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Does Environmental Footprint Influence the Resilience of Firms Facing Environmental Penalties?

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Abstract

This study aims to understand whether prior environmental footprint helps firms to be more resilient against penalties following environmental violations. While the allocation of resources to diminish the company's environmental footprint might be considered detrimental to its financial recovery, the Natural Resource-Based View (NRBV) argues that environmental capabilities may foster firm resilience when faced with the shocks of environmental penalties. We collected data from press releases using Factiva between 2006 and 2019 to constitute an original sample of 143 events concerning US listed firms subjected to fines for environmental misconduct initiated by the Environmental Protection Agency (EPA). Using survival analysis methodology, we empirically find that firms with lower environmental footprints prior to the penalty recover sooner from the financial shock, hence exhibiting higher capabilities of resilience. This finding is robust to different survival analysis models and time windows. Our empirical analysis expands the range of studies supporting environmental performance as a way for organizations to improve resilience in the face of disruptions, in providing clear evidence in the case of environmental fines.

Keywords: Environmental penalties, Environmental Footprint, Resilience, Environmental performance, Survival Analysis

JEL Classification: G12, M14, O16, Q51

1. Introduction

On April 20, 2010, BP's Deepwater Horizon oil rig exploded as high-pressure methane gas from the well rose into the rig and ignited, leading to the death of eleven workers and the discharge of an estimated 780,000 m³ of oil spanning a maximum area of 176,100 km² in the Gulf of Mexico. This event, often regarded as the most disastrous man-made environmental disaster in history, sparked international reactions and debate as containment and cleanup operations were set up for the following months and years. Numerous investigations were led by the U.S. federal Government and, in November 2012, the U.S. Department of Justice and BP settled federal criminal charges as BP pleaded guilty to "11 counts of manslaughter, two misdemeanors, and a felony count of lying to Congress", and agreed to pay a record-setting \$4.525 billion in fines and other payments. In total, charges, penalties and additional cleanup costs regarding this catastrophe were estimated to have cost the company over \$65 billion as of January 2018 (Bouso, 2018). Management scholars have often recognized such industrial disasters as suitable contexts for the study of how organizations respond to threats (Jones & Rubin, 2001; Shrivastava, 1995; Rudolph & Repping, 2002; Sheffi, 2005; Karpoff et al., 2005; Capelle-Blancard & Laguna, 2010). The Deepwater Horizon oil spill is an extreme example of how pollution can lead to multiple dire consequences, not only on the environment, but also on the financial and reputational situation of organizations that either violate environmental law or disregard the efforts necessary to limit the effects of climate change.

With each additional report on the consequences of climate change, spearheaded by the IPCC (2022), concern about the environment is growing, thereby increasing pressure on firms to behave responsibly toward the environment (Flammer, 2013). In most developed economies, increasingly stringent laws and regulation mechanisms have been put in place to ensure ecological harm is discouraged, in extreme situations where organizations violate environmental regulation, financial penalties and remediation actions are imposed by governmental institutions (Gray & Shimshack, 2011; Wang et al., 2019). In the United States, the Environmental Protection Agency (EPA) conducts environmental assessment, investigates violations, and enforces environmental law (US EPA, 2013; Brady et al., 2019). In extreme cases, the Department of Justice may also oversee the legal procedures. In many cases, as is customary

in American legal procedures involving large organizations, the process ends in settlement rather than final judgment. A settlement is an agreement before the law to end the dispute, resulting in the voluntary dismissal of any related litigation. To settle violation claims made by the EPA, companies often pay a large amount of money to the aggravated party to avoid being formally denounced as violating federal law on environmental protection. In the remainder of this paper, we will refer to these payments, whether they result from settlement or judgment, as “penalties” or “fines”.

The financial consequences of these penalties are significant for companies despite their seemingly modest amount when considered as a proportion of the targets’ revenue (Greife & Maume, 2020). Using panel data, Romero et al., (2018) find that EPA penalties lead to lower earnings. Besides, Karpoff et al. (2005) find that the financial consequences of environmental penalties are disruptive for the targeted firms. On average, from 1980 to 2000, the announcement of an allegation or of a formal charge following environmental violations was related to a loss of between 1.6% and 1.7% of the average abnormal return of the target (Karpoff et al., 2005). When disentangling the reasons for this loss, Brady et al. (2019) and Karpoff et al. (2005) find that the financial loss also results from harm to the firms’ reputation, which on average accounted for about 20 to 25 percent of the total loss. In addition, the reputational effect was found to be larger in the most recent period (Brady et al., 2019), which suggests the increased general attention to environmental issues described by Flammer (2013) has economic relevance. EPA fine announcements constitute a jolt for the affected firms, and therefore create a stimulating setting to study their ability to reduce the losses and recover.

With the multiplication and intensification of crises globally, understanding how organizations bounce back after an adverse event becomes paramount in transforming economies toward sustainability. While such an ability does not always seem desirable; since in some cases, the very core activities of an organization are what makes it unsustainable, as identified by (Bocken & Short 2021), being able to pinpoint what helps business operations endure disruptions is expected help managers make better decisions for the long-term orientation of the system they guide, thereby helping them position their organization in a sustainable path, one that not only maximizes its chances of survival, but also improves its chances to thrive in an economy adapting to climate change. In the case of disruptive situations, the

concept of “resilience” is often used and warrants clear definition and justification (Linnenluecke, 2017). In our context, we follow Gunderson and Pritchard, (2002) and consider resilience as a firm’s ability to maintain its core functions, but also to better adapt to exogenous shocks than its competitors. In recent literature, organizational response to external threats has been considered through the lens and concept of organizational resilience (Gittell et al., 2006; Lengnick-Hall et al., 2011; Linnenluecke & Griffiths, 2013; Duchek, 2020); this approach is useful in understanding what characteristics of the firm may help it respond to threats and recover from shocks.

In response to the growing concern about corporate environmental sustainability, firms can respond in various ways. As Lyon & Maxwell (2008) mention, environmental Corporate Social Responsibility (CSR), the organizational proficiency to integrate social and environmental concerns in business operations and interactions with stakeholders, allows firms to gain competitive advantages over their competitors by investing resources in improving social and environmental welfare. From this theoretical perspective, the surge of environmental CSR is the result of a combination of market and political forces. Essentially, pollution is sometimes a sign of production inefficiencies, thus pollution reduction policies can potentially lead to reduced costs and “win-win” opportunities (Porter & van der Linde, 1995). This factor is the one addressed mainly in this paper. Other factors include access to a “green customer base”, in which some consumers are willing to pay a premium price for eco-friendly products (Arora & Gangopadhyay, 1995; Harbaugh et al., 2011), improved understanding of the workings of the political system to dissuade the enforcement of stringent environmental regulations, build goodwill with regulators, and attempt to reduce the cost of compliance and the sanction associated with noncompliance (Baron, 2005; Yu, 2005), the achievement of voluntary agreements (VA) with regulators (Segerson & Miceli, 1998; Blackman et al., 2006; Glachant, 2007), the anticipation and shaping of such regulations before their implementation if they cannot be preempted (Lutz et al., 2000; Denicolò, 2008), the opportunity of being traded at a premium price among green investors (Baron, 2005; Graff et al., 2005; Baron, 2007), and screening for employees that seek socially responsible employment, who are willing to accept lower wages (Hsieh 2006; Brekke & Nyborg 2008).

By supplementing the Resource-Based-View of the firm (Wernerfelt, 1984; Barney, 1991) with additional considerations for the firm's relationship to the natural environment, Hart (1995) provides a suitable theoretical framework to understand the relationship between environmental performance (EP) and resilience. Supported by subsequent studies (Russo & Fouts, 1997; Sharma & Vredenburg, 1998; Branco & Lima Rodrigues, 2006; Aragón-Correa et al., 2008; Hart & Dowell, 2011), the Natural-Resource-Based View of the firm (NRBV) postulates that EP is derived from three strategic capabilities firms develop internally: pollution prevention, product stewardship, and sustainable development. In this framework, the environmental footprint of the firm can be assessed by taking into account both the land and natural resources used through its activities, as well as the negative environmental impacts these activities generate in the form of air pollution, water effluents and waste. As such, using the footprint approach to assess the overall environmental impacts of an organization at a given point in time is a relevant method to study how well this organization was able to implement pollution prevention processes, which in turn improve the organization's EP. According to the available empirical results, EP is likely to enable the firm to "neutralize threats" (Russo & Fouts, 1997). This ability is expected to emerge from tacit environmental skills and dynamic capabilities (Hart, 1995) which allow organizations to "adjust in rapidly changing environments by integrating, building and reconfiguring internal competences" (Teece et al., 1997), enhanced social legitimacy (Russo & Fouts, 1997), greater employee involvement and coordination as well as stronger relationships with suppliers (Branco & Lima Rodrigues, 2006). Demirel et al. (2018) also established that by adopting environmental management systems, firms may improve their ability to address regulatory pressures through the development of unique environmental management capabilities, which includes efficient pollution reduction strategies. Since a growing number of stakeholders expect companies to respect their environment (Flammer, 2013), more attention to the company's environmental footprint is likely to improve the organization's reputation, which contributes to its ability to rely on additional support in challenging times. It follows that this heightened reputation (Bruna & Nicolò, 2020) and legitimacy (Zahller et al., 2015) is likely to help firms mobilize external stakeholders in order to improve their resilience. The reason behind this is that companies with superior stakeholder trust based on reputation and legitimacy diminish the potential legal, economic, or other social sanctions that arise in situations where organizational legitimacy is

threatened, as is the case when firms are targeted by an environmental penalty, while illegitimate organizations are exposed to boycotts and loss of market shares, strikes and restricted access to labor, increased regulation, heavier taxation, restricted access to capital and increased cost of capital, as well as fewer opportunities for partnerships and joint-ventures (Dowling & Pfeffer, 1975; Freeman, 2007; Kothari et al., 2009; Lindblom, 2010; Dhaliwal et al., 2011; Freeman, 2015). High EP suggests that the firm has developed multiple capabilities to be able to cope with environmental issues, which are complex by nature (Hart, 1995) and fosters its ability to be proactive, anticipate change and adapt to unforeseen events (Russo & Fouts, 1997), thereby contributing to the ability to bounce back after a disruption.

However, Friedman's (1970) argument that allocating resources to activities that don't directly aim at improving profitability poses a financial constraint on the firm which harms its financial performance, should also be considered. The relationship between CSR and financial performance is non-trivial, as argued by Buchanan et al., (2018) who noted heavier losses for high-CSR firms than their peers in the post-subprime crisis context. In some situations, diverting resources toward the improvement of a firm's ecological footprint may harm its competitiveness in managing its core functions and in generating revenue, which would consequently hurt the organization's ability to both maintain its position and bounce back in the face of shocks such as an environmental penalty. In their study of how EP relates to resilience in the context of the subprime crisis, Marsat et al., (2021) report that, in countries with high environmental standards, high pre-crisis EP increased the time required for the firms' market prices to recover, indicating EP might be an organizational constraint in certain settings. It is thus possible that firms that make an effort to reduce their environmental footprint do so at the expense of valuable resources that may help them reduce the impact of a jolt such as an environmental penalty. As Gittell et al. (2006) show, financial reserves are a requirement for resilience, which implies that companies which use a part of their reserves to invest in pollution prevention and environmental footprint reduction strategies could be less resilient than their competitors.

From an empirical perspective, studies on the impact of EP in case of adverse events are scarce, and studies of the impact of environmental footprint on resilience to the financial setback caused by an environmental penalty are, to the best of our knowledge, lacking. While the bulk of the literature is

focused on the impact of EP on financial performance (Endrikat et al., 2014; Salem et al., 2015; Xiao et al., 2018), or the impact of overall CSR on resilience (Ortiz-de-Mandojana & Bansal 2016; DesJardine et al., 2019), only a few research papers study precisely the role of EP in resilience. Recent studies have considered the effect of EP on resilience in the Covid crisis context, like Albuquerque et al. (2020) who document higher resilience to the shock in the first quarter of 2020 for firms with high Environmental and Social ratings which retain higher returns and benefit from their lower volatility during this period. Ding et al. (2021) found that the drop in stock returns was milder for firms with more CSR activities, and Garel & Petit-Romec (2021) described a tendency for investors to reward environmental responsibility during the pandemic. However, the results are mixed since the impact seems to be negative in the case of the subprime crisis (Marsat et al., 2021) whereas it is positive when considering environmental controversies (Marsat et al., 2022). While environmental controversies are interesting shocks to focus on, controversies may be very heterogeneous, and their intensity is difficult to assess. Relying on a proprietary database of fines enables us to overcome this limitation by precisely measuring the intensity of the shock with the amount of the fine. Moreover, the mechanisms underlying resilience have been described as context-dependent, therefore studying different types of business disruptions is necessary to clarify the “resilience to what” part of the conundrum (Linnenluecke, 2017; Duchek, 2020; Su & Junge, 2023). To our knowledge, no study has directly focused on firm resilience after being affected by the shock of an environmental fine. Our study aims at filling this gap. We believe the use of a variable proxying the direct environmental footprint of a firm and how it affects resilience is original as we have found no other studies of resilience considering it.

This work thus aims to understand whether environmental footprint influences the resilience of firms to environmental penalties. To test this hypothesis, we collected data from Factiva to constitute an original sample of penalties resulting from EPA investigation. We also gathered financial data on each targeted company around the announcement of the penalty using Datastream, and environmental performance data with Trucost. Our data were compiled in a single proprietary database, allowing us to run survival analyses to observe the effect of firm characteristics on resilience. We find that, all else equal, a heavy environmental footprint significantly harms the firm’s ability to bounce back from an environmental

penalty, which implies that high prior EP significantly helps firms to bounce back after an EPA fine, in line with the arguments of the NRBV and environmental CSR. This result proves to be robust to different survival analysis models, control variables, and time windows.

In this paper, we aim at contributing to the literature by merging for the first time, to our knowledge, the literature on environmental penalties (Lott et al., 1999; Karpoff et al., 2005; Romero et al., 2018; Wang et al., 2019; Brady et al., 2019; Greife & Maume, 2020) and the literature on resilience (Gunderson & Pritchard, 2002; Linnenluecke & Griffiths, 2013; Markman & Venzin, 2014; Fiksel et al., 2015; Linnenluecke, 2017; Tisch & Galbreath, 2018; Duchek, 2020) with a survival analysis methodology (Ortiz-de-Mandojana & Bansal, 2016; DesJardine et al., 2019; Marsat et al., 2021, 2022). Moreover, our results empirically support the proactive role of EP that enables the firm to develop dynamic capabilities (Hart, 1995), and highlight its insurance-like benefits (Godfrey et al., 2009). We believe that this finding may interest managers, investors and regulators.

The rest of the paper is organized as follows: the next section discusses the methodology. The third section presents the results, and we discuss and conclude in the fourth and final section.

2. Data and methodology

2.1 Sample

As with previous financial studies that seek to evaluate the market impact of specific events (Capelle-Blancard & Laguna, 2010; Flammer, 2013; Tanimura & Okamoto, 2013), we used the Factiva database to identify our events of interest and collect information about the penalties, resulting in a proprietary database totaling 143 penalty events in the US, all targeting companies listed in the stock exchange with available environmental information in the Trucost database. The research terms were as follows: all articles in English containing either “EPA” or “Environmental Protection Agency” and at least one word among “Settlement”, “Penalty” and/or “fine”; published between January 1st, 2006 and December 31st, 2019; and only in financial news sources (DJ Newswires, The Wall Street Journal, MarketWatch, Barron’s and SmartMoney). Table 1 presents the details of this selection process and the number of

observations eliminated at each step. In this process, the identification of a start date for the event was necessary since it is a requirement for the resilience methodology.

[Insert Table 1 Here]

We consider the shock to be triggered by the first journal article in financial newswire services publicly mentioning the penalty along with sufficient information for the reader to assess its importance: the amount of the penalty, the type of violation and the name of the company and/or the violating facility targeted by the penalty. The starting date to study the recovery in the resilience process is the publication date of this first article. For each observation, the ISIN number of the parent company targeted by the penalty was identified to make the aggregation of financial and environmental data around the date of the event possible. Financial information about the targets was drawn from Thomson Reuters' Datastream, in particular, Return on Assets (ROA), information on the company's size (natural logarithm of the assets), its financial leverage, measures of momentum, and its stock closing value around the event, starting a maximum of 35 trading days before the article and ending 120 days after the article. Finally, a measure of the total direct pollution generated by the firms' activities for the year preceding the event was collected from the Trucost database for each penalized firm.

2.2 Variables

Using this data and relying on the methodology of DesJardine et al. (2019), we assess resilience based on the market prices around the event. The flexibility dimension is measured through the time necessary for the firm's stock price to recover its pre-shock value and maintain it above that threshold for 5 consecutive trading days (for a similar approach, see Marsat et al. (2021, 2022); Ullah et al. (2022)). In accordance with our methodology for assessing resilience, using financial data, it should be assumed, for the remainder of this article, that the mention of the term "resilience" should be understood as the firm's ability to recover its lost value on the stock market after the shock (DesJardine et al. 2019). Unlike the study published by DesJardine et al. (2019) where the event – the global financial crisis, starting from the bankruptcy of Lehman Brothers – is largely unexpected, in our event of interest, a certain degree of anticipation is possible for investors and other stakeholders since the EPA's investigation about the violation is not secret and the possibility of a monetary penalty seems more likely as the

investigation nears its end. Because of this possibility of anticipation, the targeted firms' stock price is more volatile during the period preceding the publication of the first article confirming the penalty than it is in normal times, as is the case in Mergers and Acquisitions, for example, between the initial bid and the final offer (Betton et al., 2008). It is common for scholars in such situations to estimate the pre-event value of the target by observing the evolution of its price during the runup period instead of merely its closing price the day before the event itself (Betton et al., 2008; Alexandridis et al., 2010). To take this issue into account and avoid biasing our results, with consideration for the temporality of environmental penalties for which we have enough data to estimate how early the results of the EPA investigation can be anticipated by investors, we decided to take the average closing price during the 20 trading days preceding the event as the threshold over which the stock price should remain afterwards to assess both time to recovery and severity of loss. The stability dimension of resilience was measured as the percentage drop in the firm's stock value from the average closing price in the 20 days preceding the event to its lowest point during the period immediately following the event. A visual representation of this methodology is provided in Figure 1. To assess a firm's environmental footprint, we mainly base our analysis on a variable named *DirPollutionBn*, extracted from Trucost, which is the estimated cost in billion USD of the firm's environmental footprint (sources and sinks), including carbon emissions and other greenhouse gases, land and water pollutants, natural resource use, water cooling and processing, waste landfill, waste incineration, and nuclear waste. In the methodology used by Trucost, for example, the estimated cost of greenhouse gas emissions is based on a CO₂eq. assessment of greenhouse gas emissions. Air pollutants from the company's activities are assessed in volume and associated with health and/or environmental costs which are also added to the firm's total direct air impact. The estimated cost of water use is assessed based on the cubic meters of water consumed in the firm's direct activities. Toxic or radioactive outputs landfilled by the firm are estimated in metric tons and associated with health and environmental costs depending on the type of waste produced, adding up to the firm's total direct land impact, etc. In summary, for each source or sink that can be listed as part of the firm's environmental footprint, Trucost gathers or estimates the physical amount of the resource used (or discharge in the environment), each source or pollutant is associated with socio-environmental costs so that the total environmental footprint can be calculated. In the absence of disclosure from the company,

the cost of water pollution (and all other types of pollution) can also be assessed through third party datasets, sustainability reports, and other sources to estimate how the pollutants discharged by the company in rivers and open water translate into costs for Society. The production of waste and land pollutants is also measured or estimated in cubic tons and associated to costs depending on the toxicity of the discharges¹. In that regard, our variable *DirPollutionBn* should be considered as a measure of total direct air, water and land pollution in a single instance, and thus a proxy of the overall environmental footprint of a firm's direct activities², in line with the concept of environmental footprint developed by Hoekstra & Wiedmann (2014) and Matušík & Kočí (2021).

[Insert Figure 1 Here]

Because the resilience process is very likely to be affected by the amount of the penalty, it was important to integrate this factor into our models, and *PenaltyMn* measures this amount in USD Million. Other control variables are presented in our models as resilience is also expected to be affected by the company's characteristics (DesJardine et al., 2019). In particular, we assess the profitability of the company's activities using its return on assets (*ROA*) since firms that are more profitable are likely to benefit from investor support in times of crisis. We assess its size by including 1 plus the natural logarithm of total assets (*Size*), Markman & Venzin (2014) showed that smaller banks were more resilient than their larger counterparts. We measure the firms' financial leverage with the debt-to-equity ratio (*FinLev*), expecting investors to flock toward companies that have a lower leverage ratio in crises. We also consider the firm's stock price momentum in the period preceding the event with a measure based on daily volatility (*Momentum*), and include binary variables to take into account the firm's industry (*Industry*), whether the firm is headquartered in the US (*Country*) since prior literature shows differences in the environmental conduct of foreign-owned companies (King & Shaver 2001) and

¹ Details about the methodology used by Trucost to measure and estimate the direct environmental impact of a company is available here :

https://www.support.marketplace.spglobal.com/en/datasets/alternative/trucost_environmental/trucost_environmental_data_methodology_guide.pdf

² Direct environmental impacts available in the Trucost database include multiple broad categories: carbon emissions, other GHG emissions, land and water pollutants, natural resource use, water cooling, water processing, waste landfill, waste incineration, and nuclear waste. The database also includes indirect impacts in the firm's upstream supply chain, which are not considered in our main independent variable, *DirPollutionBn*.

foreign-owned firms may be treated differently by the EPA because their relationship with US agencies are less entrenched than it could be for US-based companies. We also control for the type of pollution which led to the penalty (*PollutionType*), and the recency of the event with regards to the Paris Climate Agreement (*Post2015*). This last control variable was included on the grounds that the Paris Climate Agreement, by setting clear and actionable objectives to combat climate change, may have spurred a shift in corporate environmental behavior towards more sustainability (Bjørn et al., 2021), thus the relative financial impact of events that happened after the Paris Agreement is expected to be larger than it is for events that happened before it since stakeholders expect more efforts toward sustainability from firms now than they did before the agreement (Heo, 2021; Jakučionytė-Skodienė & Liobikienė 2022; Doan & Lepone, 2023). Ferreira et al. (2019) document changes in the sustainability commitment of firms in the retailing industry following the agreement, for instance.

The final dataset encompasses 143 violations that led to penalties ranging from \$3,000 to \$335.4 million from 2006 to 2019 in the following sectors respectively: 45 in Energy, 35 in Materials, 19 in Utilities and 15 in Consumer Discretionary. The majority of violations were reported under the ICIS as illegal air emissions (80 events), 29 involved illegal discharge of pollutants in water, and 34 involved issues of land waste and soil pollution. All the penalized violations in our dataset occurred in the US and were investigated by the EPA. Most of the firms targeted by the penalties are based in the US (90 observations), the 53 remaining cases, companies headquartered out of the US, were grouped in a single category of the corresponding binary variable (*Country*). Table 2 presents the sample of the study and Table 3 a summary of the variables.

[Insert Tables 2 and 3 here]

To reduce the influence of other events on the affected firms' stock prices we restrict our window of observation to the 60 trading days following the event as it is the limit around which about three quarters of the sample have recovered. Summary statistics are shown in Table 4, the average time necessary for firms in our sample to recover from the shock was 5.73 trading days, 107 firms managed to recover in the 60-day time frame, on average the fined firms lost 9.18% of their share price following the event. The average amount of pollution directly generated by their activities is \$1.87 billion, the average

penalty is \$10.24 million, their average ROA stands at 7.27, the average of debt-to-equity is 1.16 and the average momentum score is 2.00.

[Insert Table 4 here]

3. Results

Since the baseline hazard is not linear, but increasing quickly in the first days after the start of the observation period and then increasing at a diminishing pace over time, the exponential model is best fitted, which is confirmed by the higher LR Chi² compared to linear models. We then used exponential models as a baseline to analyze the relationship between EP and resilience, measured as total environmental footprint in billion USD and the survival likelihood over time, respectively. Table 5 presents the construction of our main model, the exponential survival analysis over 60 days, with gradual inclusion of control variables. These models predict the probability of recovery at time t comprised between 0 and 60 days, the relationship can be expressed as:

$$h_i(t) = e^\alpha e^{(X_{ij}\beta_j)}$$

Where $h_i(t)$ represents the hazard rate of recovery for the i^{th} observation at time t . X is a set of variables as described above, e^α is the baseline hazard function parameterized as taking an exponential form, β are the regression coefficients for all j variables. A positive coefficient indicates a positive link with resilience. In Table 5 and all other survival analysis models, we report the coefficients rather than hazard ratios, and report standard errors in parentheses for each variable beside control binary variables. The coefficient of *DirPollutionBn* is negative and consistently significant. In model Exp 7, where all controls, including binary variables for industry, country, pollution type and recency are included, the coefficient for *DirPollutionBn* is -0.22 and significant at the 99% threshold, meaning a one-unit increase in *DirPollutionBn* reduces the hazard associated with recovery by 19.7%, inducing increased time to recovery and a weaker probability of recovery in a 60-day time frame.

[Insert Tables 5 and 6 here]

Table 6 presents the survival analysis regressions including the same variables as the last model from table 5 with different specifications. In particular, the three different models of survival analysis (Cox,

Weibull and Gompertz) also result in a negative and significant relationship between *DirPollutionBn* and resilience, showing our result is not sensitive to the baseline hazard used by the survival analysis regression model. Additionally, we present a Logit regression on the probability of recovery in a 60-day frame following the event (*Recovery60d*), displaying the same relationship; a one-unit increase in *DirPollutionBn* (an increase of one billion USD in estimated cost of pollution for the firm) reduces the probability of recovery in a 60-day period following the event by 18.9% ($e^{-0.21} - 1$).

To check the robustness of our results according to different time frames, we also ran the exponential survival analysis regression of model 7 with varying time windows, ranging from 5 to 100 days. These additional regressions are presented in Table 7 and support our main result. Finally, despite the strong correlation between severity of loss and time to recovery (0.67; $p < 0.01$ in our data), we decided to run the baseline model along with our different models of survival analysis and Logit from Table 6 including severity of loss, which are reported in Table 8 and are in line with our main result. Finally, in order to verify the soundness of our method to reduce the effect of anticipation by averaging the price of each firm's stock value over 20 days before the day of the first article and using it as the baseline to observe resilience, we ran our survival analyses and logit models again using 25-, 15-, 10- and 5-day pre-event windows instead, and observe a significant and negative relationship of a comparable magnitude between environmental footprint and resilience to environmental penalties. These tests are not presented here for the sake of brevity but are available upon request. Finally, we tested whether our main independent variable was scaled appropriately by using the natural logarithm of the total direct pollution measure from Trucost, and quartiles of total direct pollution instead of *DirPollutionBn*, and obtained similar results.

[Insert Tables 7 and 8 here]

4. Discussion and conclusion

In this paper, we study whether the environmental footprint of firms affects their resilience to environmental penalties using a proprietary sample of 143 observations including EPA enforcement actions in the United-States from 2006 to 2019. We show that heavier environmental footprint, in the form of higher direct pollution levels, is associated, all else equal, with longer recovery. This result is

robust to different model specifications, different models of survival analysis and different time frames, before and after the event. It follows that firms with a heavy negative impact on the environment struggle more than their peers in the aftermath of an environmental penalty. This suggests that firms that were able to implement pollution prevention policies do not only mechanically reduce the risk of being flagged by enforcement agents for illegal pollution levels, but also improve their ability to recover from the financial and reputational shock a penalty for violating environmental regulation might cause.

This result seems to support the NRBV perspective, as the development of strategic capabilities such as pollution prevention, product stewardship and sustainable development in the aim of reducing the negative environmental impact of the firm's activities underlies the creation and expansion of specific capabilities that allow the firm to be better equipped when confronting complex situations, especially when these situations relate to environmental factors (Russo & Fouts, 1997; Ortiz-de-Mandojana & Bansal, 2016). The specific environmental capabilities mentioned above are the foundation upon which sustained competitive advantage can be achieved. Their tacit, socially complex and firm-specific nature makes them difficult to observe in an empirical study such as the one presented here. Nevertheless, these sources of competitive advantage can be inferred from good EP, and in our case, firms with more efficient pollution prevention strategies seem to be more flexible and better able to respond to disturbances following environmental violation than their peers, *ceteris paribus*. In that regard, we contribute to the NRBV literature by providing empirical groundwork that confirms the positive association between pollution prevention and financial resilience in a context of a disruption related to the environment. By minimizing emissions, effluents, waste, and resource use through the adoption of environmental management systems, firms are able to foster internal flexibility and address stakeholder expectations, which also provides external competitive advantages such as social legitimacy.

Because pollution prevention is one of the major pillars of EP, we can argue that this paper contributes to the nascent resilience literature in favor of EP as a valuable source of sustainable competitiveness in challenging times (Endrikat et al., 2014; Salem et al., 2015; Garel & Petit-Romec, 2021; Marsat et al., 2022) since reducing their environmental footprint, and thus improving their EP, helps firms reduce the time they require to bounce back from an environmental penalty. Considering that penalties for violating

environmental law constitute regulatory pressure on polluting firms, we also add reason to consider the argument expressed by Demirel et al. (2018) and Demirel & Kesidou (2019), that implementing Environmental Management Systems and CSR frameworks allows firms to build unique environmental management capabilities such as pollution prevention, thereby allowing them to effectively address regulatory pressures. Besides, the findings of our study also support the interest of studying environmental violations and penalties as a context of disruption where companies display differential resilience, as exemplified by previous academic papers (Lott et al., 1999; Karpoff et al., 2005; Romero et al., 2018; Brady et al., 2019; Greife & Maume, 2020), the financial consequences of environmental penalties are significant and help reveal firm characteristics and response patterns which favor, or harm, their future position. We therefore expect that these results expand the literature on the impacts of environmental fines.

This new result has significant managerial, financial, and regulatory implications. First, managers that wish to build resilience into their organization should consider the impact of its activities on the environment. Reducing the environmental footprint of these activities seems to have benefits beyond the ecological efficiency of operations, such as an improved capacity to bounce back from adversity. Improving the organization's footprint requires setting up strategies and processes, organizing teams and allocating budgets that work toward this single objective.

Second, investors may wish to integrate the environmental footprint of their portfolio constituents in their evaluation of the risk associated with their investments. By describing tougher times for heavy polluters following an environmental penalty, we highlight the fact that harming the environment may also harm a firm's stock price in challenging circumstances. We also advise institutional investors to carefully consider the implications of policy changes regarding pollution deterrence for the risk profiles of their portfolios. In the medium- to long-term, it may be that investors which don't value sustainability miss opportunities and yield lower returns, especially in times of crisis.

Third, regulators who are doubtful about the efficiency of the penalty approach to tackle pollution may be interested by the financial relevance of the events considered in this study, but also ponder the limitations of the current deterrence capabilities. For regulators who wish to further reduce the

environmental footprint of their economy, an obvious recommendation would be to increase the amounts in penalties, in particular for repeat offenders. Blundell (2020) shows that this approach tends to improve compliance with existing regulations. However, since the amount of the penalty has very limited relevance in our results, we would also recommend efforts to go toward increasing monitoring, control, and repression capacities. Although our study only considers violations that occurred in the US, policymakers and regulators in other jurisdictions may take interest in our results as they reflect the financial consequences of pollution deterrence policies. In similar contexts, where corporate pollution is monitored by a governmental agency which has enough resources to conduct investigations and a legal mandate to press charges against polluters so violations can be penalized with substantial severity, publicly traded firms which receive fines following such violations should be affected in a comparable fashion to the firms in our sample. The desirability of this outcome, and the potential for legal improvement thereof could be discussed by policy experts, which falls beyond the scope of this paper.

Tackling global climate change demands effort from all organizations, especially industrial companies which will be required to observe more and more stringent standards and follow increasingly demanding regulation in the coming decades. In this context, building and sustaining EP has benefits beyond improving stakeholder relations as it also enhances the organization's resilience, thereby positively affecting the bottom line over the long term. From an academic perspective, this result contributes to the body of knowledge on how EP relates to financial performance by providing an additional empirical analysis in a specific context. The study of environmental penalties with a resilience perspective is original and contributes to understanding both concepts further. Penalties following environmental violations are economically relevant for firms and can be viewed as disruptive to the company's financial and reputational situation. Such disruptions are especially interesting from the resilience perspective as the affected organizations will display measurable stability in the form of severity of loss, and flexibility through the time they need to recover their pre-shock situation. Methodologically, our paper further supports the use of the resilience approach, associated with survival analyses, to study the financial recovery following a firm-specific disruption.

Our study also contributes to the environmental CSR literature by confirming that pollution reduction policies can lead to other opportunities for competitive advantages. By improving their resilience, and in particular their flexibility in rebounding after a jolt, firms that managed to eliminate the production inefficiencies by seeking to reduce their environmental footprint seemingly end up with a competitive advantage over firms that have made less extensive efforts in greening their value-chain. It is likely that the improved financial resilience of high EP firms described in this paper stems from a multiplicity of explaining factors, such as those described in Lyon and Maxwell (2008). Although we lack the data to provide a detailed assessment of how much each of these factors affect the recovery of firms to environmental penalties, which falls beyond the scope of this paper, such an endeavor would certainly lead to interesting results.

This research, of course, is not without limitations. The first limitation is the sample bias introduced in our work by the selection methodology: by only selecting companies targeted by a penalty for violating environmental law, we restrict our sample to firms, and sectors, that are heavier polluters as they are much more likely than others to be targeted by environmental penalties. As a result, firms in polluting sectors are overrepresented in our sample (Energy, Materials, and Utilities in particular), and heavy polluters in each of these sectors are more present in our sample than in the total population of firms that could be targeted by an environmental penalty. The risk for a firm to be targeted by an environmental penalty is not equally distributed, and the study of how some firms are more likely than others to be targeted was not considered in the scope of this paper, but it should be considered for further inquiry in future research. We should also acknowledge that the penalties studied in this paper are not fully exogenous, although we found no relationship between past EP or the level of direct pollution relative to other firms in the same sector with the amount of the fine, we cannot rule out the possibility of the past relationship between the firm and the regulator affecting the amount of the penalty. The second caveat is related to the restricted size of our sample which results from the sparse availability of leverageable data on environmental penalties, especially outside of the United States. The development of our database thus relied on secondary sources through the use of Factiva. Thirdly, while it is likely the amount of the penalty and other enforcement actions are related to the EPA agency which

investigated the violation because of state level policies, controlling for the state where the violation took place, or at least the EPA region, would have been desirable, unfortunately this information was not systematically provided by Factiva. We also believe empirical research in other national contexts, under different legislations, is required to generalize the positive association between pollution prevention and financial resilience described in this study in accordance with the NRBV theoretical framework. Besides, the availability of better and additional data on EP would contribute to our knowledge of how efforts on reducing the organization's footprint on the environment also affect its overall performance. In particular, data on other dimensions of EP than pollution prevention, namely assessments of product stewardship and sustainable development, per the NRBV, would greatly increase our ability to assess the organizational impact of green policies. An important limitation of our work related to the availability of data lies in the fact that we are not able to consider the entire temporality of our events of interest. We believe researchers willing to explain our results further may be able to do so by adopting a case study methodology and a qualitative approach to investigate how firms respond to environmental penalties as soon as the allegation is declared or as the EPA investigation starts. Finally, while one would expect a higher penalty to incur heavier losses for the targeted companies, the limited relevance of the penalty amount regarding the recovery profile of affected companies in our data should be a subject of perplexity for enforcers. Putting a price on damage done to the environment is tricky, and it also risks favoring the more affluent organizations over the need to reduce the impact of human activities, the implications of this work for pollution deterrence policymakers also warrant consideration.

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Tables and figures

Table 1 - Sample Selection Methodology

Firms in the sample	Obs.
Penalized facilities and companies exposed for environmental violation in news articles of financial media during the 2006-2019 period in Factiva using search terms as described above.	927
<i>Less:</i> Observations involving non-listed parent companies and duplicates of single events.	(637)
<i>Less:</i> Observations for which no article can be found containing at least:	
- Name of parent company or name of facility	
- Correct amount of penalty (+/- 5%, allowing for rounding in press)	(47)
- Type of violation and some explanation about the pollution	
<i>Less:</i> Missing data in the TRUCOST Database for the year preceding the date of the article.	(75)
<i>Less:</i> Observations missing important data from Datastream (i.e., Total Assets, ROA/ROE, Volatility)	(25)
Final Sample	143

Table 2 - Sample Description

Year of Event		Sector	Violation Type			Country	
2006	9	Energy	45	Air (ICIS)	80	United States	90
2007	20	Materials	35	Water (NPDES)	29	United Kingdom	19
2008	11	Utilities	19	Waste (RCRA)	34	Germany	9
2009	9	Consumer Discretionary	15			Japan	5
2010	15	Other	29			Mexico	4
2011	9					Canada	3
2012	11					Other ³	13
2013	16						
2014	8						
2015	6						
2016	6						
2017	10						
2018	6						
2019	7						
N	143		143		143		143

Table 3 – Variables Description

Variables	Description	Data Source
TRecov#d	Time in days the firm's stock price took to recover (remain over baseline for 5 consecutive days) (#-day frame)	Datastream
DirPollutionBn	Environmental footprint: estimated cost of the pollution generated by the firm's direct operations in Billion USD (Y-1)	TRUCOST
PenaltyMn	Total amount of penalty from single settlement in Million USD as given in the article	Factiva
ROA	Return on assets	Datastream
Size	One plus natural logarithm of total assets	Datastream
FinLev	Financial leverage (Debt-to-Equity ratio)	Datastream
Momentum	Price momentum, based on daily volatility. Exponentially-weighted moving average of the squared daily log returns over the last 365 days.	Datastream
Industry	Binary variable for industry from the GICS 2-digit classification	TRUCOST
Country	Binary variable for country of Origin (US / Non-US)	Datastream
PollutionType	Type of violation binaries determined by the EPA agency in charge of the case (ICIS, NPDES or RCRA)	Factiva & EPA ECHO
Post2015	Binary variable for events after 2015	Factiva & EPA ECHO

Note: Datastream = Refinitiv Datastream (historical financial database), EPA = United States Environmental Protection Agency, ECHO = Enforcement and Compliance History Online, ICIS = Integrated Compliance Information System, NPDES = National Pollution Discharge Elimination System, RCRA = Resource Conservation and Recovery Act.

³ Other regions of headquarters include France (2 obs.), Republic of Ireland (2 obs.), South Korea (2 obs.), Luxembourg (2 obs.), Israel (1 obs.), South Africa (1 obs.), China (1 obs.), Taiwan (1 obs.), and Sweden (1 obs.)

Table 4 - Summary Statistics

VARIABLES	N	mean	median	sd	min	max	p25	p75
TRecov60d	107	5.73	1	9.88	1	51	1	5
Recovery60d	143	0.75	1	0.44	0	1	0	1
DepthLoss60d	143	9.18	5.47	11.23	0	62.67	1.40	14.72
DirPollutionBn	143	1.87	0.45	2.75	0.00058	15.85	0.11	3.18
PenaltyMn	143	10.24	1.95	40.38	0.003	335.40	0.98	4.20
ROA	143	7.27	5.58	14.15	-50.45	92.08	2.57	92.07
Size	143	23.83	23.82	1.92	16.91	27.36	22.61	25.55
FinLev	143	1.16	0.50	3.19	0	31.38	0.31	1.02
Momentum	143	2.00	1.82	0.82	0.77	6.09	1.42	2.25

Summary statistics of the sample. Resilience is the number of days of market price recovery calculated in a window of 60 trading days following the penalty announcement. Recovery is a binary variable meant to test the likelihood of recovery in the 60-day frame in Logit models. EP is proxied by the total pollution generated by the firm's direct activity in Billion USD (CO2eq). ROA is the return on assets ratio. Size is one plus the natural log of firms' total assets. FinLev is the financial leverage ratio (total debt divided by total equity). Momentum is the market changes in the 3 years preceding the event.

Table 5 - EP and Resilience: Survival Analysis Baseline Model (Exponential Model, 60-day time frame)

VARIABLES	(1) Exp	(2) Exp 2	(3) Exp 3	(4) Exp 4	(5) Exp 5	(6) Exp 6	(7) Exp 7
DirPollutionBn	-0.06* (0.03)	-0.06** (0.03)	-0.06** (0.03)	-0.05* (0.03)	-0.05* (0.03)	-0.05* (0.03)	-0.22*** (0.05)
PenaltyMn		0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)
ROA			-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.01)
Size				-0.05 (0.06)	-0.05 (0.06)	-0.05 (0.06)	0.13* (0.07)
FinLev					0.01 (0.03)	0.01 (0.03)	-0.01 (0.04)
Momentum						-0.09 (0.13)	0.45** (0.18)
<i>Control binaries</i>							
Industry	No	No	No	No	No	No	Yes
Country	No	No	No	No	No	No	Yes
PollutionType	No	No	No	No	No	No	Yes
Post2015	No	No	No	No	No	No	Yes
Constant	-3.62*** (0.11)	-3.69*** (0.11)	-3.66*** (0.12)	-2.51* (1.39)	-2.49* (1.39)	-2.21 (1.44)	-7.79*** (1.89)
LR Chi ²	4.39**	14.62***	15.34***	16.03***	16.06***	16.53***	59.97***
Observations	143	143	143	143	143	143	143

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. This table presents the exponential log-relative hazard regressions (survival analysis) for a window of observation of 60 days, with gradual inclusion of variables leading to our main model (Exp 7). In these models, resilience, our dependent variable, is proxied by the time to recovery of firms' market price. The coefficients for control binaries are not reported for the sake of brevity.

Table 6 - EP and Resilience: Alternative Survival Models and Logit Model (60-day time frame)

VARIABLES	(1) Cox	(2) Weibull	(3) Gompertz	(4) Logit
DirPollutionBn	-0.11** (0.05)	-0.13*** (0.05)	-0.13** (0.05)	-0.21** (0.09)
PenaltyMn	0.00 (0.00)	0.01* (0.00)	0.01** (0.00)	0.01 (0.02)
ROA	0.00 (0.01)	-0.00 (0.01)	0.00 (0.01)	-0.00 (0.01)
Size	0.06 (0.07)	0.06 (0.07)	0.09 (0.07)	-0.00 (0.15)
FinLev	-0.00 (0.04)	-0.00 (0.04)	-0.00 (0.04)	0.03 (0.12)
Momentum	0.18 (0.15)	0.18 (0.16)	0.27* (0.16)	-0.04 (0.34)
<i>Control binaries</i>				
Industry	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
PollutionType	Yes	Yes	Yes	Yes
Post2015	Yes	Yes	Yes	Yes
Constant		-3.05* (1.77)	-4.11** (1.76)	1.83 (3.79)
LR Chi ²	13.18	19.31	18.65	13.59
Observations	143	143	143	143

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. This table presents additional survival analysis models (Cox, Weibull and Gompertz) and a Logit regression on likelihood of recovery (equals 1 if the firm recovered, 0 otherwise) for a window of observation of 60 days. Control variables are the same as in our main model presented in Table 5 (Exp 7). In survival analysis models, resilience, our dependent variable, is proxied by the time to recovery of firms' market price. The coefficients for control binary variables are not reported for the sake of brevity.

Table 7 - EP and Resilience: Survival Analysis Baseline Model - Varying time frames
(Exponential Model)

VARIABLES	(1) Exp 60d	(2) Exp 5d	(3) Exp 10d	(4) Exp 20d	(5) Exp 30d	(6) Exp 40d	(7) Exp 50d	(8) Exp 100d
DirPollutionBn	-0.22*** (0.05)	-0.24*** (0.06)	-0.22*** (0.05)	-0.21*** (0.05)	-0.21*** (0.05)	-0.22*** (0.05)	-0.22*** (0.05)	-0.19*** (0.05)
PenaltyMn	0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)
ROA	-0.00 (0.01)	-0.00 (0.01)	-0.00 (0.01)	0.00 (0.01)	-0.00 (0.01)	-0.00 (0.01)	-0.00 (0.01)	-0.00 (0.01)
Size	0.13* (0.07)	0.20** (0.09)	0.18** (0.08)	0.17** (0.08)	0.14* (0.08)	0.14* (0.07)	0.14** (0.07)	0.12 (0.07)
FinLev	-0.01 (0.04)	-0.02 (0.04)	-0.01 (0.04)	-0.02 (0.04)	-0.02 (0.04)	-0.01 (0.04)	-0.01 (0.04)	-0.02 (0.04)
Momentum	0.45** (0.18)	0.58*** (0.21)	0.48** (0.21)	0.53*** (0.20)	0.49*** (0.19)	0.46** (0.19)	0.46** (0.19)	0.39** (0.18)
<i>Control binaries</i>								
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
PollutionType	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Post2015	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-7.79*** (1.89)	-9.99*** (2.21)	-9.11*** (2.12)	-9.03*** (2.03)	-8.21*** (1.95)	-8.18*** (1.92)	-8.13*** (1.91)	-7.22*** (1.81)
LR Chi ²	59.97***	55.26***	50.05***	50.17***	55.58***	58.70***	58.84***	56.48***
Observations	143	143	143	143	143	143	143	143

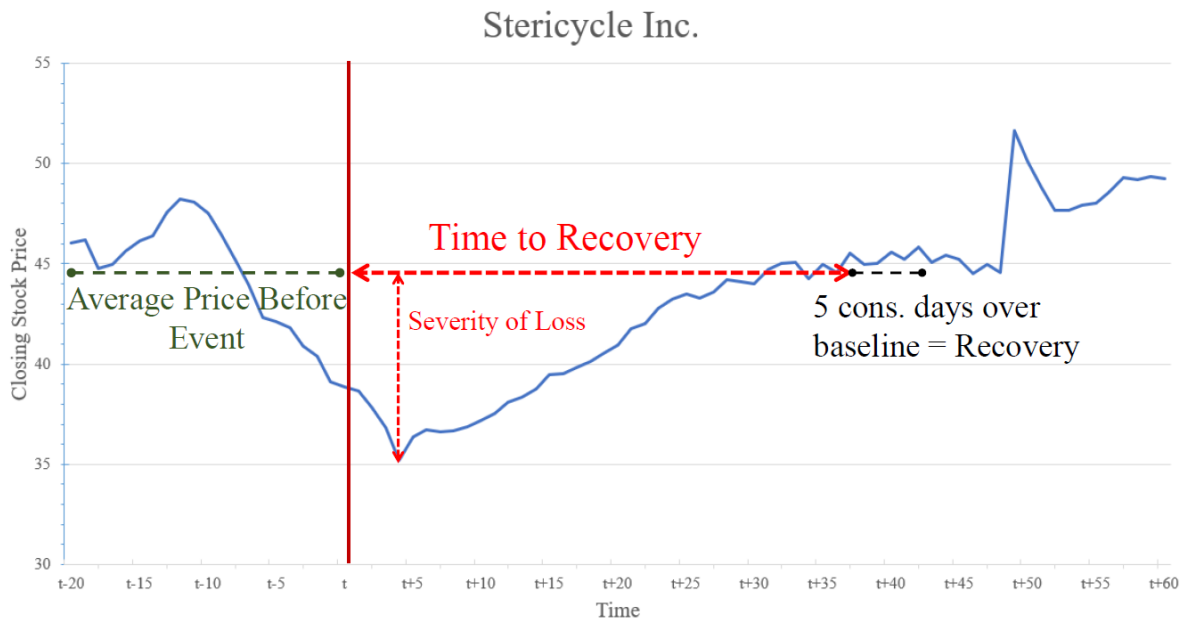
Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. This table presents variations of our main exponential survival analysis model (Exp 7, here Exp 60d) with varying windows of observation ranging from 5 to 100 trading days following the event. In these models, resilience, our dependent variable, is proxied by the time to recovery of firms' market price. Control variables are the same as in our main model presented in Table 5 (Exp 7), the coefficients for control binary variables are not reported for the sake of brevity.

Table 8 - EP and Resilience: Survival Analysis and Logit model including Severity of Loss (60 days)

VARIABLES	(1) Exp	(2) Cox	(3) Weibull	(4) Gompertz	(5) Logit
DirPollutionBn	-0.17*** (0.05)	-0.10* (0.05)	-0.14*** (0.05)	-0.10** (0.05)	-0.37*** (0.14)
PenaltyMn	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	0.04 (0.05)
DepthLoss60d	-0.27*** (0.02)	-0.15*** (0.02)	-0.20*** (0.02)	-0.17*** (0.02)	-0.28*** (0.05)
ROA	-0.00 (0.01)	0.00 (0.01)	-0.00 (0.01)	0.00 (0.01)	0.00 (0.02)
Size	0.07 (0.07)	0.06 (0.07)	0.06 (0.07)	0.08 (0.07)	0.08 (0.24)
FinLev	0.01 (0.05)	0.02 (0.05)	0.02 (0.05)	0.01 (0.05)	0.77 (0.50)
Momentum	0.71*** (0.13)	0.42*** (0.14)	0.50*** (0.14)	0.53*** (0.14)	1.15* (0.61)
<i>Control binaries</i>					
Industry	Yes	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes	Yes
PollutionType	Yes	Yes	Yes	Yes	Yes
Post2015	Yes	Yes	Yes	Yes	Yes
Constant	-4.02** (1.89)		-2.94 (1.84)	-3.40* (1.81)	0.69 (6.10)
LR Chi ²	350.44***	101.20***	157.69***	133.39***	88.26***
Observations	143	143	143	143	143

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. This table presents our main exponential survival analysis model (Exp 7, Exp DL here) with the inclusion of an additional control - severity of loss - for a window of observation of 60 days, it also displays other survival analysis models (Cox, Weibull and Gompertz) with the same specifications. In the Logit model, the dependent variable is likeliness to recover (equals 1 if the firm recovered, 0 otherwise). Control variables are the same as in our main model presented in Table 5 (Exp 7), the coefficients for control binary variables are not reported for the sake of brevity.

Figure 1: Resilience Measured as Time to Recovery (Company: Stericycle Inc.)



Note: Evolution of Closing Stock Price of Stericycle Inc. in USD. $t = 18/12/2018$. [Link to the EPA Press release](#). Baseline to assess recovery: average stock close price before event calculated as mean of close prices from $t-20$ to $t-1$. Recovery is effective only if the closing price remains above the baseline for 5 consecutive days, Time to Recovery is calculated as the difference in days between the first occurrence in press of the penalty and the first of the 5 consecutive days above the baseline, Severity of Loss is the percentage difference between the baseline and the lowest close price after the event. Here, after the EPA reveals Stericycle Inc. was fined on Dec. 18th, 2018, its stock value lost 21.24% in the days following the event relative to the baseline, and took 37 trading days to recover a value above the baseline and keep it for 5 consecutive trading days.