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The Nexus Between Firm's Environmental Performance and Financial Resilience

Muhammad Ullah

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UNIVERSITÉ CLERMONT AUVERGNE
École Universitaire de Management
École Doctorale des Sciences Économiques, Juridiques, Politiques et de Gestion
Clermont Recherche Management (CleRMA)

Sujet de la thèse :

**The Nexus Between Firms’
Environmental Performance and Financial Resilience**

Pour obtenir le titre de

DOCTEUR EN SCIENCES DE GESTION

Présentée par

Muhammad ULLAH

soutenue le 18 juin 2020

devant le jury composé de :

Directeur de thèse	Sylvain MARSAT Professeur, Université Clermont Auvergne
Rapporteur	Stéphanie SERVE Professeure, Université Paris-Est Créteil
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L'université n'entend donner aucune approbation ni improbation aux opinions émises dans les thèses ; ces opinions doivent être considérées comme propres à leurs auteurs.

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Abstract

This thesis comprises three empirical essays investigating the impact of environmental performance (EP) of firms on their financial resilience. We capitalize from the vast literature of EP on financial performance and contribute to uncover an unexplored aspect of financial performance, i.e. financial resilience. Financial resilience can be defined as “both the ability of a system to persist despite financially stressful events and the ability to regenerate and maintain existing organization” (Gunderson and Pritchard, 2002, DesJardine et al., 2017). On the one hand, based on shareholders’ expense view, high EP may be viewed as an overinvestment or waste of financial resources and may therefore reduce a company’s financial resilience when confronted to an adverse event. On the other hand, in line with the natural-resource-based and environment-as-a-resource views, high EP companies may buffer the shock and recover faster by benefitting from stakeholders’ attention through their reputation of being eco-friendly and the competitive advantage of having valuable and inimitable resources.

The first chapter introduces the EP and organizational resilience and discusses their financial implications from theoretical and empirical literatures. Bridging the literatures of both areas from a financial viewpoint lead us to our general research question, to investigate “the nexus between firms’ EP and their financial resilience”. Building on this, the chapter then introduces the avenues of research that are undertaken in the following chapters.

In the second chapter, we investigate the relationship in the context of a global shock for the worldwide economy, the subprime financial crisis of 2007. Using an international sample of 1,622 observations, we measure firm’s financial resilience by the time to recovery of their market prices to the pre-crisis level. By performing survival analysis, we find that high EP is

negatively related to the financial resilience of companies. This indicates that high EP seems to be an organizational constraint that limits the ability of a company to be financially resilient to general financial crisis. However, we also find that EP is not detrimental to resilience for its specific product innovation dimension, nor for companies in less environmentally oriented countries.

In the third chapter, we investigate the relationship in the context of regulatory requirements, more precisely by the disruptions caused by the disclosure of verified emissions under the EU ETS. Performing the survival analysis over a sample of 3,194 observations covered under the EU ETS, we find that high EP is positively related to the financial resilience, measured by time to recovery of firm's market price to the day before the publication. In line with the natural resource based view ([Hart, 1995](#), [Russo and Fouts, 1997](#)) and the environment-as-a resources framework ([Flammer, 2013](#)), this finding suggests that high EP is beneficial for company, and improves the ability of companies to be financially resilient in the context of an environmental regulative framework. However, we find that high EP is more beneficial if firm is in carbon-intensive industry, the carbon prices are high.

Finally, the fourth chapter investigates the impact of EP on financial resilience to jolts caused by company specific environmental controversies. We apply survival analysis and OLS regression models to assess the impact of firms' EP on their flexibility (time to recovery of market value) and stability (severity of loss in market value) dimensions of resilience, respectively. Using an international sample of 233 observations over the 2010-2016 period, we find that prior EP significantly enhances the both dimensions of financial resilience of companies. This finding indicates that stakeholders are more likely to consider the occurrence of a negative environmental event from a high EP firm as an anomaly rather than a usual behavior, since high EP firm benefits from good stakeholder relations. However, this

relationship is sensitive to different conditions and stands only for companies in environmentally oriented countries, in most polluting industries and for two of the dimensions of EP, i.e. emission reduction and product innovation.

Overall, if high EP seems detrimental to financial resilience in the context of general financial disruptions, we find that EP is improving financial resilience in the specific context of disruptions involving environmental engagements from companies, i.e. environmental regulations and environmental controversies. The impact of EP on resilience is then dependent to the context of the adverse event encountered by the firm.

Keywords: Financial Resilience, Environmental Performance, Survival Analysis, Firm Value, Crisis Management, Financial Markets.

Résumé

Cette thèse comprend trois essais empiriques traitant de l'impact de la performance environnementale des entreprises sur leur résilience financière. Nous mobilisons la vaste littérature concernant le lien entre la performance environnementale et la performance financière et contribuons en analysant un aspect non traité de la performance financière, à savoir la résilience financière. La résilience financière peut être définie comme “à la fois la capacité d'un système à persister malgré des événements financièrement stressants et la capacité de régénérer et de maintenir l'organisation existante” (Gunderson and Pritchard, 2002, DesJardine et al., 2017). D'une part, du point de vue actionnarial, une performance environnementale élevée peut être considérée comme un surinvestissement ou un gaspillage de ressources financières et peut donc réduire la résilience financière d'une entreprise face à un événement défavorable. D'un autre côté, conformément à la vision de l'environnement en tant que ressource, les entreprises avec un performance environnementale élevée peuvent amortir le choc et récupérer plus rapidement en bénéficiant de l'attention des parties prenantes, et cela grâce à leur réputation d'être respectueuses de l'environnement et à l'avantage concurrentiel d'avoir des ressources inimitables.

Le premier chapitre présente la performance environnementale et la résilience organisationnelle, et traite de leurs implications financières à partir des littératures théoriques et empiriques. Mobiliser la littérature des deux domaines nous amène à notre question de recherche générale, qui cherche à investiguer le lien entre la performance environnementale des entreprises et leur résilience financière. S'appuyant sur cela, le chapitre présente ensuite les pistes de recherche qui sont conduites dans les chapitres suivants.

Dans le deuxième chapitre, nous étudions la relation dans le contexte d'un choc mondial pour l'économie, la crise financière des subprimes de 2007. En utilisant un échantillon international de 1622 observations, nous mesurons la résilience financière des entreprises comme le temps nécessaire que le cours de bourse de l'entreprise retrouve son prix de marché du niveau d'avant la crise. En effectuant une analyse de survie, nous constatons qu'une performance environnementale élevée est négativement liée à la résilience financière des entreprises. Cela indique qu'une performance environnementale élevée semble être une contrainte organisationnelle qui limite la capacité d'une entreprise à être financièrement résiliente à la crise financière générale. Cependant, nous constatons également que la performance environnementale n'est pas préjudiciable à la résilience dans sa dimension spécifique d'innovation de produit, ni pour les entreprises dont le siège sociale est localisé dans des pays moins soucieux de l'environnement.

Dans le troisième chapitre, nous étudions la relation dans le contexte des exigences réglementaires, plus précisément par les perturbations causées par la divulgation des émissions vérifiées dans le cadre des ETS européens (EU ETS). En effectuant l'analyse de survie sur un échantillon de 3194 observations couvertes par l'EU ETS, nous constatons qu'un EP élevé est positivement lié à la résilience financière, mesuré par le temps nécessaire à la récupération du prix du marché de l'entreprise jusqu'à la celui de la veille de la publication. Conformément à la vision basée sur les ressources naturelles (Hart, 1995, Russo and Fouts, 1997) et au cadre de l'environnement comme une ressource (Flammer, 2013), cette constatation suggère qu'une performance environnementale élevée est bénéfique pour l'entreprise et améliore la capacité des entreprises à être financièrement résilientes dans un cadre réglementaire environnemental.

Le quatrième chapitre examine l'impact de la performance environnementale sur la résilience financière dans le contexte des controverses environnementales spécifiques aux entreprises.

Nous appliquons des modèles d'analyse de survie et de régression de moindres carrés pour évaluer l'impact de la performance environnementale des entreprises sur leurs dimensions de flexibilité (délai de récupération de la valeur de marché) et de stabilité (gravité de la perte de valeur de marché) de la résilience. En utilisant un échantillon international de 233 observations sur la période 2010-2016, nous constatons que de la performance environnementale améliore considérablement les deux dimensions de la résilience financière des entreprises. Cette constatation indique que les parties prenantes sont plus susceptibles de considérer la survenance d'un événement environnemental négatif d'une entreprise à performance environnementale élevée comme une anomalie plutôt qu'un comportement habituel, car elle bénéficie de bonnes relations avec les parties prenantes. Cependant, cette relation est sensible à différentes conditions et ne concerne que les entreprises des pays les plus impliqués dans la dimension environnementale, les industries polluantes et pour deux des dimensions de la performance environnementale, à savoir la réduction des émissions et l'innovation des produits. Dans l'ensemble, si la performance environnementale élevée semble nuire à la résilience financière dans le contexte de perturbation financière générale, nous constatons qu'elle améliore la résilience financière dans le contexte des perturbations impliquant des engagements environnementaux de la part des entreprises, à savoir les réglementations environnementales et les controverses environnementales. L'impact du EP sur la résilience dépend alors du contexte de l'événement indésirable rencontré par l'entreprise.

Mots clés : Résilience financière, Performance Environnementale, Analyse de Survie, Valeur de l'Entreprise, Gestion de Crise, Marchés Financiers,

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Abbreviations

CI	Carbon Intensity
CSR	Corporate Social Responsibility
EP	Environmental Performance
EPI	Environmental Performance Index scores
EU ETS	European Union's Emission Trading Scheme
EUTL	European Union Transaction Log
FP	Financial Performance
GHG	Greenhouse Gases emissions

بي بي او دا جي ته ڊالي*

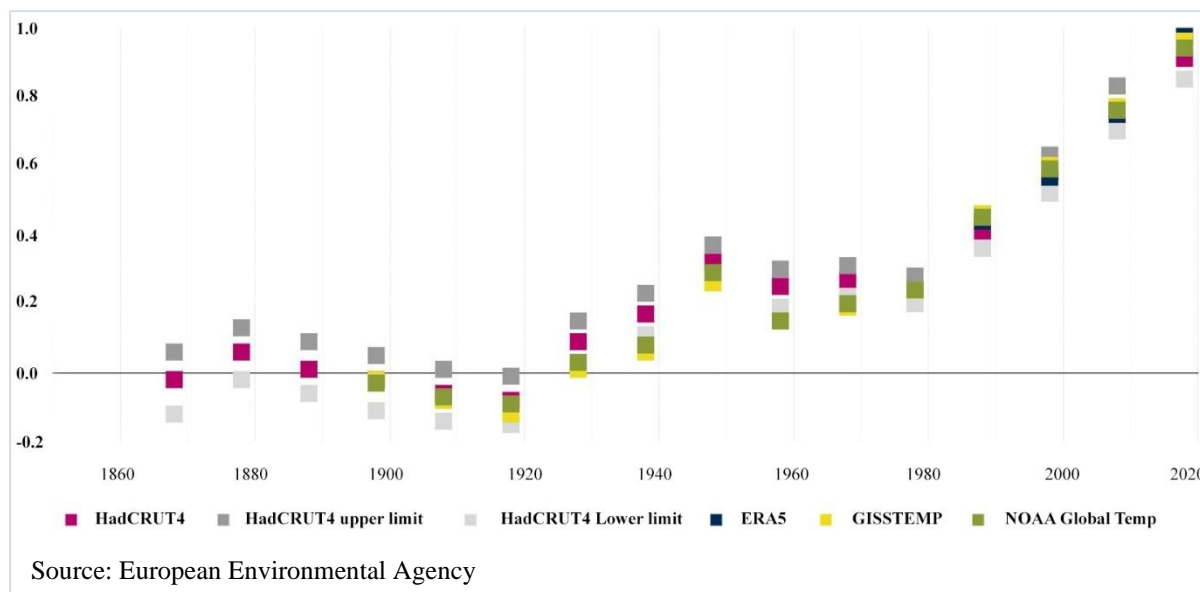
* Dedicated to my parents

General introduction

Over the last few decades, concerns about climate change are dramatically increased. These concerns are driven by the fact that the average global temperature is increasing, the amount of snow and ice is decreasing, and sea levels are rising, which has widespread impacts on human and the overall ecosystem (IPCC, 2014). While the human-induced greenhouse gasses (GHG) emissions are the main contributor to global warming, IPCC (2014) find that humans are influencing the climate system with a growing rate. As depicted in figure 1, the global decadal average temperature is continuously increasing since the industrial revolution era. It is clear now that among human-induced GHG emissions, industrial emissions are the main contributor, where they contributed the carbon emissions of about 78% to the total GHG emissions from 1970 to 2010 (IPCC, 2014). As these emissions are driven by an increase in energy usage, mainly from fossil fuel, a growth in world population and economic activity will further worsen the problem of climate change. Therefore, the impact on human wellbeing cannot be reduced if the path of sustainable development is not adopted (OECD, 2016).

Having a major contribution to the global GHG emissions, companies have been encouraged to implement environmentally friendly policies to address climate change and environmental issues, mitigate the economic impact on the environment, and develop eco-efficiencies (Linnenluecke et al., 2016, Banerjee et al., 2019). At an international level, institutions such as the World Business Council for Sustainable Development or the Conferences of Parties (COP) strongly support such practices (Bazillier et al., 2017). Environmental issues have thus become a crucial issue for companies, and all the more because stakeholders seem to be more and more sensitive to these elements (Flammer, 2013). An analysis conducted by PRI-Novethic (PRI-Novethic, 2017) reveal that global investors are considering actions on climate change as

Figure 1: Global decadal average near surface temperatures relative to the pre-industrial period



one of the most important long-term trends for investment. In their survey on PRI¹ signatories, a 74% of 302 asset owners and 63% of 935 investment managers considered climate change as a long-term issue for action. Besides, a recent survey by KPMG² reports that a solid majority of world’s largest 250 companies (67% in 2017) are now disclosing their emissions abatement targets. Furthermore, the Global Risks Perception Survey (World Economic Forum, 2020) show that for the first time in history the environmental concerns have dominated all the global risks by likelihood. The survey shows that all the top five global risks by likelihood spots are occupied by the environmental risks, whereas, three of the top five risks by impact are also environmental. This indicate that companies are now facing a significant pressure from stakeholders, and they are acting on this by adopting environmental policies to make their production and processes eco-efficient.

¹ Principles for Responsible Investment (PRI) URL: <https://www.unpri.org/>

² <https://assets.kpmg/content/dam/kpmg/xx/pdf/2017/10/kpmg-survey-of-corporate-responsibility-reporting-2017.pdf>

While companies are trying to address the environmental issues, they are simultaneously confronting a turbulent and continuously evolving marketplace. Extreme events like natural disasters, terrorist attacks, organizational controversies, and pandemic diseases (like the recent COVID-19) are frequently disrupting supply chain and paralyzing the financial markets. While unexpected events and sudden changes in the natural or financial environment are frequently surprising them, companies are now facing more and more challenges to survive and compete. Indeed, companies will then need to mobilize their resources in a way to create resilience in organization. A resilient organization has “both the ability to persist despite disruptions and the ability to regenerate and maintain existing organization” (Gunderson and Pritchard, 2002, DesJardine et al., 2017). In a challenging and unexpected adverse environment, resilient organizations have the ability to mitigate the shocks and to bounce back.

Despite capturing the success of an organization against disruptions, organizational resilience remains unexplored in empirical academic literature. This work remain scarce may be because organizational resilience is difficult to measure (DesJardine et al., 2017). Very few studies link some organizational attributes to this organizational outcome, while organizational resilience can be measured by the recovery of company’ market price to the level before a disruption. Gittell et al. (2006) examined the recovery of US airline companies in the aftermath of 9/11 terrorist attacks and find that a viable business model and financial resources help companies to recover faster from a crisis. While examining the role of CSR practices in recovery from the global financial crisis of 2007, DesJardine et al. (2017) find that strategic CSR practices, that establishes long-term adjustments in and builds interdependencies across organizational structure, improve the financial resilience relative to tactical CSR practices. Moreover, Ortiz-de-Mandojana and Bansal (2016) find a low rate of failure of firms with high CSR relative to their matching peers in the industry.

Considering both the environmental and financial claims during a distress situation, it is however not clear that the resources dedicated to address the environmental issues are penalizing or helping companies. To consider the financial impact of high environmental performance (henceforth EP) on company's financial performance (henceforth FP), majority of previous work show a positive impact while few studies show a negative or no impact at all, therefore, remains inconclusive (Horváthová, 2010). According to the neoclassical economists' shareholders' expense view, for example Friedman (1970), "the social responsibility of business is to increase its profits". Then, spending money on social-responsibility activities such as environmental protection may drain resources from the business that could be mobilized in the core or other functions of the business to maximize profits, hence shareholders wealth. It seems unrealistic for managers to achieve various goals simultaneously, i.e. financial and social goals (Jensen, 2001), therefore, it may create the agency problem due to the difficulties for shareholders to monitor them (Barnea and Rubin, 2010). Managers may then pursue their own interests (Barnea and Rubin, 2010), entrench themselves (Jiraporn and Chintrakarn, 2013, Cespa and Cestone, 2007, Surroca and Tribó, 2008, Chahine et al., 2019) and use it to mitigate control mechanisms (Surroca and Tribó, 2008, Fabrizi et al., 2014).

On the contrary, the natural resource-based view (Hart, 1995, Russo and Fouts, 1997) sees EP as a key resource for firms, suggesting that environmental engagements improve firm reputation of being eco-friendly and can gain competitive advantage through the acquisition of rare, valuable, imperfectly imitable and non-substitutable resources. As stakeholders seem more and more sensitive to the environmental issues (Flammer, 2013), high EP may protect company from the consequences of a bad environmental event and may consider it as an anomaly (Bansal and Clelland, 2004). In this vein, high EP may then provide the insurance-like benefits in case of negative events (Godfrey et al., 2009). Recent work has identified some other benefits of EP, for instance, green firms may have easier access to finance (Banerjee et

al., 2019, Nandy and Lodh, 2012, Cheng et al., 2014) and a lower cost of capital (Sharfman and Fernando, 2008, Heinkel et al., 2001, Gupta, 2018, Chava, 2014). Furthermore, high EP is also associated with a protection against the consequences of stringent environmental regulations, while carbon intensity is attributed to the latent environmental liability in the shape of future compliance or emissions abatement cost (Clarkson et al., 2015, Chapple et al., 2013, Clarkson et al., 2004).

Though the financial benefits of high EP are preoccupied with the insurance-like effect and environment-as-a-resource framework, we extend this literature by considering an unexplored aspect of financial performance, namely financial resilience. We follow the works of DesJardine et al. (2017) that explored the collective contribution of CSR practices to financial resilience. The authors, however, do not disentangle environmental practices from other CSR practices. We thus examine the precise contribution of EP to companies' financial resilience. In this thesis, we aim to answer the following main research question:

Does EP contribute to financial resilience while a company is in distress?

Keeping in view prior theoretical arguments about the financial implications of EP, we propose two contrasting views to explain the possible link between EP and financial resilience. The first view stems from neoclassical economist's shareholders' expense view, suggesting that discretionary efforts towards EP-improvement may reduce companies' profits. This indicates that managers' involvement in environmental engagements may then create an agency problem because their only objective is to maximize shareholders' wealth. In this sense, managers may mobilize the resources devoted to EP-improvement in other functions of the business to improve company profitability. Furthermore, a company may need more financial resources during the time of a crisis, and therefore these resources could be used as a slack to enable the company to recover faster from the situation (Linnenluecke, 2017). Thus, based on these views,

investors may see the environmental expenditures as an overinvestment which might not be available for the company to make necessary expenditures during the time of distress. Hence, investors may not give value to a company with high EP, therefore, the market value of company may experience a severe loss and not recover faster relative to their peers with low EP.

Second, as environmental elements have become a crucial issue for companies, and stakeholders seem to be more and more sensitive to these elements (Flammer, 2013), then high EP seems the only option to address these issues and adapt to the demanding conditions. If we consider the natural-resource-based reputation view (Hart, 1995, Russo and Fouts, 1997), then high EP seems improving the financial resilience of company. This view suggest that high EP improves the reputation of being eco-friendly among the stakeholders and can gain competitive advantage through the acquisition of rare, valuable, imperfectly imitable and non-substitutable resources. Therefore, exploiting these advantages a company may attract investors more and improve company market valuation, which will help companies when facing a financial shock and will recover faster as compare to non-reputed companies. Considering the latent environmental liability related to the carbon intensity of company (Clarkson et al., 2015, Chapple et al., 2013, Clarkson et al., 2004), an adverse event may bring investors' attention to the cost of future emissions abatement or compliance with regulations. Thus, investors may not invest in companies with higher latent environmental liabilities, therefore, a carbon-intensive company may experience more loss in market value relative to environmentally performant companies.

As organizational resilience addresses an organization's reaction to a disturbance, we consider the financial outcomes of companies in the face of three different adverse events. Furthermore, we consider these disruptions with an aim to capture organizational resilience in two kinds of situations, i.e. (1) a situation triggered by a major financial shock, and (2) a situation linked to

an environmental jolt. To examine the relationship in the first context, we assess the financial resilience of companies to the global financial crisis of 2007. Concerning the environmental side, we assess company's resilience to environmental-regulatory and company-specific environmental jolts caused by environmental controversies. Based on these situations, we raise the following three research questions to address the central point of this thesis:

Research question 1: Does EP contribute to resilience in a general financial distress?

Research question 2: Does EP contribute to resilience in an environmental regulatory distress?

Research question 3: Does EP contribute to resilience in a company specific environmental distress?

Specifically, this thesis comprises four chapters. In first chapter, we present a brief overview of our general research question, examining both EP and organizational resilience. We analyze their theoretical and empirical literatures and discuss the financial implications for companies. We then bridge their literatures, which leads us to consider more in detail the precise link between EP and organizational resilience from a financial viewpoint. Building on this chapter, we then introduce the avenues of research that are undertaken in the following chapters.

Chapter 2 investigates the relationship between EP and financial resilience in the context of a situation of general financial adverse event. The financial implications of EP are vastly discussed in academic debate, but, to our knowledge, no work is dedicated to examining its impact on financial resilience, an unexplored aspect of financial performance. We thus fill this gap in this chapter. Specifically, we conduct this analysis by assessing the financial resilience of companies to the global subprime financial crisis of 2007, and measure resilience by the time to recovery of firm's market price to their pre-crisis level. We used the environmental

dimension's data from Thomson Reuters Asset4 dataset to measure the EP of companies. Performing the survival analysis over an international sample of 1,622 observations, our finding reveals a challenging result for the existing literature since EP significantly increases the time to recovery. Hence, EP seems detrimental to the financial resilience in the context of general financial crisis. We found this result highly robust by considering the inclusion of different control variables, different time windows, and alternative survival models. Digging deeper, we find that the results are sensitive to the dimensions of EP and the country-level environmental standards. Precisely, we find that EP is not detrimental to resilience for its specific product innovation dimension, nor for companies in less environmentally oriented countries.

In chapter 3, we aim to investigate the impact of EP on financial resilience in the context of a situation demanding environmental legal requirements. We specifically consider the environmental regulatory framework by assessing the financial resilience to a disruption caused by the publication of verified emissions under the EU ETS. We thus measure companies' financial resilience by the time to recovery of their market price to the day before the publication. Various studies are conducted in this context and found a negative impact of these publication on companies' market valuation. However, they do not address the afterwards recovery and the influence of EP therein. We thus tackle this issue in chapter 3 of this thesis. Using a sample of 424 unique firm covered under the EU ETS with 3,194 observations from 47 countries, we perform survival analysis to analyze the relationship by considering the first 12 years' publications over a period from 2006 to 2017. Using the carbon emissions data from Trucost dataset as a measure of company's carbon intensity, we found a negative and significant link between carbon intensity and the rate of recovery of firm's market price. In line with the natural resource based view ([Hart, 1995](#), [Russo and Fouts, 1997](#)) and the environment-as-a resources framework ([Flammer, 2013](#)), this result indicate that EP is beneficial for

company, which significantly improves the financial resilience of companies in the context of an environmental regulatory framework. Moreover, we find the results highly robust by taking into consideration different regression models, measures of resilience and carbon intensity, control variables, and mitigating sample biasness towards countries. Furthermore, we find that high EP is more beneficial if firm is in carbon-intensive industry, in the phases of EU ETS where the carbon prices are high.

Finally, chapter 4 investigates the relationship in the context of company specific environmental jolts, a disruption concerning environmental engagements. More specifically, we examine the relationship by measuring financial resilience to a disruption caused by company specific environmental controversies. Various event studies highlighted the negative impact of environmental controversies on company's market valuation, but still they do not address what happens next, i.e. recovery after distress. To address this issue, we specifically consider the two dimensions of resilience, such as stability dimension, measured by the severity of loss in market value of firm, and the flexibility dimension, measured by time to recovery of market value. Using an international dataset of 233 observations over the 2010-2016 period, we applied survival analysis and ordinary least square (OLS) regression model to assess the impact of EP on flexibility and stability dimensions of resilience, respectively. Using the environmental dimension's data from Thomson Reuters Asset4 dataset as a measure of EP, we find that prior EP significantly reduces both the time to recovery and severity of loss. In the context of company specific environmental jolts that demands environmental engagements, this finding is coherent with the natural resource based view and environment-as-a-resource framework, suggesting that prior EP significantly increases both the dimensions of financial resilience to the shock caused by environmental controversies. We find these results robust to the inclusion of different control variables, time windows, models and measures of resilience. However, we find this relationship significant only in environmentally oriented countries, in

most polluting industries and for two of the dimensions of EP, i.e. emission reduction and product innovation.

Overall, we find that EP weakens the financial resilience of companies in the context of global financial crisis of 2007, whereas, it improves financial resilience in the context of environmental regulatory (i.e. EU ETS) shocks and environmental controversies. This indicates that the conditions of a situation moderate the impact of EP on resilience. As the first case is purely related to the financial performance of companies, EP seems detrimental. Besides, the latter two disruptions are related to environment and are demanding environmental engagements from the companies. In this context, EP proves to be beneficial for companies and enhances their financial resilience.

Chapter 1. EP and company's financial resilience

In this chapter, we first provide a brief overview of corporate environmental engagements and their financial implications from theoretical and empirical framework in section 1.1. We then introduce the organizational resilience in section 1.2. Specifically, we review the importance of organizational resilience in a turbulent environment as well as we present its historical overview and empirical review from management studies. Section 1.3 then discusses the possible link between environmental performance (EP) and organizational resilience from a financial viewpoint. More precisely, we bridge the streams of literature of both environmental performance and financial resilience of companies in this section and introduce the avenues of research that are undertaken in the following chapters.

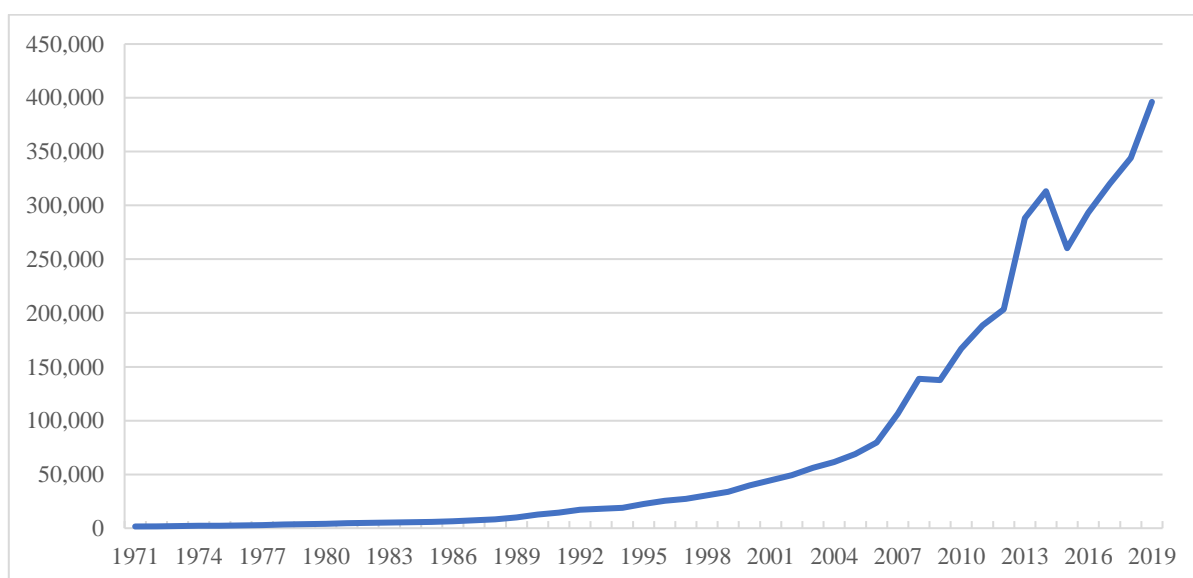
1.1. Corporate environmental engagements

1.1.1. The growing environmental pressure

Hardly a day passes without news reports mentioning about investors, regulators or businesses warning or acting on climate risk. Studies show that not only human activities are affecting the climate, but climate change is also endangering human and business survival. Growth in world economy poses major challenges for future generations. According to the projections of [OECD \(2016\)](#), the global economic output will quadruple by 2050 than today and thereby will need more energy. They estimate an 80% increase in the consumption of energy, mostly from the fossil fuels. This indicate that the economic development will massively increase the greenhouse gases emissions (GHG) and will worsen the problem of climate change. Thus, the impact on human wellbeing cannot be reduced if the path of sustainable development is not adopted ([OECD, 2016](#)).

Among the human activities, firms and industries are the main contributor to GHG and affect the natural resources. This topic has gained dramatical attention from the beginning of the century. As evidenced in figure 1.1, the research publications related to climate risk is increasing with an increasing rate. Eventually, this increase in environmental awareness has brought the proactive role of companies in sustainability into the fore (Linnenluecke et al., 2016). The increase in attention towards environmental issues has raised demand for environmental-friendly business practices (Gadenne et al., 2009).

Figure 1.1: Number of research publications related to climate risk



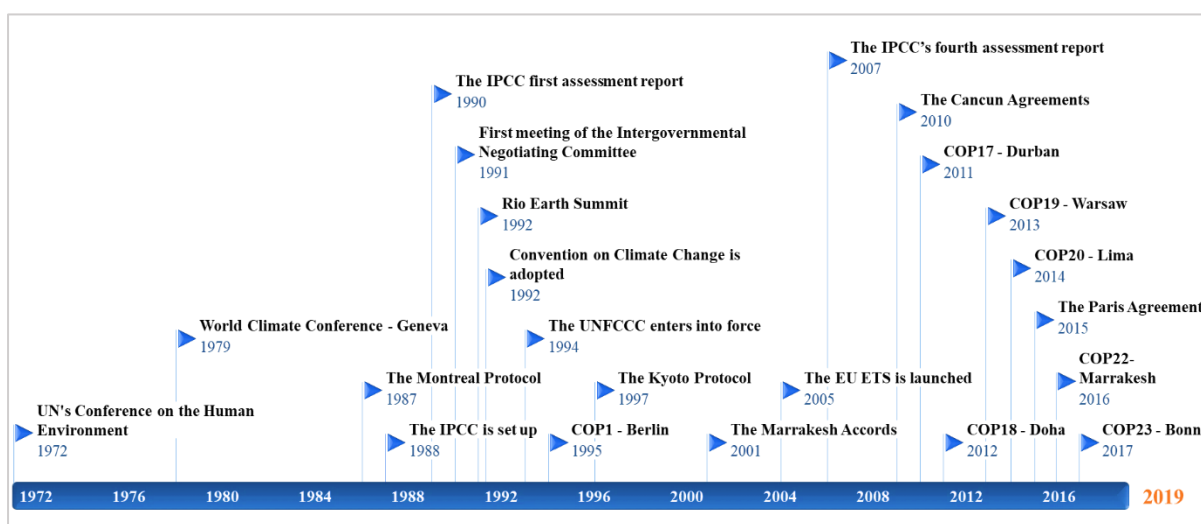
Source: Dimensions³

Many stakeholders are influencing companies to adopt an effective environmental policy. On numerous occasions international organizations got together for mainstreaming the growing understanding of the urgency of sustainability issues, for instance Rio Earth Summit in 1992,

³ The purpose of figure 1.1 is to show a trend related climate change. The number of research publications are obtained from Dimensions website by using some related keywords, i.e. “climate change”, “climate risk”, “global warming”, and “environmental performance”. URL: <https://app.dimensions.ai/discover/publication>

the Millennium Summit in 2000, the World Summit on Sustainable Development in Johannesburg in 2002, Paris agreement in 2015 (COP 21). As depicted in figure 1.2, the timeline show that international communities are making efforts to bring the world together to reduce the GHG emissions and establish environmental policies at national and international level. While 195 nations agreed to combat climate change, the historical Paris COP 21 agreement is a milestone among international efforts that specifically focuses on the low-carbon economy and green investments to make a resilient and sustainable future. Consequently, major sustainable-finance related regulations are adopted by countries, forcing companies to implement socially and environmentally friendly policies. The [PRI \(2019\)](#)'s white paper reveal that the number of sustainable-finance related policies has been increased with a prominent rate in the world's 50 largest economies and almost 97% of the policies are developed in this century. Environmental issues have thus become a crucial issue for companies, and all the more because stakeholders seem to be more and more sensitive to these elements ([Flammer, 2013](#)).

Figure 1.2: Climate change negotiations timeline



Source: European Parliament

1.1.2. Financial implications of environmental engagements for firms

Even though companies' environmental responsibility has recently gained more attention, this topic is not novel in academic debate. Their financial implications are discussed in numerous theoretical and empirical studies (Horváthová, 2010) but empirical results remain inconclusive. Some studies find a negative link (Jaggi and Freedman, 1992, Lioui and Sharma, 2012, Jacobs et al., 2010, Stanwick and Stanwick, 1998, Galema et al., 2008, Marsat and Williams, 2013) while others show a positive one (Russo and Fouts, 1997, Konar and Cohen, 2001, Clarkson et al., 2011, Guenster et al., 2011, Jo et al., 2014, King and Lenox, 2001, Flammer, 2013). Some competing rationales are offered supporting this contrasting relationship.

The negative financial implication of environmental engagements can be rooted in the neoclassical economists' view, stemming from the seminal paper of Friedman (1970). Friedman (1970) states that "the social responsibility of business is to increase its profits". Then, spending money on social-responsibility activities such as environmental protection drains resources from the business that could be mobilized in the core or other functions of the business to maximize shareholders wealth. In this vein, managers must focus on enhancing the core functions, processes and capabilities of the business. Jensen (2001) argue that it would be impossible for managers to try to achieve various goals simultaneously. While achieving several objectives at the same time, i.e. financial and social, it may be difficult for shareholders to monitor them. Thus, managers may exploit this opportunity and may pursue their own interests. This may create an agency conflict and deviate managers from their goal of maximizing shareholders' wealth (Barnea and Rubin, 2010). Spending money on social activities like the environment may give managers the opportunity to improve their own reputation (Barnea and Rubin, 2010), to entrench themselves (Jiraporn and Chintrakarn, 2013,

Cespa and Cestone, 2007, Surroca and Tribó, 2008, Chahine et al., 2019) and to mitigate control mechanisms (Surroca and Tribó, 2008, Fabrizi et al., 2014).

The neoclassical economists' view is challenged, and some scholars argue that environmental policies may on the contrary strengthen the financial position of businesses. For instance, the stakeholder theory (Freeman, 1984) pinpoints the importance of multiple stakeholders in business strategies and argue that “business should take into account all of those groups and individuals that can affect, or are affected by, the accomplishment of organizational purpose”. They demonstrate that many groups have stake in modern businesses which are very crucial for the success of the business. Securing the interest of multiple stakeholders builds long-term relations which improves the financial performance of business. This approach is further supported by the instrumental version of stakeholders theory (Jones, 1995, Donaldson and Preston, 1995), suggesting that building good stakeholder relations can give firms a competitive advantage. Thus, managers can enhance stakeholders' trust in the firm and cooperation by creating value not only for shareholders but for all stakeholders.

The natural resource based view (NRBV) (Hart, 1995, Russo and Fouts, 1997), an extension of the resource-based view theory (Wernerfelt, 1984, Barney, 1991), sees environmental engagements a key resource for firms. The NRBV postulate that a proactive environmental policy enhances both specific environmental capacities and firm's reputation among stakeholders by investing in environmentally-friendly technologies and processes. The environmental policy requires redesign of a firm's production and service delivery processes, which is difficult to imitate by competitors. Hence, environmental engagements improve firm reputation of being eco-friendly and can gain competitive advantage through the acquisition of rare, valuable, imperfectly imitable and non-substitutable resources. Environmental

engagements can then be seen as a key resource that is a source of sustainable competitive advantage (Hart, 1995).

1.1.3. The EP-FP link: evidence from empirical studies

An extensive empirical literature has documented the EP-FP relationship using different measures of EP and FP by applying different types of methodologies including portfolio, event study and regression analysis. Since the theoretical framework postulates a potential positive as well as a negative EP-FP link, empirical studies have also yielded mixed results (Endrikat et al., 2014, Horváthová, 2010). Even though some studies could not find a positive link, the tendency towards a positive relation is higher (Albertini, 2013, Dixon-Fowler et al., 2013, Endrikat et al., 2014, Endrikat, 2016). For instance, Cohen et al. (1997) and Graves and Waddock (1999) did not find any significant link, whereas, Jaggi and Freedman (1992), Fisher-Vanden and Thorburn (2011), Jacobs et al. (2010), and Lioui and Sharma (2012) found a negative EP-FP link despite using different measures of EP and FP. In a meta-analytic study, Horváthová (2010) investigated the findings of 37 studies with a total of 64 outcomes of regression analyses and portfolio studies. She finds a variation in the link between EP and FP (35 show positive, 10 negative and 19 outcomes show insignificant link). This inconsistency in results may arise from a heterogeneity in empirical methods (Horváthová, 2010), small sample size and evaluation of EP (Konar and Cohen, 2001), moderating factors in the models i.e. firm size and geographic location (Cohen et al., 1997), or the industry profile of firm (King and Lenox, 2001).

On the contrary, other meta-analytic studies have assembled the cumulative results of a substantial body of empirical work apparently showing a positive EP-FP link (Albertini, 2013, Dixon-Fowler et al., 2013, Endrikat et al., 2014, Endrikat, 2016). Apart from the financial benefits of EP, researchers have recently attributed EP to some other organizational outcomes

as well. For instance, some studies reveal that environmental performant firms have easier access to finance (Banerjee et al., 2019, Nandy and Lodh, 2012, Cheng et al., 2014) with a lower cost of capital (Sharfman and Fernando, 2008, Heinkel et al., 2001, Gupta, 2018, Chava, 2014). Moreover, in an empirical study Dögl and Holtbrügge (2014) find that environmental engagements seem to improve the environmental reputation of firm and positively influences employees' commitment. A recent literature has highlighted the insurance-like benefits of EP (Godfrey et al., 2009). Environmental activities may help firm to build long-term relationships with external stakeholders and reduce the risks associated with these relationships (Ambec and Lanoie, 2008).

Stakeholders seem highly concerned about the impact of firm on the natural environment (Flammer, 2013). Therefore, various event studies found an immediate and negative market reaction to the disclosure of bad environmental news (Hamilton, 1995, Capelle-Blancard and Laguna, 2010, Flammer, 2013, Krüger, 2015, Endrikat, 2016, Capelle-Blancard and Petit, 2019). These event studies suggest that stakeholders penalize the irresponsible behavior of firms, such as damaging the natural environment. Various studies have now focused on the long-run benefits of firm's social activities in improving firm value through decreasing the risks associated with a negative news (Peloza, 2006). Thus, environmental engagements may be considered as a cost in short run, however, this may benefit the firm in long run by mitigating the risk of firm value loss amidst a negative event in the future.

Furthermore, some studies consider the carbon intensity of companies as a latent environmental liability in the case of stringent environmental regulation and/or more sensitivity of stakeholders to the impact of company's operations on natural environment (Clarkson et al., 2015, Chapple et al., 2013, Clarkson et al., 2004). For example, carbon-intensive firms may bear the cost of investing in less carbon-intensive technologies and processes to comply with

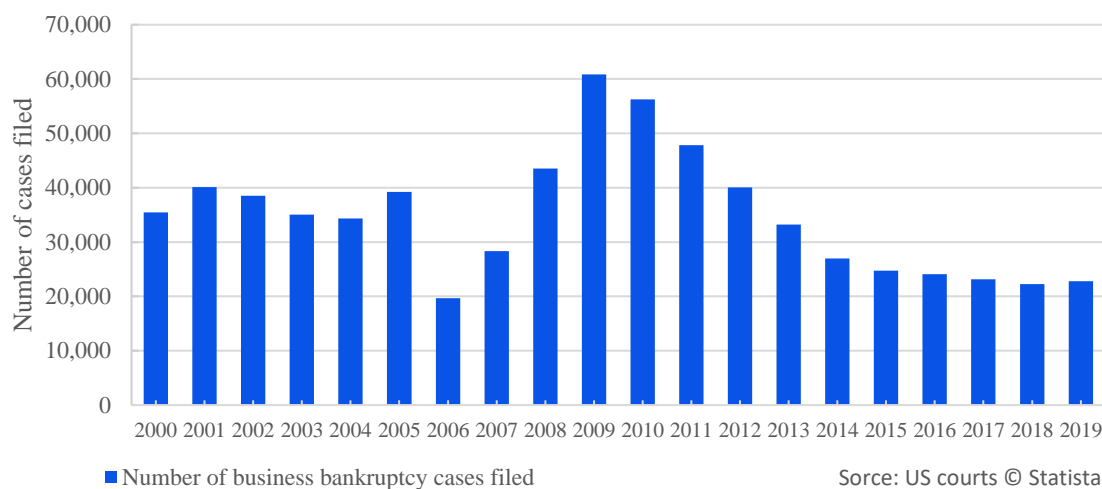
regulations, or in the case of an emission trading scheme (ETS), company may choose to buy allowances in the open market. In this vein, [Chapple et al. \(2013\)](#) found a decrease from 7% to 10% of market capitalization in the valuation of carbon-intensive firms after the announcements of a proposed environmental regulation (i.e. ETS) in Australia. [Clarkson et al. \(2004\)](#) claim that stringent environmental regulations significantly enhance firms' production costs, whereas market use emissions data, i.e. toxic release inventory data, to assess the latent environmental liabilities of a company.

1.2. Organizational resilience overview

1.2.1. Firms and turbulent environments

Nowadays, unexpected events and sudden changes in the natural or financial environment are frequently surprising organizations. Extreme events like natural disasters, terrorist attacks, organizational controversies, and pandemic diseases (like the recent COVID-19) are frequently disrupting supply chain and paralyzing the financial markets. Companies are facing more challenges to survive and compete in this turbulent and continuously evolving marketplace.

The figure 1.3 shows that a numerous number of US firms filed for bankruptcy while not facing a systematic financial crisis. However, the number of bankruptcies were multiplied by 3 between 2006 and 2009, highlighting the impact of the subprime crisis. In such challenging conditions some companies are more successful and effectively thrive through these challenging circumstances, as shown by [Gittel et al. \(2006\)](#) for US Airline companies after the Sept. 11th 2001 terrorist attack in the US. Resilience studies precisely analyze how companies manage to survive and compete after such a shock, and the determinants that allow some organizations to successfully adjust and thrive while others fail amidst these conditions ([Linnenluecke, 2017](#)).

Figure 1.3: Annual number of business bankruptcy cases filed in the United States

For [Richtnér and Löfsten \(2014\)](#), “companies’ success depends on resilience”. Moreover, [DesJardine et al. \(2017\)](#) argue that resilience is crucial for company’s sustainability as it improves their capacity to persist and adapt to environmental changes. Resilience is the capacity of a system to return to a stable state after an exogenous shock ([Bhamra et al., 2011](#)). Usually resilience is viewed as a desirable characteristic of an organization and its employees that enable them to deal with adverse events ([Linnenluecke, 2017](#)). Thus, a resilient organization may have the ability to thrive and continue its operations during a turbulent and challenging environment. Resilient organization has the ability to cope easily with different anomalies and continuously improving their capabilities and learnings ([Vogus and Sutcliffe, 2007](#)).

1.2.2. The concept of resilience

Being a multidisciplinary concept, resilience has been originally used in different fields of studies. For instance, [DesJardine et al. \(2017\)](#) endorsed resilience to the field of ecology, whereas, [Richtnér and Löfsten \(2014\)](#) attribute it to psychology. The term resilience initially appeared in the article of [Maxwell \(1865\)](#) investigating the electromagnetic fields and then used by [Hulsen \(1896\)](#) discussing the properties of bones in health sciences ([Collins, 2015](#)).

Later, the term resilience spread among other fields as well. For instance, [Drabble et al. \(1907\)](#) used the term resilience in biological sciences for describing the resistance of cells to stretching. In ecology, resilience is used to investigate the response of ecological systems to exogenous disruptions ([MacArthur, 1955](#), [Berkes et al., 2000](#), [Folke et al., 2002](#)). In psychology, resilience is attributed to human recovery from stress, for instance by [Rutter \(1987\)](#), [Bolig and Weddle \(1988\)](#). In the field of engineering, resilience is referred to the capability of a structure's recovery from or to withstand a natural disaster ([Pimm and Pimm, 1991](#), [Hollnagel et al., 2006](#)). In economics, [Reinhart and Rogoff \(2014\)](#), [Ambrosius \(2017\)](#) employed the concept of resilience to analyze the recovery of country's economy from recessions. As resilience is applicable in different disciplines, such as natural and social sciences, this concept can help to deal with some important cross-disciplinary issues, such as sustainable development ([DesJardine et al., 2017](#)).

Various conceptual studies have provided the framework of resilience in the field of business and management. Its application in management studies, however, is still scarce ([Vogus and Sutcliffe, 2007](#), [Linnenluecke, 2017](#)). As resilience is a latent variable and cannot be observed directly at organization level ([DesJardine et al., 2017](#)), empirical studies have inferred resilience to different indicators to assess stability and/or flexibility in the financial outcomes of an organization, such as a firm's market price recovery from an environmental shock ([Gittel et al., 2006](#)), change in sales growth after a shock ([Ortiz-de-Mandojana and Bansal, 2016](#)), severity of market price loss and duration of market price recovery after a crisis ([DesJardine et al., 2017](#)).

While measuring the financial resilience of companies, [DesJardine et al. \(2017\)](#) adopted a definition developed by [Gunderson and Pritchard \(2002\)](#), stating that resilience is "both the ability of a system to persist despite disruptions and the ability to regenerate and maintain

existing organization”. In an empirical study, [Ortiz-de-Mandojana and Bansal \(2016\)](#) defined resilience as “the ability of firms to sense and correct maladaptive tendencies and cope positively with unexpected situations”. At organization level, [Vogus and Sutcliffe \(2007\)](#) define resilience as “the maintenance of positive adjustment under challenging conditions such that the organization emerges from those conditions strengthened and more resourceful”.

1.2.3. Organizational resilience: main empirical studies

Numerous conceptual studies have focused on organizational resilience framework, for instance [Klibi et al. \(2010\)](#), [Pettit et al. \(2010\)](#), [Ponomarov and Holcomb \(2009\)](#), [Sheffi and Rice Jr \(2005\)](#). However, very few empirical studies have considered this organizational outcome. In the following subsections, we discuss some empirical studies, as summarized in table 1.1, that documented the role of some organizational attributes in building financial resilience.

1.2.3.1. [Gittell et al. \(2006\)](#) study of resilience: airplane companies after the September 11th, 2001 attack

[Gittell et al. \(2006\)](#) investigate the response of ten US-based major airlines to 9/11 terrorist attacks. The authors examined the impact of pre-crisis (i.e. September 10th) financial reserves, such as debt-to-equity ratio and days of cash on hand, and business models, i.e. unit cost per available seat mile, on post-crisis employees' layoffs and market price recovery of airlines. They measured quarterly performance recovery by taking the percentage of market price to the pre-crisis level of each company over a period from December 10, 2001 through September 10, 2005, and layoffs by taking percentage of post-crisis employees laid off to pre-crisis level. Their findings show that the airline industry experienced a severe decline in their market valuation after the crisis, whereas, they observed a variation in the performance recovery of

sample firms. In their sample, Southwest and Alaska Airlines were the fastest with an average recovery of around 92% and 88% of their market price over the sample period of 4 years. At the same time, United Airlines and US Airways were the slowest with an average recovery of 12% and 23% of their market prices, respectively. On average, the industry laid off around 16% of their employees after the event, while the US Airways and United Airlines were the companies with highest level of layoffs i.e. 25% and 20%, respectively. This may be because these companies had the lowest level of pre-crisis financial reserve (days of cash on hand) relative to their peers. On the other hand, Southwest and Alaska Airlines did not lay off and had the highest level of financial reserves relative to their peers.

Using Spearman's rank order correlations, the authors find that low cost business models and financial reserves are negatively related to layoffs, whereas, more layoffs show a negative relationship with the performance recovery of companies. Through an in-depth analysis, they assert that organization need to build up a viable business model that increases the level of financial reserves, so that these resources can be utilized during crisis to retain their employees and establish strong relationships with them in order to recover faster from an adverse situation.

1.2.3.2. CSR and financial resilience: the study of [Ortiz-de-Mandojana and Bansal \(2016\)](#)

[Ortiz-de-Mandojana and Bansal \(2016\)](#) study the collective contribution of company's social and environmental practices (SEPs) to organizational resilience. Though, their study is based on a long-term approach rather than focusing on a single environmental shock, one of their method, i.e. comparing the failure rates of companies in the sample period, may be relevant to organizational resilience. The authors applied a matched-pair analysis to compare the performance of treated group, firms with high SEPs from KLD 400, with a control group. To identify the candidates of the control group, they applied propensity score matching technique

by considering firm's total assets, net sales, return on assets, return on equity, and return on sales.

By taking 121 pairs of matched companies over a period 1994-2008, the authors compared the financial volatility, sales growth, and survival rates. Financial volatility for each year is measured by taking the standard deviations of monthly market returns. The authors considered the long-term growth by accumulating the growth in sales over the sample period. Survival is measured by the survival rates through a survival model, i.e. [Cox \(1972\)](#), which considers if a firm is failed or not in the sample period and its duration of survival. By applying matched-pairs t-test and repeated ANOVA test, the authors observed a low financial volatility, higher growth, and rates of survival of firms with high SEPs. Furthermore, they did not find a significant evidence in support of a hypothesis that postulates that firms with high SEPs have lower profitability over the short-term; lower profitability is measured by change in return over assets between two consecutive years. The authors argue that high SEPs enable firms to cope with shocks and keep them on their desired state, thus showing less volatility and high stability. Furthermore, they argue that SEPs help companies to attract more customers that adds to their growth.

1.2.3.3. CSR and financial resilience after the subprime crisis : [DesJardine et al. \(2017\)](#)

[DesJardine et al. \(2017\)](#) also examined the contribution of social and environmental practices to organizational resilience but in the aftermath of the subprime crisis of 2007. The authors discriminate these CSR practices in two categories, labelled as strategical and tactical practices. Strategic SEPs include practices that are embedded within an organization. They measure these practices by “the sum of firm's strengths from KLD database in categories of environment, diversity, employee relations, human rights, product quality and safety, and corporate

governance". Besides, tactical SEPs represent philanthropic contributions of firm that do not require a substantial adjustment in an organizational structure. The authors also took tactical practices from KLD database, by taking the "sum of firm's strengths in the community domain that include charitable giving strength, innovative giving, non-U.S. charitable giving, support for housing, support for education, volunteer programs, and other strengths".

The authors considered the stability, measured by the severity of loss in firm value, and flexibility, measured by the time to recovery of firm value, as the two financial dimensions of organizational resilience. They employed the two-stage least squares and Cox PH models to investigate the impact of SEPs on stability and flexibility of 963 U.S.-based firms. The authors find that strategic SEPs improve both the stability and flexibility dimensions of resilience in face of the subprime crisis. They also postulate that tactical SEPs improves the financial flexibility of firm, although less important, but they could not find a significant evidence in support of this hypothesis. The authors argue that tactical practices do not create interdependencies among organizational system relative to strategic practices, and that, therefore, strategic practices contribute more to organizational resilience that enable them to cope with a financial shock.

Overall, we can notice that research on the impact of CSR practices on financial resilience are, as far as we know, still scarce. [Ortiz-de-Mandojana and Bansal \(2016\)](#) and [DesJardine et al. \(2017\)](#) have so far examined the collective contribution of social and environmental practices as determinants of resilience. However, no attention has been precisely dedicated to the environmental dimension's contribution. Since there is a growing societal concern in environmental issues (Flammer, 2013), we believe that studying the impact of environmental performance on resilience is of particular interest.

Table 1.1: Empirical studies on financial resilience

Research article	Research question	Main methodology	Main results	Rationale
Gittell et al. (2006)	The contribution of pre-9/11 viable business model and financial resources to forgo layoffs and encourage recovery of airlines after the 9/11 attacks	<p>Models: Univariate and Random effect regressions</p> <p>Sample: US based 10 major airline companies</p> <p>Variables:</p> <p>Recovery: percentage of market price to its pre-crisis level</p> <p>Layoffs: percentage of post-crisis employees laid off to pre-crisis level</p> <p>Business model: unit cost per available seat mile</p> <p>Financial reserves: debt-to-equity ratio and days of cash on hand</p>	Both low cost business model and financial reserves enabled airlines to forgo layoffs and recover more quickly.	A viable business model enriches the level of financial reserves. These resources can be utilized during a crisis to retain their employees and establish strong relationships with them. That enables companies to recover faster from an adverse situation
Ortiz-de-Mandojana and Bansal (2016)	The contribution of company's social and environmental practices (SEPs) collectively to organizational resilience	<p>Model: matched-pair analysis (121 pairs) - comparing the performance of treated group with a control group over a period 1994-2008</p> <p>Sample: Treated group - firms with high SEPs from KLD 400.</p> <p>Control group selected through propensity score matching technique based on some financial indicators of companies</p> <p>Variables for comparison:</p> <p>Financial volatility, sales growth, and survival rates (through Cox Model) of companies</p>	Firms with high SEPs show low financial volatility, higher sales growth and higher rates of survival	The authors argue that high SEPs build resources and capabilities that enable them to cope with shocks and keep them on their desired state, thus companies with high SEPs show less volatility and high stability. Furthermore, SEPs help companies to attract more customers that adds to their growth
DesJardine et al. (2017)	The contribution of strategic versus tactical social and environmental practices (SEPs) to organizational resilience in the aftermath of global financial crisis of 2007	<p>Models: 2SLS and survival analysis</p> <p>Sample: 963 US-based firms</p> <p>Variables</p> <p>Stability dimension of resilience: Severity of loss in firm value</p> <p>Flexibility dimension of resilience: Time to recovery of firm value to its pre-crisis level</p> <p>Strategic SEPs: sum of "strengths in the domains of environment, diversity, employee relations, human rights, product quality and safety, and corporate governance" from KLD database</p> <p>Tactical SEPs: Sum of "strengths in the domain of community development" from KLD database</p>	Strategic SEPs improve both the stability and flexibility dimensions of resilience in face of general environmental disturbance	Strategic SEPs establish interdependencies among the organizational system and the broader social and environmental systems in which the organization is embedded, that improves stability and flexibility in the face general environmental disturbance

1.3. The nexus between EP and resilience

1.3.1. Bridging EP and resilience

Although the EP literature is vast but still seems inconclusive ([Horváthová, 2010](#)), and organizational resilience literature is growing ([Linnenluecke, 2017](#)), no one to our knowledge has bridged these streams of literature to analyze the precise link between EP and resilience. The growing concerns about climate change have imposed a substantial pressure on companies to adopt an effective environmentally-focused policy, because stakeholders seems more sensitive to these elements ([Flammer, 2013](#)). Facing mounting pressure, environmental obligations have thus become a key player in companies strategies ([Rugman and Verbeke, 1998](#)).

At the same time, companies are facing challenges to survive and compete in a turbulent and continuously evolving marketplace. Besides the systematic financial crises, the effects of climate change, such as extreme weather conditions, natural disasters and hurricanes, high reaction to environmental controversies, are frequently disrupting supply chain and paralyzing the financial markets. In reaction, environmental regulations and technological advancements are also impairing the assets of some companies ([Linnenluecke et al., 2016](#)).

The importance of these issues for companies then leads us to bridge the literature of EP and resilience together to answer the question whether corporate environmental policies are moderating the financial consequences of an adverse situation.

1.3.2. EP and financial resilience: theoretical framework

If we consider the neo-classical economists view, for instance [Friedman \(1970\)](#), EP seems to mitigate the capacity of companies to cope with adversities. This view suggests that discretionary efforts towards EP-improvement may reduce companies' profits, and thus

diverting managers from their only goal of maximizing shareholders' wealth. The financial resources devoted to social or environmental activities could be mobilized in the core or other activities of the business to improve company profitability. Furthermore, these resources could be utilized as slack during the time of adversity to recover faster (Linnenluecke, 2017). For instance, Gittel et al. (2006) observed a quick financial recovery from a crisis of firms with sufficient financial resources that were utilized to retain their employees and established good relations with them. Similarly, Buchanan et al. (2018) referred spending on social activities as overinvestment, since they found more loss in the value of high-CSR firms during financial crisis. This stream of literature argues that environmental expenditures deteriorates the financial position of companies, therefore, firm may experience more difficulties to bounce back to routine business due to lack of financial resource during a crisis.

On the contrary, other scholars have highlighted various benefits of EP that may help companies to recover faster from an adverse situation. For instance, Ambec and Lanoie (2008) argue that EP seems to improve companies relations with their external stakeholders. As instrumental stakeholder theory (Jones, 1995, Donaldson and Preston, 1995) argue that good relations with stakeholders is a source of competitive advantage, then environmentally-performant company may attract stakeholders support (Lins et al., 2017). Exploiting this advantage in a time of need may enable firms to recover faster from adverse situation. Besides, the natural resource based view (Hart, 1995, Russo and Fouts, 1997) specifically attributes EP to a source of reputation, therefore, investors may prefer environmentally reputed companies relative to non-reputed companies facing a same kind of adversity. Moreover, EP may be a source of skills and capacities that may help firm to adapt to demanding conditions. Thus, environmentally performant company may not face severe loss in value if investors prefer to invest in them and are more confident in their abilities to cope with the situation.

1.3.3. Conclusion: avenues of research

Organizational resilience addresses the reaction and adaptability of an organization to an adverse situation, but businesses are facing different kinds of exogenous and endogenous adversities. In the following chapters, we conduct empirical analyses to investigate the relationship through three different dimensions of adversity for observing the financial resilience of companies. We specifically study the impact of a systematic financial crisis, regulatory and company specific environmental disruptions. We focus on these situations with an aim to capture the contribution of EP to resilience observed against a general financial crisis as well as the adversity caused by new regulations, and company's specific environmental jolts.

In chapter 2, we capitalize on [DesJardine et al. \(2017\)](#) to observe the resilience of companies against the global financial crisis of 2007. This crisis originated in the USA due to the subprime mortgages. The event spread around the world and caused a substantial decline in financial market, and consequently in the market valuation of listed companies. While the crisis was very severe which caused a decline of more than 54% in the S&P index until February 2009 ([Bartram and Bodnar, 2009](#)), some companies did not experience a severe loss and recovered faster relative to their peers. Simultaneously, environmental awareness is dramatically higher, and the proactive role of firms in sustainability has increasingly been brought to the fore. Firms have been encouraged to implement environmentally friendly policies to address climate change and environmental issues, mitigate the economic impact on the environment, and develop eco-efficiencies ([Linnenluecke et al., 2016](#), [Banerjee et al., 2019](#)). Therefore, stakeholders seem more and more sensitive to the EP of companies ([Flammer, 2013](#)).

However, it is not clear whether the environmental claims and general financial turbulences are imposing contradictory pressures on companies and, to our knowledge, no study has investigated the precise link between EP and resilience in the context of a global financial

crisis. Though, [DesJardine et al. \(2017\)](#) examined the collective contribution of CSR to financial resilience in this context, their approach does not however specifically disentangle EP from other CSR practices. We thus fill this gap by investigating a precise link between EP and resilience in the context of a global financial crisis. As [Laeven and Valencia \(2018\)](#) identified that a 72% of 151 banking crisis over a period of 1945-1971 occurred after 1990, the frequency of financial crises is increased in recent decades. Therefore, the investigation of the EP-resilience link may provide some useful insights to concerned parties to address the issues related to companies' environmental obligations as well as dealing with more frequent general financial turbulences.

Besides, previous studies show that regulations may create constraints for companies and negatively affect their profitability ([Clarkson et al., 2015](#), [Chapple et al., 2013](#), [Manchiraju and Rajgopal, 2017](#), [Palmer et al., 1995](#)). This scenario gives us the opportunity to investigate whether EP mitigates the negative impact of a regulatory obligation and enable company to recover faster. In chapter 3, we thus specifically focus on company's resilience against a financial shock triggered by the publication of verified emissions, a regulatory requirement under the European Union's Emission Trading Scheme (EU ETS). Various studies show that the disclosure of this emissions information negatively affect the valuation of covered companies, for instance [Brouwers et al. \(2016\)](#), [Clarkson et al. \(2015\)](#), [Jong et al. \(2014\)](#). The findings of these studies show a decline in firm value after the disclosure of emissions data, which seems relevant to the stability dimension of resilience; however, they do not address the flexibility dimension, i.e. recovery from crisis. It is important to investigate this organizational outcome in regulatory upheavals, because it is crucial for firm's sustainability which captures firm's capacity to thrive and adapt to environmental changes ([DesJardine et al., 2017](#), [Ortiz-de-Mandojana and Bansal, 2016](#)).

Investors seem like more sensitive to the long-term impact of the EU ETS (Jong et al., 2014) because the EU ETS is demanding eco-efficiency from companies. Thus, it may bring investors' attention to the environmental policy of firms. While the EU ETS is increasing demand for EP as well as causing an environmental disturbance after the publication of verified emissions, one may wonder if these two mounting pressures are not contradictory for companies. To our knowledge, no study is however dedicated to examining whether EP moderates the adverse consequences of EU ETS, i.e. companies' recovery from disturbance triggered by the publication of verified emissions. We thus contribute to the literature by examining a specific link between EP and firm's financial flexibility against the shock triggered by the publication of verified emissions under the EU ETS. This will help us to understand whether carbon-efficient practices help companies to survive and compete in this challenging environment. Since the ETS around the world is currently covering only 15% of the global emissions and it is spreading to more and more countries (ICAP, 2018), the implications of this study may also be important for companies based in other countries that have planned to introduce the ETS in future. This will provide a guidance to concerned parties for managing the risks associated with the ETS and preparing themselves in advance.

As companies are continuously under the media spotlight and the environmental impact of their operations are attracting investors' attention (Aouadi and Marsat, 2016), prior research show that the release of company related negative news, for example environmental controversies, negatively affects their market valuation (Capelle-Blancard and Petit, 2019, Krüger, 2015, Flammer, 2013, Capelle-Blancard and Laguna, 2010, Hamilton, 1995, Endrikat, 2016). Environmental controversies, as negative news stories related to the environmental impact of the firm's operations, are therefore of paramount importance for companies' image and reputation, that may involve important costs since investors appears increasingly sensitive to environmental issues. Previous event studies have so far provided a negative indication in the

market valuation of company after a controversy. However, they do not answer the question of what happens next. We then wonder whether prior EP helps firm value to bounce back.

The importance of these issues for companies then leads us to ask whether EP is moderating the adverse consequences of environmental controversies. In chapter 4, we thus examine the link between EP and financial resilience against company specific environmental jolts. Following [DesJardine et al. \(2017\)](#), we precisely investigate this relationship by disentangling resilience into its two dimensions, i.e. financial stability and flexibility. As EP is attributed to the so-called insurance-like effect in case of negative events ([Godfrey et al., 2009](#)), we investigate whether EP also possess the resilience-like effect in this context.

Taking together, we thus test the relationship in three different dimensions of resilience amidst two kinds of shocks. In the first essay, we test the relationship while company is facing general financial turbulence, whereas, the second and third essay consider the environmental dimension, through the claims of stakeholders in the form of environmental regulations and reaction to environmental controversies.

Chapter 2. Is there a trade-off between environmental performance and financial resilience? International evidence from the subprime crisis

Abstract

Companies now face mounting pressure to be environmentally active and involved, yet they simultaneously have to cope with more and more frequent financial crises. Whether environmental performance (EP) improves or mitigates the resilience of a firm when confronted with a financial shock is then of particular importance, yet not explored to our knowledge. On the one hand, EP may benefit companies and help them to recover more rapidly from a financial shock as a result of higher stakeholder support; on the other, however, EP can be viewed as a waste of financial resources, and may therefore reduce a firm's financial resilience. Using Thomson Reuters Asset4 environmental data as a proxy for firms' EP, we perform a survival analysis on an international dataset of 1,622 firms in the aftermath of the subprime crisis. We find evidence that high pre-crisis EP significantly reduces the likelihood of a firm's market price recovery, suggesting that EP appears as an organizational constraint that limits the ability of firms to be financially resilient. This challenging result is robust to various time windows and survival models. EP is, however, not always detrimental since the specific product innovation dimension of EP does not reduce a firm's financial resilience. Moreover, in less environmentally oriented countries, EP does not negatively influence a firm's financial resilience. In these two settings, we argue that the cost-benefit of EP on resilience seems to be more balanced.

Keywords: Environmental Performance; Resilience; Subprime Crisis; Financial Markets; Firm Value

JEL Classification: G01, M14, O16, Q51

2.1. Introduction

In recent decades, companies have faced more and more frequent financial crises (Bordo et al., 2001, Laeven and Valencia, 2018). Bordo et al. (2001) observed that crisis frequency doubled in the 1973-1997 period compared to the 1945-1971 period. In addition, 72% of the 151 banking crises identified by Laeven and Valencia (2018) for the period 1970-2017 took place after 1990. Recently, the global financial crisis triggered by US subprime mortgages led to a substantial decline in all financial markets, and consequently in the market valuation of listed companies. Indeed, the S&P 500 index fell by 54.1% between September 2007 and February 2009 (Bartram and Bodnar, 2009). Simultaneously, environmental awareness dramatically increased, and the proactive role of firms in sustainability has increasingly been brought to the fore. Firms have been encouraged to implement environmentally friendly policies to address climate change and environmental issues and mitigate their economic impact on the environment (Linnenluecke et al., 2016, Banerjee et al., 2019, Siegrist et al., 2020). At an international level, institutions such as the World Business Council for Sustainable Development or the Conferences of Parties (COP) strongly support such practices (Bazillier et al., 2017). Environmental issues have thus become a crucial issue for companies, and all the more because stakeholders seem to be more and more sensitive to these elements (Flammer, 2013).

Facing both environmental claims and financial turbulence, one can wonder if these two mounting pressures are not contradictory for firms. More specifically, it is not clear to what extent the environmental policies implemented by a firm penalize or help them during a financial crisis. To our knowledge, no study has tackled this important issue so far. We thus propose to fill this gap by studying the relationship between environmental performance (EP) and a firm's financial resilience in the specific context of the subprime crisis. The concept of

resilience, originally issued from ecology, is now popular in the fields of crisis management and organization studies (DesJardine et al., 2017, Linnenluecke, 2017). Resilience can be defined as “the firm’s ability to sense and correct maladaptive tendencies and cope positively with unexpected situations” (Ortiz-de-Mandojana and Bansal, 2016). Because it enables firms to adapt to environmental changes and survive longer, resilience is a crucial and desirable characteristic of a business. More resilient organizations are considered to have a sustainable competitive advantage over peers (Teixeira and Werther, 2013). This aspect of financial performance is all the more relevant in a context where financial and banking crises are increasingly recurrent.

According to the resource-based view (RBV) theory (Wernerfelt, 1984, Barney, 1991), environmental policies can lead to a higher stakeholder commitment from non-financial stakeholders (customers, employees, communities, etc.) who are concerned about the environment (Russo and Fouts, 1997, Hart, 1995). Hence, during a crisis period, this higher level of support can be helpful in recovering from a crisis. However, in such a period, it is also possible that shareholders are less likely to invest in environmentally friendly firms since environmental policies can be linked with overinvestment concerns and agency problems (Buchanan et al., 2018). Thus, it clearly appears that the relationship between EP and resilience is theoretically ambiguous, and needs empirical investigation.

After adjustment for missing data, the relationship between EP and resilience is analyzed using a sample of 1,622 firms from 30 different countries. Our survival analysis reveals a challenging result for the existing literature since EP significantly increases time to recovery, hence reducing a firm’s financial resilience. This result is robust even taking into consideration the inclusion of various control variables and different time periods, and is not affected by alternative survival models. The result proves to be sensitive to EP dimension and country

environmental orientation. More precisely, the impact of EP on resilience is not significant for the specific product innovation dimension, nor in less environmentally oriented countries. EP in these conditions does not therefore impede a firm's recovery from a financial shock.

Our contribution to the literature is threefold. First, this study aims to contribute to the literature on the impact of environmental policies on firm value by studying the impact of EP on an unexplored aspect of financial performance. Although the link between EP and financial resilience is currently of particular importance for both managers and investors given the increasing occurrence of financial crises, no study has previously tackled this relationship. In a context where crises are becoming more frequent, it is indeed essential for firms to recover as quickly as possible from a financial shock. If [DesJardine et al. \(2017\)](#) study the impact of tactical and strategic corporate social responsibility (henceforth CSR) commitment on firms' resilience, their approach does not however specifically disentangle EP from other CSR policies. Second, even if the effect of EP on the value of firms has been widely discussed in theoretical and empirical studies, the empirical results remain inconclusive. Most papers find a positive impact ([Guenster et al., 2011](#), [Flammer, 2013](#)) while other articles show a negative one ([Jacobs et al., 2010](#), [Galema et al., 2008](#)). These contradictory results may come from an endogeneity problem that makes it difficult to assess the impact of EP on financial performance (FP). We contribute to the literature by investigating the question from a new perspective. Studying the effect of EP on firm value around the subprime crisis allows us to avoid the potential endogeneity problem between environmental performance and financial performance ([Buchanan et al., 2018](#)). Following [Lins et al. \(2013\)](#) and [Buchanan et al. \(2018\)](#), we argue that the subprime crisis is an exogenous shock that has an impact on a firms' market value, without having an impact on environmental performance in the short run. Moreover, the subprime crisis is a particularly appropriate context to see whether environmental policies are associated with

higher costs and agency concerns since this crisis has exacerbated these problems (Buchanan et al., 2018, Lins et al., 2013). Third, we find robust and challenging results for the EP-FP literature in the context of financial crises. Whereas the majority of studies document a positive financial impact of EP (Horváthová, 2010), we find evidence that the overall EP significantly reduced financial resilience during the specific subprime crisis. However, we show that EP is not always detrimental to financial resilience. In particular, firm involvement in product innovation does not reduce firm resilience, nor the EP engagement in countries with low environmental legislation. These results are stimulating and, we believe, of particular importance for both corporate managers and portfolio managers.

The remainder of this paper is organized as follows. The second section presents the hypotheses. The third section describes the data and method used. The fourth section is dedicated to our empirical results. The last section concludes.

2.2. Hypotheses

The aim of this paper is to study whether the implementation of environmental policies help firms during a crisis period. We thus propose to bring a new insight to the financial impact of EP by examining the relationship between EP and financial resilience. Two different perspectives shed light on how environmental performance may influence the way companies suffer from a financial crisis. From one perspective, the RBV theory (Wernerfelt, 1984, Barney, 1991) argues that EP may have a positive impact on financial resilience. The main idea of this theory is that firms may have competitive advantages by acquiring strategic resources that are valuable, rare, inimitable and non-substitutable. Firms can implement profitable strategies by mobilizing resources that enable them to exploit external opportunities or to mitigate threats (Barney, 1995, Russo and Fouts, 1997). These resources can be tangible such as financial or physical assets, intangible assets like such as reputation, human resources or organizational

capabilities, and “personnel-based” such as corporate culture, employees’ skills and involvement (Grant, 1991, Russo and Fouts, 1997).

Numerous papers have mobilized RBV theory to conceptualize the relationship between EP and financial performance (Branco and Rodrigues, 2006). Applying the RBV theory to the understanding of corporate environmental strategies, Hart (1995) developed a natural-resource-based-view of the firm, which is an RBV theory extension including constraints relating to the natural environment. This author suggests that firms implementing different environmental strategies linked to pollution prevention, product stewardship and sustainable development can acquire competitive advantages. For instance, firms setting up policies aiming at preventing pollution can acquire competitive advantages by reducing pollution costs and by increasing productivity thanks to the redesign of their production processes and the use of more efficient technology (Russo and Fouts, 1997). In addition, firms may acquire new capabilities by taking into account stakeholders’ claims in their product design and development processes (Hart, 1995). Such environmental policies can increase customers’ loyalty and employees’ commitment, and generate a higher reputation and strong support among customers, employees, suppliers, communities and others stakeholders who are concerned about the environment (Russo and Fouts, 1997). Environmental strategies thus involve a shift in corporate culture and organizational capabilities (Branco and Rodrigues, 2006). These policies help firms to develop better analytical skills and processes, and increase employees’ commitment that in turn enhances the firms’ ability to adapt to external changes, including crises (Orlitzky et al., 2003, Russo and Fouts, 1997).

Capitalizing on the idea that CSR policies allow firms to strengthen stakeholders’ commitment, Lins et al. (2017) found that CSR investments are more valuable during a period of crisis. When the general level of trust in firms is low, stakeholders consider that high-CSR firms are more

likely to honor their implicit contracts and are more willing to support these firms than they are others. An increased reputation for environmental friendliness can thus lead to higher stakeholder support by improving sales among environmentally sensitive consumers or by increasing employees' productivity. In addition, CSR involvement can reduce conflicts between firms and stakeholders and thus alleviate opportunistic behaviors by improving trust and cooperation (Jones, 1995). Considering the importance of environmental issues, environmental engagement may help to develop capabilities which might be particularly helpful in recovering from a crisis and reinforce support from financial and non-financial stakeholders. Thus, according to this stream of literature, we postulate, all else being equal:

H₁: High level of pre-crisis EP increases firm financial resilience

However, from a neoclassical perspective, the only goal of managers should be to maximize shareholders' wealth (Friedman, 1970). Then, spending money on CSR activities such as environmental protection drains resources that could be mobilized to achieve shareholder value maximization. As highlighted by Jensen (2001), it appears unrealistic for a manager to maximize different objectives at the same time. Hence, if managers have many objectives to achieve, such as environmental and financial ones, they may be more likely to pursue their own interests, taking advantage of the difficulty for investors to monitor them. Then, spending money on CSR activities such as environmental policies would be a way for managers to deviate from maximizing shareholders' wealth (Fabrizi et al., 2014, Cavaco and Crifo, 2014, Barnea and Rubin, 2010, Surroca and Tribó, 2008). Managers can then overinvest in CSR policies in order to pursue their own interest. CSR activities may be a way for managers to improve their own reputation (Barnea and Rubin, 2010), to entrench themselves (Jiraporn and Chintrakarn, 2013, Cespa and Cestone, 2007, Chahine et al., 2019, Surroca and Tribó, 2008) and to mitigate control mechanisms (Fabrizi et al., 2014, Surroca and Tribó, 2008). Managers

can seek to increase their own power within firms by gaining stakeholders' support thanks to a high CSR involvement. Concerning more specifically environmental policies, their implementation can also be explained by a warm-glow motivation instead of financial concern (Barnea and Rubin, 2010).

Following this stream of research, environmental policies can be a way for managers to extract private benefits, and not to increase shareholders' wealth. Costs incurred by environmental policies may detrimentally mobilize financial resources that could be used during the time of crisis. Buchanan et al. (2018) explain that agency problems were higher during the subprime crisis since "firm financial resources become more valuable and the expected return on investment falls". Thus, the subprime crisis has amplified overinvestment concerns, and thus the costs induced by CSR policies (Buchanan et al., 2018). Consistent with this hypothesis, they show that the value of high CSR firms has been more negatively impacted during the subprime crisis. Hence, given these arguments, shareholders may be especially suspicious about environmentally friendly firms during a period of financial crisis, and more reluctant to invest in such companies. Therefore, according to this view, we can hypothesize:

H₂: High level of pre-crisis EP reduces firm financial resilience

2.3. Data and methodology

2.3.1. Variables and research sample

We measure resilience by the duration of recovery, defined by Reinhart and Rogoff (2014) and Ambrosius (2017) as the number of periods (years and quarters, respectively) it takes for a country to recover to its pre-crisis period level of per capita GDP. As our study is concerned with firms, therefore, we use firm's market price to measure the duration of recovery. DesJardine et al. (2017) measure duration of recovery by using monthly stock price recovery

to its pre-crisis level. In order to have a finer measurement, we use the weekly prices with the condition that the price does not fall again for at least four weeks, to assure full recovery. Thus, we define recovery as the time needed for a firm's weekly market price to recover to its pre-crisis level, provided it remains above this threshold for at least four weeks. The pre-crisis level is defined as the end of October 2007, because the world equity market reached its all-time high market capitalization in this month and the recession started afterwards (Bartram and Bodnar, 2009). Because the world equity market reached its lowest point in September 2009, we restrict our baseline model until October 2011 to reduce the possibility of other events impacting market price fluctuations. As a robustness check, we also analyze the relationship using extended windows.

Table 2.1 describes our variables. EP is measured by the environmental dimension of Thomson Reuters ESG - Asset4, one of the major ESG rating agencies. Asset4 analyses thousands of publicly traded companies on the basis of three dimensions (i.e. environmental, social and governance), on a scale from 0 (the lowest) to 100 (the highest) relative to peers in their respective industries. As Asset4 data is issued annually, 2006 is considered as pre-crisis period. We divide Asset4 environmental firm's ratings by 100 to scale it between 0 to 1. Asset4 classifies firm's EP into three main categories – emission reduction, product innovation, and resource reduction. These reliable data are widely used in international studies, for instance by Cheng et al. (2014), Eccles et al. (2014), Shaukat et al. (2015), Lys et al. (2015) or Gupta (2018).

We include countries' overall EP in our analysis as a control variable. It may negatively influence firms' financial resilience since stricter environmental regulation induces higher costs for firms (Rennings and Rammer, 2011). However, regulations may also trigger innovation and thus enhance firms' competitiveness (Porter and Linde, 1995) and aptitude to

change, which is likely to enhance firms' skills to deal with crisis. To measure a country's EP, we rely on the environmental performance index (henceforth EPI), following [Bazillier et al. \(2017\)](#) and [Xiao et al. \(2018\)](#). This index was developed by the Yale Center for Environmental Law and Policy (YCELP), and the Center for International Earth Science Information Network (CIESIN). EPI gauges the country's overall EP linked to their policy targets. Countries are rated from 0 to 100, on an average of two broad categories – Environmental Health and Ecosystem Vitality objectives. We also divide EPI data by 100 to scale in the range from 0 to 1 for comparison purposes.

We also include some control variables that may also explain financial resilience. Our control variables are firms' intangible assets, profitability, size, leverage, operational performance, innovation, capital intensity and momentum. Intangible assets are proxied by market to book value ratio, denoted by MB. ROA measures the profitability of the firm. Firm size (SIZE) is calculated as the natural log of the firm's total assets. Leverage is the ratio between book value of total debt and total assets, denoted by DA. Sales growth (SG) is measured by total sales divided by sales in previous year. We also introduce RD in our analysis, calculated as research and development (R&D) expenditures divided by total sales, and also a dummy variable RDDUM (equal to 1 if the firm has disclosed its R&D expenditure, 0 otherwise). Capital intensity, denoted by CAPEX, is calculated as capital expenditure divided by book value of assets. We also introduce a variable denoted as MOMENTUM, representing the market price change three years prior to the crisis period. Additionally, we control for industry and region by introducing industry dummies using 2-digits GICS codes and region dummies. We define five regions: East Asia and Pacific, Western Europe and North America, Latin America and the Caribbean, Middle East and North Africa, Sub-Saharan Africa. To alleviate any concern about outliers, financial variables are winsorized at the 1% and 99 % level.

Table 2.1: Summary of variables

Variables	Description	Data source
RECOVERY	Duration of market price recovery (in weeks) to its pre-crisis level.	Thomson Reuters Datastream
EP	Environmental score from Asset4 Dataset.	Thomson Reuters-Asset4
EPI	Environmental Performance Index	Yale University
MB	Market value of equity / Book value of equity.	Worldscope
ROA	Return on asset.	Worldscope
SIZE	Natural log of firm's total assets.	Worldscope
DA	Book value of debts / Book value of assets.	Worldscope
SG	Sales growth (sales in current year divided by sales in previous year).	Worldscope
RD	R&D Expenditures / Sales.	Worldscope
RDDUM	R&D dummy, equals 1 if firms have R&D expenditure and 0 otherwise.	Worldscope
CAPEX	Capital expenditures / Book value of Assets.	Worldscope
MOMENTUM	Stock price momentum, three years' market price change before crisis.	Thomson Reuters
INDUSTRY	Dummy for industry from the GICS 2-digits classification	Worldscope

2.3.2. Sample

The construction of our sample is depicted in Table 2.2. From 5,154 firms in 66 countries, the stock prices of 787 firms, necessary for calculating duration of recovery, are missing in Thomson Reuters DataStream (from October 2007 to October 2016). EP ratings from Asset4 also reduce our sample significantly by 2,533 firms due to non-availability.

After balancing for unavailable observations of control variables, our sample is finally restricted to 1,622 unique firms from 30 countries : 555 firms are located in the USA, followed by Japan (312), UK (214) and Canada (86). The remaining countries included in the sample are detailed in Table 2.3. We also observe that three main sectors represent approximately 50% of the overall sample: financials, industrials and consumer discretionary.

Table 2.2: Sample construction

Firms in the Sample	
5,154	Total number of firms in the sample.
-787	Firms stock prices not available on DataStream, necessary for calculating our main variable of interest (i.e. Resilience)
-2,533	Firms Asset4 environmental ratings not available
-83	Environmental performance Index (EPI) score for each firm not available for their respective countries.
-26	Firms Market to Book value (MB) observations not available
-13	Firms sales growth (SG) observations not available
-90	Firms momentum observations not available
1,622	Final Sample

Table 2.3: Sample Description

Country	Obs.	Sector	Obs.
United States	555	Financials	287
Japan	312	Industrials	285
United Kingdom	214	Consumer Discretionary	265
Canada	86	Information Technology	161
Australia	66	Materials	158
France	61	Consumer Staples	143
Germany	46	Energy	134
Switzerland	38	Health Care	120
Sweden	37	Telecommunication	35
Spain	31	Utilities	34
Italy	30	Total	1,622
Netherlands	25		
Finland	20		
Ireland	17		
Belgium	13		
Austria	12		
Denmark	12		
Norway	10		
Portugal	10		
Others	27		
Total	1,622		

Summary statistics for our variables are presented in Table 2.4. RECOVERY has a mean equal to 176 weeks and a median equal to 210 weeks. Mean EP is 0.515, whereas mean EPI is 0.812.

In exploring other characteristics in the sample, we note that MB and ROA have an average of 3.274 and 0.061, respectively. Moreover, firm size is on average \$9.5 billion. Means of DA, SG, RD, CAPEX and MOMENTUM are respectively 0.236, 1.147, 0.024, 0.052 and 1.453.

Table 2.4: Summary Statistics

VARIABLES	N	Mean	Median	S.D.	p25	p75
RECOVERY	1,622	176	210	52	153	210
EP	1,622	0.515	0.474	0.320	0.170	0.868
EPI	1,622	0.812	0.814	0.031	0.785	0.829
MB	1,622	3.274	2.472	3.275	1.729	3.774
ROA	1,622	0.061	0.051	0.070	0.025	0.090
SIZE	1,622	9.155	8.934	1.526	8.059	10.079
DA	1,622	0.236	0.214	0.174	0.103	0.341
SG	1,622	1.147	1.097	0.260	1.032	1.194
RD	1,622	0.024	0.000	0.065	0.000	0.021
RDDUM	1,622	0.546	1.000	0.498	0.000	1.000
CAPEX	1,622	0.052	0.040	0.050	0.019	0.069
MOMENTUM	1,622	1.453	0.905	2.152	0.290	1.812

2.4. Results

2.4.1. Univariate tests

Using mean comparison matched t-tests, we compare EP of recovered and unrecovered firms as exhibited in Table 2.5. During the sample period, 632 firms recovered, whereas 990 firms (61%) failed to recover. The mean EP of recovered and unrecovered firms is 0.472 and 0.543, respectively. The mean EP of recovered firms average is statistically significantly less than the EP of unrecovered firms with a difference of 0.071, in accordance with H₂.

Table 2.5: Matched t-test of EP comparison between recovered and unrecovered firm's groups

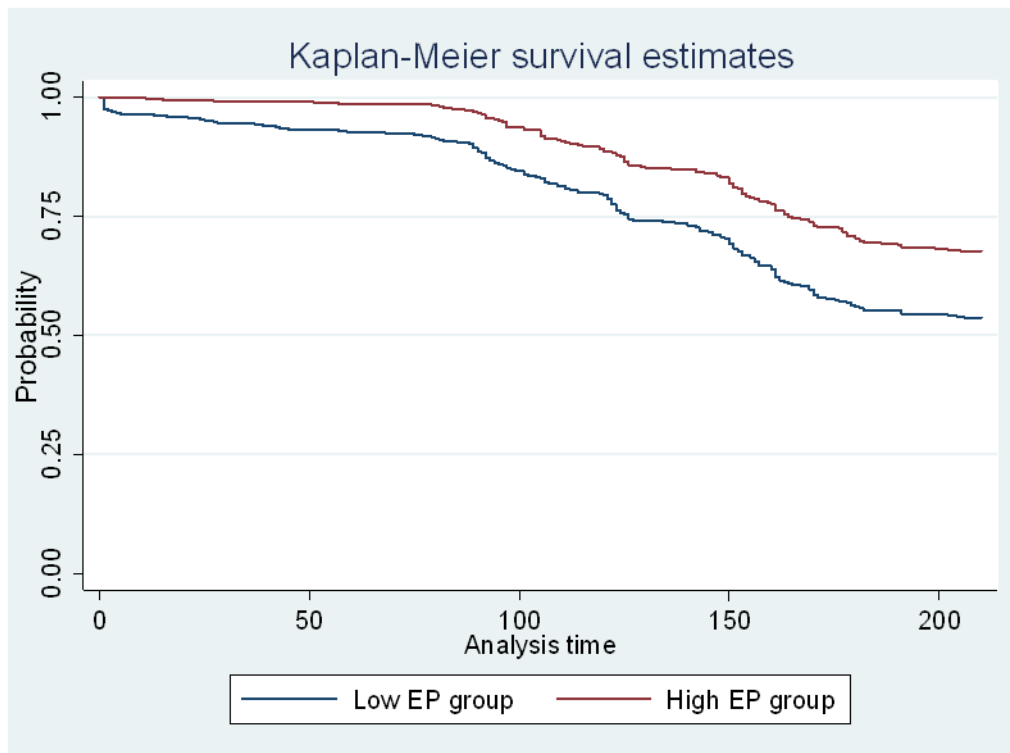
Group	Observations	Mean	Std. Err.	Std. Dev.
Recovered Firms	632	0.472	0.012	0.312
Unrecovered Firms	990	0.543	0.010	0.322
Combined	1,622	0.515	0.008	0.320
Difference		.071***	0.016	

61% of the firms didn't recover during the sample period. On average, recovered firms' EP is significantly (p-value = 0.000) less than unrecovered firms.

Furthermore, we divide our sample into two sets based on EP: high EP group when a firm's EP is greater than its median and low EP group when EP is less than the median. We then conduct Kaplan-Meier survival analysis to compare the probability of recovery of both sets. The graph, presented in Figure 2.1, shows that, through the whole path, for the same amount of time, high EP group firms have a higher probability to remain in the same state, which is the state of non-recovery. Furthermore, as the time increases, the curves get more disconnected, suggesting that EP negatively affects the recovery.

We then perform the log-rank test for both groups, to test statistical difference between both Kaplan-Meier curves. The results, exhibited in Table 2.6, show that high and low EP groups have significantly different Kaplan-Meier curves with a p-value less than 0.001.

Figure 2.1: Kaplan-Meier survival estimates between high and low EP groups



This figure shows the Kaplan-Meier curves for both groups, which have been split according to the median. The x-axis shows the analysis time, and the y-axis shows the probability to remain in the same state of non-recovery. High probability shows less resiliency. The High EP group has a comparatively high probability to remain unrecovered.

Table 2.6: Log-rank test for equality of Kaplan-Meier curves

Groups	Events observed	Events expected
Low EP group	360	296.93
High EP group	272	335.07
Total	632	632
	chi2(1) = 25.43	Pr>chi2 = 0.000

This table shows statistical significance of the difference between Kaplan-Meier curves, indicate that both curves are significantly different from each other.

2.4.2. Survival analysis estimations

In order to study the impact of EP on the duration of recovery when the subprime crisis occurred, we employ Cox proportional hazards regression model (Cox, 1972). Unlike ordinary least squares regression models, survival models permit to deal with censored observations' problem, as some firms did not recover during the sample period. Cox model estimates the probability of recovery at time t , based on the covariates. The relationship can be expressed as follows:

$$h_i(t|x_1, x_2, \dots, x_k) = h_0(t) e^{(\beta_1 x_1 + \beta_2 x_2 + \dots + \beta_k x_k)}$$

Where $h_i(t)$ represents the hazard rate for observation i . $h_0(t)$ represents the baseline hazard function of recovery at time t . x represents the covariates (i.e. EP, EPI, MB, ROA, SIZE, DA, SG, RD, RDDUM, CAPEX, MOMENTUM, INDUSTRY and REGION). β_i is the regression coefficient for its respective covariate. A positive sign of a coefficient means that a higher value of that variable indicates a quick recovery, and thus a high resilience.

Results are presented in Table 2.7. First column presents Model 1 which tests the sole relationship between the firm's EP and resilience. EP has a negative and significant coefficient, indicating that high EP firms are less likely to recover quickly after crisis. Hence, a higher level of EP is associated with longer duration of recovery, and thus a lower resilience. This result is consistent with those of our previous preliminary tests. In Model 2, we include our control variables (i.e. EP, EPI, MB, ROA, SIZE, DA, SG, RD, RDDUM, CAPEX, MOMENTUM). The coefficient of EP is still negative and significant. Moreover, the coefficient of EPI is also negative and significant, suggesting that firms located in high EPI countries are more likely to take more time to recover. In Model 3, we include dummies for industry with all control variables, and find a comparable negative and highly significant coefficient of EP with a hazard

rate of 0.614. Finally, in Model 4, we include dummies for geographical regions of the firm as well, and the link between EP and resilience remains unaffected.

Table 2.7: Impact of environmental performance on financial resilience

VARIABLES	Model 1	Model 2	Model 3	Model 4
EP	-0.608*** (0.127)	-0.286* (0.151)	-0.488*** (0.159)	-0.466*** (0.161)
EPI		-6.969*** (1.307)	-6.182*** (1.319)	-6.129*** (1.401)
MB		0.019 (0.012)	0.018 (0.012)	0.016 (0.012)
ROA		0.624 (0.613)	0.454 (0.626)	0.330 (0.621)
SIZE		-0.236*** (0.037)	-0.196*** (0.041)	-0.198*** (0.042)
DA		-0.460* (0.264)	-0.530* (0.284)	-0.561** (0.285)
SG		0.007 (0.163)	-0.022 (0.163)	-0.019 (0.165)
RD		0.075 (0.664)	0.223 (0.737)	0.043 (0.749)
RDDUM		0.427*** (0.094)	0.232** (0.100)	0.262** (0.102)
CAPEX		0.942 (0.805)	-0.366 (0.937)	-0.204 (0.937)
MOMENTUM		-0.101*** (0.024)	-0.127*** (0.026)	-0.129*** (0.026)
INDUSTRY	No	No	Yes	Yes
REGION	No	No	No	Yes
Likelihood ratio	23.57***	190.10***	248.32***	255.15***
Observations	1,622	1,622	1,622	1,622

This table presents Cox proportional hazards regression analysis for window 1, the crisis period calculated from October 2007 to October 2011. Negative coefficients indicate an increase in the value of that variable decreases the likelihood of recovery. EP is firm's environmental performance from Asset4 Dataset. EPI represents country level environmental performance. MB represents market to book value. ROA represents return on assets. Size is the natural log of a firm's total assets. DA represents book value of debt divided by book value of assets. SG represents sales growth. RD represents R&D. RDDUM represents R&D dummy, equal to 1 if firms discloses R&D expenditure and 0 otherwise. CAPEX represents capital expenditure. MOMENTUM is the pre-crisis three-year change in stock price. INDUSTRY represents a dummy for industry, REGION represents dummy for geographical region. Financial variables are winsorized at 1 and 99 % level. Standard errors are in parentheses.* Statistical significance at the 10 % level, ** Statistical significance at the 5 % level, *** Statistical significance at the 1 % level.

As a robustness check, we analyze the relationship using alternative models. First, we estimate the relationship using different windows by extending the crisis period to the October of 2012, 2013, 2014, 2015, and 2016 (Table 2.8). Coefficients of EP are still negative and significant for all windows, consistent with the results of the previous baseline model. Alternative choices of windows do not affect our findings. Second, we test the relationship using different models (Exponential, Weibull and Gompertz). As evidenced in Table 2.9, the results are comparable with than those obtained with the Cox model.

Overall, all else being equal, higher EP seems to reduce their ability to cope with the subprime crisis' shock. Extensive investment in environmental policies, therefore, appears to decrease financial resilience after a systematic crisis. Our findings seem to be in line with the neoclassical arguments stating that environmental engagements create agency problems (H₂). Investors may, especially during a financial crisis, react negatively to firm's environmental policies because they suspect environmental policies to be implemented by managers at the expense of the firm's adaptation to external financial troubles. In the vein of Friedman's (1970) argument, money invested in environmental policies cannot be made available in order to cope with a financial shock.

Environmental constraints at the institutional level also prove to have a detrimental impact on resilience. Indeed, we document a strong negative impact of EPI on financial resilience. This additional result seems to be in line with the view that an increase in stringency of environmental regulation reduce firms' profit (Palmer et al., 1995). Overall, at the level of the firm as well as the scale of the country, higher environmental performance leads companies to recover less quickly after the subprime crisis. We find that both high EP at a national level and at the firm level seem to act as a constraint for companies, reducing their capacity to adapt and to recover from the subprime crisis.

Table 2.8: Impact of environmental performance on financial resilience - Robustness to different time windows

VARIABLES	Oct. 2007- Oct. 2012	Oct. 2007- Oct. 2013	Oct. 2007- Oct. 2014	Oct. 2007- Oct. 2015	Oct. 2007- Oct. 2016
EP	-0.448*** (0.153)	-0.376*** (0.137)	-0.326** (0.132)	-0.253* (0.131)	-0.274** (0.132)
EPI	-6.175*** (1.338)	-5.581*** (1.235)	-5.044*** (1.215)	-5.552*** (1.221)	-5.408*** (1.143)
MB	0.021* (0.012)	0.015 (0.011)	0.012 (0.010)	0.010 (0.010)	0.010 (0.010)
ROA	0.171 (0.591)	0.145 (0.543)	0.345 (0.525)	0.514 (0.522)	0.591 (0.527)
SIZE	-0.152*** (0.039)	-0.114*** (0.034)	-0.114*** (0.032)	-0.116*** (0.032)	-0.112*** (0.032)
DA	-0.702*** (0.270)	-0.681*** (0.236)	-0.571** (0.225)	-0.575*** (0.221)	-0.536** (0.223)
SG	-0.048 (0.158)	-0.235 (0.153)	-0.218 (0.146)	-0.288* (0.148)	-0.247* (0.149)
RD	0.296 (0.693)	0.005 (0.673)	-0.140 (0.660)	-0.160 (0.658)	-0.197 (0.659)
RDDUM	0.242** (0.096)	0.273*** (0.087)	0.289*** (0.085)	0.352*** (0.085)	0.417*** (0.086)
CAPEX	-0.022 (0.890)	0.331 (0.800)	0.176 (0.786)	0.177 (0.790)	0.154 (0.808)
MOMENTUM	-0.133*** (0.026)	-0.131*** (0.024)	-0.142*** (0.024)	-0.148*** (0.024)	-0.192*** (0.026)
INDUSTRY	Yes	Yes	Yes	Yes	Yes
REGION	Yes	Yes	Yes	Yes	Yes
Likelihood ratio	267.18***	278.78***	284.05***	298.92***	336.13***
Recovered firms N	701	866	929	944	927
Observations	1,622	1,622	1,622	1,622	1,622

This table presents Cox proportional hazards regression analysis for crisis period restricted to October 2012, 2013, 2014, 2015, and 2016. Negative coefficients indicate that an increase in the value of that variable decreases the likelihood of recovery. EP is a firm's environmental performance from Asset4 Dataset. EPI represents country level environmental performance. MB represents market to book value. ROA represents return on assets. Size is the natural log of a firm's total assets. DA represents book value of debt divided by book value of assets. SG represents sales growth. RD represents R&D. RDDUM represents R&D dummy, and equals 1 if firms discloses R&D expenditure and 0 otherwise. CAPEX represents capital expenditure. MOMENTUM is the pre-crisis three-year change in stock price. INDUSTRY represents a dummy for Industry, REGION represents a dummy for geographical region. Financial variables are winsorized at 1 and 99 % level. Standard errors are in parentheses. * Statistical significance at the 10 % level ** Statistical significance at the 5 % level *** Statistical significance at the 1 % level.

Table 2.9: Impact of environmental performance on financial resilience – Alternative models

VARIABLES	Exponential Model	Weibull Model	Gompertz Model
EP	-0.417** (0.162)	-0.454*** (0.162)	-0.472*** (0.162)
EPI	-5.567*** (1.375)	-5.967*** (1.386)	-6.173*** (1.393)
MB	0.014 (0.012)	0.016 (0.012)	0.016 (0.012)
ROA	0.275 (0.627)	0.324 (0.622)	0.380 (0.618)
SIZE	-0.178*** (0.042)	-0.190*** (0.042)	-0.195*** (0.042)
DA	-0.534* (0.283)	-0.557* (0.284)	-0.564** (0.284)
SG	-0.019 (0.167)	-0.019 (0.165)	-0.016 (0.164)
RD	0.158 (0.718)	0.152 (0.753)	0.083 (0.748)
RDDUM	0.229** (0.101)	0.251** (0.102)	0.269*** (0.102)
CAPEX	-0.274 (0.944)	-0.236 (0.940)	-0.203 (0.937)
MOMENTUM	-0.117*** (0.026)	-0.126*** (0.026)	-0.131*** (0.026)
Constant	-0.010 (1.300)	-2.490* (1.336)	-0.417 (1.315)
Ln(p)		0.442*** (0.037)	
γ			0.009*** (0.001)
INDUSTRY	Yes	Yes	Yes
REGION	Yes	Yes	Yes
Likelihood ratio	218.82***	244.95***	259.34***
Observations	1,622	1,622	1,622

Columns 1, 2 and 3 present Exponential, Weibull, Gompertz models, respectively, for the crisis period restricted to October 2011. Negative coefficients indicate that an increase in the value of that variable decreases the likelihood of recovery. EP is firm's environmental performance from Asset4 Dataset. EPI represents country level environmental performance. MB represents market to book value. ROA represents return on asset. Size is the natural log of a firm's total assets. DA represents book value of debt divided by book value of assets. SG represents sales growth. RD represents R&D. RDDUM represents R&D dummy, and equals 1 if firms discloses R&D expenditure and 0 otherwise. CAPEX represents capital expenditure. MOMENTUM is the pre-crisis three-year change in stock price. INDUSTRY represents a dummy for Industry, REGION represents a dummy for geographical region. Financial variables are winsorized at 1 and 99 % level. Standard errors are in parentheses. * Statistical significance at the 10 % level, ** Statistical significance at the 5 % level, *** Statistical significance at the 1 % level.

2.4.3. Sensitivity to environmental policies dimension and country level environmental standards

In order to gain a finer understanding of the impact of EP on resilience, we then explore whether the effect is different depending on the different dimensions of environmental policy. Thus, we rerun our baseline model by using the three subcomponents of Asset4 environmental score, called “resource reduction”, “emission reduction” and “product innovation”. According to Asset4, “resource reduction” refers to “a company's management commitment and effectiveness toward achieving an efficient use of natural resources in the production process”, whereas “emission reduction” is defined as “a company's management commitment and effectiveness toward reducing environmental emission in the production and operational processes” (Lys et al., 2015, Gupta, 2018). Finally, “product innovation” measures “a company's management commitment and effectiveness toward supporting the research and development of eco-efficient products or services”.

Table 2.10: Impact of environmental performance on financial resilience – EP subsets

VARIABLES	Resource Reduction	Emissions Reduction	Product Innovation
EP	-0.536*** (0.154)	-0.329** (0.162)	-0.180 (0.159)
EPI	-6.471*** (1.392)	-6.988*** (1.384)	-7.563*** (1.335)
MB	0.016 (0.012)	0.016 (0.012)	0.016 (0.012)
ROA	0.272 (0.628)	0.154 (0.627)	0.022 (0.626)
SIZE	-0.191*** (0.041)	-0.215*** (0.042)	-0.239*** (0.039)
DA	-0.565** (0.286)	-0.583** (0.287)	-0.581** (0.290)
SG	-0.063 (0.166)	-0.043 (0.167)	-0.037 (0.167)
RD	-0.029 (0.750)	-0.051 (0.754)	-0.070 (0.759)
RDDUM	0.237** (0.101)	0.218** (0.101)	0.207** (0.102)
CAPEX	-0.166 (0.934)	-0.218 (0.945)	-0.312 (0.945)
MOMENTUM	-0.129*** (0.027)	-0.129*** (0.027)	-0.128*** (0.027)
INDUSTRY	Yes	Yes	Yes
REGION	Yes	Yes	Yes
Likelihood ratio	259.92***	251.86***	248.97***
Observations	1,609	1,609	1,609

Columns 1, 2 and 3 present Cox proportional hazards regression using resource reduction, emission reduction and product innovation as a proxy for EP from Asset4, respectively. Crisis period restricted to October 2011. Negative coefficients indicate that an increase in the value of that variable decreases the likelihood of recovery. EP is firm's environmental performance from Asset4 Dataset. EPI represents country level environmental performance. MB represents market to book value. ROA represents return on asset. Size is the natural log of a firm's total assets. DA represents book value of debt divided by book value of assets. SG represents sales growth. RD represents R&D. RDDUM represents R&D dummy, and equals 1 if firms discloses R&D expenditure and 0 otherwise. CAPEX represents capital expenditure. MOMENTUM is the pre-crisis three-year change in stock price. INDUSTRY represents a dummy for Industry, REGION represents a dummy for geographical region. Financial variables are winsorized at 1 and 99 % level. Standard errors are in parentheses. * Statistical significance at the 10 % level, ** Statistical significance at the 5 % level, *** Statistical significance at the 1 % level.

As reported in Table 2.10, we find that the coefficients of “resource reduction” and “emission reduction” are in line with our baseline result, negative and significant. Indeed, according to the neoclassical perspective, policies aimed at reducing pollution and the over-use of natural resources may have decreasing marginal net benefits (Horváthová, 2010). However, our results highlight that “product innovation” does not significantly decrease a firm's financial resilience. We argue that this sub-pillar may have an insignificant impact on resilience because it can be

easily directly linked to an increase in sales, achieved thanks to the development of new products (Lys et al., 2015). Indeed, as indicated by Horváthová (2010), the ongoing debate concerning the impact of policies linked to “resource reduction” and “emission reduction” on firms’ financial performance is still open since these policies are directly linked to additional costs for firms and without a clear direct impact on the revenues of the firm. “Product innovation” policies, however, are less controversial and might generate future distinctive products and competitive advantages. Opportunities created in investing in this EP sub-pillar may then counterbalance their costs and not affect significantly the firm’s financial resilience.

We also analyze whether the relationship between firm EP and financial performance is related to country-level environmental standards. The level of national environmental standards indicates how environmental issues are addressed in a given country and, as evidenced by Xiao et al. (2018), moderates the financial benefits of firm-level EP. These authors show that in countries with a low level of environmental standards, stakeholders’ expectations concerning firms’ environmental policies are especially high since environmental issues are not well addressed. In this context, an increase in firm-level EP can be a way to differentiate firms from their competitors. Therefore, in these countries, environmental policies may create value for shareholders and may be less likely to be considered as a mere financial constraint.

Conversely, in countries with high environmental standards, firms’ environmental policies are more institutionalized and stakeholders’ environmental expectations toward firms are lower. These policies may be more likely to be seen as a duty: the potential of differentiation is reduced. With costs exceeding potential benefits, this may lead to a negative impact on financial resilience. Since investors’ perception towards the potential benefits of environmental policies relies on national-level environmental standards, the impact of EP on resilience should be influenced by country-level EP.

We split our sample into two subsets based on [Bazillier et al. \(2017\)](#)'s proxies to measure country-level environmental standards, i.e. country's participation in treaties (from World Development Indicators) and EPI. As displayed in Table 2.11, in both cases our main finding is significant only for firms belonging to high environmental standards countries. When country-level environmental standards are high, we find that spending resources on EP are impeding firms to recover more quickly. In these countries, EP may then appear as unnecessary marginal expenses that are mitigating the ability of firms to adapt themselves to a financial shock. In low environmental standards countries, however, the relationship is not statistically significant. In line with the argument of [Xiao et al. \(2018\)](#), the expectations of stakeholders might be higher in these countries with EP expenses being counterbalanced by stakeholder support in the case of financial crises.

2.5. Conclusion

Society demands that firms become increasingly environmentally friendly. At the same time, firms encounter more and more financial crises that they have to cope with. The aim of this study is to assess whether EP is beneficial or not for firms attempting to recover from a financial shock. Such an exogenous event is of particular interest to disentangle endogeneity issues between environmental and financial performance. In the particular context of the subprime crisis, we investigate whether high EP firms recover quickly from the crisis compared with low EP firms. On one hand EP may trigger stakeholder support and help the firm to recover more quickly, yet on the other, EP could be perceived as an additional cost that may negatively impact on financial resilience.

Table 2.11: Impact of environmental performance on financial resilience – Split according to country-level environmental standards

VARIABLES	Less Treaties	More Treaties	Low EPI	High EPI
EP	-0.027 (-0.12)	-0.949** (-2.44)	-0.256 (-1.17)	-0.698*** (-2.73)
EPI	-6.749 (-1.17)	-3.088 (-1.06)	-7.162*** (-2.75)	-4.658 (-0.82)
MB	0.000 (-0.02)	0.0193 (0.80)	0.020 (1.23)	0.0173 (0.80)
ROA	1.886** (2.12)	-0.363 (-0.29)	0.653 (0.80)	-0.246 (-0.23)
SIZE	-0.201*** (-3.30)	-0.153* (-1.85)	-0.187*** (-3.21)	-0.252*** (-3.74)
DA	0.243 (0.58)	-0.974 (-1.57)	0.599 (1.48)	-1.337*** (-3.00)
SG	-0.318 (-1.06)	0.00899 (0.04)	-0.647** (-2.55)	0.532** (2.29)
RD	0.189 (0.21)	3.576 (1.37)	-0.340 (-0.37)	2.905 (1.52)
RDDUM	-0.025 (-0.17)	0.313 (1.55)	0.102 (0.76)	0.498*** (2.95)
CAPEX	0.060 (0.05)	-0.813 (-0.41)	-0.041 (-0.04)	-0.513 (-0.30)
MOMENTUM	-0.136*** (-3.24)	0.000 (0.07)	-0.003 (-0.47)	-0.137*** (-3.33)
INDUSTRY	Yes	Yes	Yes	Yes
REGION	Yes	Yes	Yes	Yes
Likelihood ratio	106.90***	100.24***	133.26***	117.31***
Observations	664	498	797	787

Columns 1 and 2 present Cox proportional hazards regression for a subsample of ‘less than median number of treaties’ and ‘more than number of treaties’, respectively. Column 3 and 4 presents Cox proportional hazards regression for subsample of less than median EPI score and higher than EPI score, respectively. Crisis period restricted to October 2011. Negative coefficients indicate that an increase in the value of that variable decreases the likelihood of recovery. EP is firm’s environmental performance from Asset4 Dataset. EPI represents country level environmental performance. MB represents market to book value. ROA represents return on asset. Size is the natural log of a firm’s total assets. DA represents book value of debt divided by book value of assets. SG represents sales growth. RD represents R&D. RDDUM represents R&D dummy, and equals 1 if firms discloses R&D expenditure and 0 otherwise. CAPEX represents capital expenditure. MOMENTUM is the pre-crisis three-year change in stock price. INDUSTRY represents a dummy for Industry, REGION represents a dummy for geographical region. Financial variables are winsorized at 1 and 99 % level. Standard errors are in parentheses. * Statistical significance at the 10 % level, ** Statistical significance at the 5 % level, *** Statistical significance at the 1 % level.

Using survival analysis with EP data from Thomson Reuters’s Asset4 on an international sample of 1,622 observations, we find that higher pre-crisis EP proves to significantly reduce a firm’s financial resilience. This relation, challenging for the EP-FP literature, is highly robust to different models, control variables and time periods chosen. Moreover, we find that the

impact of EP on resilience is only significant for the resource and emission reduction dimensions. Interestingly, firms investing in the precise product innovation category have not been negatively impacted on their financial resilience. We also show that the negative impact of EP on resilience is not significant for firms located in countries with low environmental standards. In such countries, since environmental issues have an important impact, firm-level environmental policies seem less to be perceived as a mere financial cost.

This study has practical implications for both corporate managers and investors. Corporate managers must be aware that environmental engagements could not help firms to cope with future financial uncertainty, as evidenced in this context of the subprime crisis. In a sense, they may have to choose between “doing good” and “doing well” concerning resource and emission reductions. Besides, and interestingly, managers are not penalized in terms of financial resilience when investing in product innovation, and in EP if their company is located in a country with low environmental standards. In these two conditions, EP did not impede the firm to financially recover from the subprime crisis. In addition, portfolio managers should be aware that a firm’s environmental policy in resource and emission reductions might increase its exposure to risk in case of a financial shock, especially in high environmental standard countries.

This study calls for future research to better understand the impact of EP on financial resilience, considering other contexts and recent exogenous shocks. Indeed, it is likely that consumers and media sensitivity to environmental issues has increased since the subprime crisis (Flammer, 2013). It would be interesting to understand whether this growing environmental awareness is likely to have altered the strength of negative effect of EP on financial resilience. Also, it might be fruitful to assess whether EP allows companies to improve financial resilience to shocks of different natures. If EP has a negative effect on financial resilience following a financial shock,

EP may besides allow firms to hedge against environmental shocks such as natural disasters or industrial accidents.

Chapter 3. Do environmental engagements improve financial resilience of firms after emission disclosure?

Abstract

Though the financial benefits of environmental engagements are preoccupied with the insurance-like effect and environment-as-a-resource framework, we extend this literature by considering their resilience, and more precisely the flexibility effect measured by the time of recovery. In the regulatory framework of the EU ETS, we argue that the disclosure of emissions data points out the latent environmental liability of carbon-intensive firm in the form of future compliance or emissions abatement costs. Market will adjust firm value for this liability. Thus, carbon-intensive firm may experience a severe market price loss as compare to their peers, and therefore may not recover easily. In line with the environment-as-a-resource view, carbon-efficient firm may neutralize the shock and recover faster by attracting stakeholders' attention through their reputation of being eco-friendly and the competitive advantage of having valuable and inimitable resources. By performing survival analysis on a sample of 3,194 observations over first twelve publication events from 2006 to 2017, we find that carbon intensity (CI) significantly downgrades the financial flexibility of firm against the shock caused by publication of emissions data. This finding, complements the flexibility effect of environmental engagements to the environment-as-a-resource concept, is robust through different time windows, models, measures of flexibility and CI, and mitigation of sample bias towards countries. However, we find that environmental engagements do not significantly demonstrates the flexibility effect in less polluting industries, and when carbon prices are low and overall allocation is high i.e. in first phase of the EU ETS.

Keywords: Crisis Management, Environmental Performance, Carbon Intensity, Emission Trading Scheme (ETS), Financial Flexibility

JEL Classification: G01, M14, O16, Q51

3.1. Introduction

The growing concerns about climate change has forced national and international institutions to interfere and regulate industrial emissions and encourage them to implement an environmental policy. To reduce the level of industrial emissions, the European Union introduced the world's largest emissions trading scheme (EU ETS), where they allocate a certain level of emissions limited to a specific industry and then allocate to individual installation either freely or via auction. Firms can therefore buy additional allowances in the market if needed or sell their surplus.

However, research show that regulations create constraints for firm and negatively affect their profitability (Clarkson et al., 2015, Chapple et al., 2013, Manchiraju and Rajgopal, 2017). Various studies have particularly examined the financial implications of the EU ETS. For instance, Brouwers et al. (2016), Clarkson et al. (2015), Jong et al. (2014) examined market reaction to the publication of verified emissions, a regulatory requirement under the EU ETS, and found a negative market reaction to the disclosure of firm's carbon emissions. Similarly, Clarkson et al. (2015) examine the value relevance of firm's emissions under the EU ETS and find that carbon intensity negatively affects firm value. These studies have so far addressed the role of environmental activities of firm in their financial stability. However, no attention is paid to the question of what happens next? For example, does firm value bounce back or not? Do environmental activities play any role in firm survival and recovery from disruption? Do environmental performant firms recover more quickly?

These questions are attributed to the flexibility dimension of organizational resilience (DesJardine et al., 2017). As flexibility represents the adaptability of firm to environmental changes (Ortiz-de-Mandojana and Bansal, 2016), it is important to study this aspect of organizational outcome during regulatory upheavals. Flexibility is crucial for firm's

sustainability as it improves firm's capacity to thrive and adapt to environmental changes (DesJardine et al., 2017). Flexibility is extremely important for firm success in turbulent environment like regulatory interruptions. We thus tackle this important issue to fill the gap by examining firm's flexibility in the context of EU ETS. Brouwers et al. (2016) and Jong et al. (2014) found a negative market reaction to the publication of verified emissions in some cases. It seems that market is sensitive to the carbon intensity of firms. We therefore study a specific link between carbon intensity and firm's financial flexibility against the shock triggered by the publication of verified emissions under the EU ETS. This will help us to understand whether carbon-efficient activities help companies to survive and compete in this challenging environment.

Concerning flexibility, previous works have mainly focused on the role of environmental activities in firm's financial stability dimension of resilience. For instance, Clarkson et al. (2015) argue that carbon-intensive firms possess a latent environmental liability, in the form of future compliance or emissions abatement cost, and market adjust firm value for this liability. Thus, firm value reduces when disclosure of verified emissions points out the carbon intensity of firm. On the other hand, eco-friendly activities of firm achieve environmental legitimacy by meeting stakeholders' expectations and therefore attracts their support while facing a shock (Bansal and Clelland, 2004). Furthermore, empirical studies show that responsible activities like protecting the environment provide an insurance-like benefit against legal or regulatory actions (Godfrey et al., 2009, Koh et al., 2014).

Even though, the insurance-like benefits of environmental activities are well documented in the context of financial stability, less attention is paid to firm recovery from a shock, i.e. flexibility dimension of resilience. Previous work show that environmental activities mitigates the impact of exogenous shock, however, this does not explain the precise link with financial

flexibility i.e. time to recovery. As the loss in firm value and time to recovery capture the duality of both dimensions of resilience i.e. stability and flexibility (DesJardine et al., 2017), we expect that environmental activities may also help firm to recover faster from a shock. Due to the insurance-like benefits of environmental activities (Godfrey et al., 2009) firm will experience less loss and therefore may easily recover. The Environmental Resource based view (Hart, 1995, Russo and Fouts, 1997) and the environment-as-a-resource view (Flammer, 2013) postulate that carbon-efficient firms possess the reputation of being eco-friendly and the competitive advantage of having valuable and inimitable resources. Thus, firm may benefit from this reputation and competitive advantage to attract stakeholders' attention and neutralize the effects of a shock and recover faster. We thus hypothesize that carbon efficiency improves firm's financial flexibility against the shock triggered by the disclosure of verified emissions.

Following DesJardine et al. (2017), we measure financial flexibility by duration of firm's market price recovery to the level before the shock. For measuring carbon intensity, we collect emissions data from Trucost dataset which is scaled by firm's revenues. We apply the Cox PH model on a final sample of 3,194 observations from 47 countries having installations covered under the EU ETS. We test the relationship by considering the first 12 years publications of verified emission from 2006 to 2017. We conduct the analysis on different time windows (i.e. from 30 to 180 trading days after the event) and found a negative and significant link between carbon intensity and the rate of firm's market price recovery. After running different regression models, using different measures of flexibility and carbon intensity, including different control variables, and mitigating sample biasness towards countries, we found our results highly robust.

Our findings suggest that carbon efficiency is crucial for firm's flexibility against regulatory upheavals. This indicate that firm should adopt an effective environmental policy to thrive

through a turbulent environment. To have a thorough understanding of this relationship we then consider the role of carbon-intensity profile of firm's sector. Where our results show that carbon intensity of firm significantly downgrades their financial flexibility only if the firm belongs to a carbon-intensive sector. Furthermore, we also test the impact of allowance shortage on financial flexibility and found that allowance shortage also significantly decreases the rate of firm's market price recovery. This indicate that firm's emissions beyond the allocated level deteriorates the financial flexibility of firm. Finally, we conduct the analysis on each phase of the EU ETS separately. We find that carbon intensity significantly increases the duration of recovery only in second and third phases. While this link is not significant in the first phase. Evidence show that carbon prices were very low in this phase (Brouwers et al., 2016) and the overall allocation was reduced in later phases. This indicate that carbon intensity significantly affects firm recovery when the carbon prices are high and the demand for allowances are high.

In this study, we first make an important contribution to the literature by documenting the Environmental Resource based view (Hart, 1995, Russo and Fouts, 1997) and the environment-as-a-resource framework (Flammer, 2013) in the context of ETS disclosure in focusing on the flexibility effect, measured as the time firm market prices needed to recover. We precisely analyze the role of environmental engagements in building the financial flexibility against a regulatory requirement of the publication of verified emissions. If the financial stability and insurance-like benefits of environmental engagements are well addressed, to our knowledge, no attention is paid to their flexibility effects and especially in the context of regulatory upheavals. By applying a survival analysis methodology, our results prove that environmental engagements enable firm to recover faster from the shock. Our findings reinforce the advantages of environmental engagements highlighted by the environment-as-a-resource

framework, such as reputation and acquisition of valuable and inimitable resources. Thus, environmental performant firms may benefit from these advantages to neutralize the effects of a shock, recover faster and adapt to a turbulent environment during regulatory upheavals. This indicate that beside the stability and insurance-like effects, environmental engagements also possess the effect of financial flexibility. Since the ETS around the world is currently covering only 15% of the global emissions and it is spreading around the world (ICAP, 2018), thus it is a timely proposition to managers for managing its risk through an effective environmental policy.

Secondly, we contribute to the literature by documenting that survival analysis can be used to substitute the conventional event study methodology. As event study methodology focuses on a very short run assessment, our measure of flexibility in survival analysis allows us to check the relationship in a comparatively long run. Survival analysis also allows to check the relationship in different time windows simultaneously. As our findings show that the relationship is strong and robust in longer time windows, this seems particularly important for shareholders. Shareholders must know that market takes some time to fully incorporate its reaction to the carbon efficiency of firms after disclosure of emissions data. Furthermore, investors may outperform in a turbulent environment by investing in carbon-efficient firms.

The rest of the paper is organized as follows. The second section presents related literature and hypothesis development. The third section describes the method used, variables and data analysis. The fourth section is dedicated to our empirical results. The last section presents the conclusion.

3.2. Literature and hypothesis development

The purpose of EU ETS is to combat climate change by reducing the GHG emissions. However, some authors argue that mandatory environmental regulation increases firm's costs (Clarkson et al., 2015, Chapple et al., 2013, Manchiraju and Rajgopal, 2017). Under the EU ETS, authorities fix a maximum level of GHG emissions from the covered installations. Some installations then receive a certain level of allowances setting a maximum level of emissions. Beyond that level, firms can purchase allowances in the market or sell their surplus. Eventually, the under-allocated firms have to bear an additional cost of purchasing the permits. Every year authorities verify the emissions of each installation and publish it at the European Union Transaction Log (EUTL) website⁴. Research, for instance Brouwers et al. (2016), show that the publication of verified emissions negatively affect the share price of carbon-intensive and under-allocated firms.

It seems that the publication of verified emissions brings some benefits as well as harms to concerned firms. For instance, as different authorities scrutinize and verify actual emissions of firm, their publication is trustworthy and increases transparency among firm stakeholders. Firms can timely identify their surplus or allowances deficiencies and can also benefit from selling their surplus allowances. Firm can minimize the risk of non-compliance through a timely identification of deficiencies against the EU ETS. However, if firm's operation is carbon intensive compared to peers, this may negatively affect firm value. To comply with the EU ETS, carbon-intensive firms will bear the cost of buying allowances in the market or will have to invest in less carbon-intensive technologies and processes. In both cases, it seems that the publication of verified emissions identifies some additional costs that firm will bear in future.

⁴ URL: <https://ec.europa.eu/clima/ets/>

Chapple et al. (2013) and Clarkson et al. (2015) attribute this compliance and future cost towards emission reduction to the latent liabilities of firm which negatively affects firm's financial stability.

Chapple et al. (2013) argue that firm's carbon intensity is value relevant. By using an event study methodology on the announcements of proposed Australian ETS implementation, they find a significant impact of these announcements on firm value. Furthermore, using a valuation model, they find a decrease from 7% to 10% of market capitalization in the market value of carbon-intensive firms. They argue that this decrease in firm value may arise from the existence of latent environmental liabilities, including emissions abatement costs or reduction in future earnings. Similarly, Clarkson et al. (2004) claim that stringent environmental regulations significantly enhances firm's production costs. In their study, based on a sample of US pulp and paper firms, they conclude that market uses firm's emissions data, i.e. toxic release inventory data, to assess the latent environmental liabilities of a firm. According to them, these liabilities represent their obligatory future spending of polluting firms towards pollution abatement, which is approximately equal to 16.6% of their market capitalization.

As EUTL discloses the compliance of firm with EU ETS by publishing the verified emissions of covered installations every year, it may bring investors' attention to the environmental policy of firms. Investors seem like more sensitive to the long-term impact of the EU ETS (Jong et al., 2014). We argue that investors may restrain from investing in firms having higher latent environmental liabilities. As the system only covers a 45% of the EU GHG emissions (European Commission, 2016), it still has a great potential to include and regulate the installations of a more array of activities. This may increase investors' concerns about firm latent environmental liability and therefore may not give value to carbon-intensive firms due to future regulative stringency. With more expected stringent regulations in future, firm will

need more environmental capital expenditures to comply with regulations and thus will affect firm's financial stability. In this vein, [Clarkson et al. \(2015\)](#) used a valuation model and find that carbon intensity reduces firm value specifically after the publication of verified emissions. We thus anticipate that firm's value may decrease after the publication of verified emissions, hence negatively affect firm's financial stability.

Showing a negative link with firm's financial stability, we argue that the publication of verified emissions may also make the carbon intensity relevant to firm financial flexibility. It appears that a severe loss in firm value will make it difficult for firm to recover quickly, thus making firm less flexible. [DesJardine et al. \(2017\)](#) argue that loss in firm value and their time to recovery capture the duality of financial stability and flexibility. Indeed, firm value will recover more quickly if they experience a smaller loss in their value. Thus, environmental activities make firm financially stable against the shock triggered by the publication of verified emissions by reducing the severity of loss in firm value. While experiencing a smaller loss, we anticipate that carbon efficient firm may recover faster from the shock, thus making firm financially flexible.

Besides the indirect impact on financial flexibility through stability, environmental commitments seem to have a direct link with financial flexibility. Environmental activities may help firm to build long-term relationships with external stakeholders ([Ambec and Lanoie, 2008](#)). Thus, environmental performant firm may exploit this advantage and positively attract investors' attention during environmental turbulence. Eventually, firm may neutralize the negative effects of a shock and recover faster. This notion can be theoretically supported by the instrumental version of stakeholder theory ([Jones, 1995](#), [Donaldson and Preston, 1995](#)), implying that building good relations with stakeholder leads to a competitive advantage for firm. Furthermore, the Environmental Resource based view ([Hart, 1995](#), [Russo and Fouts,](#)

1997) specifically advocates the environmental engagements of firm. This view postulates that environmental commitments improve firm reputation and develops other valuable and inimitable resources for the firm, leading to a competitive advantage. We thus argue that the reputation of being eco-friendly and the competitive advantage may help firm in recovery from the shock triggered by disclosure of their emissions data.

Based on above arguments, we thus anticipate that environmental performance may reduce the duration of firm recovery from the shock triggered by the disclosure of emissions data and will show higher level of financial flexibility compare to their peers. Whereas, carbon-intensive firm may experience a severe shock and may not recover quickly. We thus propose the following hypothesis:

H: More carbon intensive firms are less flexible and take more time to recover from the event of verified emissions disclosure

3.3. Variables and methodology

3.3.1. Variables

Flexibility and time frame

We examine here the link between the carbon intensity of firms and their financial flexibility against the environmental shock triggered by the publication of verified emissions under the EU ETS. As firm's market price fully reflects new set of information in an efficient market, therefore, we anticipate that firm market price will portray the indication of any potential costs, i.e. latent environmental liabilities pointed out by the disclosure of emissions data, and the green image of firm. We thus use firm's market price to measure the financial flexibility of firm. Furthermore, it is also important because it reflects not only the financial returns of firms but also the premium for meeting their social responsibility (Baron, 2009). Similarly,

[DesJardine et al. \(2017\)](#) also measured financial flexibility through firm's market price in the context of the subprime crisis. We thus measure flexibility by the number of trading days of market price's recovery to the day before the publication of verified emissions.

To measure the financial flexibility of firm, a time frame is required. There is, however, no clear benchmark available in literature in the context of this study. [DesJardine et al. \(2017\)](#) used the same approach but their study was based on firm resilience against the subprime crisis, where firm market price takes more time to bounce back and observe resilience (stability and flexibility). Therefore, they consider the shortest time window up to one year. However, the intensity of shock triggered by the publication of verified emissions seems comparatively smaller than the subprime crisis. Therefore, we measure the flexibility by using shorter time windows starting from 10 days. However, based on the univariate analysis in the following section we conclude that financial flexibility can be observed more prominently when the time windows are longer than 30 days. Furthermore, [Clarkson et al. \(2015\)](#) and [Chapple et al. \(2013\)](#) test the impact of carbon intensity on firm value (financial stability) calculated one and three months after events, respectively. This indicate that a clear link may not be observed very close to the event. However, we run our regression models on shorter as well as longer time windows starting from 30 to 180 days.

We consider the first twelve publication events starting from 2005 to 2016. EUTL publishes the verified emissions data of each period in the month of April in the succeeding year except the emission report of 2005 which was published in May 2006. The exact dates of each publication are presented in table 3.1. The market price of firm on the day before the publication's date is considered as a benchmark for measuring firm's financial flexibility.

Table 3.1: The date publications of verified emissions

Event	Period	Publication date
1	2005	May 15, 2006
2	2006	April 2, 2007
3	2007	April 2, 2008
4	2008	April 1, 2009
5	2009	April 1, 2010
6	2010	April 1, 2011
7	2011	April 2, 2012
8	2012	April 2, 2013
9	2013	April 1, 2014
10	2014	April 1, 2015
11	2015	April 1, 2016
12	2016	April 3, 2017

Carbon intensity

Firm's carbon intensity (CI) is the variable of our primary interest after financial flexibility. It represents the impact of firm's operations on natural environment. To measure firm CI, we take the carbon emissions data from Trucost dataset. Trucost is one of the prominent agencies which collects thousands of publicly listed companies' environmental data every year and was already used in [Marquis et al. \(2016\)](#), [Delmas et al. \(2015\)](#), [Walls and Berrone \(2017\)](#) studies. We specifically take the sum of direct and first tier indirect emissions (carbon and other greenhouse gases in tonnes) scaled with firm's revenues (million USD). To account for the skewness of the distribution in the analysis we take the natural log of CI. All variables are described in table 3.2. We also examine the impact of greenhouse impact ratio and total impact ratio on flexibility to test whether firm flexibility is sensitive to other environmental proxies.

Control variables

First, we include the country-level environmental standards as a control variable in the analysis. It is important to include since EU ETS came into force because the member states committed

to the Kyoto Protocol. Similarly, countries shape their environmental policy according to the international treaties ratified by them e.g. according to the Rio Earth Summit in 1992, the Millennium Summit in 2000, and the World Summit on Sustainable Development in Johannesburg in 2002. [Clarkson et al. \(2015\)](#) argue that country-level environmental policy negatively affects firm financial performance because mandatory environmental regulations increase firm's costs. Therefore, it is necessary to control its influence in the link between firm carbon intensity and financial flexibility. Following [Bazillier et al. \(2017\)](#) we use the Environmental Performance Index⁵ (henceforth EPI) scores as a proxy for country-level environmental standards. EPI rates countries from 0 (poor performance) to 100 (high performance) based on their overall environmental targets. We divide EPI scores by 100 to bring it in the range between 0 and 1.

While examining the relationship of firm's social responsibility, including environmental as well, with resilience (stability and flexibility), [DesJardine et al. \(2017\)](#) incorporated some control variables in their analysis. Therefore, to have a robust analysis, we also include some of their controls in the analysis i.e. book-to-market value, profitability, operational efficiency, size, leverage, research and development expenditures, capital intensity. In addition, we also incorporate a dummy for firm's industry. Book-to-market value represents the book value of assets scaled with market value of equity, denoted by BM. BM represents the intangible assets of the firms i.e. goodwill and reputation, therefore, controlling for it will mitigate the concern that firm's financial flexibility is driven by market reputation of firm ([DesJardine et al., 2017](#)).

⁵ EPI is developed by Yale University, Yale Center for Environmental Law and Policy (YCELP), and Columbia University, Center for International Earth Science Information Network (CIESIN), in collaboration with the World Economic Forum and Joint Research Centre (JRC) of the European Commission (2006).

Table 3.2: Summary of Variables

Variables	Description	Data source
Flexibility dimension of resilience	Duration of market price recovery in trading days to the level before the publication of verified emissions.	Datastream
CI	The carbon intensity of firms - the sum of direct and first tier indirect emissions (tonnes) scaled with firm's revenues (million USD)	Trucost
EPI	Country-level environmental standards measured by Environmental Performance Index's score.	Yale Center for Environmental Law and Policy
BM	Book value of equity of firm divided by market value of equity.	Worldscope
CF	Funds from operations divided by net sales	Worldscope
SG	Sales Growth (sales minus previous year sales divided by previous year sales).	Worldscope
SIZE	Natural log of firm's total assets (000).	Worldscope
DA	Book value of debts / Book value of assets.	Worldscope
RD	R&D Expenditures / Sales.	Worldscope
RDDum	A dummy – equals 1 if R&D data is available, otherwise zero.	
CAPEX	Capital Expenditures / Book value of Assets.	Worldscope
INDUSTRY	Dummy for industry from the GICS 2-digits classification	Worldscope

It is important to control for firm's operational efficiency. Operational efficient firms may attract investors' attention more, and therefore, may help firms market price to recover comparatively quickly. Thus, we control for firm's operational efficiency by using two proxies i.e. sales growth (SG) and cash flows from operations (CF). SG is calculated by total sales minus previous year sales and divided by previous year sales. CF is measured by total amount of funds from operations divided by net sales. As [Markman and Venzin \(2014\)](#) find smaller banks more resilient as compare to large bank against financial crisis, therefore, it seems that large firms lose investors trust more when they are facing a shock. Thus, we also control to reduce this concern in the context of recovery from the shock caused by the publication of verified emissions. We measure firm's size by taking the natural log of firm's total assets,

denoted by SIZE. We also consider the role of firm's leverage in the analysis, which is measured by firm's total debts scaled with their total assets and is denoted by DA.

We also control for firm's innovation capacity. Innovative firms may be less carbon intensive, therefore, may have less impact of the publication of verified emissions and recover quickly. Following [Brancati et al. \(2017\)](#), we measure firm's innovation by the research and development expenditure (RD). However, the data of RD is scarce, therefore, we replace the missing value of RD by zero and then create a dummy, RDDUM, which is equal to 0 if RD values are missing, otherwise 1. As [Gittell et al. \(2006\)](#) find a negative association between firm's capital intensity and financial performance of airlines after the September 2011 attack, therefore, it may also play a role in the link between firm's carbon intensity and flexibility in the context of this study. Thus, we include it in the analysis by taking the capital expenditures of firm divided by total assets, denoted by CAPEX. As different industries are scrutinized differently for their impact on natural environment, therefore, we include a dummy for industries (INDUSTRY) to control the fixed effect of industries by using GICS's two digits sector classification.

3.3.2. Survival Analysis methodology

We employ survival analysis methodology which best suits in the context of this study. Previously, event study methodology was used to examine the impact of events on the financial performance of firms, for instance [Brouwers et al. \(2016\)](#) and [Jong et al. \(2014\)](#) in the context of EU ETS. However, it does not allow to study the flexibility side of resilience as well as the role of other variables (e.g. carbon intensity as in this study) on the impact of an event on the financial performance of firm. By taking financial flexibility as a measure of firm's financial performance, survival analysis enables us to examine precisely the time to recovery and the impact of different variables (covariates) on financial performance of firm in the aftermath of

an event. Survival analysis considers if a firm is recovered or not within a specified period as well as the intensity of recovery (duration of recovery). By considering the unrecovered firms, this model also takes into account the right censored observation in the analysis, which may not be possible in standard OLS regression model. From the survival analysis methodology, we specifically use the Cox proportional hazards regression model (Cox, 1972) as a baseline model. Initially this model was used in medicine for examining the impact of a treatment on patient's health. However, its use is now growing in management studies, for instance utilized by Ambrosius (2017), DesJardine et al. (2017), Ortiz-de-Mandojana and Bansal (2016), Ogane (2015), and Roberts and Dowling (2002).

Cox model estimates the impact of different covariates on the recovery hazard rate after an event. The relationship can be expressed in the following equation.

$$h_i(t|x_1, x_2, \dots, x_k) = h_0(t) e^{(\beta_1 x_1 + \beta_2 x_2 + \dots + \beta_k x_k)}$$

Where $h_i(t)$ represents the hazard rate of recovery for observation i^{th} . $h_0(t)$ is the baseline hazard function of recovery at time t , however, Cox model leave it unpredicted. x_i represents the covariates (i.e. CI, EPI, SIZE, BM, RD, RDDum, CAPEX, DA, SG, CF and INDUSTRY). β is the regression coefficient for its respective covariate. A positive sign of a coefficient represents that increase in that variable will increase the probability of firm's recovery, and vice versa. As a robustness check, we also analyze this relationship by using other survival models, i.e. the Weibull, Gompertz, and Exponential proportional hazard models in combination with other regression models.

3.3.3. Data analysis

We conduct this study on the first twelve years of verified emissions publications starting from 2005 to 2016. This includes two completed phases and first four years of the third phase of the

EU ETS. First phase covers the years from 2005 to 2007 and second phase includes the years from 2008-2012. Third phase is comprised from 2013 to 2020, whereas, we could only include until 2016 due to the unavailability of data. Thus, we collect all data from 2005-2016 except the firm market prices. As, the EUTL publishes the verified emissions in succeeding years, therefore, we collect firm's market price data from 2006-2017. Firm's market price is required for measuring firm's financial flexibility.

We include those firms in the analysis that has at least one installation covered under the EU ETS. To collect other data of the firm, we needed an identifier of the firm, for instance ISIN or RIC code. We thus first matched the names of companies from our list with the names of parent companies of each installation available at the EUTL. We successfully found the names of 705 installations that are owned or operated by 424 unique firms. Secondly, we identify firm's inclusion in the EU ETS from Thomson Reuters Asset4 and CDP databases. These sources show whether a firm is covered or not under the EU ETS in a specific year. Overall, we were able to include 788 unique firms that has at least one installation covered under the system during the analysis period, with 5,297 of total observations. We adjust our sample for the missing values of necessary variables in the analysis. As depicted in table 3.3, our final sample is then restricted to 3,194 observations.

Table 3.3: Sample Construction

Description	Observations
Total number of observations collected	5,297
Price data necessary for measuring flexibility is not available	-359
Carbon intensity from Trucost is not available	-1402
Observations of EPI is not available	-13
Observation for calculating SIZE is not available	-16
Observations of BM is not available	-63
Observation of CAPEX is not available	-61
Observations' sector (GICS 2-digits) information is not available	-189
Final Sample	3,194

Table 3.4 summarizes the distribution of sample across countries, sectors and the year of EU ETS reporting. Our final sample includes firms from 47 countries. The USA⁶ is leading country with 812 observations having installations covered under the EU ETS, followed by the UK with 481 observations. Our sample includes observations from the EU ETS member states and firms domiciled outside the member states, but their installations are situated within the member states and covered by the system. In the sample materials sector has the large number of observations i.e. 727, followed by industrials and consumer staples sectors with observations of 646 and 374, respectively.

⁶ Though these firms are headquartered out of the EU ETS member states, their installations are in the member states and covered by the system. However, we exclude the observations from the USA with some other countries to make sure that our results are robust and are not biased towards a specific country.

Table 3.4: Sample distribution by country, sector and year

	Country	Average EPI	N		Country	Average EPI	N
1	USA	70.46	812	25	Portugal	78.6	18
2	UK	77.85	481	26	Turkey	58.56	14
3	Germany	80.54	347	27	Hungary	71.98	13
4	France	72.79	282	28	Ireland	76.51	13
5	Italy	76.85	133	29	Taiwan	65.11	13
6	Japan	73.21	123	30	Morocco	53.5	11
7	Finland	77.21	93	31	Czech Republic	81.76	10
8	Spain	81.02	86	32	Philippines	46.96	10
9	Sweden	79.19	68	33	Thailand	56.18	10
10	Switzerland	87.75	64	34	Colombia	53.42	9
11	Austria	78.98	63	35	Malaysia	61.34	9
12	Denmark	77.77	54	36	Peru	47.42	9
13	Korea	64.8	52	37	Brazil	56.16	8
14	Netherlands	77.77	48	38	Indonesia	44.1	8
15	Belgium	68.05	42	39	Chile	72.14	7
16	Canada	75.61	37	40	Singapore	83.28	7
17	Greece	74.29	37	41	New Zealand	79.31	4
18	Norway	79.91	32	42	Russia	53.32	4
19	Mexico	56.25	30	43	UAE	72.02	4
20	Australia	80.75	27	44	China	43	3
21	India	45.01	26	45	Israel	69.9	3
22	Poland	70.87	23	46	Egypt	61.11	1
23	South Africa	54.55	23	47	Romania	48.59	1
24	Hong Kong	47.07	22				
Sector Name				Year			
			47	2005			135
			300	2006			165
			374	2007			204
			265	2008			257
			126	2009			269
			256	2010			287
			646	2011			349
			108	2012			405
			727	2013			419
			24	2014			170
			321	2015			421
				2016			113
	Total		3,194	Total			3,194

This table includes the number of observations available for analysis distributed by country, GICS two-digits sector, and year. EPI represents country's Environmental Performance Index scores.

Summary statistics and correlation matrix are presented in table 3.5. Financial data are collected from Worldscope. To mitigate the impact of extreme values, financial data are winsorized at 1 and 99% level. On average, our sample firms' carbon intensity is equal to 287.15 tonnes per million dollars of revenues. As some observations are censored due to non-recovery within their prescribed time window, we do not include the flexibility variable in the table. Their descriptive statistics will not portray actual values because of censored observations. However, we present the statistics of the probability of recovery variable. Probability of recovery is equal to 1 if a firm is recovered within a time window, and zero if not. The average of this variable explains the ratio of recovered to total number of observations within a time window. Though we run our tests on different time windows, we present statistics of the probability of recovery captured only in 120 days' time window. As shown in the table, probability of recovery (Prob. Recov) has an average equal to .58. This indicates that within the time window of 120 days only 58% of observations recovered. Whereas, probability of recovery has a significantly negative correlation with the carbon intensity (Log CI) of firm. Among control variables, probability of recovery has negative and significant correlation with firm size and leverage (DA), whereas, positive and significant correlation with research and development expenditures (RD).

Our sample includes firms from 47 countries with an average EPI of .74 scores. On average, firms' size is equal to €14.8 billion. Book to market ratio has an average of .68. On average, sample firms have invested 2% of their revenues in R&D and 5% of their assets in capital expenditures. The average of debt to asset ratio is equal to .28. On average, sales growth is equal to 4%, whereas, the average funds from operations ratio with net sale is equal to 15%.

Table 3.5: Summary statistics and correlation matrix

Variable	Mean	Median	S.D	1	2	3	4	5	6	7	8	9	10
1 Prob. Recov	.58	1	.49	1									
2 Sever. Loss	13.33	10.4	11.79	-0.64***	1								
3 Log CI	5.66	5.69	1.43	-0.07***	0.12***	1							
4 EPI	.74	.76	.09	-0.03	-0.06***	-0.12***	1						
5 SIZE	16.51	16.48	1.57	-0.04*	-0.01	-0.29***	0.03	1					
6 BM	.68	.56	.53	-0.00	0.16***	0.12***	0.07***	0.08***	1				
7 CF	.15	.12	.11	0.02	-0.10***	-0.04*	-0.05**	0.08***	-0.19***	1			
8 DA	.28	.27	.14	-0.05**	0.05**	0.10***	-0.07***	0.07***	0.02	-0.01	1		
9 SG	.04	.03	.17	-0.02	0.03	-0.03	-0.09***	-0.01	-0.16***	0.11***	-0.03	1	
10 RD	.02	0	.04	0.04*	-0.09***	-0.35***	0.07***	0.09***	-0.17***	0.17***	-0.20***	0.03	1
11 CAPEX	.05	.04	.04	-0.02	0.05**	0.30***	-0.08***	-0.16***	-0.09***	0.24***	-0.03	0.11***	-0.15***
Observations	3194												

Prob. Recov represents the probability of recovery within an observation time window of 120 days, i.e. if a firm is recovered (=1) or not (=0) within the observation time window. Sever. Loss represent the percentage of maximum share price loss within the observation window of 120 days. Log CI represents the log-transformed carbon intensity of firm. EPI measure country-level environmental performance index score. SIZE is the natural log firm's total assets. BM is book-to-market ratio. ROA measures return on assts. RD represents R&D expenditures divided by firm's revenues. CAPEX is ratio of capital expenditure with firm's total assets. DA represents debt to assets ratio. SG measures firm's sales growth. CF represents the ratio of funds from operation with firm's revenues.

3.4. Results

3.4.1. Univariate tests

Before conducting the regression analysis, we perform some univariate tests to have a better understanding of the relationship between carbon intensity and financial flexibility of firm. As there is a substantial portion of observations that did not recover within the observation windows, it gives us the opportunity to check whether carbon intensity of firm play any role in the probability of firm's recovery. For this purpose, we split our sample into two groups based on the carbon intensity of firms, i.e. high CI group if firms carbon intensity is higher than median, otherwise low CI groups. We conduct the two-sample t-test through different time windows starting from 10 to 180 days. Here we find that, on average, low CI group has a higher

probability of recovery. This indicate that carbon intensity does play a role in the recovery of firm's market price from the shock. As summarized in table 3.6, the difference between both groups is consistently significant across all time windows except in the shortest window of 10 days. Furthermore, we find that the difference between both groups is increasing when the time window expands. This means that when time passes after the shock then a clear impact of carbon intensity may be observed on the recovery of firm.

Table 3.6: Two-sample t-test with equal variances for comparison of probability of recovery between high versus low carbon intensity groups.

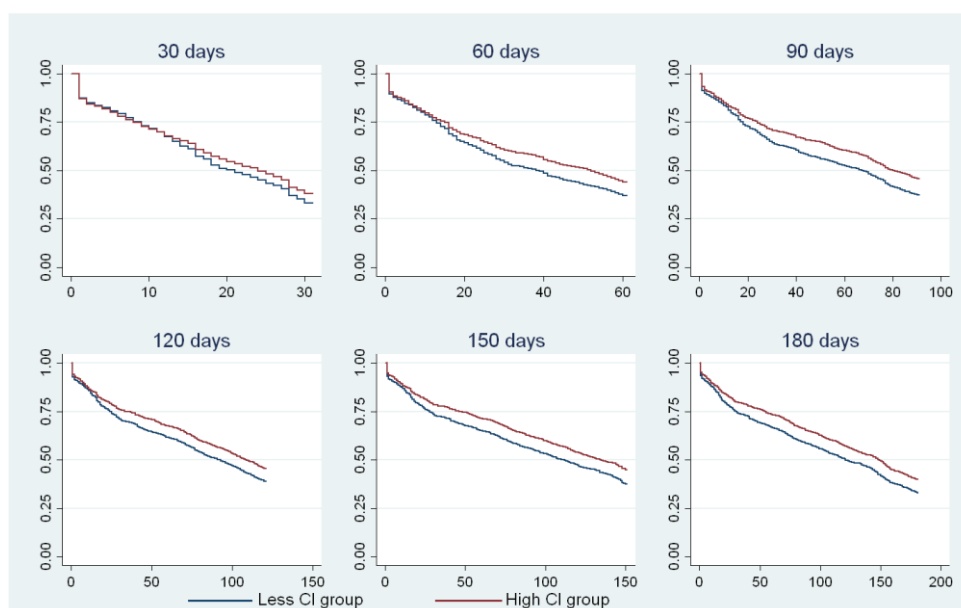
	Low CI (N)	High CI (N)	Low CI group (Avg. Prob-Recov)	High CI group (Avg. Prob-Recov)	Difference	St_Err	t_value	p_value
10 days	1597	1597	.566	.564	.002	.018	.05	.943
20 days	1597	1597	.651	.611	.041	.017	2.4	.017
30 days	1597	1597	.668	.619	.05	.017	2.9	.004
40 days	1597	1597	.652	.598	.054	.017	3.15	.002
50 days	1597	1597	.641	.565	.076	.018	4.4	.000
60 days	1597	1597	.632	.56	.072	.018	4.15	.000
90 days	1597	1597	.628	.543	.085	.018	4.85	.000
120 days	1597	1597	.611	.546	.065	.018	3.7	.000
150 days	1597	1597	.625	.551	.074	.018	4.25	.000
180 days	1597	1597	.671	.601	.071	.017	4.15	.000

This table compares the probability of recovery of high versus low carbon intensity (CI) groups. Low CI includes firms if their CI is less than median CI, otherwise included in high CI group. Avg. Prob-Recov represents the arithmetic average of probability of recovery. Difference represents the difference between the average probability of recovery, which is increasing when the observation time window expands.

We then conduct the Kaplan-Meier survival analysis to compare the survival curves (probability of non-recovery at time t) of both groups (high versus low CI groups). We also conducted this analysis for all time windows; however, the Kaplan-Meier curves of both groups does not appear to be different from each other in the time windows shorter than 30 days. As predicted by previous t-test, the role of carbon intensity may not be observed in short term after the shock. We thus present the survival curves of both groups conducted through the time window of 30 days and higher. As exhibited in figure 3.1, the Kaplan-Meier curves seem different from each other. They seem more disconnected from each other when the observation window expands. Each graph show that the probability of high CI group is higher to remain in

the same state of non-recovery than the low CI group. This indicates that low carbon-intensive firms experience a quicker recovery as compared to carbon-intensive firms. This finding is in line with the results of previous mean comparison matched t-test.

Figure 3.1: Kaplan-Meier survival estimates for high versus low CI groups



This figure shows the Kaplan-Meier curves for high and less CI groups. High CI group include firms if their CI is higher than the median CI, otherwise include in less CI group. X-axis shows the analysis time, and y-axis shows the probability to remain in same state of non-recovery. High probability shows less resiliency. High CI group has comparatively high probability to remain in the same state of non-recovery.

Finally, we test the statistical significance of the difference of survival functions of both groups by conducting the Log-rank test for equality of survivor functions. The results, presented in table 3.7, show that the survival function of high and low CI groups is significantly different from each other across all observation windows. This test suggests that if both groups had a same survivor function, then high CI group would have experienced more recovery events. However, they experienced less recovery event than the events expected. This test confirms statistically the evidence exhibited by the Kaplan-Meier curves.

These preliminary univariate tests are so far supporting our hypothesis, showing that carbon intensity of firms mitigates the financial flexibility of firm against the shock triggered by the

publication of verified emission. Furthermore, we find that a significant role of carbon intensity can be observed when time frame after the shock expands. A significant role of carbon intensity may not be observed in a short run after the event.

Table 3.7: Log-rank test for equality of survivor functions for high versus low CI groups

Window	Total Events	Less CI group		High CI group		Chi square	p-value
		Events observed	Events expected	Events observed	Events expected		
30 days	2055	1067	1009.14	988	1045.86	6.89	.009
60 days	1903	1009	920.73	894	982.27	16.92	.000
90 days	1871	1003	896.36	868	974.64	24.86	.000
120 days	1847	975	891.22	872	955.78	15.45	.000
150 days	1878	998	901.56	880	976.44	20.1	.000
180 days	2031	1072	969.59	959	1061.41	20.94	.000

This table shows statistical significance of the difference of survivor functions. p-value is less than 0.01, clearly indicating that both groups based on carbon intensity have significantly different survivor functions.

3.4.2. Main results - survival analysis model

Link between carbon intensity and firm's financial flexibility

We are examining the role of firm's carbon intensity in building the financial flexibility of firm against the shock triggered by a regulatory requirement of the publication of verified emission. We run the Cox PH model, as a baseline model, on different observational windows ranging from 30 to 180 trading days. In the analysis, we include some control variables and dummies for sectors. The results are summarized in table 3.8. Each column presents the results of Cox model for each time window. The coefficients instead of hazard rates and the robust standard errors in parentheses are presented for each variable. The coefficient of carbon intensity is consistently negative and significant across all time windows, indicating that carbon intensity reduces firm's ability to cope with the shock triggered by the publication of verified emissions. Hence, carbon intensity reduces the financial flexibility of firm in this setting. The coefficient of carbon intensity is also decreasing until the time window of 150 days, suggesting that the negative impact of carbon intensity on firm's flexibility is increasing with the passage of time

after the publication of verified emissions. The hazard rate can be obtained by exponentiating the coefficients. For instance, the coefficient of CI in the time window of 120 days is equal to -0.119, thus its hazard rate is equal to 0.89. In terms of hazard rates, it can be interpreted as a one-unit increase in CI decreases the probability of recovery by $(1 - 0.89) \times 100 = 11\%$. To mitigate the role of other events in the relationship, we also run this test on time windows of 10 and 20 days and found the same significant and negative association of carbon intensity with the likelihood of firm's market price recovery. However, in line with the univariate tests, the coefficient of carbon intensity is smaller in short term after the shock. This indicate that a material impact of carbon intensity cannot be observed in a short period after the shock.

The results also reveal that the coefficient of EPI (country-level environmental standards) is significantly positive in the first observation windows. However, its coefficient becomes negative within expanded time windows of 90 and 120 days. Control variables does not show consistently significant association with firm's recovery across all time windows. Firm's size shows a negative and significant association with recovery in some windows. Indicating that larger firms are more penalized by the publication of verified emissions and takes more time to recover. In a 30 days' time window, book-to-market (BM) show a positive link with recovery, however, the link becomes negative in a time window of 120 days. Firm's leverage (DA) also show a negative and significant link with firm's recovery in a time window of 120 days. Similarly, sales growth also shows a negative and significant association with firm's recovery in some time windows.

Table 3.8: Cox model - Impact of log-transformed carbon intensity on flexibility

	(1) 30 days	(2) 60 days	(3) 90 days	(4) 120 days	(5) 150 days	(6) 180 days
Log CI	-0.055** (0.025)	-0.063** (0.027)	-0.099*** (0.027)	-0.119*** (0.027)	-0.122*** (0.027)	-0.115*** (0.026)
EPI	0.515* (0.276)	-0.170 (0.288)	-0.974*** (0.283)	-0.929*** (0.289)	-0.229 (0.291)	-0.317 (0.280)
SIZE	-0.025 (0.017)	-0.048*** (0.018)	-0.059*** (0.018)	-0.072*** (0.018)	-0.038** (0.018)	-0.015 (0.018)
BM	-0.087** (0.044)	-0.062 (0.048)	0.001 (0.048)	0.086* (0.046)	0.076 (0.046)	0.076* (0.045)
CF	0.076 (0.233)	-0.137 (0.242)	0.396* (0.235)	0.197 (0.247)	0.370 (0.242)	0.372 (0.235)
DA	-0.071 (0.164)	-0.141 (0.173)	-0.158 (0.175)	-0.451** (0.179)	-0.204 (0.178)	-0.244 (0.173)
SG	0.148 (0.132)	-0.144 (0.146)	-0.443*** (0.148)	-0.282* (0.145)	-0.195 (0.144)	-0.362** (0.141)
RD	-0.075 (0.842)	-0.303 (0.838)	-0.914 (0.898)	-0.866 (0.900)	-0.329 (0.896)	-0.452 (0.858)
RDDum	0.123** (0.055)	0.169*** (0.058)	0.091 (0.058)	0.136** (0.059)	0.053 (0.058)	0.063 (0.056)
CAPEX	0.535 (0.678)	-0.007 (0.729)	0.342 (0.720)	1.163 (0.725)	0.893 (0.719)	0.159 (0.716)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R ²	0.002	0.002	0.004	0.004	0.002	0.002
Obs.	3194	3194	3194	3194	3194	3194

Hazard rate of recovery is dependent variable, representing flexibility. Log CI represents the log-transformed carbon intensity of firm. EPI measure country-level environmental performance index score. SIZE is the natural log firm's total assets. BM is book-to-market ratio. RD represents R&D expenditures divided by firm's revenues. CAPEX is ratio of capital expenditure with firm's total assets. DA represents debt to assets ratio. SG measures firm's sales growth. CF represents the ratio of funds from operation with firm's revenues. Standard errors are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

Robustness check

As a robustness check, we perform several tests. We first apply other alternative survival models to Cox model, such as the Weibull, Gompertz and Exponential models. As presented in table 3.9 in the first three columns, the result does not portray any significant variation from the Cox model. The relationship is almost same across all windows; however, we portray only the results of 120 days' observation window. These tests are consistently in line with our baseline model supporting our hypothesis. The results clearly indicate that carbon intensity significantly reduces financial flexibility of firm against the publication of verified emissions.

As each firm repeatedly appears in the analysis for different years, therefore, a random effect at firm level may affect the results. For instance, some firms may have learned from their experience in the beginning of the EU ETS and may be able to manage the crisis easily. We thus test the results for the existence of a random effect by making the groups of firm's observations. We specifically test for the existence of shared-frailty at firm level in our analysis. Shared-frailty model tests for the existence of within-group correlation. By running the shared-frailty Weibull model, we find that our results do not have the issue of shared frailty, indicating that we can rely on our previous results obtained from standard survival-analysis models.

Secondly, we use the probability of recovery variable as a dependent variable which is equal to 1 if the firm is recovered within a specified time window, or zero otherwise. This variable allows us to apply the Probit model. The results, as depicted in the fourth column of table 3.9, are in line with our previous results. Log-transformed carbon intensity therefore decreases the probability of firm's market price recovery. Thirdly, following [DesJardine et al. \(2017\)](#)'s measure of financial stability i.e. "severity of loss", we use it to find whether the carbon intensity of firms increases their severity of market price loss. As stated by [DesJardine et al. \(2017\)](#), the severity of loss and time to recovery capture the duality of both financial stability and flexibility. Thus, a smaller loss in firm market price will enable firm to recover faster from the shock. Severity of loss represents the absolute change in firm market price between the closing price before the publication of verified emission and the minimum value within their prescribed observational window. As the severity of loss can be calculated for the censored observations as well, therefore, we can use the conventional OLS model to examine the link between carbon intensity and severity of loss. The results are presented in fifth column of table 3.9, clearly indicate that carbon intensity significantly increase the severity of firm's market

price loss. Therefore, this indicate that carbon-intensive firm may take more time to recover from the shock because they are experiencing severe loss in their market prices.

Table 3.9: Robustness check - Impact of log-transformed carbon intensity on flexibility – 120 days window

	<u>Weibull</u> Recovery hazard rate	<u>Gompertz</u> Recovery hazard rate	<u>Exponential</u> Recovery hazard rate	<u>Probit</u> Probability of recovery	<u>OLS</u> Severity of loss
Log CI	-0.116*** (0.027)	-0.118*** (0.028)	-0.122*** (0.029)	-0.124*** (0.027)	0.882*** (0.237)
EPI	-0.920*** (0.288)	-0.952*** (0.297)	-0.989*** (0.306)	-0.845*** (0.278)	-5.570** (2.589)
SIZE	-0.071*** (0.018)	-0.073*** (0.019)	-0.076*** (0.019)	-0.067*** (0.017)	0.031 (0.158)
BM	0.081* (0.045)	0.084* (0.047)	0.090* (0.048)	0.104** (0.047)	2.360*** (0.474)
CF	0.166 (0.243)	0.174 (0.250)	0.193 (0.258)	0.255 (0.244)	-9.585*** (2.276)
DA	-0.450** (0.177)	-0.466** (0.183)	-0.478** (0.189)	-0.479*** (0.169)	5.552*** (1.573)
SG	-0.279* (0.143)	-0.293** (0.147)	-0.307** (0.152)	-0.227* (0.137)	4.140*** (1.442)
RD	-0.804 (0.885)	-0.845 (0.917)	-0.909 (0.954)	-0.851 (0.911)	1.649 (7.269)
RDDum	0.134** (0.058)	0.138** (0.060)	0.142** (0.062)	0.116** (0.056)	-1.168** (0.523)
CAPEX	1.216* (0.717)	1.255* (0.738)	1.272* (0.761)	0.775 (0.679)	2.942 (6.313)
Constant	-1.617*** (0.443)	-2.467*** (0.453)	-2.612*** (0.467)	2.378*** (0.425)	12.780*** (3.760)
ln_p	-0.283*** (0.022)				
Gamma		-0.004*** (0.001)			
Industry	Yes	Yes	Yes	Yes	Yes
FE					
chi2	105.068	104.445	104.284	93.728	
R-squared					0.074
Pseudo				0.022	
R ²					
Obs.	3194	3194	3194	3194	3194

Hazard rate of recovery is dependent variable survival models, representing flexibility. Log CI represents the log-transformed carbon intensity of firm. EPI measure country-level environmental performance index score. SIZE is the natural log firm's total assets. BM is book-to-market ratio. RD represents R&D expenditures divided by firm's revenues. CAPEX is ratio of capital expenditure with firm's total assets. DA represents debt to assets ratio. SG measures firm's sales growth. CF represents the ratio of funds from operation with firm's revenues. Standard errors are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

Table 3.10: Robustness check: Excluding the country-level sample bias in the link between carbon intensity and flexibility – 120 days window

	<u>Excluding observations from the USA and other countries with observation less than 20</u>			<u>Observations from the USA and other countries with observations less than 20</u>		
	<u>Cox Model</u>	<u>OLS Model</u>	<u>Probit Model</u>	<u>Cox Model</u>	<u>OLS Model</u>	<u>Probit Model</u>
	Recovery hazard rate	Severity of loss	Probability of recovery	Recovery hazard rate	Severity of loss	Probability of recovery
Log CI	-0.103*** (0.033)	1.115*** (0.303)	-0.112*** (0.032)	-0.174*** (0.053)	0.769* (0.404)	-0.176*** (0.054)
EPI	0.276 (0.411)	-16.519*** (3.660)	0.183 (0.368)	-2.763*** (0.510)	4.803 (4.354)	-2.563*** (0.518)
SIZE	-0.071*** (0.022)	0.095 (0.192)	-0.061*** (0.021)	-0.043 (0.036)	-0.284 (0.322)	-0.062 (0.038)
BM	0.102** (0.051)	1.696*** (0.546)	0.114** (0.053)	0.028 (0.127)	3.824*** (1.049)	0.076 (0.127)
CF	0.149 (0.301)	-10.170*** (2.675)	0.214 (0.294)	0.140 (0.479)	-4.378 (4.469)	0.274 (0.482)
DA	-0.339 (0.225)	5.722*** (2.067)	-0.366* (0.213)	-0.758** (0.326)	7.686*** (2.528)	-0.736** (0.302)
SG	-0.328* (0.176)	4.801*** (1.715)	-0.250 (0.164)	-0.116 (0.271)	2.814 (2.702)	-0.189 (0.256)
RD	-0.702 (1.179)	2.957 (9.536)	-1.176 (1.136)	-2.396 (1.460)	9.207 (11.531)	-1.272 (1.594)
RDDum	0.091 (0.071)	-0.509 (0.641)	0.071 (0.068)	0.233** (0.113)	-2.683*** (0.914)	0.190* (0.107)
CAPEX	1.650* (0.861)	-4.045 (7.455)	1.215 (0.804)	0.015 (1.472)	9.103 (12.252)	-0.112 (1.400)
Constant		19.277*** (4.821)	1.458*** (0.515)		10.106 (6.934)	3.677*** (0.875)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R ²	0.003		0.016	0.011		0.059
R ²					0.10	
Obs.	2193	2193	2193	1001	1001	1001

Country-level sample biasness is checked by running the tests on excluding the USA and other countries with observations less than 20. Log CI represents the log-transformed carbon intensity of firm. EPI measure country-level environmental performance index score. SIZE is the natural log firm's total assets. BM is book-to-market ratio. RD represents R&D expenditures divided by firm's revenues. CAPEX is ratio of capital expenditure with firm's total assets. DA represents debt to assets ratio. SG measures firm's sales growth. CF represents the ratio of funds from operation with firm's revenues. Standard errors are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

Finally, to mitigate the biasness of sample towards a specific country, we run our regression models by excluding some countries from the analysis. Since there is a substantial number of observations belonging to the USA-based firms (25% i.e. 812 observations), this may drag the explanatory power of the model. We thus exclude the observations representing companies domiciled in the USA. Furthermore, we also exclude other countries that have observations

less than 20 in the sample. By running the regressions again, as presented in the first three columns of table 3.10, the relationship is still the same and are in line with the findings of our baseline model. We also run separate tests on the sample that we excluded before (i.e. observations from the USA and other countries having observations less than 20). As presented in the last three columns of table 3.10, the coefficient of carbon intensity is still significant and in line with our main findings. This indicate that our main findings are not biased towards a specific country and are highly robust.

Overall, our results thus fully support our hypothesis and are highly robust. We find evidence that carbon intensity decreases the financial flexibility of firm against the publication of verified emissions. It appears that these publications point out the latent environmental liability of carbon-intensive firm. While our results suggest that investors seem highly concerned about the carbon intensity of firm under the circumstance of the EU ETS. Therefore, market penalizes carbon-intensive firm and investors seem reluctant to invest in firms with high level of emissions. Our findings appear to be coherent with the findings of [Manchiraju and Rajgopal \(2017\)](#), [Clarkson et al. \(2015\)](#), [Chapple et al. \(2013\)](#), arguing that regulations create constraints for firms. However, firm can outperform in this stringent environment by adopting an effective carbon-efficient environmental policy. Furthermore, our findings support the notion of the natural resource-based view ([Hart, 1995](#), [Russo and Fouts, 1997](#)) considering environment as a resource. It seems that environmental activities improve the reputation of firm among stakeholders. Which then helps them in the time of financial turbulence and neutralizes the negative effects of a shock, for instance the shock triggered by the disclosure of firm's emissions data.

Our finding is seemingly challenging the neoclassical economists view ([Friedman, 1970](#)), according to which managers involvement in the interest of other than shareholders, like

environmental engagements, may deviate them from their only goal of maximizing shareholders wealth. However, our results suggest that environmental engagements may increase firm's financial flexibility and comply with the joint cause of protecting the environment. Our findings extends the concept of insurance-like benefits of environmental engagements (Flammer, 2013), stating that environmental commitments of firm help them to reduce a negative market reaction to their eco-harmful events. Our findings show that environmental engagements play a role beyond the insurance-like benefits and makes firm financially flexible and resilient in general. Which is very crucial for firm's success in a turbulent environment (Richtnér and Löfsten, 2014).

3.4.3. Additional tests

Sensitivity to other environmental impact ratios

To have a thorough understanding of the role of firm's environmental activities in building the financial flexibility of firm against the publication of verified emission, we also test this link by using other measures of environmental engagements of firm. As the EU ETS is related firm's GHG emissions, we specifically consider the GHG impact of firm in the analysis. We also consider the "total impact ratio" of firm to check whether firm flexibility is sensitive to overall environmental performance of firm. Total impact ratio includes firm's total external environmental costs scaled with firm revenue. This indicator aggregates firm's environmental impacts of natural resources used, amount of waste generated, GHG and pollutants (air, land and water) generated. We present Cox model results as well as other models as a robustness check. The relationship is almost the same across all time windows, therefore, we only present the results of tests run on 120 days' time window. As reported in table 3.11, both environmental impact ratios show a negative association with firm recovery. This indicate that market not

only consider the GHG efficiency relevant but also considers the overall environmental performance of firm in the context of EU ETS.

Table 3.11: Sensitivity to other measures of carbon intensity – 120 days window

	<u>Cox</u> <u>Model</u> Recovery hazard rate	<u>OLS</u> <u>Model</u> Severity of loss	<u>Probit</u> <u>Model</u> Probability of recovery	<u>Cox</u> <u>Model</u> Recovery hazard rate	<u>OLS</u> <u>Model</u> Severity of loss	<u>Probit</u> <u>Model</u> Probability of recovery
Log GHG Impact	-0.174*** (0.041)	2.293*** (0.351)	-0.176*** (0.039)			
Log Total Impact				-0.165*** (0.040)	2.041*** (0.344)	-0.172*** (0.039)
EPI	-1.178*** (0.304)	-0.436 (2.798)	-1.110*** (0.299)	-1.088*** (0.298)	-2.054 (2.738)	-1.029*** (0.293)
SIZE	-0.070*** (0.018)	0.006 (0.158)	-0.065*** (0.018)	-0.075*** (0.018)	0.068 (0.157)	-0.070*** (0.018)
BM	0.084* (0.046)	2.164*** (0.466)	0.099** (0.047)	0.083* (0.046)	2.215*** (0.467)	0.099** (0.047)
CF	0.137 (0.248)	-8.924*** (2.279)	0.199 (0.245)	0.185 (0.247)	-9.512*** (2.277)	0.243 (0.244)
DA	-0.499*** (0.180)	6.146*** (1.573)	-0.526*** (0.170)	-0.481*** (0.180)	5.871*** (1.573)	-0.509*** (0.170)
SG	-0.260* (0.145)	3.892*** (1.428)	-0.202 (0.137)	-0.264* (0.145)	3.964*** (1.433)	-0.207 (0.137)
RD	-0.711 (0.898)	2.627 (7.222)	-0.653 (0.905)	-0.690 (0.898)	1.807 (7.211)	-0.627 (0.905)
RDDum	0.141** (0.059)	-1.195** (0.519)	0.124** (0.056)	0.162*** (0.059)	-1.441*** (0.519)	0.145*** (0.056)
CAPEX	1.101 (0.720)	0.599 (6.247)	0.685 (0.674)	1.036 (0.718)	1.949 (6.224)	0.622 (0.672)
_cons		10.431*** (3.665)	2.147*** (0.408)		10.659*** (3.696)	2.198*** (0.413)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R ²	0.004		0.022	0.003		0.021
R ²			0.083			0.08
Obs.	3194	3194	3194	3194	3194	3194

Hazard rate of recovery, probability of recover, severity of loss is dependent variable in Cox, Probit, OLS models representing flexibility, respectively. Log GHG Impact and Log Total Impact are alternative measures of firm's carbon intensity, representing the environmental impact of firm. EPI measure country-level environmental performance index score. SIZE is the natural log firm's total assets. BM is book-to-market ratio. RD represents R&D expenditures divided by firm's revenues. CAPEX is ratio of capital expenditure with firm's total assets. DA represents debt to assets ratio. SG measures firm's sales growth. CF represents the ratio of funds from operation with firm's revenues. Standard errors are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

Sensitivity the carbon intensity of firm's sector

As different sectors are affecting the natural environment differently, therefore, carbon-intensive sectors are receiving more scrutiny from stakeholders. We thus test whether carbon intensity of firm in carbon-intensive sectors affect financial flexibility of firms differently. For

this purpose, we split the sample into two groups based on the carbon-intensity profile of their respective sectors. Carbon intensive sectors include energy, industrials, materials, and utilities sectors, using GICS sector classifications. As expressed in table 3.12, the coefficient of carbon intensity is significant only for the firms in the carbon-intensive sectors, showing a negative link with firm's rate of recovery. This indicate that carbon intensity of firm is receiving more attention from the market in carbon-intensive sectors. Thus, environmental commitments are highly important in the sectors that are more affecting the natural environment.

Role of allowance shortage in firm's financial flexibility

Some firms receive a certain level of free emissions limit under the EU ETS, called allowance. However, many firms emit beyond that level and eventually buy additional allowances in the market. We test whether firm emissions beyond the allocated level affects their financial flexibility. We thus create an indicator variable for this allowance shortage (AS), equal to 1 if firm's verified emission is higher than allocation and 0 otherwise. As presented in table 3.13, our results show that the coefficient of allowance shortage is highly significant and negatively affecting firm's recovery.

Analysis across different phases of EU ETS

Finally, we test whether the link between carbon intensity and financial flexibility is changed with the passage of time. For this purpose, we test the relationship for each phase of the EU ETS separately. Results are expressed in table 3.14 for each phase separately. Here we find that carbon intensity significantly reduces the rate of recovery of firm in second and third phases. However, it does not show any significant association with flexibility in the introductory phase. As there was over allocation in the first phase and eventually the carbon prices dropped close to zero (Brouwers et al., 2016). Therefore, environmental performance may not have been considered important in the first phase. However, a 6.5% reduction in overall allocation was

evidenced in the second phase. This may have increased attention to the environmental policy of firm. Therefore, carbon intensity negatively and significantly affects firm flexibility in the later phases. Furthermore, the impact of CI on firm's recovery is more severe in second phase as compare to third phase. As the second phase was revised as compare to the first phase and more array of industries were included in the system, this may have increased the concerns of investors about the carbon intensity of firms in second phase. The CI-flexibility relationship is weak in third phase may be because the carbon prices were substantially dropped nearly to €4 in the third phase⁷.

⁷ Source URL: <https://ember-climate.org/2016/09/02/eu-carbon-price-falls-below-e4-2/>

Table 3.12: Sensitivity to the carbon-intensity profile of firm's sector – 120 days window

	<u>High carbon intensive sectors</u>			<u>Low carbon intensive sectors</u>		
	<u>Cox Model</u> Recovery hazard rate	<u>OLS Model</u> Severity of loss	<u>Probit Model</u> Probability of recovery	<u>Cox Model</u> Recovery hazard rate	<u>OLS Model</u> Severity of loss	<u>Probit Model</u> Probability of recovery
Log CI	-0.150*** (0.034)	0.874*** (0.300)	-0.157*** (0.033)	-0.039 (0.054)	0.502 (0.452)	-0.033 (0.055)
EPI	-0.854** (0.391)	-8.568** (3.502)	-0.700** (0.347)	-1.116** (0.446)	0.155 (3.794)	-1.228** (0.479)
SIZE	-0.058** (0.025)	0.053 (0.211)	-0.048** (0.022)	-0.073** (0.031)	-0.167 (0.261)	-0.078** (0.032)
BM	0.110* (0.059)	2.113*** (0.598)	0.121** (0.058)	0.088 (0.075)	2.684*** (0.798)	0.117 (0.085)
CF	0.165 (0.322)	-8.908*** (2.794)	0.262 (0.301)	0.430 (0.420)	-11.218*** (4.215)	0.470 (0.447)
DA	-0.560** (0.249)	5.448** (2.231)	-0.575** (0.225)	-0.274 (0.273)	5.185** (2.210)	-0.242 (0.268)
SG	-0.043 (0.182)	3.621** (1.762)	-0.025 (0.168)	-0.666*** (0.243)	4.719* (2.567)	-0.583** (0.238)
RD	-0.184 (1.541)	-8.413 (12.276)	-0.509 (1.534)	-1.192 (1.118)	7.447 (9.280)	-0.917 (1.159)
RDDum	0.104 (0.074)	-1.155* (0.676)	0.072 (0.069)	0.111 (0.106)	-0.636 (0.868)	0.109 (0.108)
CAPEX	1.058 (0.981)	4.123 (8.417)	0.474 (0.840)	1.282 (1.115)	-2.755 (8.938)	1.378 (1.194)
Constant		14.662*** (5.040)	2.210*** (0.533)		11.913** (5.606)	2.126*** (0.755)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R ²	0.003		0.017	0.005		0.026
R ²		0.05			0.09	
Obs.	3194	3194	3194	3,194	3194	3194

Hazard rate of recovery, probability of recover, severity of loss is dependent variable in Cox, Probit, OLS models representing flexibility, respectively. Log CI represents the log-transformed carbon intensity of firm. CI_Sector is an indicator variable, equal to 1 if firm belong to carbon intensive sector. EPI measure country-level environmental performance index score. SIZE is the natural log firm's total assets. BM is book-to-market ratio. RD represents R&D expenditures divided by firm's revenues. CAPEX is ratio of capital expenditure with firm's total assets. DA represents debt to assets ratio. SG measures firm's sales growth. CF represents the ratio of funds from operation with firm's revenues. Standard errors are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

Table 3.13: Link between allocation shortage and flexibility – 120 days window

	<u>Cox Model</u>	<u>Weibull Model</u>	<u>Gompertz Model</u>	<u>Exponential Model</u>	<u>OLS Model</u>	<u>Probit Model</u>
	Recovery hazard rate	Recovery hazard rate	Recovery hazard rate	Recovery hazard rate	Severity of loss	Probability of recovery
Log CI	-0.142*** (0.037)	-0.140*** (0.036)	-0.144*** (0.038)	-0.149*** (0.039)	0.939*** (0.306)	-0.143*** (0.037)
AS	-0.279*** (0.067)	-0.279*** (0.066)	-0.289*** (0.068)	-0.300*** (0.071)	1.867*** (0.593)	-0.249*** (0.068)
EPI	-1.236*** (0.349)	-1.232*** (0.349)	-1.273*** (0.359)	-1.329*** (0.371)	-2.846 (3.312)	-1.193*** (0.356)
SIZE	-0.087*** (0.025)	-0.086*** (0.025)	-0.088*** (0.026)	-0.090*** (0.027)	-0.131 (0.214)	-0.080*** (0.024)
BM	0.105* (0.057)	0.099* (0.055)	0.102* (0.057)	0.112* (0.060)	2.153*** (0.621)	0.137** (0.065)
CF	0.224 (0.372)	0.201 (0.369)	0.210 (0.380)	0.228 (0.393)	-9.658*** (3.318)	0.282 (0.366)
DA	-0.402* (0.234)	-0.406* (0.232)	-0.424* (0.240)	-0.439* (0.249)	6.317*** (2.083)	-0.433* (0.226)
SG	-0.415** (0.202)	-0.412** (0.202)	-0.431** (0.208)	-0.453** (0.216)	3.524* (1.894)	-0.355* (0.184)
RD	-1.425 (1.168)	-1.401 (1.153)	-1.487 (1.194)	-1.575 (1.247)	7.685 (9.733)	-1.076 (1.236)
RDDum	0.216*** (0.081)	0.213*** (0.081)	0.218*** (0.083)	0.225*** (0.086)	-0.876 (0.706)	0.188** (0.079)
CAPEX	2.028** (0.920)	2.055** (0.909)	2.123** (0.939)	2.199** (0.977)	-0.659 (8.741)	1.690* (0.927)
Constant		-0.989* (0.584)	-1.814*** (0.595)	-1.958*** (0.617)	13.537*** (4.996)	2.889*** (0.568)
ln_p		-0.287*** (0.028)				
Gamma			-0.005*** (0.001)			
Industry	Yes	Yes	Yes	Yes	Yes	Yes
FE						
Pseudo R ²	0.007					0.039
Chi2	108.232	108.118	106.623	105.627		93.377
R-squared					0.09	
Obs.	1,753	1,753	1,753	1,753	1,753	1,753

Hazard rate of recovery, probability of recover, severity of loss is dependent variable in survival, Probit, OLS models representing flexibility, respectively. Log CI represents the log-transformed carbon intensity of firm. AS represents allowance shortage, equals 1 of verified emission is higher than allocated, otherwise 0. EPI measure country-level environmental performance index score. SIZE is the natural log firm's total assets. BM is book-to-market ratio. RD represents R&D expenditures divided by firm's revenues. CAPEX is ratio of capital expenditure with firm's total assets. DA represents debt to assets ratio. SG measures firm's sales growth. CF represents the ratio of funds from operation with firm's revenues. Standard errors are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

Table 3.14: Impact of carbon intensity on flexibility in different phases of EU ETS – 120 days window

	Phase 1			Phase 2			Phase 3		
	<u>Cox Model</u> Recovery hazard rate	<u>OLS Model</u> Severity of loss	<u>Probit Model</u> Probability of recovery	<u>Cox Model</u> Recovery hazard rate	<u>OLS Model</u> Severity of loss	<u>Probit Model</u> Probability of recovery	<u>Cox Model</u> Recovery hazard rate	<u>OLS Model</u> Severity of loss	<u>Probit Model</u> Probability of recovery
Log CI	0.084 (0.083)	0.285 (0.686)	0.070 (0.081)	-0.211*** (0.042)	1.919*** (0.397)	-0.199*** (0.043)	-0.074* (0.041)	0.507 (0.320)	-0.099** (0.040)
EPI	-0.806 (0.944)	6.701 (8.786)	-0.650 (0.906)	-0.273 (0.490)	4.824 (5.018)	0.011 (0.489)	-1.267*** (0.424)	-9.841*** (3.305)	-1.234*** (0.383)
SIZE	-0.111* (0.059)	-0.355 (0.389)	-0.075 (0.050)	-0.112*** (0.027)	0.277 (0.248)	-0.102*** (0.028)	-0.040 (0.028)	-0.042 (0.232)	-0.044* (0.026)
BM	0.743** (0.298)	-1.336 (2.324)	0.450* (0.259)	-0.131* (0.072)	4.195*** (0.801)	-0.069 (0.072)	0.140** (0.070)	1.090* (0.574)	0.150** (0.070)
CF	0.593 (0.864)	-5.684 (6.061)	0.097 (0.835)	-0.279 (0.350)	-7.290* (3.717)	-0.105 (0.376)	0.446 (0.395)	-7.194** (3.124)	0.500 (0.360)
DA	0.029 (0.565)	0.278 (4.049)	-0.235 (0.515)	-0.368 (0.274)	7.614*** (2.632)	-0.513* (0.280)	-0.641** (0.279)	5.143** (2.218)	-0.529** (0.246)
SG	-0.739 (0.487)	2.471 (3.740)	-0.570 (0.407)	-0.517** (0.201)	7.351*** (2.230)	-0.440** (0.203)	0.281 (0.262)	-3.042 (2.020)	0.214 (0.244)
RD	1.871 (2.862)	-33.562* (18.378)	2.867 (2.823)	-0.568 (1.322)	9.130 (12.088)	-1.196 (1.468)	-1.673 (1.441)	-1.254 (10.131)	-1.505 (1.370)
RDDum	0.335* (0.187)	-2.775* (1.530)	0.270 (0.168)	0.144 (0.089)	-1.394 (0.848)	0.144 (0.089)	0.055 (0.092)	-1.278* (0.738)	0.020 (0.085)
CAPEX	-0.823 (2.065)	21.288 (16.574)	-0.794 (1.947)	2.489** (1.035)	-14.815 (10.074)	1.706 (1.070)	0.560 (1.269)	0.530 (9.523)	0.224 (1.059)
Constant		13.954 (11.124)	0.916 (1.232)		-5.052 (6.485)	2.975*** (0.706)		20.127*** (5.188)	2.153*** (0.626)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R ²	0.013		0.042	0.009		0.051	0.004		0.023
R-squared		0.12			0.14			0.06	
Obs.	413	413	413	1366	1366	1366	1415	1415	1415

Hazard rate of recovery, probability of recover, severity of loss is dependent variable in Cox, Probit, OLS models representing flexibility, respectively. Log CI represents the log-transformed carbon intensity of firm. AS represents allowance shortage, equals 1 of verified emission is higher than allocated, otherwise 0. EPI measure country-level environmental performance index score. SIZE is the natural log firm's total assets. BM is book-to-market ratio. RD represents R&D expenditures divided by firm's revenues. CAPEX is ratio of capital expenditure with firm's total assets. DA represents debt to assets ratio. SG measures firm's sales growth. CF represents the ratio of funds from operation with firm's revenues. Standard errors are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

3.5. Conclusion

Do environmental engagements improve the financial flexibility of firm after carbon emission disclosure? We investigate the impact of carbon intensity on financial flexibility of firms against the shock triggered by a regulatory requirement of the publication of verified emission under the EU ETS. Following [Clarkson et al. \(2015\)](#) we argue that these publications point out the latent environmental liability of carbon-intensive firm in the form of additional costs of future compliance or emissions abatement. Eventually, market will negatively adjust the market value of carbon-intensive firm for this liability. Thus, carbon-intensive firm will bear a severe loss in market prices and may also take more time to recover from the shock. On the other hand, carbon-efficient firms may be more financially flexible because they may have less environmental liabilities and therefore will not experience a severe loss in market value. Furthermore, carbon-efficient firm may also benefit from their good relations with stakeholders, based on the instrumental stakeholder theory ([Jones, 1995](#), [Donaldson and Preston, 1995](#)), and the reputation of being eco-friendly among stakeholders, the Environmental Resource-based view ([Hart, 1995](#), [Russo and Fouts, 1997](#)), to neutralize the negative impact of the shock and recover faster. We thus hypothesize that carbon-intensive firm are less financially flexible and will take more time for their market price to recover from the shock triggered by the disclosure of firms' emissions data.

We take firm's carbon intensity data from Trucost dataset and measure the financial flexibility by the duration of market price recovery to the level before the publication of verified emissions. By applying the Cox model on a sample of 3,194 observations, we find that carbon intensity significantly increases the duration of firm's market price recovery, supporting our hypothesis. We found this relationship highly robust by applying different regression models, through different time windows, using different measures of flexibility, with the inclusion of

different variables, and mitigating the sample bias towards a specific country. Our findings are in line with the concept of insurance-like benefits of environmental activities (Godfrey et al., 2009) and the environment-as-a resource framework (Flammer, 2013), that environmental engagements of firms are crucial for firm to survive and thrive in a turbulent environment. We contribute to the literature in expanding resilience in focusing on its flexibility dimension, measured as the time to recover from the disclosure.

By using other measures of firm environmental activities, we found the same association. This indicate that the role of environmental activities in building financial flexibility of firm is not sensitive to other environmental measures. However, we find that this relationship is sensitive to carbon-intensity profile of firm's sector. Carbon-intensity is significantly weakening the financial flexibility of firm associated with carbon-intensive sectors. Allocation shortage is also negatively affecting firm's flexibility. Moreover, the carbon intensity does not mitigate firm financial flexibility in the beginning phase of the EU ETS, where the carbon prices were very low, and the allocated level of emission were high. However, it does mitigate flexibility when the overall allocations were reduced after the first phase. We argue that carbon intensity deteriorates the flexibility of firm when firm receive more scrutiny for their impact on natural environment, i.e. from a carbon-intensive sector, and when their emissions bring additional costs to the firm, i.e. under-allocated firms or after the first phase of the system.

This study has some important practical implication for managers, investors and regulators. As the findings show that carbon intensity deteriorates financial flexibility, thus besides the insurance-like benefits, environmental engagements seems to provide a "flexibility effect" too. This is particularly important for managers. They must know that environmental regulations are affecting firm subject to the carbon intensity of firm. They can manage this risk through an effective environmental policy to improve firm's adaptability and flexibility against the

turbulence caused by environmental regulations. Portfolio managers and investors must know that carbon-intensive firms may experience more financial turbulences during regulatory upheavals. They may outperform in a turbulent environment by investing in carbon-efficient firms if they foresee stringency in environmental regulations. As the environmental regulations are still developing and the ETS is spreading across the globe, the implications of this study will become more and more crucial in future. Furthermore, as sustainability finance is gaining more attention, responsible investment managers may use the environmental data of firms, to assess firm's financial flexibility as well as their role in sustainable development.

Limitations

This study has some limitations that may be addressed in future research. As compare to event studies, our analysis time windows are long. Therefore, other events may also happen during that time and may have affected firm performance. Though, we mitigate this issue by testing the link in shorter time windows of 10 and 20 days and found a significant link. However, it is important to mention that with an increase in the time window, the relationship between carbon intensity and duration of firm's market price recovery is becoming stronger and robust. This indicate that if other events happened during the analysis time, it has increased the importance of environmental policy of firm in their financial flexibility. However, we do not know if these other events are related to the environmental impact of firm or not. Thus, future research may address this issue by checking whether other events, that are not related to natural environment, are affecting the role of firm's environmental performance in their financial flexibility.

Chapter 4. Do environmentally responsible firms bounce back more quickly after environmental controversies? International evidence

Abstract

Does environmental performance (EP) increase firm financial resilience against environmental controversies (EC)? If the stability dimension has gained evidence through insurance-like benefits effect, we expand preceding literature in considering the whole spectrum of resilience, including the flexibility dimension measured by the time of recovery, and in documenting the conditions of the relationship. In line with the environment-as-a-resource framework, high EP firms should develop environmental skills, competitive advantage and reputation that fosters stakeholder support. In the case of a controversy, we then postulate that high EP firms should be more flexible, adapt themselves more easily and therefore recover more quickly. By performing survival analysis on an international dataset of 233 observations over the 2010-2016 period, we find that prior EP significantly increases both facets of firms' financial resilience to the shock caused by environmental controversies. These findings, in line with the environment-as-a-resource framework, are robust to the inclusion of different time windows, models and measures of resilience. The relationship, however, is only significant in environmentally oriented countries, in most polluting industries and for two of the subcategories of EP, i.e. "emission reduction" and "product innovation". We therefore document that firm preparedness and flexibility to cope with environmental controversies rely more precisely on the use of specific environmental skills developed throughout firm environmental innovation as well as demanding conditions from both the country environmental policy and industry scrutiny.

Keywords: Resilience; Environmental Controversies; Environmental Performance; Crisis Management; Survival Analysis

JEL Classification: G12, M14, O16, Q51

4.1. Introduction

The growing concerns about climate change have dramatically increased the pressure on firms to behave responsibly towards the environment (Flammer, 2013). Firms are more and more pressured to improve their environmental performance (EP) by greening their operations as part of their environmental policy, voluntarily or mandatory by law (Zhu and Sarkis, 2004). In the same time, firms are particularly under the media spotlight and grab investors' attention in the cases of controversies (Aouadi and Marsat, 2016). Environmental controversies (henceforth EC), as negative news stories related to the environmental impact of the firm's operations, are therefore of paramount importance for companies' image and reputation. Moreover, these adverse events can involve important costs since investors appears increasingly sensitive to environmental issues. Recently, environmental controversies caused substantial losses in firms' share value due to negative investor attention. For instance, Cairn Energy lost almost 21% of its share value within 15 days after the protest from environmental group about its Arctic exploration plans (The Guardian, published on July 18, 2011). Similarly, protests against transferring water from a lake to a reservoir caused almost 19% drop in share value within 15 days to Newmont Mining Corp as part of its Conga gold project (Reuters, published on May 30, 2013).

The importance of this issue for companies then leads us to ask whether corporate environmental policies are moderating the adverse consequences of environmental controversies. Recently, researchers have focused more precisely on organizational resilience, which refers to the capacity of a firm to adapt to exogenous shocks such as terrorist attacks, natural disasters, or financial crises (DesJardine et al., 2017, Ortiz-de-Mandojana and Bansal, 2016, Linnenluecke, 2017, Vogus and Sutcliffe, 2007). We follow DesJardine et al. (2017) in adopting the definition developed by Gunderson and Pritchard (2002), according to which

organizational resilience is “both the ability of a system to persist despite disruptions and the ability to regenerate and maintain existing organization.” In other words, resilience entails two dimensions in facing an adverse event, both stability and flexibility (DesJardine et al., 2017, Ortiz-de-Mandojana and Bansal, 2016).

Concerning the stability aspect of resilience, previous works have underlined that a high EP appears to enable firms to gain stakeholders legitimacy by meeting their expectations, and thus enhances the stability of the firm by reducing the risk of a negative investors’ reaction (Bansal and Clelland, 2004). A strong environmental commitment can provide the so-called insurance-like benefits in case of negative events (Godfrey et al., 2009). When an eco-friendly firm is confronted with a negative environmental event, its reputation should indeed be less affected compared to other firms. Since eco-friendly firms benefits from good stakeholder relations, stakeholders are more likely to consider the occurrence of a negative environmental event as an anomaly rather than a usual behavior (Flammer, 2013). Market reaction is thus less negative, the possible effects induced by such events (boycott, fines, etc.) being expected to be less important. The firms’ moral capital thus act as an insurance against reputation losses (Flammer, 2013, Shiu and Yang, 2017, Godfrey et al., 2009). Empirical studies find that a strong CSR commitment mitigates negative investor reactions to legal or regulatory actions (Godfrey et al., 2009), and has a higher impact on market value for firms with higher litigation risks (Koh et al., 2014). In this vein, Flammer (2013) shows that market reactions to the announcement of eco-harmful behavior is less negative for eco-friendly firms.

If these insurance-like benefits of environmental performance (Godfrey et al., 2009) are interesting and now well documented, little is known to our knowledge about the way firms bounce back in the following days after the event. As a matter of fact, the mitigation of the impact of a controversy does not fully explain the time for a company to recover. The bouncing

back dimension thus adds to our understanding of the flexibility dimension of resilience. In the vein of [Vogus and Sutcliffe \(2007\)](#) and [DesJardine et al. \(2017\)](#), we believe that studying more precisely firm recovery after such an event is of particular interest and may shed the light on the conditions needed to better adapt to adverse events. In this study, we then contribute to this literature by assessing whether a high environmental commitment can also improve organizational flexibility. We assert that firms' environmental policies lead to the acquisition of specific resources that allows firm to be more responsive to the stakeholders' environmental expectations, enabling them to react more quickly in the event of environmental controversies. For instance, according to the natural resource-based view, the implementation of environmental policies improve employees' skills by increasing the complexity of the production process ([Russo and Fouts, 1997](#)). Additionally, pollution prevention policies foster a higher interdependency between different firms' departments.

In short, environmental activities allows firms to develop skills that will be useful in dealing with and adapting to potential environmental problems in the future. A high EP also increase the environmental reputation of firms and allows them to gain a stronger support from their stakeholders, leading to a greater propensity on their part to support the company in the event of controversies. In line with the "environment-as-a-resource" framework ([Flammer, 2013](#)), we postulate that environmental performance generates competitive resources and skills, as well as environmental reputation and stronger stakeholder support, that help firms to adapt towards environmental adverse events. We then hypothesize that EP not only helps firms to minimize its stock price short term loss, as in preceding studies ([Flammer, 2013](#)), but also helps firms to recover more quickly from the environmental controversy jolt.

Insofar as organizational resilience is not a directly observable variable, we draw inspiration from the previous literature by measuring the impact of our explanatory variable on resilience

through another organizational outcome (DesJardine et al., 2017, Gittell et al., 2006, Ortiz-de-Mandojana and Bansal, 2016). More precisely, we investigate the impact of EP on resilience by assessing the time to recovery of a firm's market price to the level before the environmental controversy (DesJardine et al., 2017). EP, on the other hand, is measured by the environmental scores from Thomson Reuters Asset4 and financial variables are drawn from Worldscope. The sample obtained from merging these databases includes 233 controversies over the 2010-2016 period and we perform both OLS regressions concerning the stability dimension, severity of loss, and a survival analysis that is best fitted to measure flexibility, as the time of recovery after a jolt (DesJardine et al., 2017).

Our findings suggest that the firms with high degree of EP are, all else equal, significantly more resilient against the financial shock caused by environmental controversies. High EP firm not only experience a lower severity of loss, but also a shorter time and a higher probability to recover. These results, in line with the environment-as-a-resource framework, are robust to different time windows and models of resilience. We then try to better understand the conditions for this main result. By taking environmental performance index scores (EPI) as a measure of country-level environmental standards, we also show that the link between EP and resilience is only significant in countries with more stringent environmental standards, where environmental reputation and stakeholder support are stronger. Besides, the relationship depends on firm industry. For low polluting industries, EP does not help firm to be more resilient, whereas it is in the case for high polluting industries. Furthermore, we find that the two subcategories of EP, i.e. emission reduction and product innovation, have the same effect, which is positive and significant. The resource reduction category, however, does not show any significant association with resilience. All in all, these results pinpoint that EP enhances firm resilience when firms have developed specific environmental skill for flexibility, throughout innovation and the pressure of states and stakeholders.

In this study, we first contribute to the literature in analyzing more precisely the flexibility side of firm resilience when facing a controversy. If numerous studies tackle the insurance-like effect of EP and then the stability dimension of resilience, no one to our knowledge, analyses the way a company recovers and adapts itself in the following days after the controversy. We try to fill this gap and to extend preceding literature in using a survival analysis methodology. To the first time to our knowledge, we show that besides the insurance-like effect, EP proves to help firms to recover more quickly from the shock as well. These results confirm that the “environment-as-a-resource” framework (Flammer, 2013) also fosters resilience through higher skills, competitive resources and reputation. From a managerial perspective, investing in EP cumulates the two interesting facets of resilience. The insurance-like effect, mitigating the severity of loss, is then interestingly complemented by a flexibility effect, since the recovery takes less time. Besides, we also contribute to the literature in this field in documenting when EP more precisely helps firm to face adverse events. We argue that EP helps firms to recover if they are more prepared for adaptability. Firms in high environmental standards countries and in high polluting industries are more prone to develop these specific skills, as well as when they focus on environmental innovation.

The remainder of the paper is organized as follows. The second section presents the hypotheses. The third section describes data and the method used. The fourth section is dedicated to empirical results. The last section concludes.

4.2. Literature and Hypothesis

Given growing environmental concerns from a variety of stakeholders, companies and researchers have become increasingly concerned about understanding the impact of environmental policies on financial performance. The neo-classical perspective has long been preponderant, and academics tended to view environmental policies only as a source of

additional costs, penalizing the firms' competitiveness and going against the profit maximization objective (Palmer et al., 1995). Firms' environmental commitment is thus considered as being contrary to the maximization of shareholders' wealth, which is seen as the only social responsibility that a company should have (Friedman, 1970, Jensen, 2001). This theoretical perspective, however, was increasingly questioned, and arguments to demonstrate the existence of financial benefits for firms to set up environmental policies have strengthened. As pointed out by Endrikat (2016), the stakeholder theory (Freeman, 1984) and the natural resource-based view (Hart, 1995, Russo and Fouts, 1997) form the theoretical basis for postulating a positive relationship between EP and financial performance. Indeed, the instrumental version of stakeholder theory (Jones, 1995, Donaldson and Preston, 1995) suggests that building good stakeholder relations can give firms a competitive advantage. For its part, the natural resource-based view (Hart, 1995, Russo and Fouts, 1997), as an extension of the resource-based view theory (Wernerfelt, 1984, Barney, 1991), postulates that firms can gain competitive advantage through the acquisition of rare, valuable, imperfectly imitable and non-substitutable resources. The natural resource-based view argues that a firm can develop such resources by addressing environmental issues.

An extensive empirical literature has sought to address the question of the impact of EP on financial performance. The various meta-analyses conducted on this topic seems to show a positive relationship (Albertini, 2013, Dixon-Fowler et al., 2013, Endrikat et al., 2014, Endrikat, 2016). Beyond the impact on financial performance, many benefits to the implementation of environmental policies have been recently highlighted. For instance, green firms appear to have easier access to finance (Banerjee et al., 2019, Nandy and Lodh, 2012, Cheng et al., 2014) and a lower cost of capital (Sharfman and Fernando, 2008, Heinkel et al., 2001, Gupta, 2018, Chava, 2014). Several event studies also show that the market reacts immediately and negatively to the release of environmental bad news (Hamilton, 1995,

Capelle-Blancard and Laguna, 2010, Flammer, 2013, Krüger, 2015, Endrikat, 2016, Capelle-Blancard and Petit, 2019), suggesting that investors penalize environmentally irresponsible behavior. Many academics have sought to move beyond this short-term view to look at the ability of CSR to increase the value of companies by reducing the risks in the event of a negative event (Pelozo, 2006). EP is then understood as a short-term cost, which can limit the loss of value due to a negative event affecting the company in the future.

A recent literature tend to show that a high EP provides insurance-like benefits (Flammer, 2013). Indeed, high environmental performance may enable companies to improve their external stakeholder relationships, and thus to reduce the risk associated with these relationships (Ambec and Lanoie, 2008). In particular, it may reduce the potential costs associated with fines and litigation. A high environmental performance also enables companies to be one step ahead of future environmental regulations, and limit the potential consequences of poorly anticipating changes that may impact a company's competitiveness. Additionally, eco-friendly companies are less likely to suffer boycotts from consumers or environmental NGOs. The green reputation of a high EP seems to offer a protection against reputation losses and mitigates the potential costs of an environmental controversy. Thus, a high environmental performance allows firms to improve the stability of the company by complying with the pressures and expectations of the various stakeholders regarding environmental issues. This EP outcomes can then be related to organizational resilience, defined as “both the ability of a system to persist despite disruptions and the ability to regenerate and maintain existing organization.” (Gunderson and Pritchard, 2002). Organizational resilience is then composed of two complementary sides: stability and flexibility.

If previous literature seems to demonstrate that EP provides more stability in case of bad environmental events (Flammer, 2013), to the best of our knowledge, no study has been carried

out on the precise impact of EP on organizational adaptability and flexibility in the face of these events. We hypothesize that a high level of environmental performance makes it easier to adapt to a controversy in this field. A strong environmental commitment implies that policies are already in place to cope with environmental externalities. For example, the use of more environmentally friendly technologies will make production processes more complex, which will help to increase the skills of employees (Russo and Fouts, 1997). In addition, policies aiming to prevent pollution require greater employee involvement and coordination between different departments (Russo and Fouts, 1997). These policies also involve strengthening relationships with suppliers (Branco and Rodrigues, 2006), which make easier to adapt to the occurrence of unanticipated events (Ortiz-de-Mandojana and Bansal, 2016). We also argue that eco-friendly policies aim to address environmental problems, which are complex and urgent in nature. Thus, confronting these problems allows companies to develop certain organizational skills that will be useful to them when they find themselves having to deal with a complex problem again (Orlitzky et al., 2003, Russo and Fouts, 1997, Ortiz-de-Mandojana and Bansal, 2016). Meanwhile, a strong EP allows firms to build a good reputation and gain stronger support from their stakeholders. In case of environmental controversies, stakeholders will then be more likely to see this event as an anomaly, and will be more inclined to support the company, which will lead to greater resilience. These arguments, in line with the environment-as-a-resource framework (Flammer, 2013), lead us to postulate that in the event of an environmental controversy, eco-friendly firms have a greater capacity to adapt quickly to the situation and to deal with it, insofar as these firms benefit from greater support from all of their stakeholders and that they have capabilities that allow them to be more flexible and to face the event. As a result, their stock prices as measure of resilience should be less impacted and take less time to recover to their pre-controversy levels. We therefore postulate:

H₁: The higher a firm's EP, the higher the resilience after an environmental controversy.

4.3. Data and methodology

4.3.1. Variables

Following [DesJardine et al. \(2017\)](#), we measure resilience in its two main dimensions. Stability is proxied through the severity of loss. Severity of loss is computed as the absolute percentage change in firm market price between the closing price before disclosure of EC and the lowest market price within the observation window. The adaptation dimension is proxied as the time to recovery of the daily market price to its previous level after disclosure of EC for an observation window of 15 trading days. As a robustness check, the analysis is also conducted on 5, 10, 20, 25, and 30 days' observational windows.

EC is a controversial news story disclosing the negative impact of a firm's activities on environment. We thus manually extract the exact date of each EC from Thomson Reuters' Asset4 ESG database for each controversy. A firm's EP is measured by the environmental dimension score from the Thomson Reuters' Asset4 ESG dataset. Asset4 is one of the prominent ESG rating agencies. Every year, Asset4 analyzes thousands of publicly traded firms based on the three dimensions of CSR i.e. Environmental, Social, and Governance. Asset4 rates firms from 100 (superior EP) to 0 (poor EP) relative to the peers in their respective industry. However, in order to normalize the data in the range between 1 and 0, these ratings are divided by 100. EP is proxied from this dataset in various studies, for instance [Cheng et al. \(2014\)](#), [Eccles et al. \(2014\)](#) or [Shaukat et al. \(2015\)](#). As Asset4 issues these ratings on an annual basis, prior year ratings are considered for each controversy to determine its impact on severity of loss and time to recover after controversy.

It is noteworthy that every country faces pressure from local and international communities to cope with the problem of climate change. International treaties, such as the agreements of the

Rio Earth Summit in 1992, the Millennium Summit in 2000, the World Summit on Sustainable Development in Johannesburg in 2002, the Paris COP 21, shape a country's regulations and governance systems to comply with their environmental policy. Therefore, firms may customize their environmental policies according to their country-level environmental standards. We thus include in our analysis the overall EP of a country. A country's EP is proxied by the environmental performance index⁸ (henceforth EPI), also used by [Bazillier et al. \(2017\)](#) as a proxy for country-level environmental standards. EPI gauges each country in two broad categories (Environmental Health and Ecosystem Vitality objectives) based on environmental performance linked to policy targets from 0 to 100.

We also control for other variables likely to have an impact on time to recover after an EC. Therefore, we include in our models the market to book value ratio (MB), return on assets ratio (ROA), cash flows from operating activities scaled by net sales (CF), firm size (SIZE) measured by natural log of a firm's total assets, leverage (DA) calculated by dividing the total debts of the firm by its total assets, sales growth (SG) measured by net sales divided by the previous year's net sales, research & development expenditure divided by net sales (RD), capital expenditure (CAPEX) divided by total assets, and stock price momentum (MOMENTUM). MOMENTUM represents a change in market price in the last three years before the controversy. A dummy for RD is also included, denoted by RDDUM. RDDUM is equal to 1 if firms have RD expenditure available in the database, 0 otherwise. These variables are summarized in table 4.1. Besides these control variables, dummies for industries and regions are also included. GICS classification (2-digits) is used for each industry.

⁸ EPI is developed by Yale University, Yale Center for Environmental Law and Policy (YCELP), and Columbia University, Center for International Earth Science Information Network (CIESIN), in collaboration with the World Economic Forum and Joint Research Centre (JRC) of the European Commission (2006).

Table 4.1: Summary of Variables

Variables	Description	Data source
Severity of loss	Absolute percentage change in firm market price between the closing price before disclosure of EC and the lowest market price within the observation window	Datastream
Time to recover	Duration of market price recovery in trading days to the level before disclosure of controversy.	Datastream
EP	Environmental scores from Asset4 Dataset.	ESG Asset4/Thomson Reuters
EPI	Country level environmental performance index scores.	Yale Center for Environmental Law and Policy
MB	Market value of equity / Book value of equity.	Worldscope
ROA	Return on asset.	Worldscope
CF	Cash flow from operations/Net sales	Worldscope
SIZE	Natural log of firm's total assets.	Worldscope
DA	Book value of debts / Book value of assets.	Worldscope
SG	Sales Growth (sales in current year divided by sales in previous year).	Worldscope
RD	R&D Expenditures / Sales.	Worldscope
RDDUM	R&D Dummy, equals 1 if firms document R&D expenditure in Worldscope database and 0 otherwise.	Worldscope
CAPEX	Capital Expenditures / Book value of Assets.	Worldscope
MOMENTUM	Stock price Momentum, three years' market price change before the controversy	Datastream
INDUSTRY	Dummy for industry from the GICS 2-digits classification	Worldscope
REGION	Geographical regions dummy	

4.3.2. Sample

Controversy data are downloaded from the Asset4 Thomson Reuters dataset. We collected 301 controversies related to EC for the period 2010-2016. We then manually extracted their exact publishing dates from the same database. Since the exact dates is not available for 37 controversies, the number of observations is reduced to 264. As illustrated in the Table 4.2, the sample for primary analysis is finally composed of 233 observations from 16 countries after balancing for the missing observations of control variables. As summarized in Table 4.3, in the final sample, the USA is the leading country with 89 observations, followed by Canada and UK with 42 and 31 observations, respectively.

Table 4.2: Sample Construction

Total number of environmental controversies over the 2010-2016 period in Thomson Reuters Asset4 database	301
Exact date of controversies is not available for these observations	-37
One country EPI rating is not available where one firm is located	-1
Firms Market to Book value (MB) for these observations are not available on Worldscope	-4
Total assets information of these observations is not available to measure firms' size	-2
Firms Sales Growth (SG) for this one observation is not available	-1
Firms Momentum for three observations is not available	-3
Cash flows data for these observations are not available	-20
Final Sample	233

Table 4.3: Sample distribution by country, industry and year

By country	N	By industry	N
Australia	8	Energy	103
Brazil	10	Materials	57
Canada	42	Utilities	39
Chile	2	Industrials	8
China	7	IT	10
France	14	Consumer Staples	14
Italy	1	Consumer Discrete	2
Japan	6	<i>Total</i>	<i>233</i>
Mexico	2	<i>By year</i>	<i>N</i>
Korea	6	2010	44
Russia	1	2011	19
Spain	5	2012	9
Switzerland	4	2013	22
Taiwan	5	2014	33
UK	31	2015	28
USA	89	2016	78
<i>Total</i>	<i>233</i>	<i>Total</i>	<i>233</i>

Descriptive statistics are summarized in Table 4.4. Financial data come from Worldscope and are winsorized at 1 and 99% to alleviate the impact of potential outliers. In the final sample, 30 observations have a resilience equal to 1, indicating that these controversies have not impacted

firm market price negatively⁹. The maximum value of resilience (i.e. 16 working days) indicates that firm market prices did not recover within the observation window of 15 working days. Therefore, these observations are censored due to non-recovery; however, the survival analysis considers the censored observations in the analysis as well. The observations that are censored (not recovered within 15 days) are equal to 39% (91 observations) of the total sample. Median resilience is equal to 5 days indicating that at this point the probability of recovery is equal to 50%. Average resilience is equal to 6.72 days. However, it does not portray the actual average of recovery because it also reflects the impact of censored values here.

Table 4.4: Summary Statistics

	N	Mean	Median	Min	P25	P75	Max	Skewness	Kurtosis
Severity of loss	233	5.02	3.64	0	1.18	6.7	23.15	1.43	4.86
Time to recovery	233	6.72	5	1	1	13	16	0.6	1.77
EP	233	0.77	0.87	0.1	0.71	0.91	0.95	-1.68	4.89
EPI	233	0.7	0.68	0.43	0.68	0.73	0.89	-1.06	5.49
MB	233	1.96	1.53	0.34	1.01	2.27	12.19	3.49	18.41
ROA	233	2.91	3.23	-16.63	0.9	6.53	17.85	-0.95	5.03
CF	233	22.38	18.63	-8.7	13.06	31.04	56.26	0.71	3.04
SIZE	233	17.75	17.81	14.03	16.9	18.91	19.78	-0.47	2.57
DA	233	28.65	25.87	0	18.33	38.48	59	0.33	2.28
SG	233	0.91	0.91	0.49	0.76	1	1.44	0.34	3.05
RD	233	0.46	0	0	0	0.35	10.55	5.85	41.99
RDDUM	233	0.47	0	0	0	1	1	0.11	1.01
CAPEX	233	8.97	8.3	1.32	5.28	11.5	28.46	1.28	5.59
MOMENTUM	233	-0.09	0.06	-2.61	-0.21	0.22	1	-1.98	7.85

Summary statistics of the sample. Resilience is the number of days of market price recovery calculated within a window of 15 trading days. EP is the environmental performance of firm from Asset4. EPI is country's overall environmental performance. MB is the market-to-book value ratio. ROA is firm profits divided by book value of assets. CF represents cash flows from operation scaled by net sales. SIZE is the natural of firms' total assets. DA represents leverage measured as total debts of firms divided by total assets. SG is the sales growth measured as total sales divided previous year sales. RD is the research & development expenditure divided by net sales. RDDUM represents dummy for RD (equals to 1 if firm has RD expenditure, otherwise 0). CAPEX is the capital expenditures divided by last year total assets. MOMENTUM is previous three years market price change. Financial variables are winsorized at 1 and 99 % level.

⁹ Excluding these observations does not affect our results.

The EP of firms varies from 0.1 to 0.95 with an average and median of 0.77 and 0.87, respectively. The environmental performance of countries (EPI) in the sample varies from 0.43 to 0.89. The sample includes a variety of observations based on their MB (mean 1.96), ranges from 0.34 to 12.19. The average profitability (ROA) of firms is equal to 3.29. On average, cashflows from operations scaled with net sales is equal to 22.38 percent. The sample includes firms of different sizes. The total assets of firms (mean \$51.14 billion) vary from \$1.24 billion to \$389.35 billion. Leverage (DA) and sales in the current year divided by sales in the previous year (SG) have means equal to 28.65 and 0.91, respectively. Almost 47% of firms have R&D expenditures in the dataset, with the average RD 0.46% of net sales. The capital expenditures divided by the last year's total assets has average and median of 8.97 and 8.3, respectively. Market price change in the last three years (MOMENTUM) varies from -2.61 to 1.00 with an average of -0.09.

4.4. Results

4.4.1. EP and resilience after a controversy

We first test whether a high EP allows firms to improve their stability using the severity of loss as a proxy for the stability dimension of resilience, following [DesJardine et al. \(2017\)](#). In table 4.5, we display three specifications of the OLS regression, model 1 in the first column include main control variables, model 2 included dummies for industries and model 3 also includes dummies for geographical regions. We clearly find a negative association between EP and severity of loss, since an increase in EP decreases the severity of firm's market price loss. While considering time windows as reported in table 4.6, if the effect is always significant, it seems to be more pronounced between 10 and 25 days, and less for very short term (5 days). Overall, this result adds evidence that a strong environmental commitment mitigates negative investor's reactions to EC. A high EP ensures firms' stability to cope with such negative events,

confirming the insurance-like benefits of EP (Godfrey et al., 2009) and preceding empirical studies (Flammer, 2013).

Table 4.5: EP and Severity of Loss after an environmental controversy – Time window of 15 days

VARIABLE	Severity of loss		
	Model 1	Model 2	Model 3
EP	-4.91** (2.04)	-5.18** (2.13)	-5.73*** (2.13)
EPI	2.08 (4.37)	3.12 (4.52)	2.76 (5.67)
MB	-0.07 (0.23)	-0.08 (0.27)	-0.04 (0.27)
ROA	-0.05 (0.07)	-0.05 (0.07)	-0.06 (0.07)
CF	-0.03 (0.03)	-0.02 (0.03)	-0.03 (0.04)
SIZE	0.01 (0.31)	0.23 (0.32)	0.17 (0.35)
DA	0.03 (0.03)	0.04 (0.03)	0.03 (0.03)
SG	1.55 (1.85)	1.43 (1.97)	1.88 (1.96)
RD	0.34 (0.33)	0.30 (0.32)	0.24 (0.32)
RDDUM	1.14 (1.03)	0.86 (1.10)	0.75 (1.22)
CAPEX	0.10 (0.08)	0.10 (0.09)	0.10 (0.09)
MOMENTUM	-1.07 (0.75)	-0.72 (0.79)	-0.32 (0.79)
Constant	4.18 (6.55)	-2.31 (8.01)	-1.03 (8.76)
INDUSTRY	No	Yes	Yes
REGION	No	No	Yes
Observations	233	233	233
R-squared	0.09	0.11	0.13

This table presents OLS regression analysis for the observation window of 15 trading days. Negative coefficient indicates an increase in the value of that variable increase resilience. EP is firm's environmental performance proxied by environmental scores from ESG Asset4 Dataset. EPI represents Environmental Performance Index score of the country of firm. MB is the market-to-book value ratio. ROA is firm profits divided by book value of assets in percent. CF represents cash flows from operation scaled by net sales. SIZE is the natural of firms' total assets. DA represents leverage measured as total debts of firms divided by total assets. SG is the sales growth measured as total sales divided previous year sales in percent. RD is the research & development expenditure divided by net sales in percent. RDDUM represents dummy for RD (equals to 1 if firm has RD expenditure, otherwise 0). CAPEX is the capital expenditures divided by last year total assets in percent. MOMENTUM is previous three years market price change. INDUSTRY represents a dummy for Industry, REGION represents dummy for geographical region. Financial variables are winsorized at 1 and 99 % level. Standard errors are in parentheses. * Statistical significance at the 10 % level, ** Statistical significance at the 5 % level, *** Statistical significance at the 1 % level.

Table 4.6: EP and severity of loss after an environmental controversy - Robustness to Different Time Windows

VARIABLES	5 days	10 days	20 days	25 days	30 days
EP	-2.71*	-4.63***	-5.79***	-6.15***	-5.52**
	(1.39)	(1.75)	(2.21)	(2.27)	(2.57)
EPI	1.10	4.51	3.38	4.29	8.22
	(3.74)	(4.70)	(5.93)	(6.10)	(6.89)
MB	0.07	-0.06	-0.04	-0.13	-0.27
	(0.19)	(0.24)	(0.30)	(0.31)	(0.35)
ROA	-0.10**	-0.11*	-0.03	-0.01	0.00
	(0.05)	(0.06)	(0.08)	(0.08)	(0.09)
CF	0.00	-0.02	-0.03	-0.05	-0.04
	(0.02)	(0.03)	(0.03)	(0.03)	(0.04)
SIZE	-0.05	-0.15	0.35	0.51	0.54
	(0.24)	(0.31)	(0.39)	(0.40)	(0.45)
DA	0.03	0.03	0.04	0.03	0.02
	(0.02)	(0.03)	(0.03)	(0.03)	(0.04)
SG	1.12	1.12	2.94	3.91*	3.97*
	(1.30)	(1.63)	(2.06)	(2.12)	(2.39)
RD	-0.08	0.16	0.52	0.69*	0.93**
	(0.24)	(0.30)	(0.38)	(0.39)	(0.44)
RDDUM	0.83	0.99	0.00	-0.79	-1.02
	(0.82)	(1.03)	(1.29)	(1.33)	(1.50)
CAPEX	0.05	0.07	0.11	0.10	0.09
	(0.05)	(0.07)	(0.08)	(0.09)	(0.10)
MOMENTUM	0.01	0.30	-0.40	-0.02	-0.28
	(0.48)	(0.60)	(0.75)	(0.77)	(0.87)
Constant	0.77	1.98	-3.55	-5.73	-6.83
	(5.76)	(7.24)	(9.13)	(9.39)	(10.60)
INDUSTRY	Yes	Yes	Yes	Yes	Yes
REGION	Yes	Yes	Yes	Yes	Yes
Observations	233	233	233	233	233
R-squared	0.18	0.17	0.15	0.20	0.18

This table presents OLS regression analysis for different observation windows. Negative coefficient indicates an increase in the value of that variable increase resilience. EP is firm's environmental performance proxied by environmental scores from ESG Asset4 Dataset. EPI represents Environmental Performance Index score of the country of firm. MB is the market-to-book value ratio. ROA is firm profits divided by book value of assets in percent. CF represents cash flows from operation scaled by net sales. SIZE is the natural of firms' total assets. DA represents leverage measured as total debts of firms divided by total assets. SG is the sales growth measured as total sales divided previous year sales in percent. RD is the research & development expenditure divided by net sales in percent. RDDUM represents dummy for RD (equals to 1 if firm has RD expenditure, otherwise 0). CAPEX is the capital expenditures divided by last year total assets in percent. MOMENTUM is previous three years market price change. INDUSTRY represents a dummy for Industry, REGION represents dummy for geographical region. Financial variables are winsorized at 1 and 99 % level. Standard errors are in parentheses. * Statistical significance at the 10 % level, ** Statistical significance at the 5 % level, *** Statistical significance at the 1 % level.

Concerning the impact of EP on the flexibility dimension of organizational resilience, we use the Cox proportional hazard model to assess the relationship between EP and time to recover after the impact of EC on a firm's market price. The Cox model predicts the impact of covariates on the probability of recovery at time t . The relationship can be expressed as :

$$h_i(t|X_j) = h_0(t) e^{(X_j\beta_j)}$$

Where $h_i(t)$ represents the hazard rate of recovery for observation i^{th} and covariate j^{th} . X represents the list of covariates i.e. EP, EPI, MB, ROA, CF, SIZE, DA, SG, RD, RDDUM, CAPEX, MOMENTUM, INDUSTRY and REGION. $h_0(t)$ is the baseline hazard function, which the Cox model leaves non-estimated. β represents the regression coefficient of its covariate. A positive sign of β indicate a positive link with resilience. We run the model over different windows between 5 and 30 days to ensure that our results are not sensitive to time windows.

In the results, as presented in Table 4.7, coefficients are reported rather than hazard rates as well as standard errors in parentheses for each variable for a time window of 15 days. Model 1 in the first column include main control variables. The coefficient of EP appears to be positive and highly significant. In model 2, dummies for industries are included, whereas dummies for geographical regions are additionally included in model 3. The model 3 includes all the control variables and dummies and is our baseline model for explanation purposes. A positive sign of coefficients indicates that a higher value of that variable increases the likelihood of market price recovery from the shock of EC. Since EP has a positive and significant coefficient, we find that EP have a negative impact on time for stock market prices to recover after an environmental controversy. Exponentiation of the coefficient gives the hazard rate of $e^{1.62} = 5.05$. In terms of hazard rate, it can be interpreted as a one-unit increase in EP enhances the probability of recovery by $(5.05 - 1) = 4.05$ times.

Table 4.7: Recovery after an environmental controversy (Cox Proportional Hazard Regression)

VARIABLES	Model 1	Model 2	Model 3
EP	1.49*** (0.51)	1.66*** (0.56)	1.62*** (0.56)
EPI	-0.74 (1.09)	-0.76 (1.12)	0.00 (1.67)
MB	-0.18** (0.08)	-0.19** (0.09)	-0.19** (0.09)
ROA	-0.02 (0.02)	-0.02 (0.02)	-0.02 (0.02)
CF	0.01* (0.01)	0.01* (0.01)	0.01 (0.01)
SIZE	-0.16** (0.08)	-0.17** (0.08)	-0.18** (0.09)
DA	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)
SG	-0.47 (0.50)	-0.42 (0.54)	-0.38 (0.54)
RD	-0.22 (0.16)	-0.22 (0.17)	-0.26 (0.18)
RDDUM	0.21 (0.27)	0.21 (0.28)	0.44 (0.36)
CAPEX	-0.02 (0.02)	-0.01 (0.02)	-0.01 (0.02)
MOMENTUM	0.09 (0.16)	0.06 (0.17)	0.08 (0.19)
INDUSTRY	No	Yes	Yes
REGION	No	No	Yes
Pseudo R-squared	0.02	0.02	0.02
Observations	233	233	233

This table presents Cox PH regression analysis for the observation window of 15 trading days. Positive coefficient indicates an increase in the value of that variable increase resilience. EP is firm's environmental performance proxied by environmental scores from ESG Asset4 Dataset. EPI represents Environmental Performance Index score of the country of firm. MB is the market-to-book value ratio. ROA is firm profits divided by book value of assets in percent. CF represents cash flows from operation scaled by net sales. SIZE is the natural of firms' total assets. DA represents leverage measured as total debts of firms divided by total assets. SG is the sales growth measured as total sales divided previous year sales in percent. RD is the research & development expenditure divided by net sales in percent. RDDUM represents dummy for RD (equals to 1 if firm has RD expenditure, otherwise 0). CAPEX is the capital expenditures divided by last year total assets in percent. MOMENTUM is previous three years market price change. INDUSTRY represents a dummy for Industry, REGION represents dummy for geographical region. Financial variables are winsorized at 1 and 99 % level. Standard errors are in parentheses. * Statistical significance at the 10 % level, ** Statistical significance at the 5 % level, *** Statistical significance at the 1 % level.

Table 4.8: Recovery after an environmental controversy : Robustness to Different Time Windows (Cox Proportional Hazard Regression)

VARIABLES	5 days	10 days	20 days	25 days	30 days
EP	1.10 (0.71)	1.40*** (0.54)	1.06* (0.54)	1.42*** (0.53)	0.88* (0.53)
EPI	-0.63 (1.42)	-0.67 (1.73)	-0.33 (1.57)	-1.16 (1.74)	-0.61 (1.56)
MB	-0.17* (0.10)	-0.24*** (0.08)	-0.10 (0.08)	-0.03 (0.08)	-0.03 (0.07)
ROA	0.02 (0.02)	-0.00 (0.02)	-0.02 (0.02)	-0.04** (0.02)	-0.01 (0.02)
CF	0.00 (0.01)	0.01 (0.01)	0.02** (0.01)	0.02*** (0.01)	0.02** (0.01)
SIZE	-0.05 (0.11)	-0.16* (0.09)	-0.07 (0.09)	-0.13 (0.08)	-0.08 (0.09)
DA	-0.00 (0.01)	0.00 (0.01)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)
SG	0.30 (0.56)	0.14 (0.52)	-0.60 (0.55)	-0.83 (0.57)	-0.54 (0.56)
RD	-0.36 (0.25)	-0.25 (0.18)	-0.10 (0.16)	-0.21 (0.20)	-0.18 (0.19)
RDDUM	0.33 (0.34)	0.10 (0.35)	0.12 (0.33)	0.32 (0.37)	0.05 (0.37)
CAPEX	-0.01 (0.03)	0.01 (0.02)	-0.00 (0.02)	0.00 (0.02)	0.01 (0.02)
MOMENTUM	-0.23 (0.19)	-0.07 (0.15)	0.00 (0.19)	0.07 (0.20)	0.10 (0.22)
INDUSTRY	Yes	Yes	Yes	Yes	Yes
REGION	Yes	Yes	Yes	Yes	Yes
Pseudo R-squared	0.01	0.01	0.01	48	18
Observations	233	233	233	233	233

This table presents Cox PH regression analysis for different windows of observation. Positive coefficient indicates an increase in the value of that variable increase resilience. EP is firm's environmental performance proxied by environmental scores from Asset4 Dataset. EPI represents Environmental Performance Index score of the country of firm. MB is the market-to-book value ratio. ROA is firm profits divided by book value of assets in percent. CF represents cash flows from operation scaled by net sales. SIZE is the natural of firms' total assets. DA represents leverage measured as total debts of firms divided by total assets. SG is the sales growth measured as total sales divided previous year sales in percent. RD is the research & development expenditure divided by net sales in percent. RDDUM represents dummy for RD (equals to 1 if firm has RD expenditure, otherwise 0). CAPEX is the capital expenditures divided by last year total assets in percent. MOMENTUM is previous three years market price change. INDUSTRY represents a dummy for Industry, REGION represents dummy for geographical region. Financial variables are winsorized at 1 and 99 % level. Standard errors are in parentheses. * Statistical significance at the 10 % level, ** Statistical significance at the 5 % level, *** Statistical significance at the 1 % level

As a robustness check, we tested the link through short and extended observational windows of 5, 10, 20, 25 and 30 days. As depicted in table 4.8, the results show that the relationship is significant for all observational windows except of 5 days window. Secondly, we reran the baseline model using alternative survival models i.e. Weibull, Gompertz and Exponential. The results, as presented in Table 4.9, still show a consistently significant and positive relationship between EP and resilience. Thirdly, we assess firm recovery state instead of time to recovery. Recovery state equals to 1 if firm market price recovers within the observational window and zero otherwise. These tests suggest that choice of observational windows (except for the shorter one, i.e. 5 days window) and regression model as well as measurement of resilience do not affect the link between EP and resilience.

Overall, our results provide significant evidence in support of our hypothesis. EP clearly enhances resilience when facing a controversy, mitigating both the severity of loss and the time to recovery. Beyond the insurance-like effect, we therefore find evidence supporting the environment-as-a-resource framework, and more precisely the flexibility effect of environmental performance. Environmentally friendly companies enjoy greater support from all their stakeholders, a better reputation, and they develop organizational skills that enable them to not only mitigate the shock, but also demonstrate greater flexibility in managing these controversies, in overcoming more quickly these environmental controversies.

4.4.2. When does EP helps firms to be more resilient?

In order to have a deeper understanding of the relationship, we further analyze the sensitivity of this main result according to country environmental policy, polluting industries and environmental performance subsets. To examine the role of the environmental standards of a country in the relationship between a firm's EP and resilience, we split the sample into two groups based on the stringency of the countries' environmental standards. Following [Bazillier](#)

et al. (2017), we use EPI to measure the environmental standard stringency of countries. The high environmental standards' group (high EPI) means that the EPI of the country is greater than the median EPI. We then performed the Cox and OLS models using time to recovery and the severity of loss as a measure of resilience, respectively. As shown in table 4.10, the results indicate that the relationship is only significant in countries where environmental standards are strong. These results support that the link between EP and resilience is strong in countries where national environmental performance is high. From a theoretical perspective, institutions promoting CSR policies and thus environmental commitment enable stakeholders' expectations to be seen as more legitimate, and increases stakeholders' power (van der Laan Smith et al., 2005, Dhaliwal et al., 2014, Belasri et al., 2020). Thus, managing stakeholders' environmental expectations is therefore all the more crucial in these countries, and the negative investor reaction to an EC seem to be more likely to be high than in other countries. Benefits of strong environmental performance appear therefore logically also be higher in these countries. Indeed, in a country where sensitivity to ecological issues is high, the increase in reputation and legitimacy induced by a strong environmental performance should be higher (Bansal and Clelland, 2004), and firms may therefore develop more specific skills.

Besides, we also checked the sensitivity of the results to level of pollution of the industry. We expect results to be more significant when environment is a material issue for the sector, since companies are more used to deal with these adverse events. Besides, the greater scrutiny of these firms on environmental issues lead them to be more transparent on these issues towards the stakeholders and to further develop specific environmental skills. In line with these intuitions, we find that the relationship stands only for industries in which pollution is a material issue, as shown in table 4.11.

Table 4.9: Recovery after an environmental controversy: Robustness to Different Models

VARIABLES	Weibull Time to recovery	Gompertz Time to recovery	Exponential Time to recovery	Probit Recovery (Yes/No)
EP	1.76*** (0.58)	1.71*** (0.58)	1.76*** (0.58)	1.90*** (0.60)
EPI	-0.00 (1.67)	-0.02 (1.67)	-0.00 (1.67)	-0.41 (1.53)
MB	-0.20** (0.10)	-0.20** (0.10)	-0.20** (0.10)	-0.21** (0.09)
ROA	-0.03 (0.02)	-0.02 (0.02)	-0.03 (0.02)	-0.04 (0.02)
CF	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	0.02* (0.01)
SIZE	-0.20** (0.09)	-0.19** (0.09)	-0.20** (0.09)	-0.25** (0.11)
DA	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)
SG	-0.39 (0.56)	-0.39 (0.55)	-0.39 (0.56)	-0.31 (0.54)
RD	-0.29 (0.19)	-0.28 (0.18)	-0.29 (0.19)	-0.27 (0.17)
RDDUM	0.47 (0.36)	0.46 (0.35)	0.47 (0.35)	0.58 (0.36)
CAPEX	-0.02 (0.02)	-0.01 (0.02)	-0.02 (0.02)	-0.03 (0.02)
MOMENTUM	0.09 (0.20)	0.09 (0.20)	0.09 (0.20)	0.17 (0.20)
Constant	-12.21 (446.32)	-12.91 (661.96)	-12.20 (443.99)	-1.00 (177.95)
INDUSTRY	Yes	Yes	Yes	Yes
REGION	Yes	Yes	Yes	Yes
Ln(P)	0.00 (0.07)			
Gamma		-0.02 (0.02)		
Wald Chi-Square	36	34	36	
Pseudo R-Square				0.13
Observations	233	233	233	233

This table presents Probit, OLS and different survival model i.e. Weibull, Gompertz and Exponential analysis for a window of observation window of 15 days. In Probit model resilience is proxied by firms' market price recovery, equals 1 if recovered and zero otherwise. In survival models, resilience is proxied by time to recovery of firms' market price. In OLS resilience is the percentage loss of firm's market price. EP is firm's environmental performance proxied by environmental scores from Asset4 Dataset. EPI represents Environmental Performance Index score of the country of firm. MB is the market-to-book value ratio. ROA is firm profits divided by book value of assets in percent. CF represents cash flows from operation scaled by net sales. SIZE is the natural of firms' total assets. DA represents leverage measured as total debts of firms divided by total assets. SG is the sales growth measured as total sales divided previous year sales in percent. RD is the research & development expenditure divided by net sales in percent. RDDUM represents dummy for RD (equals to 1 if firm has RD expenditure, otherwise 0). CAPEX is the capital expenditures divided by last year total assets in percent. MOMENTUM is previous three years market price change. INDUSTRY represents a dummy for Industry, REGION represents dummy for geographical region. Financial variables are winsorized at 1 and 99 % level. Standard errors are in parentheses. * Statistical significance at the 10 % level ** Statistical significance at the 5 % level *** Statistical significance at the 1 % level.

Table 4.10: Resilience in High and Low Environmentally Performant Countries

VARIABLES	High EPI		Low EPI	
	Severity of Loss	Time to Recovery	Severity of Loss	Time to Recovery
EP	-7.67*	2.91**	-2.88	1.01
	-4.38	-1.47	-3.1	-0.81
EPI	16.03	-9.72	-14.84	2.75
	-18.1	-6.98	-15.28	-4.43
MB	0.49	-0.35	-0.06	-0.23*
	-0.79	-0.25	-0.33	-0.13
ROA	-0.09	-0.04	0.01	-0.02
	-0.12	-0.03	-0.11	-0.03
CF	-0.04	0.02*	0.04	0
	-0.05	-0.01	-0.06	-0.02
SIZE	0.16	-0.01	-0.06	-0.33**
	-0.63	-0.16	-0.64	-0.14
DA	0.02	0	0.03	0
	-0.05	-0.02	-0.06	-0.01
SG	-2.16	0.77	4.53	-1.25
	-2.94	-0.77	-3	-1.01
RD	1.22	-0.69	0.03	-0.15
	-1.44	-0.54	-0.48	-0.21
RDDUM	-0.17	0.37	1.26	0.24
	-1.86	-0.7	-2.25	-0.6
CAPEX	0.04	0.03	0	-0.01
	-0.13	-0.06	-0.14	-0.03
MOMENTUM	0.38	-0.17	-1.91	0.38
	-0.99	-0.25	-1.31	-0.28
Constant	-2.86		7.73	
	-15.4		-15.67	
INDUSTRY	Yes	Yes	Yes	Yes
REGION	Yes	Yes	Yes	Yes
Pseudo R-squared		0.06		0.06
R-squared	0.18		0.24	
Observations	113	113	120	120

This table analyses the impact of EP on time to recovery using Cox PH model and the impact of EP on Severity of Loss using OLS regression analysis for a 15 days observation window by splitting the sample based on EPI score of countries. EP is firm's environmental performance dimensions from Asset4 Dataset. EPI represents Environmental Performance Index score of the country of firm. MB is the market-to-book value ratio. ROA is firm profits divided by book value of assets in percent. CF represents cash flows from operation scaled by net sales. SIZE is the natural of firms' total assets. DA represents leverage measured as total debts of firms divided by total assets. SG is the sales growth measured as total sales divided previous year sales in percent. RD is the research & development expenditure divided by net sales in percent. RDDUM represents dummy for RD (equals to 1 if firm has RD expenditure, otherwise 0). CAPEX is the capital expenditures divided by last year total assets in percent. MOMENTUM is previous three years market price change. INDUSTRY represents a dummy for Industry, REGION represents dummy for geographical region. Financial variables are winsorized at 1 and 99 % level. Standard errors are in parentheses. * Statistical significance at the 10 % level ** Statistical significance at the 5 % level *** Statistical significance at the 1 % level

Table 4.11: Resilience in High and Low polluting industries

VARIABLES	High Polluting Sectors		Low Polluting Sectors	
	Severity of Loss	Time to Recovery	Severity of Loss	Time to Recovery
EP	-8.42*** (2.69)	1.57** (0.73)	-1.21 (3.83)	1.56 (1.26)
EPI	0.85 (6.25)	-0.18 (1.95)	9.31 (18.15)	2.28 (5.41)
MB	-0.03 (0.39)	-0.16 (0.14)	0.32 (0.47)	-0.21 (0.16)
ROA	-0.07 (0.08)	-0.02 (0.02)	-0.09 (0.25)	-0.09 (0.08)
CF	-0.07** (0.03)	0.01* (0.01)	0.20* (0.11)	0.01 (0.04)
SIZE	0.16 (0.47)	-0.15 (0.12)	0.15 (0.68)	-0.23 (0.17)
DA	-0.00 (0.04)	0.01 (0.01)	0.12* (0.06)	-0.01 (0.02)
SG	3.16 (2.11)	-0.65 (0.65)	-10.11* (5.16)	2.41* (1.46)
RD	0.43 (0.42)	-0.28 (0.19)	0.35 (0.85)	-0.03 (0.62)
RDDUM	0.14 (1.45)	0.48 (0.45)	-2.41 (2.73)	1.38 (0.95)
CAPEX	0.18** (0.09)	-0.04 (0.03)	-0.30 (0.18)	0.07 (0.08)
MOMENTUM	-0.15 (0.80)	0.09 (0.21)	-0.22 (1.67)	-0.39 (0.52)
Constant	4.76 (8.92)		7.35 (18.47)	
INDUSTRY	Yes	Yes	Yes	Yes
REGION	Yes	Yes	Yes	Yes
Pseudo R-squared		0.05		0.05
R-squared	0.20		0.33	
Observations	160	160	73	73

This table analyses the impact of EP on time to recovery using Cox PH model and the impact of EP on Severity of Loss using OLS regression analysis for a 15 days observation window by splitting the sample based on EPI score of countries. EP is firm's environmental performance dimensions from Asset4 Dataset. EPI represents Environmental Performance Index score of the country of firm. MB is the market-to-book value ratio. ROA is firm profits divided by book value of assets in percent. CF represents cash flows from operation scaled by net sales. SIZE is the natural of firms' total assets. DA represents leverage measured as total debts of firms divided by total assets. SG is the sales growth measured as total sales divided previous year sales in percent. RD is the research & development expenditure divided by net sales in percent. RDDUM represents dummy for RD (equals to 1 if firm has RD expenditure, otherwise 0). CAPEX is the capital expenditures divided by last year total assets in percent. MOMENTUM is previous three years market price change. INDUSTRY represents a dummy for Industry, REGION represents dummy for geographical region. Financial variables are winsorized at 1 and 99 % level. Standard errors are in parentheses. * Statistical significance at the 10 % level ** Statistical significance at the 5 % level *** Statistical significance at the 1 % level

Finally, we wonder if our results are robust to the different dimensions of EP in table 4.12. In disentangling the three different sub pillars of the Thomson-Reuters Asset4 dataset, we find that product innovation is the most dimension fostering resilience. According to Asset4 “the product innovation category measures a company's management commitment and effectiveness toward supporting the research and development of eco-efficient products or services”. As a matter of fact, environmental innovation is an important driver to acquire specific skills to adapt towards an environmental controversy. The emission dimension, as “a company's management commitment and effectiveness toward reducing environmental emission in the production and operational processes” is also significantly related to financial resilience. The resource reduction subset, however, proves to have no significant link. We wonder if the efficient use of natural resources might be more related to cost reduction than to innovation and flexibility.

Overall, we find that environmental performance increases financial resilience in facing a controversy only when firms are more prepared for external challenging conditions. In countries with high environmental settings and in high polluting sectors, companies are facing demanding conditions and high expectations from stakeholders. They therefore seem to develop specific environmental skills that help them to mitigate the adverse environmental events and to bounce back more quickly afterwards. The role of outside pressure may also foster the innovation process (Porter and Van der Linde, 1995) which is documented to be linked with resilience insofar as it helps organizations to adjust to turbulences (Linnenluecke, 2017). We therefore argue that EP only helps firms when firms are more prepared to future environmental challenges, i.e. in more stringent country environmental settings, in more polluting sectors and mainly when they innovate in the environmental dimension, which is in line with the arguments of the Porter hypothesis (Porter and Van der Linde, 1995).

Table 4.12: Resilience after an environmental controversy – Sensitivity to EP Dimensions

VARIABLES	OLS Model			Cox PH Model		
	Severity of Loss	Severity of Loss	Severity of Loss	Time to Recovery	Time to Recovery	Time to Recovery
Resource Reduction	-1.74			0.48		
	-2.21			-0.52		
Emission Reduction		-4.77**			1.08**	
		-2.33			-0.53	
Product Innovation			-4.06***			1.32***
			-1.44			-0.42
EPI	0.79	2.1	3.38	0.51	0.26	-0.23
	-5.62	-5.56	-5.75	-1.62	-1.6	-1.78
MB	-0.11	-0.02	-0.14	-0.16**	-0.19**	-0.14*
	-0.27	-0.28	-0.26	-0.08	-0.08	-0.08
ROA	-0.09	-0.07	-0.05	-0.01	-0.02	-0.02
	-0.07	-0.07	-0.07	-0.02	-0.02	-0.02
CF	-0.01	-0.02	-0.04	0.01	0.01	0.01**
	-0.04	-0.03	-0.04	-0.01	-0.01	-0.01
SIZE	-0.1	0	0.09	-0.11	-0.13	-0.17*
	-0.34	-0.35	-0.35	-0.09	-0.08	-0.09
DA	0.04	0.04	0.04	0.01	0.01	0
	-0.03	-0.03	-0.03	-0.01	-0.01	-0.01
SG	2.73	2.08	1.97	-0.58	-0.43	-0.38
	-2.01	-2	-1.97	-0.52	-0.53	-0.54
RD	0.31	0.21	0.25	-0.23	-0.26	-0.18
	-0.32	-0.33	-0.31	-0.17	-0.18	-0.16
RDDUM	0.59	0.72	0.86	0.44	0.47	0.27
	-1.28	-1.23	-1.25	-0.36	-0.36	-0.36
CAPEX	0.1	0.09	0.09	-0.02	-0.01	-0.01
	-0.09	-0.09	-0.09	-0.02	-0.02	-0.02
MOMENTUM	-0.24	-0.49	-0.09	0.05	0.1	-0.02
	-0.8	-0.81	-0.79	-0.19	-0.19	-0.2
Constant	2.55	1.22	-1.11			
	-8.46	-8.43	-8.84			
INDUSTRY	Yes	Yes	Yes	Yes	Yes	Yes
REGION	Yes	Yes	Yes	Yes	Yes	Yes
Observations	233	233	233	233	233	233
R-squared	0.1	0.12	0.13			
Pseudo R-squared				0.02	0.02	0.02

This table presents OLS and Cox PH regression analysis on the observation window of 15 trading days. Negative (positive) coefficient under OLS (Cox PH) model indicates an increase in the value of that variable increase resilience. EP is firm's environmental performance's subcategories i.e. resource reduction, emission reduction and product innovation from Asset4 Dataset. EPI represents Environmental Performance Index score of the country of firm. MB is the market-to-book value ratio. ROA is firm profits divided by book value of assets in percent. CF represents cash flows from operation scaled by net sales. SIZE is the natural of firms' total assets. DA represents leverage measured as total debts of firms divided by total assets. SG is the sales growth measured as total sales divided previous year sales in percent. RD is the research & development expenditure divided by net sales in percent. RDDUM represents dummy for RD (equals to 1 if firm has RD expenditure, otherwise 0). CAPEX is the capital expenditures divided by last year total assets in percent. MOMENTUM is previous three years market price change. INDUSTRY represents a dummy for Industry, REGION represents dummy for geographical region. Financial variables are winsorized at 1 and 99 % level. Standard errors are in parentheses. * Statistical significance at the 10 % level ** Statistical significance at the 5 % level *** Statistical significance at the 1 % level

4.5. Conclusion

Are environmentally performant firms more resilient towards environmental controversies? Whereas preceding literature is documenting an insurance-like effect on the stability dimension, the flexibility issues remains to our knowledge, unexplored. In this study, we therefore analyze the impact of firms' EP on their financial resilience by considering for the first time both stability and flexibility aspect of resilience. We contribute to the literature in both investigating the flexibility dimension and in documenting the conditions needed for EP to increase firm resilience against an environmental adverse event.

We apply both OLS and survival models by using EP data from the Thomson Reuters' Asset4 on a sample of 233 observations from 16 countries over the 2010-2016 period. Our results clearly find evidence that EP increases firm financial resilience from the shock caused by environmental controversy in its two dimensions, both mitigating the severity of loss and enhancing firm market price recovery. All else equal, environmentally performant firm are less affected by the controversy and bounce back more quickly. These results, in line with the environment-as-a resource framework ([Flammer, 2013](#)), are robust to different measures of variables, time windows, and models used. Moreover, we investigate more precisely when this relationship is significant. We find more that this link is only significant for firms located in high environmentally oriented countries, for the more polluting sectors, and concerning the specific production innovation and emission reduction dimension. We argue that these are facing more demanding conditions and have developed more environmental skills to deal with the threat of an environmental controversy.

The findings have practical implications for corporate managers, investors, and regulators. For managers and investors, we find evidence that environmental engagements not only provides an "insurance-like effect" (Godfrey et al., 2009), but also a "flexibility effect", which enable

firms to cope with future uncertainty like financial shock specifically caused by environmental controversies. This effect, however, proves to be sensitive to the capacity of the firm to be flexible, which is fostered by outside pressure of country and stakeholder, as well as the innovation dimension of EP that enhances adaptability. For regulators, then, more stringent environmental settings may, in line with the Porter hypothesis ([Porter and Van der Linde, 1995](#)), help firms to be more prepared to environmental jolts.

Appendix A. Examples of environmental controversies

Table 4.A: Some examples of controversies

News Story	Source
<p>1 Concerning firm: Cairn Energy</p> <p>Greenpeace target Cairn Energy in 'polar bear' protest Environmental campaigners step up pressure on energy firm over its oil spill response strategy and Arctic exploration plans Greenpeace activists dressed as polar bears occupied the Edinburgh offices of Cairn Energy on Monday as the environmental group stepped up the pressure on the company over its Arctic exploration plans. Last month the organisation's international head, Kumi Naidoo, was arrested after boarding a 52,000-tonne Cairn rig 75 miles off the west coast of Greenland. But on Monday Greenpeace switched its tactics from commando to panto in the Scottish capital as more than 60 campaigners, including dozens in polar bear suits, entered Cairn's offices near Edinburgh Castle. Greenpeace said the invasion was the latest step in a campaign to make the firm publish its oil spill strategy. Cairn announced in June that it had begun drilling two wells off Nuuk, the capital of Greenland. Both drilling operation are in water deeper than 900 metres, situated 100 miles and 185 miles from Nuuk...</p>	<p>The Guardian (July 18, 2011)</p> <p>https://www.theguardian.com/business/2011/jul/18/greenpeace-cairn-energy-polar-bear</p>
<p>2 Concerning firm: Newmont</p> <p>Foes of Newmont's \$5 billion Peru mine in standoff with police LIMA (Reuters) - Hundreds of protesters were locked in a standoff with police in northern Peru on Wednesday as they vowed to stop Newmont Mining from transferring water from a lake to a reservoir as part of its \$5 billion Conga gold project. Residents and local officials said it was the second straight day of tensions near the proposed mine that would be Peru's most expensive ever. On Tuesday, a minor clash between protesters and police marked an end to a stretch of relative calm since August, when the government of President Ollanta Humala said it would stop trying to overcome local opposition to the mine. The new round of protests came after a top official for the Conga project - Chief Executive Roque Benavides of Newmont's partner Buenaventura - told Reuters last week that water from Perol would be transferred to a new reservoir later this year...</p>	<p>Reuters (May 30, 2013)</p> <p>https://www.reuters.com/article/us-peru-mining-conga/foes-of-newmonts-5-billion-peru-mine-in-standoff-with-police-idUSBRE94S1E120130529</p>
<p>3 Concerning firm: ANGLO AMERICAN</p> <p>Protest at Anglo's Alaskan quest Top jewellers are refusing to use gold from a proposed mine because it threatens a major fishing ground Fifty jewellers with billions of pounds in sales and stores around the world have pledged to boycott Anglo American's planned Pebble project in Alaska, saying they will not use gold from the proposed mine as it threatens Bristol Bay, the world's most important fishing ground for wild sockeye salmon. Anything from 10 million to more than 30 million sockeye – the third most abundant species of Pacific salmon – are caught each year during the span of a few weeks of intensive fishing, according to the National Oceanic Atmospheric Administration in the United States. Earthworks, a non-profit group campaigning against the Pebble mine, says that if it goes ahead, the project – a partnership between Anglo and Canada's Northern Dynasty Minerals – "would destroy salmon spawning habitat in a designated fishery reserve and jeopardise the commercial fishing industry and the livelihoods of the Alaska native communities in the region"...</p>	<p>Independent (Nov 3, 2010)</p> <p>https://www.independent.co.uk/news/business/analysis-and-features/protest-at-anglos-alaskan-quest-2123518.html?utm_source=twitterfeed&utm_med</p>

General conclusion

Due to its major role in achieving the sustainable development goals (SDGs)¹⁰ (IPCC, 2018), environmental commitments of companies are nowadays a pressing issue, and their financial consequences are well discussed in academic literature. While some studies show a negative EP-FP link (Jaggi and Freedman, 1992, Lioui and Sharma, 2012, Jacobs et al., 2010, Stanwick and Stanwick, 1998, Galema et al., 2008, Marsat and Williams, 2013), others do not find a significant link (Cohen et al., 1997, Waddock and Graves, 1997), whereas more document a positive EP-FP link (Albertini, 2013, Dixon-Fowler et al., 2013, Endrikat et al., 2014, Endrikat, 2016). In addition, some studies refer high EP to insurance-like benefits (Godfrey et al., 2009), easy access to finance (Banerjee et al., 2019, Nandy and Lodh, 2012, Cheng et al., 2014) with a lower cost of capital (Sharfman and Fernando, 2008, Heinkel et al., 2001, Gupta, 2018, Chava, 2014). Several event studies suggest that investors penalize environmentally irresponsible behavior (Hamilton, 1995, Capelle-Blancard and Laguna, 2010, Flammer, 2013, Krüger, 2015, Endrikat, 2016, Capelle-Blancard and Petit, 2019), which may draw attention to the latent environmental liabilities of companies (Clarkson et al., 2015, Chapple et al., 2013, Clarkson et al., 2004).

While facing challenges to survive and compete in a turbulent and continuously evolving marketplace, some companies show more resilience against various disruptions. Besides the voluminous literature on EP-FP relationship, the link between EP and organizational resilience is to our knowledge surprisingly not precisely addressed in the academic debate. More

¹⁰ “The Sustainable Development Goals (SDGs), also known as the Global Goals, were adopted by all United Nations Member States in 2015 as a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity by 2030”. Source: <https://www.undp.org/content/undp/en/home/sustainable-development-goals.html>

specifically, it is not clear whether EP of companies is a determinant of resilience against an adverse situation. As resilience is “both the ability of a system to persist despite disruptions and the ability to regenerate and maintain existing organization” (Gunderson and Pritchard, 2002, DesJardine et al., 2017), this aspect of organizational outcome is more relevant to examine the role of EP in the context of a turbulent and challenging environment.

Considering the mounting pressure of environmental engagements and the importance of resilience in organization’s success, this thesis thus aims to enrich and bridge their literatures. More precisely, we extend the literature by studying the specific contribution of EP to financial resilience, for the first time to our knowledge. Facing both the environmental claims and financial turbulences, we try to answer if these two mounting pressures are not contradictory for firms. We also contribute to the literature in documenting how the relationship between EP and organizational resilience is context dependent. For this purpose, we focused on three types of adverse events, namely general financial crisis, regulatory disruptions, and company specific environmental controversies. Specifically, we raise the following three questions in this thesis:

1. Does EP contribute to resilience in a general financial distress?
2. Does EP contribute to resilience in an environmental regulatory distress?
3. Does EP contribute to resilience in a company specific environmental distress?

We first measure the financial resilience against the global financial crisis of 2007 as a general financial distress. Second, we consider the disruptions caused by the publication of verified emissions, a regulatory requirement under the EU ETS, to measure the financial resilience of companies in the context of a regulatory distress. Finally, we measure the financial resilience against the disruptions caused by environmental controversies to consider the company specific environmental distress. Hence, the above three questions investigate the EP-resilience relationship in two kinds of situations. In the first question, the situation is particularly related

to financial engagements, whereas, the situation in second and third questions consider the conditions of environmental engagements, through the claims of stakeholders in the form of environmental regulations and reaction to environmental controversies.

Research findings

In the first chapter, we introduce firm's EP and organizational resilience and discuss their financial implications from theoretical and empirical literatures. Considering the turbulent environment, we bridge the literatures of both areas from a financial viewpoint and propose two contrasting views to explain the possible link between EP and financial resilience. On one hand, based on shareholders' expense view (Friedman, 1970), high EP may be viewed as an overinvestment or waste of financial resources and may therefore reduce a company's financial resilience when confronted to an adverse event. On the other hand, based on Natural Resource Based view (Hart, 1995, Russo and Fouts, 1997) and the environment-as-a-resource view (Flammer, 2013), high EP companies may minimize the consequences of a shock and recover faster by benefitting from stakeholders' attention through their reputation of being eco-friendly and the competitive advantage of having valuable and inimitable resources. Building on this chapter, we introduce the avenues of research that are undertaken in the following chapters.

To answer the above questions, we categorically examined each question in three different empirical essays (presented in chapter 2, 3, and 4, respectively). Using an international dataset of 1,622 observations in our first essay, we applied the survival analysis, Cox PH Model, along with EP score from Thomson Reuters Asset4 database. We find evidence that high pre-crisis EP significantly reduces the likelihood of a firm's market price recovery after the global financial crisis of 2007, suggesting that EP appears to be an organizational constraint that limits the ability of firms to be financially resilient. Specifically, we find that one unit increase in EP reduces the probability of recovery by 38.6%. However, we find that this relationship subject

to certain conditions. EP does not seem mitigating the financial resilience for companies located in less environmentally oriented countries. Moreover, the product innovation dimension of EP does not reduce the financial resilience, while the other two dimensions, i.e. emissions and resource reduction, proved to be detrimental to resilience. This essay is the first attempt to investigate the precise role of EP in financial resilience, which somehow challenges the findings of [DesJardine et al. \(2017\)](#). Though [DesJardine et al. \(2017\)](#) found a positive contribution of CSR to resilience in the same context of global financial crisis, they however do not disentangle EP from other CSR practices.

In second essay, we find that EP significantly enhances the financial resilience in a regulatory framework of the EU ETS. By performing survival analysis on a sample of 3,194 observations over first twelve publication events from 2006 to 2017, we find that carbon intensity significantly mitigates the financial flexibility of companies covered under the EU ETS against the shock caused by publication of emissions data. This indicate the EP prepares companies to cope with a regulatory disruption that demands eco-efficiency. This finding complements the flexibility (resilience) effect of EP to the environment-as-a-resource framework ([Flammer, 2013](#)) and its insurance-like effect ([Godfrey et al., 2009](#)). This relationship is however dependent on the carbon-intensity profile of industry since the relationship is only significant in most polluting industries. Moreover, we find that this relationship significant in the second and third phases of the EU ETS, where carbon prices were high relative to the first phase and the overall allocation of emissions limit was reduced. To our knowledge, we made a first attempt to examine the EP-resilience link in the context of a regulatory framework.

Finally, the third essay show that EP significantly enhances the financial resilience against company specific environmental jolts. In this essay we used an international sample of 233 observations over the 2010-2016 period, along with environmental scores from Thomson

Reuters Asset4 database as a measure of companies' EP. By performing survival analysis, we find that prior EP significantly improves the both facets of firms' financial resilience, i.e. stability and flexibility, to the shock caused by environmental controversies. These findings seem in line with the environment-as-a-resource framework, suggesting that high EP enable companies to be more flexible, adapt easily to an adverse situation and therefore recover more quickly. However, we find that the relationship is only significant in environmentally oriented countries, in high polluting industries and for two of the subcategories of EP, i.e. "emission reduction" and "product innovation". To our knowledge, this essay is first attempt to investigate the role of EP in building financial resilience to companies' specific environmental jolts. We therefore document that firm preparedness and flexibility to cope with environmental controversies rely more precisely on the use of specific environmental skills developed throughout firm environmental innovation as well as demanding conditions from both the country environmental policy and industry scrutiny.

Altogether, we thus test the relationship in three different dimensions of resilience amidst two kinds of shocks, i.e. financial versus environmental jolts. While the EP-resilience relationship is negative in case of general financial distress and positive in case of environmental demanding jolts, this indicate that the relationship is also dependent on the conditions of an adverse situation. As the environmental-demanding jolts highlight the environmental claims, through the claims of stakeholders in the form of environmental regulations and reaction to environmental controversies, our findings show that high EP may benefit in these cases and enable company to neutralize the negative consequences of the environmental-demanding jolts. On the other hand, as general financial distress is not particularly related to the environmental claims of stakeholders, therefore, investors may be more concerned about the financial health of companies. Investors may see high EP as a waste of resources that could be mobilized in the

core or other functions of business to bring back company to routine business during a general financial crisis.

Contributions

Overall, we contribute to the literature at several stages. Firstly, we, for the first time to our knowledge, enrich and bridge the literatures of EP and organizational resilience. Previous research overwhelmingly determined EP from the perspective of cost, the neoclassical economists view (Friedman, 1970), and the environment-as-a-resource framework (Flammer, 2013). Considering the importance of resilience in a turbulent environment, the contribution of EP to organizational resilience is however scarcely addressed in literature. If DesJardine et al. (2017) study the impact of tactical versus strategic CSR commitments on firms' resilience, their approach does not however specifically disentangle EP from other CSR policies. Building upon the previous literature of EP, we theoretically demonstrate that EP could be a determinant of organizational resilience. We show that market may use the prior information related to company's EP (cost or reputation of being eco-friendliness) to respond to an adverse event.

Secondly, as organizational resilience embeds company's reaction to a disruption, we contribute to the literature by studying company's reaction to different adverse events and include the role of EP therein. This is not new since various studies examined the role of EP in an adverse situation (Jong et al., 2014, Brouwers et al., 2016, Hamilton, 1995, Capelle-Blancard and Laguna, 2010, Flammer, 2013, Krüger, 2015, Endrikat, 2016, Capelle-Blancard and Petit, 2019) in the short term, however, they do not address the question of what happens next. Such as, did company recover back and does EP play any role in the recovery after an adverse event? We specifically observe companies' resilience to adverse situations caused by general financial crisis, regulatory, and environmental controversies. Considering more frequent occurrence of financial crisis and regulatory interruptions, and high reaction to

environmental controversies then lead us to contribute to the literature on the impact of environmental policies on firm value by studying the impact of EP on an unexplored aspect of financial performance (financial resilience).

Thirdly, since we find a negative EP-resilience relationship in the context of general financial crisis, as presented in chapter 2, this finding offers a challenging result for the EP-FP literature from a new perspective. As high level of financial resources enable company to recover faster from a crisis ([Gittell et al., 2006](#)), our findings are in line with neoclassical economists view ([Friedman, 1970](#)) that resources invested in high EP may not be mobilized in other functions of the business to cope with a financial shock. Furthermore, these findings confirm the assertions of [Buchanan et al. \(2018\)](#), stating that shareholders may be more likely to invest less in environmentally performant firms since high EP can be associated with overinvestment concerns and agency problems. However, we find that EP is not always mitigating to financial resilience, since our results show that firm involvement in product innovation dimension of EP does not reduce firm resilience. Furthermore, we also find that EP is not detrimental for companies in countries with low environmental legislation. Hence, these findings seem particularly important for both corporate and portfolio managers.

Fourthly, we find a positive impact of EP on financial resilience in the context of regulatory and company specific environmental jolts. This contribution documents the benefits of EP highlighted by the Environmental Resource based view ([Hart, 1995](#), [Russo and Fouts, 1997](#)) and the environment-as-a-resource framework ([Flammer, 2013](#)) in the context of adverse events in focusing on the resilience effect. More precisely, we assessed the impact of EP on the financial flexibility, measured by the time to recovery, to adverse events caused by the disclosure of verified emissions, a regulatory requirement under the EU ETS, and environmental controversy. Applying a survival analysis methodology, our results confirm the

advantages of environmental engagements highlighted by the environment-as-a-resource framework, such as reputation and acquisition of valuable and inimitable resources. This indicate that beside the financial stability and insurance-like effects ([Godfrey et al., 2009](#)), high EP also possess the effect of financial flexibility. Besides, we also contribute to the literature by documenting that different kinds of environmental involvement do not play the same role. More precisely, only those dimensions of EP improve resilience that attracts more attention, i.e. emission reduction, or induces innovation, i.e. product innovation. Furthermore, our findings show that high EP is more beneficial if the company is in high polluting industry, in environmentally oriented country.

Finally, we contribute to the literature by documenting that the situation moderates the EP-FP relationship. More specifically, our findings show that EP-resilience relationship is negative in the context of a general financial distress, indicating that EP could be detrimental if the situation demands particularly financial engagements. This relationship, however, is positive in the context of environmental regulations and environmental controversies. As both of these latter situations demand environmental engagements from the companies, to comply with environmental regulations and reduce irresponsible behavior, high EP seems benefiting the company. Indeed, if a company is well prepared and fulfils the demanding conditions in advance relative to their peers, then they may have an advantage to adapt to new situation. Previous studies identified various reason for the inconsistency in EP-FP relationship, for example heterogeneity in empirical methods ([Horváthová, 2010](#)), small sample size and evaluation of EP ([Konar and Cohen, 2001](#)), moderating factors in the models i.e. firm size and geographic location ([Cohen et al., 1997](#)), or the industry profile of firm ([King and Lenox, 2001](#)). We thus extend this literature by considering the moderating impact of the demanding conditions of a situation.

Practical implications

The findings of this thesis have some important practical implications for corporate managers, investors and regulators.

Firstly, as the findings show that high EP could be detrimental to FP (particularly resilience) in the context of general financial shock, corporate managers seem to have a trade-off between “doing good” and “doing well” in the context of a general financial shock. However, they must know that only two of the subcategories of EP, i.e. resource reduction and emissions reduction, pose this dilemma. Besides, and interestingly, managers may invest wisely in product innovation, which does not seem reducing the capacity of company to cope with general financial shock. Furthermore, they must also know the environmental conditions of company’s country because EP may not be detrimental to resilience if their company is in a country with low environmental standards. On the contrary, as EP seems beneficial in the context of a shock demanding environmental engagements, then “doing good” may also be considered as “doing well”. In this context, the relationship is however only significant in environmentally oriented countries, in high polluting industries and for two of the subcategories of EP, i.e. “emission reduction” and “product innovation”. Thus, these elements must be considered while adopting environmental policy to prepare organization for future uncertainties.

Secondly, our findings indicate that investors may see the high EP as a waste of resources or overinvestment in the context of a general financial shock, but they must know that EP is however beneficial for companies in relatively more frequent upheavals that are related to environmental issues. As passive investors adopt buy-and-hold strategy, they should consider the environmental policy of a company as a part of their buying due-diligence process. If they invest in a company with high EP, it may cost during a general financial crisis but seems beneficial in a long run. As our findings confirms the moderating role of the demanding

conditions of situations, therefore, investors must know that these conditions may have been changed with the passage of time that may affect the EP-resilience relationship in future general financial crises. As pinpointed by the [World Economic Forum \(2020\)](#) report, the concerns about environmental issues are very high nowadays and the environmental events are occurring more frequent now that cause severe losses to firms and the overall economy. Thus, in this environmental turbulent landscape, investment in high EP firm seems a best choice for investors in long run. Many countries have now adopted the sustainable and responsible investment (SRI) focused regulations (see the PRI webpage¹¹) that directly impose some obligations on investors and asset management companies. For example, the article 173 of new French law (LTECV 2015¹²) imposes an obligation on investors and asset managers to report or explain how they integrate the ESG-Climate factors into their investment processes and decisions ([FIR, 2016](#)). To comply with CSR-oriented regulations, investors may now prefer to invest in high EP companies to prove their legitimacy while companies are facing general financial shocks.

Finally, our findings highlight the importance of environmental policies implemented by regulators. In line with the Porter hypothesis ([Porter and Van der Linde, 1995](#)), these policies help companies to be more prepared to environmental jolts. However, we find that stringent regulations have placed companies in a challenging position during a general financial crisis. Considering the moderating role of demanding conditions of a situation, regulators may improve the conditions through CSR-oriented policies to encourage companies as well as investors to adopt environmentally oriented strategies. Likewise, they will be able to protect

¹¹ Responsible investment regulation map: <https://www.unpri.org/sustainable-markets/regulation-map>

¹² Loi sur la transition énergétique et pour la croissance verte (LTECV), Law No. 2015-992 of 17 août 2015. It can be accessed at: <https://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000031044385&categorieLien=id>

the natural environment and at the same time will improve the ability of companies to cope with environmental disruptions. As our findings show that high EP is not beneficial against environmental jolts in less environmentally oriented countries, this brings the responsibility of regulators in these countries into the fore. Environmental NGOs may also play an important role by increasing awareness, imposing more pressure on investors to adopt SRI strategies, and rewarding companies for their environmental friendliness.

Limitations and directions for future research

If our results are robust in the context of our settings, there are still some limitations that open various opportunities for future research. Firstly, to measure the EP of companies in the context of general financial and environmental controversies' shocks, our analysis relies on the environmental scores provided by Thomson Reuters Asset4. While previous studies show concerns about the disagreement among different rating agencies, for example [Chatterji et al. \(2016\)](#), it would be interesting to use alternative measures of EP from other agencies to make sure that the EP-resilience relationship does not provide different outcome. To some extent we address this issue by using carbon emissions data from Trucost dataset in the second essay, yet it seems necessary to use alternative measures in the same essay. Furthermore, Thomson Reuters Asset4 consider more than 60 environmental indicators to calculate environmental scores, therefore, we encourage future researchers to further disentangle this measure to have a thorough understanding of the EP-resilience relationship. We considered the three subcategories of EP (i.e. emissions reduction, resource reduction, and product innovation) and found different results for some subcategories. However, these categories still have a great potential to be disentangled more to examine more precise relationship.

Secondly, future research may identify different measure of organizational resilience. We assessed organizational resilience by the reaction of market prices to a disruption, which seems

relevant but may not directly represent organizational resilience (DesJardine et al., 2017). Future researchers may focus on the rate of failures of companies in the aftermath of an adverse event, or other quantitative or qualitative techniques to test resilience. Besides, as we apply survival analysis to assess the impact of EP on the flexibility dimension of financial resilience, measured by the time to recovery of company's market price, this method restricts us to observe recovery in a specified time window. Though this method allows us to assess the relationship in a longer run relative to event study methodology, but still this method does not allow us to disentangle the impact of other events that may have happened in the observation window. Therefore, future researchers may come up with a new approach to identify numerous disturbances in a time window. Controlling for this issue will allow us to further expand the time windows and assess the relationship if a company is facing numerous disturbances.

Thirdly, as our findings show the significance of the demanding conditions of adverse events, future researchers may also consider other range of disturbances to further the EP-resilience relationship in the demanding conditions of other disturbances. For instance, companies' reaction to disruptions caused by natural disasters, pandemic diseases interruptions, regulations, may provide good avenues for assessing organizational resilience. As we assessed the impact of EP on financial resilience to environmental controversies and found a positive relationship, future researches may consider the other two dimensions related controversies of ESG framework (i.e. social and governance) to see whether EP is protecting companies from controversies that are not specifically related to environment.

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