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Industrial accidents: The mediating effect of corporate social responsibility and environmental policy measures

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Abstract

Using a novel hand-collected sample including 159 industrial events that occurred between 2000 and 2020, we document that corporate social performance (CSP) generally acts as a halo effect mitigating the stock market drop following these events. These findings, robust to many alternative specifications, provide novel evidence shedding light on how corporate social capital acts as a mitigating device against the consequences of tail events. To the best of our knowledge, this is one of the first studies investigating the mitigation role of CSP in the aftermath of an industrial accident by analyzing a large global sample of industrial incidents. The practical and theoretical implications of our findings are at the bottom of that form of a socially normative corporate force embedded in social trust, smoothing managers' and stakeholders' interests together.

KEYWORDS

CO_2 emission, corporate social performance, environmental policy, ESG, industrial accidents, mitigation effect, stock returns

JEL CLASSIFICATION

Q51, G14, Q53, Q54

1 | INTRODUCTION

Major industrial accidents caused some of the most severe man-made natural and humanitarian disasters recorded in recent history. These events resulted in enormous social and economic losses that affected not only the responsible corporations but also many stakeholders.

Estimating the dollar losses originated by these events is difficult, as they include direct expenses such as expected clean-up costs and litigation costs arising from personal injury and health issues (Capelle-Blancard & Laguna, 2010), as well as indirect costs emerging from political and reputational considerations. Firms deemed responsible for these accidents are likely to be targeted by international regulators, with severe economic sanctions negatively affecting these firms' ability to conduct business in global markets (Diestre & Rajagopalan, 2014; Flammer, 2013). Similarly, a significant industrial accident damages investors' perception of a firm's ability to comply with security and environmental standards (Carpentier & Suret, 2015; Wang et al., 2020), ultimately resulting in lower market valuations.

To shed light on the economic consequences of these dramatic events, recent studies have focused on a small number of significant industrial accidents to assess their real and financial consequences for responsible corporations. Focusing on the 2010 British Petroleum oil spill in the Gulf of Mexico region, Lee and Garza-Gomez (2012) find that BP's stock market capitalization dropped by \$104.8 billion in the months following the disaster. Furthermore, Brown et al. (2015) report that BP stated, 'The group income statement for 2010 includes a pre-tax charge of \$40.9 billion about the Gulf of Mexico oil spill. This comprises costs incurred up to 31 December 2010 and estimated obligations for future costs that can be estimated reliably.

Despite the lack of external validity characterizing the intrinsic nature of the studied events, the significant economic and social consequences of these disasters have resulted in the development of extensive literature focusing on their determinants and preventive mechanisms. Recent industrial disasters such as the release of radiation at Fukushima in 2011 and the BP oil spill have indeed shed light on the flaws of traditional operational risk models, as well as emphasized the need to enact new strategies concerning firms' environmental risk management and disclosure practices (De Abreu & de Andrade, 2019). Climate change disclosure is an effective tool to limit information asymmetry while improving transparency (Giannarakis et al., 2018). Within this framework, many studies highlight the role of corporate social responsibility (CSR) and the increasing importance of socially responsible investing strategies as crucial forces pressing shareholders to push the management towards increasing their efforts to control environmental hazards (Kock et al., 2012). Yet, while much focus has been spent on mitigating the effects of corporate social practices on firms' environmental risk, little is known about whether and how these policies affect firms' ability to recover after an industrial disaster (Blackman et al., 2017). On the one hand, firms' social and environmental performance allows investors to price firms' environmental risk. As such, an environmental failure of a previously considered low firm risk might lead the market to re-evaluate its risk profile, thus resulting in a larger stock price reduction at the event announcement date. Conversely, a high level of social capital preceding the industrial disaster might support the responsible firm's efforts to rebuild its reputation in the aftermath of the event, facilitating a smooth recovery (De Abreu & de Andrade, 2019). As such, a firm's social and environmental performance may directly impact their financial and economic performance following an industrial disaster, ultimately reducing the generally observed selling pressure observed at the public disclosure of these events (Davidson & Stevens, 2013).

Documenting if and how corporate social and environmental performance affects stock market reaction in the aftermath of a tail event—an industrial disaster—is central to the debate (see for a recent literature review: Bouzzine, 2021; Capelle-Blancard et al., 2021) on how corporate policies and market forces may supplement eventual environmental regulatory weakness (Dasgupta et al., 2001; Karpoff et al., 2005). In this article, we aim to determine the extent that the firm's CSP may directly impact the financial performance of firms at the onset of an industrial accident, indirectly addressing a fundamental and still open question in extant literature: the extent to which the stock market can incentivize companies to adopt better environmental behavior. Moreover, we stressed in the introduction that when we talk about a disaster, we mean when it is not already clear from the context, industrial disaster or industrial accident.

To answer this research question, we investigate a novel, hand-collected sample including 200 industrial accidents that occurred in 34 countries from 2000 to 2020. By executing a wide array of event studies, we document for the first time using a large, global sample that firms' pre-disaster Corporate Social Performance (CSP) activities mitigate the stock market capitalization decline that follows the public disclosure of an industrial accident. These mitigating effects appear robust to the use of different specifications and, importantly, are not materially affected by the signing of the 2015 Paris Agreement. This finding confirms that the identified result is not just an artifact of investors' time-varying attention to environmental considerations but, rather, the direct consequence of firms' social and environmental performance.

This article contributes to the growing literature on the risk mitigation effects of firms' CSP along two main dimensions. First, to the best of our knowledge, this is the first study investigating the stock market consequences of firms' CSP by investigating a large global sample of industrial incidents (not restricted to a specific country or a limited period, e.g., Zou et al., 2015). Second, this study extends our understanding of the halo effect of CSP by assessing its financial and economic implications within a novel framework——that of industrial disasters. Moreover, we decide to focus on two aspects. On the one hand, the most critical event potentially affecting the company's business is an industrial accident (more than negative news or violations, Claeys & Cauberghe, 2015; Flammer, 2013). On the other, we rely on a well-established CSP paradigm that is the ESG score more than company reputation (Claeys & Cauberghe, 2015), which is a broader concept and not only focused on the environmental and social performance of the company.

The article is structured as follows. Section 2 describes the background and develops the hypotheses. Section 3 presents the definitions, the selection process, and data features. Section 4 presents the methodological approach. Section 5 discusses the empirical results. Section 6 concludes the article.

2 | LITERATURE BACKGROUND AND HYPOTHESIS

As expected, recent academic studies confirm that the market reacts negatively to the public disclosure of an industrial accident. In particular, large sample analyses estimate these costs to range between a 1% and 5% abnormal loss in market capitalization over a two days window, confirming the economic relevance of these events (Capelle-Blancard & Laguna, 2010; Carpentier & Suret, 2020; Ho et al., 2013). Attributing this market reaction to specific economic and financial costs is far more complicated. Yet, several recent studies attempt to tackle this task, documenting that these losses originate mainly from three effects. First, we have the tangible costs, that is, investors discounting direct costs, including (i) physical and material damages and (ii) clean-up costs (Carpentier & Suret, 2015), and (iii) temporary shutdown of plants or production lanes (Carpentier & Suret, 2020); legal costs, including fines and legal penalties for environmental damage (Diestre & Rajagopalan, 2014; Karpoff et al., 2005) or indemnities and reputational costs connected to potential lawsuits and increased insurance premium (Brown et al., 2015; Carpentier & Suret, 2020). A second effect is related to intangible costs in the form of reputational damages, including (i) the eventual reduction in the perceived quality of the firm's product and services and the consequent decline in consumers' propensity to use them (Carpentier & Suret, 2020; Jones & Rubin, 2001; Walker et al., 2014), and (ii) the impact of the disaster over the company reputation (please see Gatzert, 2015 for a good literature analysis of the impact over the financial performance of reputation damaging events), which could result in a change in investors' preferences and portfolio allocations following the event (Racine et al., 2020). A third effect deals with investor irrationality and is connected with a recent stream of literature that investigates these market reactions through behavioral lenses by documenting that, after over-reacting to the disaster announcement, investors revert their trade after a few days, causing the stock price to reverse and erasing the initial losses within a few weeks (Capelle-Blancard & Laguna, 2010; Flammer, 2013; Jones & Rubin, 2001; Kaplanski & Levy, 2010; Lai et al., 2002; Wei et al., 2017).[1] In particular, Carpentier and Suret (2020) show that only two studies out of 24 report document significant cumulative abnormal returns at the 1% confidence over a 20 days window, with only two additional studies identifying statistical significance at the 5% level.

These evidences support the assertion that financial markets may provide incentives for managers to work on their firms' environmental and safety profiles (Dasgupta et al., 2001; Engelen & van Essen, 2011; Konar & Cohen, 1997). From an *ex-ante* perspective, recent studies document that firms can gain legitimacy and reputational benefits, thereby reducing costs and risks, through socially responsible activities (Carroll & Shabana, 2010; Ortas et al., 2014). These socially oriented policies positively affect firms' financial and economic performance. In particular, extant literature documents that green marketing strategy leads to a significant positive impact on the firm's profitability and market performance (Figge & Hahn, 2013; Flammer, 2013), CSR strategies contribute to shareholders' value creation by reducing information asymmetry and lowering firm's capital constraints (Cheng et al., 2014; Mariani et al., 2021), and corporate social trust acts as a form of socially normative force, contributing to aligning managers and stakeholders' interests (Pureza & Lee, 2020). Moreover, Servaes and Tamayo (2013), Alniacik et al. (2011), and Carpentier and Suret (2015) document that customers consider CSR activities when making purchasing decisions, and they are more likely to purchase goods from more socially responsible companies. Yet, the *ex-post* mitigation role of CSP is sparsely investigated. In this sense, CSP might contribute to preserving and recreating corporate reputation following the occurrence of an adverse event (Jones et al., 2000; Pfarrer et al., 2010; Wei et al., 2017). In this sense, we posit and test whether CSP might act as a mitigating factor in the aftermath of a major industrial accident.

Concerning the link between CSP and corporate performance, in the meaning of a mitigation role acted by the CSP, we observe: (i) an inverse relationship (Gangi et al., 2021) between the cost of debt and prior CSR performance (especially at the occurrence of a punishment announcements by regulatory authorities. Gong et al., 2021) while emphasizing benefits for firms to communicate their environmental performance to debt holders; (ii) companies with superior CSR activities had higher earnings transparency (Park & Ha, 2020); (iii) a company's ongoing and consistent CSR commitment can serve as a buffer in mitigating the negative impact of a brand crisis (Sojin & Stacy, 2022).

3 | BUILDING AN ACCIDENTS DATASET AND FIRM CHARACTERISTICS

Following Adikaram and Nawarathna (2018), even though destructive events can be very different, they can be classified into two major categories: natural disasters and industrial accidents.

The difference between these two groups lies in their source of origination, as the latter includes environmental degradation, accidents, and pollution, and they are ultimately man-made. In this sense, industrial accidents can be defined following the indications of The International Labour Office (Carpentier & Suret, 2015) as "an unexpected, sudden occurrence including, in particular, a major emission, fire or explosion, resulting from abnormal developments in the course of industrial activity, leading to a serious danger to workers, the public or the environment, whether immediate or delayed, inside or outside the installation and involving one or more hazardous substances. At the very least, it causes substantial injuries, deaths, financial costs, and serious damage to your reputation." (Shin, 2013).

Following this definition, we hand-collect information on industrial disasters between 2000 and 2020 from different sources. Data are gathered from several news avenues, other peer-reviewed studies, and the "Emergency Events Database" EMDAT (www.emdat.be) managed by the Centre for Research on the Epidemiology of Disasters of the Université Catholique de Louvain (Belgium). This dataset contains core data on the occurrence and the consequences of worldwide mass disasters from 1900, including nearly 7000 events. The database incorporates data from various sources, including UN agencies, non-governmental organizations, insurance companies, research institutes, and press agencies.

These sources result in a sample of 344 events that we can confidently label as an industrial accident. We drop events related to private firms, obtaining a final sample of 200 industrial accidents caused by publicly traded firms. Importantly, we also exclude airline accidents. The resulting sample includes many of the best-known industrial accidents in recent history, including the BP Deepwater Horizon accident and the Fukushima Dai—Ichi Nuclear Disaster.

We obtain data on firms' CSP from Refinitiv. In particular, we use corporations' ESG overall score, its three pillars—Environmental Score, Governance Score, and Social Score—in isolation, and total CO_2 emission as proxies for one of the most relevant aspects in the corporate environmental aspect, indeed, in the spotlight today in particular after the event of the ruling against Royal Dutch Shell. Our approach focuses on ESG in measuring the CSP is coherent with both common practices in the academic literature and with the evidence that the ESG framework is widely used nowadays by investors as a criterion to assess whether a company is environmentally, socially, and governmentally conscious (Arouri et al., 2019; Zhang et al., 2019, among others).

[1]Jones and Rubin (2001), find an overall insignificant capital market response to a sample of 98 adverse environmental events, in which electric power companies or oil firms with listed stocks were involved, reported in the Wall Street Journal between 1970 and 1992. Capelle-Blancard and Laguna (2010), in their sample of 64 chemical disasters, show no significant effect after ten trading days. Lai et al. (2002) find that there is a rapid adjustment to substantial. Kaplanski and Levy (2010) find evidence of a significant negative event effect with an average market loss of more than $60 billion per aviation disaster. In contrast, the estimated loss is no more than $1 billion. Walker et al. (2014) examine how aviation disasters affect the stock prices of airlines and airplane manufacturers, finding that the regulatory environments significantly impact the market reaction. In their sample, Wei et al. (2017) observe that after 30 days, the average cumulative abnormal return is a non-significant 1%.

TABLE 1 Variables

Variables	Symbol	Description
ESG score	*ESG score H-L*	This is a dummy variable taking the value of 1 if the ESG score is greater than median and 0 otherwise.
Emission CO_2	*Emission CO_2 H-L*	This is a dummy variable taking the value of 1 if the emission of CO_2 is greater than median and 0 otherwise.
Environmental Pillar	*Environmental H-L*	This is a dummy variable taking the value of 1 if the environmental pillar is greater than median and 0 otherwise.
Governance Pillar	*Governance H-L*	This is a dummy variable taking the value of 1 if the governance pillar is greater than median and 0 otherwise.
Social Pillar	*Social H-L*	This is a dummy variable taking the value of 1 if the social pillar is greater than median and 0 otherwise.
Size	*Size*	This variable is the log of total asset.
Profitability	*Profitability*	This variable is the ratio of EBITDA, that is, earning before interest, and total asset.
Leverage	*Leverage*	This variable is the ratio of total debt and total asset.
Intangible assets	*Intangible*	This variable is the ratio between intangible assets and total assets.

Note: This table reports all variables used in the paper. All variables have been collected from EIKON-Datastream database.

In addition, we obtained data on daily variations in firms' stock prices around the accident date and their financial and accounting profiles from Refinitiv. In particular, we gather information on firms' size, measured as the logarithm of Total Assets; leverage, defined as total debt over total assets; and profitability, calculated as EBITDA over total assets. Table 1 reports detailed definitions of each variable, Table 2 reports summary statistics for our full sample, and Table 3 is the correlation matrix.

4 | IDENTIFICATION STRATEGY

To test out the central hypothesis, that is that CSP plays a mitigation role in the aftermath of a major accident, we estimate the following cross-sectional model:

$$Caar[0;+1]_{i,t} = \alpha + \beta CSP_{i,t} + \delta Control_{i,t-1} + \gamma_t + \varepsilon_{i,t}, \tag{1}$$

where the dependent variable *Caar* represents cumulative abnormal returns based on either a CAPM model, the Fama–French three factors model, or the Carhart four factors model, as discussed in Section 3, *CSP* is proxied by firms' overall CSR performance—measuring their ESG intensity, both in terms of the overall score and of single pillars (social, government environmental)—and CO_2 emissions. We believe that these two variables are suitable to capture two different aspects of CSR. The ESG score is a summary measure of an overall assessment of CSR as widely understood by previous academic literature. The variable CO_2 emission focuses in particular on the topic of emissions which is an issue that has become increasingly important in the assessment of the sustainability engagement of a company since the treaty of Paris COP 25 but in particular from recent developments in the European legislation on the subject (taxonomy and climate benchmarks) and the media case connected with the Royal Dutch Shell ruling. Moreover, according to the Intergovernmental Panel on Climate Change (IPCC), the variable CO_2 emission is the most important metric in environmental policy aiming to cope with the primary goal of keeping global warming below two degrees centigrade. Firms' CSP performance are reported as dummy variables in which the value one is assigned to above median firms on this dimension, 0 otherwise. Controls include *Size*, measured as a log of total assets; *Leverage*, measured as the ratio of total debt to total assets; and *Profitability*, measured as EBITDA over total assets. We also include time and sector fixed effects to capture eventual changes in investors' preferences and attitudes towards firms' environmental profiles. All independent variables are lagged 1 year and winsorized at the first and last percentile of the sample distribution. We cluster standard errors at the firm and sector levels to control for heteroscedasticity.

Abnormal returns are computed as the difference between the observed returns and a normal return, estimated using either the single market model described in Capelle-Blancard and Laguna (2010), the Fama–French three factors model, or the Carhart four factors model. We checked for the most remarkable confounding events related to macro or monetary policy announcements, including those connected with corporate governance actions or price-sensitive market communications. In addition, short event windows can limit confounding effects between the impact of several measures announced in a limited period. It can also reduce potential endogeneity between announcements and market responses (Aït-Sahalia et al., 2012). We estimate abnormal returns (ARs), the forecast error of a specific normal return-generating mode, focusing on stock returns of single sectors. Regarding the estimation procedure, we estimate the AR adopting an asset of a single or multifactor market model.

The CAPM is the most used model to measure the performance of mutual funds. Jensen (1968) proposes to estimate the CAPM by running the following time-series regression:

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i (R_{m.t} - R_{f,t}) + \mu_{i,t}, \tag{2}$$

where the $R_{m.t}$ and R_f are the market return (represented by a local market equity index) and the risk-free rate, respectively. Error term $\mu_{i,t}$ is serially independent and verifies $E[\mu_{i,t}] = 0$ and var $(\mu_{i,t}) = \sigma_i^2$.

The Fama French model reads:

TABLE 2 Descriptive statistics

Variables	Obs.	Minimum	Mean	Median	Maximum	St. Dev.
CAR [0;+1]	159	−0.1234	−0.0050**	−0.0013	0.0330	0.0266
CARHART [0;+1]	159	−0.2387	−0.0099***	0.0003	0.0450	0.0486
CARFF [0;+1]	159	−0.1197	−0.0049**	−0.0014	0.0338	0.0262
Size	161	12.7566	17.7049	17.7069	23.4172	2.4191
Leverage	161	0.0001	0.2714	0.2587	0.8812	0.1701
Profitability	160	−0.0322	0.1226	0.1089	0.3993	0.0713
Intangible	137	0	0.3357	0.0371	29.0877	2.4882

Note: We report descriptive statistics on all variables used in the empirical analysis. Statistics are obtained by trimming each variable's first and last percentile of the sample distribution. ***, **, * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

TABLE 3 Correlation matrix

		1	2	3	4	5	6	7	8	9
1	ESG score H-L	1.00								
2	Emission CO_2 H-L	0.00	1.00							
3	Environmental H-L	**0.71**	0.04	1.00						
4	Governance H-L	**0.36**	0.09	0.10	1.00					
5	Social H-L	**0.84**	−0.04	**0.68**	**0.20**	1.00				
6	Size	−0.08	**0.40**	−0.10	−0.09	−0.06	1.00			
7	Profitability	−0.07	−0.17	−0.06	−0.19	0.05	0.13	1.00		
8	Leverage	−0.01	−**0.37**	−0.06	−**0.21**	0.14	0.11	−**0.24**	1.00	
9	Intangible	**0.22**	−**0.31**	0.18	0.11	**0.24**	−0.10	−0.04	−0.06	1.00

Note: We report correlations among variables. Coefficients statistically significant at the 5% level are reported in bold characters.

$$R_{it}-R_{ft}=\alpha_i+b_i(R_{Mt}-R_{ft})+s_iSMB_t+h_iHML_t+e_{it} \quad (3)$$

where R_{it} is the return on fund i for month t, R_{ft} is the risk-free rate and R_{Mt} is the market return over the same period, SMB and HML_t are the Fama and French (1993) size and book-to-market factors. SMB is the realization of the capitalization factor (small-cap return minus large-cap return) for month t; HML_t is the realization of the value factor (value return minus growth return) for month t e_{it} = an error term corresponding to the regression residuals. Carhart (1997) extends the Fama–French model by adding a fourth factor that captures the Jegadeesh and Titman (1993) momentum anomaly as follows:

$$R_{it}-R_{ft}=\alpha_i+b_i(R_{Mt}-R_{ft})+s_iSMB_t+h_iHML_t+m_iMOM_t+e_{it}. \quad (4)$$

The momentum factor, MOM_t, is a measure of the difference between the returns on past high-performing versus past poor-performing stocks. Hence, $\check{M}OM_t$ reflects a fund's sensitivity to pursuing a zero-investment strategy of purchasing past outperforming “momentum” stocks and short-selling stocks with low historical returns.

According to each Market model specification, parameters are obtained with daily log returns over a 252-day estimation period, ending 20 days before the announcement. ARs are then obtained as the difference between the actual stock return and the return predicted by the (single or multi-factor) market model. ARs are cumulated over a time period (cumulative average abnormal return (CAAR)) around the announcement date ($t = 0$). For each event window, CAARs are obtained as follows:

$$CAR_i(t_1,t_2)=\sum_{t=t1}^{t2}AR_{i,t} \quad (5)$$

where t_1 and t_2 are the considered window's start and end dates. ARs can be aggregated on a time or a cross-section basis for a portfolio of N observations. The CAAR is calculated as follows:

$$CAAR_i(t_1,t_2)=\frac{1}{N}\sum_{i=1}^{N}CAR_i(t_1,t_2). \quad (6)$$

As documented in Table 2, we confirm results reported in extant literature by ensuring that the CAAR computed over a two-day window surrounding industrial disasters have negative mean and median values (except for Carhart's median) ranging between 0.03% and 0.14%. In some cases, the negative change in the abnormal return is very significant, as demonstrated by the reported minimum values.

Corporations are all of the medium-large size: the most prominent firm has a total asset value of about \$15 billion. Debt to total assets (leverage) features a high degree of cross-sectional variation, ranging from almost zero to 88%. On average, companies have positive profitability of 12% (median of nearly 11%).

TABLE 4 Baseline model

	Panel A CAR(0 + 1)	Panel B CARHART (0 + 1)	Panel C CARFF(0 + 1)	Panel D CAR(0 + 1)	Panel E CARHART(0 + 1)	Panel F CARFF(0 + 1)	Panel G CAR(0 + 1)	Panel H CARHART (0 + 1)	Panel I CARFF(0 + 1)
ESG score H-L	0.0086*	0.0078	0.0081*				0.0125**	0.0118**	0.0120**
	(0.0042)	(0.0043)	(0.0042)				(0.0040)	(0.0040)	(0.0040)
Emission CO_2 H-L				−0.0130***	−0.0136***	−0.0132***	−0.0172***	−0.0175***	−0.0171***
				(0.0034)	(0.0037)	(0.0035)	(0.0045)	(0.0048)	(0.0046)
Size	−0.0032	−0.0031	−0.0031	−0.0043*	−0.0041*	−0.0041*	−0.0043*	−0.0040*	−0.0041*
	(0.0032)	(0.0031)	(0.0031)	(0.0022)	(0.0021)	(0.0021)	(0.0021)	(0.0020)	(0.0020)
Profitability	0.0526	0.0538	0.0528	0.0663*	0.0677*	0.0659*	0.0667***	0.0678***	0.0663***
	(0.0320)	(0.0320)	(0.0321)	(0.0313)	(0.0307)	(0.0307)	(0.0170)	(0.0164)	(0.0169)
Leverage	−0.0242	−0.0247	−0.0243	−0.0159	−0.0165	−0.0159	−0.0439	−0.0449	−0.0438
	(0.0255)	(0.0258)	(0.0253)	(0.0280)	(0.0279)	(0.0277)	(0.0524)	(0.0540)	(0.0528)
Intangible	0.0168	0.0174	0.0169	0.0003	−0.0003	0.0000	−0.0113	−0.0107	−0.0108
	(0.0230)	(0.0225)	(0.0225)	(0.0278)	(0.0282)	(0.0278)	(0.0177)	(0.0173)	(0.0173)
Constant	0.0793	0.0763	0.0763	0.0004	−0.0002	−0.0003	−0.0153	−0.0160	−0.0159
	(0.0626)	(0.0612)	(0.0614)	(0.0455)	(0.0438)	(0.0441)	(0.0483)	(0.0462)	(0.0467)
N	81	81	81	71	71	71	67	67	67

Note: This table reports empirical results by running our baseline model using the Cumulated Average Abnormal Returns calculated for listed firms involved in a disaster between January 2000 and May 2020. We compute the effect using a 2-day event window [0;+1]. Variables are described in Table 1. We control for time and sector-fixed effects. Cluster standard errors at firm and sectors level are in parentheses. ***, **, * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Concerning CSP, we measure it by considering two dimensions, the first capturing the overall level of CSP proxied by the overall ESG score of the studied firm, and the second focusing on its emission intensity, proxied by the total CO_2 emission level (CO_2 equivalents emission in tonnes), as observed in t-1. The two dimensions capture a different segment of the mitigation effect we aim to study, as suggested by their low pairwise correlation (0,00).

We propose three alternative approaches to assess the robustness of these results. First, we test for the existence of an anticipation effect by analyzing the CAARs' behavior 1 day and 2 days before the disaster. Cars should be indistinguishable from zero and orthogonal to a firm's CSP profile. Second, we change the interval of the event window to 6 days (0;+5). In this way, we verify the permanence of the result over a longer time horizon.

Finally, we analyze the mitigation effect of companies that show a significant fall in stock market prices. For this analysis, we select only companies with a CAAR below the median value.

5 | EMPIRICAL RESULTS

Table 4 reports the CAARs estimated for the event window, including the 2 days following the studied industrial disasters (0;+1). Panel A–C reports estimates on ESG-based measures of CSP, while Panels D–F relies on emission variables only. Finally, G–I reports results based on both variables.

Following the studied events, we observe that firms' positive CSP mitigates the negative market reaction documented in Table 2. In particular, we report firms featuring an above median ESG performance to suffer from a lower decline in stock market valuations, whose economic magnitude ranges between 78 and 86 basis points according to the calculation method of the CAARs. This mitigating effect is statistically significant at 5% in all the estimated models.

Similarly, Panel D–F document that when we measure firms' corporate environmental performance in terms of CO_2 emissions, its mitigating effects is even more pronounced, resulting in a reduced stock price reaction ranging between 130 and 136 basis points. These estimates are statistically significant at the 1% level of probability.

When we consider the ESG and the Emission variables together (Panels G–I), we observe that the direction of the effect remains unchanged—positive for companies with higher ESG scores and negative for those with higher CO_2 emissions—even if the magnitude of both coefficients increases. The positive impact of the ESG variable ranges between 118 and 125 basis points depending on the calculation method of the CAARs. In contrast, the effect of the Emissions ranges between 171 and 175 basis points. The ESG variable is significant at 5%, while the CO_2 emissions variable is at 1%. This result is particularly interesting. In the presence of a disaster, for which the company will probably be called to pay damages, the investors' reaction rewards the more virtuous companies with a higher CSP and lower CO_2 emissions. This is consistent with our hypothesis, confirming that firms' CSP generates a halo effect whose economic consequences also materialize in the aftermath of an adverse event.

TABLE 5 Baseline model with ESG pillars

	Panel A CAR(0 + 1)	Panel B CARHART (0 + 1)	Panel C CARFF(0 + 1)	Panel D CAR(0 + 1)	Panel E CARHART(0 + 1)	Panel F CARFF(0 + 1)	Panel G CAR(0 + 1)	Panel H CARHART(0 + 1)	Panel I CARFF(0 + 1)
Environmental H-L	0.0089	0.0083	0.0084						
	(0.0057)	(0.0055)	(0.0056)						
Governance H-L				0.0041*	0.0039*	0.0039*			
				(0.0022)	(0.0021)	(0.0020)			
Social H-L							0.0108**	0.0102**	0.0104**
							(0.0036)	(0.0036)	(0.0035)
Size	−0.0030	−0.0029	−0.0028	−0.0032	−0.0030	−0.0030	−0.0030	−0.0028	−0.0028
	(0.0030)	(0.0029)	(0.0029)	(0.0033)	(0.0032)	(0.0032)	(0.0031)	(0.0030)	(0.0030)
Profitability	0.0518	0.0530	0.0520	0.0515	0.0526	0.0517	0.0448	0.0464	0.0452
	(0.0351)	(0.0349)	(0.0351)	(0.0341)	(0.0341)	(0.0342)	(0.0339)	(0.0337)	(0.0339)
Leverage	−0.0222	−0.0226	−0.0223	−0.0282	−0.0281	−0.0280	−0.0293	−0.0292	−0.0290
	(0.0235)	(0.0238)	(0.0233)	(0.0243)	(0.0245)	(0.0242)	(0.0230)	(0.0234)	(0.0229)
Intangible	0.0136	0.0143	0.0139	0.0249	0.0249	0.0245	0.0204	0.0206	0.0203
	(0.0219)	(0.0215)	(0.0216)	(0.0208)	(0.0204)	(0.0204)	(0.0218)	(0.0213)	(0.0213)
Constant	0.0764	0.0737	0.0736	0.0685	0.0663	0.0662	0.0805	0.0776	0.0776
	(0.0602)	(0.0590)	(0.0591)	(0.0606)	(0.0595)	(0.0596)	(0.0605)	(0.0591)	(0.0593)
N	81	81	81	81	81	81	81	81	81

Note: This table reports empirical results by running our baseline model with ESG pillars using the cumulated average abnormal returns calculated for listed firms involved in a disaster between January 2000 and May 2020. We compute the effect using a 2-day event window [0;+1]. Variables are described in Table 1. We control for time and sector-fixed effects. Cluster standard errors at firm and sectors level are in parentheses. ***, **, * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Concerning the other variables included in our specifications, profitability appears to be systematically and strongly associated with higher CAARs. That is, companies with higher profitability in the year before the disaster react better to changes in stock prices. The magnitude of this variable is exceptionally high (between 438 and 449 basis points for the full models in Panel G–I), with a statistical significance at 1% for the full models. This is reasonable, as more profitable firms are more likely to cope with the often-large financial consequences of these adverse events. Conversely, size is never statistically significant. However, we must recognize that our sample includes only large listed companies, thus displaying limited heterogeneity on this dimension. Surprisingly, even the degree of indebtedness, measured by leverage, is never statistically significant. We would have expected the markets to penalize the most indebted companies due to the future higher costs that the company will be called to bear. Yet, this might be because the profitability variable also captures this effect.

Table 5 replicates our main model after disentangling the ESG scores into their three fundamental components—environmental, governance, and social. We find that two pillars—Governance and Social—are statistically significant with a positive sign. Therefore, a higher score of Social and Governance sustainability score offers a "shield" to the company in the event of a disaster. On average, the positive impact is 105 basis points for social pillar and 40 basis points for the governance. Arena et al. (2015) assess the strategic role of the governance rules and procedures at the bottom of the governance ESG dimension while supporting boards' stakeholder orientation and playing a transparency role in communicating the firm's superior performance. Next, we test for the robustness of the identified results.

In Table 6, we analyze if the impact of the ESG score and CO_2 emissions on the CAARs calculated 1 day (CAAR-1) and 2 days (CAAR-2) before the disaster are statistically insignificant. This form of placebo test confirms our prior, documenting that the mitigating effect of firms' CSP is relevant *after* the event's occurrence exclusively.

In Table 7, we analyze what happens considering a different longer event window (6 days). Even in this case, the mitigation effect remains, although the statistical significance of the ESG score of CO_2 emissions is lower (10%). As we might have expected, having widened the event window, the effect on CAARs is systematically smaller, with an average reduction compared to the two-day window (0; +1) of 50% for the ESG score and 300% for the Emission variable. These results concern the complete models (Panels G–I).

Finally, Table 8 shows the effect of the ESG and CO_2 emission variables for corporations that have shown a more marked decline in prices, that is, companies that present a Caar value below the sample median. The result seems particularly interesting to us. Comparison

TABLE 6 Robustness 1: anticipation effect

	Panel A CAR(−1)	Panel B CARHART(−1)	Panel C CARFF(−1)	Panel D CAR(−2)	Panel E CARHART(−2)	Panel F CARFF(−2)
ESG score H-L	0.0088	0.0087	0.0085	0.0017	0.0017	0.0014
	(0.0061)	(0.0061)	(0.0061)	(0.0055)	(0.0055)	(0.0054)
Emission CO_2 H-L	0.0042	0.0042	0.0040	0.0195	0.0195	0.0190
	(0.0064)	(0.0064)	(0.0063)	(0.0130)	(0.0131)	(0.0125)
Size	−0.0020	−0.0019	−0.0019	−0.0002	−0.0002	−0.0001
	(0.0017)	(0.0017)	(0.0017)	(0.0007)	(0.0007)	(0.0007)
Profitability	−0.0343	−0.0338	−0.0307	−0.0654	−0.0675	−0.0626
	(0.0206)	(0.0206)	(0.0207)	(0.0423)	(0.0432)	(0.0406)
Leverage	−0.0178	−0.0174	−0.0180	0.0333	0.0332	0.0319
	(0.0363)	(0.0360)	(0.0357)	(0.0314)	(0.0312)	(0.0298)
Intangible	−0.0750	−0.0742	−0.0746	0.0313*	0.0316*	0.0315*
	(0.0658)	(0.0655)	(0.0654)	(0.0145)	(0.0148)	(0.0143)
Constant	0.0579	0.0559	0.0562	0.0003	−0.0003	−0.0012
	(0.0425)	(0.0423)	(0.0422)	(0.0181)	(0.0183)	(0.0181)
N	67	67	67	67	67	67

Note: This table reports empirical results by running our baseline model using the cumulated average abnormal returns calculated for listed firms involved in a disaster between January 2000 and May 2020. We compute the effect using an event window of 1 day [−1] and 2 days [−2] before the disaster. Variables are described in Table 1. We control for time and sector-fixed effects. Cluster standard errors at firm and sectors level are in parentheses. ***, **, * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

TABLE 7 Robustness 2: CAAR window (0 + 5)

	Panel A CAR(0 + 5)	Panel B CARHART(0 + 5)	Panel C CARFF(0 + 5)	Panel D CAR(0 + 5)	Panel E CARHART(0 + 5)	Panel F CARFF(0 + 5)	Panel G CAR(0 + 5)	Panel H CARHART(0 + 5)	Panel I CARFF(0 + 5)
ESG score H-L	0.0053*	0.0051*	0.0050*				0.0061*	0.0059*	0.0058*
	(0.0024)	(0.0025)	(0.0025)				(0.0028)	(0.0028)	(0.0028)
Emission CO_2 H-L				−0.0045*	−0.0047*	−0.0047*	−0.0048*	−0.0051*	−0.0051*
				(0.0023)	(0.0021)	(0.0022)	(0.0025)	(0.0023)	(0.0024)
Size	−0.0016	−0.0016	−0.0016	−0.0024**	−0.0024**	−0.0024**	−0.0023*	−0.0022**	−0.0023**
	(0.0014)	(0.0014)	(0.0014)	(0.0010)	(0.0010)	(0.0010)	(0.0010)	(0.0010)	(0.0010)
Profitability	0.0442**	0.0447**	0.0450**	0.0488**	0.0491**	0.0496**	0.0500**	0.0505**	0.0509**
	(0.0153)	(0.0151)	(0.0153)	(0.0196)	(0.0191)	(0.0194)	(0.0193)	(0.0187)	(0.0190)
Leverage	−0.0090	−0.0092	−0.0090	−0.0064	−0.0069	−0.0067	−0.0117	−0.0123	−0.0121
	(0.0118)	(0.0117)	(0.0117)	(0.0153)	(0.0148)	(0.0149)	(0.0138)	(0.0137)	(0.0137)
Intangible	0.0026	0.0027	0.0027	−0.0025	−0.0026	−0.0025	−0.0036	−0.0035	−0.0035
	(0.0035)	(0.0035)	(0.0036)	(0.0051)	(0.0051)	(0.0051)	(0.0053)	(0.0053)	(0.0054)
Constant	−0.0009	−0.0015	−0.0012	0.0236	0.0229	0.0229	0.0161	0.0155	0.0156
	(0.0291)	(0.0288)	(0.0289)	(0.0201)	(0.0198)	(0.0199)	(0.0177)	(0.0173)	(0.0175)
N	87	87	87	76	76	76	72	72	72

Note: This table reports empirical results by running our baseline model using the cumulated average abnormal returns calculated for listed firms involved in a disaster between January 2000 and May 2020. We compute the effect using a 6-day event window [0;+5]. Variables are described in Table 1. We control for time and sector-fixed effects. Cluster standard errors at firm and sectors level are in parentheses. ***, **, * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

with the baseline model of Table 4 shows that those with the most significant sustainability perform better in the subset of companies with a stronger stock market reaction. The ESG's mitigation role is practically double compared to the base model; this result does not depend on the methodology used to estimate the Caar. The same result holds for the CO_2 emission variable. In this case, the companies

TABLE 8 Baseline model for corporations with a CAAR value below the median

	Panel A CAR(0 + 1)	Panel B CARHART(0 + 1)	Panel C CARFF(0 + 1)	Panel D CAR(0 + 1)	Panel E CARHART(0 + 1)	Panel F CARFF(0 + 1)	Panel G CAR(0 + 1)	Panel H CARHART(0 + 1)	Panel I CARFF(0 + 1)
ESG score H-L	0.0160**	0.0149**	0.0146**				0.0290***	0.0275***	0.0276***
	(0.0052)	(0.0054)	(0.0053)				(0.0064)	(0.0065)	(0.0074)
Emission CO_2 H-L				−0.0269***	−0.0265***	−0.0266***	−0.0429***	−0.0415***	−0.0416***
				(0.0039)	(0.0045)	(0.0047)	(0.0090)	(0.0090)	(0.0091)
Size	−0.0054	−0.0051	−0.0051	−0.0077	−0.0074	−0.0072	−0.0069	−0.0065	−0.0066
	(0.0047)	(0.0045)	(0.0046)	(0.0054)	(0.0052)	(0.0054)	(0.0047)	(0.0045)	(0.0048)
Profitability	0.1321*	0.1368*	0.1213	0.1232	0.1304	0.0965	0.1805	0.1850	0.1757
	(0.0672)	(0.0665)	(0.0951)	(0.1059)	(0.1044)	(0.1302)	(0.1008)	(0.1003)	(0.1599)
Leverage	−0.0076	−0.0086	−0.0059	−0.0775	−0.0769	−0.0686	−0.0554	−0.0559	−0.0547
	(0.0273)	(0.0289)	(0.0331)	(0.0625)	(0.0637)	(0.0810)	(0.0596)	(0.0617)	(0.0709)
Intangible	0.0152	0.0166	0.0196	−0.0329	−0.0313	−0.0184	−0.0760	−0.0720	−0.0719
	(0.0513)	(0.0505)	(0.0616)	(0.1119)	(0.1111)	(0.1394)	(0.0788)	(0.0785)	(0.1101)
Constant	0.1046	−0.0013	0.0725	0.0802	0.1449	0.1145	0.0781	0.1157	0.0737
	(0.0736)	(0.0860)	(0.0857)	(0.1910)	(0.1803)	(0.1278)	(0.1018)	(0.1150)	(0.0983)
N	45	46	45	36	37	36	35	36	35

Note: This table reports empirical results by running our baseline model using the cumulated average abnormal returns calculated for listed firms involved in a disaster between January 2000 and May 2020, with the Caar value below the median. We compute the effect using a 2-day event window [0;+1]. Variables are described in Table 1. We control for time and sector-fixed effects. Cluster standard errors at firm and sectors level are in parentheses. ***, **, * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

that emit the most perform worse. Also, in this case, the coefficients are two times greater than those of the basic model presented in Table 4, regardless of the type of Caar. This leads us to say that CSR has a very pronounced mitigation effect, especially in the most challenging moments for the company.

6 | CONCLUSIONS

Recent industrial disasters have resulted in some of the most severe man-made natural disasters, resulting in deaths, serious injuries, and enormous economic losses. The most striking example in recent years is April 20, 2010, deepwater horizon explosion in the Gulf of Mexico. This event caused the largest marine natural disaster in the history of the petroleum industry, resulting in $104.8 billion in losses in the subsequent months for British Petroleum, beyond a wide array of negative externalities.

The role of CSP and capital as a preventive measure to mitigate the risk of these extreme events has been extensively studied in the literature. Yet, its ex-post implications have not received much attention. In this study, we document that CSP produces a halo effect, limiting tail events' negative impact. In particular, we investigate a novel panel dataset including 200 events that occurred in 34 countries between 2000 and 2020. We find that the accumulated level of CSP mitigates the drop in the stock price following these events.

The practical and theoretical implications of our findings are at the bottom of that form of a socially normative corporate force embedded in social trust, smoothing managers' and stakeholders' interests together. The implications of our results are primarily regarding two aspects.

First, from the corporate strategy side, in terms of risk mitigation, our overall results contribute to the CSR literature by confirming a possible mechanism for risk reduction of CSR already found by previous scholars. This insurance-like effect influences corporate risk management practices. It can help managers who are involved in facing disastrous events to conduct the best strategy to reduce the overall adverse effects. They should consider CSR's effect to benefit from better financial performance in the post-event periods. From previous scholars, we know that companies with better CSR performance are more likely to adopt an integrated risk management approach as a risk mitigation mechanism. Moreover, on the other hand, the value for shareholders in terms of performance in the post-event period is higher if the company starts with a high sustainability level. Therefore, the goal of the manager who intends to minimize the impact of an industrial accident and, at the same time, maximize the value of his shareholders is to increase the sustainability setting of his company, boosting the company's social capital. Under this perspective, corporate social trust acts as a form of socially normative force, contributing to aligning managers' and stakeholders' interests.

Second, these results also provide implications for the portfolio manager and investors. They should take care of the CSR level when building their portfolios and, under a risk mitigation view, prefer those more sustainability-oriented companies.

This empirical work presents some limitations, mainly due to the availability of data related from on hand to sustainability performance. At the same time, from the other, we realized that in the procedure of data hand collection, not for all the observations, we obtain a full data set concerning the loss measures, that is, wounded, dead, and damaged. Concerning sustainability performance and subdimensions, additional research suggestions involve two other aspects, one related to the CSR rating methodology and the other to the specific drivers of the CSR framework. For the first aspect, we refer to the issue of variability in CSR scores according to different data providers. It would be very interesting to check the robustness of our results when the data source changes. Previous scholars measured the ESG scores of the three major sustainability rating agencies by comparing different rating methods, proving that ESG measurement fails in achieving a full degree of convergence among different data providers.

In terms of future research agenda, we realize that it would be of great interest to deepen not only the overall CSR score and its pillars as performed in this analysis but also the individual drivers that make up the three pillars (e.g., use of resources, innovation; human rights, workforce, community, and product responsibility) to understand where it would be more effective to act to minimize the adverse effect of an industrial accident.

CONFLICT OF INTEREST

The authors declare there are no conflicts of interest.

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REFERENCES

Adikaram, K. K. N. B., & Nawarathna, C. M. (2018). Business sector preparedness in disaster management: case study with businesses in Southern Sri Lanka in both aspects of natural and technological disasters. *Procedia Engineering*, *212*, 918–920.

Aït-Sahalia, Y., Andritzky, J., Jobst, A., Nowak, S., & Tamirisa, N. (2012). Market response to policy initiatives during the global financial crisis. *Journal of International Economics*, *87*, 162–177.

Alniacik, U., Alniacik, E., & Genc, N. (2011). How corporate social responsibility information influences stakeholders' intentions. *Corporate Social Responsibility and Environmental Management*, *18*(4), 234–245.

Arena, C., Bozzolan, S., & Michelon, G. (2015). Environmental reporting: Transparency to stakeholders or stakeholder manipulation? An analysis of disclosure tone and the role of the board of directors. *Corporate Social Responsibility and Environmental Management*, *22*(6), 346–361.

Arouri, M., Gomes, M., & Pukthuanthong, K. (2019). Corporate social responsibility and M&A uncertainty. *Journal of Corporate Finance*, *56*, 176–198.

Blackman, D., Nakanishi, H., & Benson, A. M. (2017). Disaster resilience as a complex problem: why linearity is not applicable for long-term recovery. *Technological Forecasting and Social Change*, *121*, 89–98.

Bouzzine, Y. D. (2021). Stock price reactions to environmental pollution events: A systematic literature review of direct and indirect effects and a research agenda. *Journal of Cleaner Production*, *316*, 128305.

Brown, G. D., Corbet, S., McMullan, C., & Sharma, R. (2015). Do industrial incidents in the chemical sector create equity market contagion? *Journal of Safety Research*, *55*, 115–119.

Capelle-Blancard, G., Desroziers, A., & Scholtens, B. (2021). Shareholders and the environment: A review of four decades of academic research. *Environmental Research Letters*, *16*(12), 123005.

Capelle-Blancard, G., & Laguna, M. A. (2010). How Does the stock market respond to chemical disasters? *Journal of Environmental Economics and Management*, *59*(2), 192–205.

Carhart, M. (1997). On persistence in mutual fund performance. *Journal of Finance*, *52*(1), 57–82.

Carpentier, C., & Suret, J. M. (2015). Stock market and deterrence effect: A mid-run analysis of major environmental and non-environmental accidents. *Journal of Environmental Economics and Management*, *71*, 1–18.

Carpentier, C., & Suret, J. M. (2020). On the rationality of institutional investors: The case of major industrial accidents. *Journal of Behavioral Finance*, *22*(3), 1–17.

Carroll, A. B., & Shabana, K. M. (2010). The business case for corporate social responsibility: A review of concepts, research and practice. *International Journal of Management Reviews*, *12*(1), 85–105.

Cheng, C., Tan, W., & Liu, L. (2014). Numerical simulation of water curtain application for ammonia release dispersion. *Journal of Loss Prevention in the Process Industry*, *30*(1), 105–112.

Claeys, A. S., & Cauberghe, V. (2015). The role of a favorable pre-crisis reputation in protecting organizations during crises. *Public Relations Review*, *41*(1), 64–71.

Dasgupta, S., Laplante, B., & Mamingi, N. (2001). Pollution and capital markets in developing countries. *Journal Environmental Economics and Management*, *42*(3), 310–335.

Davidson, B. I., & Stevens, D. E. (2013). Can a code of ethics improve manager behavior and investor confidence? An experimental study. *The Accounting Review*, *88*(1), 51–74.

De Abreu, M. C. S., & de Andrade, R. D. J. C. (2019). Dealing with wicked problems in socio-ecological systems affected by industrial disasters: A framework for collaborative and adaptive governance. *Science of the Total Environment*, *694*, 133700.

Diestre, L., & Rajagopalan, N. (2014). Toward an input-based perspective on categorization: Investor reactions to chemical accidents. *Academy of Management Journal*, *57*(4), 1130–1153.

Engelen, P. J., & van Essen, M. (2011). The role of financial markets to induce corporate responsibility. In *Responsible investment in times of turmoil* (pp. 55–74), Springer.

Fama, E. F., & French, K. R. (1993). Common risk factors in the returns on stocks and bonds. *Journal of Financial Economics*, *33*(1), 3–56.

Figge, F., & Hahn, T. (2013). Value drivers of corporate eco-efficiency: Management accounting information for the efficient use of environmental resources. *Management Accounting Research*, *24*(4), 387–400.

Flammer, C. (2013). Corporate social responsibility and shareholder reaction: The environmental awareness of investors. *Academy of Management Journal*, *56*(3), 758–781.

Gangi, F., D'Angelo, E., Daniele, L. M., & Varrone, N. (2021). Assessing the impact of socially responsible human resources management on company environmental performance and cost of debt. *Corporate Social Responsibility and Environmental Management*, *28*(5), 1511–1527.

Gatzert, N. (2015). The impact of corporate reputation and reputation damaging events on financial performance: Empirical evidence from the literature. *European Management Journal*, *33*(6), 485–499.

Giannarakis, G., Zafeiriou, E., Arabatzis, G., & Partalidou, X. (2018). Determinants of corporate climate change disclosure for European firms. *Corporate Social Responsibility and Environmental Management*, *25*(3), 281–294.

Gong, G., Huang, X., Wu, S., Tian, H., & Li, W. (2021). Punishment by securities regulators, corporate social responsibility and the cost of debt. *Journal of Business Ethics*, *171*(2), 337–356.

Ho, J. C., Qiu, M., & Tang, X. (2013). Do airlines always suffer from crashes? *Economics Letters*, *118*(1), 113–117.

Jegadeesh, N., & Titman, S. (1993). Returns to buying winners and selling losers: Implications for stock market efficiency. *The Journal of Finance*, *48*(1), 65–91.

Jensen, M. C. (1968). The performance of mutual funds in the period 1945-1964. *The Journal of Finance*, *23*(2), 389–416.

Jones, G. H., Jones, B. H., & Little, P. (2000). Reputation as reservoir: Buffering against loss in times of economic crisis. *Corporate Reputation Review*, *3*(1), 21–29.

Jones, K., & Rubin, P. H. (2001). Effects of harmful environmental events on reputations of firms. In *Advances in financial economics*. Emerald Group Publishing Limited.

Kaplanski, G., & Levy, H. (2010). Sentiment and stock prices: The case of aviation disasters. *Journal of Financial Economics*, *95*(2), 174–201.

Karpoff, J. M., Lott, J. R., & Wehrly, E. W. (2005). The reputational penalties for environmental violations: Empirical evidence. *The Journal of Law and Economics*, *48*(2), 653–675.

Kock, C. J., Santalo, J., & Diestre, L. (2012). Corporate governance and the environment: what type of governance creates greener companies? *Journal of Management Studies*, *49*(3), 492–514.

Konar, S., & Cohen, M. A. (1997). Information as regulation: The effect of community right to know laws on toxic emissions. *Journal of Environmental Economics and Management*, *32*(1), 109–124.

Lai, G. C., McNamara, M. J., & Oppenheimer, H. R. (2002). Large losses and firm value: Investor response and managerial decisions. *Journal of Insurance Issues*, *25*, 63–84.

Lee, Y. G., & Garza-Gomez, X. (2012). Total cost of the 2010 deepwater horizon oil spill reflected in US stock market. *Journal of Accounting and Finance*, *12*(1), 73–83.

Mariani, M. M., Al-Sultan, K., & De Massis, A. (2021). Corporate social responsibility in family firms: A systematic literature review. *Journal of Small Business Management*, *59*, 1–55.

Ortas, E., Moneva, J. M., Burritt, R., & Tingey-Holyoak, J. (2014). Does sustainability investment provide adaptive resilience to ethical investors? Evidence from Spain. *Journal of Business Ethics*, *124*(2), 297–309.

Park, H. J., & Ha, M. H. (2020). Corporate social responsibility and earnings transparency: Evidence from Korea. *Corporate Social Responsibility and Environmental Management*, *27*(3), 1498–1508.

Pfarrer, M. D., Pollock, T. G., & Rindova, V. P. (2010). A tale of two assets: The effects of corporation reputation and celebrity on earnings surprises and investors' reactions. *Academy of Management Journal*, *53*(5), 1131–1152.

Pureza, A. P., & Lee, K. H. (2020). Corporate social responsibility leadership for sustainable development: An institutional logics perspective in Brazil. *Corporate Social Responsibility and Environmental Management*, *27*(3), 1410–1424.

Racine, M., Wilson, C., & Wynes, M. (2020). The value of apology: How do corporate apologies moderate the stock market reaction to non-financial corporate crises? *Journal of Business Ethics*, *163*(3), 485–505.

Servaes, H., & Tamayo, A. (2013). The impact of corporate social responsibility on firm value: The role of customer awareness. *Management Science*, *59*(5), 1045–1061.

Shin, I. J. (2013). Major industrial accidents in Korea: The characteristics and implication of statistics 1996–2011. *Process Safety Progress*, *32*(1), 90–95.

Sojin, J., & Stacy, H. L. (2022). The buffering effect of continuous corporate social responsibilities engagement on negative consumer responses toward brand crises. *Corporate Social Responsibility and Environmental Management*, *29*(5), 1636–1646.

Walker, T. J., Walker, M. G., Thiengtham, D. N., & Pukthuanthong, K. (2014). The role of aviation laws and legal liability in aviation disasters: A financial market perspective. *International Review of Law and Economics*, *37*, 51–65.

Wang, A., Marinova, D., Wang, F., & Wei, J. (2020). Corporate investor confidence in the aftermath of a mega natural disaster: An empirical study of the 2008 Wenchuan earthquake. *Safety Science*, *125*, 104620.

Wei, J., Ouyang, Z., & Chen, H. (2017). Well known or well liked? The effects of corporate reputation on firm value at the onset of a corporate crisis. *Strategic Management Journal*, *38*(10), 2103–2120.

Zhang, F., Li, M., & Zhang, M. (2019). Chinese Financial Market Investors Attitudes toward Corporate Social Responsibility: Evidence from Mergers and Acquisitions. *Sustainability*, *11*(9), 2615.

Zou, H., Zeng, R., Zeng, S., & Shi, J. J. (2015). How do environmental violation events harm corporate reputation? *Business Strategy and the Environment*, *24*(8), 836–854.

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ANNEX 1

Corporation names, event type, and date of the disaster

Company Name	Disaster type	Date	Company name	Disaster type	Date	Company name	Disaster type	Date
BP	Explosion	07 Jun 2000	BP	Explosion	23 Mar 2005	Harmony Gold	Fire	01 Jun 2009
BP	Explosion	10 Jun 2000	BP	Explosion	24 Mar 2005	Seadrill, PTT	Explosion	21 Aug 2009
Total	Explosion	03 Sep 2000	Exelon's Braidwood	Contamination	16 Jun 2005	Pingdingshan Tianan Co Ltd	Explosion	08 Sep 2009
Massey Energy	Contamination	11 Oct 2000	Murphy Oil	Spill	30 Aug 2005	Vedanta Resources	Collapse	23 Sep 2009
Solutia	Explosion	12 Oct 2000	Formosa Plastics	Explosion	06 Oct 2005	Indian Oil Corporation	Explosion	29 Oct 2009
Exxon Mobil	Explosion	09 Dec 2000	CNPC	Explosion	13 Nov 2005	CNPC	Contamination	30 Dec 2009
ConocoPhillips	Explosion	16 Apr 2001	Total	Fire	11 Dec 2005	Siemens	Explosion	07 Feb 2010
ConocoPhillips	Explosion	16 Apr 2001	Massey Energy	Fire	19 Jan 2006	Siemens	Explosion	08 Feb 2010
Rhodia	Explosion	25 Apr 2001	CNPC	Explosion	20 Jan 2006	Siemens	Explosion	08 Feb 2010
Total	Explosion	14 Jul 2001	Shanxi Coking Coal Group	Explosion	01 Feb 2006	Shanxi Coking Coal Group	Other	28 Mar 2010
Total	Explosion	21 Sep 2001	Grupo Mexico	Explosion	19 Feb 2006	Massey Energy	Explosion	05 Apr 2010
Asahi Kasei	Explosion	12 Mar 2002	BP	Pollution	02 Mar 2006	Massey Energy	Explosion	05 Apr 2010
Guerbet	Explosion	03 Sep 2002	Highland Gold Mining	Fire	09 Jul 2006	BP	Contamination	20 Apr 2010
Rhodia	Explosion	08 Jan 2003	Evraz	Explosion	18 Mar 2007	BP	Contamination	21 Apr 2010
West Pharma. Services Inc	Explosion	29 Jan 2003	Evraz	Explosion	19 Mar 2007	Zhongjin Lingnan	Fire	08 Jun 2010
Exxon Mobil	Explosion	21 Feb 2003	Evraz	Explosion	19 Mar 2007	Chevron	Contamination	11 Jun 2010
Repsol YPF	Explosion	14 Aug 2003	Evraz	Explosion	24 May 2007	Enterprise products partners	Explosion	06 Jul 2010
PetroChina Company Ltd	Explosion	23 Dec 2003	Consolidated Edison	Explosion	19 Jul 2007	CNPC	Contamination	16 Jul 2010
CNPC	Poisoning	15 Jan 2004	Samsung Heavy Industries	Contamination	07 Dec 2007	Enbridge	Contamination	25 Jul 2010
Odfjell	Explosion	28 Feb 2004	Imperial sugar	Explosion	08 Feb 2008	Codelco	Collapse	05 Aug 2010
BP	Explosion	31 Mar 2004	Favelle Favco Group	Collapse	15 Mar 2008	Raspadskaya	Explosion	05 Aug 2010
Fluxys	Explosion	30 Jul 2004	Imperial sugar	Explosion	02 Jul 2008	MSC	Contamination	07 Aug 2010
LG Chem	Explosion	25 Aug 2004	Tennessee Valley Authority	Sewage spill	22 Dec 2008	DSM Koninklijke	Other	12 Sep 2010
Sasol	Explosion	01 Sep 2004	Shanxi Coking Coal Group	Explosion	21 Feb 2009	Zijin Mining Group	Flooding	21 Sep 2010
Fushun Mining Group	Gas leak	31 Oct 2004	Shanxi Coking Coal Group	Explosion	22 Feb 2009	Pike River Coal	Explosion	19 Nov 2010
Newmont Mining	Contamination	22 Dec 2004	Shanxi Coking Coal Group	Explosion	22 Feb 2009	Exxon Mobil	Contamination	10 Jan 2011
Company name	**Disaster type**	**Date**	**Company name**	**Disaster type**	**Date**	**Company name**	**Disaster type**	**Date**
Merck & Co. Inc.	Contamination	03 Feb 2011	Stirol, Ostchem Holding	Fertilizer plant	06 Aug 2013	Shell	Oil spill	12 May 2016
Tokyo Electric Power Co	radiation leak	11 Mar 2011	Matson, Inc.	Contamination	09 Sep 2013	Formosa Plastics	Contamination	30 Jun 2016

Company name	Disaster type	Date	Company name	Disaster type	Date	Company name	Disaster type	Date
Rio Tinto	Contamination	15 Apr 2011	Sherritt International Co	Collapse	31 Oct 2013	CNPC	Explosion	20 Jul 2016
Plains All American Pipeline	Oil spill	29 Apr 2011	Tata Steel	Explosion	14 Nov 2013	Crescent Point Energy	Oil spill	03 Aug 2016
Foxconn	Explosion	13 May 2011	Sinopec	Explosion	22 Nov 2013	Delta Airlines	Oil spill	24 Aug 2016
Diageo	Spill	26 May 2011	General Mills	Contamination	05 Dec 2013	Mosaic Co.	Contamination	16 Sep 2016
ConocoPhillips	Contamination	04 Jun 2011	Mitsubishi Materials	Explosion	09 Jan 2014	Enterprise products partners	Oil spill	24 Oct 2016
Orica	Contamination	08 Aug 2011	Empresas Copec	Spill	17 Jan 2014	Norsk Hydro ASA	Oil spill	25 Nov 2016
Live Nation Entertainment	Collapse	13 Aug 2011	Duke Energy	Contamination	03 Feb 2014	Apple	Pollution	06 Dec 2016
UGI Corp.	Explosion	31 Oct 2011	Consolidated Edison	Gas leak	13 Mar 2014	NTPC Limited	Explosion	11 Jan 2017
Orica	Spill	09 Nov 2011	Amazon.com	Spill	02 Apr 2014	Dominion Energy	Contamination	23 Mar 2017
Costamare, MSC	Oil spill	10 Nov 2011	Poly Real Estate	Other	08 Apr 2014	CNPC	Pollution	06 Apr 2017
PPL Corp.	Explosion	06 Dec 2011	LG Chem	Explosion	31 Jul 2014	PepsiCo	Flooding	25 Apr 2017
Exxon Mobil	Spill	14 Jun 2012	Imperial Metals Co	Tailings spill	04 Aug 2014	Ford Motor	Spill	27 Jun 2017
Live Nation Entertainment	Collapse	16 Jun 2012	Padma Oil Company Ltd	Contamination	09 Dec 2014	Yum! Brands	Contamination	20 Jul 2017
Tokyo Electric Power Co	Contamination	12 Jul 2012	General Electric	Explosion	03 Apr 2015	Arkema	Explosion	24 Aug 2017
BHP Group	Spill	25 Jul 2012	Plains All American Pipeline	Contamination	19 May 2015	Arkema	Explosion	30 Aug 2017
Chevron	Explosion	06 Aug 2012	Ecopetrol SA	Oil spill	22 Jun 2015	Enbridge	Gas leak	23 Oct 2017
Consolidated Edison	Hurricane	29 Oct 2012	Kinross Gold	Spill	05 Aug 2015	Norsk Hydro ASA	Contamination	16 Feb 2018
NiSource	Explosion	23 Nov 2012	Cameco	Spill	19 Aug 2015	Norsk Hydro ASA	Contamination	05 Mar 2018
Exxon Mobil	Oil spill	29 Mar 2013	Chevron	Spill	23 Oct 2015	Huamei Group	Explosion	06 May 2018
Freeport McMoran	Collapse	14 May 2013	BHP Group	Contamination	05 Nov 2015	Vale S.A.	Collapse	25 Jan 2019
Williams Companies	Explosion	13 Jun 2013	Sempra Energy	Gas leak	02 Dec 2015	J Resources Asia Pasifik	Collapse	26 Feb 2019
Canadian Natural Resources	Spill	24 Jun 2013	PetroChina Company Ltd	Explosion	20 Dec 2015	Optimum Coal Holdings Ltd	Explosion	02 Mar 2019
Heidelbergcement	Pollution	15 Jul 2013	ENI	Oil spill	01 Feb 2016	Kamoto Copper Company	Collapse	27 Jun 2019
PTT	Contamination	27 Jul 2013	Anglo American PLC	Spill	08 Feb 2016	LG Chem	Gas leak	07 May 2020
Ferrellgas	Explosion	29 Jul 2013	Teck resources ltd.	Spill	13 Apr 2016	Oil India	Explosion	27 May 2020