \Sigma\beta\mathrm{FE} + \epsilon_{i,t}$, where CAR is again defined as above, while the respective control variables are collected and incorporated as size, which is measured as the natural logarithm of total assets; return on assets (ROA) estimated as the analysed company's net income divided by total assets; leverage defined as total corporate debt divided by total assets; market-to-book value (MB) measured as the end of period closing price multiplied by the number of common shares outstanding, which is subsequently divided by total equity. Standard errors are presented in parentheses. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

pharmaceutical sector. For instance, within the social category, differentiating between labour rights violations, clinical trial ethics scandals, drug pricing or access controversies, and community health impacts might reveal specific issues that trigger significantly different market reactions. Similarly, within governance-related issues, separating board independence from executive compensation disputes or shareholder rights limitations could reveal nuanced effects.

The persistent finding of negative pre-event CAR drifts necessitates research into the specific channels through which relevant information might diffuse before the formal event date. This could involve exploring "alternative data" sources such as expert network call transcripts, analysing sentiment shifts on specialised social media platforms to track news flow in related industries or supply chains, or examining trading patterns suggestive of informed activity (e.g., options markets). Further, ESG events at one firm might have implications beyond its own valuation. Future research should investigate the effects of contagion within the pharmaceutical sector, specifically upon sectoral peers. For example, it would be very interesting to investigate whether a significant environmental breach or product safety scandal at a major company triggers negative ARs for its peers, suggesting that investors perceive heightened systemic or regulatory risk across the entire industry. Analysing these inter-firm effects provides insights into whether ESG risks are viewed as primarily idiosyncratic or sector-wide, with implications for portfolio diversification and systemic risk assessment.

Our analysis focuses on the market response to the ESG event and does not explicitly incorporate firm actions that may occur after the news release, such as press statements, corrective measures, or remediation plans. These actions can shape investor beliefs and may ease or strengthen the post-event return path. The persistence of negative CARs in our results, therefore, reflects the aggregate market reaction to the initial event rather than the effect of specific management responses. Future work could track the timing and content of corporate communication to assess how rapid and credible responses influence recovery dynamics.

6 | Concluding Comments

This study investigates the investor response to reputationally damaging ESG-related events across the US pharmaceutical industry, specifically considering incidents including environmental compliance failures, product safety concerns, ethical lapses in clinical trials, and supply chain issues. Due to the pharmaceutical sector's significant reliance on public trust and its presence within a distinct, robust regulatory environment, understanding how investors, indicative of the broader public, evaluate and price ESG controversies is essential for the appropriate identification and quantification of corporate risk. Further, such analysis informs stakeholders of the true level of respect allocated to corporate ESG performance and infringement. Results indicate that negative ESG events are associated with significant negative abnormal stock returns for pharmaceutical firms. A consistent pattern observed is the negative drift in CARs preceding the formal media release date, suggesting that market anticipation, or potential information leakage, significantly dampens the informational surprise of the public announcement. Although the market reaction exhibits a sharp negative impact on the news release day itself, followed by a relatively rapid reversion of daily ARs, the negative CAR impact persists in the subsequent weeks. This pattern suggests that while the immediate shock is processed, the full valuation consequences may unfold over a longer period. Amongst the considered firm characteristics, corporate size consistently emerges as the most substantial mitigating factor against adverse market reactions, particularly over extended horizons, offering more enduring resilience than that provided by pre-event profitability.

Investor response exhibits significant heterogeneity based on event characteristics. Environmentally-focused corporate misdemeanours uniquely trigger significant, albeit delayed, negative CARs, indicating that investors perceive these risks as carrying the most direct and financially material consequences across the pharmaceutical industry. In contrast, events categorised under the social and governance categories were not found to generate significant market penalties, raising important questions about their perceived financial materiality or the pathways through which their impacts might manifest for pharmaceutical firms. Furthermore, investors significantly penalise firms presenting evidence of recurring ESG incidents more harshly than first-time offenders. Events characterised by initial ambiguity regarding corporate responsibility also led to larger, delayed negative cumulative returns than those associated with clearly attributed incidents. Conversely, the initial news source's dissemination reach and the assessed severity of the incident did not appear to systematically influence the magnitude of market reactions. This latter finding is particularly noteworthy; the indifference to reach suggests sophisticated information aggregation through intermediaries and rapid diffusion via modern channels may overshadow traditional media hierarchies, while the lack of a clear severity gradient points towards potential threshold effects in investor responses or limitations in how current external metrics capture financially material severity differentials within this specific industrial and risk context. These findings highlight the context-dependent nature of ESG materiality in the pharmaceutical sector.

Our study focuses exclusively on short-term market responses to ESG-related reputational events in the US pharmaceutical sector. We do not incorporate detailed firm-level responses (e.g., public apologies, remedial investments) or stakeholder reactions (e.g., consumer boycotts, activist campaigns) that may influence longer-term outcomes. In addition, while our use of RepRisk data provides comprehensive coverage of ESG incidents, the classification of event attributes (e.g., severity, novelty) is based on third-party algorithms and may introduce latent measurement bias. Future research could extend our work by analysing ESG event spillovers to peer firms, sectoral differences in market reactions, and the interaction between media tone and investor behaviour. Incorporating textual analysis of earnings calls or press releases may further illuminate how corporate narrative framing shapes market response and recovery.

These findings collectively demonstrate that financial markets engage in a nuanced, context-dependent discovery process when evaluating ESG reputational risks in the pharmaceutical sector. The results confirm the financial relevance of ESG performance, particularly with respect to environmental standards and consistent compliance, while also highlighting the significant structural advantages and defensive mechanisms that the firm's size provides in mitigating negative shocks. The financial market's differential sensitivity across ESG pillars and event characteristics, such as novelty and ambiguity, underscores the limitations of simplistic or universal approaches to ESG materiality. This translates into a clear market imperative for the pharmaceutical industry to prioritise robust environmental risk management, as these failures carry the most significant financial penalty. Such results also suggest that while social and governance issues are important for stakeholder relations, investors may perceive their immediate financial impact differently. The increased penalties for repeated lapses and ambiguous disclosures further emphasise the critical value of proactive transparency, consistent compliance, and deep reputational resilience in a sector fundamentally dependent on public and regulatory trust.

Endnotes

[1] RepRisk is a specialist of ESG and business conduct risk research, developing daily-updated data synthesised in 23 languages using a rules-based methodology; the company systematically flags and monitors material ESG risks and violations of international standards that can have reputational, compliance, and financial impacts on a company.

[2] We have added Supporting Information: Table A2, which provides descriptive statistics showing that our sample contains firms of heterogeneous size and listing characteristics, suggesting that event detection is not only concentrated among large firms.

[3] The severity is determined as a function of three dimensions: firstly, what are the consequences of the risk incident (e.g., concerning health and safety: no further consequences, injury, death); secondly, what is the extent of the impact (e.g., one person, a group of people, a large number of people); and thirdly, was the risk incident caused by an accident, by negligence, or intent, or even in a systematic way. There are three levels of severity: low, medium, and high.

[4] All sources are pre-classified by reach: limited reach, medium reach, and high reach. Limited-reach sources include local media, smaller NGOs, local government bodies, and social media. Medium-reach sources include most national and regional media, international NGOs, and state, national, and international governmental bodies.

[5] The selected TRBC subsectors include Alternative Medicine, Bio Diagnostics & Testing, Bio-Medical Devices, Bio Therapeutic Drugs, Biopharmaceuticals, Biotechnology & Medical Research, Generic Pharmaceuticals, Pharmaceuticals, Pharmaceuticals Wholesale, Proprietary & Advanced Pharmaceuticals, and Veterinary Drugs.

[6] Methodological and data-selection variants are omitted for brevity of presentation; however, they are available from the authors upon request.

[7] More specifically, Equation (5) compares the effect of the analysed events by industry, where we omit industry fixed-effect from the selected methodological structure to compare and contrast the effects of the selected variables upon each industry separately.

[8] Specifically, the scaled values for each variable are denoted for each RepRisk characteristic as follows: severity is determined by RepRisk in a rule-based way as a function of the alleged violation of national laws and international standards along three dimensions (first, what are the consequences of the risk incident, second, what is the extent of the risk incident, and thirdly, was the risk incident caused by an accident, by negligence, or intent, or even in a systematic way), which is scored as one for a low severity incident, two for a medium severity incident, and three for a high severity incident; novelty represents newness of the issues addressed for the criticised company, defined as one if the company is experiencing a reoccurring issue, or two if the issue is new; reach is valued as either one, two, or three, which represents low reach (inclusive of local media smaller NGOs, local governmental bodies, blogs, internet sites, etc.), medium reach (including most national and regional media, international NGOs, and state, national, and international governmental bodies), and high reach events (denoted as the few international media, for example, the FT, NY Times, BBC, and others) respectively as separated; while finally, unsharp events (defined to indicate whether a risk incident is sharp or unsharp, where more specifically, unsharp risk incidents are when the entity is mentioned, but the criticism is complex and/or not precisely defined) are estimated to be denoted by a value of unity and zero otherwise.

[9] Select examples of such events are presented in Supporting Information: Table A1.

[10] Further, the dynamics of the estimated ARs and CARs are presented through a range of histograms and quantile plots that are presented in Supporting Information: Figures A1–A4.

[11] For robustness, we provide a comparison between pharma firms that we used in the paper and non-pharma firms (others), where we examine the behaviour of abnormal returns for pharmaceutical and non-pharmaceutical firms around the same event dates. We took 250 firms distributed across industries from LSEG (formerly Refinitiv), such as Consumer Cyclical, Financials, Industrials, Technology and Basic Materials and estimated the abnormal returns on the same dates as the pharma firms. As reported in Supporting Information: Table A3, pharmaceutical firms exhibit consistently significant negative CAARs across nearly all event windows according to the non-parametric Sign test. This pattern indicates a systematic adverse market reaction within the pharmaceutical sector. In contrast, the CAARs for non-pharmaceutical firms are not significant, suggesting that the events under study do not generate a comparable response outside the pharmaceutical industry. The difference between the two groups highlights the distinctive sensitivity of pharmaceutical firms to reputational or regulatory signals, reinforcing the sector-specific nature of the market response on the events we study.

[12] Specifically, if the firm is perceived as inherently riskier post-event, its subsequent realised returns might consistently fall slightly short of the pre-event benchmark model's expectation, contributing to a negative CAR drift over time.

[13] Supporting Information: Figures A1–A4 present evidence of the significant differential behaviour that exists across the analysed days and windows for both ARs and CARs, through both histogram plots and quantile plots respectively.

[14] Firm size is measured as the natural logarithm of market capitalisation as it typically exhibits significant positive skewness. Applying the natural logarithmic transformation serves several key purposes, as it compresses the scale of the variable, reducing the influence of large outliers and making the distribution more symmetric, thereby improving the statistical properties for regression analysis; while secondly, it often linearises relationships, such that the estimated coefficient represents the approximate change in the dependent variable for a percentage change in size; and thirdly, it helps to stabilise the error variance, thereby reducing heteroskedasticity, which is a common issue when using untransformed scale variables in financial models.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Data S1:** csr70396-sup-0001-Supinfo.pdf.