Adaptation or inertia, Company response to European green finance policy.

Mater Thesis Economics and Business (Financial Economics)

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Abstract

This paper investigates, using a Difference-in-Difference design, the relevance of firm adaptive capabilities by studying the firm-level response to the European green finance policy. Specifically, the implementation of the Action plan on sustainable finance and the EU Taxonomy. Decarbonizing the economy is an important part of the globally policy agenda. The European Commissions' "Action plan" aims to establish a financial industry that supports the climate transition and drives investments towards sustainable economic activities. A key component of the Action plan is the EU Taxonomy, meant to combat greenwashing. Firstly, I investigate how European firms respond to the implementation of the Action plan. I look into firm responses consistent with factors previously established as driving Environmental disclosure. I find evidence consistent with increased Debt service capacity and a decrease in Current Ratio. Secondly, I investigate the adaptation response to the EU Taxonomy in a sample within Europe and in comparison to the US. I find evidence of increased investment behaviour following the intervention. Overall, while not presenting a causal relationship, our findings are mainly consistent with the theory of firm adaptive capabilities

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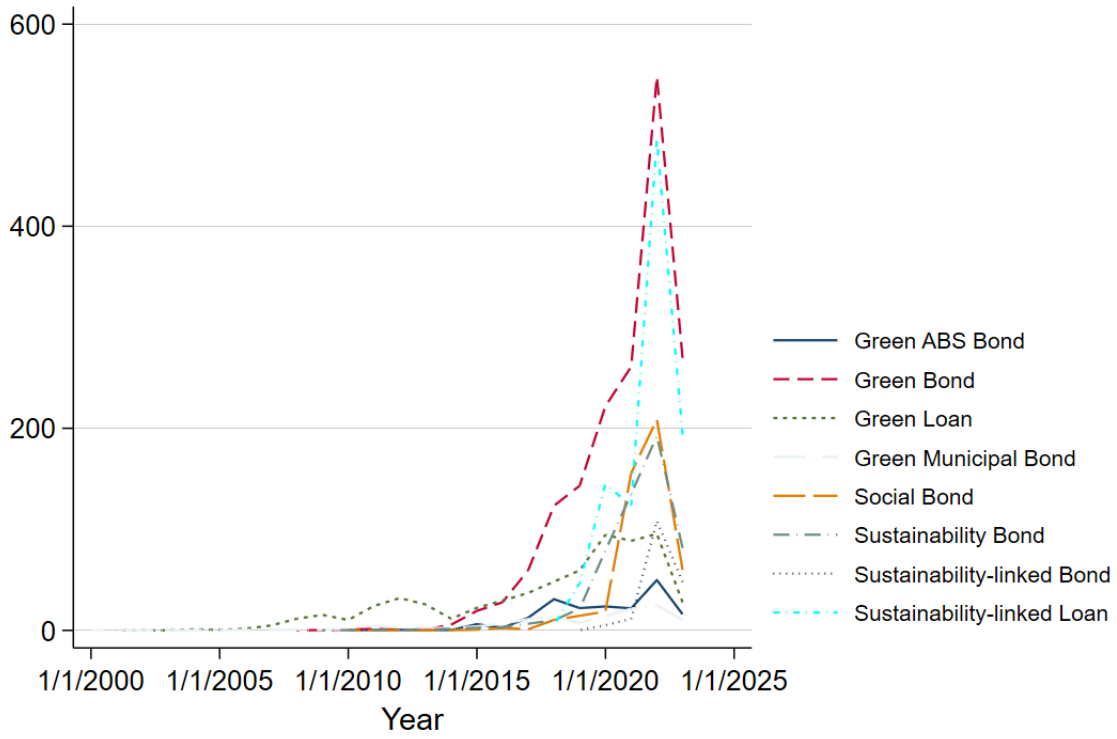
Introduction

The European Commission has since 2018 been developing an action plan to define sustainable finance objectively. This policy agenda contains the "Action plan on financing sustainable growth and developing a renewed sustainable finance strategy" (Overview of Sustainable Finance, 2022). From the Action plan came the European green deal, a growth strategy to make Europe climate-neutral by 2050. As a key objective of the Action plan, the European Commission and a group of experts established the EU Taxonomy. The Taxonomy comprises a list of economic activities and performance criteria for contributing to six distinct environmental objectives. To be included in the EU Taxonomy, economic activities must substantially contribute, Meet "do no significant harm" criteria and comply with minimum safeguards. Ultimately the EU Taxonomy aims to be the definitive guide on sustainable investing, a tool to help investors, companies, and issuers navigate the transition to a low-carbon and resource-efficient economy, a "Green Bible". This taxonomy represents a significant legislative push for the formalization of what can be considered a sustainable activity and investment and an important step towards eradicating "Green-washing". The Taxonomy regulation is accompanied by new requirements for companies. As of January 2022, firms must disclose on the first two objectives, "Climate change mitigation" "Climate change adaptation". For example, firms must disclose the percentage of EU-taxonomy aligned revenue, capital expenditure (CAPEX) and operating expenditure (OPEX).

Over the last few years, there has been a dramatic increase in sustainable investments. Asset managers and other institutional investors have started offering "Green" products focused on low emissions, Net-Zero transition readiness, best-in-class ESG ratings, and various other criteria. Hand-in-hand with the adoption of sustainable investments in institutions, are the increased offerings of Sustainability-linked credit by companies and municipalities alike. Figure 1 illustrates the tremendous growth of Green debt issuance over the last ten years. In 2021 cumulative green debt hit reached over 1 trillion USD, and while market turn downs in early 2022 have limited debt issuance, global green credit is poised to reach 1 trillion again by the end of the year.

Figure 1.1. Global green debt issuance over time



*Note.*Debt issuance in Billions of USD, Source: Bloomberg Intelligence.

There are particularly significant risks associated with improper management of climate related issues. Investors have started to regard the importance of corporate environmental responsibility (Krueger, Sautner & Starks, 2020). In particular, investors are acutely aware of the regulatory risk and associated liabilities some companies face. Investors are eager to reward companies' attempts at adopting sustainable practices through with a lower cost of debt or positive abnormal stock returns following green debt issuance (Tang & Zhang, 2020).

However, there is currently no consensus on what should be considered sustainable and what should not. Now, decisions are based on companies' biased and subjective disclosure and is driven by third-party data providers on Environmental, Social and Governance (ESG) performance, such as Sustainalytics, MSCI and Refinitiv. While these data providers are consistently innovating and improving, there is a disturbing lack of convergence regarding their methodologies (Dorfleitner, Halbritter, & Nguyen, 2015). Weights attributed to the individual ESG pillars significantly drives the direction of the rating. Companies with good governance and social initiatives might rank higher than privately held companies with no outside board members adopting Net-zero initiatives. It is up to investors to decide which issues are more material. However, even within pillars, there are no standards or guidelines to define what constitutes a sufficient contribution.

Using a quasi-experimental setting and a Difference-in-Difference estimator, this paper investigates if there has been a direct response, by firms, to European policy initiatives. More precisely, I take European firms affected by the policies as the treatment group and a sample of US firms and European firms not affected by the intervention as control group. I study two related settings, the implementation of the Action plan and the EU Taxonomy.

The expected adaptation response is postulated by comparing two views on firm behaviour to external shocks. The first view on firm behaviour I will describe, which is more often supported by empirical evidence, is the environmental determinism perspective (Lewin et al., 2004). This view argues that firms have a limited capacity to adapt. Following the deterministic perspective, the most efficient strategy for firms is structural inertia, characterized by slow adaptation. Consequently, industries adapt through the replacement of outdated firms. If this holds in the proposed settings, and firms have not adapted to the revealing disclosure requirements in the taxonomy, capital would flow away from these firms into younger firms that have adapted to environmental legislation and have made changes beyond favourable marketing campaigns.

The second perspective on firm strategy described in this paper is the strategic choice perspective. Under this view, firms innovate and adapt to external demands to obtain a strategic advantage over their competitors. This view is substantiated by the perspective on value creation and the pursuit of sustained competitive advantage, either through an internal or external approach, as described by Smit and Trigeorgis (2012). The Natural Resource Based View (NRBV) stresses the importance of the consideration of the natural environment in value creation (Hart, 1995).

In what follows, I describe the relationship between a firm's Corporate Social Responsibility (CSR) and value creation. Furthermore, I highlight the benefits to firm shareholders and stakeholders of improving environmental performance. The relationship between capital structure and Environmental, Social and Governance (ESG) and CSR has been well studied and offers evidence that high ESG performance reduces the cost of financing (Cantino, Devalle & Fiandrino, 2017). In the proposed setting, being eligible for the EU Taxonomy means increased access to finance and lowering the cost of equity and debt. The adaptation responses that I will investigate stem from the dynamics of voluntary corporate environmental disclosure as posed by Cormier and Magnan (1999). Trough lowering information asymmetries, companies can benefit from additional disclosure. However, there can be substantial costs associated with stakeholder activism driving corporations to withhold damaging information.

With this research, I will build on the the study of firm environmental disclosure dynamics, as posed by Cormier and Magnan (1999), by investigating its prevalence in a natural-experiment setting. I will contribute to the theory of firm behaviour by investigating the prevalence of firm inertia, as described by Meeus and Oerelmans (2000) & Kelly and Amburgey (1991), compared to actively adapting

to external opportunities (Teece et al. 1997) (Hart, 1995). I build on findings by Sautner, van Lent, Vilkov and Zhang (2020) by studying if exposure to climate regulation drives companies to change behaviour. Lastly, due to the unique setting of the EU Taxonomy, I will contribute to the literature on environmental disclosure regulation by studying the ex-ante impact of disclosure requirements and, more specifically, the preliminary impact of the EU taxonomy on firm behaviour.

Framework

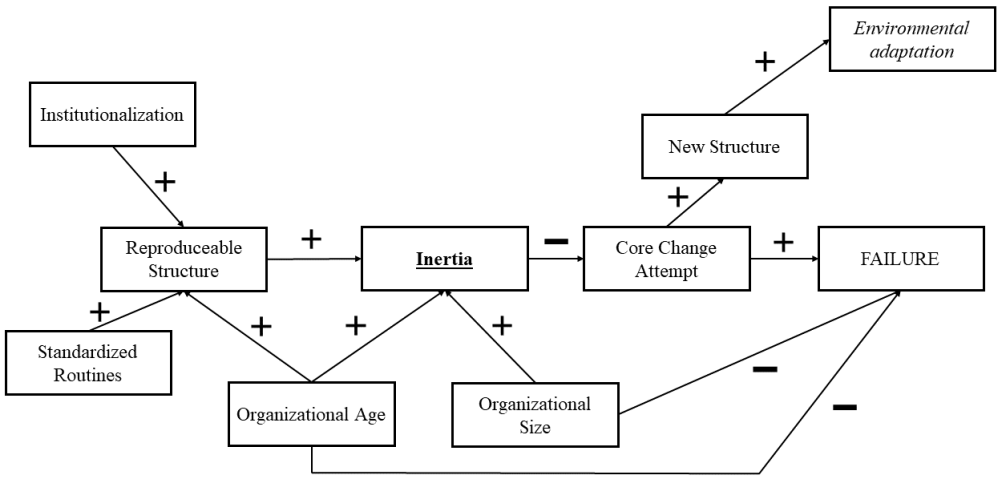
2.1 Innovation and firm inertia

Innovation in all aspects is a risky endeavour; it requires taking chances and changing existing structures and routines. The risk is no different for the innovation required to reduce and mitigate environmental impact. The innovators' dilemma, first described by Christensen (2013), describes the complex dynamics and tradeoff between reliability and consistency to achieve organizational goals and the drive for change for organizational survival. Meeus and Oerelmans (2000) set out a framework that describes two concepts in the theory of organizational structure and innovation to explore the dynamics of conflicts between internal and external demands on firms. Namely, firm inertia and firm adaptive capabilities.

Firm inertia, or the selection perspective, highlights the limited adaptive capabilities of firms. The inertia theory poses that due to "cognitive limits on strategic and efficient choice", there is an increased risk associated with changing behaviour (Meeus & Oerelmans, 2000). The selection perspective suggests that inert behaviour is the best strategy for firm longevity. Structural inertia limits the risk of poor short to medium-term performance, and as such, innovation and change are risks best avoided. Similarly, the environmental determinism perspective argues that firms have a limited capacity to adapt (Lewin et al., 2004).

Consequently, industries adapt through the replacement of outdated firms. Thus, under the theory of structural inertia, firms would be better off responding to changes slowly, taking on minimal risk. Hannan and Freeman (1984) described how formal institutionalized organizations have two distinct advantages over others, reliability and accountability. To achieve and maintain both, an organization must have a stable structure that produces reproducible results (Hannan and Freeman, 1984). Figure 2 illustrates a view of the factors that drive firm inertia and the interrelation between these factors. Organizational Age and size are significant drivers of structural inertia, enabling the reproducible structure. Nevertheless, it is formalized standardization that makes organizations averse to change. In their theory of structural inertia, Kelly and Amburgey (1991) describe how organizational members seek to sustain the existing conditions to protect their own interests. Thus, in a setting with demands from investors and policymakers for improved environmental performance that requires substantial innovation and change, firms would be forced to take additional risks that can harm performance. As such, under firm inertia, I expect that there has not been an adaptation response to the EU taxonomy.

Figure 2.1. Structural Inertia Theory



Note Modeled after Figure 1 in Kelly and Amburgey (1991). (+), indicates a positive relation between factors. (-), indicates a negative relationship.

2.2 Theory of firm adaptation

Adaptation theory emphasizes the interrelation between organizational competencies and external dynamics, such as environmental factors, and stresses the importance of integrating environmental change in strategic choice. A similar theory is the "fit theory" by Lewin, Weigelt & Emery (2004). In this view, firms dynamically respond to changes in the environment to strengthen their economic position vis-à-vis competitors. Following this perspective, firms can employ strategies to gain a competitive advantage. Consequently, if the fit theory holds, I expect to find a measurable response to capitalize on the regulation.

2.2.1 Value creation & competitive advantage

Value creation is the goal of strategic decision-making by executives and investors. Starting from a rather classical economics point of view, firms in competitive markets with no barriers to entry or exit and homogeneous products can make no profit in the long run due to increased supply. Therefore, a firm must generate a competitive advantage to produce excess profits. Firms can create this coveted competitive advantage by obtaining absolute cost advantages, economies of scale and scope, and product differentiation (Shapiro, 1989).

There are broadly two perspectives when creating excess profits due to a competitive advantage, an internal and an external view. The externally oriented view concerns itself with the exploitation of limited markets. Imperfections in the market allow firms to position themselves to capture excess returns. The most famous analysis of the external perspective is that of Porter's Five Forces (Grundy, 2006).

However, to capitalize on strategic opportunities due to external dynamics, a firm has to leverage its resources. The internal perspective on value creation is based on the various methods firms use to create an advantaged position within the organization (Smit & Trigeorgis, 2012). Every company is made out of a unique set of resources and capabilities that can be levered strategically to generate competitive advantage (Penrose & Penrose, 2009). According to the internal resource-based view, excess profits can be obtained and sustained by acquiring rare, incomparable and valuable resources and capabilities, conditional on having an organizational structure in place to capitalize on them (Kraaijenbrink et al., 2010). Examples of such resources include tangible assets such as firm size or plant size and other financial resources, as well as intangible assets such as brands.

The "dynamic capabilities" framework proposed by Teece et al. (1997) offers a complement to the resource-based view. The authors pose that in environments characterized by rapid change and innovation, firms' source of competitive advantage is shaped through the distinctive process it has adopted, the unique assets and knowledge of the firm, as well as the choices it has made to get to its current position (path dependencies). Akin to the resource-based view, dynamic capabilities argue that excess returns can be obtained by strategically employing the resources and know-how of a firm. Contrary to the resource-based view, Teece et al. (1997) emphasize the importance of flexibly adapting and responding to changes. In essence, what Teece et al. (1997) propose is that a sustained competitive advantage in an environment with rapid technological change can be obtained through identifying and adapting to opportunities.

Both the strategic resources and the dynamic capabilities view, fail to consider the constraints on a firm by the natural environment. The Natural Resource Based View (NRBV), proposed by Hart (1995), construes the interrelationship of strategic value creation and the biophysical environment. The author poses that the inevitable and substantial impact that the environment will have on operations, be it through physical risk or regulatory requirements, creates an opportunity for a firm to establish a competitive advantage through environmental responsibility. Hart (1995) describes three strategies firms can adopt to establish a competitive advantage. Firstly, reducing operational emissions and increasing pollution abatement efforts through increased operational control enables firms to capture cost benefits. The reduced cost will not only be realized by using resources more efficiently but also by reducing compliance and liability costs associated with pollution (Rooney, 1993). Secondly,

through continuous and innovative sustainable development, firms reduce the impact of their growth on the external environment, improving their future competitive position. In particular, Hart (1995) emphasizes the importance of establishing a growth strategy that abolishes the negative relationship between economic development and environmentalism in developing economies. Lastly, Hart's final tenant of the NRBV, product stewardship, revolves around integrating external stakeholders into the decision-making process. The cost of the environmental impact along every step of the value chain has to be internalized. The commitment towards a more sustainable future thus has to shift concerns away from maximizing shareholder value to incorporating stakeholder values. However, applying the NRBV is costly; substantial investments must be made to integrate the tenets of Hart's strategy. Such a strategy thus requires the owners of the company to forgo immediate profits in favor of long term gains.

2.2.2 The shareholder vs. stakeholder debate on CSR

Integrating environmentally sustainable behaviour is a managerial issue that can be directly related to the Shareholder vs Stakeholder debate. Ultimately, the firm's officers have a direct responsibility to create value for the owners of the firm, the shareholders. Academic literature has long concerned itself with the degree to which this responsibility means managers reserve the right to consider the interest of external stakeholders. Theories favouring the shareholder perspective are built on the principle that managers must optimize shareholder value and only spend funds in ways authorized by the providers of capital (Smith, 2003). A much-offered criticism of the shareholder view is that it is conducive to managerial myopia and short-terminism. A short-term focus can lead firms to under investment, choosing immediate gains over long-term profits (Marginson & McAulay, 2008). Contrastingly, the stakeholder view argues that managers are responsible to all parties that potentially benefit or bear the risks of firm operations. The belief in the stakeholder-oriented view drives Corporate Social Responsibility (CSR). However, an argument against the stakeholder view is that additional consideration of stakeholders goes at the expense of firm profitability. In fact, Corporate Social Investment goes directly against the classical consideration of profit-maximizing rational shareholders. On the other hand, as stated by Hart (1995), the pursuit of sustained competitive advantage and long-term profits drives corporate social responsibility.

For Investors, the rationale behind socially responsible investment stems from two tenets: increased returns due to the prospect of long-term value creation and improved risk management at the firm and at the portfolio level (Ho, 2010). A vast body of literature encompasses the effects of integrating corporate responsibility on firm-level characteristics and performance. Many studies have emerged linking firm-level ESG performance to performance and value creation. Eccles et al. (2012)

compared various firm behaviour and performance metrics from companies that integrated environmental and social policies in the past to those that did not. The authors find, using a sample of high sustainability companies matched to companies that did not adopt CSR policies; the sustainable companies significantly outperform in the long run. Moreover, The authors find that firms that have an established culture of sustainability have significantly different corporate governance structures, including processes for stakeholder engagement and managerial remuneration linked to ESG metrics. It is indeed this enhanced governance structure that appears to create shareholder value. Margolis et al. (2007) Illustrate that Corporate Social Performance (CSP) can is a proxy for good management. In their paper, they argue that while other activities are more directly linked to profit, the maintained favour of consumers through improved social performance results in a positive relationship between CSP and financial performance. A comprehensive literature review conducted by Van Beurden and Gössling (2008) further corroborates the findings that social performance is positively related to financial performance. Other studies show that besides the evolution in corporate governance structure, other factors influence CSR firms' out-performance. Luo and Bhattacharya (2006) illustrate using Tobin's Q, as well as equity returns that incorporating CSR increases market value through increased consumer satisfaction.

Given the societal consequences of events such as the COVID-19 pandemic, it is simple to see how disregarding social and environmental risks can hurt companies' financial stability. Investors have started to regard and, most importantly, price-in the risk associated with management (or lack thereof) of ESG factors. Sautner, van Lent, Vilkov and Zhang (2020) use a Machine Learning based Natural language based processor to capture firm exposure to regulatory risk. Suatner et al.(2020) find that, particularly in recent years, exposure to climate regulation is negatively correlated with valuations.

A firm's implied cost of capital, measured by the internal rate of return that equates market value to discounted future earnings, is a proxy for firm risk (Pástor et al. 2008). Consequently, based on previously described literature, I expect that CSR efforts are related to a lower cost of equity. Indeed, Ghoul et al. (2011) find that firms with concrete CSR commitments can finance their equity more cheaply. More precisely, investments made by firms into bettering labour relations, incorporating environmental strategies & policies and other ESG-related efforts reduce a firm's implied cost of capital. Similarly, Bassen et al. (2006) highlight the reduced regulatory risk as a consequence of corporate responsibility, leading to a reduced capital cost.

A further implication of reduced firm risk should be reflected in the interest a firm must pay to borrow. The cost of debt is directly related to the financial health of a firm and the market's conviction that a company will be able to service interest payments. The view that CSR integration reduces

firm risk should lead to a reduction in the cost of debt. However, investments in CSR are not universal instruments for risk reduction. Goss and Roberts (2011) show that for high yield borrows, investments into CSR can sufficiently decrease the firm's immediate financial position, leading to the issuance of lower maturity debt and increased spreads. While CSR investments in the presence of credit risk can decrease firm value, overall, the authors find that firms with poor CSR performance pay up to 18 basis points more on loans vis-a-vis responsible firms. Similarly, Bauer and Hann (2010) argue that risks associated with poor environmental management lead to increased default likelihood, causing investors to demand premiums on the cost of debt. Consequently, firms ahead of the curve in implementing environmentally sustainable policies enjoy a lower cost of debt. Thus, improper management of climate-related risks is viewed by investors as a source of risk. This is especially true in countries with an increasing focus on corporate responsibilities from the policy side. The anticipation of future liabilities due to increasingly demanding laws and regulations imposed on companies leads investors to price in the additional risk, leading to higher yields (Schneider, 2011).

Investors' concerns extend beyond reducing firm-level risk. At the portfolio level, adjusting for ESG risk requires a broader approach. Following the CAPM model, investors are not compensated for unsystematic risks that can be diversified away. Therefore, theoretically, investors have no additional benefit in reducing firm-specific risk (Ho, 2010). However, certain firm-level environmental risks can impact other firms as well. Poor environmental performance of one portfolio firm can affect the rest of the portfolio, either directly through physical damage caused (e.g. environmental harm to real estate owned by other firms) or indirectly against the whole economy (e.g. higher tax rates to cover cleanup costs) (Hawley & Williams, 1997). As ownership concentration becomes increasingly centralized, highly diversified investors, described by Hawley and Williams as "Universal owners", have additional incentives to understand and maintain the direct and indirect risks associated with the natural environment in which a firm operates. Thus, for the diversified investor, monitoring and reducing firm-level environmental risk can benefit the risk-adjusted returns of the whole portfolio. Moreover, recent evidence has also shown that in the face of significant systematic shock, ESG-tilted portfolios outperform. Broadstock et al. (2021) show that during the COVID-19 pandemic in China, high-ESG portfolios outperformed and exhibited lower risk than low-ESG portfolios.

There is overwhelming evidence of the benefits of integrating CSR and being environmentally sustainable. However, there remain considerable challenges for investors aiming to integrate sustainable performance into portfolios properly. There is still much debate about what constitutes a "green investment". Conley and Williams (2005) conducted an ethnographic study on the meaning of "CSR" to various investor types and corporates. Their survey findings highlight justified concern with investors that CSR efforts represent nothing more than corporate communication to promote reputa-

tion rather than a concerted effort by firms to make an impact. The issue of "Greenwashing" remains the most significant challenge for establishing sustainable investment and, consequently, reaching global environmental targets. In fact, in April 2021, the division of examinations of the Securities and Exchange Commission (SEC) published a "risk alert" on ESG Investing. The risk alert published by the SEC highlights concerns and best practices observed by the division of examinations. In particular, the report found "Inadequate controls to ensure that ESG-related disclosures and marketing are consistent with firm practices" (SEC, 2021). The division described discrepancies between disclosure and practices mainly due to poor internal controls and marketing practices.

2.3 The dynamics of environmental disclosure

Firm disclosure on environmental performance is lacking. Investors require a breath of information to establish the sustainability characteristics of a firm. However, as firms are not required to disclose, they often do not choose to do so or highlight successes and omit the most considerable ESG risks. While there can be many reasons why firms decide not to disclose voluntarily, empirical evidence shows that firms who decide increase experience significant benefits (Lev, 1992). Voluntarily decreasing information asymmetries can be a valuable tool for management to increase firm value.

In order to determine what drives the decision to disclose additional information on environmental performance, Cormier and Magnan (1999) established a framework to describe a firm disclosure strategy. The framework the authors describe compares the cost and benefits of environmental disclosure to identify what drives the decision to withhold information. More specifically, a firm's disclosure strategy depends on the benefits of reducing information costs associated with information asymmetries between managers and investors/shareholders and the impact of a firm's financial condition through the use of the disclosure by external shareholders. Firstly, agency conflicts can arise between investors and firm executives because of information asymmetries. When information is not readily available and costly to collect, uninformed investors are crowded out, leaving remaining investors with a less liquid and more costly market (Cormier & Magnan, 1999). In particular, for firms that rely on external capital, there is a significant incentive to decrease the cost for investors to reduce information asymmetries to increase the firm access to financing. I previously established the perceived benefits of CSR on firm performance and risk, which is reflected in both the cost of capital and the cost of equity. As such, it is in the firms' interest to highlight environmental performance, thus reducing information asymmetries and increasing access to finance. However, investors always benefit from complete information.

There are costs associated with disclosing environmental performance. Besides the cost associ-

ated with measuring and ultimately reporting on various metrics and performance, the second factor Cormier and Magnan (1999) describe in their cost-benefit framework are the costs associated with stakeholder activism.. The reaction of external stakeholders drives the cost that arises from disclosing poor environmental disclosure. These adverse reactions can be through lobbying of environmental groups, reputational concerns with customers, or changes in the company's perceived risk by lenders and investors. The costs are particularly high for firms in poor financial conditions as the risk of future liabilities due to environmental regulation may drive concerns of future required capital expenditure to absorb the costs. DesJardine and Durand (2020) identify the long-term effect of hedge fund activism on firms. They find a persistent decrease in profitability, investments and employees following an activism campaign. As in the previously discussed paper by Roberts (2011), it is, in particular, the concern of required future investments to improve environmental performance for high yield borrowers that elevate concerns of illiquidity and inability to service interest payments.

Currently, with limited disclosure requirements on environmental performance, the cost associated with disclosure described above can explain why there is limited firm disclosure, despite the perceived benefits of disclosing environmental impact. The cost is substantial for firms with poor financial conditions and lagging environmental performance. As such, these firms are less likely to increase disclosure voluntarily. However, disclosure regulation is constantly evolving and imposing standardized disclosure requirements on companies.

2.4 The European push towards sustainable finance

2.4.1 The Action plan

In the public sector, funding the decarbonization of the economy and the transition towards an increasingly sustainable growth strategy has been an important policy topic in recent years. Starting with the Paris Climate Accord agreed upon at COP 26 in 2015, where adopters pledged to limit global warming to 1.5 degrees Celsius. Participating countries have developed their strategies on how to reach this long-term target. The EU's response was to task a group of experts in the field of sustainable finance with developing a proposed action plan. This expert group, comprising 20 members from the financial sector, academia, civil society and international institutions, published their final report at the beginning of 2018. Building on the expert group's recommendations, the European Commission announced the implementation of their strategy, "The Action plan," for a financial industry that supports the European green goals and agenda in May 2018 (Q2 2018).

The Action plan's policy agenda provided opportunities for "green" investments and consequently,

opportunities for issuers. However, scrutiny of poor environmental risk management also increased. Sautner et al. (2020), describe how in recent years, exposure to climate regulation has a negative impact on valuations.

The Action plan comprises ten key topics that fall under three categories, reorienting capital flows towards a more sustainable economy, Mainstreaming sustainability into risk management and Fostering transparency and long-termism. The first category established several essential developments in financial markets, which consequently directly affected companies. Among these developments are the creation of an EU Green Bond Standard and green financial product labels. Moreover, under category one of the Action plan, the Commission proposed several other initiatives, such as developing low-carbon and positive impact benchmarks, increasing investment in sustainable projects and defining a framework on how to incorporate sustainability in consultancy services. However, the number one key feature of the action plan was the establishment of the EU taxonomy, a unified classification tool to define sustainable economic activities.

2.4.2 The EU Taxonomy

The EU Taxonomy was published on June 22 2020 and entered into force the following month. The Taxonomy, which represents a legislative push to end "Greenwashing", is a comprehensive list detailing economic activities and criteria that establish contribution to 6 defined environmental objectives. The Objectives, climate change mitigation, climate change adaptation, sustainable use and protection of water and marine resources, transition to a circular economy, pollution prevention and control and protection of healthy ecosystems have been defined by a collective of experts from different fields, including but not limited to finance and academia, called "The Expert Group" (TEG). This group, supported by over 200 additional experts, proposed a list of Taxonomy-eligible activities. Activities were included based on their potential to contribute to the first two environmental objectives, Climate Change mitigation and adaptation. The Taxonomy is ever expanding, and various economic activities are yet to be assessed. To be included in the Taxonomy, an activity must meet several criteria. Firstly, an activity must substantially contribute to at least one of the six objectives. Secondly, it may not harm any of the remaining objectives. Lastly, entities engaged in the activities must meet social safeguards. Qualitative and quantitative criteria have been set for each activity to define a substantial contribution toward the formalized objectives.

The Taxonomy brings various benefits for investors interested in aligning portfolios with environmental goals or creating sustainable products. Importantly, by setting out activities that can contribute to environmental objectives, the Taxonomy can guide how investment can contribute to es-

tablished global initiatives such as the Paris Agreement and the UN's Sustainable Development Goals. Gaining a shared understanding of what activities and, more importantly, what companies are contributing towards a low-emission transition will help investors increase the credibility of their sustainable strategies. Moreover, the formalization of activities that contribute, along with strict criteria, creates a standardized system that allows investors and policymakers to "speak the same language" regarding sustainable finance, diminishing the influence of greenwashed marketing campaigns. The benefits of an established and recognized Taxonomy extend to companies as well. Understanding how to contribute to environmental objectives through the taxonomy framework gives companies a direction to move towards. Furthermore, companies pursuing taxonomy alignment will likely be able to raise external financing more efficiently, decreasing the cost of finance, much as I observe with Green debt issuance. The EU Taxonomy will also reward companies that do well by highlighting their contribution to the environmental objectives.

Along with the Taxonomy, there is new disclosure regulation for entities. The original reports published by The Expert group after the finalization of the green deal already included detailed overviews of disclosure requirements. Based on these recommendations, disclosure requirements were set out in the publication of the EU Taxonomy in June 2020 (Q3 2020). The delegated act on taxonomy disclosure regulation was published in July of the following year. The delegated act refers to article 8 of the taxonomy regulation, which states that any entity required to publish a non-financial report under article 19a or 29a of the Non-financial disclosure regulation (NFDR) must disclose how and to what extent the entity is involved in activity included in the EU Taxonomy. Both articles 19a and 29a mandate that entities with offices in the European Union with an average of 500 employees during the year must disclose a non-financial report (250 if based in Sweden or Finland and only ten if based in Greece).

Financial market participants are required to disclose on Taxonomy alignment by the end of 2021. As of January 2022, Companies are required to disclose on the first two environmental objectives, with disclosure on the remaining four objectives coming into effect at the beginning of 2023. Currently, economic activities with the potential to contribute and mitigate in seven macro sectors have been identified; ICT, Buildings, Transport, Water, Waste and Sewerage, Manufacturing, Agriculture and Forestry and Electricity, gas, steam and air conditioning. However, the scope of the Taxonomy is dynamic, and many activities are yet to be assessed and included. However, some activities will never be included due to their polluting nature. Under the disclosure regulation, companies are required to disclose the extent to which their economic activities consider and include sustainability as defined by the EU Taxonomy. Furthermore, firms must disclose the percentage of turnover aligned with Taxonomy and the share of capital expenditure (CAPEX) and operational expenditure (OPEX). Aligned

revenue or turnover gives investors a clear picture of the current position of a company vis-à-vis contributing to climate change mitigation and adaptation. At the same time, CAPEX and OPEX can is used to analyze how companies invest in becoming more aligned and improving their environmental performance.

2.5 Measures of adaptation

While the intricacies of firm-level differences make it complicated to narrow down specific adaption responses, I will utilize the cost-benefit framework on environmental disclosure described by Cormier and Magnan (1999) to drive the rationale behind expected responses. Due to standardized sustainable frameworks and mandatory disclosure, information asymmetries between managers and investors regarding the environmental impact and the commitments to improve diminish further. Even when disclosure was available, the standardization and the audit requirement of the disclosure that accompanies the EU taxonomy regulation means that investors trust the information more, reducing the adverse impact of greenwashing. Following the cost-benefit framework described, I can identify firm behaviour consistent with an adaptive response to Environmental Policy.

2.5.1 Investments to improve environmental footprint

Consistent with reducing financing costs and the Natural Resource Based (NRBV) view on creating competitive advantage, firms will want to capitalize on the opportunities enhanced green finance frameworks bring, and increase the benefits they experience from disclosure. Consequently, following the theory of firm adaptive capabilities, I expect firms that fall under the scope of the European green finance agenda and those required to disclose on EUT activities to have increased their efforts related to environmental performance. In particular, over the period leading up to January 2022, starting at the announcement date of the Green action plan. In this study, I do not looking at a firm's direct environmental impact (as reflected by the E-pillar of an ESG rating), as this is a lagging result of operational changes made earlier. Adopting large-scale strategies involving operational change and engagement with suppliers and various stakeholders takes time to implement. As such, the E pillar rating does not reflect adaptive responses made with the intent to improve environmental impact until later when the new policies take effect. Therefore, metrics are needed to examine firm behaviour that constitutes an adaptive response to improve the environmental profile of a firm.

Innovation directly is a hard-to-measure concept. A determining factor in driving change is environmental innovation. Thus, to proxy for a firm's level of innovation, I will use research and develop-

ment (R&D) expenditure. While R&D is a common proxy for firm innovation, there are limitations to this metric. Specifically, an often offered criticism of the use of R&D is that it is an input to innovation rather than the output (Johnstone & Labonne, 2007). However, for the purposes of this paper, it is more accurate to investigate changes to the input to innovation. The output to innovation is almost secondary as I am looking for changes that represent efforts to improve innovation rather than successful innovation. Therefore, for our purposes, R&D expenditure will serve adequately as a proxy for innovative adaptative efforts.

Another expenditure related adaptation response that I propose is expenditure directly related to improving existing organizational structures, processes, and infrastructure. More precisely, capital expenditure (CAPEX), operational expenditure (OPEX) and investments in Property, Plant & Equipment (PP&E). A further reason why CAPEX and OPEX are expected to change is that under the taxonomy regulation, firms must directly disclose the percentage of CAPEX and OPEX that is aligned with each environmental objective, creating even more incentive to drive change in these metrics. Firms can make specific investments into their operations to enhance their eligibility for the EU taxonomy. For example, investments made to meet critical contribution criteria for an activity as set out by the Taxonomy, such as cement manufacturers investing to lower emissions to 0,722 tCO2e per tonne of grey cement clinker to meet the criteria for contribution to Climate Change Mitigation (EC, 2020). Alternatively, to have a more significant percentage of aligned revenue, firms can divest and shift capital away from activities that do not classify for the Taxonomy in favour of those that are. Demonstrating clear commitment through expenditure is a commonly used criterion to assess a company's forward-looking alignment with environmental targets. In the Net-Zero investment guidelines published by The Institutional Investors Group on Climate Change (IIGCC), Capital Allocation Alignment is one of the critical criteria to be considered for a Net Zero transition plan (IIGCC, 2021).

In light of the various measures described above, I construct an aggregate expenditure measure, comprising of R&D, PP&T, CAPEX and OPEX to represent investments that are able to improve environmental performance. Consequently, I use this measure to represent a adaptive response to European green finance policy, representing an effort to increase environmental performance.

2.5.2 Mitigating costs of disclosure

There are costs associated with increased disclosure. Not only is it costly to track, estimate and process all the information related to disclosing the full scope of a firm's environmental impact, but there are also costs associated with stakeholder activism. Cormier and Magnan (1999) describe how the cost of stakeholders using the information on environmental metrics can drive firms not to disclose.

Therefore, in the proposed setting, I expect companies in the treatment group to preemptively adapt to the disclosure regulation and endeavour to minimize the associated costs. The costs of stakeholder activism are specifically impactful in firms with poor financial conditions due to the risk of future liabilities (Cormier & Magnan, 1999) (Goss & Roberts, 2011). As such, I expect an adaptation response in improving factors associated with an increased likelihood of financial distress. Jones and Hensher (2004) use a mixed logit model to predict financial distress using a variety of explanatory variables. Notably, they use financial metrics based on liquidity, financial structure and debt-servicing capacity.

Similarly, I will investigate adaptive responses through the change of these metrics. I utilize the Current Ratio (short-term assets over short-term liabilities) to proxy cash position. The current ratio measures a firm's ability to repay current obligations with short-term assets and thus provides a normalized proxy for a firm's liquidity. I use a leverage ratio to evaluate changes in financial structure. In particular, the Debt Ratio (total Liabilities over Total Assets) measures the amount of assets provided by debt. Lastly, I use the Debt service coverage ratio (Operating income over Total Debt Service) to proxy the ability of a firm to pay debt obligations. I expect that following the European green deal and the EU Taxonomy, the firm will mitigate the costs associated with environmental disclosure by increasing the Current Ratio and the Debt service coverage ratio while decreasing the Debt Ratio, consistent with decreasing the likelihood of financial distress.

Research question development

Under the theory of adaptation, firms under the new European regulation and initiatives measurably changed versus those that are not affected. Contrastingly, if firm inertia holds, companies make no measurable change and maintain the status quo. Given the substantial disclosure regulation lifting the veil on firms' environmental performance, the dynamic of the cost-benefit framework on disclosure has completely shifted. It is now inevitable to incur additional costs associated with the impact on perceived risk by investors and some degree of external stakeholder activism.

As such, under the theory of firm adaptation, I expect that managerial strategy may have shifted in the recent year to improve environmental performance and mitigate increased disclosure costs following regulatory framework shocks.

To determine the reaction to policy changes, I utilize a Difference-in-Difference methodology to investigate two points in time corresponding to the formalization of the European Green Deal and, subsequently, the EU Taxonomy. For the first point in time, the announcement of the Green Deal, I utilize a sample of European firms and a sample of firms from the United States of America (USA). Afterwards, I use the same subset of European firms to distinguish between firms eligible to disclose under Taxonomy regulation and those not required to do so, to investigate the impact of the EU Taxonomy regulation.

3.1 Firm response to the European Green deal

3.1.1 Hypothesis 1:

To test the prevalence of the adaptive capabilities theorem in the setting of European sustainable finance policy, I employ a difference-in-difference design to test if potential adaptive responses were a consequence of regulatory changes. To do this, I initially investigate the implementation of the European Commission's Action Plan on Sustainable finance. In this setting, I compare a European sample to an equivalent sample of firms in the USA. Accordingly, I expect that the European firm will exhibit evidence of adaptation following the implementation of the Action plan. I separate the expected adaptation measures into those improving the benefits and those reducing the costs. Consequently, hypotheses H2.1 and H2.2 are as follows.

H1.1: European firms exhibited a measurable change in aggregated adaptation expenditure vis-a-vis firms in the USA following the formal implementation of the European commission's action plan.

H1.2: European firms exhibited a measurable increase in factors representing improvement of financial positions, financial structure and debt-servicing capacity, vis-a-vis firms in the USA following the formal implementation of the European commission's action plan.

3.2 Adaptive response to the EU Taxonomy

3.2.1 Hypothesis 2:

Following the formalization of the EU Taxonomy, I investigate the adaptive response of companies required to disclose under the new regulation. As this represents a sub-group within Europe, I can do a difference-in-difference analysis within Europe to minimize external differences between the two groups. From this follows Hypothesis H2.1 and H2.2.

H2.1: European firms required to disclosure under EU Taxonomy regulation exhibited a measurable change aggregated adaptation expenditure vis-a-vis European firms not required to disclose following the publication of the EU Taxonomy regulation

H2.2: European firms required to disclosure under EU Taxonomy regulation exhibited a measurable increase in factors representing improvement of financial positions, financial structure and debt-servicing capacity, vis-a-vis European firms not required to disclose following the publication of the EU Taxonomy regulation

3.2.2 Hypothesis 3:

Additionally, to further determine the effect of the treatment on firms. I conduct a further Difference-in-Difference analysis following the date the EU taxonomy went into effect where the control group is the same sample of US firms used in Hypothesis 1, and the group receiving the treatment are European firms required to disclose. Hypothesis H3.1 and H3.2 are as follows:

H3.1: European firms required to disclosure under EU Taxonomy regulation exhibited a measurable change aggregated adaptation expenditure vis-a-vis firms in the USA following the publication of the EU Taxonomy regulation

H3.2: European firms required to disclosure under EU Taxonomy regulation exhibited a measurable increase in factors representing improvement of financial positions, financial structure and debt-servicing capacity, vis-a-vis firms in the USA following the publication of the EU Taxonomy regulation

Methodology

4.1 Quasi experimental design

In order to measure the adaptation response to the European regulation, I will utilize a natural experiment research design. Implementing quasi-experimental frameworks is commonplace in the study of public policy. The experimental design is used to assess the effects of past policies and help guide future decisions where randomized controlled trials are not possible. (Wing et al., 2018). Similarly, I will use the natural experiment-based approach to investigate the impact of the EU green finance regulation.

I will use a Difference-in-difference (DID) design to investigate the policy effect by comparing the outcomes of two different groups. The Difference-in-Difference contains two categorical variables, Treated and After. Treated takes on value 1 for the treatment group, and After is equal to 1 after the treatment comes into effect (Both are otherwise 0). The interaction term between Treated and After represents the Difference-in-Difference estimator, which measures the post-treatment change in the treatment group relative to the control group (the average change in the outcome for treated firms less the average change in the outcome for control firms).

To employ the DID estimator, I must define a treatment and control group. For a Difference-in-difference estimator to be valid, the treatment must be as-if randomly assigned conditional on an observable characteristic. It is important that the assignment of the treatment is not up to the individual, rather it must be determined on a higher level.

In our first hypothesis, I assess the impact of implementation of the European Action plan on the 24th of May 2018. The Intervention represents a policy shock affecting firms in the European Union. The control group is a sample of US firms. Firms in the United States are the most comparable group as they share numerous similarities. Manu (1992) compared innovative behavior for firms in the US and non-US markets. He finds similarities between the US and Europe which indicate that the geographical markets are not a determining component in adopting innovation types. Moreover, US firms face a comparable level of external demand for improved environmental performance from investors and regulators. In fact, in early 2022, The Securities and Exchange Commission proposed Standardized Climate-Related Disclosure requiring domestic filers to include emissions and climate-related targets in their annual statements.

For hypothesis 2, the treatment group is comprised of a sample of European firms that are required to disclose on EU Taxonomy activities. The assignment of intervention is based on firm size,

as measured by number of employees, and was decided on a national level. As The Taxonomy applies to a subset of European firms, the control group is a sample of European firms who are not required to disclose. A comparison within Europe minimizes additional unobserved variation.

In our last hypothesis (H3), the treatment group is identical as in Hypothesis 2. However, in this setting the control group is the sample of equivalent US firms utilized in the first hypothesis.

4.2 Parallel trends

A Difference-in-Difference estimator can account for both time-invariant and time-varying unobserved factors within the data. However, the estimator will not be unbiased if there are time-varying influences that affect the treatment and control group differently. A crucial assumption of the DID estimator is that of parallel trends. The assumption, also known as the constant bias assumption, states that any trend in the dependent outcome variable would continue at the same rate in the absence of the treatment. For this to hold, external factors unrelated to the treatment must affect both groups equally.

4.2.1 Treatment of the COVID-19 pandemic

At the start of 2020, the coronavirus spread worldwide, paralyzing the global economy. This period coincides with implementing the Green Deal and the EU Taxonomy. Fear, social distancing, lockdowns and monetary policy created a global environment of uncertainty and difficulties for many companies while creating opportunities for others. It is essential to discuss the impact of the pandemic on our treatment and control groups to ensure that differences following the treatment assignment did not arise due to varying responses to COVID-19.

While much of the actual impact from nearly two years in lockdown remains to be seen, studies have emerged empirically discussing the perceived impact of the pandemic. Ozili & Arun (2020) highlight the spillover effects that lockdown and social distancing had on the global economy. The authors present that mobility restrictions and social distancing policies reduced general economic activity and caused negative abnormal stock returns. As national covid restrictions are at the lawmakers' discretion, I must control for country-level differences.

A study conducted on Chinese firms shows that smaller firms (as measured by sales revenue) experienced a more negative performance decrease due to the impact of COVID-19 (Shen et al., 2020). While arguments can be made refuting the comparability of Chinese firms and western firms during the pandemic, I include total revenue as a proxy for firm size in estimating our results. Moreover,

Shen et al. highlight how the impact varies drastically between sectors.

Foss (2020) published a commentary on the impact of COVID on organizational design. There have been adaptation responses to the external shocks of restrictive lockdowns. Changes such as remote working and the increased adoption of technological platforms augmented the information asymmetries between employee and employer. In the longer term, Foss (2020) argues that significant disturbances lead to permanent changes in organizational differentiation, interdependencies, boundaries and the overall organization of work. However, Foss provides no comment on the differential effect between regions and sectors. While it is likely that the firms in our sample adaptively responded to the COVID-19 restrictions through organizational changes, I pose that this effect is equal for our treatment and control group. Thus, allowing us to investigate the additional effect of the European Green finance policies in the last two years.

While the impact of decreased economic activity and restrictive measures was more strongly felt in some countries, in this paper, I assume that, in aggregate, our treatment group (European firms) and Control (US firms) were affected similarly. In particular, I will later show that both groups contain an equal share of sectors. Thus, after controlling for specific country and firm level differences, I also assume that the treatment and control group under hypothesis 3 (EU firms required to disclose and those not required to) were similarly impacted by the pandemic. Consequently, it is valid to conduct a Difference-in-Difference study on these samples.

4.2.2 Test for parallel trends

In order to evaluate if the parallel trends assumption holds, I will first analyze the parallel trends graphically. I present relevant figures illustrating the average observed outcome variable over time for both the control and treatment groups. Non-parallel trends indicate that time prior to the treatment affected both groups differently. Therefore, I formally test for non-parallel trends by including leads of the treatment variable in the regression. By including leads of a variable that takes on a value of 1 if the firm is in the treatment group and in the time period following the treatment assignment, I can test if there are similar trends before the intervention. If the treatment leads coefficient equals zero, the trends run parallel before the treatment date.

4.3 Regression specification

In our estimation of the hypotheses, I isolate the effect of the treatment by including time-varying controls in the regression. An essential determinant of controls is that there can be no mechanisms,

and thus they may not be affected by the treatment. Expressly, I incorporate controls of firm size (proxied by Total Revenue). Organizational size are essential drivers of firm inertia (Kelly & Amburgey,1991). Consequently, I expect this control to affect the proposed adaptive responses negatively. Additionally, I include profitability as measured by Return On Equity (ROE) and Return on Assets (ROA). Firms that are more profitable and more efficient free up additional resources to make fundamental changes and investments. Thus, I expect ROA and ROE to affect the adaptive expenditure measure positively. On the contrary, there are varying relationships between profitability and financial stability measures. On the one hand, increasing profitability can improve the Current and debt servicing ratios. However, high profitability can encourage firms to increase leverage.

Furthermore, I include fixed effects to remove unobserved heterogeneity between groups. I include Year fixed effects to aggregate time effects to eliminate the setting that groups were already on different growth trajectories in the pre-treatment variable of interest and firm age effects. Investment patterns and exposure to climate risk varies by industry. Thus, to remove variation between industries I include industry fixed effects. Furthermore, in Hypothesis 2, where the setting is within Europe, I include country fixed effect to reduce heterogeneity due to location specific influences in Europe.

In all regression I will cluster the standard errors on the firm level. Clustered standard errors account for within firm heteroskedasticity and can deal with situations where observations within each group are not independently and identically distributed (Cameron & Miller, 2015). Thus, by including firm clustered standard errors I adjust for unobserved issues in the outcome variable of interest that are correlated within firms (Abadie et al. 2017).
For Hypothesis 1 I utilize regression 4.1:

$$\gamma_{it} = \beta_0 + \beta_1 Treated_{it} + \beta_2 After_{it} + \beta_3 (TreatedXAfter)_{it} + \beta_4 ROA_{it} + \beta_5 ROE + \beta_6 Revenue + Industry\ FE + Year\ FE + \epsilon_{it} \quad (4.1)$$

where γ_{it} is substituted by the proposed measures of adaptation. Treated indicates firms headquartered in the European Union and After indicates the time periods after the implementation of the European Commission's (EC's) Action Plan on Sustainable Finance (Q2 2018).

For Hypothesis 2 I use the following regression (equation 4.2):

$$\gamma_{it} = \beta_0 + \beta_1 Treated_{it} + \beta_2 After_{it} + \beta_3 (TreatedXAfter)_{it} + \beta_4 ROA_{it} + \beta_5 ROE + \beta_6 Revenue + Industry\ FE + Year\ FE + Country\ FE\epsilon_{it} \quad (4.2)$$

Lastly for Hypothesis 3 I utilize a regression similar to equation 4.1

$$\gamma_{it} = \beta_0 + \beta_1 Treated_{it} + \beta_2 After_{it} + \beta_3 (TreatedXAfter)_{it} + \beta_4 ROA_{it} + \beta_5 ROE + \beta_6 Revenue + Industry\ FE + Year\ FE + \epsilon_{it} \quad (4.3)$$

For both equation 4.2 and 4.3 $_{it}$ is substituted by the proposed measures of adaptation. Treated indicates firms Required to disclosure under the EU Taxonomy regulation and After indicates the time periods after the implementation of the Taxonomy (Q3 2020).

For hypotheses 1, 2 and 3 there is a two-sided null:
H0: $\beta_3 = 0$,meaning the interaction terms has no effect on the outcome variable.

4.4 Adaptive measures

To determine the relevance of the described adaptation measures in improving environmental performance, I examine the correlation between the investment expenditure metrics individually, the aggregated expenditure component and the Environmental pillar (E-pillar) score and Environmental Innovation (E-innovation) rating (Table A2). E-innovation is a sub-component of the total E-pillar rating. E-innovation is a forward-looking metric, accounting for investments and other efforts to improve sustainability. As the study focuses on adaptive behaviour to improve environmental performance, E-innovation captures this effort better than the total Environmental score

Furthermore, I conduct a comprehensive regression, of the proposed adaptation measures on a firm's E-pillar score and E-innovation rating including various controls for profitability and size (Table A3).

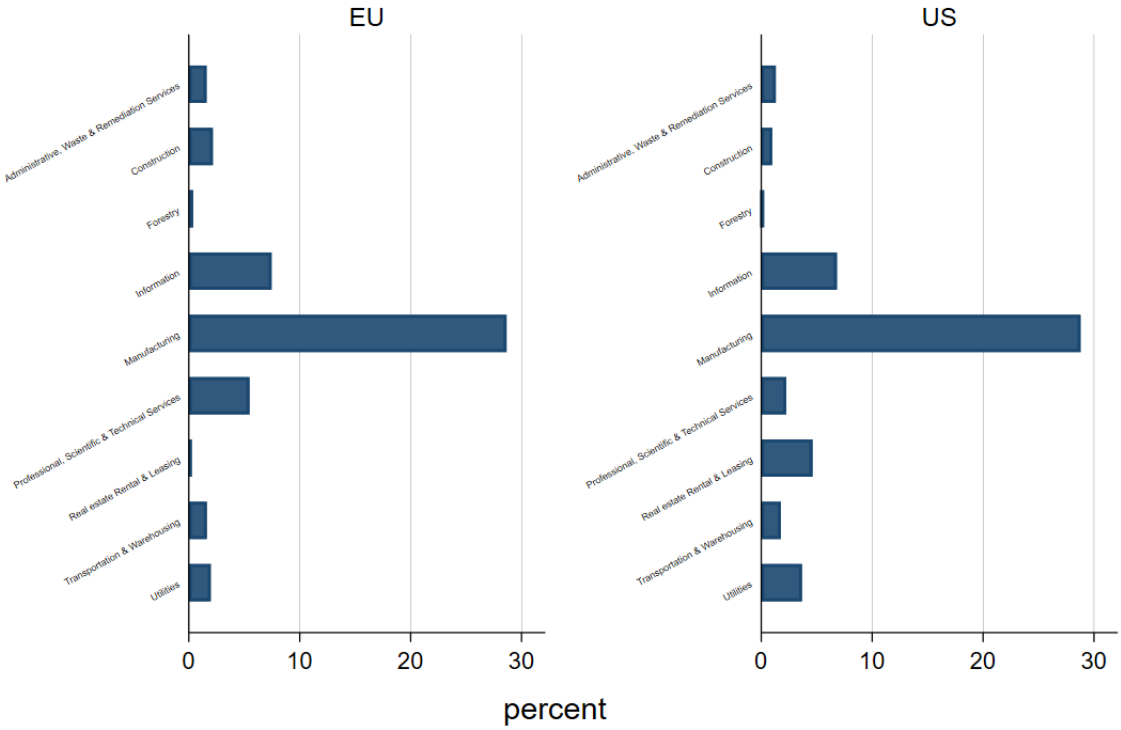
Data

To answer our hypotheses, I use a dataset comprising quarterly company-level data for a total of 8899 companies in the US and Europe starting in the fiscal year 2010 till 2021. Company financial data is collected from the SP Global Market Intelligence Data Compustat Capital IQ database. Compustat provides fundamental financial statements and market data on global and North American companies.

As described, I create a measures of aggregate investment expenditure, expected to be related to increasing the benefits of the disclosure framework. This value is created from Capital Expenditure (CAPEX), Operational expenses (OPEX), Property Plant Equipment (PP&E), as well as Research and development expenses (R&D). Total Assets is used to convert and normalize the variables to improve comparability across firms. Furthermore, to investigate cost mitigation behaviour, I established the Current Ratio, using current assets and liabilities. Additionally, to measure the financial health of a company, I use the Debt ratio (the share of Liabilities over Assets) and Interest Coverage Ratio (Net Income over interest and related expenses). To proxy for profitability, I use total revenue, assets, and Stockholders' equity to establish quarterly ROA and ROE.

In order to ensure consistency and evaluate the most relevant firms, I limit the analysis to industries which are currently defined as being able to contribute to climate change mitigation and adaptation pursuant to the EU Taxonomy. While the formal classification of these sectors did not exist prior to 2020, the selection is based on the expert recommendation and fundamental industry characteristics related to activities and environmental impact, which were well known before the publication of the EU Taxonomy. I utilize the first two digits of the North American Industry Classification System (NAICS) to define an industry. Figure 5.1 presents an overview of the share of sectors in the sample, separated by geographical region. The distribution for both regions is comparable, with Manufacturing and IT representing the largest share.

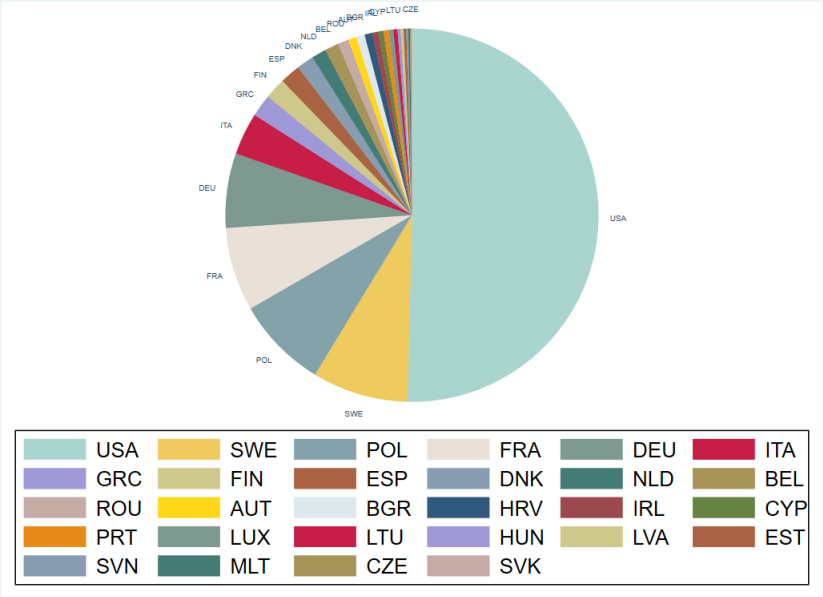
Figure 5.1. Industries by region



Note: Share of industries by region in percentages.

The EU taxonomy is an initiative by the European Commission, as such regulation only applies to members of the European Union. Thus, I drop companies from countries not headquartered in a member of the EU from the sample (excluding US firms). Figure 5.2 highlights the overall share of countries in the sample. In Particular, I see a large number of companies in Germany, France, Poland and Sweden. Moreover, about half of the sample consists of US companies.

Figure 5.2. Share of countries

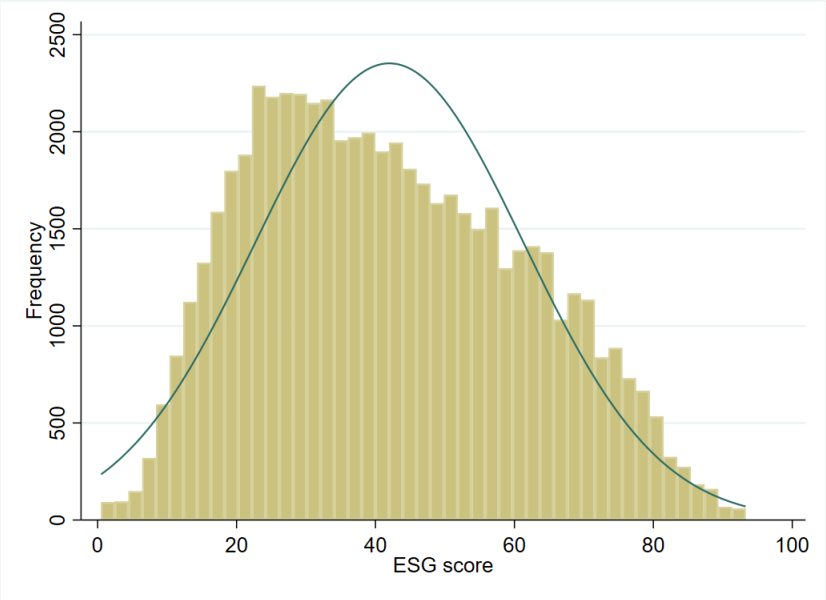


*Note:*Share of countries in the complete sample.

5.1 ESG Characteristic of the sample

Figure 5.3 shows the sample's frequency distribution of ESG ratings, fitted with a standard normal distribution. While there is a good distribution of ratings, the frequency of ESG ratings in the sample appears to be slightly skewed towards the lower end. I collect Environmental performance data from the Refinitiv ESG company scores dataset. Refinitiv, a part of the London Stock Exchange Group, is a financial infrastructure and market data provider. The ESG scores created by Refinitiv's proprietary methodology are widely used among institutional investors. The database covers over 80% of the global market capitalization and has historical data starting in 2002 (Refinitiv, 2022). The ESG scores are based on several sources, including companies' disclosure, news, and information provided by Non-Governmental Organizations (NGOs). Refinitiv utilizes its proprietary models to arrive at an ESG rating between 0 (D-), indicating an inadequate performance and disclosure on ESG topics, and 100 (A+), which denotes the ESG leaders. The relative importance of ESG issues is mapped on an industry level to account for fundamental differences in company activities and footprint. Additionally, any potential controversies on ESG material topics are taken into account.

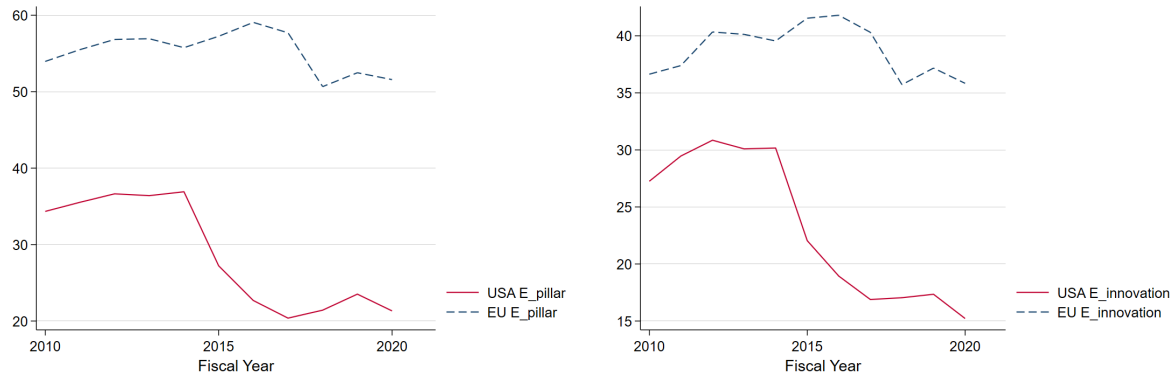
Figure 5.3. ESG score frequency distribution



Note: ESG rating distribution across the sample, fitted with a standard normal distribution

To assess the validity and the direction of aggregated investment expenditure , I focus on the environmental pillar of the ESG score. The Environmental sub-score consists of 3 categories, Emissions, Innovation and Resource use. While the materiality of individually assessed components differs by sector, the Environmental score covers emissions & waste, product innovation, water usage, energy and supply chain management issues. Besides using the E pillar score on its own, I also take the Environmental innovation score separately. E-innovation consists of topics related to product and services innovation and the percentage of "Green revenue" and green investments. Figure 5.4 shows the mean annual scores for the EU and the US. On average, the European firms perform significantly better in terms of overall Environmental pillar rating and innovation. A prominent trend in the figures is the steep decline in both measures for US firms following 2014.

Figure 5.4. Environmental Innovation and Pillar score over time.



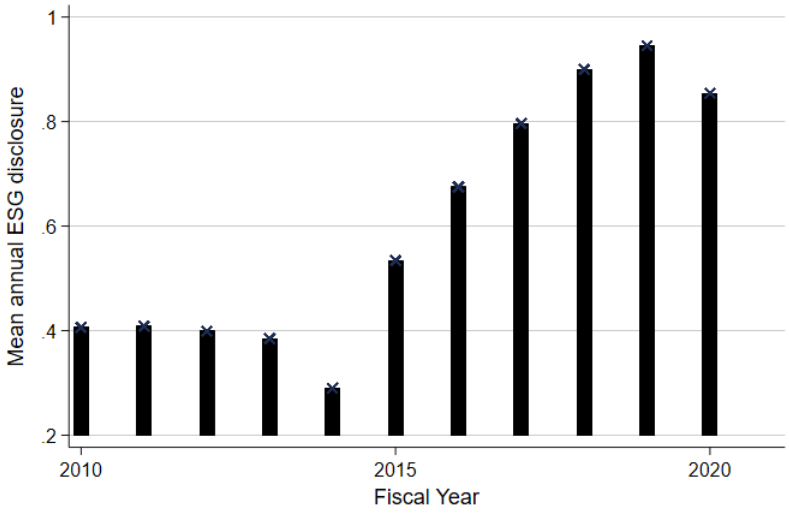
(a) E-Pillar *(b)* E-Innovation

Note: E-pillar and E-innovation over time separated by geographical region

While the exact reason for this systematic decline of the mean ratings is challenging to pinpoint, it is likely partly due to the increasingly strict scrutiny of ESG methodology. In 2015 Refinitiv ESG data debuted on Eikon, a proprietary software used in the financial industry for various functions, including monitoring and analyzing financial information. With the inclusion of ESG data into a widely used institutional platform like Eikon, there was likely an incentive to refine the methodology and ensure quality. Moreover, the decrease is also attributable to an increase in information availability. Refinitiv utilizes company disclosure and other public information to base the assessment. In more recent years, there has been an increasing focus on CSR and Sustainability, leading to an increase in data availability and external studies refining assessments. Also, ESG ratings reflect leaders and laggards; favourable European policy developments and early adoption of sustainable initiatives probably led EU firms to broaden the lead on their US counter parties.

This suspicion is further corroborated when comparing the amount of ESG disclosure available. As the ESG rating of Refintiv are based on company disclosure, an "NA" score in Refintiv indicates that there was not enough information available to establish an ESG rating. figure 5.5, describes the average number of assessed companies in the sample relative to those who received an "NA". There is indeed a sharp increase in disclosure, following 2014.

Figure 5.5. ESG disclosure



Note: Average amount of assessed ESG scores compared to companies that don't disclose (NA)

5.2 Descriptive Statistics

Table 5.1 presents the summary statistics of our data for the quarterly ratios, separated for the US and European samples. Being required to disclose on the EU Taxonomy is determined by firm size, as the number of employees determines eligibility, pursuant to the Non-Financial Disclosure regulation. Consequently, significant differences exist between our sample's top and bottom percentiles. I symmetrically winsorise the data at the 5% level to avoid extreme results due to drastic size differences. Doing so avoids the influence of significant outliers on either side. Wisorising is preferred to dropping extreme values to preserve the completeness of the sample, as the values are not incorrectly reported. The ID variable represents a unique identifier for each firm; there are 8899 firms in the sample for a total of 243804 observations in the 11-year dataset. US firm represents 49% of the whole sample. Moreover, the dataset's mean and median age of companies is 13 years, while the oldest company is 53 years old. About 30% of the whole sample (including US companies) is eligible under the EU Taxonomy regulation; this represents about 60% of European companies in the sample.

The EU and US samples are very comparable in characteristics. Due to the winsorization the samples have equalized extremes. The US firms are on average larger (in terms of revenue) than the European group. However, judging by the standard deviation there is an comparable amount of variation. Another difference that arises from table 2, is that European firms have on average a net income 15 time larger than interest and related expenses, whereas the us firms have a interest coverage ratio of 8.4 on average.

Table 5.1

Variable descriptive statistics.

Variables	Observations	Mean	Median	St.Dev	min.	max.
Full data						
ID	243804	4571.352	4728	2544.83	8899	1
USA	243804	0.49	0	0.5	1	0
eligible	237200	0.301	0	0.459	1	0
age	72850	12.996	13	9.325	53	0
USA						
W Revenue	117840	481.275	83.902	884.133	3461.564	0.005
W ROE	115915	0.405	0.258	0.467	1.801	-0.024
W ROA	115700	0.178	0.144	0.153	0.537	0.001
W CAPEX/AT	115014	0.008	0.005	0.009	0.037	0
W OPEX/AT	115582	0.208	0.161	0.166	0.602	0.022
W PP&T/AT	110939	0.222	0.125	0.237	0.75	0.002
W R&D/AT	63795	0.039	0.02	0.045	0.147	0
W Expend/AT	59050	0.404	0.345	0.236	0.921	0.108
W Current Ratio	106642	2.954	1.978	2.681	10.017	0.408
W Debt Ratio	97908	0.567	0.516	0.352	1.334	0.112
W Debt Service	91008	8.385	4.419	37.538	132.167	-73.75
EU						
W Revenue	117761	385.091	30.828	866.538	3461.564	0.005
W ROE	114436	0.556	0.43	0.485	1.801	-0.024
W ROA	112141	0.219	0.203	0.14	0.537	0.001
W CAPEX/AT	96612	0.01	0.006	0.011	0.037	0
W OPEX/AT	115410	0.211	0.186	0.14	0.602	0.022
W PP&T/AT	113866	0.228	0.162	0.214	0.75	0.002
W R&D/AT	53199	0.017	0.006	0.028	0.147	0
W Expend/AT	46852	0.438	0.416	0.202	0.921	0.108
W current ratio	117854	2.241	1.528	2.108	10.017	0.408
W debt ratio	110801	0.545	0.542	0.244	1.334	0.112
W debt service	104587	15.444	7.133	42.626	132.167	-73.75

Note: W indicates a winsorised variable at the 5% level). All absolute numbers is millions of USD.

5.3 Annual variables

To determine the effectiveness of the proposed investments to improve environmental footprint I aggregate quarterly data to match the frequency of ESG rating. Descriptive statistics of these variables are presented in Table A1. Furthermore, Table A2. describes the correlation between the annual variables and the E-pillar and E-innovation rating. Both E-pillar and E-innovation are highly correlated, at the 1% level with the proposed investment measures.

Results

6.1 Explanatory power adaptive measure

Table A.3 describes the regressions results of the adaptation responses on the E-pillar and E-innovation to determine the relevance of the proposed adaptive responses. As ESG ratings are annual, the quarterly ratios are aggregated into a yearly data point. The first five columns present the regressions with Environmental pillar rating as the dependent variable. Importantly, column V shows that an increase in the aggregated investment expenditure measure increases E-pillar. The following five columns show the regressions results on E-innovation. Again, an increase in Expenditure over Total Assets leads to an increase the innovation component of the Environmental rating.

6.2 Graphical analyses of parallel trends

Figures 6.1 through 6.8 illustrate the average (AV) outcome variable's trend over time, separated by treatment and control group fitted with a linear trend line. While the trends do not need to be linear to satisfy the parallel trends assumption, the linear fit improves the interpretation of the graphs. The graphs displays time in quarters, from 1 till 48, representing fiscal quarter 1 2010 until fiscal quarter 4 2021. For figures 6.1 to 6.4, the red line represents the treatment assignment as posed under hypothesis 1, the implementation of the European commission's Action plan on sustainable finance. In the first four figures, I illustrate the average trends over time of both European firms (Treatment) and US firms (Control). In figures 6.5 to 6.8, the treatment represents the EU Taxonomy entering into force (side a). On the b side of the figures, the treatment group represents Firms required to disclose under the EU Taxonomy, whereas the control group is European firms which are not required to do so.

6.2.1 Firm response to The Action plan

Figure 6.1 graphs the trends for investment expenditure over Total Assets (AT.) Both groups display a gradual decline in the ratio. The trends over time appear to be somewhat parallel. The fitted lines converge as the treatment time (T=34) approaches. Following the intervention, there is an apparent decline for the control group, while the treated group remains in a similar trajectory as before. This difference can be due to a relatively higher level of investment expenditure for the control group,

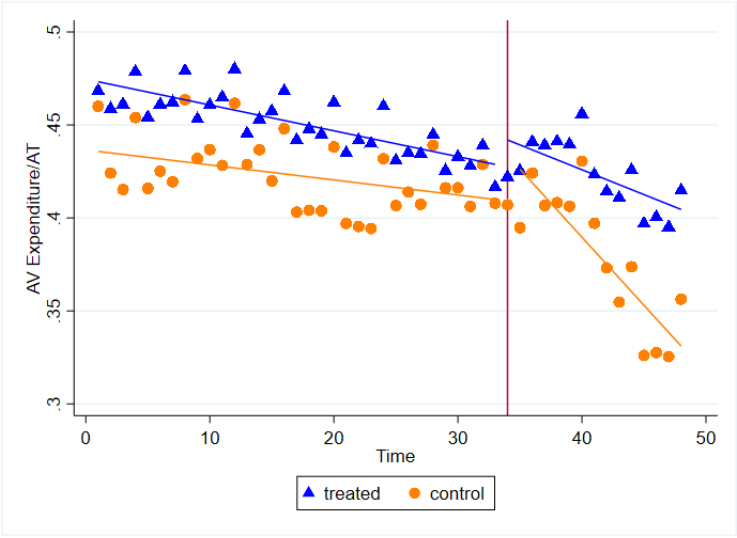
consistent with a an adaptive response.

Figure 6.2, similarly, illustrates a relative parallel trending AV Current Ratio over the period. Contrastingly, there is an increase in the ratio for both group. After the implementation of the action plan the control group increases the ratio significantly relative to the treatment group. While this result is not consistent with the notion that the treatment group should increase the current ratio to improve their financial position and incur less cost due to environmental scrutiny, it is consistent with a higher level of investment, increasing liabilities relative to the control group.

In Figure 6.3 the parallel trend assumption is clearly violated. The AV Debt Ratio in the control group is increasing drastically relative to the treatment group. Following the intervention, the treatment group remains on a similar trajectory, whereas the control group decreases the ratio back to around the starting level at T=0.

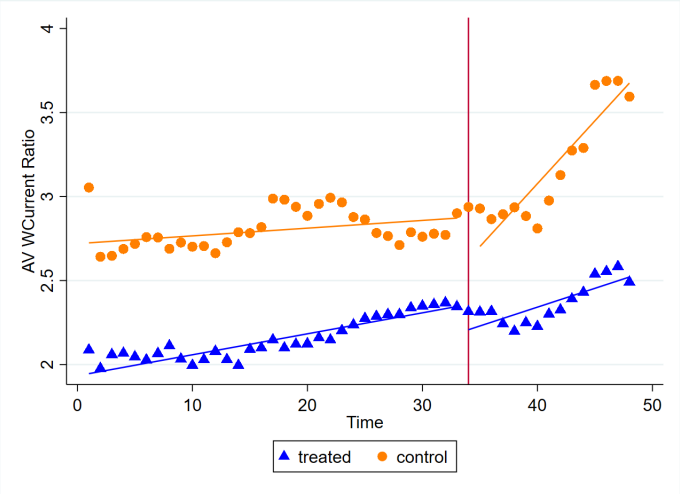
Figure 6.4 presents the AV Debt service ratio over time. In this figure, the treatment group remains constant across the period, showing a very slight increase following the implementation of the Action plan. In the control group average interest coverage decreases steadily across time.

Figure 6.1. AV Expenditure/AT over time (H1)



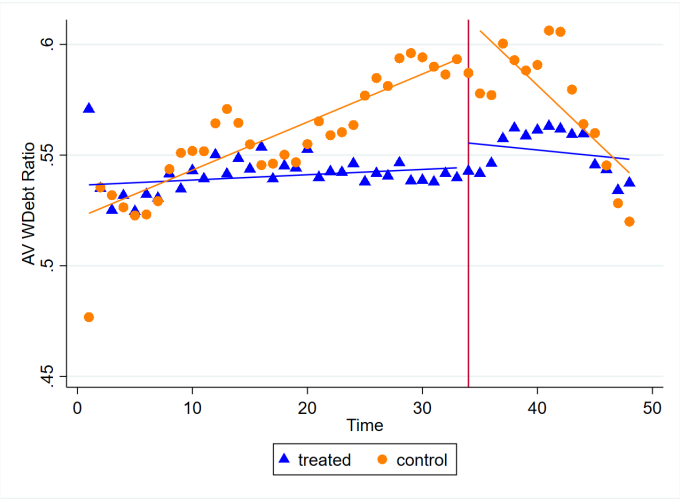
Note: Graph comparing winsorized outcome variable for treatment and control groups over time fitted with a linear line. Treated group represents European companies and Control US firms. Red line is the assignment of the treatment (Q2 2018). Time in fiscal quarters starting at Q1 2010.

Figure 6.2. AV Current Ratio over time (H1)



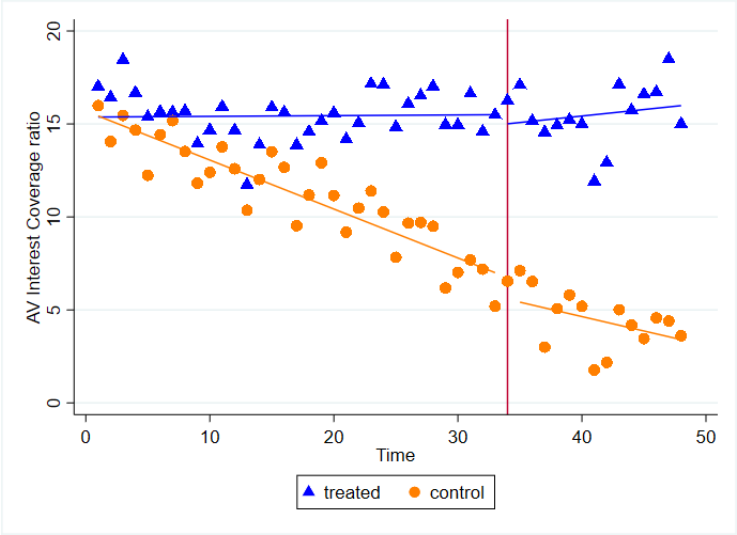
Note: Graph comparing winsorized outcome variable for treatment and control groups over time fitted with a linear line. Treated group represents European companies and Control US firms. Red line is the assignment of the treatment (Q2 2018). Time in fiscal quarters starting at Q1 2010.

Figure 6.3. AV Debt Ratio over time (H1)



Note: Graph comparing winsorized outcome variable for treatment and control groups over time fitted with a linear line. Treated group represents European companies and Control US firms. Red line is the assignment of the treatment (Q2 2018). Time in fiscal quarters starting at Q1 2010.

Figure 6.4. AV Debt service ratio over time (H1)



Note: Graph comparing winsorized outcome variable for treatment and control groups over time fitted with a linear line. Treated group represents European companies and Control US firms. Red line is the assignment of the treatment (Q2 2018). Time in fiscal quarters starting at Q1 2010.

6.2.2 Firm response to the EU Taxonomy

Figures 6.5 to 6.8 illustrate the trends of the average outcome variables consistent with hypotheses 2 & 3. The red line breaking the linear trend in two represents the implementation of the EU Taxonomy (T=43). As the Treatment group and the intervention are equal for both H2 and H3, the graphs for each outcome variable are presented together. For side (a), the control group represents firms who are not required to disclose under the EU Taxonomy regulation. On side (b) the control group is the sample of US firms used under Hypothesis 1.

Figure 6.5, presents the average Expenditure as a ratio of Total Assets (AT) across time. On Side (a) there is evidence that the parallel trend assumption is violated. The control group trends downwards much steeper than the treatment group does. Following the implementation of the EU Taxonomy, the decrease in Expenditure is even steeper, while the treatment group remains relatively stable. On side (b) the trends in AV Expenditure/AT appear to be parallel. After the intervention the treatment group presents a much slighter decrease in the ratio relative to the control group. This is consistent with the findings reported in figure 6.1 and consistent with the expected adaptive response.

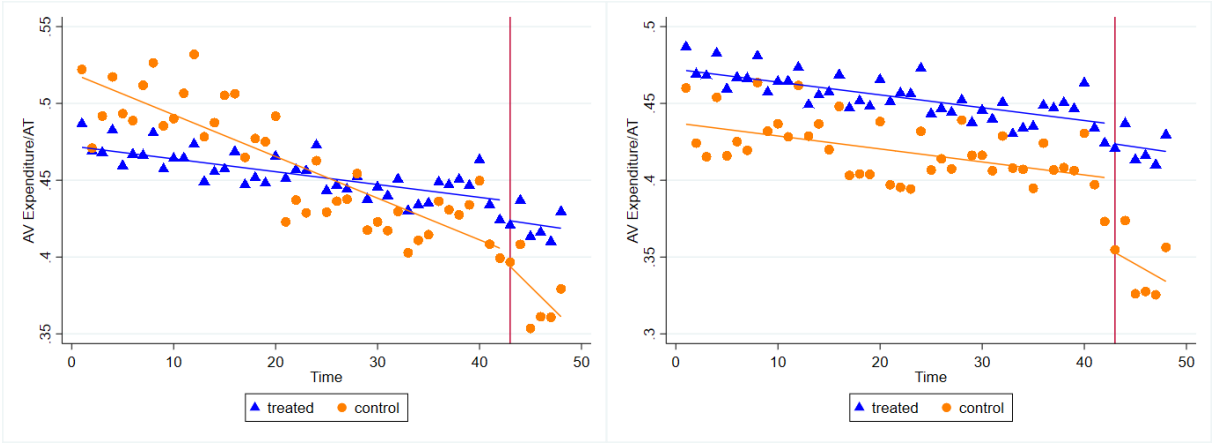
In Figure 6.6, the trends on both side (a) and (b) appear to be parallel. There is a steady increase in the AV Current Ratio for both treatment and control. After the requirements imposed by the EU Taxonomy, the treatment group remains consistent with a slightly increasing trend. Both control groups show a sudden jump upwards following the intervention. Again, these findings are consistent with those in Figure 6.2.

In the following figure (6.7), there is little evidence that the parallel trends assumption holds. Both

control groups trend upwards, while the treatment group maintains a consistent ratio until the intervention. For all groups, following the treatment there is a decrease in the leverage ratio.

Lastly, Figure 6.8 presents the AV Debt service ratio across time. On side (b) the trends deviate significantly. Thus, it appears that the parallel trend assumption does not hold in this setting. However, on side (a) the trends seem parallel. After the EU taxonomy treatment, there is a noticeable increase in the ratio for the treatment group relative to the control. This is consistent with the notion of improving financial position to mitigate costs associated with increase stakeholder scrutiny and activism.

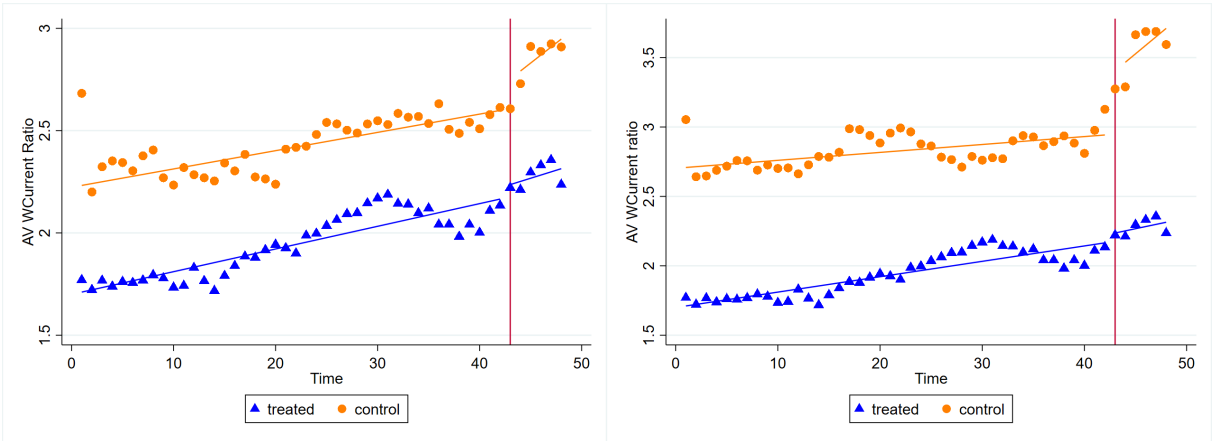
Figure 6.5. AV Expenditure/AT over time (H2&H3)



(a) H2 *(b)* H3

Note: Graph comparing winsorized outcome variable for treatment and control groups over time fitted with a linear line. Treated group represents European companies required to disclose under Taxonomy regulation. in H2 the Control is EU firms not required to disclose. In H3 the control group is US firms. Red line is the assignment of the treatment (Q2 2018). Time in fiscal quarters starting at Q1 2010.

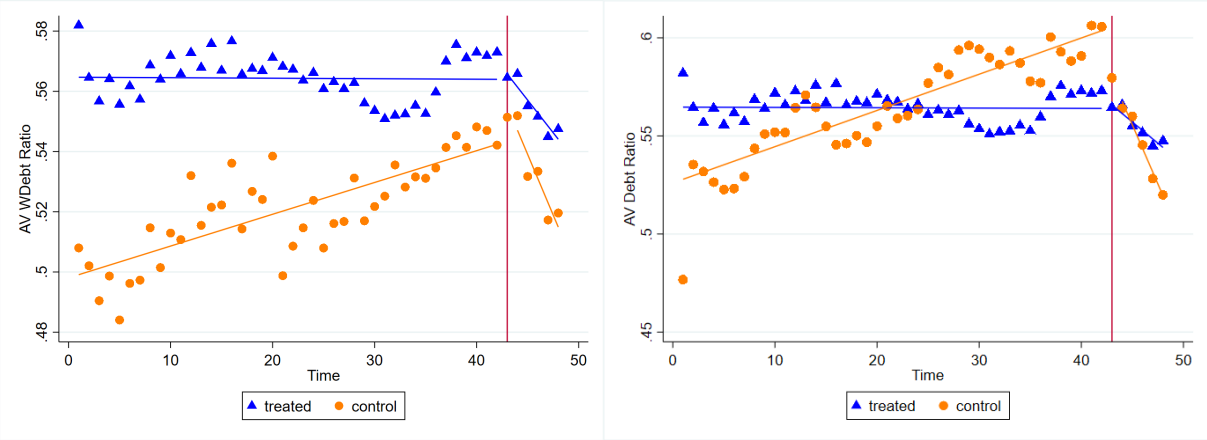
Figure 6.6. AV Current Ratio over time (H2&H3)



(a) H2 *(b)* H3

Note: Graph comparing winsorized outcome variable for treatment and control groups over time fitted with a linear line. Treated group represents European companies required to disclose under Taxonomy regulation. in H2 the Control is EU firms not required to disclose. In H3 the control group is US firms. Red line is the assignment of the treatment (Q2 2018). Time in fiscal quarters starting at Q1 2010.

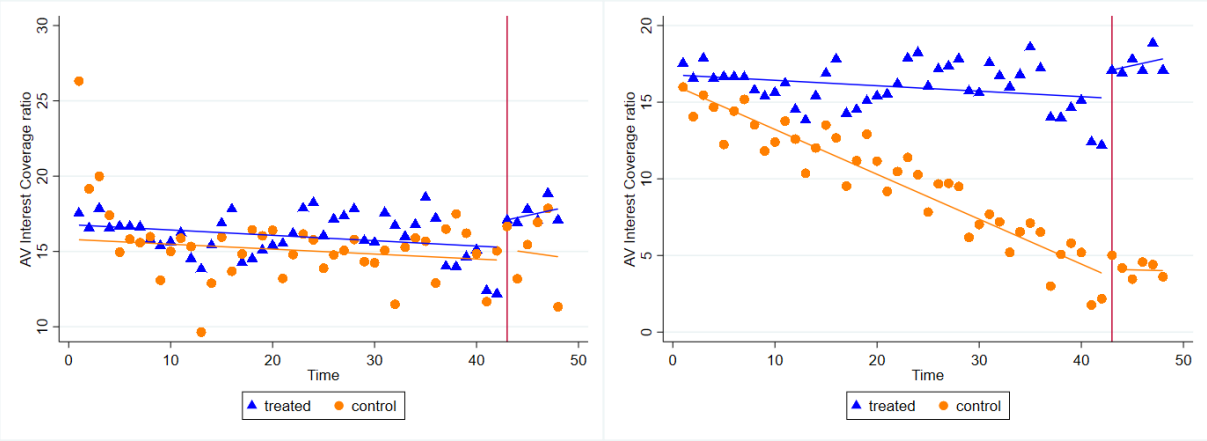
Figure 6.7. AV Debt Ratio over time (H2&H3)



(a) H2 *(b)* H3

Note: Graph comparing winsorized outcome variable for treatment and control groups over time fitted with a linear line. Treated group represents European companies required to disclose under Taxonomy regulation. in H2 the Control is EU firms not required to disclose. In H3 the control group is US firms. Red line is the assignment of the treatment (Q2 2018). Time in fiscal quarters starting at Q1 2010.

Figure 6.8. AV Debt service ratio over time (H2&H3)



(a) H2 *(b)* H3

Note: Graph comparing winsorized outcome variable for treatment and control groups over time fitted with a linear line. Treated group represents European companies required to disclose under Taxonomy regulation. in H2 the Control is EU firms not required to disclose. In H3 the control group is US firms. Red line is the assignment of the treatment (Q2 2018). Time in fiscal quarters starting at Q1 2010.

6.2.3 Leads test for parallel trends

For the parallel trends assumption to hold, the two groups cannot be differently affected by time indicators in the regression. To formally test whether the parallel trends assumption holds, I run the Difference-in-Difference regression as proposed under equations 4.1, 4.2 & 4.3, including leads of the treatment variable. Tables 6.1 to 6.3 present the results of the regressions with the addition of leads. The tables only present the coefficient of the leads in the tables along with indicators that there are control variables in the regressions. The tables present the results with and without control variables

to assess if the trends become parallel due to the inclusion of controls. To determine if the coefficient is statistically different from 0, I Asses if the 95% confidence interval. Consequently, I can assess if the coefficient is 0 with 95% certainty.

Table 6.1 report the leads coefficients of the regressions under Hypothesis 1. In column VII, the leads coefficient is negative and significant at the 10% level. The significance is removed with the inclusion of the controls. Furthermore, while no coefficients is exactly equal to zero, all confidence intervals contain zero. With the exception of Debt Ratio, including all controls brings the leads coefficient closer to zero.

In Table 6.2 the regressions are consistent with those proposed under hypothesis 2. In column I the leads coefficient on Expenditure over Assets total is significant at the 5% level and zero does not fall into the interval. However, on the inclusion of controls the coefficient loses its significance and zero now lies within the confidence interval. Column III & IV present a similar situation. Without controls, it is evident that the coefficient is statistically different that 0, whereas the inclusion of various controls and fixed effects brings zero into the 96% confidence interval. In columns V and VI even with controls there is no evidence that the treatment leads on Debt Ratio are equal to zero, violating the parallel trend assumption. The last two columns (VII & VIII) present a similar story as the first four columns. After the controls are included 0 falls in the interval, otherwise it does not.

Table 6.3 presents more determining results. The coefficient of the leads is exactly 0.000 on Expend/AT if the controls are included. However, for all other regressions, the treatment leads coefficient is significant and not equal to zero nor does zero lie in the confidence interval.

Table 6.1

Leads coefficients (H1)

	W Expend/AT		W Current Ratio		W Debt Ratio		W Debt Service Ratio	
	I	II	III	IV	V	VI	VII	VIII
Leads	0.034	-0.004	0.318	0.199	-0.033	-0.034	-4.904*	-3.482
	(0.022)	(0.123)	(0.205)	(0.175)	(0.033)	(0.032)	(2.953)	(2.760)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
[95%$ConfInterval$]	[−0.009; 0.076]	[−0.069; 0.012]	[−0.083; 0.720]	[−0.144; 0.542]	[−0.099; 0.032]	[−0.095; 0.029]	[−10.693; 0.885]	[−8.892; 1.929]

Note: Leads coefficient and 95% confidence interval of the regressions corresponding to hypothesis 1 where Treated group represents European companies and Control US firms. Controls are: ROA, ROE, Revenue and Industry and time FE. Standard error presented in brackets. Significance denoted with: *** p<0.01, ** p<0.05, * p<0.1

Table 6.2

Leads coefficients (H2).

	W Expend/AT		W Current Ratio		W Debt Ratio		W Debt Service Ratio	
	I	II	III	IV	V	VI	VII	VIII
Leads	-0.027**	-0.011	-0.252***	0.138*	-0.043***	-0.028***	-6.365***	0.94
	(0.01)	(0.01)	(0.09)	(0.07)	(0.01)	(0.01)	(1.65)	(1.48)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
[95%$ConfInterval$]	[−0.051; −0.003]	[−0.029; 0.008]	[−0.424; −0.080]	[−0.006; 0.281]	[−0.065; −0.022]	[−0.047; −0.010]	[−9.599; −3.131]	[−1.958; 3.839]

Note: Leads coefficient and 95% confidence interval of the regressions corresponding to hypothesis 2 where Treated group represents European companies required to disclose and Control EU firms not required. Controls are: ROA, ROE, Revenue and Industry, location and time FE. Standard error presented in brackets. Significance denoted with: *** p<0.01, ** p<0.05, * p<0.1

Table 6.3

Leads coefficients (H3).

	W Expend/AT		W Current Ratio		W Debt Ratio		W Debt Service Ratio	
	I	II	III	IV	V	VI	VII	VIII
Leads	-0.02	0	0.598***	0.386***	-0.050**	-0.041**	-7.956***	-6.332**
	(0.03)	(0.02)	(0.17)	(0.15)	(0.02)	(0.02)	(2.91)	(2.73)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
[95%$ConfInterval$]	[−0.070; 0.030]	[−0.039; 0.040]	[0.274; 0.922]	[0.102; 0.669]	[−0.092; −0.007]	[−0.076; −0.005]	[−13.669; −2.242]	[−11.688; −0.975]

Note: Leads coefficient and 95% confidence interval of the regressions corresponding to hypothesis 2 where Treated group represents European companies required to disclose and Control US firms. Controls are: ROA, ROE, Revenue and Industry and time FE. Standard error presented in brackets. Significance denoted with: *** p<0.01, ** p<0.05, * p<0.1

6.2.4 Regression results

In order to answer the if the European green finance policies (The Action plan & The EU Taxonomy) provoked an adaptation response in firms, tables 6.4, 6.5 and 6.6 present the results of various Difference-in-Difference regressions, consistent with the hypotheses and equations 4.1 through 4.3. Treated represents a dummy which indicates if the firm is assigned the treatment. After, indicates the time periods following the assignment of the treatment. Consequently, the interaction term between Treated and After is the Difference-In-Difference estimator. The regressions include controls for profitability (ROA & ROE), Firm size (revenue), and several fixed effects. The results are presented with and without controls.

The first table (table 6.4) illustrates the results of the regressions consistent with Hypothesis 1, where the treatments group are European firms affected by The Action plan, and the control group a sample of US firms. In column I the coefficient of the interaction term is highly significant (at the 1% level). However, in column II the significance falls away and the magnitude of the coefficient decreases. The controls for ROA and Revenue are both significant at the 1% level. The positive coefficient of the ROA coefficient on Expenditure is representative of an increase in profitability leading

to increased investments. While the Revenue coefficient is essentially zero, the negative term is consistent with the theory of firm inertia, where size is a main determinant of inert behaviour. With the inclusion of controls column II explains close to 23% of the variation in Expenditure/AT, as measured by the R-squared.

Both columns III & IV present a significant coefficient of the interaction between Treated and After. On the inclusion of controls the significance decrease from 1% to 10%. The result in Column IV can be interpreted as firms in the treatment group decreased the current ratio by 0.08 following the implementation of The Action plan. While this is not consistent with the interpretation that firms decrease the likelihood of financial distress, it is consistent with an increased level of investments, leading to more current liabilities. Current Ratio decreases with both ROA and ROE, reflecting that as profitability increases, the Ratio of short-term assets to short-term liabilities decreases. This finding is consistent with the definitions of the variables, as when ROA (Income over total assets) increases, either asset decreases or Revenue increases, leading to a decrease in Current assets over Current liabilities (Current Ratio). While the mechanics of how ROE affects Current Ratio are more convoluted, an increase in ROE could mean a decrease in Shareholders' Equity, leading to a decrease in Total Assets if liabilities do not increase to close to the difference between Assets and Liabilities plus Shareholders' equity. With the inclusion of the controls, the explained variation increased from 2.5% to 20%.

Columns V and VI present no significant relation between the Difference-in-Difference estimator and the Debt Ratio. The controls are all significant at the 1% level. The negative coefficient of ROA is consistent with the interpretation of the coefficient in column IV. The positive coefficient of ROE can be explained by a decrease in Shareholders' equity, leading to an increase in liabilities to match Total Assets. In the full specification only about 8% of the variation in Debt Ratio is explained by the regression.

Lastly, in both columns VII and VIII, the Difference-in-Difference estimator is positive and statistically significant, meaning that firms in the treatment group increased the debt service ratio following the implementation of the action plan on sustainable finance. The dynamics of the positive coefficient of ROA are due to a potential increase in Revenue relative to assets, leading to more liquidity and a better debt servicing capacity. The negative coefficient of ROE could be related to an increase in liabilities consistent with the finding in column VI. Unlike previous columns, Revenue has a noticeable effect on Debt Service ratio, consistent with the interpretation of the positive ROA coefficient.

Table 6.5 presents a similar table to the previous 1 with the inclusion of country-fixed effects. The regression results presented in the table are consistent with Hypothesis 2 and equation 4.2. The treated variable in Table 6.5 takes a value of 1 when a firm is required to disclose under the EU Taxonomy framework. The After dummy is 1 after the Taxonomy went into effect, otherwise 0.

The results presented in column I and II of the regression on Expenditure/AT are consistent with the interpretation that Taxonomy eligible firms increased investments related to an improvement in environmental performance. In both columns the coefficient are significant and positive. The controls can be interpreted equally as in the previous table. Over 40% of the variation in the outcome variable in column II is explain by the regression.

Column III presents no significance of the interaction term. However, when including controls (column IV), the estimator is significant at the 5% level. The interaction coefficient describes a negative relationship between receiving the treatment and the Current Ratio. This is consistent with the findings described in the pervious table and indicate an increase in liabilities in the treatment group relative to the control group. Similarly, the control variables illustrate the same relationship as described for column III and IV of the previous table.

Unlike Table 6.4, columns V & VI present a negative and significant coefficient of the interaction term. This results indicate that firms in the treatment group decreased the leverage ratio after the disclosure requirements of the EU Taxonomy became known. This is consisted with the predicted behaviour following the disclosure dynamics discussed previously.

The last two columns of Table 6.5 present no significant results of the Difference-in-Difference estimator on the Debt service ratio.

Table 6.6 present the results consistent with hypothesis 3. Unlike the previous results, the interaction coefficient is significant for all outcome variables. The interpretation of the findings on Expenditure/AT, Current Ratio and Debt service ratio presented in table 6.6 are comparable with those described in the previous tables. However, there is a positive effect of the estimator on Debt ratio. This result can be interpreted as EU firms required to disclose under the EU Taxonomy regulation increased leverage compared to US firms, following the intervention. The positive relationship is not consistent with the expectations that firms improve their financial position in order to incur less cost following the disclosure requirements.

Table 6.4

Regression results (H1).

	W Expend/AT		W Current Ratio		W Debt Ratio		W Debt Service Ratio	
	I	II	III	IV	V	VI	VII	VIII
Treated	0.026***	-0.015**	-0.638***	-0.645***	-0.021***	-0.045***	4.647***	4.696***
	(0.008)	(0.007)	(0.053)	(0.048)	(0.008)	(0.007)	(0.858)	(0.866)
After	-0.044***	-0.005	0.384***	0.083***	0.011**	-0.008**	-6.250***	-2.712***
	(0.004)	(0.003)	(0.037)	(0.028)	(0.005)	(0.004)	(0.579)	(0.580)
Treated*After	0.019***	0.008	-0.188***	-0.084*	0.000	-0.001	6.323***	5.057***
	(0.006)	(0.005)	(0.047)	(0.043)	(0.006)	(0.006)	(0.782)	(0.747)
WROA		0.729***		-2.151***		-0.147***		117.294***
		(0.025)		(0.167)		(0.042)		(3.916)
WROE		-0.002		-0.862***		0.161***		-12.480***
		(0.006)		(0.038)		(0.011)		(0.903)
WREV		-0.000***		0.000***		0.000***		0.004***
		(0.000)		(0.000)		(0.000)		(0.000)
Industry FE	No	Yes	No	Yes	No	Yes	No	Yes
Year FE	No	Yes	No	Yes	No	Yes	No	Yes
Constant	0.423***	0.302***	2.806***	3.924***	0.562***	0.521***	10.770***	-9.749***
	(0.006)	(0.007)	(0.043)	(0.054)	(0.006)	(0.008)	(0.642)	(0.749)
obs	105902	105324	224496	217893	208709	203829	195595	190163
R2	0.012	0.236	0.025	0.204	0.002	0.078	0.010	0.130

Note: the regressions corresponding to hypothesis 2 where Treated group represents European companies and Control US firms. After indicates time period after the assignment of the treatment (Q2 2018). W indicates a winsorized variable (at the 5% level). Standard error presented in brackets. Significance denoted by: *** p<0.01, ** p<0.05, * p<0.1.

Table 6.5

Regression results (H2).

	W Expend/AT		W Current Ratio		W Debt Ratio		W Debt Service Ratio	
	I	II	III	IV	V	VI	VII	VIII
Treated	0.000	-0.008	-0.467***	-0.424***	0.041***	0.004	0.857	7.440***
	(0.010)	(0.009)	(0.060)	(0.059)	(0.008)	(0.008)	(1.069)	(1.278)
After	-0.073***	-0.020***	0.388***	0.220***	0.012	0.004	0.169	0.958
	(0.010)	(0.007)	(0.066)	(0.053)	(0.007)	(0.006)	(1.192)	(1.145)
Treated*After	0.042***	0.017*	-0.080	-0.145**	-0.022**	-0.015*	1.393	2.080
	(0.011)	(0.009)	(0.074)	(0.068)	(0.009)	(0.008)	(1.377)	(1.287)
WROA		0.818***		-0.620***		-0.394***		145.260***
		(0.040)		(0.219)		(0.052)		(5.554)
WROE		0.014		-0.996***		0.269***		-21.571***
		(0.010)		(0.049)		(0.014)		(1.330)
WREV		0.000***		-0.000***		0.000***		0.004***
		(0.000)		(0.000)		(0.000)		(0.001)
Industry FE	No	Yes	No	Yes	No	Yes	No	Yes
Year FE	No	Yes	No	Yes	No	Yes	No	Yes
Country FE	No	Yes	No	Yes	No	Yes	No	Yes
Constant	0.452***	0.265***	2.433***	3.189***	0.523***	0.471***	15.045***	-10.378***
	(0.009)	(0.010)	(0.052)	(0.071)	(0.007)	(0.008)	(0.845)	(1.107)
obs	43358	42859	111424	105488	104825	100315	99142	95012
R2	0.007	0.430	0.016	0.173	0.006	0.271	0.001	0.167

*Note:*Regressions corresponding to hypothesis 2 where Treated group represents European companies required to disclosure under EU Taxonomy regulation and the control group are EU firms not required. After indicates time period after the assignment of the treatment (Q3 2020). W indicates a winsorized variable (at the 5% level). Standard error presented in brackets. Significance denoted by: *** p<0.01, ** p<0.05, * p<0.1.

Table 6.6

Regression results (H3).

	W Expend/AT		W Current Ratio		W Debt Ratio		W Debt Service Ratio	
	I	II	III	IV	V	VI	VII	VIII
Treated	0.034***	-0.012*	-0.872***	-0.753***	-0.006	-0.035***	6.716***	5.688***
	(0.008)	(0.007)	(0.052)	(0.045)	(0.008)	(0.007)	(0.894)	(0.894)
After	-0.073***	-0.031***	0.701***	0.333***	-0.021***	-0.031***	-4.986***	0.693***
	(0.005)	(0.003)	(0.048)	(0.029)	(0.006)	(0.004)	(0.670)	(0.516)
Treated*After	0.043***	0.030***	-0.392***	-0.281***	0.012*	0.011*	6.547***	4.334***
	(0.007)	(0.006)	(0.058)	(0.051)	(0.007)	(0.007)	(0.943)	(0.881)
WROA		0.711***		-2.791***		-0.093**		113.050***
		(0.027)		(0.185)		(0.047)		(4.475)
WROE		-0.003		-0.738***		0.134***		-11.049***
		(0.007)		(0.040)		(0.013)		(1.000)
WREV		-0.000***		-0.000***		0.000***		0.005***
		(0.000)		(0.000)		(0.000)		(0.000)
Firm FE	No	Yes	No	Yes	No	Yes	No	Yes
Year FE	No	Yes	No	Yes	No	Yes	No	Yes
Constant	0.418***	0.310***	2.839***	3.967***	0.570***	0.523***	9.185***	-10.678***
	(0.005)	(0.007)	(0.042)	(0.057)	(0.006)	(0.008)	(0.568)	(0.742)
obs	91320	90987	175375	172388	162823	160812	153351	150177
R2	0.020	0.225	0.044	0.247	0.001	0.066	0.011	0.136

Note: Regressions corresponding to hypothesis 3 where Treated group represents European companies required to disclosure under EU Taxonomy regulation and the control group are US firms. After indicates time period after the assignment of the treatment (Q3 2020). W indicates a winsorized variable (at the 5% level). Standard error presented in brackets. Significance denoted by: *** p<0.01, ** p<0.05, * p<0.1.

Conclusion

7.1 On the relevance of proposed adaptation measures

Based on the cost-benefit analysis framework on environmental disclosure proposed by Cormier and Magnan (1999), I investigate whether firm expenditure is related to an increase in a company's environmental performance. Table A.2 shows that all proposed measures are significantly correlated with both Environmental ratings. To formally test the effect of the adaptive responses on their supposed outcome (improving Environmental performance) Table A.3 present various regression results of the described components and aggregated investments. Table A.3 presents evidence that an increase in aggregated investment expenditure over Total assets is significantly related to an increase in both the E-pillar and E-innovation rating. These findings corroborate that the adaptive responses I investigate have a real effect on the environmental footprint of companies.

7.2 Firm adaptive response to The Action plan

To assess the prevalence of firm adaptation theory in the setting of European green finance policies, I conducted several Difference-in-Difference regressions on the proposed adaptive responses. I presented figures and introduced treatment leads into the regression to test if the parallel trends assumption holds. As can be seen from 6.1 the leads coefficients for each outcome variable contain 0 in the 95% confidence interval. While I cannot conclude that the trends are perfectly parallel, the leads coefficients tell us there were likely no similar trends prior to the intervention.

Table 6.4 presents the results of the Difference-in-Difference regressions pursuant to Hypothesis 1. There is not enough evidence to reject H1.1, as with the inclusion of controls, there is no significant effect of the Difference-in-Difference estimator. However, the results show that following the implementation of the Action plan, treated firm decreased Current ratio and increased Debt service ratio. An increase in debt servicing capacity is consistent with a response to the cost of additional stakeholder scrutiny on environmental performance. Consequently, I have, in part, found enough evidence to reject the null of no effect for H1.2. The contrasting direction of the coefficient on Current Ratio can be interpreted as an increased level of short term liabilities related to increased spending. However, this conclusion requires further evidence.

Based on the evidence provided above, there is evidence present that the treatment group re-

sponded to the intervention by improving financial conditions. This finding is consistent with the theory of firm adaptive capabilities.

7.3 Response to the EU Taxonomy

Hypothesis 2 sets out to answer if firms required to disclose under the EU Taxonomy, changed behaviour in a manner consistent with the dynamics of increased disclosure.

The treatment leads coefficient illustrate that there is only evidence of parallel trends on the inclusion of controls, except for the Debt Ratio where the parallel trend assumption is always violated. Consequently, the significant results found in Table 6.5 on the Debt Ratio are not valid. However, I find evidence that treated firms following the EU Taxonomy increased Expenditure over total Assets, consistent with an adaptive response representing an effort to improve environmental performance. Thus, the null of no effect in H2.1 can be rejected. Furthermore, I find a significant result for Current Ratio, denoting that treated firms reduce the ratio. This finding goes hand in hand with the positive relationship of the Expenditure ratio, as increased investments in projects can lower short term liquidity. I find no further significant results. Therefore, with the exception of Current Ratio, I fail to reject H2.2.

Table 6.6 present the results to answer hypothesis 3. Changing the control group from a European sample to a US sample resulted in a clear violated in all parallel trends, except for Expenditure/AT. Consequently, H3.2 cannot be rejected. However, the first two columns of Table 6.6 present a highly significant result of the Estimator on Expenditure. Thus, H3.1 can be rejected.

In the second Setting of European Green Fiance policy that is included in this study, I find compelling results that firms that fall under the EU Taxonomy disclosure requirements increased investment expenditure vis-a-vis companies that are not required to do so, as postulated under the adaptive capabilities theorem.

Discussion

Overall I have found evidence of valid adaptation measures, and I suggest that there has been a measurable response to the European Green finance policies. However, the explained variation measured by the R-squared is relatively low for all regressions in tables 8 and 9, indicating that the treatment was not driving the change uniquely.

While a Difference-in-Difference estimator can be used to establish causality by testing the counterfactual, I believe our results are not strong enough to substantiate direct causality. In particular, the results do not unequivocally support the parallel trend assumption. Instead, only when looking at a confidence interval can I suggest parallel trends. A matched sample where pre-treatment similarities are stronger could provide better results. Furthermore, future research can include an additional specification to improve the reliability of the results. Notably, to account for errors that are present within groups a random-effects GLS estimator can provide less biased standard errors (Donald & Lang, 2007). Additionally, the results can be tested again using bias-corrected standard errors as posed by Bell and McCaffrey (2002).

Firms might still be hesitant to commit to a particular green finance framework. While the European Green Deal and the Taxonomy are well established, there is still some debate. Only recently, in July 2022, 7 months after the starting date of the disclosure requirements, the European Commission decided to label Natural Gas and Nuclear energy as necessary transitionairy sources and as sustainable investments in the EU Taxonomy, much to the disagreement of various parties. Furthermore, besides the European policies, other countries are developing similar frameworks. Multinational organizations will soon be faced with various, potentially diverging, disclosure requirements. Thus, while the importance of improved environmental performance is evident, companies might hold off immediate changes until they have more clarity on all obligations.

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Appendix

Table A.1

Descriptive statistics annual variables

	N	Mean	Median	SD	Max	Min
W Revenue Y	64255	1588.393	146.792	3342.291	13846.26	0
W ROE Y	64255	1.721	1.24	1.758	7.204	-0.096
W ROA Y	64255	0.703	0.61	0.566	2.146	0
W CAPEX/AT Y	64255	0.03	0.021	0.031	0.148	0
W OPEX/AT Y	64255	0.753	0.632	0.58	2.407	0
W PP&T/AT Y	64255	0.788	0.45	0.861	3	0
W R&D/AT Y	64255	0.052	0	0.115	0.588	0
W Expend/AT Y	64255	0.691	0	0.927	3.684	0
W current ratio Y	64255	9.012	6.087	8.899	40.066	0
W debt ratio Y	64255	1.803	1.753	1.266	5.338	0
W debt service Y	64255	37.014	13.785	121.55	528.667	-295

Note: Descriptive statistics of annualized variables

Table A.2

Correlation annual variables and Environmental rating

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) E_pillar	1												
(2) E_innovation	0.748***	1											
(3) WREV_Y	0.630***	0.449***	1										
(4) WROE_Y	0.169***	0.143***	0.182***	1									
(5) WROA_Y	0.055***	0.078***	0.080***	0.712***	1								
(6) Wexpend_AT_Y	0.076***	0.124***	0.016***	0.045***	0.117***	1							
(7) WCAPEX_AT_Y	0.137***	0.097***	0.164***	0.116***	0.143***	0.131***	1						
(8) WOPEX_AT_Y	-0.071***	-0.013***	-0.056***	0.522***	0.777***	0.293***	0.007***	1					
(9) Wpp&T_AT_Y	0.214***	0.132***	0.174***	0.029***	-0.005***	0.017***	0.548***	-0.132***	1				
(10) WR&D_AT_Y	-0.291***	-0.216***	-0.149***	-0.214***	-0.189***	0.480***	-0.131***	0.187***	-0.232***	1			
(11) Wcurrent_ratio_Y	-0.343***	-0.233***	-0.180***	-0.252***	-0.164***	0.053***	-0.104***	-0.088***	-0.202***	0.290***	1		
(12) Wdebt_ratio_Y	0.164***	0.090***	0.114***	0.314***	0.261***	0.247***	0.015***	0.395***	0.041***	0.108***	-0.294***	1	
(13) Wdebt_service_Y	0.126***	0.085***	0.123***	0.171***	0.317***	-0.029***	0.164***	0.052***	0.094***	-0.230***	-0.065***	-0.070***	1

Note: Correlation between annual variables, Y indicates a yearly variable, W indicates a winsorised variable (at the 5% level). Significance denoted by: *** p<0.01, ** p<0.05, * p<0.1

Table A.3

Regression results of proposed adaptive responses

	E-Pillar					E-innovation				
	I	II	III	IV	V	VI	VII	VIII	IX	X
WCAPEX/AT_ Y	26.574					37.47				
	(18.801)					(24.050)				
WOPEX/AT_Y		-4.456***					-2.567			
		(1.210)					(1.584)			
WPP&T/AT_ Y			0.569					1.35		
			(0.953)					(1.261)		
WR&D/AT_ Y				-14.520***					-20.122***	
				(3.546)					(4.263)	
WExpend/AT_ Y					1.593**					3.285***
					(0.689)					(0.937)
USA	-26.356***	-25.619***	-26.372***	-25.991***	-26.025***	-16.240***	-15.896***	-16.185***	-15.737***	-15.494***
	(2.292)	(2.316)	(2.297)	(2.291)	(2.303)	(2.991)	(3.033)	(3.000)	(3.003)	(2.944)
Age	0.365***	0.359***	0.362***	0.327***	0.379***	0.325***	0.323***	0.316***	0.272	0.352***
	(0.063)	(0.061)	(0.064)	(0.065)	(0.062)	(0.072)	(0.070)	(0.075)	(0.074)	(0.071)
Wrevenue_Y	0.004***	0.004***	0.004***	0.004***	0.004***	0.003***	0.003***	0.003***	0.003***	0.003***
	-	-	-	-	-	-	-	-	-	-
Constant	36.204***	39.361***	36.810***	37.083***	36.619***	19.809***	22.365***	20.396***	21.048***	20.089***
	(4.029)	(4.088)	(4.011)	(4.059)	(4.029)	(5.726)	(5.754)	(5.656)	(5.805)	(5.728)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs	7040	7040	7040	7040	7040	7040	7040	7040	7040	7040
R2	0.506	0.509	0.505	0.508	0.507	0.306	0.306	0.306	0.311	0.312

Note: Regression results of proposed adaptive responses on Environmental pillar and Environmental innovation.Standard error presented in brackets. Significance denoted with: *** p<0.01, ** p<0.05, * p<0.1