Does Environmental Mandatory Disclosure Drive Emissions Reduction? A Comparative Study

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Abstract

Rising concerns about climate change have prompted regulatory initiatives that mandate corporate sustainability reporting, yet their effectiveness in reducing greenhouse gas (GHG) emissions is still under debate. This study investigates the impacts of France's Grenelle II Law (2010) and the UK's Greenhouse Gas Reporting Regulation (2013), using Germany as a control. Utilizing a difference-in-differences (DiD) methodology, the research assesses emissions reductions across Scopes 1, 2, and 3. The findings present mixed results. The UK's Companies Act successfully reduced Scope 1 and Scope 2 emissions, addressing direct and energy-related emissions. However, Scope 3 emissions—associated with supply chain activities—showed limited progress and signs of displacement. France's Grenelle II law achieved modest reductions, primarily in Scope 2 emissions, underscoring challenges in targeting direct emissions and supply chains. Regulatory design, compliance structures, and market dynamics had a significant impact on outcomes. The Herfindahl-Hirschman Index (HHI) indicated minimal effects of industry competition, except in less competitive markets under France's framework. Cultural and institutional differences further influenced the effectiveness of the laws. The study stresses the necessity for comprehensive policies that address all emission scopes while curbing strategic behaviors like emissions shifting. Policymakers must ensure that mandatory reporting aligns with strong accountability mechanisms to promote genuine environmental progress. These findings provide actionable insights for enhancing sustainability and achieving global climate goals.

Keywords: *Climate Change, Mandatory Sustainability Reporting, Greenhouse Gas (GHG) Emissions, Difference-in-Differences (DiD), Industry Competition, Compliance Structures, Scope Emissions, Accountability Mechanisms.*

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Sumário

As crescentes preocupações com as alterações climáticas levaram a regulamentações obrigando empresas a relatarem sua sustentabilidade. No entanto, a eficácia na redução de emissões de gases de efeito estufa (GEE) ainda é incerta. Este estudo analisa os impactos da lei Grenelle II da França (2010) e do Regulamento de Relatórios de GEE do Reino Unido (2013), utilizando a Alemanha como grupo de controlo. Com uma metodologia de Diferença nas Diferenças (DiD), a investigação avalia as emissões nos âmbitos 1, 2 e 3. Os resultados apresentam um cenário misto. O Companies Act do Reino Unido reduziu eficazmente emissões dos âmbitos 1 e 2, relacionadas a fontes diretas e energia. Contudo, as emissões de âmbito 3, associadas à cadeia de abastecimento, mostraram progressos limitados e deslocamentos. A lei Grenelle II resultou em reduções modestas, concentradas no âmbito 2, reforçando os desafios no combate a emissões diretas e da cadeia. A conceção das regulamentações, estruturas de conformidade e dinâmica de mercado tiveram papéis significativos. O Índice Herfindahl-Hirschman (HHI) revelou impacto limitado da concorrência setorial, exceto em mercados menos competitivos sob a regulação francesa. Diferenças culturais e institucionais também influenciaram os resultados. Este estudo destaca a necessidade de políticas abrangentes que abordem todos os âmbitos e restrinjam comportamentos estratégicos, como deslocamento de emissões. Políticas eficazes devem alinhar relatórios obrigatórios com mecanismos de responsabilização, promovendo avanços ambientais genuínos e sustentabilidade global.

Palavras-chave: *Mudanças Climáticas, Relatórios de Sustentabilidade, Emissões GEE, Diferença nas Diferenças, Concorrência, Conformidade, Emissões de Escopo, Responsabilidade.*

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TABLE OF CONTENT

List of Tables and Figures

List of Acronyms

CDP – Carbon Disclosure Project

CEO – Chief Executive Officer

CERES – Coalition for Environmentally Responsible Economies

CO_2 – Carbon Dioxide

COP28 – Conference of the Parties 28

CSR – Corporate Social Responsibility

CSRD – Corporate Sustainability Reporting Directive

DiD – Difference-in-Differences

ESG – Environmental, Social, and Governance

EU – European Union

GHG – Greenhouse Gas Emissions

GICS – Global Industry Classification Standards

GRI – Global Reporting Initiative

MSCI – Morgan Stanley Capital International

SEC – Securities and Exchange Commission

SDGs – Sustainable Development Goals

UK – United Kingdom

1. Introduction

Mandatory reporting of greenhouse gas (GHG) emissions is often seen as a tool to push for transparency and drive emissions reductions. The research on whether these disclosures will actually drive CO_2 reductions or move the deck chairs really has some solid evidence. While initiatives such as the Carbon Disclosure Project have moved companies to share more data, it's unclear whether this leads to real environmental progress or just better reporting strategies (Reid & Toffel, 2009). Companies have an emerging number of voluntary frameworks to orient their business actions on, like the 17 Sustainable Development Goals (SDGs) implemented in 2015 by the United Nations (UN). To be fully effective, there is a need to work on the proposed indicators for the SDGs as they only focus on the targets but lack the mechanisms on how to reach them. Furthermore, earlier research has emphasized the importance of aligning intended outcomes with specific indicators to foster a policy-driven approach grounded in scientific validity. There is a pressing need for additional research into frameworks encompassing both mandatory and voluntary aspects.

The increasing prominence of environmental, social, and governance (ESG) standards in corporate strategies has sparked debate about their effectiveness in delivering meaningful sustainability outcomes. While ESG practices are often portrayed as essential tools for addressing societal and environmental challenges, recent research highlights significant challenges in their implementation and evaluation. For instance, Serafeim et al. (2019) call attention to significant inconsistencies in ESG data quality, suggesting that existing ESG metrics often fail to accurately capture companies' true performance on sustainability, complicating efforts to hold companies accountable and meet societal goals. They also note that effectively addressing material ESG issues can improve financial performance. However, the poor quality of ESG data and inconsistent metrics undermine the ability to assess risks and opportunities reliably. This may lead to misinformed investment decisions and missed occasions for companies to improve their financial performance by effectively addressing material ESG issues, ultimately resulting in financial underperformance. Halbritter and Dorfleitner (2015) provide a critical examination of ESG investing, questioning the assumption that high ESG ratings consistently lead to positive financial returns. Their study suggests that ESG investments do not guarantee abnormal returns and that the perceived benefits of socially responsible investments may not hold universally across different ESG rating providers and time periods. Edmans (2023) contends that ESG should not be treated as a specialized concept, as it's simply one of many intangible factors stimulating long-term value. He suggests that the

focus on ESG over other value drivers is misplaced and that controversies surrounding ESG become less relevant when viewed as part of long-term value creation. Khan, Serafeim, and Yoon (2016) underline the importance of materiality in sustainability investing, showing that companies focused on material ESG issues significantly outperform their peers regarding stock returns and profitability while investing in non-material issues does not provide financial benefits. Their findings highlight that prioritizing material ESG efforts supplements shareholder value and profitability, while immaterial efforts may waste resources without meaningful results. This underscores the need for ESG metrics to incorporate materiality to provide clearer insights for investors and companies.

The voluntary nature of reporting, in turn, means that companies have a wide degree of latitude in deciding how much and what quality of sustainability information to report, and this can be done for strategic purposes: good performers would want to use high-quality disclosure so that their high achievement is communicated effectively, while as poor performers would want to use low-quality disclosure to cover up their failures and affirm legitimacy (Hummel & Schlick, 2016). There's still uncertainty about whether mandatory reporting leads to real improvements in sustainability or just reduces the visibility of greenwashing. While the goal of mandatory reporting is to prevent superficial compliance by increasing transparency, as Bowen and Aragon-Correa (2014) discuss, it sometimes ends up focusing more on ticking boxes than creating meaningful environmental or social impact, as Crilly, et al. (2012) suggest. Thus, this thesis focuses on the following research question:

RQ: What is the impact of mandatory reporting on sustainability?

While there is considerable research on the effects of disclosure on investment and economic factors (Reid & Toffel, 2009), there remains a significant gap in understanding how mandatory sustainability reporting affects greenhouse gas (GHG) emissions. This study addresses this gap by examining the effects of France's Grenelle II Law (2010), which mandates the disclosure of Scope 1 and Scope 2 emissions data, while Scope 3 emissions remain voluntary; and the UK's Companies Act (2013), which similarly requires quoted companies to report on their Scope 1 and Scope 2 emissions. Reporting Scope 3 emissions is also voluntary under this framework compared to Germany, which serves as a control group without similar mandatory reporting laws. It focuses on whether mandatory reporting reduces emissions, how firms respond strategically, and the role of competitive intensity in shaping these outcomes.

This thesis uses a difference-in-differences approach to study the impact of mandatory sustainability reporting on corporate carbon emissions (i.e. GHG emissions). The findings reveal a mixed picture: the UK's Companies Act significantly reduced Scope 1 and Scope 2 emissions, effectively addressing direct and energy-related emissions. However, Scope 3 emissions, encompassing supply chain activities, showed no meaningful reductions and, in some cases, evidence of a strategic shift to this scope of emissions as this type of emission is still the most difficult to measure. In contrast, France's Grenelle II law demonstrated modest success, with reductions confined to Scope 2 emissions, highlighting persistent challenges in comprehensively addressing direct and supply chain emissions.

This study has both practical and academic implications. For managers, it provides insights into navigating stricter regulations such as the EU's Corporate Sustainability Reporting Directive (CSRD), which emphasizes the need to align with transparent sustainability goals. Policymakers can refine reporting frameworks to reduce strategic misreporting and ensure environmental impact. Academically, the research contributes to understanding how regulatory pressures influence corporate environmental performance across jurisdictions. It fills a critical gap by providing a comparative analysis of the impact of mandatory reporting on emissions and corporate strategy and provides causal insights for future regulatory developments.

The thesis will proceed as follows. Chapter 2 reviews the relevant literature, focusing on the impact of mandatory reporting on CO_2 emissions, stakeholder pressure, and the role of competition in ESG disclosure. Chapter 3 describes the methodology, including the research design, sample characteristics, independent and dependent variables, and control variables. Chapter 4 presents the data analysis and results, starting with descriptive statistics and correlation analysis, followed by findings on France's Grenelle II Law and the UK's Companies Act, along with robustness checks and trend testing. Chapter 5 discusses the broader implications of the findings, emphasizing practical and theoretical contributions, limitations, and directions for future research. The discussion underscores the need for comprehensive policies and verification mechanisms to prevent emissions displacement and ensure meaningful reductions. The thesis concludes with actionable recommendations for policymakers and managers navigating frameworks like the EU's Corporate Sustainability Reporting Directive (CSRD) while contributing to the academic discourse on sustainability reporting. In Chapter 6, the references used will be displayed.

2. Literature Review

Regulatory interventions, such as mandatory sustainability reporting, represent a critical mechanism for influencing corporate behavior, particularly in areas where voluntary adoption of environmental and social responsibility practices might be limited. Drawing on stakeholder and population ecology theories, this section explores how such interventions act as both ethical imperatives and adaptive pressures, reshaping the relationship between companies and their stakeholders.

Stakeholder theory provides a basic framework for understanding the rationale behind mandatory reporting requirements. This theory emphasizes that companies have a responsibility to create value for all stakeholders, including employees, customers, suppliers, communities, and investors (Freeman & McVea, 1984). Based on this principle, regulatory policies require companies to disclose their environmental and social impacts. These policies aim to increase transparency, address stakeholder concerns, and refocus corporate priorities on sustainable, long-term value creation. Mandatory reporting reflects societal demands for greater accountability and ethical corporate behavior (Berman et al., 1999). It goes beyond mere transparency to administer basic responsibility standards, ensuring that companies integrate environmental and social ruminations into their decision-making processes. For example, France's Grenelle II Law requires large companies to report on a range of sustainability metrics, while the UK's 2013 Companies Act requires listed companies to disclose greenhouse gas emissions. Such measures act as external levers that push companies to consider stakeholder interests, particularly in industries where voluntary sustainability efforts may be weak. This is consistent with Bansal and Roth's (2000) findings on ecological responsiveness, which identified competitiveness, legitimacy, and ethical motives as key motivators for firms to adopt sustainable practices. According to their model, mandatory disclosure laws address legitimacy and environmental responsibility by requiring firms to conform to societal expectations and institutional norms. They force firms to act, creating a level playing field for sustainability practices and effectuating stakeholder theory's emphasis on balancing diverse stakeholder interests (Bansal & Roth, 2000). In this context, mandatory reporting becomes more than a transparency tool - it changes the competitive landscape by rewarding firms that proactively address sustainability challenges and marginalizing those that fail to adapt.

While stakeholder theory highlights the ethical and relational dimensions of disclosure requirements, population ecology theory offers a complementary lens that emphasizes the

adaptive pressures imposed by regulatory interventions. Rooted in the work of Hannan and Freeman (1977) this theory frames organizations as entities within a broader ecosystem whose survival depends on their ability to respond to environmental pressures and resource constraints. Mandatory sustainability reporting exemplifies such pressures by forcing compliance and adaptation. Under the Grenelle II Law and amendments to the UK Companies Act, companies must actively reduce emissions and address social impacts to meet regulatory standards. From a population ecology perspective, these interventions act as selective pressures, forcing firms to adapt or risk losing legitimacy, market share, or even viability. This adaptation is not simply a compliance activity but a strategic response to changing market dynamics and societal expectations.

By integrating stakeholder theory and population ecology theory, this study provides a comprehensive perception of how mandatory sustainability reporting influences corporate behavior. Stakeholder theory frames these measures as ethical imperatives that ensure companies address the concerns of diverse stakeholders and contribute to societal well-being. Population ecology theory, on the other hand, emphasizes their role as adaptive pressures, driving survival and competitiveness in increasingly sustainability-oriented markets. Together, these perspectives underscore the dual role of mandatory reporting as both an accountability mechanism and a driver of organizational change. Legislation such as the Grenelle II Law and the amendments to the UK Companies Act not only increase transparency but also catalyze meaningful change in corporate practices. These regulatory measures compel companies to act in line with societal and environmental priorities, ensuring long-term value creation for stakeholders and fostering resilience in a rapidly evolving business environment.

2.1. The Impact of Mandatory Reporting on CO_2 Emissions

Transparency and accountability, fulfilled through sustainability reporting, improve reputation, attract long-term investors, and create opportunities for competitive differentiation. This increased transparency holds companies accountable while providing stakeholders – such as investors, regulators, and consumers – with valuable insights into companies' sustainability performance (Ioannou & Serafeim, 2017). Increased scrutiny of ESG ratings reflects heightened concerns about climate change, as global warming and environmental degradation underscore the urgent need for corporate accountability. Integrating environmental responsibility into corporate strategy has led to competitive advantage and improved performance, as shown by Eccles, Ioannou, and Serafeim (2012) who highlighted that companies that adopt sustainability

practices achieve better financial and operational outcomes due to robust governance structures, long-term stakeholder engagement, and transparent disclosure of non-financial information. Similarly, Huisingh et al. (2015) draw attention to the role of regulatory interventions in standardizing practices and promoting low-carbon systems, enabling firms to adapt to evolving environmental challenges.

In line with the goals of the Paris Agreement, initiatives like the Carbon Disclosure Project (CDP) promote corporate transparency by gathering data on emissions, water usage, and deforestation. The CDP empowers stakeholders to make informed decisions and encourages companies to adopt sustainable practices that mitigate risk and contribute to climate action, the circular economy, and net zero goals (Depoers et al., 2016). Similarly, Climate Action 100+ urges companies to meet accountability benchmarks and align their strategies with global climate goals (Climate Action 100, 2024). The movement for uniform reporting frameworks began with the launch of the Global Reporting Initiative (GRI) in 1997 by CERES and the United Nations Environment Programme (UNEP). The GRI established essential guidelines for reporting on the 'triple bottom line' of economic, environmental, and social performance (Ioannou & Serafeim, 2017). However, mandatory reporting declined until the emergence of the UN SDG framework in 2015, when voluntary reporting aligned with specific SDGs gained momentum (Global Reporting Institute (GRI), 2023) and provided a useful framework through which companies began to select SDG targets, providing clearer guidance for their sustainability disclosures. Despite this progress, significant challenges remain. Companies struggle to define sustainability and establish consistent benchmarks, which complicates efforts to effectively measure and report progress. Moreover, as highlighted by Diaz-Sarachaga et al. (2018), the SDG Index itself faces limitations, including the omission of 60% of defined SDG indicators due to the unavailability of data, raising concerns about its adequacy as a comprehensive framework. These challenges highlight the need for better data collection, tailored regional indices, and a more balanced representation of sustainability dimensions to ensure accurate and meaningful sustainability reporting (Diaz-Sarachaga et al., 2018). Tracking sustainability impacts across complex value chains, particularly upstream supplier networks, adds further complexity. Grewal and Serafeim (2020) argue that addressing these challenges is essential to ensure that reporting delivers meaningful, actionable results. As Wasara and Ganda (2019) suggest, assessing long-term sustainability has become critical as stakeholders increasingly prioritize impacts beyond financial performance.

Mandatory reporting influences companies' approach toward sustainability by providing a standardized tool to assess the company's sustainability track; it can move sustainability from being seen as a mere compliance cost to a critical driver of business success. Moreover, Porter, Serafeim, and Kramer (2019) point to a major flaw in traditional ESG practices: they often treat social and environmental goals as separate from a company's core business strategy. To address this, they propose a 'shared value' approach that weaves these priorities directly into the fabric of a company's operations, making them a source of competitive advantage.

Prior literature highlights the multiple impacts of mandatory sustainability reporting, noting that firms shift their corporate behavior when under external pressure. Empirical evidence on the impact of mandatory sustainability reporting highlights the benefits of such mandates, showing their effectiveness in enhancing transparency and aligning corporate practices with stakeholder interests and expectations. A study from Taliento et al. (2019) highlights that the European Union's Directive 2014/95/EU has significantly improved the transparency of non-financial information, especially for larger companies. Their findings suggest that the 'extra-ESG advantage' (i.e., where companies exceed industry standards in environmental, social and governance (ESG) performance) acts as a source of competitive advantage, positively influencing financial results and stakeholder perceptions (Taliento et al., 2019). Similarly, Aerts et al. (2018) investigated the role of environmental disclosure in reducing information asymmetry, noting that more accurate environmental reporting leads to improved analyst forecasts and stakeholder confidence. However, the study also finds regional differences, with stricter enforcement in Europe amplifying these effects compared to North America (Aerts et al., 2008). Another study finds similar results. Alsayegh et al. (2020) highlight that thorough ESG reporting plays a key role in promoting corporate sustainability by increasing transparency and building trust with stakeholders, which results in increased operations efficiency. Their findings show that effective ESG practices enhance environmental and social outcomes and positively impact a company's financial performance (Alsayegh et al., 2020).

In contexts without explicit mandatory reporting, such as the U.S. in 2008 before recent SEC proposals, formal requirements have led to inconsistent corporate responses to sustainability pressures. Delmas and Toffel (2008) found that, without a unified mandate, internal departments respond variably to these pressures. Legal departments focus on compliance, framing environmental practices to mitigate legal risks and fulfill regulatory and community expectations. In contrast, marketing departments often view beyond-compliance efforts as

opportunities to increase, create value, and gain a competitive edge. This fragmentation highlights the unifying role that mandatory reporting could play. Formalized reporting requirements standardize corporate responses across departments, making environmental management a common objective rather than a collection of separate departmental strategies (Delmas & Toffel, 2008).

Mandatory reporting by companies plays a key role in guiding business decisions. Stakeholder pressure brings about rapid changes in corporate thinking and action. Findings from several key studies shed light on the interplay of stakeholder pressure, regulatory frameworks, and organizational responses and provide a solid foundation for understanding how mandatory reporting influences corporate behavior (Eccles et al., 2012). Building on stakeholder theory, sustainability reporting is an important mechanism through which companies can communicate their social and environmental impacts to a wide range of stakeholders. This mandated transparency not only enriches accountability but also leads to higher scrutiny from stakeholders, which can drive companies to take concrete actions to reduce emissions**.** Bansal and Roth (2000) present a comprehensive model for understanding corporate environmental responsiveness, identifying three primary motivations that drive companies to address environmental issues: competitiveness, legitimacy, and environmental responsibility. Legitimation emerges as a key driver as companies seek to align their practices with societal norms, regulatory expectations, and stakeholder values in order to maintain their license to operate. This alignment strengthens the link between transparency and environmental improvement: as companies disclose their impacts, they are pressured to adopt meaningful practices, such as reducing carbon emissions, to maintain social acceptability. Competitiveness also plays an important role, as companies use environmental initiatives to improve profitability, differentiate their offerings or drive innovation. Finally, environmental responsibility reflects ethical considerations, with companies engaging in sustainability efforts out of a sense of obligation or moral commitment. This nuanced model highlights how different motivations interact with contextual factors to shape corporate sustainability behavior (Bansal & Roth, 2000).

Stakeholder theory, as proposed by Freeman (1984), highlights how formalized reporting integrates stakeholder expectations into corporate strategies, promotes compliance, and drives the adoption of sustainable practices. Henriques and Sharma (2005) further demonstrate that stakeholder influence works through direct mechanisms, such as regulatory frameworks, and

indirect channels, such as activism and societal pressure, to increase corporate accountability. Mandatory reporting harnesses these dynamics by institutionalizing proactive stakeholder engagement (Buysse & Verbeke, 2003) thereby promoting transparency, trust, and legitimacy. For example, Reid and Toffel (2009) show that firms that are subject to shareholder or activist resolutions are more likely to adopt disclosure practices, ensuring consistent stakeholder pressure across industries. Fernandez-Feijoo et al. (2014) reinforce this argument, showing that stakeholder pressure improves the quality and clarity of sustainability disclosures, particularly for larger or publicly traded firms.

Taken together, these findings underline the relevance of stakeholder theory in framing the implementation and effectiveness of mandatory reporting laws. By requiring transparency, these laws not only provide stakeholders with the information they need to evaluate corporate performance but also create external pressures that drive firms to take meaningful actions, such as reducing CO_2 emissions. Thus, I argue that:

H1: Mandatory sustainability reporting is associated with future reductions in CO_2 emissions.

2.2. Effect of Competition on ESG Disclosure

Population ecologists suggest that organizations are not only influenced by internal decisions but also affected by external environmental forces, similar to species in nature. Following this theory, organizations must evolve and adapt to these forces to ensure survival within their respective populations. External pressures, such as regulatory changes, significantly impact organizations' ability to thrive or face decline by altering their structures, practices, and strategies to meet new environmental demands, such as investing in renewable energy sources, adopting innovative technologies, or restructuring supply chains to align with sustainability goals. The COP28 conference, held in November 2023 and all subsequent, provides an illustrative example. In a joint statement, CEOs from around the globe, including influential members of the Business Roundtable and the European Round Table for Industry, have emphasized the importance of technology and clean energy in reducing greenhouse gas (GHG) emissions. Their advocacy for frameworks like the CSRD reflects a global trend towards the standardization of sustainability reporting, to promote accountability and transparency (Business Roundtable, 2023).

As societal expectations of corporate responsibility increase, a debate is emerging about the financial implications of sustainability, in particular, whether it is financially advantageous to

adopt environmentally friendly practices. On the one hand, sustainable practices can offer competitive advantages by strengthening reputation, improving stakeholder relations, and reducing regulatory risks. On the other hand, regulations - especially those targeting CO_2 emissions - can impose significant compliance and operating costs. Chatterji and Toffel (2010) show that poor environmental ratings can spur companies to improve their sustainability performance in order to mitigate reputational damage and financial risks. Their findings highlight that while sustainability practices may initially be seen as burdensome, they also create opportunities for firms to differentiate themselves, align with stakeholder expectations, and achieve long-term financial benefits through improved efficiency and stakeholder trust (Chatterji & Toffel, 2010). For example, the U.S. Clean Air Act has encountered resistance from industries concerned about compliance costs (Kim et al., 2014). Nevertheless, expanding environmental, social, and governance (ESG) considerations as pivotal organizational imperatives indicates that organizations that neglect these domains may face reputational and survival risks. ESG engagement is frequently characterized as offering a form of "insurance-like" protection, thereby safeguarding competitiveness and financial health in the context of evolving regulatory landscapes (Gangi et al., 2020).

A study conducted by Martins (2022) provides evidence of a causal relationship between competition and ESG practices in emerging markets. The study shows that increased competition has a negative impact on ESG activities in these regions. For example, following a significant competitive shock in Brazil in 2015, companies reduced their ESG initiatives and prioritized cost-cutting measures to remain competitive. This finding contrasts with developed markets, where competition often leads to increased ESG investment. The study highlights the role of institutional and market maturity in shaping the relationship between competition and sustainability, highlighting that weaker regulatory environments and limited stakeholder pressure in emerging markets may hinder companies' ESG efforts (Martins, 2022).

Katsamakas and Sanchez-Cartas (2023) use a computational model to examine how ESG investments influence competitive dynamics. The model shows that ESG investments increase competition by increasing product value or reducing costs, benefiting consumers through lower prices and higher quality. The study highlights a paradox: while individual companies can benefit from ESG as a rivalrous strategy, widespread adoption can undermine overall profitability through increased competition. ESG investments can also lead to a “winner-takes-it-all” dynamic. Companies that are strategic leaders in ESG practices often dominate markets,

while those who fall behind can be pressured out. In addition, a strategic signal or weakening of competition through disclosure of ESG practices can curb profit losses (Katsamakas & Sanchez-Cartas, 2023). Another study by Ioannou and Serafeim (2021) found that companies can maintain their competitive advantage through sustainability-focused differentiation, even in the face of significant imitation threats from competitors. The analysis identifies two key factors that influence convergence rates across industries: the relative importance of environmental and social issues compared to governance, and the nature and strength of stakeholder feedback. The study also highlights that initiatives launched in a stable regulatory environment are more likely to be imitated, while novel and innovative approaches are less likely to be copied. In addition, unique sustainability strategies have a strong positive impact on performance metrics compared to commonly imitated practices (Ioannou & Serafeim, 2021).

Population ecology theory provides a compelling framework for understanding how organizations compete for scarce resources such as capital, customers, and regulatory compliance. Hannan and Freeman (1977) emphasize that organizations must adapt to external pressures, such as mandatory sustainability reporting, to ensure survival or risk being 'selected out' of the market. This perspective highlights how external pressures shape organizational behavior and determine survival or exit. Its framework is based on three key concepts. Variation refers to the diversity of organizations within a population resulting from differences in structures, strategies, and practices. Selection describes the process by which external pressures - such as resource constraints, competition, and regulatory requirements - determine which organizations survive. This mirrors natural selection, with adaptive organizations more likely to persist. Finally, persistence focuses on how successful organizations institutionalize adaptive practices, creating stability and resilience. By embedding these strategies, organizations ensure their long-term survival and competitiveness (Hannan & Freeman, 1977).

In contrast, resource dependence theory, as formalized by Pfeffer and Salancik (2015), shifts the focus to the agency of organizations in actively managing their environments. Whereas population ecology emphasizes the deterministic role of external pressures, resource dependence theory highlights how organizations strategically navigate interdependencies to secure critical resources. This perspective suggests that organizations can buffer environmental pressures and exert influence over their environments to maintain legitimacy and survival (Pfeffer & Salancik, 2015). Aldrich and Pfeffer (1976) further explore this dynamic, arguing that environments shape organizations not only by imposing constraints but also by providing

opportunities for strategic adaptation. Their work highlights how organizations respond to societal expectations and stakeholder demands for access to resources, emphasizing the importance of proactive management over passive adaptation. Together, these theories provide complementary lenses for understanding how organizations respond to external pressures - balancing environmental determinism with organizational agency.

Meyer (1970) extends this discussion by pointing out how institutional environments influence organizational structures. His findings emphasize that external norms and expectations, such as those imposed by regulatory frameworks, can shape internal organizational decisions and drive structural isomorphism within industries. This is consistent with the broader argument that mandatory sustainability reporting frameworks, such as the Corporate Sustainability Reporting Directive (CSRD), can act as a selective force, distinguishing adaptive organizations from less responsive counterparts.

The concept of 'strategic self-regulation' explains why firms may adopt ESG practices that go beyond mere compliance. Companies might proactively reduce emissions and implement sustainable initiatives to pre-empt regulations and build stakeholder trust. Research shows that the threat of regulation and rising activism drives companies to limit toxic emissions, highlighting how regulatory pressures shape corporate behavior (Peyton et al., 1998). Nevertheless, these actions are not always driven by an unwavering dedication to sustainability. Some organizations may resort to "greenwashing" in order to project an environmentally conscious image without implementing tangible changes. The population ecology theory offers an explanation for this phenomenon by proposing that organizations that engage in transparency and genuine adaptation are better positioned for survival.

Moreover, the implementation of mandatory sustainability reporting can give rise to complexities that may result in a range of outcomes for organizations. The impact of sustainability reporting is contingent upon a number of factors, including industry competitiveness, firm size, and the degree of regulatory enforcement (Meurer et al., 2020). In a further study, Christensen et al. (2021) examined the economic impact of mandatory sustainability and corporate social responsibility (CSR) reporting for US firms. They found that mandatory sustainability reporting generally increases transparency and stakeholder trust. Investors responded positively to improved disclosure, often rewarding companies with higher market valuations. However, the benefits varied: firms with rigorous, materiality-focused disclosures benefited more from stakeholder trust and market confidence, while firms with

weaker reporting benefited less. Although mandatory reporting increased compliance costs, particularly for smaller companies, these were typically outweighed by long-term benefits such as improved access to capital. The study also highlighted the critical role of enforcement - firms in jurisdictions with stricter oversight produced higher-quality reports and reaped greater benefits. However, challenges such as superficial compliance (e.g. greenwashing) underline the need for strong regulatory frameworks to ensure meaningful outcomes (Christensen et al., 2021). Organizations that are able to adapt to the inherent variation, selection, retention and competition of their environments (Aldrich & Pfeffer, 1976; McKelvey, 1978) are better positioned to survive. This notion is echoed in the sustainability paradigm.

In competitive markets, organizations may be more responsive to external pressures such as mandatory sustainability reporting, which drives them towards sustainability practices with the objective of enhancing their legitimacy, differentiation, and survival. Nevertheless, further research is required to elucidate the precise impact of mandatory reporting in these high-competition sectors, particularly with regard to CO_2 emissions. In light of the above, the present study seeks to examine the following hypothesis:

H2: The effect of mandatory reporting on CO_2 emissions is amplified for industries with high competition.

3. Methodology

3.1. Sample

This study analyzes the Trucost Europe dataset, matched with Compustat, to assess the impact of mandatory sustainability reporting on corporate carbon emissions. The dataset covers the period from 2005[1] to 2020 and includes publicly traded companies monitored annually by Trucost, representing approximately 80% of global market capitalization. Trucost's data, widely recognized for its reliability and validated by other prominent sources (e.g., CDP, MSCI), provides detailed information on environmental impacts, including Scope 1 (direct emissions), Scope 2 (indirect emissions from energy), and Scope 3 (indirect emissions through supply chains) (Azar et al., 2021). Complementing this, financial data from Compustat—including share prices, balance sheets, and income statements—has been matched with Trucost emissions

[1] It is uncommon for carbon emission data to be made available before 2005. In 2006, the Carbon Disclosure Project (CDP) initiated the inaugural climate change survey, thereby facilitating the uniform disclosure of emission data by companies.

data. The merged dataset comprises 21,730 observations across multiple European industries, allowing for a comprehensive analysis of emissions trends and their relationship with financial metrics. Industries are categorized using the Global Industry Classification Standard (GICS). This study's datasets have been filtered to focus on companies in France, the UK, and Germany. The filtered France-Germany dataset includes 4,008 observations from 587 companies spanning the years 2007 to 2013, while the UK-Germany dataset consists of 8,064 observations from 959 companies between 2010 and 2016. The year of the natural shock is filtered out—2010 for France and 2013 for the UK—to avoid distortions or anomalies caused by the shock. Removing these years ensures sudden changes do not skew the analysis and allows for a clearer comparison of the periods before and after the shock.

This thesis uses a panel dataset, where the number of observations and unique companies varies because the same companies report data across multiple years. The datasets are filtered to include three years before and three years after the introduction of mandatory reporting laws. This timeframe was chosen to examine how companies managed their emissions and reporting practices before and after these regulatory changes.

3.2. Independent Variable

The independent variable in this study is the regulatory treatment, specifically whether companies are subject to mandatory sustainability reporting requirements under either the Grenelle II Law in France (implemented in 2010) or the UK's Greenhouse Gas Reporting Regulation (introduced in 2013) and whether a measurable change in future CO_2 emissions is observable. This variable reflects the shift in reporting obligations for firms in these countries, with France leading in early adoption through the Grenelle II Law and the UK following in 2013 under the Companies Act 2006 (Strategic Report and Directors' Report), which required quoted companies to disclose greenhouse gas emissions as part of their annual reporting. These regulatory changes serve as a natural shock in their respective countries, marking the introduction of mandatory sustainability disclosures. The Grenelle II Law primarily emphasized the disclosure of Scope 1 and Scope 2 emissions and the UK's regulation that also addressed Scope 1 and Scope 2 reporting requirements. To capture potential shifts in disclosure practices and emissions, this study examines Scope 1, Scope 2 and Scope 3 emissions across the treated countries, as the disclosure of Scope 3 emissions was in both cases voluntary. Germany serves as the control group in this analysis, as it did not implement a comparable mandatory reporting requirement until 2017, following the introduction of EU-wide sustainability regulations. By

comparing France (*post-2010*) and the UK (*post-2013*) with Germany (*no early regulation*), the study isolates the effects of these country-specific laws. Thus, 2010 and 2013 act as the respective post-treatments for France and the UK, respectively. In Hypothesis 2, I adopt the Herfindahl-Hirschman Index (HHI), derived from Compustat sales data (*hhi_sale*), as a moderator to assess how industry competition influences the relationship between mandatory sustainability reporting and carbon emissions. The HHI is a standard measure of market concentration, which is calculated by summing the squares of the market shares of all companies within an industry. Higher HHI values indicate less competition, while lower values indicate more competition. Using Compustat sales data, market competition captures variations in industry dynamics. By including market competition in the models, the study tests whether firms in highly competitive industries respond more strongly to mandatory reporting than firms in less competitive environments.

3.3. Dependent Variables

Building on the work of Azar et al. (2021), this study examines Scope 1, Scope 2, and Scope 3 emissions as dependent variables. These emissions are measured annually and log-transformed to produce the variables Scope 1 (direct), Scope 2 (indirect energy-related emissions), and Scope 3 (supply chain emissions). Logarithmic transformation standardizes emissions data, removes the inherent skewness of raw emissions data, and allows meaningful comparisons between companies of different sizes and industries. This transformation ensures a consistent and robust approach to measuring corporate emissions performance.

The use of Trucost environmental data offers various advantages. It acts as a reliable source of environmental information, especially in tracking corporate carbon emissions. It delivers comprehensive insights into emissions across three primary categories: direct emissions from operations (Scope 1), indirect emissions from energy consumption (Scope 2), and emissions throughout the supply chain (Scope 3). By combining company reports, financial data, and proxy estimates, Trucost ensures that its data is consistent and comparable across industries (Ung et al., 2016). Researchers have often relied on Trucost for studies on corporate sustainability and the impact of regulation. One notable example is Azar et al. (Azar et al., 2021), who used Trucost data to study how institutional investors such as BlackRock, Vanguard, and State Street - known as the 'Big Three' - influence corporate emissions. Their findings showed that when the Big Three held larger stakes in companies, emissions tended to fall by around 2%, highlighting how investor pressure can drive meaningful environmental change. Trucost's standardized and reliable approach has also been essential in addressing

inconsistencies in ESG ratings (Berg et al., 2022; Chatterji et al., 2016). Its data helps benchmark emissions, analyze trends, and assess how governance and regulatory efforts shape environmental outcomes, making it an essential tool for researchers and policymakers alike.

3.4. Control Variables

To strengthen the validity of this study, a carefully selected set of control variables has been included to refine the analysis and ensure accurate measurement of treatment effects. These variables consider firm-specific and industry-level factors that may influence emissions outcomes independently of the regulatory interventions. Building on the article by Bolton and Kazcpercic (2021), I use several variables that can anticipate higher/lower emissions at the organizational level. Firm size is represented by the natural logarithm of tangible fixed assets (*lppe*). This variable provides a focused measure of investment in physical assets, reflecting a firm's capacity to produce and manage emissions. Larger companies with significant physical assets often have different emissions profiles, possibly due to economies of scale, increased regulatory scrutiny, or greater resources for emissions reduction initiatives. In addition, leverage, calculated as the ratio of long-term debt to total assets, remains a key indicator of a company's financial structure and its ability to adapt to or comply with emissions-related regulations. Return on assets (ROA), calculated as earnings before interest and taxes (EBIT) divided by total assets, is included as an indicator of financial performance that may correlate with a company's ability to invest in emission reduction strategies. In addition, the inclusion of the Herfindahl-Hirschman Index of sales (*hhi_sale*) adds an important dimension to the analysis by capturing market concentration or competitive dynamics within industries.

3.5. Research Design and Econometrics Approach

This study employs a difference-in-differences (DiD) approach to analyze the impact of mandatory sustainability reporting laws on corporate CO_2 emissions. Drawing from the article by Azar et al. (2021), who examined the role of large investment firms in influencing global corporate emissions, this study adapts their econometrics approach to evaluate the effects of France's Grenelle II Law (introduced in 2010) and the UK's Greenhouse Gas Reporting Regulation (introduced in 2013). France and the UK serve as the treatment groups, while Germany, which did not implement similar reporting requirements during this period, acts as the control group. The DiD methodology tracks changes in corporate reporting practices and subsequent emissions before and after these regulatory interventions. By comparing trends between the treatment and control groups, the approach isolates the causal effects of the legislation, considering both time-invariant differences between groups and broader trends over

time. By utilizing the DiD approach, this study effectively addresses heterogeneity and approximates causal inference. The reliability of this method relies on the assumption of parallel trends, ensuring that the emissions trajectories of the treatment and control groups would have been similar in the absence of the interventions, thereby removing the influence of time-invariant differences. This assumption is tested and validated using pre-treatment data.

To ensure the robustness of these results, robust standard errors were used to account for potential heteroskedasticity, ensuring reliable inference across groups and time periods. I included year and firm fixed effects in my models to account for unobserved heterogeneity that might otherwise bias the estimation of the treatment effect. Year fixed effects control for time-varying factors that are constant across firms, such as macroeconomic trends, policy changes, or industry-wide shocks. This ensures that any time variation in the outcome variable that is unrelated to the treatment is adequately accounted for. Firm fixed effects, on the other hand, take into account time-invariant firm-specific characteristics, such as management quality, firm culture or structural advantages, that may affect the outcome variable. By controlling for these unobservable differences, the model isolates within-firm changes over time, allowing for a more precise estimation of the causal effect of the treatment. Together, these fixed effects increase the robustness of the model by reducing omitted variable bias and ensuring that the treatment effect is identified from variation that is not confounded by broader time trends or firm-specific attributes.

The use of moving averages for the dependent variables, particularly greenhouse gas (GHG) emissions, provides a robust framework for analyzing and drawing reliable conclusions about future emission patterns. Furthermore, I include year- and firm-fixed effects to control for unobserved heterogeneity that could influence emissions not directly measured in the dataset. Their inclusion helps isolate the impact of the treatment (e.g., mandatory reporting laws) by accounting for systematic differences across time and company that might otherwise bias the results. Thus:

$$\begin{aligned}\text{emissions}_{it} = \beta_0 + \beta_{1\text{post}_t} + \beta_{2\text{treated}_i} + \beta_3(\text{treated}_i \times \text{post}_t) \\ + \beta_4(\text{treated}_i \times \text{post}_t \times \text{hhi\_sale}) + X_{it}\beta + \varepsilon_{it}\end{aligned}$$

The equation models the emissions_{it} (Scope 1, Scope 2, or Scope 3 emissions) for company ii in a given year, tt, to understand the effects of mandatory reporting laws and other factors. The baseline level of emissions is captured by the intercept β_0. The term $\beta_{1\text{post}_t}$ reflects the change

in emissions over time after the introduction of the reporting laws while $\beta_{2\text{treated}_i}$ accounting for whether a company is part of the treated group subject to the reporting requirements. The interaction term, $\beta_3(\text{treated}_i \times \text{post}_t)$, is the key part of the model, measuring the combined effect of being in the treated group and operating in the post-reporting period. The term $\beta_4(\text{treated}_i \times \text{post}_t \times \text{hhi\_sale})$ captures how the effect of mandatory reporting laws β_3 varies depending on the concentration of market concentration hhi_sale within the treated firms during the post-law period. Additional factors like company-specific characteristics are included with X_{it}, representing these variables and β their associated impacts. The error term ε_{it} accounts for any unexplained variations in emissions. This framework uses a difference-in-differences approach to compare changes over time between treated and untreated companies, allowing us to isolate the impact of mandatory reporting laws on emissions.

4. Data Analysis and Results

4.1. Descriptive Statistics

Table 1 provides the emissions for France, Germany, and the UK in comparison. It shows that Germany consistently reports the highest emissions for both Scope 1 and Scope 3. For Scope 1 emissions, German companies have the highest mean (10.59) and median (10.24), followed by France (mean = 10.04) and the UK, which has the lowest mean (9.12) and variability. Similarly, for Scope 3 emissions, Germany leads with a mean of 12.59 and higher variability, while French companies follow closely with higher heterogeneity. The UK again has the lowest Scope 3 emissions, with the most consistent levels across companies. These patterns are reflected in Figure 1, where Germany shows higher medians and greater variability for both Scope 1 and Scope 3 emissions. French companies have slightly lower medians but a wider range for Scope 3, while UK companies have the narrowest distributions across all scopes, indicating more consistent emissions management. For Scope 2 emissions, French companies report slightly higher averages than their counterparts, likely due to their reliance on nuclear power, which reduces Scope 1 emissions but affects Scope 2 through electricity consumption. Figure 2 shows a distinct downward trend in emissions across all scopes, especially from 2010 onwards. German companies, starting from the highest levels, show significant reductions over time, while French and UK companies follow similar patterns at lower levels. The sharp drop in 2020 probably reflects the disruptions caused by the COVID-19 pandemic. Investigating figure 3 shows that firms based in the UK consistently lead in emissions reporting, with a significant

increase from 2013 onwards, likely in preparation for the Paris Agreement. In comparison, France and Germany lag behind despite significant increases in reporting after 2012.

Table 1
Summary Statistics by Country

country	Scope1_Mean	Scope1_Median	Scope1_SD	Scope2_Mean	Scope2_Median	Scope2_SD	Scope3_Mean	Scope3_Median	Scope3_SD
FRANCE	10.041614	9.924843	3.086129	10.055412	10.228339	2.603617	12.04110	12.07990	2.629063
GERMANY	10.591602	10.240711	3.013733	10.730409	10.699652	2.430686	12.58961	12.66556	2.429728
UNITED KINGDOM	9.122893	9.120495	2.832311	9.334293	9.268708	2.285112	11.15478	11.18838	2.212498

Figure 1
Boxplot of Emissions by Country and Scope

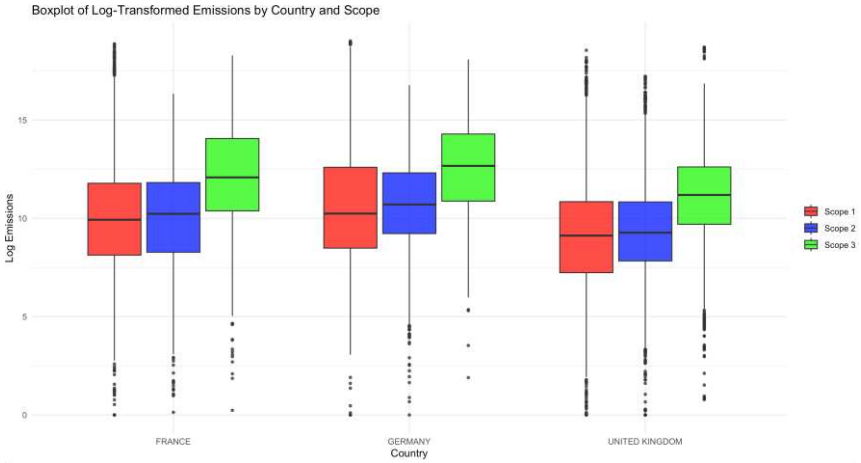


Figure 2
Average Emissions (Scope 1, 2 and 3) by Country and by Year

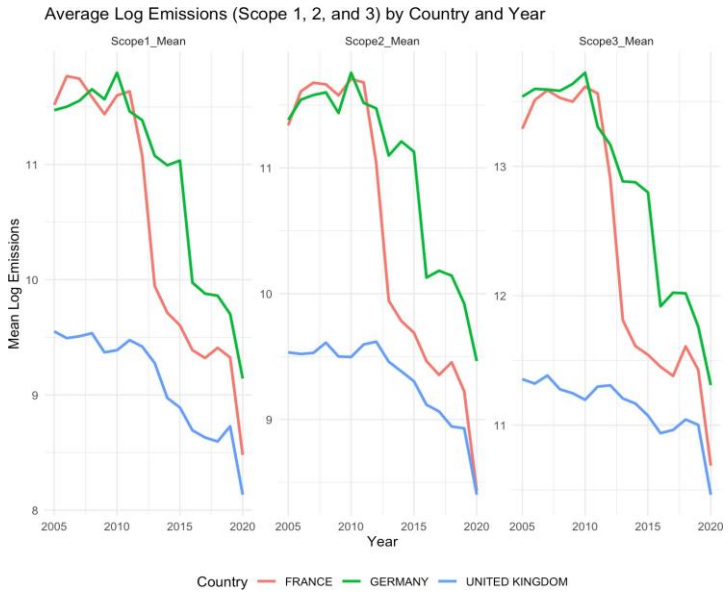
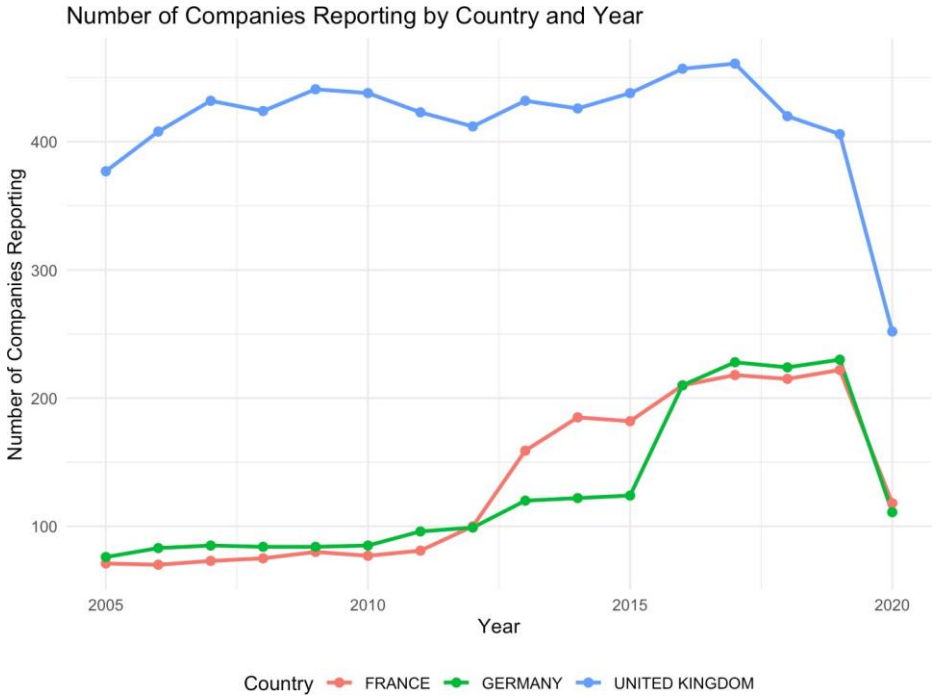


Figure 3
Number of Companies Reporting by Country and Year



4.2. Correlation Analysis and Multicollinearity Check

The correlation analysis in figure 4 for the France-Germany dataset shows low correlations between most variables, with all values remaining below 0.5. This suggests that there are no major concerns about multicollinearity in the dataset. The highest correlation is 0.33 between leverage and lppe (log of property, plant, and equipment), which makes sense as fixed assets often play a role in determining leverage. ROA and leverage have a weak negative correlation of -0.25, reflecting a slightly inverse relationship between profitability and financial leverage. The variable hhi_sale, which measures market concentration, shows almost no correlation with the other variables, suggesting that it does not significantly explain issuance outcomes. The correlations are even lower in the UK-Germany dataset, displayed in Figure 5, with none exceeding 0.4. The strongest relationship is a moderate correlation of 0.22 between leverage and lppe. As in the France-Germany dataset, ROA and leverage show weak relationships, with the highest being only -0.05. Market concentration, represented by hhi_sale, again shows little or no correlation with other variables. These low correlations in both datasets confirm that multicollinearity isn't an issue, making the models more reliable. However, because the independent variables don't strongly predict emissions outcomes on their own, the difference-in-differences (DiD) approach is crucial for isolating the effects of mandatory reporting policies. The DiD framework ensures that we can accurately measure the impact of these regulations on corporate behavior.

Figure 4
Correlations France and Germany

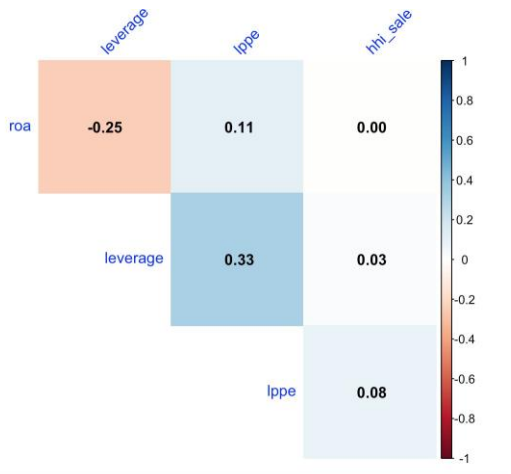
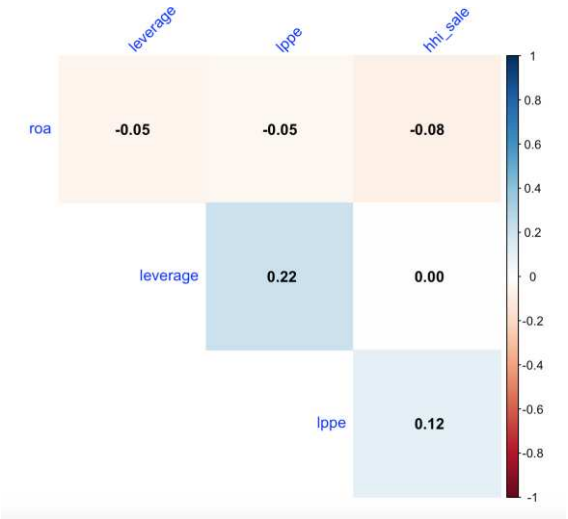


Figure 5
Correlations UK and Germany



4.3. Results

4.3.1. France Grenelle II Law (2010)

The analysis of the basic DiD models, as displayed in Table 2, shows that the interaction between treatment and the passing of the mandate is statistically significant only for Scope 2 emissions, with a coefficient of β_3 = -0.282 ($p < .05$, statistically significant on a 95% confidence level). In contrast, the treatment effect is non-significant for Scope 1 (β_3 = -0.177, $p > .10$) and Scope 3 emissions (β_3 = 0.003, $p > .10$), suggesting that the regulation did not affect direct or supply chain emissions. The low R-squared values highlight the limited explanatory power of these models. When control variables are added, the results for Scope 2 emissions remain consistent, with the treatment effect remaining statistically significant (β_3 = 0.303, $p < .05$, statistically significant on a 95% confidence level). The model with control variables can be seen in Table 3. However, the treatment effect remains non-significant for Scope 1 and Scope 3 emissions. Financial performance (ROA) and physical assets (lppe) show strong positive associations with emissions across all scopes, underlining their importance in shaping companies' emissions profiles. Overall, the results provide partial support for hypothesis 1. The Grenelle II Law appears to have significantly reduced Scope 2, therefore indirect emissions, while no measurable effect is observed for Scope 1 and Scope 3 emissions.

Table 2
France Basic DiD Models

Basic Models for Scope 1, Scope 2, and Scope 3 Grenelle 2

	Dependent variable:		
	Log Scope 1 (1)	Log Scope 2 (2)	Log Scope 3 (3)
post	0.094	0.281***	0.075
	(0.085)	(0.088)	(0.049)
treatment:post	-0.177	-0.282**	0.003
	(0.125)	(0.117)	(0.074)
Year Fixed Effects	YES	YES	YES
Firm Fixed Effects	YES	YES	YES
Observations	4,008	4,008	4,008
R^2	0.002	0.012	0.006
Adjusted R^2	-0.169	-0.158	-0.165
F Statistic (df = 2; 3419)	4.149**	21.164***	10.137***
Note:			*p<0.1; **p<0.05; ***p<0.01
			Robust standard errors are reported in parentheses.

Table 3
France DiD Models with Controls

DiD Models with Controls for Scope 1, 2, and 3 Emissions Grenelle 2

	Dependent variable:		
	Log Scope 1 (1)	Log Scope 2 (2)	Log Scope 3 (3)
post	0.084	0.271***	0.036
	(0.092)	(0.096)	(0.055)
roa	1.179***	1.241***	1.453***
	(0.391)	(0.417)	(0.318)
leverage	0.222	0.079	-0.088
	(0.329)	(0.291)	(0.228)
lppe	0.127**	0.134**	0.248***
	(0.057)	(0.053)	(0.046)
hhi_sale	-0.390	-0.044	0.146
	(0.336)	(0.216)	(0.094)
treatment:post	-0.192	-0.303**	-0.082
	(0.130)	(0.119)	(0.060)
Year Fixed Effects	YES	YES	YES
Firm Fixed Effects	YES	YES	YES
Observations	3,746	3,746	3,746
R^2	0.023	0.032	0.168
Adjusted R^2	-0.146	-0.136	0.023
F Statistic (df = 6; 3190)	12.776***	17.559***	107.206***
Note:			*p<0.1; **p<0.05; ***p<0.01
			Robust standard errors in parentheses

The extended models, respective Table 4 and Table 5, include the triple interaction term that measures how the impact of the reporting laws is influenced by the level of market competition. These models provide critical insights into the moderating role of the regulatory impact of the Grenelle II Law. In Table 4, the triple interaction term is statistically significant for Scope 1

emissions in both the baseline models ($\beta_4 = 0.589$, $p < .05$, indicating a statistical significance with 95% confidence) and the models shown in Table 5, including controls ($\beta_4 = 0.550$, $p < .10$, statistically significant on a 90% confidence level). This indicates that firms in less competitive markets, as indicated by higher HHI scores, experienced an increase in direct emissions after regulation. These findings suggest that concentrated markets may lack sufficient competitive pressure to reduce emissions in response to regulatory mandates. For Scope 2 and Scope 3 emissions, however, the impact of the reporting laws is influenced by the level of market competition, which is not statistically significant in either set of models. This suggests that market concentration does not significantly influence firms' emissions behavior for these scopes in the post-regulation period. The lack of significance for these scopes may reflect the inherent challenges of addressing indirect and supply chain emissions, which involve broader systemic factors beyond market competition. In Table 5, the control variables remain consistent with previous findings. Financial performance (ROA) and physical assets (lppe) are positively and significantly associated with emissions across all scopes, highlighting the importance of firm resources in shaping emissions outcomes. The inclusion of the market competition slightly improves the explanatory power of the models, as reflected in marginal increases in the R-squared values. Overall, these results provide partial support for H2. While market competition moderates the impact of the Grenelle II Law on Scope 1 emissions, its role in shaping Scope 2 and Scope 3 emissions remains inconclusive. The results highlight the complexity of emissions dynamics and the multiple ways in which regulatory and market pressures interact to influence firm behavior.

Table 4
Basic DiD Models with Moderator Market Competition

Basic DiD Models with Triple Interaction Grenelle 2			
	Dependent variable:		
	Log Scope 1	Log Scope 2	Log Scope 3
	(1)	(2)	(3)
post	0.177	0.293**	0.123
	(0.160)	(0.145)	(0.098)
hhi_sale	-0.377**	-0.195	0.013
	(0.336)	(0.264)	(0.163)
treatment:post	-0.434	-0.273	-0.021
	(0.189)	(0.173)	(0.111)
treatment:hhi_sale	-0.476**	-0.019	0.456
	(0.474)	(0.382)	(0.313)
post:hhi_sale	-0.164	-0.021	-0.099
	(0.280)	(0.220)	(0.146)
treatment:post:hhi_sale	0.589**	-0.022	0.032
	(0.405)	(0.325)	(0.226)
Year Fixed Effects	YES	YES	YES
Firm Fixed Effects	YES	YES	YES
Observations	4,008	4,008	4,008
R^2	0.012	0.014	0.009
Adjusted R^2	-0.159	-0.157	-0.162
F Statistic (df = 6; 3415)	7.158***	7.819***	5.365***
Note:			*p<0.1; **p<0.05; ***p<0.01
			Robust standard errors in parentheses

Table 5
France DiD Models with Controls and Moderator Market Competition

DiD Models with Controls and Triple Interaction Grenelle 2			
	Dependent variable:		
	Log Scope 1	Log Scope 2	Log Scope 3
	(1)	(2)	(3)
post	0.148	0.228	0.048
	(0.186)	(0.153)	(0.109)
hhi_sale	-0.240	-0.034	0.125
	(0.351)	(0.279)	(0.145)
roa	1.201***	1.241***	1.450***
	(0.294)	(0.331)	(0.229)
leverage	0.227	0.083	-0.090
	(0.169)	(0.175)	(0.116)
lppe	0.124	0.137***	0.247***
	(0.052)	(0.042)	(0.037)
treatment:post	-0.442***	-0.184	-0.111
	(0.209)	(0.182)	(0.110)
treatment:hhi_sale	-0.688***	-0.191	0.146
	(0.479)	(0.371)	(0.208)
post:hhi_sale	-0.134	0.089	-0.023
	(0.341)	(0.246)	(0.153)
treatment:post:hhi_sale	0.550	-0.249	0.060
	(0.418)	(0.331)	(0.183)
Year Fixed Effects	YES	YES	YES
Firm Fixed Effects	YES	YES	YES
Observations	3,746	3,746	3,746
R^2	0.026	0.033	0.168
Adjusted R^2	-0.145	-0.136	0.023
F Statistic (df = 9; 3187)	9.454***	12.042***	71.691***
Note:			*p<0.1; **p<0.05; ***p<0.01
			Robust standard errors in parentheses

4.3.2. UK Companies Act (2013)

The difference-in-differences (DiD) analysis of the UK Companies Act 2013 reveals notable findings regarding its impact on corporate greenhouse gas (GHG) emissions. Using Germany as a control group, the analysis incorporates robust standard errors, firm-specific controls, and year-fixed effects to isolate the regulatory effects of the Act. Table 6 shows the results from the baseline models. The treatment effect, represented by the interaction term, is statistically significant for Scope 1 ($p < .05$, statistically significant on a 95% confidence level) and Scope 2 ($p < .05$, indicating a statistical significance with 95% confidence) emissions, but not for Scope 3 ($p > .10$). For Scope 1 and Scope 2, the negative coefficients (β_3 = -0.432 and β_3 = -0.432 respectively) indicate a significant reduction in post-regulation emissions for the treatment group compared to the control group. These results highlight the immediate impact of the UK Companies Act in reducing direct (Scope 1) and indirect energy-related (Scope 2) emissions. However, Scope 3 emissions, which include supply chain-related activities, show no significant change, reflecting the complexity of addressing broader, indirect emissions. When firm-specific controls are included, as shown in Table 7, the models provide additional insights. The treatment effect term remains statistically significant for Scope 1 ($p < .05$, indicating a statistical significance with 95% confidence) and Scope 2 ($p < .05$, statistically significant on a 95% confidence level) emissions, with coefficients of β_3 = -0.343 and β_3 = -0.365, respectively. These results further confirm the effectiveness of the Act in reducing direct and indirect emissions within companies. Among the controls, ROA ($p < .01$, indicating a statistical significance with 99% confidence) and lppe ($p < .01$, indicating a statistical significance with 99% confidence) emerge as significant predictors of emissions across all scopes, with higher financial performance and physical assets associated with higher emissions. Notably, market competition shows mixed effects and is only significant for Scope 2 emissions ($p < .05$, indicating a statistical significance with 95% confidence). In summary, the analysis highlights the effectiveness of the UK Companies Act in promoting emissions reductions within companies, particularly in relation to Scope 1 and Scope 2 emissions. The results also highlight the challenges of tackling Scope 3 emissions, suggesting the need for more targeted measures to tackle supply chain emissions. The inclusion of company-specific controls strengthens the robustness of these conclusions and provides a more nuanced understanding of the regulatory impact of the Act.

Table 6
UK Basic DiD Models

Basic Models for Scope 1, Scope 2 and Scope 3 Companies Act

	Dependent variable:		
	Log Scope 1 (1)	Log Scope 2 (2)	Log Scope 3 (3)
treatment	0.500***	0.705***	0.440***
	(0.104)	(0.077)	(0.044)
post	0.012	0.204***	0.056
	(0.082)	(0.073)	(0.050)
treatment:post	-0.432***	-0.432***	0.011
	(0.107)	(0.099)	(0.065)
Year Fixed Effects	YES	YES	YES
Firm Fixed Effects	YES	YES	YES
Observations	8,064	8,064	8,064
R^2	0.040	0.016	0.004
Adjusted R^2	-0.090	-0.118	-0.131
F Statistic (df = 3; 7102)	98.542***	37.650***	9.306***
Note:			*p<0.1; **p<0.05; ***p<0.01
			Robust standard errors are reported in parentheses.

Table 7
UK DiD Model with Controls

DiD Models with Controls for Scope 1, Scope 2 and Scope 3 Companies Act

	Dependent variable:		
	Log Scope 1 (1)	Log Scope 2 (2)	Log Scope 3 (3)
treatment	0.343**	0.526***	0.238***
	(0.137)	(0.112)	(0.054)
post	-0.103	0.125	-0.051
	(0.088)	(0.078)	(0.051)
roa	0.771***	0.490	0.974***
	(0.295)	(0.334)	(0.228)
leverage	0.295*	0.235	0.143
	(0.168)	(0.175)	(0.116)
lppe	0.315***	0.257***	0.346***
	(0.052)	(0.042)	(0.037)
hhi_sale	-0.279	0.305*	0.115
	(0.239)	(0.159)	(0.087)
treatment:post	-0.343***	-0.365***	0.055
	(0.107)	(0.099)	(0.052)
Year Fixed Effects	YES	YES	YES
Firm Fixed Effects	YES	YES	YES
Observations	7,341	7,341	7,341
R^2	0.093	0.051	0.247
Adjusted R^2	-0.032	-0.080	0.143
F Statistic (df = 7; 6454)	94.013***	49.161***	301.797***
Note:			*p<0.1; **p<0.05; ***p<0.01
			Robust standard errors are reported in parentheses.

The inclusion of the interaction term, like the models testing for the law in France, that measures how the impact of the reporting laws is influenced by the level of market competition in the models for the UK Companies Act dataset provides valuable insights into the role of market competition in moderating emissions outcomes. This can be seen in Table 8. For Scope 1 emissions, the triple interaction term is statistically non-significant ($\beta_4 =$

0.125, p > .10), suggesting no detectable effect of market competition on direct emissions. Similarly, the triple interaction term remains statistically non-significant for Scope 2 and Scope 3 emissions, with coefficients of $\beta_4 = 0.215$ (p > .10) and $\beta_4 = 0.108$ (p > .10), respectively. While the R-squared values show slight increases compared to the baseline models, especially for Scope 1 (0.042), these results do not provide substantial evidence for hypothesis 2, which posits a moderating effect of competition. When additional controls, as well as year- and firm-fixed effects are included, shown in Table 9, the analysis provides more nuanced results. For Scope 1 emissions, the triple interaction term remains statistically non-significant ($\beta_4 = 0.310$, p > .10), indicating a limited impact of market concentration on direct emissions post-regulation. In contrast, the interaction term becomes more relevant for Scope 2 emissions, where the triple interaction has a positive but statistically non-significant coefficient ($\beta_4 = 0.198$, p > .10). For Scope 3 emissions, the triple interaction term continues to lack statistical significance ($\beta_4 = 0.192$, p > .10), highlighting the complexity of addressing supply chain emissions through regulatory intervention. Overall, these results suggest that while the inclusion of market competition metrics adds depth to the analysis, the regulatory effects of the UK Companies Act are not significantly moderated by market concentration. The results highlight the need for more targeted measures or complementary policies to address the challenges posed by different competitive pressures in different sectors.

Table 8

UK Basic DiD Model with Moderator Market Competition

Basic DiD Models with Triple Interaction Companies Act

	Dependent variable:		
	Log Scope 1 (1)	Log Scope 2 (2)	Log Scope 3 (3)
treatment	0.446**	0.414**	0.528***
	(0.214)	(0.178)	(0.147)
post	0.085	0.234	0.096
	(0.160)	(0.145)	(0.098)
hhi_sale	-0.409	-0.097	0.014
	(0.336)	(0.264)	(0.163)
treatment:post	-0.485**	-0.519***	-0.032
	(0.189)	(0.173)	(0.111)
treatment:hhi_sale	0.188	0.501	-0.191
	(0.474)	(0.382)	(0.313)
post:hhi_sale	-0.174	-0.068	-0.083
	(0.280)	(0.220)	(0.146)
treatment:post:hhi_sale	0.125	0.215	0.108
	(0.405)	(0.325)	(0.226)
Year Fixed Effects	YES	YES	YES
Firm Fixed Effects	YES	YES	YES
Observations	8,064	8,064	8,064
R^2	0.042	0.018	0.005
Adjusted R^2	-0.088	-0.115	-0.131
F Statistic (df = 7; 7098)	44.884***	18.879***	4.709***
Note:			*p<0.1; **p<0.05; ***p<0.01
			Robust standard errors are reported in parentheses.

Table 9
UK DiD Model with Controls and Moderator Market Competition

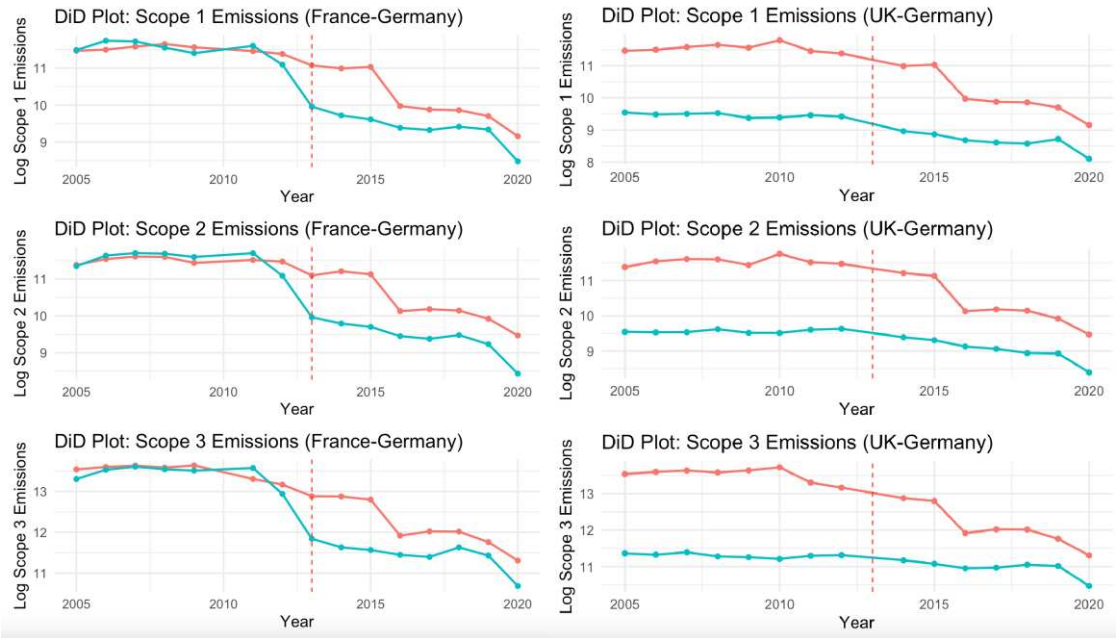
DiD Models with Controls and Triple Interaction Companies Act

	Dependent variable:		
	Log Scope 1 (1)	Log Scope 2 (2)	Log Scope 3 (3)
treatment	0.330	0.366	0.271
	(0.403)	(0.397)	(0.200)
post	-0.066	0.055	-0.042
	(0.097)	(0.096)	(0.048)
hhi_sale	-0.290*	0.047	0.155*
	(0.173)	(0.171)	(0.086)
roa	0.771***	0.492***	0.972***
	(0.123)	(0.121)	(0.061)
leverage	0.292***	0.231***	0.142***
	(0.080)	(0.079)	(0.040)
lppe	0.313***	0.254***	0.346***
	(0.016)	(0.016)	(0.008)
treatment:post	-0.455***	-0.410***	0.037
	(0.105)	(0.104)	(0.052)
treatment:hhi_sale	-0.088	0.208	-0.090
	(0.231)	(0.227)	(0.115)
post:hhi_sale	-0.078	0.148	-0.017
	(0.181)	(0.179)	(0.090)
treatment:post:hhi_sale	0.310	0.198	0.052
	(0.208)	(0.205)	(0.103)
Year Fixed Effects	YES	YES	YES
Firm Fixed Effects	YES	YES	YES
Observations	7,341	7,341	7,341
R^2	0.093	0.053	0.247
Adjusted R^2	-0.032	-0.078	0.143
F Statistic (df = 10; 6451)	66.402***	36.055***	211.274***
Note:			*p<0.1; **p<0.05; ***p<0.01
			Robust standard errors are reported in parentheses.

The trends shown in Figure 6 highlight notable differences in emissions trajectories between the treatment and control groups, shedding light on the impact of regulatory interventions in France and the UK. Both the Grenelle II Law in France and the Companies Act in the UK appear to have had a significant impact on emissions reductions, particularly for Scope 1 and Scope 2. In these cases, the treatment groups (France and the UK) show steeper and more immediate reductions than the control group (Germany). For Scope 1 emissions, which represent direct emissions, France and the UK show large reductions following the implementation of their respective regulations. This suggests that these policies have directly encouraged compliance and accelerated the reduction of on-site emissions. The impact is particularly striking in France, where the Grenelle II Law led to an almost immediate and faster decline than in the UK. Scope 2 emissions, which reflect energy-related emissions (Figure 6) also show significant reductions in both treatment groups. These trends suggest that the regulatory framework has effectively incentivized cleaner energy consumption. Again, France illustrates a more pronounced reduction, possibly due to stronger enforcement mechanisms or economic incentives linked to the Grenelle II Law. In contrast, Scope 3 emissions, which include supply chain emissions, show a less dramatic but still significant downward trend in both treatment groups. The slower pace of reduction likely reflects the

challenges of addressing emissions associated with upstream and downstream activities, where external dependencies and limited direct control complicate progress. Nevertheless, the continued decline underlines the overall efforts of companies to address these complex issues. The control group, Germany, shows a more gradual decline in all emission sectors. This slower pace of reduction may reflect general market trends or independent national policies not explicitly captured in this analysis. However, it also highlights the distinct and more targeted effects of the Grenelle II Law and the Companies Act in driving emissions reductions in France and the UK. Germany's steadier, less aggressive decline serves as a useful benchmark, highlighting the effectiveness of these targeted policy interventions. Comparing the treatment groups, the Grenelle II Law in France appears to have had a faster and more immediate impact, particularly on Scope 1 and Scope 2 emissions. The Companies Act in the UK, while still effective, appears to have led to a slightly more gradual reduction. These differences may reflect differences in regulatory design, enforcement mechanisms, or broader economic and market conditions in the two countries.

Figure 6
Emission Trends



5. Discussion

The results of this study provide a detailed insight into the impact of mandatory sustainability reporting laws on corporate greenhouse gas (GHG) emissions and address the research question: What is the impact of mandatory reporting on sustainability? Through the lens of Hypothesis 1, which posits that mandatory reporting reduces future GHG emissions, and

hypothesis 2, which suggests that market concentration moderates these effects, the analysis presents nuanced results for both the French Grenelle II Law and the UK Companies Act. The effectiveness of mandatory reporting in reducing corporate GHG emissions is evident, albeit with variations depending on the scope and legal context. For the UK Companies Act, significant reductions in Scope 1 and Scope 2 emissions were observed, fully supporting hypothesis 1 for these emission scopes. Scope 1 emissions showed a robust reduction in direct emissions, likely reflecting operational efficiencies and reduced combustion-related activities. Similarly, Scope 2 emissions showed a significant reduction, which was attributed to changes in energy procurement practices, such as sourcing renewable energy. However, Scope 3 emissions did not follow this trend. Instead, they showed no statistically significant reduction, highlighting the challenges of addressing emissions within supply chains, where external dependencies and reporting complexities often prevail. This may also reflect a change in reporting practices or the externalization of emissions-intensive activities, raising questions about unintended regulatory consequences. In contrast, the Grenelle II Law in France provides partial support for hypothesis 1. While significant reductions in Scope 2 emissions were observed in both the baseline and extended models, there were no significant changes in Scope 1 and Scope 3 emissions. This finding underlines the effectiveness of the regulation in reducing energy-related emissions but highlights its limited impact on direct and supply chain emissions. The results suggest that the regulatory design or enforcement mechanisms of the legislation may have been insufficient to drive comprehensive emissions reductions across all scopes. Market structure, as measured by the Herfindahl-Hirschman Index (HHI), provided additional insights into the moderating effects of competition on regulatory outcomes. For the French Grenelle II Law, hypothesis 2 was partially supported. In the baseline models, the triple interaction term investigating the impact on the treatment effect of market concentration was statistically significant for Scope 1 emissions, indicating that firms in less competitive markets (higher HHI) experienced greater reductions in direct emissions. However, this finding did not hold in the extended models with controls, and no evidence of market concentration effects was observed for Scope 2 or Scope 3 emissions. This suggests that while competition may influence direct emissions reductions under certain conditions, its role in shaping energy-related or supply-chain emissions is less pronounced. For the UK Companies Act, hypothesis 2 was not supported. Across all emission sectors, the triple interaction term investigating the impact on the treatment effect of market concentration was statistically non-significant, indicating that market concentration did not moderate the regulatory effects of the Act. These results suggest that the Companies Act influenced emissions reductions regardless of market competitiveness,

reflecting the robustness of its design and implementation. Control variables provided valuable context for understanding emissions behavior. In both datasets, financial performance (ROA) and physical assets (lppe) were consistently and positively associated with emissions across all scopes, suggesting that larger and more financially successful companies tend to emit more. Leverage also emerged as a significant predictor, particularly for Scope 1 emissions, highlighting the challenges faced by financially constrained companies in taking action to reduce emissions. In summary (Table 10), the analysis highlights the effectiveness of the UK Companies Act in achieving significant reductions in Scope 1 and Scope 2 emissions, while also highlighting the complexity of addressing supply chain (Scope 3) emissions. The Grenelle II Law, on the other hand, showed partial success, with significant reductions limited to Scope 2 emissions. The moderating role of market concentration was evident in the French dataset for direct emissions under baseline models but was otherwise limited, suggesting that systemic factors and regulatory design play a critical role in shaping outcomes. These findings provide a nuanced answer to the research question and shed light on the differential impact of mandatory reporting laws across regulatory contexts and emissions scopes.

Table 10
Overview of the Hypothesis Test

Testing the Hypothesis Results for Grenelle II Law in France and Companies Act in the UK		
Hypothesis	Grenelle II Law (France)	Companies Act (UK)
H1: Mandatory reporting reduces future CO2 emissions	Partial support (Scope 2)	Supported (Scope 1, Scope 2)
H2: Market concentration moderates the impact of mandatory reporting	Partial support (Scope 1, basic models only)	Rejected

5.1. Implications

The findings of this study have important implications for both theory and practice, particularly when viewed through the lens of stakeholder theory and population ecology. From a stakeholder theory perspective, mandatory sustainability reporting serves as a formalized mechanism for aligning corporate behavior with the expectations of different stakeholders, such as regulators, investors, and the wider public (Freeman & McVea, 1984). The results show that such reporting frameworks can encourage reductions in specific categories of emissions, such as Scope 1 and Scope 2 emissions under the UK Companies Act, by promoting transparency and accountability. These findings are consistent with the work of Reid and Toffel (2009) who

highlighted the role of disclosure practices in harmonizing stakeholder pressure across industries and ensuring the consistency and legitimacy of companies' environmental efforts.

However, the lack of statistically significant reductions in Scope 3 emissions under the UK Companies Act reflects the complex dynamics of stakeholder pressure. Stakeholders, particularly investors and regulators, tend to focus more on emissions directly attributable to companies, such as Scope 1 and Scope 2 emissions. This disproportionate focus can limit the effectiveness of mandatory reporting frameworks in addressing supply chain emissions, where external dependencies and reporting complexities often prevail. While this strategic gap is consistent with reporting requirements, it underscores the broader challenges of transparency and accountability (Fernandez-Feijoo et al., 2014). Such findings highlight the need for stakeholders to extend their scrutiny to supply chain activities and for policymakers to implement frameworks considering the full life cycle of emissions. On the other hand, the French Grenelle II Law showed significant reductions in Scope 2 emissions, demonstrating its effectiveness in influencing energy-related practices. However, the lack of significant changes in Scope 1 and Scope 3 emissions highlights the limited reach of the legislation and points to potential weaknesses in enforcement and design.

The study also highlights the critical role of proactive stakeholder engagement. Partial support for hypothesis 2 in the French dataset, where companies in less competitive markets showed stronger responses in Scope 1 emissions (baseline models only), suggests that the absence of intense market pressure allows companies to focus more on stakeholder-driven compliance efforts. However, this effect was not observed in the UK dataset, where market competition showed no moderating effect, indicating the variability of these dynamics across regulatory contexts. These findings are consistent with the work of Buysse and Verbeke (2003) who emphasized the importance of engaging a wide range of stakeholders to build trust and legitimacy.

From a population ecology perspective, the results highlight the importance of external pressures in shaping organizational survival and adaptation. The significant reductions in Scope 1 and Scope 2 emissions observed under the UK Companies Act can be interpreted as a form of environmental selection whereby firms adapt their practices to meet regulatory requirements to ensure their competitiveness and long-term survival (Hannan & Freeman, 1977). However, the lack of statistically significant changes in Scope 3 emissions suggests that addressing these emissions will require more comprehensive adaptation strategies. This is consistent with the concept of variation and selection in population ecology: firms respond differently to regulatory pressures, and only those that effectively balance compliance with market and operational

expectations are likely to thrive (Aldrich & Pfeffer, 1976). For the Grenelle II Law, the significant reduction in Scope 2 emissions reflects successful adaptation in energy-related practices, while the lack of broader emissions reductions suggests limited adaptation in more complex operational and supply chain activities.

The study's findings also have implications for policymakers. While the UK Companies Act demonstrates the potential of mandatory reporting frameworks to achieve measurable reductions in direct and energy-related emissions (Scopes 1 and 2), the lack of significant change in Scope 3 emissions highlights a critical limitation. Policymakers should consider integrating more comprehensive reporting requirements for supply chain emissions alongside robust verification mechanisms to ensure meaningful results. For the Grenelle II Law, the significant reduction in Scope 2 emissions illustrates the potential of well-targeted interventions. However, the lack of significant reductions in other scopes suggests that stronger enforcement and broader coverage may be required to achieve a more comprehensive impact. The study also highlights the role of industrial competition as a moderator of regulatory effectiveness. For the French Grenelle II Law, companies in less competitive markets showed greater responsiveness to Scope 1 emissions, but this effect was not observed in the UK dataset. These differences highlight the importance of tailoring regulatory frameworks to the unique market dynamics of each jurisdiction and industry. Finally, this study adds valuable insights to the ongoing debate on the financial implications of sustainability practices. The consistent association of financial leverage and company size (as captured by lppe) with higher emissions highlights the challenges that larger and more financially constrained companies face in reducing emissions. These findings are consistent with the work of Ioannou and Serafeim (2021) who highlight the role of sustainability-focused differentiation in sustaining competitive advantage. Companies that fail to adapt to evolving environmental and regulatory pressures risk not only compliance penalties but also reputational and competitive disadvantages.

5.2. Limitations and Future Research

While this study provides important insights into the impact of mandatory sustainability reporting, it is important to acknowledge several limitations that provide avenues for future research. First, the analysis from the full dataset is limited to the period from 2005 to 2020, which, while informative, may not capture the long-term effects of these regulatory measures. The datasets are also filtered further to three years before and after the respective laws, limiting the long-term predictions even more. The inclusion of years affected by the global financial crisis of 2008-2009 represents a critical confounding factor, as the economic downturn is likely

to have affected corporate behavior and emissions trends independently of the regulatory interventions studied, as well as COVID-19 approaching in the dataset by the year 2020. These macroeconomic disruptions underscore the need for cautious interpretation and highlight the potential for bias that may obscure regulatory effects. Geographically, the study focuses on France, Germany and the UK, three countries within the European regulatory and cultural landscape. While this provides a valuable context for understanding the impact of sustainability reporting within the European Union, it inherently limits the generalisability of the findings to regions with different regulatory environments, cultural norms or economic priorities. Extending this analysis to countries outside Europe, particularly those with contrasting regulatory frameworks or economic conditions, would provide a richer understanding of the global impact of mandatory sustainability reporting. While I have analyzed a number of control variables in this paper, I have not examined other economic factors. The current market situation obviously has a significant impact on a country's emissions, which also limits the significance of the results. For example, Brexit in the UK and the associated transport routes will have an impact on emissions. This is why there are already systems in place, such as the Carbon Border Adjustment Mechanism (CBAM), to help compensate for border adjustments in non-EU countries.

Methodologically, the difference-in-differences approach used in this study effectively accounts for heterogeneity but does not take into account the precise timing of regulatory implementation. The inability to pinpoint the exact day or month of the policy shock introduces the possibility of unobserved confounding factors that could influence the results. In addition, country-specific regulations beyond those examined in this analysis may have contributed to emissions trends, further complicating the attribution of observed effects solely to the laws examined. The heterogeneous treatment effects across sectors and firms are also not fully explored, which may mask varying responses to regulatory interventions. While the use of robust standard errors mitigates heteroskedasticity concerns, residual bias cannot be entirely ruled out. Additionally, the generalizability of these findings to various regulatory environments is limited because the design focuses on the contexts of specific European countries.

Another limitation is the reliance on self-reported emissions data. The lack of standardized reporting frameworks and third-party verification increases the risk of selective disclosure or 'greenwashing,' whereby companies may exaggerate or misrepresent their sustainability performance to meet public or regulatory expectations. Addressing this challenge in future research by including standardized and independently verified emissions data would improve

the reliability and comparability of results. Finally, this study does not explicitly examine requirement mechanisms or their interaction with corporate compliance. The intensity and consistency of enforcement are likely to vary across jurisdictions and play a critical role in determining the effectiveness of reporting mandates. Comparative studies examining the role of enforcement mechanisms in different regulatory contexts could provide important insights into the conditions under which sustainability reporting policies achieve their intended outcomes. Future research should aim to address these limitations by broadening the geographical scope to include non-European contexts, extending the time horizon to capture long-term effects, and incorporating more granular data on reporting practices and enforcement dynamics. Such efforts would contribute to a more comprehensive understanding of the interplay between mandatory reporting, corporate behavior, and environmental outcomes and ultimately inform the design of policies that maximize the effectiveness of sustainability reporting as a tool for advancing global climate and sustainability goals.

5.3. Conclusion

This study provides evidence that mandatory sustainability reporting laws can lead to significant reductions in greenhouse gas emissions, although their effectiveness varies by context and emission category. The Grenelle II Law in France showed limited success, with significant reductions observed only in Scope 2 emissions, reflecting improved control of energy-related emissions. However, the law had no impact on Scope 1 and Scope 3 emissions, highlighting weaknesses in policy design and enforcement when addressing more complex and direct emissions. In addition, companies in less competitive markets showed increased Scope 1 emissions, suggesting that regulatory efforts in concentrated markets require stronger mechanisms to counteract weak competitive pressures. In contrast, the UK Companies Act showed stronger effects, particularly on Scope 1 and Scope 2 emissions, highlighting the potential for well-structured reporting mandates to drive reductions in direct and energy-related emissions. The significant role of financial performance and physical assets (ROA, lppe) in shaping emissions reductions further underlines the importance of firm-specific resources in meeting regulatory targets. Moreover, the lack of significant changes in Scope 3 emissions in both cases highlights the complexity of addressing supply chain emissions and suggests the potential for regulatory displacement where emission-intensive processes are externalized to suppliers.

Hypothesis 2 highlights the role of market competition, with companies in less competitive markets responding more strongly to regulatory requirements for Scope 1 emissions.

Competitive dynamics played a limited role in shaping reductions in Scope 2 and Scope 3 emissions, highlighting the need for additional mechanisms to address systemic factors affecting these categories. These findings suggest that while mandatory sustainability reporting laws hold promise, their success depends on robust application, complementary policies, and a targeted focus on complex emissions categories such as supply chains.

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