Environmental Performance and Financial Resilience to the Covid-19 Crisis: International Evidence

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Abstract

This study brings a new perspective on the relationship between environmental performance (EP) and financial resilience by empirically considering two outcomes of resilience: stability and flexibility. Using data from financial markets and environmental performance reporting to study the financial resilience of a sample of 6,663 companies worldwide to the wild card Covid-19 crisis, it reports that while EP and its constituents are predominantly associated with a longer and less likely recovery from the loss, environmental innovation and emissions reduction helped firms by reducing the severity of their loss in the period immediately following the crisis. These results imply that the relationship between EP and resilience is not straightforward and depends heavily on the context of the resilience process, informing both managers and investors about the synergies and tradeoff between EP constituents and resilience. This study extends our theoretical understanding of both the global financial consequences of the pandemic and how EP affects the resilience process.

Keywords: Resilience; Environmental Performance; Survival Analysis; Corporate Social Responsibility, ESG Ratings

JEL Classification: G12, M14, O16, Q51

1. Introduction

On February 20th, 2020, following the first death from the newly spreading Coronavirus, the mayor of the South Korean city of Daegu urged the 2.5 million citizens of his southeastern city to remain home and wear masks as much as possible (New York Post, 2020). The following day, as many more cases of Covid-19 were reported in multiple areas around the globe, and as many business sectors were expected to be affected by the spread of the virus and the efforts to contain it, stock markets started declining dramatically. By the end of February 21st, confirmations of the spread of Covid-19 in 26 countries outside China, and 11 related deaths corroborated the markets' concerns. Over the following weeks, lockdown measures were taken by most of the affected countries during what is now often called the first lockdown period, or "fever" period according to Garel & Petit-Romec (2021). This period marks the end of an eleven-year long bull market that lasted since the Global Financial Crisis following the 2007 – 2008 Subprime Mortgage Crisis, and the start of a bear market. In the initial period spanning over March and April 2020, most market indices fell by loss rates the likes of which hadn't been seen since the Wall Street Crash of 1929. To name a few examples, the U.S. S&P 500 fell by 30% in March, the U.K. FTSE plunged by 29.72%, the German DAX index lost 33.37%, the French CAC 33.63%, and the Japanese NIKKEI dropped by 26.85% (Jabeen et al., 2021). Since then, most market indices have recovered their pre-crisis value. The S&P overtook its February 19th level on August 21st 2020 and kept increasing afterwards, the FTSE 100 did so in early June 2022, the DAX and the CAC recovered in early January 2021, and the NIKKEI recovered in early September 2020. As financial markets, and economies more generally, have experienced different patterns of recovery, the companies traded on those markets have also undergone radically different processes in confronting the crisis.

In this episode of massive worldwide disruption, many voices were raised to underline the necessity to make use of the recovery effort to promote sustainability in business practices. These calls for a "Green Economic Recovery" (OECD, 2020; Taherzadeh, 2021) stem from the evident ability of governments to take immediate and dramatic measures to tackle an existential threat, and the possibility for populations to adapt their lifestyles to restrictions, at least temporarily (Koundouri, 2020). For over a decade, firms have been pressurized to reduce their negative impacts on their external environment, and on the climate in particular (Flammer, 2013). In this context, firms rely on Corporate Social Responsibility (CSR), the organizational proficiency to integrate social and environmental concerns in business operations and interactions with stakeholders, and the improvement of their Environmental Performance (EP) in particular, to demonstrate their capability in facing challenges related to climate change, and gradually improve or transform the efficiency of their operations for a sustainable future.

Organizational response to threats and crises is where the use of the resilience concept is most useful (Linnenluecke, 2017; Duchek, 2020). In recent academic papers, the resilience framework has been used to empirically explore the response of firms to disruptive events such as the 2008 global financial crisis

(DesJardine et al., 2019; Marsat et al., 2021), the terrorist attacks of September 11th, 2001 (Gittell et al., 2006), or the COVID-19 crisis (Ullah et al., 2022; Azeem et al., 2023). Many of these studies took interest in the effect of CSR and its constituents on resilience, with contradicting theoretical arguments and results.

The primary intent of this paper is to study the influence of EP on the resilience of firms to the Covid-19 crisis on the global scale, using as large a sample as possible. By doing so, the intention is to bring new answers to the following overarching problem: does environmental performance reduce the impact of financial disruptions and recover the losses?

Answering this question broadens our knowledge of how firms recovered from the global financial crisis caused by the pandemic because no other international empirical study has considered the long-term recovery period following the crisis with a methodology that allows for the separation of the outcomes of resilience, stability and flexibility, which supports a more nuanced perception of the effect of EP on resilience. By reviewing the influence of each available constituent of EP, this study further contributes to the academic knowledge about the place EP holds in the relationship between CSR and resilience and which aspect of EP is relevant in a wild card health crisis. This empirical study should also be viewed as a contribution to the literature studying the relationship between EP and the financial performance (FP) of firms. Specifically, it brings empirical evidence that EP significantly affects the financial situation of firms in a disruptive environment as the tests presented in this paper, based on a sample of 6,663 firms from 80 countries, support a positive effect of environmental innovation and emissions reduction on stability, but a negative effect of all EP constituents on flexibility. This research thus calls into question the position of EP as a contributing factor to financial resilience despite the support provided by prior studies (Albuquerque et al., 2020; Foulon & Marsat, 2023; Marsat, Pijourlet, & Ullah, 2022).

The remainder of this paper is organized with the following sequence: the next section reviews the academic literature relevant to the resilience framework, the research on the EP – resilience relationship, as well as the study of the Covid-19 crisis, with a particular attention to studies that employed a survival analysis methodology. Section 3 describes the sample construction, the variables used and the methodological choices. Section 4 describes the results obtained and the robustness tests. Ultimately, the results are discussed, and a conclusion is made in Section 5.

2. Literature Review

2.1 The economic and financial impact of Covid-19

Many researchers interested in empirically studying Organizational Resilience (OR) have done so by observing the way systems respond to adverse events. In his renowned study of the Mann Gulch Disaster, Weick (1993) observed the effects of individual and group characteristics on organizational resilience.

Gittell et al. (2006) used the crisis in the U.S. airline industry following the terrorist attacks of September 11, 2001 to determine which firm strategies fostered recovery and which had not. In a very similar manner, as mentioned above, the 2008 Global Financial Crisis gave researchers an empirical context to appraise organizational resilience (Buchanan, Cao, & Chen, 2018; DesJardine et al., 2019; Lins et al., 2017; Marsat et al., 2021). Therefore, it is not surprising that the recent financial crisis following the spread of Covid-19 gave way to a significant number of similar studies from researchers interested in OR, risk response, or business continuity. Although it has been argued that the financial consequences of the pandemic situation were predictable due to previously existing instabilities (Wullweber, 2020), most observers and researchers seem to agree that the Covid-19 crisis was not predictable, it was characterized as a "*wild card crisis*" by Safón et al. (2024). An exogeneous and disruptive shock constitutes a particularly suitable setting to observe resilience to an adverse event for which preparation was very limited, it allows researchers to alleviate endogeneity issues between EP and financial performance.

Albuquerque et al. (2020), for instance, considered that "the magnitude and speed of the stock market crash [...] took everyone by surprise." They documented how firms with high environmental and social ratings benefited from significantly higher returns and lower return volatility over the first quarter of 2020 in the U.S., thereby indicating EP had a positive effect on resilience in this context, at least on the stability dimension. In another early study of resilience to the Covid-19 crisis, Huang et al. (2020) reported that pre-shock CSR performance positively influenced the organizational resilience of a large sample of Chinese firms from January 20th to June 10th, 2020, they used the methodology of DesJardine et al. (2019) to support their argument, CSR positively affecting both dimensions of OR (stability and flexibility). The positive effect of CSR activities on the stability dimension of resilience was further confirmed at the international scale by the work of Ding et al. (2020), who also reported that the drop in stock returns was milder for firms with stronger finances before 2020 (cash, undrawn credit, less debt and larger profits). Garel & Petit-Romec (2021) studied the influence of EP on the stock returns of a large sample of U.S. companies, focusing on the crisis period (January 20th to Mach 20th). They found that firms with responsible strategies on environmental issues experienced better stock returns, and that the effect was mainly driven by initiatives related to climate change such as emission reduction policies, or energy use reduction. Extrapolating these results a bit, it can be speculated that EP (especially firm policies pertaining to resource use and emissions reduction) favors the stability dimension of resilience. Cardillo et al. (2022) also studied the stock returns in a large sample of firms from 15 European countries over the entire year 2020 and concluded that firms with high ESG scores are less volatile and outperform their peers in terms of stock returns.

Some studies also brought to light some interesting facts about *how* and *why* some firms resisted and bounced back, and some did not. Hermundsdottir et al. (2022) reported that the most environmentally innovative firms in a large sample of Norwegian manufacturers were more impacted by the crisis (lower stability). Using survey data, Ferrón-Vílchez & Leyva-de la Hiz (2023) mainly revealed that resilience is associated with improvements in business performance in SMEs, they also underlined how the adoption of social and environmental practices underlies the development of OR. In an analogous spirit, Karman et al. (2023) revealed the effects of the triple bottom line (TBL) approach on firm value. By comparing the crisis period to a more stable period, they managed to establish that the economic and social dimensions of the TBL approach positively influence firm value regardless of the period, but that during the Covid-19 crisis, the ecological dimension did not improve firm value, they concluded that a normal economic period is required for green initiatives to positively affect firm value.

To the best of my knowledge, only a handful of studies employed a survival analysis methodology, analogous to the one employed in the present paper, to assess the flexibility dimension in the Covid-19 period. First, Li et al. (2022) focused on how service-oriented business models (servitization) affected resilience during the Covid-19 outbreak, and conclude that manufacturing firms with more revenue from service businesses endured heavier stock price losses and took longer to bounce back from those losses than their peers, and that the impact was more pronounced in firms providing product-oriented services rather than customer-oriented services. Ullah et al. (2022) used it to document a better flexibility of firms with green supply chain management practices relative to their peers in a large international sample, and Azeem et al. (2023) employed this method to report how boardroom gender diversity negatively impacts flexibility in countries with female directorship quotas, strong governance and lower GDP per capita.

Altogether, I argue that the dual approach addressing both stability and flexibility to assess the full outcome process of resilience is the most thorough approach to properly address how an anticipated factor affects resilience, it also has the advantage to rely on accessible financial data, which allows researchers to leverage large quantities of data in international samples including multiple business sectors. In this research paper, the main objective is to assess the effect of EP on financial resilience to the Covid-19 crisis, it is addressed by measuring resilience with the stability and flexibility dimensions in a large international sample. In so doing, this study is expected to contribute to the resilience literature by producing a thorough analysis of how EP and its constituents affect stability and flexibility in a comprehensive international database covering two years of data (2020 – 2021) to cover the full crisis period. By considering the two main outcome characteristics of resilience separately, this paper contributes to the literature by bringing empirical evidence that the effect of a factor on financial resilience can be ambiguous, affecting stability and flexibility in opposing directions. This point suggests more theoretical attention should be given to both antecedents and outcomes in the resilience process, which should not be treated as a monolithic concept, but a conjunction of *ante-crisis characteristics* (e.g. anticipation, preparedness, resources) and *post-crisis outcomes* (e.g. stability, flexibility, learning).

2.2 Environmental performance, financial performance, and financial resilience

Many empirical researchers have sought to provide evidence on how CSR influences FP. In the 2008 GFC context, Lins et al. (2017) documented that high CSR intensity helped firms generate better financial performance through higher stock returns, profitability, growth, and sales per employee relative to their low-CSR peers. In a meta-analysis, Endrikat et al. (2014) compiled 149 such empirical studies to assert the overall link between EP and FP is positive, partially bidirectional, and is stronger when the strategic approach supporting EP is proactive rather than reactive. Overall, the outperformance of socially responsible assets during times of crises is well established in empirical analyses.

While all organizations face challenges throughout their existence, not all crises can be overcome by every previously existing organization. The ability to overcome disruptions and bounce back gradually became understood as *Organizational Resilience* (OR) in the business literature and should be understood as an extension of the ecological concept of resilience, namely the ability for an ecosystem to absorb external shocks (As in Holling (1973): *"there is another property, termed resilience, that is a measure of the persistence of systems and of their ability to absorb change and disturbance and still maintain the same relationships between populations or state variables"*). While multiple definitions of organizational resilience have been used in this growing strand of literature (Linnenluecke, 2017), there seems to be an agreement between empirical analysts over the "sustain and recover" approach, for which the definition given in Gunderson & Pritchard (2002) is adapted to properly understand the implications of this concept (DesJardine et al., 2019; Ullah, 2020; Marsat et al., 2022; Foulon & Marsat, 2023). In this paper, the term resilience is used under the same meaning: *the ability of a system to persist despite disruptions and the ability to regenerate and maintain existing organization*.

A narrow body of literature investigated the effect of CSR on resilience, many of which employing various definitions of resilience and sundry methodologies to assess resilience outcomes. For example, in their seminal work on the subject, Ortiz-de-Mandojana & Bansal (2016) proxied resilience (defined as *"the firm's ability to sense and correct maladaptive tendencies and cope positively with unexpected situations"*) with long-term outcomes such as financial volatility, sales growth and survival on 121 pairs of firms over a 15-year period. Their investigation concluded that social and environmental practices contribute to organizational resilience, and short-term desirable outcomes in the meantime. Other researchers employed qualitative methodology (e.g. Tisch & Galbreath, 2018), but in quantitative empirical papers, one of the most common academic views in recent years is the two-dimensional definition of resilience (Gunderson & Pritchard, 2002), which leads researchers to observe two characteristics : stability, the *"size of the drop in performance"* and flexibility, *"the time it took to recover to pre-shock performance levels"* (Aven, 2011; Buyl et al., 2019; DesJardine et al., 2019; Foulon & Marsat, 2023; Sajko et al., 2021).

The aim of this paper is to bridge these strands of literature by addressing, in detail, the relationship between corporate environmental performance (EP), its constituents, and financial resilience in the context of the Covid-19 global financial crisis. Some studies investigated how EP affects financial resilience, but most did not use a survival analysis methodology, and none did so in the context of the Covid-19 crisis.

2.3 Conceptual framework and hypotheses

Because the term resilience itself was adapted from an ecological concept, it is not surprising that multiple authors have attempted to study and describe the relationship between EP and resilience. This leads to multiple theoretical frameworks being useful to hypothesize on the effect of EP on both the persistence and recovery of firms in disruptive environments.

First, organizations can integrate social and environmental concerns in their operations and interactions with stakeholders, thereby expecting to obtain competitive advantages and organizational resources in exchange for their attention to social and environmental welfare. This view of Corporate Social Responsibility (CSR) leads us to various arguments pertaining to the effect of improving EP on resilience. Porter & van der Linde (1995) showed that pollution reduction policies can lead to reduced costs and other “win-win” opportunities as pollution is sometimes a sign of inefficacy in the production process. Arora & Gangopadhyay (1995) explained how overcompliance in green production allows firms to access a “green customer base” with a higher willingness to pay a premium price for environmentally friendly products. Baron (2005) argued CSR efforts help firms understand the workings of the political system in order to dissuade the enforcement of stringent regulation, build goodwill with regulators and reduce the sanction associated with noncompliance (see also Yu (2005) and Foulon & Marsat (2023)). These efforts may also help firms reach voluntary agreements with regulators (Blackman et al., 2006; Glachant, 2007; Segerson & Miceli, 1998), anticipate and shape regulation when it cannot be stopped (Denicolò, 2008; Lutz, Lyon, & Maxwell, 2000), screen for employees interested by socially responsible employment, even if it is associated with lower wages (Brekke & Nyborg, 2008; Hsieh, 2006), and have their shares trade at a premium price among “green investors” (Baron, 2005, 2007; Graff et al., 2005). All these arguments uphold advantages for firms with extensive approach to CSR with regards to their resilience, they should have access to better resources, better anticipate changes, and be able to respond appropriately when a crisis emerges to resist the disruption and perhaps recover their pre-crisis situation, it may also serve as a framework leading the organization to a modified, better adapted position.

Secondly, the stakeholder theory helps complement this initial strand of arguments in favor of a mostly positive relationship between EP and resilience. Flammer (2013) reported that positive information about a firm’s behavior towards the environment see their stock price increase, while negative information leads to a stock price decrease, which demonstrates the market value of EP, but she also shows that this relationship is moderated by the external pressure to behave responsibly towards the environment, and that this pressure has increased dramatically in recent decades. In this view, the increase of firm value derived from EP stems from company reputation (Bruna & Nicolò, 2020) and improved legitimacy (Zahller et al., 2015), which help firms mobilize support from their external stakeholders, or at least mitigate their opposition. It is also expected that this advantageous position in the web of stakeholders helps firms reduce the impact of a crisis and recover faster from the loss. By contrast, organizations impeded by a lack of legitimacy and a negative reputation are exposed to strikes, boycotts, restricted access to labor, restricted access to capital with increased costs, heavier taxation and regulation, and have fewer opportunities for partnerships and joint-ventures (Dhaliwal et al., 2011; Dowling & Pfeffer, 1975; Freeman, 2007, 2015; Kothari et al., 2009; Lindblom, 2010). While it seems rather clear how EP affects the firm's relationship with stakeholders, the reciprocal relationship is also true; Wang et al. (2020) used a meta-analysis to examine how stakeholder pressures affect corporate environmental strategies. They reported that environmental strategies are mainly driven by pressure from internal stakeholders (shareholders, board of directors, managers, and employees), are more effective in developed countries, and changed with more ease in non-manufacturing sectors. It follows that the development of EP should allow the firm to enter a virtuous circle in terms of its relationship with stakeholders, and respond to both internal and external stakeholder expectations, granting it access to stronger support in the advent of a crisis, and thereby an improved capacity to mitigate losses.

Thirdly, building on the foundations of the Resource-Based View (RBV) theory (Barney, 1991; Wernerfelt, 1984), Hart (1995) brought further theoretical arguments supporting the influence of EP on business performance, which can also help us understand its effect on organizational resilience. In this Natural-Resource-Based View (NRBV) of the firm, EP relies on three strategic capabilities firms can deploy to foster key resources and competitive advantages. (1) *pollution prevention* (minimizing emissions, effluents and waste) helps the firm initiate and reinforce its continuous improvement process, which leads to a cost advantage over its competitors (Porter & van der Linde (1995)). (2) *product stewardship* (minimizing the life cycle cost of products) cultivates positive stakeholder interactions and integration, allowing the organization to preempt competitors by obtaining priority access to important but limited resources, or by establishing a set of rules, regulations and standards tailored to the firm's superior capability. (3) *sustainable development* (minimizing the environmental burden of firm growth and development) nurtures a strong sense of social and environmental purpose and guides the organization's strategy. This implies working over an extended period to create products and services that align with continued prosperity rather than growth at all costs, with consideration for planetary boundaries. These efforts stimulate the generation of a consensus around a shared vision about the purpose of the organization, which greatly favors its future position.

Since the inception of the NRBV, many studies have attempted to empirically substantiate its main arguments. For example, Russo & Fouts (1997) established a positive relationship between EP and economic performance. Sharma & Vredenburg (1998) documented the emergence of unique organizational capabilities (stakeholder integration, higher-order learning, and continuous innovation) as a result of strategies of proactive responsiveness to environmental uncertainty, without any negative impact on corporate competitiveness. Aragón-Correa et al. (2008) confirmed this result in SMEs which can also develop proactive environmental strategies and benefit from similar capabilities. Dixon-Fowler et al. (2013) revealed in a meta-analysis that the relationship between EP and financial performance is generally positive, supporting the arguments from the NRBV, but stressing the importance of employing a contingency approach since the relationship is context dependent, moving the question from "does it pay to be green?" to "when does it pay to be green?". Demirel & Kesidou (2019) also relied on the same arguments to document how firms are more likely to produce eco-innovation if they possess three specific capabilities tied to organizational processes: voluntary self-regulation, environmental R&D, and green market sensing. These arguments, along with the others presented above lead to the following hypotheses:

> **H1:** Firms with higher pre-crisis EP benefit from increased financial stability in the period immediately following the Covid-19 crisis.

> **H2:** Firms with higher pre-crisis EP yield more financial flexibility than their peers, they require less time to recover from the shock.

All the theoretical arguments and empirical results supporting a positive relationship between EP and diverse aspects of firm performance, including resilience, have of course been debated in the scientific literature. The spearhead of this criticism is rooted in neoclassical economics, epitomized in the Friedman doctrine (Friedman, 1970), according to which "the social responsibility of business is to increase its profits". This principle and other such prescriptions were applied while he served as an advisor to Ronald Reagan in the U.S. and Margaret Thatcher in the U.K. (Ebenstein, 2009). Fundamentally, this view does not expect any effort toward CSR to have a positive impact on corporate financial performance under capitalism. The rationale behind this argument is that the allocation of resources to activities that do not directly aim at improving profitability is counterproductive, it restrains the capacity for the firm to invest in a cost-effective and lucrative manner to maximize its market value. In this view, it would be expected that a firm which strives to improve its environmental performance does so at the expense of its financial performance, and thus at the expense of its financial sustainability and competitivity.

Because the relationship between CSR and financial performance is nontrivial, examples of empirical results that support the arguments of the neo-classical view can be found in the recent literature. For example, in their study of how CSR affects firm value around the 2008 GFC, Buchanan et al. (2018) reported that firms with higher CSR scores experienced more losses of value during the crisis than their peers. In the same context of the GFC, Marsat et al. (2021) showed that EP hinders the flexibility dimension of resilience of firms in countries with high environmental standards as it took more time for high-EP firms to recover their pre-crisis market value than for their low-EP counterparts, all else equal. Such studies indicate that investments in EP can constitute an organizational constraint in certain settings. In particular, certain conditions are required for organizations to be resilient in disruptive situations, including sufficient financial reserves (slack resources), as described by Gittell et al. (2006). With this in mind, it seems logical that firms which invest a significant part of their resources to improve their CSR profile, or their EP, have less available resources when an unpredictable crisis emerges, and are at a disadvantage, especially if the crisis is not related to ecological issues for which the company may have developed contingency plans. Relatedly, as argued by Yang et al (2023), a broad portfolio of CSR activities produces diversification in the firm's CSR initiatives, which complexifies the management processes, dilutes the focus of management and adds intricacy in interdepartmental connections, which may result in slower responsiveness and higher organizational rigidity in critical situations such as the 2020 pandemic. This argument aligns with the results from Sun & Govind (2017) who found that a firm's diversification increases its idiosyncratic risk during turbulent times.

3. Methodology

3.1 Research design

While recent empirical studies of financial resilience, in the wake of DesJardine et al. (2019) have used a bidimensional approach to measure resilience outcomes in critical situations. It should first be acknowledged that resilience has "three core characteristics: an adverse event as a trigger, a performance setback, and a recovery" (Su & Junge, 2023). In this paper, the start of the massive loss of stock value in exchange markets caused by the Covid-19 pandemic is considered the trigger of the resilience process. February 20th, 2020 is retained as the starting date for the period corresponding to the performance setback, and the remainder of year 2020 and year 2021 are taken as the recovery period by observing weekly variations of the stock prices to assess recovery. Garel & Petit-Romec (2021) used the same date to distinguish the pre-crisis from the crisis period based on a graphical analysis, the major international indices started their decline from that date.

Given the possible variability in the start of the crisis between countries, exemplified in Chinese markets being affected as early as January 21st (Huang et al., 2020), the baseline value for estimating the recovery of firms is determined as the highest weekly value of their stock prior to February 20th, since it is admitted all international markets were affected by then. This may lead to recovery periods being longer than what was observed in earlier empirical works using an analogous loss and recovery methodology. I believe this approach contributes to our improved understanding of the recovery period following the heat of the Covid-19 crisis.

Taking a longer recovery period involves setbacks, the first of which is the possibility of observing the consequences of other major events, unrelated to the Covid-19 crisis, which would harm the interpretability of the results. While not all firms recovered from the initial shock before the start of

2022, a significant proportion has (about 70%). Extending the time window of analysis is difficult because financial markets were disturbed following the Russian invasion of Ukraine on February 24th, 2022, even for firms considered the least exposed to Russia (Leromain & Biermann, 2023). For analogous reasons, Yang et al. (2023) also used this 2-year approach in their study of the flexibility dimension of resilience to the Covid-19 crisis in a sample of Chinese firms.

3.2 Data collection

The data used in this study was collected based on a screening of the Thomson Reuters' Eikon database for firms which environmental performance data could be drawn for the year 2019 by accessing the Asset4 database through Thomson Reuters Datastream. Financial data for all companies included in ESG data for the year preceding the Covid-19 crisis (2019) were retrieved using Thomson Reuters Datastream. Only observations that were missing important information such as the firm's stock price in the period surrounding February 20th, 2020, its (ESG) environmental pillar score or any of its constituents, the firm's number of employees, its return on assets ratio, its momentum, or capital expenditures, were withdrawn so as to retain as large a sample as possible. The sample selection methodology is detailed in Table 1. From an initial sample of 8,059 firms worldwide that were screened for having available ESG data in the Asset4 database, a total of 1,396 had to be withdrawn, leading to a sample of 6,663 observations.

[Insert Table 1 here]

Table 2 presents some detailed information on the variables drawn for each observation in the sample. Most of these variables were collected using Datastream. Each firm's country of headquarters' Environmental Performance Index (EPI) for the year 2020 was retrieved from the dedicated website of Yale University[1]. The GDP per capita of each firm's country of headquarters was collected from the IMF's website. A great part of the sample is composed by companies headquartered in the United States, 37.04% of the total sample. The rest comprises mostly firms from developed western economies but not only. The detail for the most represented countries is available in Table 3, which also presents the breakdown of the sample by sector. The most represented sectors are industrials (1,144 obs, 17.2%), financials (1,042 obs, 15.6%) and healthcare (784 obs, 11.8%).

[Insert Table 2 here]

[Insert Table 3 here]

The main variables for resilience analysis are calculated as follows: *DepthOfLoss* is assessed by first identifying each firm's highest weekly stock value between January 1st and February 20th, 2020, this

[1] This data is available at https://epi.yale.edu

value is also considered the firm's baseline to assess recovery. Then, the firm's lowest weekly stock value following February 2020th is also identified and *DepthOfLoss* is the result of the division of the lowest post-crisis price by the highest pre-crisis price multiplied by 100. *TimeToRecover* is calculated with a proprietary algorithm in Stata by identifying the first occurrence of 5 consecutive weeks of stock value over the recovery baseline (the highest stock price before February 20th, 2020), it takes the value of the number of weeks until the first of the 5 consecutive weekly prices above the recovery baseline. *Recovered* is a binary variable which takes the value 1 if the firm's weekly stock price manages to recover its pre-crisis value and remain above it for 5 consecutive weeks before January 1st, 2022.

4. Results

4.1 Descriptive statistics

Table 4 presents the summary statistics of the variables used in the analyses presented in this paper. The main variables for resilience reveal a 68% recovery rate for the sampled firms (*Recovered*), which took an average 57.08 weeks to recover from their loss caused by the Covid-19 crisis (*TimeToRecover*). The average loss of market value from the early 2020 peak is 45.3% (*DepthOfLoss*). The average ESG environmental pillar score (*EScore*) is 0.34, the average score for resource use (*ResourceUse*) is 0.37, for environmental innovation (*EnvInnovation*) 0.23, and 0.38 for emissions (*Emissions*). The correlations matrix is also provided in Table 5.

[Insert Table 4 here]

4.2 Correlation analysis

[Insert Table 5 here]

Some correlations from Table 5 should be noted. *DepthOfLoss* is positively correlated with *TimeToRecover* (0.39, p<0.01), as expected, but not so strongly that they should be systematically mutually exclusive in regressions. *Recovered* and *TimeToRecover* have a strong negatively correlation (-0.84, p<0.01), this is expected as companies that take longer times to recover are, by definition, less likely to recover within the time frame. *Recovered* and *DepthOfLoss* are negatively correlated (-0.29, p<0.01), as expected, companies that lose more value are less likely to recover within the time frame. *EScore* is strongly correlated with its constituents (*ResourceUse*, *EnvInnovation*, and *Emissions*), which is not surprising, the strength of these correlations makes them mutually exclusive in regressions (0.91, 0.73 and 0.91 respectively, p<0.01). The constituents of *EScore* are correlated with one another, all coefficients above 0.5 (p<0.01), so they should not be included in the same model to avoid multicollinearity issues. Because of the high correlation values between multiple variables included in our models, due attention is paid to measures of multicollinearity (VIF) in initial regression models to make sure it does not distort the results.

4.3 Analysis of graphs and bivariate tests

First, it is intuitively useful to observe the overall shape of the loss and recovery of the value of the firms in the sample. To do so, Figure 1, plots the evolution of the average firm value over the 105 weeks of analysis from 01/01/2020 to 01/01/2022, distinguishing high-EP firms from Low-EP firms. This reveals two curves that seem to support both hypotheses formulated above, as the lowest point for High-EP firms is higher than for Low-EP firms, and the recovery from that low point is then slower for High-EP firms than for Low-EP firms.

[Insert Figure 1 here]

Using the same sample split based on environmental performance (*EScore*) from Figure 1, the observation that High EP firms lost less value than Low EP firms on average is confirmed by a bar graph and a t-test comparing the mean of *DepthOfLoss* between the groups of EP separated by the median, Table 6 reports this t-test and Figure 2 gives a visual representation. On average, Low EP firms experienced losses 5.2% harder than high EP firms.

[Insert Table 6 here]

[Insert Figure 2 here]

With the same split, it appears from Figure 1 that firms with higher EP seem to take a slightly longer time to recover from the shock than their lower EP peers. A t-test comparing the mean of *TimeToRecover* (excluding non-recovered firms) between groups of EP separated by the median confirms this observation. Table 7 reports this t-test, and Figure 3 give a visual representation showing that among the firms that recovered before the end of 2021 Low EP firms required on average 3.38 weeks less than high EP firms to recover from the Covid-19 shock. If all the data is included so the maximum duration value is applied to unrecovered firms (Table 8), the difference increases to 5.38 weeks on average, which is an indication that high EP firms are also less likely to recover before the end of 2021.

[Insert Table 7 here]

[Insert Figure 3 here]

[Insert Table 8 here]

Before running survival analyses and other regressions, it is common to graphically observe the shape of the recovery hazard, the Kaplan-Meier failure estimate graphs in Figure 4 additionally shows how EP affects the recovery of firms to the Covid-19 crisis, with the lower EP curve systematically remaining higher than that of high EP firms, this means firms with high EP require more time to recover from the shock than their peers.

[Insert Figure 4 here]

4.4 Regression analysis

The OLS regression models of *EScore* on *DepthOfLoss,* gradually including other independent variables and controls in Table 9, reveal a negative and statistically significant relationship between EP and severity of loss, that is, a better environmental pillar score reduces the maximum percentage loss of stock value, improving stability. The t-test previously suggested a 5.2% difference of severity of loss between Low EP firms and High EP firms, the coefficient in the OLS regression model 5 of Table 9 shows that, all else equal, a one-unit increase of EScore is associated with a 2.35% decrease of severity of loss. These results support H1, EP is associated with a stronger stability.

Other statistically significant effects should be noted. *ROA* is negatively associated with severity of loss; more profitable firms lost less value than their peers following the Covid-19 crisis. *FinLev* has a positive and statistically significant relationship with *DepthOfLoss*; firms that are more leveraged were hit harder by the shock than others, losing more value. *Momentum* is also positively associated with *DepthOfLoss*; firms with a price following a stronger momentum before the advent of the crisis stood to lose more than others. *Beta19* positively affects the severity of loss; the share prices of firms which strongly follow local financial market trends lost more value than their peers. Likewise, Country *EPI* is positively associated with severity of loss; firms headquartered in countries with more stringent environmental regulation lost more value than others. This is expected, according to the results in Xiao et al. (2018), because stakeholders in a country where high EP is expected due to stringent regulation will take such sustainable practices for granted, and firms with high EP will find it harder to capitalize on their efforts in improving their environmental profile. The effect of country GDP per capita is positive and statistically significant in all models in which it is included, suggesting firms headquartered in more developed economies lost more value than others[2]. The specifications of model OLS 5 will be reproduced in robustness checks and other tests.

[Insert Table 9 here]

In the following section addressing the relationship between EP and the flexibility dimension of resilience, Weibull survival analysis regressions are used as the main specification in Table 10. Initial tests comparing the LR Chi^2 of different specifications of survival analysis regressions revealed it best fitted the data. Robustness tests will include other types of survival analysis regressions regardless.

[2] The sequential inclusion of the control variables shows that country-fixed effects should be excluded in further regressions as it generates multicollinearity issues, which is made explicit by the high VIF observed in model 2 of Table 9 (Max VIF: 112.82). To control for differences in the resilience process of firms headquartered in different countries, it is preferable to replace country-fixed effects with 2 control variables which incur much less multicollinearity issues: *EPI* and *GDP19*. While the inclusion of sector-fixed effects also slightly raises the measure of multicollinearity in model 5, the VIF remains under the threshold of 5 recommended by James et al. (2013). Alternatively, the inclusion of a measure of industry growth in another OLS regression instead of sector-fixed effects allows the control for industry specific effects on the resilience process, the results for EP in this model do not differ substantially from those of model 5, they are not reported here but can be made available upon request.

The Weibull survival analysis regressions in Table 10 show how EP, as well as other independent and control variables affect the rate of recovery. In all survival analysis regressions presented in this paper, a negative coefficient should be interpreted as a negative relationship with the flexibility dimension of resilience, which means it took more time for firms with a higher value of the concerned variable to recover from the shock. In these regression models, the effect of *EScore* is negative and significant in all models, meaning firms with higher environmental pillar scores took more time to recover than their peers. According to the coefficient for *EScore* in model Weibull 4 of Table 10, it can be estimated that all else equal, a one-unit increase of *EScore* leads to a multiplicative change in the hazard function of 0.6903, in other words, a reduction of 30.97% of the overall rate of recovery. This leads to the same outcome obtained by observing means difference between groups. In the t-tests reported previously in Table 7 and Table 8: firms with above-median *EScore* took on average 3.38 weeks more than firms with below-median *EScore* if non-recovered firms are excluded, and 5.38 weeks if they are included. These results contradict H2, as EP is associated with less flexibility.

Other statistically significant effects should be noted. *DepthOfLoss* is negatively associated with the rate of recovery, this is expected as firms that lose more value generally take more time to recover to their pre-crisis level. Excluding this variable which assesses the stability dimension of resilience does not affect the significance of the negative relationship between *EScore* and the rate of recovery. *ROA* is positively associated with the rate of recovery in most models, firms that are more profitable require less time than others to recover, as expected. *FinLev* negatively affects the rate of recovery in model 5, firms that rely more heavily on debt took more time to recover than their peers, this is also expected. *Momentum* has a positive effect on the rate of recovery, this suggests that firms with a better momentum before the crisis recover better. Country *EPI* is negatively associated with the rate of recovery in model 5, it seems that firms headquartered in countries with more stringent environmental regulation may experience slower recoveries than firms in less stringent legal environments, but the effect is not significant in other models. *GDP* per Capita is positively associated with the rate of recovery, so firms headquartered in richer economies recovered faster than firms in emerging or developing countries.

The effect of *EScore* on the flexibility dimension of resilience appears to be rather significant in terms of economic relevance. The specifications of Model Weibull 4 will be reproduced in robustness tests.

[Insert Table 10 here]

4.5 Robustness of main models

To test the robustness of the result, the main regression model is first rerun to test the effect of *EScore* on the flexibility dimension of resilience using alternative specifications. Reproducing model Weibull 4 with different survival analysis regression specifications shows that the results are not dependent on model specification. Finally, I run a Logit model on the likeliness to recover (*Recovered*), which confirms the results. The effect of *EScore* on the dependent variable is consistently negative and statistically significant ($p < 0.01$), these robustness tests are presented in Appendix 1.

To further examine the robustness of the results, the main models, OLS 5 and Weibull 4 are regressed again, using different windows of observation for the recovery period in Appendix 2. These additional observation windows end in November 2021 (92 weeks), October 2021 (88 weeks) and September 2021 (84 weeks), respectively. As the results in Appendix 2 show no significant difference with the main result, the effect of *EScore* on either stability or flexibility is confirmed as not sensible to different time specifications.[3]

4.6 Effect of Resource Use, Environmental Innovation and Emissions on stability

By alternatively replacing *EScore* with *ResourceUse*, *EnvInnovation* and *Emissions,* and rerunning the main OLS regression model (OLS 5 from Table 9) in the left section of Table 11, I obtain results very similar to that of the environmental pillar score for *EnvInnovation* and *Emissions*, but not for *ResourceUse*, which effect is not significant. It would thus seem that the positive effect of EP on the stability dimension of resilience in the Covid-19 crisis is due to the firms' capabilities in environmental innovation and emission reduction, but not resource use.

[Insert Table 11 here]

The same approach is then reproduced for the main survival analysis model (Weibull 4 from Table 10), replacing *EScore* by its components, in the right section of Table 11. All three components have a negative effect on flexibility, very similar to that of *EScore*, firms with a better score for resource use, environmental innovation, and/or emissions have a reduced rate of recovery in the Covid-19 crisis. Considering the coefficients, the effect of *Emissions* (-0.326) is stronger than the effect of *ResourceUse* (-0.250), which is itself stronger than the effect of *EnvInnovation* (-0.159).

5. Discussion and Conclusion

In this study, I investigate the relationship between environmental performance and the resilience of an international sample of public firms to the Covid-19 crisis, and consider the effects of the constituents of EP: resource use, environmental innovation and emissions. The results described above reveal that EP positively affects the stability dimension of resilience in the Covid-19 context, meaning firms with better environmental performance lose less value after the shock appears, all else equal. The positive effect of EP on stability is only confirmed for two constituents: environmental innovation and emissions. The results of the survival analyses present a contradicting effect of EP on the flexibility dimension of resilience, as EP is associated with both a longer recovery period and decreased likeliness to recover, all

[3] The main tests were also reproduced including only the observations for firms headquartered in the United States, the results did not differ from those presented in Tables 9 and 10.

else equal. These results are robust to multiple model specifications and are not sensible to variations in the period of analysis.

Consequently, firms which made extensive efforts towards improving their EP before the crisis relative to their peers can benefit from the improved stability of their organization and reduce the financial impact of a crisis such as the Covid-19. But in the following period, these high-EP firms are less likely to rebound quickly as they will require a longer period to recover to their pre-crisis value relative to their peers. This contrasting result confirms and denies various theoretical arguments in the context of the recent pandemic.

For the stability dimension of resilience, the results presented here support the CSR literature, the stakeholder theory and the NRBV. According to the CSR literature, the improved stability of firms with better environmental initiatives may come from advantages such as the access to a loyal green customer base (Arora & Gangopadhyay, 1995), lower production costs thanks to improvements in the production process towards pollution reduction (Porter & van der Linde, 1995), good relationships with regulators (Baron, 2005), less costly and more motivated workers (Brekke & Nyborg, 2008), or retaining a higher market price for their shares thanks to "green investors" remaining loyal (Baron, 2007; Graff et al., 2005). This last argument is also supported by the stakeholder theory as investors that screen for socially responsible investment are able and willing to pay a premium price following positive information about the firm's environmental actions (Flammer, 2013). Tenants of the stakeholder theory may also consider that by behaving more responsibly towards the environment, high EP firms should benefit from improved reputation and legitimacy (Bruna & Nicolò, 2020; Zahller et al., 2015), and as such garner more support from their stakeholders to maintain continuity in their business processes, thereby improving stability. The NRBV of the firm adds that firms that effectively implement pollution prevention, product stewardship, and sustainable development strategies benefit from sustainable competitive advantages over their competitors thanks to improved capabilities (Hart, 1995). The improved economic performance resulting from these capabilities (Russo & Fouts, 1997) helps the firm overcome the initial tremors of a crisis such as a pandemic situation, remain more stable than their peers because of increased attention to their environment and better preparedness for business discontinuity in the form of contingency plans.

This paper contributes to these strands of theoretical literature by providing empirical support to the positive relationship between EP and the stability dimension of resilience. Firms with better environmental performance, and particularly environmental innovation and emissions reduction proficiencies, benefit from advantages because of their CSR profile, better reputation and legitimacy with stakeholders, and improved capabilities based on pollution prevention, product stewardship and sustainable development resources and routines. They can withstand the major financial shock resulting from the Covid-19 crisis better than their peers, all else equal.

Though these arguments can be verified in the relationship between EP and stability, it seems the advantages described above don't apply to the flexibility dimension of resilience in the case of the Covid-19 crisis. In essence, it is possible that efforts made to improve EP deviate resources from the core business processes which primarily aim at improving profitability, this in turn deteriorates flexibility in the advent of a pandemic. After all, one of the most critical requirements for resilience, as described by Gittell et al. (2006), is slack resources, the ability for the firm to constitute a stock of resources and retain redundant capacities to allow for critical situations to generate some losses without jeopardizing core business continuation. The main argument in this case is that a major unpredictable crisis such as Covid-19, which results in immense losses, is only limitedly mitigated by preparedness, even for organizations which deploy extensive efforts to maintain their license to operate (DesJardine et al., 2019; Ortiz-de-Mandojana & Bansal, 2016) and anticipate environmental disruptions. As a result, these firms take longer to recuperate because they are less endowed in financial resources when the crisis erupts. Furthermore, the process diversification required for creating and maintaining CSR commitments generates managerial complexities and communicational intricacies (Yang et al., 2023) which slow the response of organizations and reduce their flexibility. They are also less likely to renege on commitments for environmental sustainability if these engagements are embedded in their long-term strategy towards sustainable development, which makes them relatively less flexible in the long recovery period following the market crash of February-March 2020. Because the market crash was rapid and historically massive, the results presented here align with those of some previous studies in the 2007 - 2008 Subprime Mortgage Crisis context (Buchanan et al., 2018; Marsat et al., 2021).

This paper contributes to the literature on the financial impact of environmental policies. By assessing the effect of EP on resilience in an international exogeneous crisis, further developments of the academic knowledge about business continuity strategies and the input of environmental sustainability activities are brought. The EP – FP literature is both supported and challenged here in observations highly robust to different specifications, with a substantial international sample and a long period of observation. The positive effect of EP on the stability dimension of resilience for the environmental innovation and emission reduction capabilities is confirmed, whereas efforts in reducing the use of resources do not seem to affect stability.

At present, no theoretical arguments stand in this stream of literature to explain the perplexing result that EP hinders flexibility, which leads to the following conclusion: more qualitative research is required to develop new theoretical explanations pertaining to the relationship between dimensions of EP and the flexibility dimension of resilience, which is beyond the scope of this empirical study.

Furthermore, this work contributes to the empirical financial literature on resilience by highlighting important methodological implications for researchers. As demonstrated here, resilience should not be empirically treated as a single outcome but the conjunction of multiple post-crisis outcomes as these may not be affected in a similar fashion by a pre-crisis characteristic. The intrinsic positive relationship between stability and flexibility does not mean an organizational attribute positively affecting one, also improves the other. This partly explains why the papers that previously studied the effect of EP on resilience focusing on a single of these outcomes led to opposing results; some mostly studied stability in the short-term consequences of the shock, and few focused on flexibility, with samples limited to a single country and timelines of analysis that only allowed the study of a part of the recovery period. In addition to the bidimensionality of post-crisis resilience, this paper also addresses our lack of knowledge about the context dependent nature of the resilience process recognized by previous research on the subject (Duchek, 2020; Linnenluecke, 2017; Su & Junge, 2023) within its limits. In that regard, properly categorizing the type of crisis studied in empirical analyses of resilience is a necessary stage of any such study, as it allows a proper understanding of why certain organizational traits such as good EP may positively affect stability or flexibility in a certain disruptive context, and negatively in another.

The arguments and results presented in this document also have managerial implications for managers and investors. Managers should be conscious about the implications of devoting more resources and time to improve environmental performance for the financial resilience profile of their organization. In a way, an arbitrage is required between "doing good" and "doing well" as improving EP strengthens the organization's financial stability in the advent of a major financial crisis such as the one triggered by the spread of Covid-19, but also hinders its flexibility after the initial shock period. Furthermore, portfolio managers and investors need to properly evaluate the implications of voluntary environmental policies, as these policies might increase the risk exposure of firms to major systemic disruptions such as the Covid-19 pandemic.

This study has limitations and calls for further research to better grasp how EP affects financial resilience, by observing the relationship in other contexts, and particularly other recent exogeneous shocks. It is possible the attention devoted by media, corporate leaders and other stakeholders on environmental issues has deepened since 2020 because of the many calls to make use of recovery funds to improve the environmental sustainability of our societies. Consequently, it is possible that the effect of EP on resilience to wild card crises evolves. From a research standpoint, it would also be fruitful to assess the relationship between EP and resilience in other types of shocks, such as natural disasters, extreme weather events, and other ecological disruptions. While EP may have a detrimental effect on flexibility in financial crises, it may also serve as a hedge in environmental shocks of a different nature.

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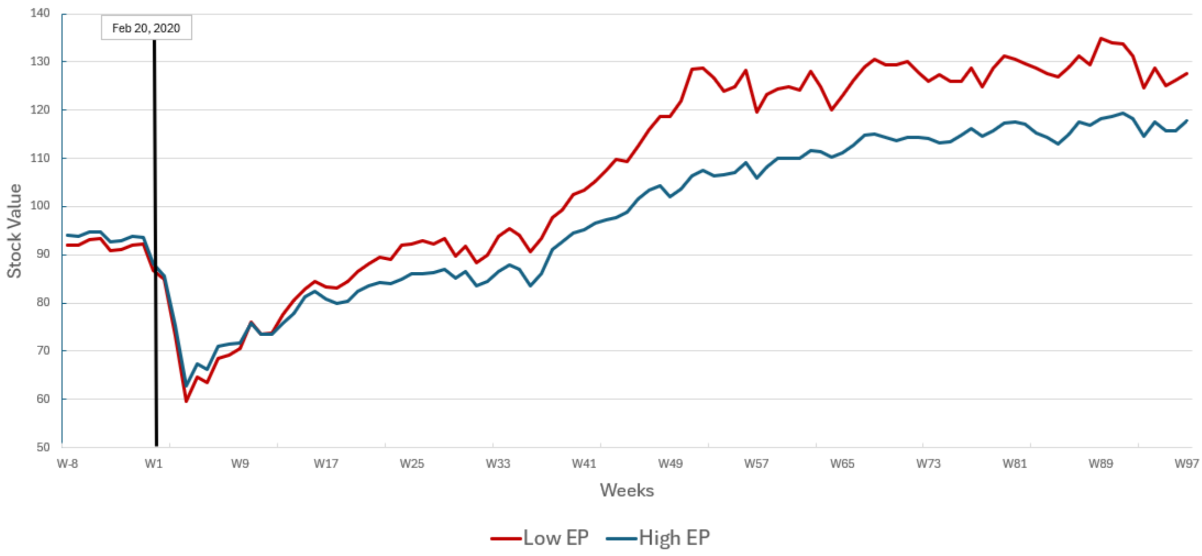
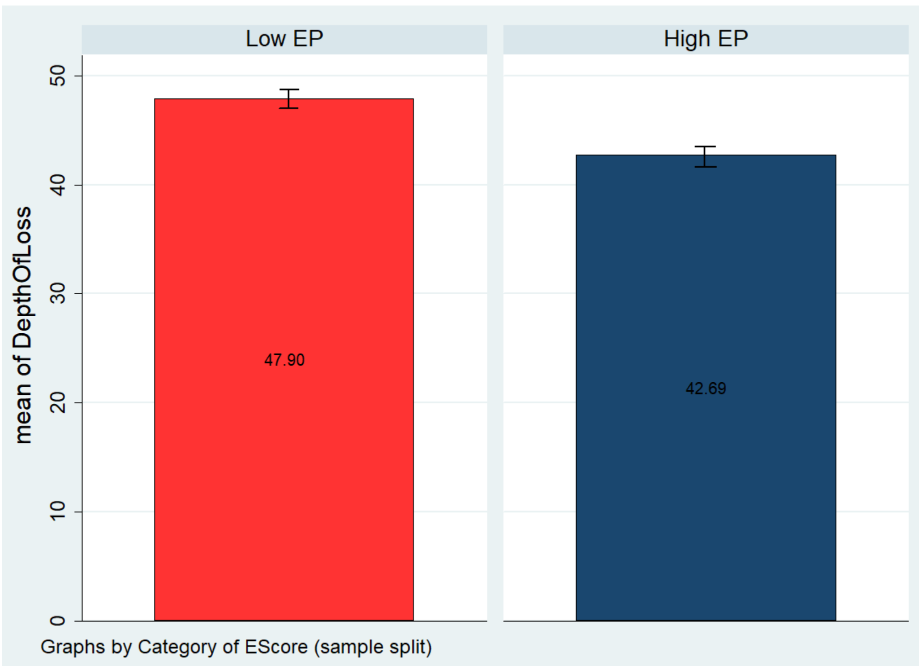
Figures and Tables

Figure 1: Average stock price evolution by category of EP



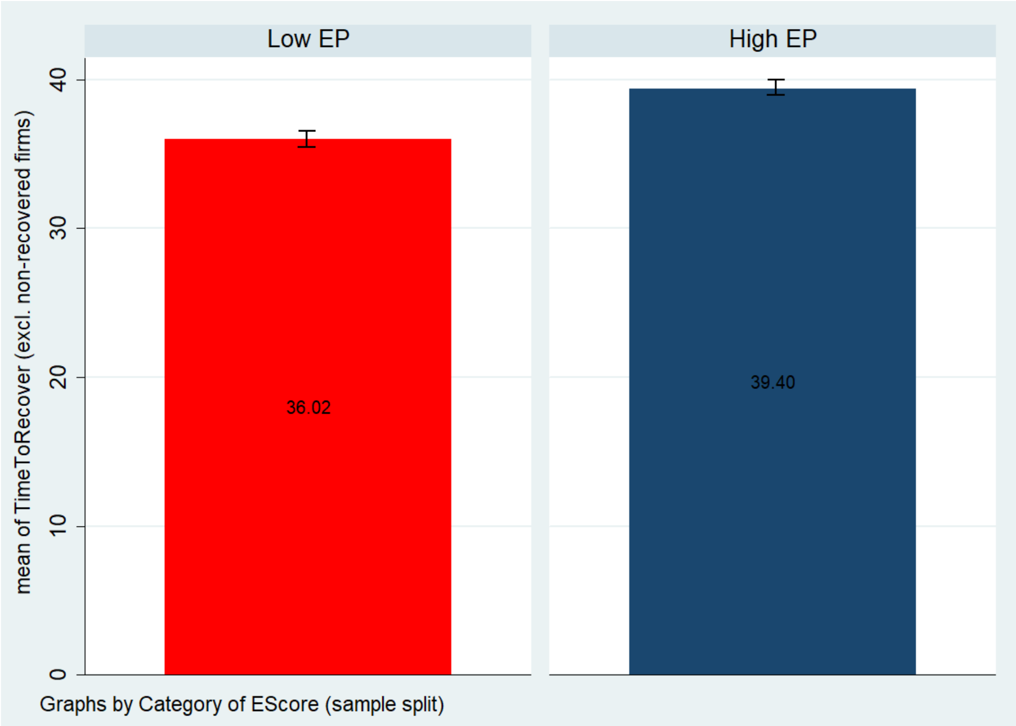
Source: created by the author. This graph plots the evolution of stock prices averaged over categories of EP, split by the median. Base 100 was taken as the maximum stock value of each firm before February 20, 2020. The curve for High EP firms reaches its lowest point on Week 4 at 62.78, the curve for Low EP also reaches its lowest point at Week 4 at 59.62. The average of Low EP stock prices overtakes 100 at Week 40 (last week of November 2020), while the average of High EP stock prices overtakes 100 at Week 46 (first week of January 2021).

Figure 2: Severity of Loss by category of EP



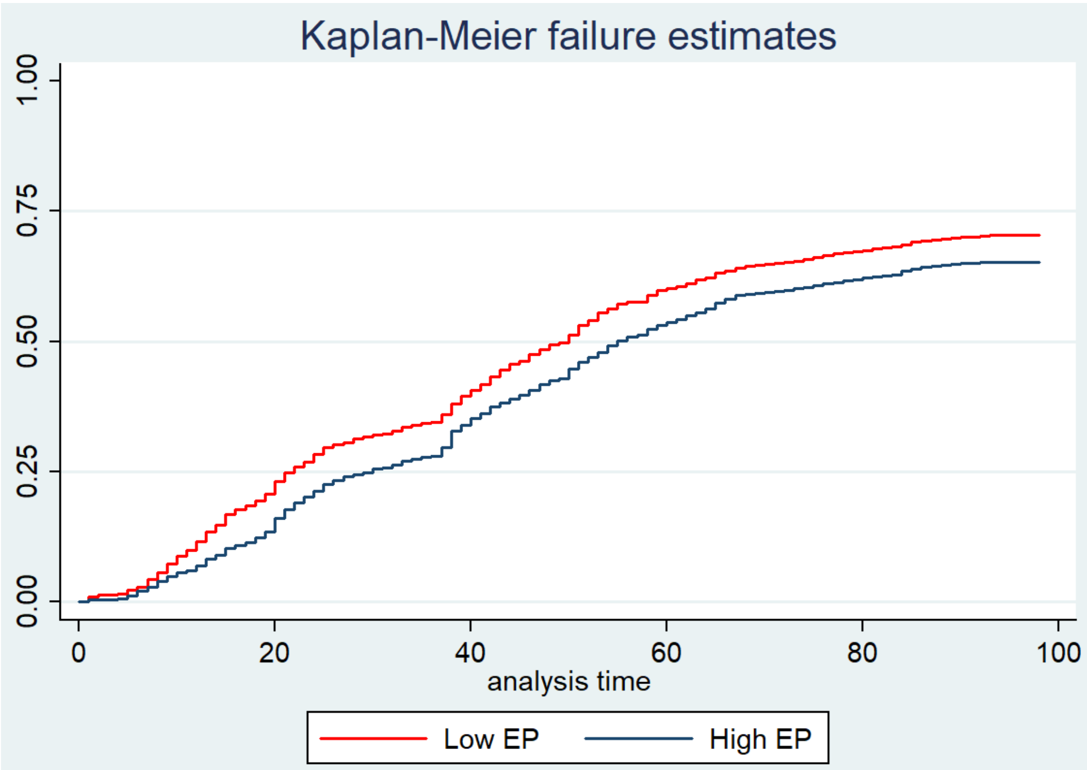
Note: Graphical representation of the distribution of variable *DepthOfLoss* over sample split categories of *EScore*.

Figure 3: Time to recover (excluding non-recovered firms) by category of EP (n=4,518)



Note: Graphical representation of the distribution of variable *TimeToRecover* over sample split categories of *EScore*.

Figure 4: Kaplan-Meier failure estimates, sample split by EP



Source: created by the author. Note: Kaplan-Meier failure estimates split between high and low EP groups. This figure shows the Kaplan-Meier failure curves for both groups, which have been split according to the median. The x-axis shows the analysis time in weeks, and the y-axis shows the probability to change the state of recovery (to become *Recovered*). High probability shows better flexibility. The High EP group has a comparatively lower probability to recover overall.

Table 1: Sample Selection Methodology

Firms in the sample	Obs.
Screened firms with ESG data available for year 2019.	8,059
Less: Observations missing stock price around Feb 20, 2020	(94)
Less: Observations missing important data:	
- Environmental pillar score and subconstituents	(36)
- Number of Employees	(781)
- ROA	(47)
- Momentum	(142)
- CAPEX	(296)
Final Sample	6,663

Table 2: Variables Description

Variables	Description	Data Source
TimeToRecover	Time in weeks for the firm's stock price to recover (remain over baseline for 5 consecutive weeks)	Datastream
DepthOfLoss	Maximum percentage loss of firm's stock price after 20/02/2020	Datastream
Recovered	Binary variable for recovery (1 if recovered, 0 otherwise)	Datastream
Size	One plus natural logarithm of the number of employees, winsorized at 1% and 99%	Datastream
ROA	Return on assets (2019), winsorized at 1% and 99%	Datastream
FinLev	Financial leverage (Debt-to-Assets ratio) (2019), winsorized at 1% and 99%	Datastream
Momentum	Based on stock Price volatility, exponentially weighted moving average of the squared daily log returns over the last 200 days, winsorized at 1% and 99%	Datastream
CAPEX	One plus natural logarithm of Capital Expenditures (2019), winsorized at 1% and 99%	Datastream
Beta19	Firm's beta to local index in 2019. Covariance of the firm's stock price movement in relation to the market's price movement (local index)	Datastream
EPI	Country Environmental Performance Index (EPI) in 2020	Yale University
GDP19	Country GDP Per Capita (Current USD thousands) in 2019	IMF
EScore	Environmental Pillar Score (ESG) (2019)	Datastream (Asset4)
ResourceUse	Resource Use Score (ESG) (2019)	Datastream (Asset4)
EnvInnovation	Environmental innovation Score (ESG) (2019)	Datastream (Asset4)
Emissions	Emissions Score (ESG) (2019)	Datastream (Asset4)
Sector	Binary variable for Sector from the GICS 2-digit classification	Datastream
Country	Binary variable for country of headquarters	Datastream

Note: Datastream = Thomson Reuters' Refinitiv Datastream (historical financial database).

Table 3: Sample Description

Sector		Country of HQ	
Industrials	1,144	USA	2,468
Financials	1,042	China	705
Health Care	784	Japan	431
Consumer Discretionary	775	UK	349
Information Technology	611	Canada	268
Materials	572	Germany	180
Consumer Staples	426	Australia	167
Real Estate	383	Sweden	145
Communication Services	338	India	143
Energy	326	France	140
Utilities	262	Hong Kong	135
		Switzerland	131
		South Africa	93
		Italy	87
		Thailand	76
		Brazil	69
		Spain	68
		Other	1,008
N	6,663		6,663

Table 4: Summary Statistics

VARIABLES	N	mean	median	sd	min	max	p25	p75
TimeToRecover	6,663	57.08	52	33.48	1	98	25	98
DepthOfLoss	6,663	45.30	44.20	18.07	0	99.54	32.37	56.65
Recovered	6,663	0.68	1	0.47	0	1	0	1
Size	6,663	9.19	9.43	2.04	3.64	13.40	7.91	10.61
ROA	6,663	1.87	3.71	15.77	-89.85	31.52	0.93	7.88
FinLev	6,663	24.10	21.82	20.06	0	87.22	6.11	36.81
Momentum	6,663	2.48	2.12	1.32	0.88	8.32	1.65	2.87
CAPEX	6,663	18.90	19.09	2.25	12.00	23.56	17.55	20.44
Beta19	6.663	1.04	1.00	0.56	-7.16	4.76	0.69	1.33
EPI	6,663	50.53	51.10	13.72	18.90	77.90	50	57.20
GDP19	6,663	45.77	48.28	23.04	0.96	167.02	33.63	65.08
EScore	6,663	0.34	0.29	0.29	0	0.99	0.04	0.58
ResourceUse	6,663	0.37	0.33	0.34	0	0.99	0	0.67
EnvInnovation	6,663	0.23	0	0.30	0	0.99	0	0.50
Emissions	6,663	0.38	0.34	0.34	0	0.99	0	0.68

Summary statistics of the sample. The Flexibility dimension of Resilience is *TimeToRecover*, the number of weeks of market price recovery calculated over the 97 weeks following 20/02/2020, until 01/01/2022. The Stability dimension of Resilience is *DepthOfloss*, the maximum percentage loss of the firm's stock price after 20/02/2020. *Recovered* is a binary variable meant to test the likelihood of recovery in Logit models. *Size* is one plus the natural log of firms' number of employees. *ROA* is the return on assets ratio. *FinLev* is the financial leverage ratio (total debt divided by total assets). *Momentum* reflects the market changes in the 200 days preceding the event. *CAPEX* is the firm's capital expenditures in 2019, in Billion USD. *Beta19* is the covariance of the firm's stock price movement in relation to the market's price movement in 2019. All the financial control variables are winsorized at the 1% and 99% levels. *EPI* is the measure of the Environmental Performance Index of the country of headquarters in 2020. *GDP19* is the GDP per Capita of the country of headquarters in 2019. Multiple Scores are derived from the Asset4's ESG databases, these scores range from 0 to 1 and denote a firm's attention and action in differentiated topics related to Environmental, Social or Governance issues.

Table 5: Correlations matrix

	TimeToRecover	DepthOfLoss	Recovered	EScore	ResourceUse	EnvInnovation	Emissions	Size	ROA	FinLev	Momentum	CAPEX	Beta19	EPI
TimeToRecover	1													
DepthOfLoss	0.39***	1												
Recovered	-0.84***	-0.29***	1											
EScore	0.09***	-0.16***	-0.05***	1										
ResourceUse	0.09***	-0.14***	-0.05***	0.91***	1									
EnvInnovation	0.06***	-0.14***	-0.01	0.73***	0.53***	1								
Emissions	0.10***	-0.15***	-0.07***	0.91***	0.84***	0.51***	1							
Size	-0.01	-0.21***	0.03**	0.53***	0.52***	0.37***	0.50***	1						
ROA	0.01	-0.25***	0.03**	0.23***	0.22***	0.14***	0.23***	0.35***	1					
FinLev	0.07***	0.11***	-0.06***	0.13***	0.11***	0.08***	0.11***	0.14***	-0.02	1				
Momentum	-0.06***	0.44***	0.00	-0.32***	-0.29***	-0.25***	-0.31***	-0.36***	-0.49***	-0.02	1			
CAPEX	0.06***	-0.17***	-0.02*	0.56***	0.53***	0.37***	0.54***	0.73***	0.34***	0.27***	-0.37***	1		
Beta19	-0.08***	0.26***	0.08***	-0.05***	-0.04***	-0.01	-0.05***	0.00	-0.17***	0.04***	0.24***	0.01	1	
EPI	0.07***	0.15***	-0.02	0.10***	0.10***	0.08***	0.11***	-0.12***	-0.04**	-0.04**	0.00	-0.09***	-0.07***	1
GDP19	-0.02	0.22***	0.06***	-0.17***	-0.16***	-0.09***	-0.19***	-0.26***	-0.18***	-0.01	0.18***	-0.19***	0.04**	0.57***

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. This table presents the pairwise correlations of all the variables used in the statistical analysis.

Table 6: t-test - Equality of means of DepthOfLoss between groups of EP

Group	Mean	Std. Err.	Std. Dev.	95% Conf. interval	
Low EP	47.90	0.33	19.18	47.25	48.55
High EP	42.69	0.29	16.48	42.13	43.25
Combined	45.30	0.22		44.86	45.73
Diff	5.20***	0.44		4.35	6.06

* p < 0.05, ** p < 0.01, *** p < 0.001. This table presents the equality of means test (t-test) for variable *DepthOfLoss* over two categories of *EScore*, separated by the median.

Table 7: t-test - Equality of means of TimeToRecover (excluding non-recovered firms) between groups of EP (n = 4,518)

Group	Mean	Std. Err.	Std. Dev.	95% Conf. interval	
Low EP	36.02	0.46	22.10	35.13	36.92
High EP	39.40	0.46	21.61	38.49	40.31
Combined	37.65	0.33	21.92	37.01	38.29
Diff	-3.38***	0.65		-4.65	-2.10

* p < 0.05, ** p < 0.01, *** p < 0.001. This table presents the equality of means test (t-test) for variable *TimeToRecover* over two categories of *EScore*, separated by the median. Firms that have not recovered before 01/01/2022 are excluded.

Table 8: t-test - Equality of means of TimeToRecover between groups of EP

Group	Mean	Std. Err.	Std. Dev.	95% Conf. interval	
Low EP	54.39	0.59	33.83	53.24	55.54
High EP	59.76	0.57	32.92	58.65	60.88
Combined	57.08	0.41	33.48	56.27	57.88
Diff	-5.38***	0.82		-6.98	-3.78

* p < 0.05, ** p < 0.01, *** p < 0.001. This table presents the equality of means test (t-test) for variable *TimeToRecover* over two categories of *EScore*, separated by the median. Firms that have not recovered before 01/01/2022 are included.

Table 9: OLS regressions on severity of loss – Effect of EScore on severity of loss (stability)

VARIABLES	(1) OLS 1	(2) OLS 2	(3) OLS 3	(4) OLS 4	(5) OLS 5
EScore	-9.861***	-3.453***	-2.616***	-2.036**	-2.347***
	(0.748)	(0.827)	(0.828)	(0.843)	(0.810)
Size		0.130	-0.654***	-0.608***	-0.094
		(0.151)	(0.142)	(0.142)	(0.153)
ROA		-0.084***	-0.012	-0.008	-0.093***
		(0.014)	(0.014)	(0.014)	(0.014)
FinLev		0.070***	0.110***	0.108***	0.090***
		(0.009)	(0.010)	(0.010)	(0.010)
Momentum		4.708***	5.028***	4.978***	4.750***
		(0.168)	(0.176)	(0.177)	(0.169)
CAPEX		-0.114	0.242*	0.208	-0.310**
		(0.136)	(0.135)	(0.135)	(0.138)
Beta19		4.454***	5.474***	5.408***	4.489***
		(0.333)	(0.353)	(0.353)	(0.341)
EPI			0.218***	0.180***	0.164***
			(0.014)	(0.018)	(0.017)
GDP19				0.039***	0.041***
				(0.011)	(0.010)
Sector-fixed effects	No	**Yes**	No	No	**Yes**
Country-fixed effects	No	**Yes**	No	No	No
Constant	48.612***	27.910***	15.790***	16.193***	22.776***
	(0.333)	(4.314)	(2.293)	(2.293)	(2.454)
Max VIF	1.00	**112.82**	2.56	2.58	3.76
R-squared	0.025***	0.421***	0.263***	0.265***	0.361***
Observations	6,663	6,663	6,663	6,663	6,663

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. This table presents the coefficients of independent and control variables regressed with the Ordinary Least Squares (OLS) method over the dependent variable *DepthOfLoss*, the severity of loss following the Covid-19 crisis. A positive coefficient means the variable increases the losses following the advent of the crisis. The coefficients for control binary variables are not reported for the sake of brevity.

Table 10: Weibull Survival Analysis regression - Effect of EScore on rate of recovery (flexibility)

VARIABLES	(1) Weibull 1	(2) Weibull 2	(3) Weibull 3	(4) Weibull 4
EScore	-0.321***	-0.432***	-0.435***	-0.371***
	(0.051)	(0.063)	(0.065)	(0.068)
DepthOfLoss		-0.045***	-0.047***	-0.048***
		(0.001)	(0.001)	(0.001)
Size		0.041***	0.062***	-0.008
		(0.012)	(0.012)	(0.014)
ROA		0.003***	0.004***	0.002
		(0.001)	(0.001)	(0.001)
FinLev		0.001	0.001	0.002***
		(0.001)	(0.001)	(0.001)
Momentum		0.233***	0.231***	0.198***
		(0.013)	(0.013)	(0.014)
CAPEX		-0.045***	-0.047***	-0.020
		(0.011)	(0.011)	(0.012)
Beta19		0.446***	0.470***	0.370***
		(0.028)	(0.028)	(0.029)
EPI			0.000	-0.003*
			(0.001)	(0.001)
GDP19			0.007***	0.007***
			(0.001)	(0.001)
Sector-fixed effects	No	No	No	**Yes**
Constant	-4.918***	-3.932***	-4.392***	-4.296***
	(0.067)	(0.171)	(0.187)	(0.219)
LR Chi^2	39.87***	1873.24***	1979.97***	2456.92***
Observations	6,663	6,663	6,663	6,663

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. This table presents the coefficients of independent and control variables regressed with the Weibull survival analysis method over the dependent variable *TimeToRecover*, the number of weeks required for the firm to recover from the loss following the Covid-19 crisis, taking the full period (20/02/2020 – 01/01/2022) to assess the recovery. A positive coefficient means the variable accelerates the recovery (it increases the hazard rate of recovery). The coefficients for control binary variables are not reported for the sake of brevity.

Table 11: OLS and Weibull regression models - Effects of subcomponents of EScore on stability

VARIABLES	(1) OLS RU	(2) OLS EI	(3) OLS Em	(1) Weibull RU	(2) Weibull EI	(3) Weibull Em
ResourceUse	-1.091			-0.250***		
	(0.675)			(0.057)		
EnvInnovation		-2.814***			-0.159***	
		(0.669)			(0.057)	
Emissions			-1.932***			-0.326***
			(0.691)			(0.058)
DepthOfLoss				-0.048***	-0.048***	-0.048***
				(0.001)	(0.001)	(0.001)
Size	-0.142	-0.096	-0.112	-0.011	-0.021	-0.010
	(0.154)	(0.151)	(0.152)	(0.014)	(0.014)	(0.014)
ROA	-0.092***	-0.096***	-0.093***	0.002	0.002	0.002
	(0.014)	(0.014)	(0.014)	(0.001)	(0.001)	(0.001)
FinLev	0.091***	0.090***	0.090***	0.002***	0.002***	0.002**
	(0.010)	(0.010)	(0.010)	(0.001)	(0.001)	(0.001)
Momentum	4.774***	4.733***	4.752***	0.200***	0.200***	0.198***
	(0.169)	(0.169)	(0.169)	(0.014)	(0.014)	(0.014)
CAPEX	-0.357***	-0.336**	-0.310**	-0.024**	-0.029**	-0.019
	(0.137)	(0.135)	(0.138)	(0.012)	(0.012)	(0.012)
Beta19	4.487***	4.555***	4.478***	-0.003**	-0.004***	-0.002*
	(0.341)	(0.341)	(0.341)	(0.001)	(0.001)	(0.001)
EPI	0.158***	0.162***	0.165***	0.369***	0.375***	0.368***
	(0.017)	(0.016)	(0.017)	(0.029)	(0.029)	(0.029)
GDP19	0.044***	0.044***	0.040***	0.008***	0.008***	0.007***
	(0.010)	(0.010)	(0.010)	(0.001)	(0.001)	(0.001)
Sector-fixed effects	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Constant	23.992***	23.103***	22.992***	-4.194***	-4.052***	-4.285***
	(2.429)	(2.357)	(2.439)	(0.216)	(0.211)	(0.217)
R-squared	0.360***	0.362***	0.361***			
LR Chi^2				2455.7***	2444.1***	2467.9***
Observations	6,663	6,663	6,663	6,663	6,663	6,663

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The left section of this table presents the coefficients of independent and control variables regressed with the Ordinary Least Squares (OLS) method over the dependent variable *DepthOfLoss*, the severity of loss following the Covid-19 crisis. A positive coefficient means the variable increases the losses following the advent of the crisis. The right section of this table presents the coefficients of independent and control variables regressed with the Weibull survival analysis method over the dependent variable *TimeToRecover*, the number of weeks required for the firm to recover from the loss following the Covid-19 crisis, taking the full period (20/02/2020 – 01/01/2022) to assess the recovery. A positive coefficient means the variable accelerates the recovery (it increases the hazard rate of recovery). The main independent variable, *EScore* in previous models, is replaced alternatively with its constituents: *ResourceUse*, *EnvInnovation*, and *Emissions*. The coefficients for control binary variables are not reported for the sake of brevity.

Appendices

Appendix 1: Robustness checks, multiple survival analysis models on rate of recovery and logit model on likeliness to recover

VARIABLES	(1) Cox	(2) Gompertz	(3) Exp	(4) Logit
EScore	-0.370***	-0.347***	-0.331***	-0.485***
	(0.068)	(0.068)	(0.068)	(0.133)
DepthOfLoss	-0.048***	-0.044***	-0.042***	-0.060***
	(0.001)	(0.001)	(0.001)	(0.002)
Size	-0.013	-0.007	-0.008	0.003
	(0.014)	(0.014)	(0.014)	(0.025)
ROA	0.002	0.002	0.002	0.005**
	(0.001)	(0.001)	(0.001)	(0.002)
FinLev	0.002**	0.002**	0.002**	0.003
	(0.001)	(0.001)	(0.001)	(0.002)
Momentum	0.202***	0.183***	0.174***	0.235***
	(0.014)	(0.014)	(0.014)	(0.031)
CAPEX	-0.017	-0.020	-0.019	-0.044**
	(0.012)	(0.012)	(0.012)	(0.022)
Beta19	0.362***	0.345***	0.323***	0.627***
	(0.029)	(0.029)	(0.029)	(0.062)
EPI	-0.003**	-0.003*	-0.003*	-0.006**
	(0.001)	(0.001)	(0.001)	(0.003)
GDP19	0.007***	0.007***	0.007***	0.015***
	(0.001)	(0.001)	(0.001)	(0.002)
Sector-fixed effects	**Yes**	**Yes**	**Yes**	**Yes**
Constant		-3.249***	-3.078***	2.686***
		(0.210)	(0.210)	(0.405)
LR Chi²	2378.8***	2198.5***	2112.2***	1393.0
Observations	6,663	6,663	6,663	6,663

Standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. This table presents the coefficients of independent and control variables regressed with varying survival analysis methods over the dependent variable *TimeToRecover*, the number of weeks required for the firm to recover from the loss following the Covid-19 crisis, taking the full period (20/02/2020 – 01/01/2022) to assess the recovery. A positive coefficient means the variable accelerates the recovery (it increases the hazard rate of recovery). It also presents Logit regressions of the same independent and control variables over the binary variable *Recovered*, which equals 1 if the firm has recovered, 0 otherwise, to test the effect on the likeliness to recover. A positive coefficient in a Logit model means the associated variable increases the likeliness to recover. The coefficients for control binary variables are not reported for the sake of brevity.

Appendix 2: Robustness checks, multiple OLS and survival analysis windows

VARIABLES	(1) OLS Nov	(2) OLS Oct	(3) OLS Sep	(4) Weibull Nov	(5) Weibull Oct	(6) Weibull Sep
EScore	-2.425***	-2.337***	-2.217***	-0.384***	-0.383***	-0.371***
	(0.805)	(0.803)	(0.802)	(0.069)	(0.069)	(0.070)
DepthOfLossNov				-0.048***		
				(0.001)		
DepthOfLossOct					-0.048***	
					(0.001)	
DepthOfLossSep						-0.048***
						(0.001)
Size	-0.099	-0.125	-0.154	-0.008	-0.003	-0.003
	(0.152)	(0.152)	(0.152)	(0.014)	(0.014)	(0.014)
ROA	-0.085***	-0.083***	-0.081***	0.002*	0.002*	0.002*
	(0.014)	(0.014)	(0.014)	(0.001)	(0.001)	(0.001)
FinLev	0.094***	0.096***	0.096***	0.002***	0.002***	0.002***
	(0.010)	(0.010)	(0.009)	(0.001)	(0.001)	(0.001)
Momentum	4.470***	4.294***	4.192***	0.188***	0.183***	0.183***
	(0.168)	(0.168)	(0.168)	(0.014)	(0.014)	(0.014)
CAPEX	-0.299**	-0.275**	-0.253*	-0.018	-0.021*	-0.022*
	(0.137)	(0.137)	(0.137)	(0.012)	(0.012)	(0.013)
Beta19	4.490***	4.500***	4.505***	0.366***	0.365***	0.362***
	(0.339)	(0.338)	(0.338)	(0.029)	(0.030)	(0.030)
EPI	0.168***	0.169***	0.169***	-0.003**	-0.003**	-0.003**
	(0.017)	(0.017)	(0.017)	(0.001)	(0.001)	(0.001)
GDP19	0.044***	0.047***	0.050***	0.008***	0.008***	0.008***
	(0.010)	(0.010)	(0.010)	(0.001)	(0.001)	(0.001)
Sector-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Constant	22.524***	22.366***	22.177***	-4.438***	-4.456***	-4.492***
	(2.441)	(2.434)	(2.433)	(0.221)	(0.223)	(0.226)
R-squared	0.354***	0.350***	0.348***			
LR Chi^2				2419.1***	2427.3***	2450.4***
Observations	6,663	6,663	6,663	6,663	6,663	6,663

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. This table presents the coefficients of independent and control variables regressed with the Ordinary Least Squares (OLS) method over the dependent variable *DepthOfLoss* in the left section, and with the Weibull survival analysis method over the variable *TimeToRecover* in the right section, assessing the recovery over different periods than the main analysis, with observation windows finishing at the end of November 2021, October 2021, and September 2021, respectively. A positive coefficient in OLS models means the variable increases the losses following the advent of the crisis. A positive coefficient in Weibull survival analysis models means the variable accelerates the recovery (it increases the hazard rate of recovery). The coefficients for control binary variables are not reported for the sake of brevity.