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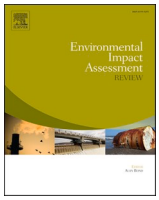

# Stock market reaction to environmental lawsuits: Empirical evidence from the case against Boliden-Apirsa

Inés Merino Fdez-Galiano [a], José Manuel Feria-Dominguez [b,*], Jacobo Gomez-Conde [a]

[a] Department of Accounting, Universidad Autónoma de Madrid, Madrid, Spain
[b] Department of Financial Economics and Accounting, Universidad Pablo de Olavide, Ctra. de Utrera, Km1, 41013 Seville, spain

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ABSTRACT

The aim of this paper is to assess investors' environmental awareness using reputational losses as a punishment for environmental misconduct. To do so, we examine the 17-year court case against Boliden-Apirsa, implicated in one of the worst environmental catastrophes in the European mining industry. We conduct a short-term standard event study on 55 court rulings, published between 2002 and 2015, to analyze the financial market reaction, differentiating between 34 negative court rulings that blame Boliden-Apirsa for the catastrophe and 21 positive court rulings that exonerate the company from any liability. We also estimate the reputational damage faced by the company considering the fine claimed during the judicial process. Using a financial approach (Reputational Cumulative Abnormal Returns, Rep CAR), we identify and isolate the reputational risk linked to environmental lawsuits. The results reveal an immediate negative market response to announcements of court rulings. In addition, our study indicates that investors are more sensitive to announcements of positive court rulings than to negative ones. However, our study does not provide empirical evidence on the existence of reputational damage, in terms of RepCARs, suggesting that the stock market is selective in reacting to these announcements of environmental court rulings.

## 1. Introduction

In the latter part of the 1990s, interest in environmental and social awareness increased due to various political, social, and cultural factors. Environmental disasters such as the Exxon Valdez in Alaska in 1989 fueled growing concern for corporate environmental and social responsibility (Patten, 1992). For the companies responsible for these incidents, continued exposure in the media can generate reputational damage. Thus, these environmental disasters are of relevance for companies, not only because of the purely economic implications such as the payment of lawsuits or fines, but also due to the possible dissatisfaction of interest groups (hereinafter stakeholders) (Sturm, 2013) endangering the future of the company. As for investors, environmental disasters have direct implications on stock markets. Previous literature shows the existence of a stock market reaction to environmental catastrophes (Magness, 2006) in the case of well-known spills such as the 1989 Exxon Valdez spill (Patten and Nance, 1998) or the BP Deepwater Horizon explosion in 2010 (Heflin and Wallace, 2017).

As for investors, environmental disasters have direct implications for stock markets. Previous literature shows the existence of a stock market reaction to environmental catastrophes (Magness, 2006) in the case of well-known spills such as the 1989 Exxon Valdez spill (Patten and Nance, 1998) or the BP Deepwater Horizon explosion in 2010 (Heflin and Wallace, 2017). In this paper we focus on the case of the Swedish company Boliden. In 1998, the rupture of the tailings dam of the lead-zinc mine "Los Frailes" spilled approximately 5 million cubic meters of toxic sludge and acidic water over the surrounding landscape, affecting a total area of 4630 ha of agricultural soils, as well as the surroundings of the Doñana National Park.

Moreover, this environmental catastrophe and others later set a legal benchmark for the European mining industry, increasing public awareness of environmental issues and safety hazards, prompting EU Directive 2000/60/EC. The mining company Boliden-Apirsa faced the failure of the incident and transferred the responsibility to the companies that built the dam. A more than 10 year-legal battle began between Boliden-Apirsa and the Spanish government. Ultimately the case against Boliden-Apirsa failed due to loopholes in the Spanish legal system (Aparicio et al., 1998).

While extant prior work provides evidence of stakeholders rewarding firms for their CSR (Madsen and Rodgers, 2015), there is a gap in the

* Corresponding author.
*E-mail addresses:* ines.merino@uam.es (I.M. Fdez-Galiano), jmferdom@upo.es (J.M. Feria-Dominguez), jacobo.gomez@uam.es (J. Gomez-Conde).

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literature on how they react when their interests *clash*. In this sense, we provide a better understanding of how investors react to environmental lawsuits. First, we explore the potential impact of legal public disclosures—distinguishing between positive and negative events—on the market returns of Boliden-Apirsa. Secondly, we identify and isolate the reputational damage incurred by the mining firm derived from such environmental lawsuits. We analyze the reputational loss and stock market reaction incurred by Boliden-Apirsa due to legal rulings passed due to the Spanish toxic spill in 1998. To do this, we carry out a standard event study on a sample of 55 legal ruling announcements involving Boliden-Apirsa from 2002 to 2015. Overall, we study the association between reputational risk and legal rulings regarding the Spanish mining spill. This relationship is supported by expectations about the possible future losses incurred by the firm because of its liability for the environmental disaster. Specifically, we find novel evidence about investors´ perceptions and legal events. Surprisingly, our findings do not show the existence of a reputational loss for Boliden-Apirsa despite regular attention in the media.

We extend current knowledge about the effects on corporate reputation derived from environmental catastrophes caused by the firm, adding to the ongoing debate about the extent to which stakeholders value being socially responsible (Bellucci et al., 2021a; Bellucci et al., 2021b). We examine legal rulings because of their relevance and their prominence. Contrary to impression management practices about CSR (Corazza et al., 2020), legal rulings are necessarily neutral, attempting to generate a good impression for stakeholders. To the best of our knowledge, no prior work has specifically analyzed the role of legal rulings related to CSR activities in shaping corporate reputation. This is potentially surprising, as legal rulings are important for several reasons. First, legal rulings attract media attention, being eye-catching and creating a durable impression. This is particularly relevant, as corporate information is usually subject to less attention in popular media than other items (Guillamon-Saorin et al., 2012). Second, while corporate information management tries to offer positive first impressions, legal rulings offer additional 'objective' information for investors' judgments. Moreover, news on the media is likely to be biased; newspapers are filtered by editors or journalists attracting audience (Capelle-Blancard et al., 2021). According to this, while news on the media are biased, legal rulings are neutral and, therefore, a very valuable and unbiased source of information for the investors. In the case against Boliden-Apirsa the responsibility of the leaked dam is not clear. In this context, legal rulings played a decisive role for investors to become a "good" or "bad" impression about the firms´ behaviour. Then, the case against Boliden-Apirsa represents a unique opportunity to study the investors´ environmental awareness through the market reaction to legal ruling announcements. By using a standard short-term event study, we precisely identify relevant events related to CSR legal rulings instead of using alternative research methods such as surveys, large databases, or case studies, which are common in CSR research analyzing stakeholder reactions.

This paper is structured as follows. Section 2 describes the theoretical background, and Section 3 settles the hypothesis development. The methodological approach and data sample are presented in Section 4, while the results are included in Section 5. Finally, we report the main conclusions in Section 6.

## 2. Theoretical background

### 2.1. Stakeholders and capital market's reaction to the news

Previous literature has devoted much attention to understand how the market reacts to news. In general, this previous research identifies three main categories (Cuellar Fernández et al., 2011) (i) corporate news, (ii) macroeconomic announcements, and (iii) analysts' recommendations. First, corporate news includes information issued in newspapers or magazines (Cuellar Fernández et al., 2011; Gillet et al., 2010; Godfrey et al., 2009; Guillamon-Saorin et al., 2012; Madsen and Rodgers, 2015; Plunus et al., 2012; Sabet et al., 2012; Sturm, 2013), websites (Gao and Huang, 2020), social media (Blankespoor et al., 2014; Lee et al., 2015; Gómez-Carrasco et al., 2021) or other real-time sources (Brown and Hartzell, 2001). This news includes information about new product launches or product recalls (Lee et al., 2015), changes in the management team (Lee and James, 2007), mergers and acquisitions (Anagnostopoulou and Tsekrekos, 2015), awards (Hendricks and Singhal, 1996), social and environmental issues (Flammer, 2013), corporate financial policies (Akhigbe and Madura, 1996) such as dividend policy, or other strategic decisions such as changes in business policies or management systems (Bharadwaj et al., 2009). Second, market reactions to macroeconomic announcements, such as gross domestic product (GDP) (He et al., 2020), employment reports (Gely and Zardkoohi, 2001), consumer price index (Fischer and Amstad, 2005), and import and export price indexes (Ju et al., 2014), are also often analyzed. Third, analysts' recommendations include additional information content and forecast future returns, reducing information asymmetries (Howe et al., 2009).

Corporate social and environmental events have been increasingly analyzed in recent years (Brooks and Oikonomou, 2018), and refer to an event that increases or eliminates "something that is either positive for stakeholders or negative for them" (Groening and Kanuri, 2013, p. 1852). Despite the efforts of several previous studies, there is still an ongoing debate on how these social and environmental events affect market reactions (Luo et al., 2015; Noor et al., 2020; Choi et al., 2021). Therefore, there is a need to open the black box of this relationship to understand the underlying mechanisms (Luo et al., 2015; Corazza et al., 2020). Corporate social and environmental developments are complex and multidimensional. The potential effect on market reactions is difficult to track, as it will be mainly conditioned by the content of the information (e.g., positive/negative, social, or environmental), by who disseminates it (e.g., management team, customers, competitors, government or creditors) and by the channel (e.g., financial statements, newspapers or social media) (Johnson et al., 2014; Lee et al., 2015; Luo et al., 2015). Thus, an under-researched topic is the effect of court rulings on market actions. Previous research focused more on litigation than on court rulings. Moreover, to the best of our knowledge, none is related to corporate social and environmental developments.

### 2.2. Environmental disasters and market reactions

The literature on environmental catastrophes has focused on two approaches (Sabet et al., 2012): (i) the broad treatment of environmental catastrophes or (ii) the analysis of specific incidents. Within the first group are studies on topics such as the impact of tropical storms (Fink et al., 2010) or hurricanes (Liu et al., 2021) and the disclosure of various environmental violation events, such as pollution (Xu et al., 2012) or hazardous waste incidents (Capelle-Blancard and Laguna, 2010; Feria-Domínguez et al., 2016), on market reactions. Our manuscript is in the second group, which includes studies analyzing specific events, such as the Exxon Valdez oil spill in 1989 (Dekel and Scotchmer, 1990; Mansur et al., 1991; Patten and Nance, 1998), the BP oil spill in 2010 (Heflin and Wallace, 2017; Sabet et al., 2012), the Three Mile Island nuclear catastrophes in 1979 (Bowen et al., 1983; Hill and Schneeweis, 1983), that of Chernobyl in 1986 (Pruitt et al., 1987) and that of the Japanese Fukushima-Daiichi catastrophe (Ferstl et al., 2012) or the 2009 Abruzzo earthquake (Sergiacomo, 2015) and that of the Tohoku Pacific coast (Tao et al., 2019). These studies consider the media and the negative impact on markets, mainly because future cash flows.

This manuscript studies the impacts of environmental lawsuits (e.g., legal rulings) on capital markets in the context of environmental misconduct. Similarly, prior studies show negative market reactions to environmental violations (Bhagat et al., 1998; Karpoff et al., 2005). However, no previous study analyzes the markets' reaction to the different legal rulings (positive and negative), which involves a new

setting. An even more salient issue is the potential positive effects in the market after an environmental disaster.

### 2.3. Reputational risk

The literature examining reputational risk in financial industries is strong (Campbell and Slack, 2011; Cummins et al., 2006; Fiordelisi et al., 2013; Gillet et al., 2010). However, the studies related to non-financial industries is still rare (Feria-Domínguez et al., 2016). From a financial perspective, reputational risk is the risk derived from the negative perception of a banks´stakeholders that may affect commercial relations in the present as well as the ability to obtain financing in the future (Basel Committee on Banking Supervision, 2009, p.19). More broadly, Power (2004, p. 61) denotes that "From an accounting point of view, reputational risk inverts the concept of materiality". Reputation means that the impact of an event regardless of its importance can be amplified by factors beyond the control of the company.

Previous work provides evidence of some examples of determinants of reputational risk on financial industry (Fiordelisi et al., 2013), such as internal or external frauds, employment practices and workplace safety, customer, technology and systems failures, damage to physical assets, products and business practices, or execution and process management (Zyglidopoulos, 2005; Bermiss et al., 2014; Love and Lim, 2017). Our paper advances this prior evidence by considering legal rulings as a driver of reputational risk in a setting of an environmental disaster. Legal rulings provide a setting of uncertainty and have considerable economic effects, for example, being harmful to investment (Diller et al., 2017). Therefore, in contrast to previous studies, we analyze both the costs and benefits of a determinant of reputational risks, such as legal rulings.

## 3. Hypothesis development

This section develops three general hypotheses about investor responses to environmental misconduct. To examine our hypotheses, we use a standard short-term event study based on daily excess stock returns. This approach is widely employed in the study of financial events and is particularly appropriate for the sample for at least three reasons (Griffin et al., 2004) (i) the events (court judgments) are identifiable and have a similar format, (ii) the information has the potential to change stock markets, and (iii) the events are widely dispersed over the litigation period. Thus, the event studies literature examines reputation-damaging events and their impact on corporate reputation, financial performance, and equity markets over a given period. The results of the literature show a significant negative reaction to environmental catastrophes for the companies involved, such as Blacconiere and Patten (1994), who focus on the Bhopal toxic chemical leak caused by Union Carbide in 1984. Similarly, Hamilton (1995) finds a negative reaction on markets for companies reporting their emissions according to the first Toxics Release Inventory (TRI), published in 1989. Patten and Nance (1998) analyze the Exxon Valdez incident, while Magness (2006) studies the effect of stock price following an environmental accident at a mining site owned by Placer Dome in the Philippines in 1996.

In addition, Heflin and Wallace (2017) focus on BP's Deepwater Horizon in 2010, demonstrating that these events have a potential contagion effect on capital markets. Several studies also explore nuclear catastrophes, such as the Three Mile Island accident in 1979 (Bowen et al., 1983) and the Chernobyl accident in 1986 (Pruitt et al., 1987). Capelle-Blancard and Laguna (2010) focus on industrial disasters, such as explosions in petrochemical industries, and Ferstl et al. (2011) study the impact of the Japanese Fukushima-Daiichi disaster.

The distinction of positive or negative events should affect most types of news, shaping market reactions. This is relevant for event studies, even those that focus on a particular type of event, positive or negative. Unexpectedly, the existing literature on event studies rarely makes this distinction because the impact of an individual shock is often difficult to measure directly. We address this gap. We start from the assumption that, at least in semi-efficient markets, news is incorporated into prices as soon as it occurs. Survey data by Graham et al. (2005) propose that managers view the release of bad news very differently from the release of good news. Specifically, about half of the managers agree with the statement that they limit disclosure to avoid lawsuits. In contrast, most managers agree with the statement that they disclose bad news faster than good news to avoid lawsuits (77% agree versus only 8% who disagree). Consequently, and related to accounting conservatism (Shroff et al., 2013), negative news is more likely to be incorporated into prices in a timely manner compared to positive news. Thus, auditors and managers have incentives to recognize potential losses in a timely manner to decrease litigation risks, even more so when the bad news (i.e., losses) is material, such as the case of relevant environmental disasters (Shroff et al., 2013). This marked difference underscores the importance of examining the type of disclosure (i.e., good news versus bad news). Thus, following the above literature and reasoning, we hypothesize the following:

**H1**. Positive legal rulings regarding the Boliden spillage positively impact the firm's stock price.

**H2**. Negative legal rulings regarding the Boliden spillage have a negative impact on the firm's stock price.

While stakeholders drive environmental and social responsibility, they have fiduciary interests in how these issues affect the value of the firm in terms of revenues and costs. The magnitude of the price decline should depend on the size of the discrepancy between reputation and behavior, as market participants react only to new information (Ball and Brown, 1968). The magnitude of losses associated with environmental violations is attributable to direct legal costs, such as cleanup and restoration costs, and reputational penalties are captured by additional losses (Karpoff et al., 2005). We use environmental lawsuits as a means of delinking a firm's perceived reputation from its actual behavior as captured by lawsuits. We assume that if capital market participants positively value the environmental reputation of firms, the filing of a lawsuit for environmental misconduct should result in a negative market update. Therefore, we expect to reject the null hypothesis regarding the absence of abnormal cumulative returns. Thus, as in the previous literature, we consider a sample of negative events for the firm (i.e., those that hold Boliden-Apirsa primarily responsible for this environmental disaster). Reputational risk arises when the price decline in the markets is greater than the expected monetary loss. We assume a negative impact on the company's reputation due to loss events (i.e., reputational damage occurs when the decline in the company's market value is greater than the legal event).

There are some possible opposing theoretical reasons for analyzing the asymmetric impact of positive and negative news in an environmental catastrophe scenario. While investors and shareholders have fiduciary interests in responding positively to good news (i.e., positive court rulings), this reaction clashes with corporate reputation, as media attention and, in general, society, responds negatively to the cause of the environmental disaster. Social and environmental responsibility is a major concern for investors (Rodrigue, 2014), and the conjunction with economic and primary profit interests is an open question. Although good news (positive court rulings) has a positive economic impact in terms of lower accounting provision for environmental restoration which, in turn, increases profit figures. We expect that environmental catastrophes are more likely to shape social attention and focus, which could erase corporate reputation. Thus, the fourth hypothesis is as follows:

**H3**. Legal rulings regarding the Boliden spillage negatively affect the firm's reputation.

## 4. Methodology

### 4.1. The case against Boliden-Apirsa

On April 25 (1998) the largest mining spill in Europe (Nikolic et al., 2011) occurred at the Los Frailes mine (SW Spain), owned by the Swedish company Boliden-Apirsa. A dam breach occurred, and the contents were spilled, discharging sludge with a high percentage of toxic heavy metals. The spill flowed into the lower course of the Guadalquivir River, affecting areas of great economic and environmental value. The sludge covered an area of 4634 ha, including the Doñana National Park (see Fig. 1). Shortly afterwards, legal proceedings were initiated to find the person responsible for this disaster. The governments of Boliden and Spain were parties to several lawsuits for economic, ecological, and public health damages. An administrative proceeding was initiated for the damage caused to the Guadalquivir River basin and a criminal case


**Fig. 1.** Evidence of the environmental disaster (Retrieved from https://elpais.com/elpais/2018/04/20/album/1524211696_728584.html#foto_gal_12) for: a) Aerial view of the breakage of the Aznalcóllar reservoir (Seville). May 12, 1998; Aerial view of the flood of five million cubic meters of contaminated water and sludge that washed away the Guadiamar River, the river that feeds the Doñana National Park. May 24, 1998.

was initiated to assess the criminal liability of the Boliden-Apirsa company. The Junta de Andalucía claimed the amount of 89.9 million euros, considering Boliden-Apirsa as the main responsible for the disaster. The company contributed $42.5 million to cover the estimated net loss of insurance proceeds from the tailings dam breach (based on current estimates of costs, allocation of liability and insurance proceeds). There can be no assurance that the company will not have to increase the provision. Boliden produces zinc, copper, gold, lead, and silver at 14 mines organized in eight mining areas. Its mining and milling operations are in Canada, Chile, Saudi Arabia, Spain and Sweden. Mining accounted for approximately 26% of Boliden's revenues in 1998. However, responsibility for the dam breach was unclear. Hence, the legal proceedings lasted more than 10 years. Thus, a sequence of court rulings against the Swedish company ensued, setting a legal benchmark for the European mining industry (Boliden Annual Report, 1998a, p. 27; 1998b, p. 47).

### 4.2. Sample and research design

We apply the event study methodology (MacKinlay, 1997) to test for the existence of daily abnormal returns (Brown and Warner, 1985) due to the announcement of the court rulings regarding the Spanish toxic spill. The current and expected financial performance of the company affects the price of publicly traded shares and thus the market value of the company, assuming that the information is publicly available (Fama, 1970). The event study method is used in several recent previous studies in accounting and finance (Loipersberger, 2018; Wang et al., 2019; Pham et al., 2020). The FACTIVA news database is used to collect press articles related to legal announcements about the Spanish environmental disaster faced by the Boliden-Apirsa company. The CENDOJ website provided additional data on court rulings. The sample consists of 55 court rulings published between 2002 and 2015. In addition, two subsamples are analyzed differentiating between positive and negative expected effects: 34 negative court rulings and 21 positive court rulings. The expected effect on the stock exchange will depend on Boliden's exemption to payment imposed by the Junta de Andalucía. Positive events are those environmental lawsuits that we assume are "good news" for the firm. These sentences are mainly; exemption from paying the fine, Boliden-Apirsa appeals and lawsuits against the firm that built the dam. On the contrary, negative events for the firm are the following: resolutions declaring the firm as guilty for the leaked dam, appeals imposed by the Spanish government and resolutions that exempt the firm that built the dam. We assume that this type of new information in the market is considered "bad news" by the investors of Boliden-Apirsa and object of reputational damage by them. Table 1 shows the sample data by date.

**Table 1**
Legal ruling classification events of sample by type and year.

| Year | Legal ruling | Positive event | Negative event | Legal ruling (%) | Positive event (%) | Negative event (%) |
|---|---|---|---|---|---|---|
| 2002 | 8 | 4 | 4 | 14.55 | 19.05 | 12 |
| 2003 | 2 | 1 | 1 | 3.64 | 4.76 | 3 |
| 2004 | 4 | 1 | 3 | 7.27 | 4.76 | 9 |
| 2005 | 3 | 2 | 1 | 5.45 | 9.52 | 2.94 |
| 2006 | 3 | 2 | 1 | 5.45 | 9.52 | 2.94 |
| 2007 | 4 | 1 | 3 | 7.27 | 4.76 | 8.82 |
| 2008 | 4 | 2 | 2 | 7.27 | 9.52 | 5.88 |
| 2009 | 3 | 0 | 3 | 5.45 | 0 | 9 |
| 2010 | 8 | 3 | 5 | 14.55 | 14.29 | 14.71 |
| 2011 | 6 | 2 | 4 | 10.91 | 9.52 | 11.76 |
| 2012 | 7 | 2 | 5 | 12.73 | 9.52 | 14.71 |
| 2013 | 1 | 0 | 1 | 1.82 | 0 | 2.94 |
| 2014 | 1 | 0 | 1 | 1.82 | 0 | 2.94 |
| 2015 | 1 | 1 | 0 | 1.82 | 4.76 | 0.00 |
| *N* | *55* | *21* | *34* | *100* | *100* | *100* |

In a second step, we define the period in which the company's stock prices are examined: the event window. Previous studies find statistically significant results using short size event windows for environmental disaster events; Sabet et al (2012) for a 6-day window (0, 5), Ferstl et al. (2012) for a 5-day event window (0, 4) and Capelle-Blancard and Laguna (2008) analysed a 4-day event window (0, 3). To satisfactorily capture the impact of the event, we select 12 short event windows considering five days after the event date, namely (0, +1), (0,+2), (0, +3), (0,+4), and (0,+5), and including one day before the event date (0,0) due to the possibility of information dripping before the date (Wang et al., 2019; Flammer, 2013; Karpoff et al., 2005), namely (−1, +1), (−1,+2), (−1, +3), (−1,+4), and (−1,+5). The Eikon Datastream database is used to obtain stock price, market index and market capitalization.

We use the market model (Biell and Muller, 2013; Eckert and Gatzert, 2017; Wang et al., 2019) to obtain the abnormal returns of stock *i* on day *t*. Abnormal returns ($AR_{it}$) are obtained as the difference between actual returns ($R_{it}$) and expected returns, i.e., stock returns in case the event does not occur.

$$AR_{it} = R_{it} - (\widehat{\alpha}_i + \widehat{\beta}_i R_{mt}) \tag{1}$$

Where, $R_{it}$ are the normal returns of stock *i* on day *t*, $R_{mt}$ is the market index, and $\widehat{\alpha}_i$ and $\widehat{\beta}_i$ are the parameters estimated by OLS and using a period of 250 trading days before the event for each trigger event analyzed according to previous literature (Cannas et al., 2009; Eckert and Gatzert, 2017; Fiordelisi et al., 2013; Gillet et al., 2010). Thus, expected returns are calculated as follows:

$$R_{it} = Ln(P_{it}/P_{it-1}) \tag{2}$$

Where, $R_{it}$ is the stock return for firm *i* on day *t,* and $P_{it}$ is the stock price for day *t*. To gauge the robustness of our results we apply another estimation approach: the three-factor model (Fama and French, 1993). Daily time-series data are obtained from Kenneth Frenchs'website. Abnormal return using Fama and French three-factor model is calculated as follows.

$$(R_{it} - r_{it}) = \alpha_i + \beta_{i,m}(R_{mt} - r_{it}) + \beta_{i,SMB}SMB_t + \beta_{i,HML}HML_t \tag{3}$$

Where stands for "small minus big", capturing the excess return of small over big stocks. The stands for "high minus low", indicating the excess return of stock with a high market-to-book ratio over stocks with a low market-to-book ratio.

At a later stage, we assess the reputational risk faced by the firm due to legal events by adjusting abnormal returns to the loss ratio following Gillet et al. (2010) and using it extensively in previous studies (Perry and de Fontnouvelle, 2005; Fiordelisi et al., 2013; Eckert and Gatzert, 2017).

$$Rep\ AR_{i0} = AR_{i0} + |Loss_i/Market\ Cap_i| \tag{4}$$

Where, $AR_{i0}$ is the abnormal return for firm *i* on day 0 (event day), $Loss_i$ is the loss amount incurred by firm *i,* and $Market\ Cap_i$ is the market capitalization of firm *i*. The regional government's fine imposed on the firm is considered the target loss amount (EUR 89.9 million). Consistent with Fiordelisi et al. (2014), large operational losses exceeding $1 million cause significant reputational losses. We analyze the accumulated abnormal averaged returns (Eq. 5), obtained from the aggregation of abnormal returns $AR_{it}$ within the event window to assess event impact.

$$CAR_i = \sum_{t=T_1}^{T_2} AR_{it} \tag{5}$$

$$Rep\ CAR_i = \sum_{t=T_1}^{T_2} Rep\ AR_{i0} \tag{6}$$

The cumulative abnormal returns (CARs) and reputational cumulative abnormal returns (RepCARs) (Eq. 6) were statistically tested using a

parametric *t*-test. For robustness, we also run two nonparametric tests, specifically the Sign test and Corrado Rank test.

## 5. Results

In this section we present the main results obtained from our empirical models. Table 2 lilustrates the abnormal returns (AR) on average for the twelve event windows and distinguishing between market model and three-factor model. Table 3 presents the results for the subsample of positive events, therefore hypotheses 1. In Panel A of Table 3 the mean cumulative abnormal return is 0.97%, 1.17% 1.13% and 1.33% and statistically significant for the following cases, respectively; 1-day window (0, 0), 2-day windows (-1, 0) and (0, 1), and 3-day window (-1, 1). Graphically, Figure 2 and Figure 3 presents these data graphically. In Panel B of Table 3 the mean cumulative abnormal return is 2.30%, 2.65% and 2.52% and statistically significant for the following cases, respectively; 1-day window (0, 0), 2-day windows (-1, 0), and 3-day window (-1, 1). Figure 8 and Figure 9 presents this data graphically. Thus, these findings provide support for Hypothesis 1.

Table 4 shows the results for the negative events subsample. Panel A of Table 4 shows the following statistically significant windows; 1-day window (0,0), 2-day windows (0, +1), 5-day window (0, +4) and 6-day window (0, +5) at the 0.01 α-levels. Additionally, cumulative abnormal returns (CAR), on average, are negative and significant for the 3-day window (0, +2) and 7-day windows (-1, +5) at the 0.05 α-level. Finally, cumulative abnormal returns (CARs) are negative and significant for the 2-day window (-1, 0), 3-day windows (-1, +1), 4-day window (0, +3) and 6-day window (-1, +4) at the 0.10 α-levels. Figure 4 and Figure 5 show the data from Panel A for the 7-day window (-1, 5). In Panel B of Table 4 the mean cumulative abnormal return is -1.47% and significant for the 1-day window (0, 0) and the mean cumulative abnormal return is -1.49% and statistically significant for the three-day window (0, 1). Figure 10 and Figure 11 represent this data for the 7-day window (-1, 5), graphically. Panel A and Panel B show cumulative abnormal return statistically significant for 1-day window (0, 0) and 2-day window (0, 1). Thus, these findings provide support for Hypothesis 2.

Table 5 provides the results for Hypothesis 3. In Panel A of Table 6 the mean reputational cumulative abnormal return (Rep CAR) is 0.64% and statistically significant for the 2-day window (0, 1). Graphically, Figure 6 and Figure 7 present reputational abnormal return and reputational cumulative abnormal return from Panel A of Table 5. Panel B of Table 5 the mean cumulative abnormal return is 1.39% and statistically significant for the two-day window (0, 1); cumulative abnormal return is 1.86% and statistically significant for the three-day window (0, 2); cumulative abnormal return is 1.44% and statistically significant for the 4-day window (0, 3); cumulative abnormal return is 0.16% and statistically significant for the 5-day window (0, 4). Graphically, Figure 12 and Figure 13 present reputational abnormal return and reputational cumulative abnormal return from Panel B of Table 5. However, reputational cumulative abnormal returns are positive. Thus, these findings do not provide support for Hypothesis 3 regarding the existence of reputational risk.

**Table 3**
Cumulative abnormal returns on average (CAR) for positive events.

*Panel A: Market model*

| | | | *Parametric Test* | *Non-Parametric Tests* | |
|---|---|---|---|---|---|
| Window | N | CAR (%) | t-test | Sign T | Corrado T |
| (0,0) | 1 | 0.97 | 1.82* | 1.91* | 2.07** |
| (−1, 0) | 2 | 1.17 | 1.55* | 1.03 | 1.69* |
| (0,+1) | 2 | 1.13 | 1.50* | 1.03 | 1.56* |
| (−1, +1) | 3 | 1.33 | 1.44* | 1.91* | 1.46* |
| (0,+2) | 3 | 0.73 | 0.78 | 1.47* | 0.98 |
| (−1, +2) | 4 | 0.93 | 0.87 | 0.16 | 1.02 |
| (0,+3) | 4 | 1.08 | 1.01 | 1.03 | 0.94 |
| (−1, +3) | 5 | 1.29 | 1.08 | 1.47* | 0.98 |
| (0,+4) | 5 | 0.68 | 0.57 | 1.91* | 0.69 |
| (−1, +4) | 6 | 0.89 | 0.68 | 0.60 | 0.76 |
| (0,+5) | 6 | 0.37 | 0.28 | 1.03 | 0.45 |
| (−1,+5) | 7 | 0.57 | 0.40 | 0.16 | 0.55 |

*Panel B: FF three factor model*

| | | | *Parametric Test* | *Non-Parametric Tests* | |
|---|---|---|---|---|---|
| Window | N | CAR (%) | t-test | Sign T | Corrado T |
| (0,0) | 1 | 2.30 | 3.15*** | 2.38** | 2.98*** |
| (−1, 0) | 2 | 2.65 | 2.58*** | 2.38** | 2.00** |
| (0,+1) | 2 | 2.52 | 2.44* | 1.51 | 2.00** |
| (−1, +1) | 3 | 2.87 | 2.28** | 1.51 | 1.67 |
| (0,+2) | 3 | 2.36 | 1.86* | 1.94* | 1.81* |
| (−1, +2) | 4 | 2.71 | 1.86* | 0.63 | 1.53 |
| (0,+3) | 4 | 3.69 | 2.53** | 1.07 | 1.99** |
| (−1, +3) | 5 | 4.04 | 2.48** | 1.51 | 1.75* |
| (0,+4) | 5 | 3.89 | 2.39** | 1.94* | 1.96* |
| (−1, +4) | 6 | 4.24 | 2.38** | 0.63 | 1.76* |
| (0,+5) | 6 | 2.47 | 1.39 | 0.20 | 1.08 |
| (−1,+5) | 7 | 2.83 | 1.47 | 0.20 | 0.97 |

Significant at: α = 0.01***; α = 0.05**; α = 0.10*. Significant at: α = 0.01***; α = 0.05**; α = 0.10*. This table presents the mean cumulative abnormal return (CAR) estimated over twelve event windows by applying OLS-regression methodology for time of one full trading year (250 trading days) prior the event window. Panel A reports results for estimating daily AR using market model and Panel B reports results for estimated daily AR using Fama and French three-factor model.

## 6. Conclusions

This paper studies how investors perceive corporate environmental misconduct. Analyzing a sample of court rulings affecting the listed

**Table 2**
Abnormal returns (ARs) on average and Reputational Abnormal returns (RepARs) for the sample.

| | | *Market model* | | | *Three-factor model* | | |
|---|---|---|---|---|---|---|---|
| | | Positive Event | Negative Event | | Positive Event | Negative Event | |
| Window | N | ARs(%) | ARs(%) | RepARs(%) | ARs(%) | ARs(%) | RepARs(%) |
| (0,0) | 1 | 2.39 | −2.47 | 0.88 | 2.27 | −1.47 | 1.39 |
| (−1, 0) | 2 | 1.79 | −0.94 | 0.58 | 1.33 | −0.43 | 0.01 |
| (0,+1) | 2 | 1.56 | −1.23 | 0.32 | 1.24 | −0.74 | 1.48 |
| (−1, +1) | 3 | 1.44 | −0.62 | 0.31 | 0.96 | −0.29 | 0.01 |
| (0,+2) | 3 | 0.94 | −0.57 | 0.39 | 0.77 | −0.19 | 1.80 |
| (−1, +2) | 4 | 1.01 | −0.29 | 0.36 | 0.68 | 0.01 | 0.01 |
| (0,+3) | 4 | 0.93 | −0.53 | 0.26 | 0.91 | −0.23 | 1.85 |
| (−1, +3) | 5 | 0.99 | −0.30 | 0.27 | 0.81 | −0.06 | 0.00 |
| (0,+4) | 5 | 0.71 | −0.67 | −0.07 | 0.76 | −0.43 | 1.63 |
| (−1, +4) | 6 | 0.80 | −0.46 | −0.01 | 0.71 | −0.26 | 0.00 |
| (0,+5) | 6 | 0.36 | −0.57 | −0.09 | 0.40 | −0.39 | 1.41 |
| (−1,+5) | 7 | 0.48 | −0.40 | −0.04 | 0.40 | −0.25 | 0.00 |

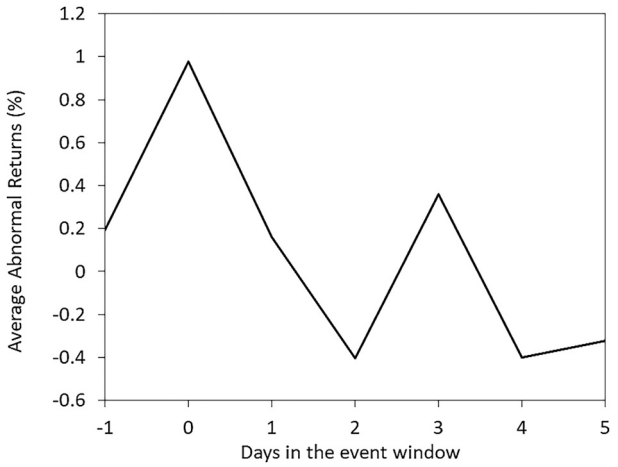


**Fig. 2.** Average abnormal returns (AARs) using market model to POSITIVE legal ruling events for (-1, +5) window.

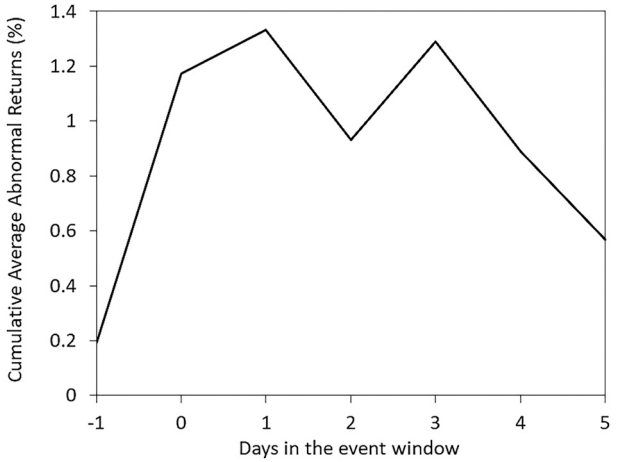


**Fig. 3.** Cumulative average abnormal returns (CAARs) using market model to POSITIVE legal ruling events for (-1, +5) window.

mining company Boliden-Apirsa from 2002 to 2015, we distinguish between positive and negative events based on the expected effect on the financial stock market. We also examine the potential reputational damage faced by the company using a new metric, RepCAR. This study shows empirical evidence on investor reactions to environmental claims. However, our study does not ensure that investors punish this type of misconduct (i.e., reputational damage is not appreciated in the short term). The results reveal a negative and immediate market response to announcements of court rulings. Thus, investors react immediately to both types of events (positive and negative): we observe statistically significant cumulative abnormal returns (CARs). Moreover, investors perceive each type of event differently; the market impact is more severe with negative news. Negative legal announcements have a greater impact on the market than positive announcements. In addition, the impact of negative events persists five days after the event occurs, and recovery does not manifest itself quickly. We identify the reputational risk of the mining company, but we also isolate the impact of investor perception. However, the results do not provide empirical evidence on the existence of reputational damage, suggesting that investors are more concerned about the costs arising from lawsuits than the reputational damage of the environmental disaster. This result due to several things. First, investors are not sensitive to environmental misconduct in the mining sector. Tailing dam failures are very common in such economic sector. Then, investors do not respond to this type of incident and their

**Table 4**
Cumulative abnormal returns on average (CAR) for negative events.

*Panel A: Market model*

| | | | *Parametric Test* | *Non-Parametric Tests* | |
|---|---|---|---|---|---|
| Window | N | CAR (%) | t-test | Sign T | Corrado T |
| (0,0) | 1 | −1.34 | −3.18*** | −4.07*** | −3.64*** |
| (−1, 0) | 2 | −1.05 | −1.76* | −1.32 | −1.67* |
| (0,+1) | 2 | −1.59 | −2.66*** | −1.67* | −3.00*** |
| (−1, +1) | 3 | −1.3 | −1.77* | −1.67* | −1.71* |
| (0,+2) | 3 | −1.06 | −1.45* | −2.35** | −2.13** |
| (−1, +2) | 4 | −0.77 | −0.91 | −1.67* | −1.20 |
| (0,+3) | 4 | −1.18 | −1.4* | −2.35** | −1.94** |
| (−1, +3) | 5 | −0.89 | −0.94 | −1.67* | −1.16 |
| (0,+4) | 5 | −2.58 | −2.74*** | −1.67* | −2.50*** |
| (−1, +4) | 6 | −2.28 | −2.20** | −1.67* | −1.76* |
| (0,+5) | 6 | −2.76 | −2.67*** | −2.70*** | −2.57*** |
| (−1,+5) | 7 | −2.46 | −2.20** | −2.01** | −1.89** |

*Panel B: FF three factor model*

| | | | *Parametric Test* | *Non-Parametric Tests* | |
|---|---|---|---|---|---|
| Window | N | CAR (%) | t-test | Sign T | Corrado T |
| (0,0) | 1 | −1.47 | −2.39** | −2.76*** | −2.91*** |
| (−1, 0) | 2 | −0.86 | −0.99 | −0.36 | −0.91 |
| (0,+1) | 2 | −1.49 | −1.71* | −2.41** | −2.15** |
| (−1, +1) | 3 | −0.88 | −0.82 | −1.39 | −0.82 |
| (0,+2) | 3 | −0.56 | −0.53 | −1.39 | −0.82 |
| (−1, +2) | 4 | 0.05 | 0.04 | −0.70 | 0.10 |
| (0,+3) | 4 | −0.92 | −0.75 | −0.70 | −0.95 |
| (−1, +3) | 5 | −0.31 | −0.22 | −0.70 | −0.12 |
| (0,+4) | 5 | −2.15 | −1.56 | −1.04 | −1.28 |
| (−1, +4) | 6 | −1.54 | −1.02 | −0.70 | −0.51 |
| (0,+5) | 6 | −2.32 | −1.54 | −0.36 | −1.26 |
| (−1,+5) | 7 | −1.72 | −1.05 | −0.02 | −0.55 |

Significant at: α = 0.01***; α = 0.05**; α = 0.10*. Significant at: α = 0.01***; α = 0.05**; α = 0.10*. This table presents the mean cumulative abnormal return (CAR) estimated over twelve event windows by applying OLS-regression methodology for time of one full trading year (250 trading days) prior the event window. Panel A reports results for estimating daily AR using market model and Panel B reports results for estimated daily AR using Fama and French three-factor model.

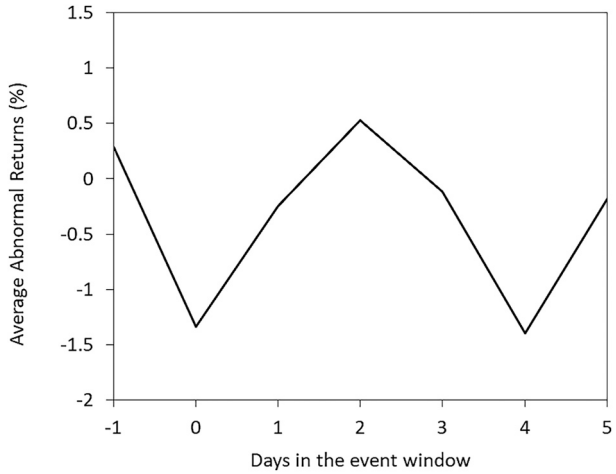


**Fig. 4.** Average abnormal returns (AARs) using market model to NEGATIVE legal ruling events for (-1, +5) window.

impression about the firm is not altered, consequently. Second, reputation losses are small or negligible because the harmed parties do not do business with the firm (Karpoff and Lott, 1993). Although our results shed light on investors' perception of environmental misconduct, they cannot be generalized to other sectors or types of events. Furthermore, our analysis focuses on several small daily windows, implying that reputational effects are not reflected in the market as instantaneously as

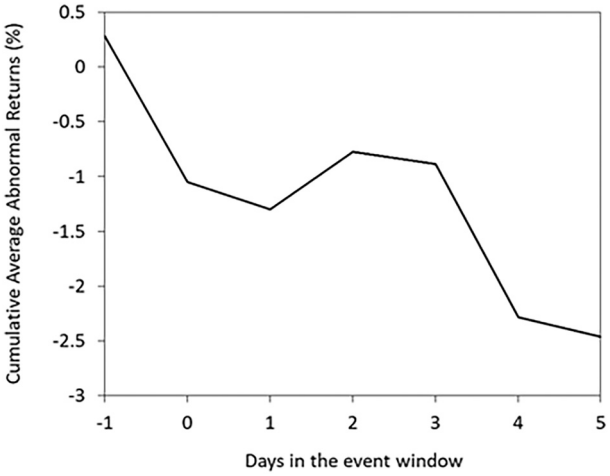


**Fig. 5.** Cumulative average abnormal returns (CAARs) using market model to NEGATIVE legal ruling events for (-1, +5) window.

**Table 5**
Reputational cumulative abnormal returns (Rep CAR) on average for negative events.

*Panel A: Market model.*

| | | | *Parametric Test* | *Non-Parametric Tests* | |
|---|---|---|---|---|---|
| Window | N | Rep CAR (%) | t-test | Sign T | Corrado T |
| (0,0) | 1 | 0.88 | 0.37 | −1.72* | 0.00 |
| (−1, 0) | 2 | 1.16 | 0.1 | 0.33 | 0.26 |
| (0,+1) | 2 | 0.64 | −0.61 | −2.41** | −1.55* |
| (−1, +1) | 3 | 0.92 | −0.65 | −0.69 | −1.05 |
| (0,+2) | 3 | 1.16 | −0.32 | −3.1*** | −0.87 |
| (−1, +2) | 4 | 1.45 | −0.41 | −1.72* | −0.57 |
| (0,+3) | 4 | 1.05 | −0.11 | −2.41** | −0.68 |
| (−1, +3) | 5 | 1.33 | −0.21 | −0.69 | −0.44 |
| (0,+4) | 5 | −0.35 | 0.10 | −0.35 | −0.26 |
| (−1, +4) | 6 | −0.06 | −0.02 | −0.69 | −0.08 |
| (0,+5) | 6 | −0.53 | 0.22 | −2.07** | −0.25 |
| (−1,+5) | 7 | −0.25 | 0.1 | −0.69 | −0.09 |

*Panel B: FF three factor model.*

| | | | *Parametric Test* | *Non-Parametric Tests* | |
|---|---|---|---|---|---|
| Window | N | Rep CAR (%) | t-test | Sign T | Corrado T |
| (0,0) | 1 | 0.83 | 0.39 | −0.45 | 0.69 |
| (−1, 0) | 2 | 1.39 | 0.02 | 0.92 | 0.80 |
| (0,+1) | 2 | 1.01 | −0.65 | −1.83* | −1.13 |
| (−1, +1) | 3 | 1.57 | −0.74 | −1.14 | −0.67 |
| (0,+2) | 3 | 1.86 | −0.36 | −1.83* | −0.63 |
| (−1, +2) | 4 | 2.43 | −0.49 | −1.14 | −0.33 |
| (0,+3) | 4 | 1.44 | −0.14 | −2.17** | −0.39 |
| (−1, +3) | 5 | 2.00 | −0.28 | −0.79 | −0.15 |
| (0,+4) | 5 | 0.16 | −0.03 | −1.82* | −0.61 |
| (−1, +4) | 6 | 0.73 | −0.18 | −0.79 | −0.37 |
| (0,+5) | 6 | −0.24 | 0.13 | −0.79 | −0.55 |
| (−1,+5) | 7 | 0.33 | −0.02 | −0.45 | −0.34 |

Significant at: α = 0.01***; α = 0.05**; α = 0.10*. Significant at: α = 0.01***; α = 0.05**; α = 0.10*. This table presents the mean reputational cumulative abnormal return (Rep CAR) estimated over twelve event windows by applying OLS-regression methodology for time of one full trading year (250 trading days) prior the event window. Panel A reports results for estimating daily AR using market model and Panel B reports results for estimated daily AR using Fama and French three-factor model. We adjust stock returns by adding the ratio between the loss amount and the market capitalization of the firm. The negative return as result of the event, is added to the abnormal returns at time 0 before computing the average abnormal return of each day t, ($AR_{j,\ 0}$) to isolate the reputational effect.

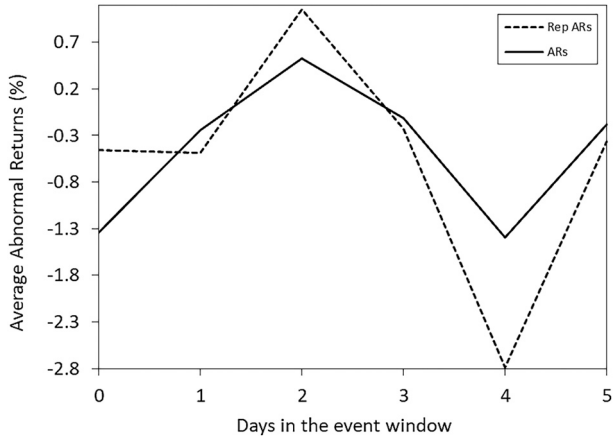


**Fig. 6.** Reputational abnormal returns (RepARs) using market model to NEGATIVE legal ruling events for (-1, +5) window.

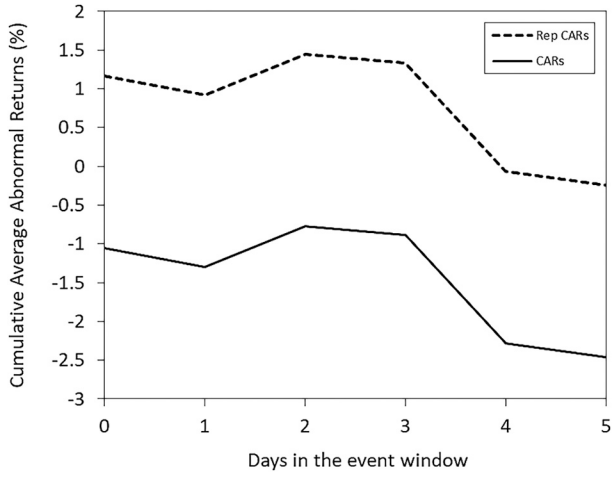


**Fig. 7.** Reputational cumulative abnormal returns (RepCARs) using market model to NEGATIVE legal ruling announcements for (-1, +5) window.

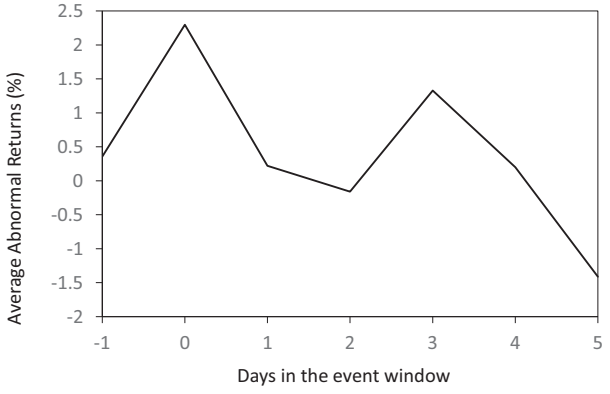


**Fig. 8.** Reputational cumulative abnormal returns (RepCARs) using market model to NEGATIVE legal ruling announcements for (-1, +5) window.

expected. We only consider press release activity. Consequently, caution should be exercised in extrapolating our results. Future work using other long-term dimension may provide additional information on investors' environmental perceptions. Nevertheless, our results reveal novel empirical data on the environmental awareness of investors in the mining industry, which provides several implications for decision

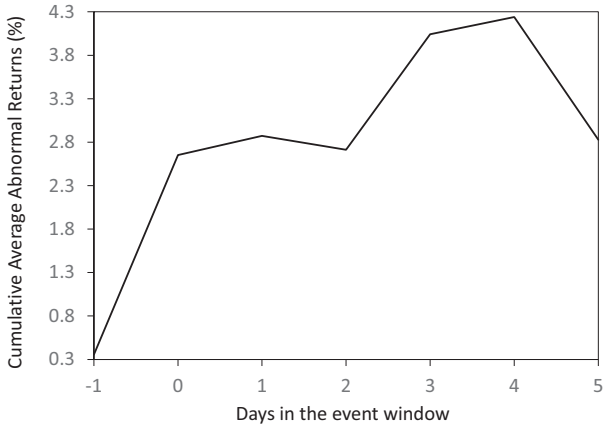


**Fig. 9.** Cumulative average abnormal returns (CAARs) using three factor model to POSITIVE legal ruling events for (-1, +5) window.

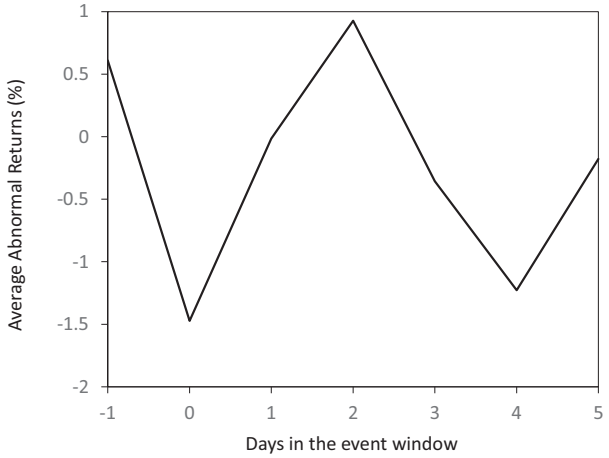


**Fig. 10.** Average abnormal returns (AARs) using three factor model to NEGATIVE legal ruling events for (-1, +5) window.

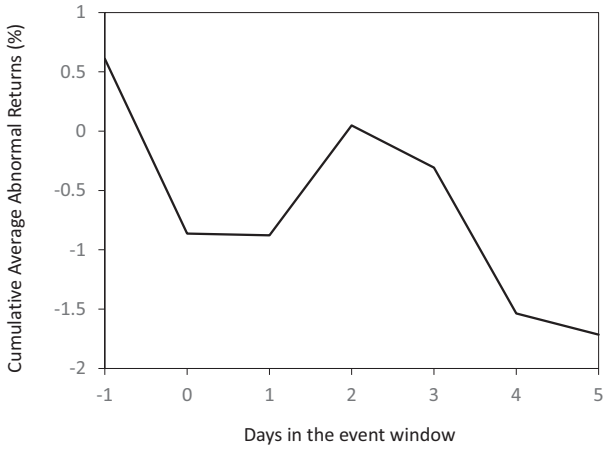


**Fig. 11.** Cumulative average abnormal returns (CAARs) using three factor model to NEGATIVE legal ruling events for (-1, +5) window.

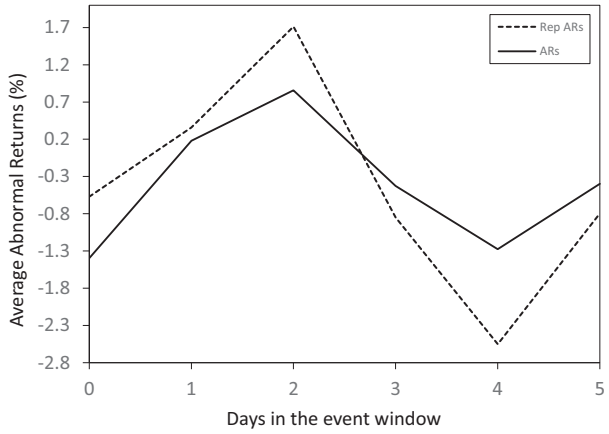


**Fig. 12.** Reputational abnormal returns (RepARs) using three factor model to NEGATIVE legal ruling events for (-1, +5) window.

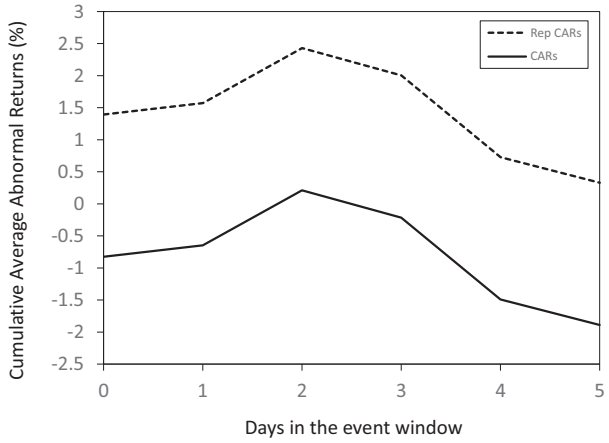


**Fig. 13.** Reputational cumulative abnormal returns (RepCARs) using three factor model to NEGATIVE legal ruling events for (-1, +5) window.

making and valuation, analyst recommendations, and shareholder activism in relation to companies' environmental policies.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

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