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Non-Financial Reporting, Double Materiality, and Business Model Evaluation: An Empirical Study of ESG Ratings in Europe

Author

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Abstract

Purpose: This paper investigates the adoption of non-financial reporting (NFR) standards and the double materiality (DM) principle, and their possible implications on external performance measures, namely ESG ratings. By doing so, it positions reporting practices as mechanisms that affect disclosure quality and the transparency and accountability of firms' business models.

Design/Methodology/Approach: Longitudinal analysis over three years (2020–2022) was conducted using the 366 European listed companies' annual reports. Descriptive statistics and ordinary least squares regressions were employed to analyze the association between reporting practices, DM adoption, and ESG ratings from several rating agencies.

Findings: The results show that the adoption of non-financial reporting frameworks is associated with higher ESG ratings among European firms. However, the early adoption of double materiality does not yet have a significant impact on ESG performance at this stage.

Research implications: The study contributes to the business model literature by demonstrating how reporting practices and regulatory development build external representations of firms' value creation, delivery, and capture. It highlights the role of disclosure frameworks and double materiality as institutional forces with the capacity to transform business models to meet stakeholder and regulatory pressures.

Originality/Value: This study is one of the first longitudinal tests that empirically analyze the impact of non-financial reporting frameworks and DM on ESG ratings, and which sheds new light on how they impact evaluation of sustainable business model.

Keywords Reporting, Non-Financial Reporting, Double Materiality, ESG Ratings, Business Models

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1. Introduction

Recent European regulation has substantially increased interest in non-financial reporting (Hummel and Jobst, 2024a). Significant developments have occurred in the field of sustainability reporting, with the Non-Financial Reporting Directive (NFRD 2014/95/EU) representing the starting point for this discussion. The directive requires large public-interest companies (with more than 500 employees) to disclose sustainability-related information.

Subsequently, in 2022, the European Commission released a new directive, the Corporate Sustainability Reporting Directive (CSRD 2022/2464). The CSRD takes effect for the financial year 2024, extending the NFRD and converting previously voluntary non-financial reporting obligations into mandatory requirements. Such commitments were described in the European Sustainability Reporting Standards (ESRS) set forward by the European Financial Reporting Advisory Group (EFRAG) (Atanassov, 2022; Hummel and Jobst, 2024a). Furthermore, the standards introduced the principle of double materiality, which has emerged in conjunction with this rapid regulatory evolution.

The European Commission's 2019 Guidelines on Non-financial Reporting introduced the principle of double materiality (DM), which emphasizes the consideration of both financial and impact materiality. Financial materiality is defined as the impact of sustainability issues on a company's financial well-being. Conversely, impact materiality represents the effect of companies' activities on society and the environment. The guidelines instruct companies to consider both types when reporting their activities. Under the CSRD, companies must assess each materiality type separately and disclose material topics from both perspectives, ensuring that financial and impact-related information is reported independently (Hummel and Jobst, 2024b).

In addition to the European directives and regulations, several international sustainability reporting frameworks have emerged to facilitate the flow of information between companies and stakeholders (Atanassov, 2022). Examples of these frameworks include those set by the Global Reporting Initiative (GRI), the International Integrated Reporting Council (IIRC), the Sustainability Accounting Standards Board (SASB), and the Task Force on Climate-Related Financial Disclosures (TCFD) (Atanassov, 2022; Hummel and Jobst, 2024a).

There is a strong association between non-financial reporting and external organizational evaluations. Business model research increasingly focuses on how sustainability objectives can be incorporated into value creation, delivery, and capture. For instance, Lüdeke-Freund *et al.* (2024) offer sustainable business model design patterns that are very similar to non-financial reporting as well as ESG practices. Another illustrative example is the organization's sustainability performance, where the most precise measure is the ESG ratings (Banke *et al.,* 2022). A considerable number of studies have investigated the discrepancies in ESG ratings across different rating agencies, where the primary criterion examined was the quality of organizational reporting. For instance, some studies have examined the features of annual disclosures like size, content, readability, specificity, and usage of visual information in reports (Christensen *et al.,* 2021; Du and Yu, 2021). A few studies have examined the implementation of corporate reporting requirements (Antolín-López and Ortiz-De-Mandojana, 2023; Oliver Yébenes, 2024), while others (Aras and Hacioglu Kazak, 2022; Madison and Schiehll, 2021) examined the materiality assessments of the organizations in question. Some studies tested the general characteristics of the organizations, like their size, industry, leverage, and returns (Liu, 2022), while a few have objectively examined the

significance of adopting non-financial reporting frameworks. Additionally, longitudinal research on the impact of double materiality on ESG ratings remains limited.

The present study examines the development and evolution of these reporting standards/frameworks and the double materiality (DM) principle. The main objective is to test the potential impact of these developments on company reporting methods. Furthermore, it aims to assess their impact on performance evaluations by sustainability rating agencies that assess companies' environmental, social, and governance (ESG) practices. Business models not only dictate how firms produce and capture value but also serve as platforms for performance measurement. Reporting frameworks, as explained by Montemari *et al.* (2019), take a central role in setting these measurements since they influence the way external stakeholders judge firms. In this context, non-financial reporting and the double materiality approach can be explained as institutional drivers that extend beyond disclosure, directly influencing business model configurations due to regulatory and stakeholder pressures.

To achieve this objective, this study employed a longitudinal research approach combining two distinct analytical methods: descriptive analysis and ordinary least squares (OLS) regression. A sample of 366 European-listed companies was used, and their annual reports were collected alongside the ratings they obtained over three years (2020, 2021, and 2022). Furthermore, the ESG ratings of the sample from several different agencies were examined, measuring the correlation between the ratings and assessing their divergence (standard deviation). Subsequently, the impact of companies' adoption of non-financial reporting frameworks and double materiality on the ratings and their divergence was tested.

This study contributes to the existing research on non-financial reporting and sustainability ratings. The findings provide valuable insights to companies, regulators, and stakeholders and assist those who wish to gain a deeper understanding of the significance of the double materiality principle, non-financial reporting frameworks, and other elements that influence ESG ratings.

The remaining sections of this paper are organized as follows: Section 2 provides relevant background information describing the various key aspects related to the objective of this study. This includes non-financial reporting, the double materiality principle, the sustainability rating agencies (ESG ratings), and the relationship between them. Section 3 presents the adopted theoretical framework that informs the objectives and hypotheses of the study. The subsequent section of the paper (section 4) describes the methodology employed, while section 5 presents the results. This paper ends with a discussion of the results in Section 6 and a conclusion in Section 7.

2. Background

2.1 Background on Non-financial Reporting

Non-financial reporting is the process of disclosing and sharing information related to a company's activities and operations. Such a process is essential for the comprehension of a company's performance and position. Furthermore, it enables the identification of the impact of their activities concerning the environment, society, respect for human rights, anti-corruption, and bribery matters (Stolowy and Paugam, 2018). This practice reflects how companies integrate social and environmental concerns into business operations while prioritizing stakeholder engagement (Khan and Chinnasamy, 2022).

Haller *et al.* (2017) demonstrated that the term "non-financial information" includes a range of interpretations encompassing data about intangible assets, intellectual capital, contextual business information, and environmental, social, and governance (ESG) issues. However, the study did not identify a widely accepted definition of the term across academic and regulatory references.

In the study of Perrini (2006), the author employs a range of criteria to illustrate the concept of non-financial reporting, viewing it as an additional component to the conventional financial and economic reports. This form of reporting integrates both qualitative and quantitative data, encompassing social and environmental dimensions. By doing so, it broadens the scope of business disclosure and embeds stakeholder-oriented perspectives into corporate reporting. Perrini emphasizes that non-financial reporting focuses on continuous stakeholder engagement, aiming to balance their diverse interests. Moreover, it explicitly links a company's overarching purpose—achieving sustainable success—to the idea that improving social and environmental performance ultimately supports superior financial results (Perrini, 2006).

Similarly, Stolowy and Paugam (2018) describe non-financial reporting as an account of a company's business model, including an overview of its environmental, social, and governance (ESG) policies, initiatives, and performance outcomes. Their framework also highlights the disclosure of risks related to ESG issues, which are deeply intertwined with corporate strategy, operations, and management practices.

2.2 The Need for Non-financial Reporting

Numerous reporting regulations have been established to enhance corporate transparency and accountability to stakeholders (Manes-Rossi *et al.,* 2018). Although traditional financial reports address some stakeholder needs, they often fail to capture broader sustainability concerns. There remains a clear demand for non-financial information that addresses social and environmental issues. In this context, non-financial frameworks seek to bridge the gap between companies and their stakeholders. To achieve this, they provide disclosure guidelines and requirements that assist companies in providing high-quality, relevant, useful, comparable, and consistent non-financial information necessary for stakeholders (Manes-Rossi *et al.,* 2018).

Prior studies have investigated and compared non-financial reporting directives, regulations, and frameworks (Antolín-López and Ortiz-De-Mandojana, 2023; Bossut *et al.,* 2021; Hummel and Jobst, 2024a). The evolution of these frameworks was tracked and reviewed (Antolín-López and Ortiz-De-Mandojana, 2023) to gain insight into the current state of sustainability in businesses, comparing them and identifying their significant implications for both researchers and practitioners (Hummel and Jobst, 2024a). Furthermore, studies have investigated the implementation of materiality judgments and associated them with non-financial reporting practices (Antolín-López and Ortiz-De-Mandojana, 2023; Bossut *et al.,* 2021; Hummel and Jobst, 2024a).

The studies drew upon the Non-financial Reporting Directive (Directive 2014/95/EU) to analyze regulations requiring companies to disclose non-financial statements and sustainability performance evaluations. Antolín-López and Ortiz-De-Mandojana (2023) also discussed the recent replacement of the NFRD by the Corporate Sustainability Reporting Directive (CSRD, 2022), which expands the reporting scope to include larger companies as well as listed small and medium-sized enterprises (SMEs). Under the CSRD, companies are required to report sustainability performance in accordance with the European Sustainability

Reporting Standards (ESRS, 2023) established by the European Financial Reporting Advisory Group (EFRAG).

In addition to these directives, the authors reviewed international sustainability reporting frameworks, including the Global Reporting Initiative (GRI), Sustainability Accounting Standards Board (SASB), Task Force on Climate-related Financial Disclosures (TCFD), and the Carbon Disclosure Project (CDP). They found that these regulations and frameworks guide organizations in disclosing and assessing their environmental, social, and governance (ESG) impacts. Furthermore, the authors emphasized that such frameworks play a critical role in supporting stakeholders' understanding by ensuring companies report relevant and meaningful ESG information.

2.3 Introduction of the Double Materiality Principle

In 2019, the European Commission published the "Guidelines on non-financial reporting: Supplement on Reporting Climate-Related Information" (2019/C 209/011), assisting companies in the disclosure of non-financial information. Following Commission Delegated Regulation 2023/2772, ESRS 1, Section 3.3, page 9, and the CSRD Directive 2022/2464, Article 37, page 26, such information must be relevant, useful, consistent, and presented in a comparable manner. Like the 2019 guidelines, the communications from the European Commission did not impose any new legal requirements, yet the communication (Part 2.2) contains a novel regulatory principle called double materiality. Under this section, the reference to the "impact of [the company's] activities" introduces a new factor to be considered when assessing the materiality of non-financial information. In essence, the Non-Financial Reporting Directive (hereafter, the Directive) employs a dual perspective on materiality, which is referred to as "double materiality" (DM). This DM principle combines:

- The reference to the company's "development, performance, [and] position" indicates that the information in question is of a financial nature and therefore falls under the category of financial materiality (hereafter FM). In a general sense, it indicates the impact on the value of the company to facilitate an understanding of its development, performance, and position. Thus, climate-related information should be reported if it is necessary. This perspective is of particular interest to investors.
- The reference to the "impact of [the company's] activities" suggests that the company's operations have an environmental and social impact, which is a concept known as impact materiality. To facilitate an understanding of the external impacts of the company, climate-related information should be reported if necessary. This perspective is typical and of most interest to citizens, consumers, employees, business partners, communities, and civil society organizations.

The double materiality perspective assesses corporate performance from an economic, social, and environmental standpoint. The objective is to capture the overall effects of operations and events for a company and its surrounding stakeholders simultaneously.

The double materiality principle was subsequently adopted by EFRAG as a foundation for sustainability disclosures [i] and is defined in the Corporate Sustainability Reporting Directive (CSRD 2022/2464), which entered into force in January 2023. The initial application of this approach is scheduled for 2024, with the first reports incorporating this methodology expected in 2025. Under the CSRD, reporters must adopt a double-materiality perspective and consider, separately, risks to the undertaking (financial materiality) and the undertaking's societal/environmental impacts (impact materiality). The fitness checks on corporate reporting indicate that these two perspectives are frequently misunderstood or misapplied

(CSRD, Par. 29). Building on the principle of double materiality, standards should encompass all information that is material to users (CSRD, par. 37).

In addition to the significant efforts made by European regulations to adopt a dual perspective, research has explored various aspects of double materiality (DM), focusing on its definition and its measurement from two complementary perspectives (Adams *et al.,* 2021; Alexander, 2022; Baumüller and Sopp, 2022). These perspectives integrate the company's interests with those of its surrounding stakeholders. Other studies have investigated the application of DM to sustainability and ESG-related issues (Pronobis and Venuti, 2021; Worthington-Smith and Giamporcaro, 2022), as well as the relationship between corporate communication, ESG metrics, and sustainability. The overarching goal is to assess how double materiality can enhance sustainability reporting and performance evaluation. Similarly, Pronobis and Venuti (2021) argue that increased precision and transparency in measuring the overall impact of business activities can facilitate the adoption of DM. This approach provides a potential foundation for consistent reporting, enabling more effective disclosure of sustainability-related issues.

The findings of Worthington-Smith and Giamporcaro (2022) demonstrate the considerable influence of ESG factors on investment decisions, with a notable impact on companies, their financial performance, and sustainable development. To date, a few academic researchers (such as De Cristofaro and Gulluscio, 2023) have investigated the way companies have adopted DM as a guideline. The authors surveyed the publications of 58 corporations over three years in the context of fragmented regulatory frameworks for non-financial reporting across nations. The findings revealed that few companies—both European and non-European—incorporated double materiality into their reports. However, there was a notable increase in the number of companies that began to do so in 2021. Nevertheless, this was accompanied by distortions in the way they disclosed and described DM in their reports.

2.4 The Corporate Social Responsibility Ratings

Regulations play a pivotal role in facilitating the disclosure of information by companies. Similarly, other market participants have emerged to assess the sustainability performance of organizations, including corporate social responsibility (CSR) rating agencies. The concept of corporate social responsibility (CSR) emerged as a significant phenomenon in the twentieth century, with its explicit references dating back to the 1950s (Carroll, 2008). Escrig-Olmedo *et al*. (2019) have emphasized this growing significance of CSR and ESG (Environmental, Social, and Governance) rating agencies, which was particularly evident in the aftermath of the 2008–2009 financial crisis.

Scalet and Kelly (2010) defined CSR rating agencies as those that assess corporations based on their social and environmental performance. Escrig-Olmedo *et al*. (2019) demonstrated that these agencies evaluate corporate sustainability performance by implementing their own research methodologies to achieve this goal. The findings of these assessments serve as a fundamental and indispensable point of reference for stakeholders like investors, companies, financial markets, and academia. Avetisyan and Ferrary (2013) identified corporate social responsibility rating agencies (e.g., KO-CSR, ECODES, and Vigeo) as pivotal entities that assess companies' CSR performance by issuing scores and rankings that reflect the social and environmental conduct of the companies in question.

Corporate social responsibility (CSR) ratings guide the responsible conduct of businesses, directing stakeholders towards firms with responsible practices. These ratings reflect the transparency and accountability of companies in their reporting and enhance stakeholders'

trust in these firms and the broader global economy (Wilburn and Wilburn, 2013). Bui *et al.* (2022) demonstrate that climate change disclosure ratings exert pressure on poorly rated firms and prompt them to improve their disclosure practices concerning environmental matters. For example, the public disclosure of firms' emissions exerts pressure on high-polluting entities, which in turn compels them to adjust their practices and intensify their efforts to reduce these emissions.

CSR and environmental, social, and governance (ESG) ratings serve a similar function to that of a compass by indicating a firm's current position and charting its trajectory (Veenstra and Ellemers, 2020). According to the authors, these ratings specify the actions required in the realms of social, environmental, and governance considerations.

2.5 Non-financial Reporting and Its Relationship with ESG Ratings

The use of ESG data, whether it is disclosed by reporting businesses or sourced from external assessment bodies, has become increasingly prevalent in research. Using such data helps gain an understanding of the operations of companies and their impact on society and the environment (Fiaschi *et al.,* 2020). In their 2023 publication, Antolín-López and Ortiz-De-Mandojana discuss the potential effects of standardization and international reporting frameworks in facilitating the comparison of measurement metrics. Nevertheless, the authors emphasized the intricacy and heterogeneity of such sustainability reporting frameworks, which makes it challenging to integrate their requirements into the ESG rating methodologies. Another cause of heterogeneity is the large number of reporting entities involved and the differences between them. Furthermore, the authors highlighted issues with identifying material topics or selecting the significant reporting items, which is a key concern in this area. This selection task is complex due to the varying characteristics across different industries. Additionally, a significant proportion of CSR/ESG ratings appear to adhere exclusively to a financial materiality framework like the ratings of Bloomberg ESG, FTSE Russell, Sustainalytics Ratings, and MSCI (Antolín-López and Ortiz-De-Mandojana, 2023). These ratings concentrate on which ESG-related factors might affect business performance, particularly relevant in the context of shareholder returns. Adopting such an approach (that is, making investment portfolios more profitable) is at odds with the definition of corporate sustainability. The concept of corporate sustainability is predicated upon the identification of sustainability impacts that reflect the operations of companies, which in turn necessitate their mitigation.

According to the authors, only a few ESG ratings use a double materiality approach. Examples include Moody's ESG Scores, S&P Global ESG Scores, and ISS ESG Corporate Rating. However, the specific way in which they implement this is not apparent, adding to the complexity in the process of differentiating between sustainability and financial materiality.

External rating agencies also struggle to provide consistent performance assessments or ratings due to the lack of consistent sustainability reporting standards (Berg *et al.,* 2022; In and Schumacher, 2021). According to the authors, other problems prevent the provision of reliable ratings, like the unvalidated results provided by external bodies/raters, the lack of homogeneity of results, and the inaccuracy of the raw data provided by the rated companies in the disclosures. Finally, there is the subjectivity of the methodologies used by the assessors and their different weightings to the issues analyzed (Fiaschi *et al.,* 2020). In and Schumacher (2021) identify gaps in frameworks and standards for addressing ratings; additionally, there are stakeholders' concerns about potential ESG greenwashing. These gaps have led to efforts by key regulators to establish more robust sustainability frameworks.

In this case, there should be some consistent, robust, and well-structured disclosure requirements that accompany the development of the double materiality assessment.

3. Theoretical Framework and Research Purposes

3.1 Theoretical Framework

From a theoretical point of view, this study examined different theories that have been adopted by previous research to explain the impact of non-financial reporting on external ratings (ESG ratings). The findings show that several studies adopted the stakeholder theory (Dewi *et al.,* 2023; Du and Yu, 2021; Freeman, 1984) and legitimacy theory (Lai *et al.,* 2016; Manes-Rossi *et al.,* 2018; Umoren, 2015; Suchman, 1995), while others have adopted an interplay between different theories (Modugu, 2020), combining agency theory, stakeholder theory, and legitimacy theory.

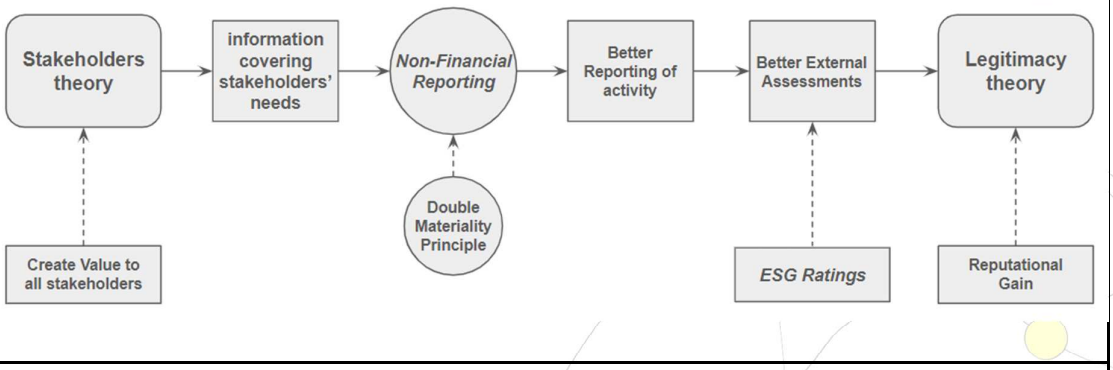
Some studies have highlighted the adoption of stakeholder theory and how it influences the production of high-quality sustainability reports that address the information needs of stakeholders, with the information in these reports relating to corporate social responsibility (CSR) efforts (Dewi *et al.,* 2023; Du and Yu, 2021). This theory facilitates engagement between stakeholders and companies by improving the mutual understanding of stakeholder needs and expectations (Dewi *et al.,* 2023). It also promotes transparency and accountability and builds trust by openly sharing information about organizations' sustainability efforts (Dewi *et al.,* 2023). The market response to CSR reports highlights investors' need for clear and transparent information, which is consistent with instrumental stakeholder theory, suggesting that satisfying stakeholder needs improves financial performance (Du and Yu, 2021).

Legitimacy theory highlights how reputational risks emerge when companies deviate from societal expectations (Lai *et al.,* 2016; Manes-Rossi *et al.,* 2018). In this sense, sustainability reporting becomes a strategic approach for organizations, helping them to gain legitimacy, especially when their actions are inconsistent with societal expectations (Lai *et al.,* 2016; Umoren, 2015). Despite the potential for greenwashing, sustainability reporting benefits companies, allowing those with better ESG performance to demonstrate social responsibility. This leads to an improvement in their reputation, which in turn attracts investors and customers (Manes-Rossi *et al.,* 2018). Non-financial reporting increases accountability and transparency and helps understand the social and environmental impacts of companies (Lai *et al.,* 2016; Manes-Rossi *et al.,* 2018; Umoren, 2015).

Combining several theories leads to a comprehensive examination of the factors that influence corporate sustainability disclosure practices (Modugu, 2020). Each theory has an advantage, including the reduction of information asymmetry with agency theory, taking stakeholder interests into account with stakeholder theory, and gaining social acceptance and legitimacy according to the legitimacy theory (Modugu, 2020).

This study applies stakeholder theory and legitimacy theory to examine regulatory developments in non-financial reporting and double materiality, testing their influence on external assessments such as ESG ratings. Stakeholder theory focuses on the concerns and interests of different stakeholders, aiming to align their interests by addressing their information needs. This underscores the importance of non-financial reporting and the use of a double materiality approach to identify material issues. Such reporting captures the overall impact of an organization's activities, leading to more comprehensive disclosure of its

operations. Consequently, improved transparency can result in better evaluations from ESG rating agencies, which in turn helps companies enhance their reputation and demonstrate the legitimacy of their business practices in the eyes of stakeholders, as explained by legitimacy theory. Figure 1 below illustrates the theoretical framework applied in this study.



Note: Stakeholder theory guarantees that the interests of stakeholders are considered, covering the stakeholders' demand for information. Such information is presented by the non-financial reporting, which adopts the double materiality to assess performance, leading to better reporting activity. In turn, such activity guides better reporting quality, which is then translated into better external assessments (ESG ratings). Eventually, better ratings provide the organizations with reputational gains, explained by legitimacy theory.

Figure 1. Theoretical Framework. Source: Author own work

3.2 Purpose and Objectives of the Study

There are potential benefits from the adoption of non-financial reporting and the double materiality principle, particularly evident in their potential impact on external ratings (ESG ratings). In this context, this study seeks to identify and confirm the relationship between the two.

Previous research has identified several factors that influence the rating of companies' performance, like the characteristics of companies' annual reports, including the size, content, readability, and specificity (Christensen *et al.,* 2021; Du and Yu, 2021), the adoption of corporate reporting standards (Antolín-López and Ortiz-De-Mandojana, 2023; Oliver Yébenes, 2024), and their materiality judgments (Aras and Hacioglu Kazak, 2022; Madison and Schiehll, 2021). The general characteristics of companies also play a role in influencing the assessment, like the company size, industry, leverage, and returns (Liu, 2022). These studies represent some of the attempts to identify the factors that influence ESG ratings; however, few have attempted to confirm the influence of non-financial reporting frameworks and the double materiality principle on such external ratings. To the best of available knowledge, there are no studies that have empirically tested such an influence over several years.

In this study, we examine the adoption of non-financial reporting and double materiality by analyzing annual disclosures from 366 European-listed companies. We track the development of reporting frameworks and double materiality over three consecutive years

(2020, 2021, and 2022), providing a descriptive analysis of their level of adoption and testing their impact on ESG ratings. The rating scores used in this study were obtained from five different rating agencies, which were used to conduct multiple regression models. The study used the individual ratings that the companies received over the three years by each of the rating agencies, alongside the average of these ESG ratings and the standard deviation (divergence) between them. In doing so, this study tries to answer the following question:

RQ. ***Do companies' adoption of non-financial reporting frameworks and the double materiality (DM) principle in their annual reports influence the ESG ratings they obtain and their divergence?***

Studies have discussed non-financial reporting frameworks and the double materiality principle and examined how they contribute to the provision of high-quality, relevant, comparable, and consistent non-financial information (Manes-Rossi *et al.*, 2018; Pronobis and Venuti, 2021). They have also demonstrated the potential of such frameworks and DM to improve the comparability of metrics used by organizations in reporting the impact of their activities. In addition, some studies examined the implementation of materiality judgments linked to non-financial reporting practices, which can improve the quality of reporting (Dewi *et al.,* 2023; Hummel and Jobst, 2024a; Pronobis and Venuti, 2021). Some also argue that there is a lack of consistent sustainability reporting standards, leading to inconsistent external assessments by ESG rating agencies (Berg *et al.,* 2022; In and Schumacher, 2021). Based on prior research findings, we propose the following hypotheses:

H1. Companies' adoption of non-financial reporting frameworks leads to better ESG ratings.

H2. Companies' adoption of the double materiality principle leads to better ESG ratings.

H3. Companies' adoption of non-financial reporting frameworks reduces the divergence between different ESG ratings.

H4. Companies' adoption of the double materiality principle reduces the divergence between different ESG ratings.

4. Methodology

4.1 Sample Composition and Data Collection

For this study, we selected 366 European-listed companies operating in 25 countries and covering 42 sectors based on the ICB sector classification. These companies vary in size, with their total assets ranging from 1.2 million euros to 25.8 billion euros. Sample selection was primarily driven by data availability. We randomly selected 1,000 European-listed companies from Refinitiv Eikon and collected available ESG ratings. Because many firms lacked ratings, we retained the 366 companies with the most complete rating records. The final sample comprised the 366 companies with the most available ratings from different agencies. The details about the companies, including their size, industry, and origin, are provided in Appendix 1.

In the following phase, we collected the annual reports of the 366 companies over three years (2020, 2021, and 2022). We obtained 1,097 reports from the companies' official websites. We then maintained the ESG ratings for the sample from five ESG rating agencies, including Reuters Refinitiv, MSCI, Sustainalytics, CSRhub, and S&P Global ESG. In addition to the ESG ratings, we also collected ratings from three credit rating agencies, including Moody's, S&P Global Credit Ratings, and Fitch Ratings, to compare the ESG vs Credit ratings convergence.

In the collection process of the ratings, we searched the rating agencies' official online open-source databases like MSCI ESG Ratings & Climate Search Tool [ii] and the Sustainalytics ESG Rating tool [iii]. Missing ratings were retrieved manually from company annual reports by searching for rating-agency mentions and extracting reported scores. Appendix 2 contains a detailed description of the ratings obtained.

In the next step, we used R-Studio to extract data from the annual reports, including 366 in 2020, 366 in 2021, and 365 in 2022 (1097 in total). Specifically, we extracted keyword occurrences and frequencies. In addition, we performed a manual extraction of the tables of contents of these reports. Finally, we collected data on the general and financial characteristics of the sample from the Refinitiv Eikon database. These variables included information on company size, industry, and country of origin, in addition to some financial variables such as their returns, total capital, and leverage.

After collecting the data, we calculated several variables representing the different factors covered by previous research. These include the characteristics of the reports, such as their readability using the LIX index, the specificity of the reports measured by checking the frequency and variety of units of measurement used in the report, and the level of visualization in the report by checking the frequency and variety of visual content presented (e.g., the number of tables, figures, charts, and other visual content included).

In addition to the characteristics of the reports, we created variables that describe the content of these reports by examining their main structure. We identified the main sections included based on their tables of contents, investigating their level of adoption of non-financial reporting standards and frameworks. We reviewed their use of specific indicators suggested by these frameworks to report on their performance and included variables describing their process for making materiality judgments. Finally, we examined companies' tendency to use specific targets and baseline references to measure and report changes in their performance and identified the likelihood of them advertising the previous ratings they received from the various agencies in the previous year.

4.2 Data Analysis

4.2.1 Phase One: Adoption of Non-financial Reporting Standards and Double Materiality by Companies

We divided the analysis into two main phases. In the first phase, we examined the current state of non-financial reporting and the double materiality principle by analyzing its evolution in companies' annual disclosures over the three years 2020, 2021, and 2022. We searched the names and acronyms of several non-financial reporting regulations/frameworks identified in previous research (Antolín-López and Ortiz-De-Mandojana, 2023; Bossut *et al.,* 2021; Hummel and Jobst, 2024a). We also searched for keywords related to materiality principles like financial materiality, impact materiality, and double materiality. We aggregated counts and frequencies of frameworks and materiality keywords and used them to visualize adoption trends for 2020–2022.

4.2.2 Phase Two: Investigating the Factors in Non-financial Reports that Influence ESG Ratings

In the second stage of the analysis, we ran ordinary least squares (OLS) regression to examine the potential influence of companies' adoption of non-financial reporting frameworks and the double materiality principle on their ESG ratings. To run this regression, we constructed

three separate datasets, each dedicated to a specific year (2020, 2021, and 2022). We then associated each dataset with the ratings received by companies in the following year (n+1). For example, we associated the file containing the data related to the annual reports of 2020 with the ratings obtained in 2021 to investigate the influence of the 2020 factors in the reports on the ratings that the companies received later in 2021.

We tested multiple (OLS) regression models to examine the influence of this adoption (frameworks and double materiality) on the external ESG ratings, their average, and their divergence. In this sense, we ran three general models in several iterations over the three years. Equation 1 tests the influence of the variables we explained earlier on each of the ratings (by each unique rating agency). This test changes in the ratings that companies received from the five ESG rating agencies separately. Equation 2 tests the impact of the variables on the average ESG ratings in each year, while Equation 3 tests the dispersion (standard deviation) of the ESG ratings per year. We provide the three equations below.

$$\textbf{\textit{ESG-rate20xx}} = \beta 0 + \beta 1(DM\text{-}Frq) + \beta 2(MAT\text{-}Fre) + \beta 3(MAT\text{-}Div) + \beta 4(FW\text{-}Frq) + \beta 5(FW\text{-}Div) + \beta 6(TAR\text{-}Frq) + \beta 7(TAR\text{-}Div) + \beta 8(SPE\text{-}VIS\text{-}Frq) + \beta 9(SPE\text{-}VIS\text{-}Div) + \beta 10(TOPIC\text{-}Fin) + \beta 11(TOPIC\text{-}Gov) + \beta 12(TOPIC\text{-}Imp) + \beta 13(READ\text{-}Ind) + \beta 14(RATE\text{-}INC) + \beta 15(LEV) + \beta 16(LIQ) + \beta 17(LOG\text{-}TA) + \beta 18(ROA) + \beta 19(ROE) + \beta 20(INDUS) + \varepsilon \quad (1)$$

$$\textbf{\textit{AVG-rate20xx}} = \beta 0 + \beta 1(DM\text{-}Frq) + \beta 2(MAT\text{-}Fre) + \beta 3(MAT\text{-}Div) + \beta 4(FW\text{-}Frq) + \beta 5(FW\text{-}Div) + \beta 6(TAR\text{-}Frq) + \beta 7(TAR\text{-}Div) + \beta 8(SPE\text{-}VIS\text{-}Frq) + \beta 9(SPE\text{-}VIS\text{-}Div) + \beta 10(TOPIC\text{-}Fin) + \beta 11(TOPIC\text{-}Gov) + \beta 12(TOPIC\text{-}Imp) + \beta 13(READ\text{-}Ind) + \beta 14(RATE\text{-}INC) + \beta 15(LEV) + \beta 16(LIQ) + \beta 17(LOG\text{-}TA) + \beta 18(ROA) + \beta 19(ROE) + \beta 20(INDUS) + \varepsilon \quad (2)$$

$$\textbf{\textit{SD-rate20xx}} = \beta 0 + \beta 1(DM\text{-}Frq) + \beta 2(MAT\text{-}Fre) + \beta 3(MAT\text{-}Div) + \beta 4(FW\text{-}Frq) + \beta 5(FW\text{-}Div) + \beta 6(TAR\text{-}Frq) + \beta 7(TAR\text{-}Div) + \beta 8(SPE\text{-}VIS\text{-}Frq) + \beta 9(SPE\text{-}VIS\text{-}Div) + \beta 10(TOPIC\text{-}Fin) + \beta 11(TOPIC\text{-}Gov) + \beta 12(TOPIC\text{-}Imp) + \beta 13(READ\text{-}Ind) + \beta 14(RATE\text{-}INC) + \beta 15(LEV) + \beta 16(LIQ) + \beta 17(LOG\text{-}TA) + \beta 18(ROA) + \beta 19(ROE) + \beta 20(INDUS) + \varepsilon \quad (3)$$

The ratings provided by the various agencies have different scale levels. We therefore standardized them to make the scores of the different agencies comparable. The scale adjustment process we performed on the scores/ratings is shown in Appendix 3. Once we had all the scores in a comparable format (percentages from 0% to 100%), we started by investigating the status of the scores obtained and checked the ratings that the companies had received from different rating agencies. We plotted credit and ESG ratings and calculated correlations to examine whether companies received similar ratings from different agencies in the same year.

In the next step, we identified the variables to include in our model by exploring several studies that tried to identify the factors that influenced ESG ratings. One example is the study by Conway (2019), which examined the relationship between good integrated reporting and ESG ratings. The author found no correlation between the two; however, higher governance scores were observed for companies that produced exemplary reports.

Tang (2022) found that firms' ownership structure affects ESG outcomes. In Liu's (2022) study, the results showed that greater quantitative ESG disclosure leads to greater rating divergence. The author also found several factors that reduce the divergence, including the adoption of sustainable reporting tools and standards developed by regulators or non-

governmental organizations. The author also found that rating divergence is reduced when companies use similar metrics.

Santamaria *et al*. (2021) highlighted the important role of integrated reporting in promoting high ESG scores, while Kotsantonis *et al*. (2019) emphasized the need for a clearer understanding of ESG metrics and addressed inconsistencies between data providers. Giannarakis *et al*. (2014) found that the inclusion of more sustainability/impact topics positively influenced ESG scores. Examples of these topics include carbon reduction initiatives and greenhouse gas emissions.

We collected different sets of variables that the studies have used and tested. Appendix 4 shows the variables in each of these studies. For the dependent variables, these studies tried to assess several factors, including the average of the ESG ratings and their standard deviation (dispersion). Some used disclosure score, materiality score, and reporting quality, while others tested the level of innovation by analyzing the number of patents held by companies.

For the independent and control variables, the studies used several variables in their analysis. Some of these variables are related to the quality of companies' disclosure, which is assessed by using existing indices or by developing new ones. For example, some used scores provided by existing databases, like the disclosure score provided by the Refinitiv Eikon database. There are also other variables used, such as the number of ESG metrics/indicators reported by companies, the disclosure of material issues, the tone of the annual report, and its readability. Additionally, the studies used variables related to the characteristics of the company, like company size, age, industry, sector, and origin. There are also variables related to the auditors and analysts who assess the companies, and the financial condition/performance of the companies, including return on assets and equity, liquidity, leverage, and operating costs.

We selected independent variables reflecting organizations' adoption of non-financial reporting frameworks and application of double materiality assessments. For this reason, we chose several variables, including Framework Frequency (FW-Frq), Framework Diversity (FW-Div), and Double Materiality Frequency (DM-Frq). We examined these variables to confirm their impact on external evaluations (ESG ratings) and to test their influence on the ratings' average and their convergence (the reduction in the standard deviation between different ratings).

As for the other variables, we chose the ones used in previous studies to assess the impact of reporting on external ratings. The variables combine the characteristics and financials of the reporting companies, like their size (log-total assets), industry, leverage, liquidity, return on assets, and return on equity. We used other control variables that describe the annual reports like the readability of the file (using the LIX index), the level of specificity (using more units of measurement to report performance), and the level of visualization (the number and variety of graphical representations included in the file, such as tables, figures, charts, graphs, maps, etc.).

We also included factors that describe the content of the files by summarizing the main themes found in the table of contents, including financial governance and sustainability/impact issues. In addition, we added variables that describe how companies assess the performance of their activities, such as their use of materiality judgments. These combine the reference to double materiality, financial materiality, impact materiality, and the materiality matrix. We also examined companies' use of targets and baseline references by searching for keywords such as 'baselines,' 'base years,' 'base values,' and 'targets.

Finally, we checked whether the companies disclosed their previous ratings from different rating agencies, and if they used them as a way of promoting their responsible performance. To achieve this, we counted the number of ratings received from different agencies in the files. A detailed description of the variables and how we calculated them is presented in Table 1.

Independent & Control Variables	Definition	Source
DM-Frq	The number of the double materiality principle mentions in the company's report (searching the frequency or the word double materiality) *(scale)*	Annual Report
MAT-Fre	The sum of the keywords related to materiality including the following keywords: Double materiality / Materiality / Materiality Matrix / Financial Materiality / Impact Materiality *(scale variable)*.	
MAT-Div	The count of the keywords described in (MAT-Frq) *(ordinal variable between 0 and 5)*.	
FW-Frq	The sum of the frequencies of non-financial reporting frameworks/standards mentions including the acronyms like ESRS, CSRD, NFRD, TCFD, SASB, IIRC, SASB, DJSI, SDG, and CDP *(scale variable)*.	
FW-Div	The diversity or count of the keywords described in (FW-Frq) *(categorical from 0 to 10)*.	
TAR-Frq	The sum of keywords specifying a target & baseline reference in assessing companies' activities (frequency of the following keywords: target, baseline, base year, base value). *(scale)*	
TAR-Div	Counting the occurrences of the keywords described in (TAR-Frq) *(ordinal variable between 0 and 4)*	
SPE-VIS-Frq	Summing the: - frequencies of financial Units including USD / EUR / $ / € / and the following measurement units tCO2e/ tCO2e_1/ °C/ °F/ kelvin/ kWh/ MWh/ GWh/ m^3/ Mm^3/ Tonnes/ Kilograms/ Hectares/ hours/ days/ years/ m^2/ ft^2/ mi/ miles *(scale variable)*. - frequencies of visualization-related keywords including Table / Chart / Graph / Figure / Diagram / Image / Map / Histogram / Plot *(scale variable)*.	
SPE-VIS-Div	Counting the: - occurrences of financial units, measurement units, and visualization-related keywords *(ordinal variable between 0 and 29)*.	
TOPIC-Fin	The reports' table of contents lists financial topics with keywords: shareholder, investor, balance sheet, income statement, capital, liquidity, debt, cost, revenue, return, and profit *(ordinal variable between 0-10)*.	Annual Report Table of content
TOPIC-Gov	The reports' table of contents lists governance topics with keywords: Corporate Governance, Management report, Strategic report, Risk factors, Risk management, Internal control *(ordinal variable between 0-6)*	
TOPIC-Imp	The report's table of contents lists sustainability topics with keywords: Stakeholders, environment, climate change, pollution, emissions, energy, water, waste, society, human rights, anti-corruption, employee, customer, client, supplier, competitors, community, community engagement, compensation, diversity, diversity and inclusion, product safety *(ordinal variable between 0-22)*.	

Independent & Control Variables	Definition	Source
READ-Ind	Lix index assesses the readability of the annual report (calculated by summing two numbers: the average sentence length and the percentage of words of more than six letters (Van Oosten et al., 2010).	Annual Report
RATE-INC	The number of previous year ratings mentioned by the companies in their reports using keywords: MSCI, Vigeo eiris, S&P global, ISS ESG, Sustainalytics, CSRhub, Refinitiv, Ecovadis, Robecosam (0-9 categories).	
LEV	The company's Leverage (using borrowed money to invest) *(scale)*	Eikon Database
LIQ	The company's liquidity (availability of liquid assets to a market or company) *(scale)*	
LOG-TA	The company's size is measured by the log of its total assets *(scale)*	
ROA	The company's total return on assets *(scale)*	
ROE	The company's total return on equity *(scale)*	
INDUS	The company's sector group according to Industry Classification Benchmark (ICB) *(ordinal variables with 42 category codes)*	
Dependent Variable	**Description**	**Source**
CRD-rate20xx	The credit ratings are obtained manually from official websites/databases of three credit rating agencies (and the sample annual reports to fill in missing values) including Moody's S&P Global, and FITCH rating. *(scale adjusted using the table in Appendix 2)*	Rating agencies' official websites & companies' annual reports
ESG-rate20xx:	The ESG ratings are obtained manually from official websites/databases of five ESG rating agencies (and the sample annual reports to fill in missing values) including Eikon, MSCI, Sustainalytics, CSRhub, S&P global ESG in years 2021, 2022, and 2023 *(scale adjusted using the table in Appendix 2)*	
AVG-rate20xx	the average ratings obtained from the different agencies in a specific year (2021, 2022, and 2023). *(scale)*	
SD-rate20xx	the standard deviation of the ratings obtained from the different agencies in a specific year (2021, 2022, and 2023). *(scale)*	

Table 1. Variables' description and sources

After identifying the variables to be tested in this study, we provide their descriptive statistics, measure the correlation between the dependent variables, and then develop the regression models.

5. Results

5.1 Phase One: Adoption of Non-financial Reporting Standards and Double Materiality by Companies

We begin this phase by showing the adoption of non-financial reporting regulations/frameworks and double materiality by companies in the three years 2020, 2021, and 2022. Figures 2 and 3 below show the results.

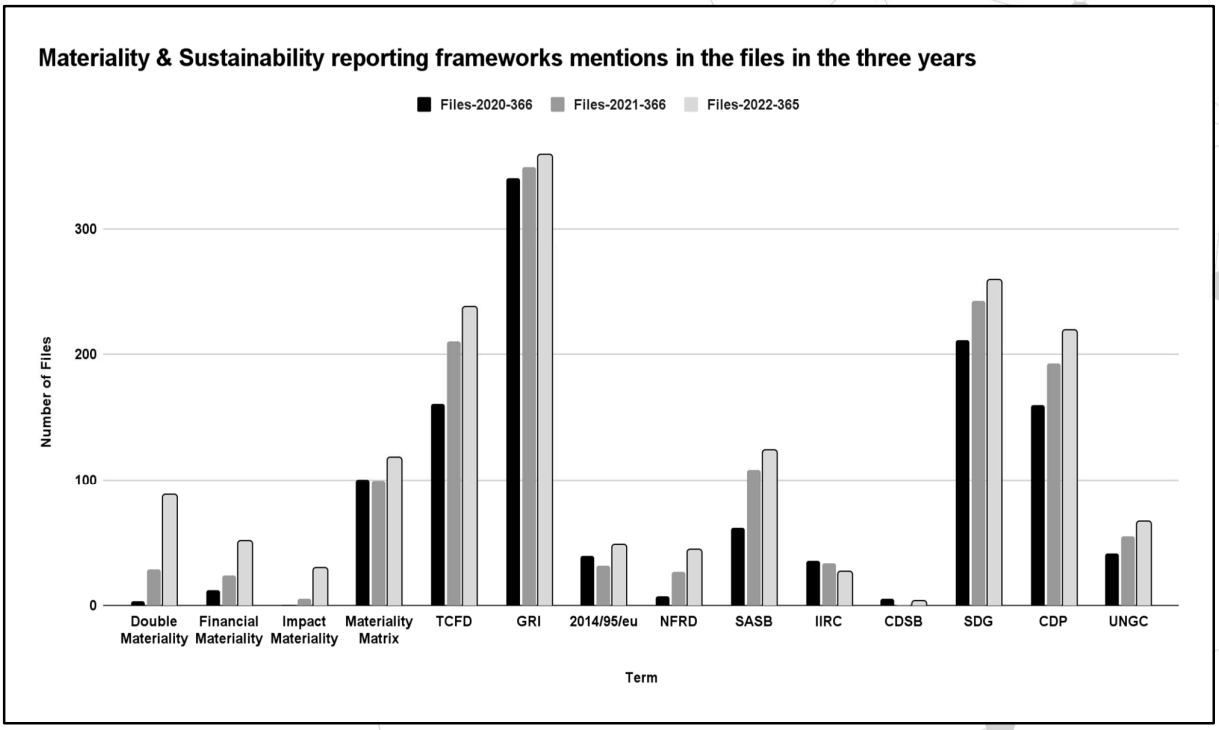


Figure 2. Non-financial reporting regulations/frameworks and materiality adoption.

The number of sustainability frameworks and materiality-related keywords used in reports increased, reflecting a rising adoption trend. Mentions of double materiality rose from 4/366 (≈1.1%) in 2020 to 29/366 (≈7.9%) in 2021, and 88/365 (≈24.1%) in 2022, indicating rapid uptake. The related concepts (financial materiality, impact materiality, and materiality matrix) have also increased. On the other hand, non-financial reporting regulations and frameworks also showed a very high adoption rate in 2022, including GRI (359/365 reports), SDG (259/365), TCFD (237/365), and CDP (219/365).

Figure 3 shows the double materiality principle referenced by the 366 companies in the reports of the three years 2020, 2021, and 2022. Only one company adopted the principle in all three years. 20 companies adopted it in 2021 and 2022. One company mentioned it in 2020 and 2021 but stopped in 2022. In total, 4/366 companies in our sample mentioned it in 2020, 29/366 in 2021, and then 88/365 in 2022. This increase in adoption reflects companies' interest in and consideration of the principle, reflected by the growing rate, from 1.09% in 2020 to 24.1% in 2022.

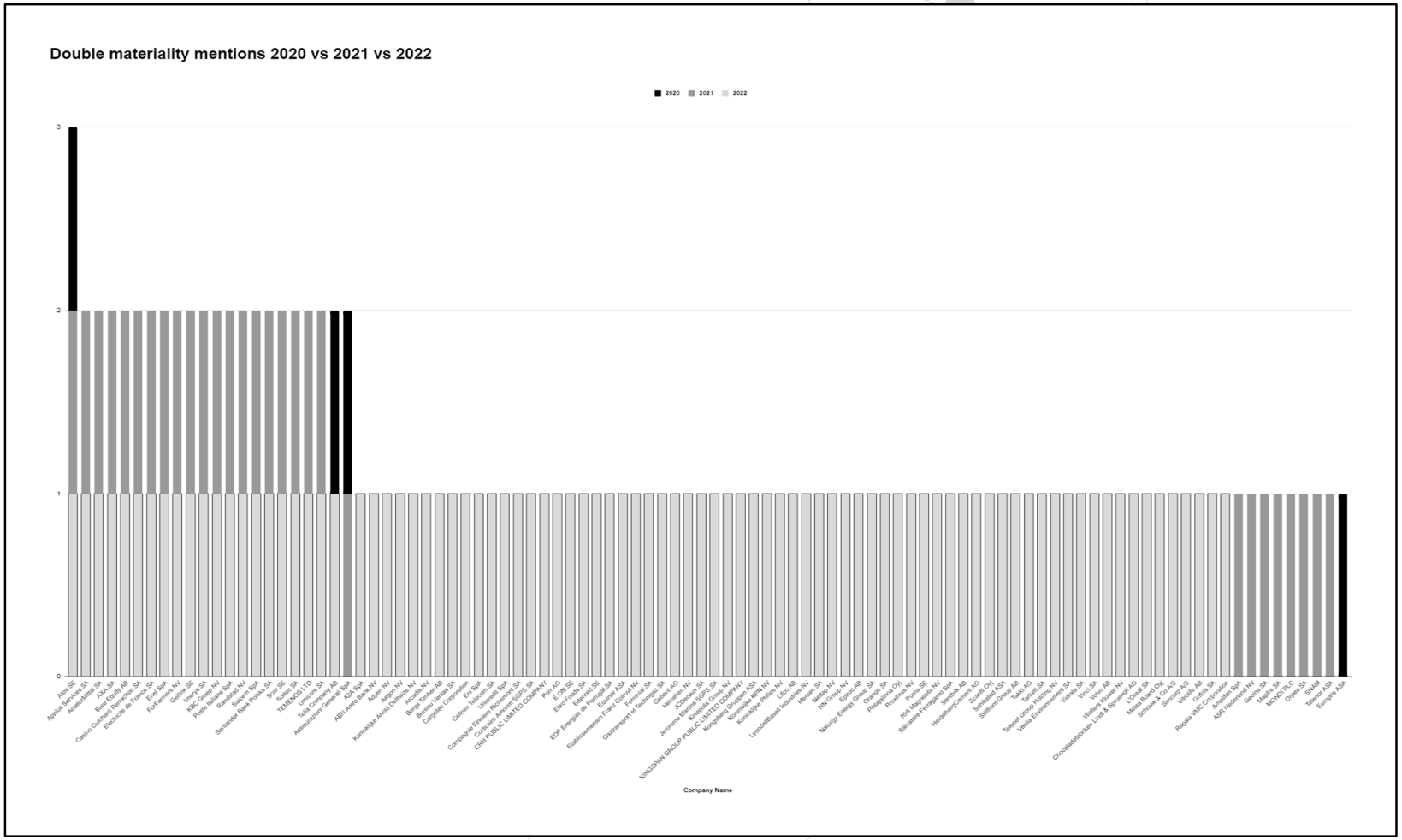


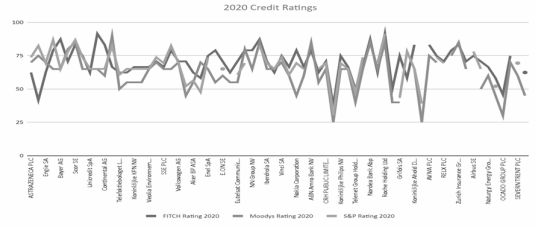
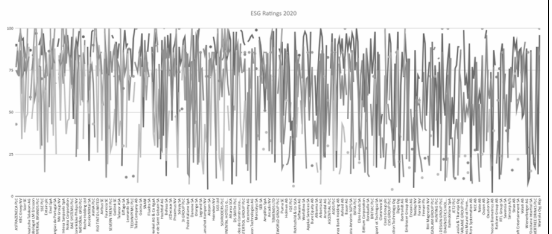
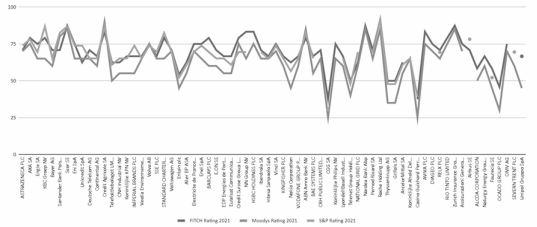
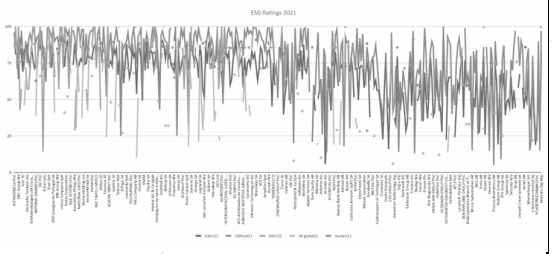
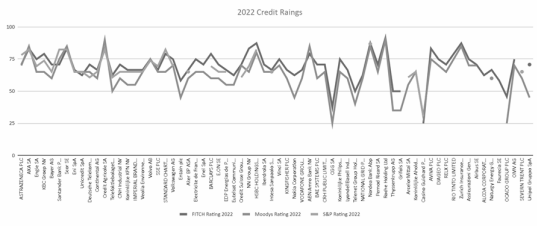
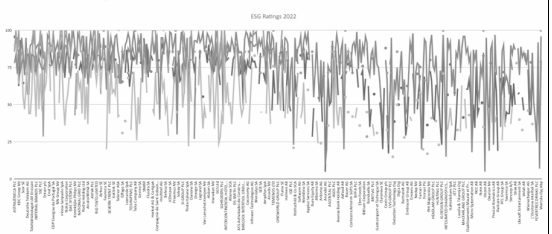
Figure 3. The evolution of double materiality adoption from 2020 to 2022

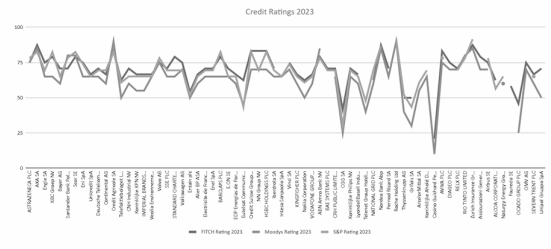
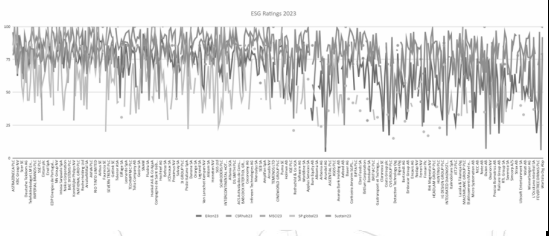
In the following section, we move on to the second phase of the analysis, which presents the results of the empirical and regression analysis. This analysis helps to identify the influence of non-financial reporting and double materiality on external assessments of companies' ESG performance.

5.2 Phase Two: Investigating the Factors in Non-financial Reports that Influence ESG Ratings

5.2.1 Descriptive Statistics

We begin this phase of the analysis by examining the relationship between credit and ESG ratings and examining the convergence between them over four years (2020, 2021, 2022, and 2023). We plotted the credit and ESG ratings and calculated their correlation. Figure 4 below shows the plots of the different ratings over the four years.

Credit Ratings	ESG ratings
	
	
	

Credit Ratings	ESG ratings
	

Note: This table displays the credit and ESG rating plots for four years. It starts with the graphs of the year 2020 and ends with those of 2023.

Figure 4. The plot of Credit ratings vs ESG ratings from the years 2020 to 2023

In addition to the graphs, we calculated the correlations between the credit ratings and the ESG ratings. Table 2 shows the minimum, maximum, average, and standard deviation of the ratings.

		Credit Ratings		
Year	**2023**	**2022**	**2021**	**2020**
Min	0.878	0.836	0.877	0.494
Max	0.939	0.889	0.932	0.861
Avg	0.855	0.854	0.905	0.643
SD	0.029	0.029	0.027	0.192
		ESG Ratings		
Min	0.065	0.079	0.015	0.031
Max	0.692	0.704	0.745	0.452
Avg	0.351	0.374	0.361	0.268
SD	0.195	0.243	0.202	0.116

Table 2. The descriptives of Credit and ESG ratings across the four years

Both the graphs in Figure 4 and the correlations in Table 2 show a significantly high degree of convergence between the three credit ratings. Over the four years, the average correlations ranged from 0.643 to 0.905. The opposite is true for ESG ratings, with an average correlation ranging from 0.268 to 0.374. These results are in line with previous research (Berg *et al.,* 2022). Appendix 2 provides additional descriptive analysis of the different ratings.

After presenting the descriptive statistics of the dependent variables (ESG ratings), we display the descriptive statistics of the independent variables in Table 3 for the three years (2020, 2021, and 2022). The results show that variables of interest, such as double materiality mentions per report (DM-Frq), increased over time. The maximum mention frequency of this principle has increased from 2 to 5 to 25 times in some reports between 2020 and 2022. The diversity of frameworks mentioned (FW-Div), and their frequency (FW-Frq) also increased over the three years. Other variables in the model also increased, including materiality diversity (MAT-Div), materiality frequency (MAT-Frq), the target diversity (TAR-Div), and frequency (TAR-Frq).

Independent Variables															
Year	2020					2021					2022				
Descriptive Statistics	**Obs**	**Mean**	**Std. Deviation**	**Minimum**	**Maximum**	**Obs**	**Mean**	**Std. Deviation**	**Minimum**	**Maximum**	**Obs**	**Mean**	**Std. Deviation**	**Minimum**	**Maximum**
DM-Frq	366	0.014	0.138	0	2	365	0.167	0.634	0	5	365	0.702	2.204	0	25
MAT-Fre	366	13.615	13.32	0	88	366	17.063	17.679	0	140	365	20.481	20.172	0	144
MAT-Div	366	1.258	0.611	0	4	366	1.418	0.813	0	5	365	1.746	1.107	0	5
FW-Frq	366	76.217	190.086	0	2733	366	101.587	302.971	0	5160	365	104.658	201.12	0	3156
FW-Div	366	2.989	1.9	0	9	366	3.661	2.014	0	9	365	4.339	2.195	0	11
TAR-Frq	366	79.154	63.848	0	362	366	96.563	79.56	0	484	365	118.648	90.198	0	554
TAR-Div	366	1.695	0.741	0	3	366	1.855	0.724	0	4	365	2.036	0.759	0	4
SPE-VIS-Frq	366	495.56	349.931	21	1949	366	3308.574	2614.299	68	18734	365	3636.077	2653.578	87	18932
SPE-VIS-Div	366	11.324	2.839	4	16	366	20.008	3.716	5	29	365	21.62	3.978	7	29
TOPIC-Fin	366	2.041	1.561	0	8	366	1.893	1.511	0	8	365	1.88	1.503	0	8
TOPIC-Gov	366	2.984	1.704	0	9	366	2.899	1.633	0	8	365	3.038	1.633	0	9
TOPIC-Imp	366	1.835	1.842	0	10	366	2.036	2.166	0	12	365	2.107	2.128	0	11
READ-Ind	366	53.406	5.568	0	63.828	366	54.011	5.122	26.09	67.19	365	54.069	6.143	0	111.91
RATE-INC	366	2.349	2.596	0	10	366	2.623	2.645	0	10	365	2.861	2.566	0	10
LEV	366	0.231	0.148	0	0.759	366	0.22	0.15	0	1.01	365	0.219	0.151	0	0.959
LIQ	366	0.316	2.198	-0.387	33.836	366	0.453	3.485	-0.405	50.387	365	0.378	2.883	-0.578	40.233
LOG-TA	366	16.035	2.382	10.442	33.086	366	16.089	2.24	9.846	24.021	365	16.149	2.242	9.392	23.973
ROA	366	2.933	9.83	-56.36	80.13	366	5.9	16.451	-109.6	234.58	365	3.732	14.038	-205.15	44.9
ROE	366	5.051	26.447	-188.42	165.82	366	-1.186	258.656	-4883.64	451.12	365	1.807	90.887	-1117.92	103.93
INDUS	366	5586.075	2237.812	1310	8592	366	5573.589	2239.495	1310	8592	365	5573.589	2239.495	1310	8592

Note(s): All variables are defined in Table 1

Table 3. The descriptives of the different independent variables in the three years

Following the presentation of the descriptive statistics, we provide an analysis of the correlations for the different variables we tested in this study.

5.2.2 Correlation Analysis

Table 4 shows the Pearson correlation matrix and the variance inflation factor (VIF) for the variables in this study in 2020. We conducted the same analysis for the variables in 2021 and 2022 with untabulated results. After checking the different correlations between the variables, we found that double materiality mentions (DM-Frq) had no significant correlation with average ESG ratings, which was the case in the three years (2020, 2021, and 2022). The opposite was true for the diversity frameworks (FW-Div) that had significant positive correlations ranging from 0.457 to 0.55 over the three years. The same can be said for the divergence (standard deviation) of the ESG ratings. Double materiality had no impact on the divergence. However, the use of different sustainability reporting frameworks (FW-Div) had a significant negative correlation with the divergence of the ESG ratings over the three years, with a correlation ranging from -0.12 to -0.26.

In terms of collinearity between the independent variables, the matrices show acceptable ratios (Dormann *et al.,* 2013), all below 0.7 for all variables in all three years. In addition, the variance inflation factor (VIF) of the independent variables was less than 3 in the three years, ruling out the possibility of collinearity between these variables (Dormann *et al.,* 2013; García *et al.,* 2015).

5.2.3 Multivariate Analysis

In this section, we present the results of the multivariate analysis to examine the possible influence of the adoption of non-financial reporting standards/frameworks and the double materiality principle on the ESG ratings of reporting companies. Table 5 summarizes the results of the three main (OLS) regressions. These regressions consist of three models, including the individual ESG ratings, the average ESG ratings, and their divergence. Each of the three models has multiple iterations based on the years 2020, 2021, and 2022. Appendices 5, 6, and 7 report the detailed multivariate results of these regressions for each year separately, in addition to the evaluation metrics of the models.

In total, we tested 21 models, seven models per year in 2020, 2021, and 2022. These seven models are distributed as follows. Five models that use each agency's ratings as the dependent variable, e.g., Eikon, CSRhub, MSCI, S&P Global ESG, and Sustainalytics. One model uses the average of the ratings, and one uses their divergence (standard deviation) as the dependent variable.

Of the 21 models we tested, 16 were significant. In 2020 and 2021, five of the seven models were significant, excluding the MSCI and Sustainalytics models. In 2022, all models except MSCI's were significant (six out of seven).

Pearson's Correlations	2020																					
Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	VIF
1 SUS-AVG-2021	—																						-
2 SUS-SD-21	**-0.265**	—																					-
3 DM-Frq	0.097	-0.062	—																				1.213
4 MAT-Fre	**0.23**	-0.068	0.096	—																			1.451
5 MAT-Div	**0.29**	-0.075	**0.317**	**0.418**	—																		1.677
6 FW-Frq	**0.19**	-0.019	0.08	**0.195**	**0.182**	—																	1.205
7 FW-Div	**0.55**	**-0.121**	0.074	**0.393**	**0.422**	**0.295**	—																2.325
8 TAR-Frq	**0.476**	**-0.181**	0.014	**0.344**	**0.29**	**0.127**	**0.529**	—															1.827
9 TAR-Div	**0.311**	-0.039	0.095	**0.378**	**0.29**	**0.143**	**0.485**	**0.444**	—														1.447
10 SPE-VIS-Frq	**0.434**	**-0.108**	0.011	**0.326**	**0.414**	**0.256**	**0.569**	**0.565**	**0.364**	—													2.403
11 SPE-VIS-Div	**0.313**	-0.039	0.024	**0.303**	**0.45**	**0.251**	**0.485**	**0.355**	**0.355**	**0.588**	—												1.798
12 TOPIC-Fin	0.043	0.045	-0.041	-0.004	-0.007	-0.096	-0.038	-0.062	0.051	-0.012	0.005	—											1.239
13 TOPIC-Gov	**0.178**	-0.013	-0.069	**0.137**	**0.226**	0.03	**0.191**	**0.253**	**0.134**	**0.317**	**0.265**	**0.39**	—										1.525
14 TOPIC-Imp	**0.285**	**-0.142**	-0.067	**0.159**	**0.182**	**0.197**	**0.28**	**0.24**	**0.185**	**0.235**	0.101	**0.245**	**0.405**	—									1.442
15 READ-Ind	0.095	-0.1	0.015	**0.139**	0.104	0.077	**0.213**	**0.113**	**0.163**	**0.17**	**0.192**	-0.056	-0.015	-0.056	—								1.102
16 RATE-INC	**0.472**	**-0.109**	0.056	**0.271**	**0.294**	**0.248**	**0.616**	**0.488**	**0.313**	**0.58**	**0.4**	0.101	**0.161**	**0.211**	**0.15**	—							2.063
17 LEV	**0.116**	-0.021	-0.011	-0.022	0.001	0.026	0.08	0.055	0.035	0.08	0.06	-0.051	0.028	0.016	-0.008	0.095	—						1.158
18 LIQ	-0.095	**0.116**	-0.013	0.013	0.036	-0.037	-0.094	-0.076	-0.026	-0.074	-0.057	-0.021	-0.019	-0.07	0.057	-0.075	0.044	—					1.101
19 LOG-TA	**0.473**	-0.091	0.098	0.052	0.036	**0.194**	**0.351**	**0.31**	**0.23**	**0.337**	**0.11**	0.025	0.019	**0.16**	0.07	**0.446**	-0.004	**-0.167**	—				1.483
20 ROA	-0.004	-0.038	-0.012	0.04	0.074	-0.00088	-0.00022	-0.002	0.024	-0.039	0.007	-0.046	-0.059	0.042	-0.016	-0.058	**-0.151**	**0.148**	0.017	—			2.756
21 ROE	-0.007	-0.062	0.005	0.058	0.04	0.01	0.031	0.01	0.012	-0.066	-0.06	-0.014	-0.062	0.061	-0.00062	-0.025	**-0.161**	0.101	0.067	**0.586**	—		2.715
22 INDUS	-0.096	0.051	0.042	0.074	-0.004	-0.021	-0.071	**-0.136**	-0.066	-0.043	-0.07	-0.031	-0.032	0.064	-0.025	0.011	**0.24**	-0.064	-0.094	0.058	-0.002	—	1.194

Notes: Correlations in bold are significant at $p < 0.05$. VIF is the variance inflation factor. I have similar correlation tables for the years 2021 and 2022 but did not include them in the paper.

Table 4. The variables' correlation for the model of 2020

	Separate Agencies				Ratings' Average (Model)				Ratings' Divergence					
Year	2020	2021	2022	Total	2020	2021	2022	Total	2020	2021	2022	Total	Overall Models	Association
DM-Frq	0	0	2	**2**	0	0	1	**1**	0	0	0	0	**3**	-
MAT-Div	1	1	0	**2**	0	0	0	**0**	0	0	0	0	**2**	+
TAR-Frq	2	1	0	**3**	1	0	0	**1**	1	0	0	1	**5**	+
TAR-Div	1	0	0	**1**	0	0	0	**0**	0	0	0	0	**1**	+
MAT-Fre	0	0	1	**1**	0	0	0	**0**	0	1	0	1	**2**	+
FW-Frq	0	0	0	**0**	0	0	0	**0**	0	0	0	0	**0**	
FW-Div	2	0	3	**5**	1	0	1	**2**	0	0	0	0	**7**	+
SPE-VIS-Div	0	1	2	**3**	0	0	0	**0**	0	0	0	0	**3**	-
SPE-VIS-Frq	0	1	1	**2**	0	0	0	**0**	0	0	1	1	**3**	+
TOPIC-Fin	0	0	0	**0**	0	0	0	**0**	0	0	0	0	**0**	
TOPIC-Gov	0	0	1	**1**	0	0	0	**0**	0	0	0	0	**2**	+
TOPIC-Imp	1	2	1	**4**	0	0	0	**0**	1	0	0	1	**5**	+
READ-Ind	0	1	0	**1**	0	0	0	**0**	1	0	0	1	**2**	+
RATE-INC	1	2	4	**7**	0	1	1	**2**	0	0	0	0	**9**	+
LEV	0	1	0	**1**	0	0	0	**0**	0	1	1	2	**3**	-
LIQ	0	2	2	**4**	0	1	1	**2**	1	0	0	1	**7**	-
LOG-TA	2	3	2	**7**	0	1	1	**2**	1	0	0	1	**10**	+
ROA	0	2	1	**3**	0	0	1	**1**	0	0	0	0	**4**	+
ROE	0	0	1	**1**	0	0	0	**0**	0	0	0	0	**1**	
INDUS	0	1	1	**2**	0	0	0	**0**	0	0	0	0	**2**	-
Maximum	3	3	4	**10**	1	1	1	**3**	1	1	1	**3**	**16**	

Notes: All variables are defined in Table 1. The total columns represent the number of models where a variable was significant. The overall Models column

	Separate Agencies				Ratings' Average (Model)				Ratings' Divergence					
Year	2020	2021	2022	Total	2020	2021	2022	Total	2020	2021	2022	Total	Overall Models	Association
DM-Frq	0	0	2	**2**	0	0	1	**1**	0	0	0	0	**3**	-
MAT-Div	1	1	0	**2**	0	0	0	**0**	0	0	0	0	**2**	+
TAR-Frq	2	1	0	**3**	1	0	0	**1**	1	0	0	1	**5**	+
TAR-Div	1	0	0	**1**	0	0	0	**0**	0	0	0	0	**1**	+
MAT-Fre	0	0	1	**1**	0	0	0	**0**	0	1	0	1	**2**	+

represents the number of all the models (out of 16) where a variable was significant.

Table 5. The summary of the different OLS regression results across the three years

Starting with the individual scores *(Equation 1)*, the results of the regressions show that five out of the ten models are significant. These five models confirm that the adoption of non-financial reporting frameworks (FW-Div) has a significant positive impact on ESG ratings, confirming our first hypothesis (H1). FW-Div had a positive and significant coefficient β ranging from 0.957 to 2.409 and a p-value between < 0.05 and < 0.001. In the average rating models *(Equation 2)*, two out of three (2020 and 2022) were positively significant. Their β coefficient ranged from 1.008 to 2.463, with a p-value between < 0.001 and < 0.05, which also supports hypothesis H1.

DM-Frq was significant only in 2022 for two agency ratings ($\beta \approx -1.06$, $p < 0.01$) and negatively significant for one average rating ($\beta = -0.699$, $p < 0.05$). Thus, H2 is not supported — DM is associated with lower ratings in these models. Finally, Hypotheses H3 and H4 — that reporting frameworks and DM reduce rating divergence — were not supported (no significant effects observed).

Further analysis of the other variables included in our models revealed some significant variables. For example, the inclusion of previous ratings in annual reports (RATE-INC) was influential, as was the company size (LOG-TA). Both were positive and highly influential for the different ratings (in 7/10 models) and for the average ratings score (2/3 models). The company's liquidity (LIQ) and the inclusion of more sustainability-related topics/sections in the report (TOPIC-Imp) were also significant and influential in 4/10 separate rating models. While TOPIC-Imp had a positive influence, LIQ had a negative one and was also significant and negatively influential for 2 out of 3 average ratings. These results are in line with previous research (Christensen *et al.,* 2021; Madison and Schiehll, 2021; Modugu, 2020).

Finally, we tested the dispersion of the ratings (standard deviation). The firm's leverage (LEV) had a negative impact in 2 of the 3 models, with β coefficients ranging from -8.398 to -7.185, and a p-value < 0.01. This means that leverage helps to reduce the rating inconsistencies, leading to more convergence. Some other variables also had the potential to reduce the divergence between the ratings and were significant in 1 out of 3 models. These combine the inclusion of

specific sustainability sections/topics in the report (TOPIC Imp) and the specification of more targets (TAR-Frq) when reporting the performance. In addition, mentioning more materiality-related topics (MAT-Frq) and being more precise in reporting with more specificity and the use of visuals (SPE-VIS-Frq) were influential. Finally, the report readability (READ-IND) and company size (LOG-TA) positively influenced convergence, while only liquidity (LIQ) had a negative impact on such convergence.

5.2.4 Robustness tests

In this study, we ran multiple regression models (21 models) and used different proxies (several ESG ratings). We tested variables extracted from annual reports for three consecutive years (2020, 2021, and 2022) and used three different datasets (one dataset per year). We used a sample of 366 randomly selected European-listed companies. In addition, we conducted further robustness checks using 1000 iterations of bootstrapping to test the significance and consistency of the results. We confirmed the effect of adopting different non-financial reporting frameworks (FW-Div) and double materiality (DM-Frq) across the different models in the three years.

We compared the results of the original significant models with those of the bootstrap, and the results show that the non-financial reporting framework (FW-Frq) remained significant. This was the case for the same 3 out of 5 (Eikon23, CSRhub23, and S&P23) separate ratings in 2022. It also remained the same for 2 out of 5 (Eikon20 and CSRhub20) models in 2020. FW-Frq also remained significant for the average rating models in both years (SUS-AVG-2023 and SUS-AVG-2020). Double materiality (DM-Frq) also remained significant and negatively associated with the same two ratings for 2023 (Eikon23 and S&P23). This was also the case for the average rating in that year (SUS-AVG-2023). Finally, we compared the performance of the models to check their robustness by comparing the adjusted R^2 values of the original models with those of the bootstrapping. Table 6 shows the results.

2022	Eikon23	0.423	0.479
	SP global23	0.228	0.166
	Sustain23	0.126	0.126
2021	SP global22	0.228	0.167
2020	CSRhub21	0.377	0.324
	SP global21	0.088	0.067

Table 6. Model robustness (Bootstrapping)

The values of the bootstrapped adjusted R^2 were close to those of the original models (Table 6). Based on these results and the longitudinal nature of the study (using three different datasets), we consider the results obtained to be robust. In addition, this study aims to examine the current

state of non-financial reporting and the principle of double materiality, and check their evolution over time and their potential impact on improving external assessments of corporate performance (ESG ratings). As a result, the models we have presented are an exploratory attempt to provide preliminary insights.

6. Discussion of Results

This study explores the adoption of non-financial reporting frameworks and the double materiality principle in the annual reports of listed companies in Europe. Additionally, it examines their potential influence on ESG ratings and their convergence. The findings contribute to the growing literature on sustainability reporting and have implications for corporate performance assessment.

The results show a significant increase in the adoption of non-financial reporting frameworks, which is consistent with the evolving regulatory landscape, particularly in Europe. The adoption of the double materiality principle has also increased, which was displayed in companies' reports over the three years from 2020 to 2022. This trend is in line with the efforts of European regulatory initiatives, including the Corporate Sustainability Reporting Directive (CSRD) and the European Sustainability Reporting Standards (ESRS), which aim to modulate and standardize sustainability-related performance reporting (Antolín-López and Ortiz-De-Mandojana, 2023; Fiaschi *et al.,* 2020). These findings add to the growing literature that calls for stronger theorization of business models. Roslender and Lund (2024), for example, argue that reporting practices need to be theorized as being integral to the way business models are interpreted and evaluated. Our findings support this argument by showing that frameworks and double materiality influence not only disclosure quality, but also the way business performance and legitimacy are judged by external stakeholders.

The positive impact of adopting non-financial reporting frameworks on ESG ratings is consistent with the findings of previous research (Manes-Rossi *et al.,* 2018), suggesting that following such frameworks increases transparency and accountability to stakeholders. These results support our hypothesis and show that compliance with established frameworks is valued by rating agencies. Thus, it contributes to better ESG ratings.

Unexpectedly, the analysis revealed a negative impact of the double materiality (DM) principle. For some models, there was a negative impact on ESG ratings. This counterintuitive result contradicts the initial hypothesis and suggests that the adoption of DM does not necessarily lead to higher ESG ratings. One explanation is that ESG rating agencies had not yet fully integrated this principle into their rating methodologies during the study period. Double materiality is a relatively recent development, and the rating agencies may not have adapted their assessment criteria. As a result, the implications of this approach are not fully captured. Thus, companies' efforts to implement double materiality may not be reflected in the ESG ratings, which leads to the observed negative association.

Reporting frameworks and double materiality do not have a significant impact on reducing the divergence between ESG ratings. This suggests that other factors may be more influential in determining the consistency of ratings across agencies. This result contradicts the hypotheses and highlights the need for further research that can help identify and address the underlying causes of rating inconsistencies.

Consistent with the existing literature (Conway, 2019; Giannarakis *et al.,* 2014; Liu, 2022; Santamaria *et al.,* 2021), the analysis revealed several other factors that positively influence ESG ratings. For example, the inclusion of previous ratings in annual reports, the company size, and the inclusion of sustainability topics and sections were influential. Conversely, liquidity had a negative impact on ESG ratings, which warrants further investigation into the reasons for this association.

Interestingly, company leverage positively influenced rating convergence, suggesting that highly leveraged companies received more consistent ratings across agencies. This finding could potentially guide companies in managing their capital structure, which helps them to improve the consistency of their ratings. In addition, some factors have a positive impact on rating convergence, like the inclusion of sustainability issues, the specificity of reporting, the use of visuals, and the readability of the report.

7. Conclusion

The regulatory landscape for sustainability and non-financial reporting is evolving, particularly at the European level. Accordingly, this study had two main objectives. The first is to examine the adoption of non-financial reporting standards/frameworks and the double materiality principle by following European listed companies in their annual reports for three consecutive years (2020, 2021, and 2022). The second objective of the study was to examine the factors related to companies' disclosures that may influence external assessments of their performance. This performance is reflected in companies' sustainability ratings. The main interest was to examine the impact of the adoption of non-financial reporting frameworks/standards and the DM principle on companies' external ESG ratings and their convergence.

The results demonstrate increased adoption of non-financial reporting frameworks and double materiality among European listed companies. One possible explanation is the development of regulatory initiatives such as the CSRD and ESRS (Antolín-López and Ortiz-De-Mandojana, 2023; Bossut *et al,* 2021; Hummel and Jobst, 2024a). Regulatory innovation has long been known to be a driver of business model innovation (Nielsen, 2023). The diffusion of CSRD-related frameworks within our sample substantiates this dynamic, showing how regulation may transform firms' logics of value creation and disclosure practices. By linking reporting frameworks and the double materiality concept to external examinations, this study validates that disclosure and transparency are not only compliance activities but central to how business models are built, legitimized, and configured to absorb institutional pressure.

Concerning the second objective of this study, we identified factors that influence ESG ratings and found that companies' adoption of non-financial reporting frameworks has a positive impact on ESG ratings. However, DM had no impact in 2020 and 2021, except for a negative impact in 2022. This could be due to a lack of consideration of the principle by rating agencies (Antolín-López and Ortiz-De-Mandojana, 2023). Regarding the convergence of ratings, there is no evidence that the reporting frameworks or DM have contributed to its reduction.

For practitioners and policymakers, the results highlight the benefits of adopting established non-financial reporting frameworks. They help companies to report on their activities and operations, which adds transparency, accountability, and legitimacy to these companies. Such transparency is directed towards different stakeholders. It relates to the information that

companies share, which, in turn, leads to better external assessments of their performance. This research contributes to our understanding of the evolving landscape of non-financial reporting. It helps to understand the principle of double materiality, particularly in corporate reporting, and answers the research question by identifying key factors in companies' annual disclosures. Such factors influence external ratings (ESG ratings) and their divergence. The study examines the potential impact of non-financial reporting and double materiality and shows how they help to provide a clear picture of companies' activities and communicate information to stakeholders.

This study contributes to the business model literature by linking non-financial reporting practices and the notion of double materiality to external evaluations of corporate performance. In doing so, it highlights how reporting standards and regulatory reform influence how firms create, deliver, and capture value in practice. By demonstrating that disclosure choices affect ESG ratings and stakeholder interpretation, the study establishes that transparency and disclosure are not mere compliance activities but are at the heart of business model innovation and design. The findings contribute to the growing literature on responsible and sustainable business models, offering evidence of how institutional pressures reshape firms' value logics.

Our sample comprises only European listed companies, which may limit generalizability to other regions or to private firms. Future studies should test whether the observed relationships hold in other jurisdictions and for different firm populations. Another important limitation was the availability of data. We manually collected ratings from various online open-source databases, including the official websites of seven rating agencies. We also manually downloaded the annual reports (1097 reports) from the companies' official websites and extracted the tables of contents from these reports. This process was time-intensive because data collection spanned multiple periods and required waiting for the publication of annual ratings and reports. We also used several techniques and tools to clean, organize, and merge the three datasets and to perform the textual analysis and regression. For all these reasons, we could not use a larger sample, which led to potentially less robust and generalizable results.

Future research can extend the investigation of the effects of the variables of interest in this study. It can either use a larger sample size, extend it beyond the European level, or use a longer time frame. This is important, especially in view of the rapidly developing non-financial reporting and the double materiality principle, which would help reporting companies and standard setters, as well as external evaluators (rating agencies), and guide them to prioritize the factors that will contribute to better reporting in the future. This is ultimately in the interest of companies and their stakeholders. Future research could explore the reasons for the negative relationship between DM and ESG ratings. Such research could use qualitative investigations to examine the specific assessment criteria used by rating agencies. In addition, cross-regional or cross-industry comparisons could provide valuable insights that would highlight the variability in reporting practices and their impact on ESG ratings.

From a practical point of view, the results of this study have implications for several different entities, including companies, policymakers, and rating agencies. Companies should continue to prioritize transparency and comprehensiveness in their non-financial reporting practices. They should adhere to established frameworks and guidelines, in addition to the principle of double materiality, which is gaining traction. The results also encourage rating agencies to review their assessment methodologies to ensure that the implications of this approach are properly captured. Policymakers could also consider developing more specific guidelines or regulations

that help ensure consistent interpretation and application of the DM principle extended to different industries and regions.

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Data Availability Statement

Data available upon reasonable request from the corresponding author.

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Appendices

Appendix 1: Sample characteristics, country of origin, Sector of activity, and Size

	Country of origin	
Country	**Count**	**Total**
#N/A	19	366
UNITED KINGDOM	57	366
GIBRALTAR	1	366
ITALY	20	366
NETHERLANDS	21	366
SPAIN	14	366
GERMANY	38	366
FRANCE	73	366
UNITED STATES	1	366
SWEDEN	43	366
SWITZERLAND	13	366
LUXEMBOURG	6	366
NORWAY	9	366
ISLE OF MAN	1	366
TURKEY	1	366
BELGIUM	12	366
FINLAND	16	366
AUSTRALIA	3	366
PORTUGAL	3	366
AUSTRIA	6	366
DENMARK	2	366
POLAND	1	366
RUSSIAN FEDERATION	1	366
JERSEY	2	366
IRELAND	2	366
CYPRUS	1	366

Level	Sector of activity	
	Count	Total
Investment Banking and Brokerage Services	7	350
Construction and Materials	30	350
Travel and Leisure	9	350
Electricity	9	350
Banks	13	350
Personal Goods	12	350
Industrial Support Services	15	350
Life Insurance	4	350
Personal Care, Drug and Grocery Stores	15	350
Aerospace and Defense	8	350
Chemicals	6	350
Oil, Gas and Coal	13	350
Automobiles and Parts	6	350
Industrial Metals and Mining	6	350
Electronic and Electrical Equipment	13	350
Real Estate Investment Trusts	8	350
Health Care Providers	5	350
Medical Equipment and Services	8	350
Real Estate Investment and Services	2	350
Software and Computer Services	14	350
Gas, Water, and Multi-utilities	9	350
Retailers	10	350
Non-life Insurance	8	350
Food Producers	10	350
Pharmaceuticals and Biotechnology	5	350
Closed-End Investments	2	350
Waste and Disposal Services	3	350
Leisure Goods	9	350
Industrial Transportation	10	350
Beverages	7	350
Telecommunications Service Providers	9	350
General Industrials	11	350

Industrial Engineering	7	350
Consumer Services	3	350
Industrial Materials	7	350
Telecommunications Equipment	6	350
Household Goods and Home Construction	6	350
Precious Metals and Mining	1	350
Technology Hardware and Equipment	9	350
Media	11	350
Alternative Energy	3	350
Tobacco	1	350

TOTAL ASSETS-2022

Valid	366
Missing	0
Mean	162,700,000
Std. Deviation	1,405,000,000
Minimum	1,199,300
Maximum	25,790,000,000

Appendix 2: Ratings I obtained for the sample across the 8 rating agencies per year

Rating	N	Missing	Mean	Median	SD	Variance	Minimum	Maximum
Eikon20	312	55	75.8	86	24.41	596	2	100
Eikon21	343	24	66.7	71.7	17.87	319.3	5.6	95.8
Eikon22	260	107	67	71.9	18.16	329.8	4.89	95.7
Eikon23	348	19	66.8	71.5	17.74	314.6	4.79	95.7
CSRhub20	301	66	63.7	68	19.03	362.2	9	99
CSRhub21	358	9	78.4	86	21.32	454.4	5	99
CSRhub22	363	4	80.8	87	18.72	350.5	5	99
CSRhub23	362	5	81.8	89	18.05	325.8	6	100
MSCI20	172	195	77.8	85.7	18.49	341.7	14.28	100
MSCI21	151	216	80	85.7	17.06	291.1	14.28	100
MSCI22	151	216	83.1	85.7	15.12	228.6	28.57	100
MSCI23	147	220	83.4	85.7	15.65	245	28.57	100
SP global20	199	168	49.7	45	24.62	606.1	4	90
SP global21	104	263	50.7	48.5	23.92	572.3	6	91
SP global22	225	142	53.8	51	17.96	322.6	15	91
SP global23	231	136	54.1	51	17.88	319.6	15	91
Sustain20	248	119	58.3	73.4	29.26	856.2	7.4	94.6
Sustain21	246	321	80.8	82.5	7.78	60.5	59.8	91
Sustain22	189	178	79.9	80.6	7.92	62.7	27	94.7
Sustain23	324	43	79.5	80.2	7.59	57.5	43.7	94.6
FITCH Rating 2023	83	284	68.1	70.7	11.56	133.7	20.8	87.4
FITCH Rating 2022	85	282	67.7	70.7	11.76	138.3	24.96	91.5
FITCH Rating 2021	85	282	68	66.6	11.06	122.2	37.44	91.5
FITCH Rating 2020	81	286	69.5	70.7	10.49	110	37.44	91.5
FITCH Rating 2019	73	294	70.1	70.7	8.81	77.5	45.76	91.5
Moody's Rating 2023	124	243	61.9	65	14.14	199.9	10	95
Moody's Rating 2022	130	237	62	62.5	13.49	182.1	15	95
Moody's Rating 2021	130	237	61.4	60	13.33	177.6	15	95

Moody's Rating 2020	123	244	61.5	65	13.19	174.1	20	90
Moody's Rating 2019	113	254	61.9	65	12.7	161.2	25	90
S&P Rating 2023	169	198	66.7	69.4	11.82	139.7	30.38	99.8
S&P Rating 2022	67	300	68.6	65.1	10.43	108.8	30.38	91.5
S&P Rating 2021	107	260	65.5	65.1	12.18	148.4	30.38	91.5
S&P Rating 2020	130	237	65.8	65.1	11.86	140.7	21.7	91.5
SUS-AVG-2020	366	0	66.545	63.171	17.999	323.958	16.05	100
SUS-AVG-2021	366	0	74.545	69.531	18.275	333.963	15.55	99
SUS-AVG-2022	366	0	74.05	70.341	15.951	254.441	7.45	94
SUS-AVG-2023	366	0	73.88	71.697	13.285	176.497	6.4	98
SUS-SD-20	366	0	21.1	21.095	10.804	116.716	0	53.74
SUS-SD-21	366	0	12.485	13.826	8.709	75.853	0.11	51.9
SUS-SD-22	366	0	16.26	16.257	7.802	60.866	0.87	43.13
SUS-SD-23	366	0	16.305	16.435	6.937	48.122	1.7	48.69
Max	**363**	**321**	**89**	**83.448**	**24.07**	**579.377**		
Min	**46**	**4**	**12.485**	**13.826**	**2.732**	**7.463**		

Appendix 3: The rating scales adjusted across different agencies

	Moody's		S&P Global		Fitch		MSCI	
STEP	Moody's	Moody's ADJ %	S&P Global	S&P Global ADJ %	Fitch	Fitch ADJ %	MSCI	MSCI AJD %
1	Aaa	100	AAA	99.82	AAA	99.84	AAA	99.96
2	Aa1	95	AA+	95.48	AA+	95.68	AA	85.68
3	Aa2	90	AA	91.48	AA	91.5	A	71.4
4	Aa3	85	AA-	86.8	AA-	87.36	BBB	57.12
5	A1	80	A+	82.46	A+	83.2	BB	42.84
6	A2	75	A	78.12	A	79.04	B	28.57
7	A3	70	A-	73.78	A-	74.88	CCC	14.28
8	Baa1	65	BBB+	69.44	BBB+	70.72		
9	Baa2	60	BBB	65.1	BBB	66.56		
10	Baa3	55	BBB-	60.76	BBB-	62.4		
11	Ba1	50	BB+	56.42	BB+	58.24		
12	Ba2	45	BB	52.08	BB	54.08		
13	Ba3	40	BB-	47.74	BB-	49.92		
14	B1	35	B+	43.4	B+	45.76		
15	B2	30	B	39.06	B	41.6		
16	B3	25	B-	34.72	B-	37.44		
17	Caa1	20	CCC+	30.38	CCC+	33.28		
18	Caa2	15	CCC	26.04	CCC	29.12		
19	Caa3	10	CCC-	21.7	CCC-	24.96		
20	Caa	5	CC	17.36	CC	20.8		
21			C	13.02	C	16.64		
22			SD	8.68	DDD	12.48		
23			D	4.34	DD	8.32		
24					D	4.16		

Note: The agencies not presented in this table provide their ratings in the form of a decimal scale.

Appendix 4: Variables used by previous literature to investigate ESG ratings and disclosures

Authors	(Christensen et al., 2021)	(Otu Umoren, 2015)	(Liu, 2022)	(Lai et al., 2016)	(Dewi et al., 2023)	(Modugu, 2022)	(Tang, 2022)	(Du & Yu, 2021)	(Madison & Schiehll, 2021)	Count-Var
Dep-Var	**ESG_Score**	**Disclosure Score**	**ESG SD**	**ESG SD**	**Reporting Quality**	**ESG Score**	**Number of patents**	**ESG_Current year+1**	**ESG_Scores**	
Independent Variables					**Variables Sig**					
ESG_Disclosure	***									1
ESG_Avg	***		**				***			3
Firm Size-Total Assets (log)	***	x	***	x	x	***			*	7
ROA	**		x	x	x		***			5
book V/market V (equity)	***		**						*	3
Leverage			**	***	x	x	***	**		6
Analyst Following	***							x		2
Inst. Ownership	***									1
Intercept	***		x		***		***			4
ESG Rater F.E.	Ctr		Ctr							2
Year F.E.	Ctr		Ctr		x		Ctr			4
Industry F.E.	Ctr		Ctr				Ctr			3
Country F.E.	Ctr									1
Firm F.E.	Ctr		Ctr							2
ROE		*				x			*	3

Auditor type	x			1
State F.E. (state-owned company)		x	x	2
TobinQ		x		1
ESG_Qmetrics (number of indicators)		***		1
European nationality company			x	1
Industry Change			***	1
Materiality (Disclosed material topics & process)			x	1
Stakeholder engagement			x	1
Corporate governance			x	1
environmentally and socially sensitive industries F.E.			**	2
Liquidity			***	2
Board Construction			***	1
CEO duality			x	1
Agency cost			*	1
Financial Constraints			***	1
% on institutions' investors			***	1
Company Age			***	1
Risk control capability			x	1
Ratio of large stakeholders			x	1

Independent directors/all directors		**		1
Growth rate of operating income		x		1
ESG_Current year			***	1
ESG_Current Year-1			***	1
Report Tone			***	1
Report Readability			**	1
debt and equity capital raised by the firm (Fin)			x	1
Research & Development (RD)			**	1
The proportion of negative words			**	1
Proportion positive words			***	1
Applied Financial Materiality				* 1

Notes: *p < 0.05, **p < 0.01 and ***p < 0.001. x is insignificant, and Ctr is the control variables

Appendix 5: Results of the 2020 model

	Eikon21	CSRhub21	MSCI21	S&P21	Sust21	SUS-AVG-21	SUS-SD-21
Variables				**Coefficients (t-statistic)**			
(Intercept)	21.899*	25.713*	84.279***	44.144***	82.64***	17.522	20.886***
	(-2.376)	(-2.046)	(-10.399)	(-4.834)	(-40.5)	(-1.742)	(-3.298)
DM-Frq	**5.917**	**-1.087**	**4.862**	**4.611**	**0.477**	**4.139**	**-4.414**
	(-1.134)	(-0.153)	(-1.06)	(-0.892)	(-0.413)	(-0.727)	(-1.231)
MAT-Div	0.460	3.936*	0.257	-0.304	-0.179	2.492	-0.268
	(-0.322)	(-2.019)	(-0.204)	(-0.215)	(-0.567)	(-1.598)	(-0.273)
TAR-Frq	0.041**	0.043*	0.027*	0.027	-0.007*	0.051***	-0.021*
	(-2.938)	(-2.25)	(-2.198)	(-1.957)	(-2.217)	(-3.338)	(-2.222)
TAR-Div	0.805	1.034	-0.965	-2.355**	-0.049	-0.359	1.053
	(-0.729)	(-0.687)	(-0.994)	(-2.152)	(-0.201)	(-0.298)	(-1.388)
MAT-Fre	-0.032	-0.070	0.058	0.029	0.002	-0.006	-0.009
	(-0.545)	(-0.861)	(-1.105)	(-0.493)	(-0.169)	(-0.099)	(-0.222)
FW-Frq	**-0.004**	**0.001**	**-0.005**	**0.002**	**-0.001**	**-0.003**	**0.002**
	(-1.115)	(-0.226)	(-1.534)	(-0.481)	(-0.907)	(-0.67)	(-0.935)
FW-Div	**1.945*** **	**2.409*** **	**0.021**	**0.459**	**0.093**	**2.463*** **	**0.063**
	(-3.637)	(-3.304)	(-0.046)	(-0.867)	(-0.789)	(-4.22)	(-0.171)
SPE-VIS-Div	0.416	0.582	0.083	-0.266	-0.083	0.594	0.120
	(-1.188)	(-1.218)	(-0.269)	(-0.765)	(-1.071)	(-1.552)	(-0.498)
SPE-VIS-Frq	0.000	0.000	-0.003	0.001	0.001	-0.001	-0.001
	(-0.084)	(-0.063)	(-0.99)	(-0.345)	(-1.144)	(-0.444)	(-0.355)
TOPIC-Fin	-0.653	-0.536	-0.153	0.060	-0.041	-0.541	0.463
	(-1.392)	(-0.838)	(-0.37)	(-0.13)	(-0.398)	(-1.056)	(-1.435)
TOPIC-Gov	0.223	0.254	-0.438	-0.120	0.149	0.044	0.286
	(-0.467)	(-0.39)	(-1.042)	(-0.253)	(-1.404)	(-0.085)	(-0.872)
TOPIC-Imp	0.893*	0.817	0.606	0.798	0.041	1.108	-0.815**
	(-2.075)	(-1.392)	(-1.6)	(-1.871)	(-0.435)	(-2.359)	(-2.755)
READ-Ind	-0.081	-0.173	-0.016	0.006	0.015	-0.059	-0.169*
	(-0.653)	(-1.021)	(-0.148)	(-0.049)	(-0.537)	(-0.437)	(-1.977)
RATE-INC	0.928**	0.184	0.169	0.629	0.194*	0.382	-0.064
	(-2.548)	(-0.37)	(-0.526)	(-1.743)	(-2.4)	(-0.96)	(-0.256)

LEV	12.045	10.042	0.436	0.796	0.194	9.023	-3.242
	(-2.51)	(-1.535)	(-0.103)	(-0.167)	(-0.182)	(-1.723)	(-0.983)
LIQ	-0.534	0.211	0.041	0.194	0.005	-0.037	0.477*
	(-1.709)	(-0.495)	(-0.148)	(-0.627)	(-0.079)	(-0.107)	(-2.223)
LOG-TA	2.066***	2.193***	-0.309	0.403	-0.121	2.110	-0.003***
	(-6.139)	(-4.778)	(-1.044)	(-1.207)	(-1.63)	(-5.745)	(-0.014)
ROA	0.107	0.031	-0.122	-0.055	-0.017	0.104	-0.016
	(-0.96)	(-0.202)	(-1.241)	(-0.497)	(-0.679)	(-0.854)	(-0.203)
ROE	-0.046	-0.038	0.043	0.027	0.005	-0.053	-0.019
	(-1.107)	(-0.675)	(-1.179)	(-0.648)	(-0.582)	(-1.177)	(-0.668)
INDUS	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(-2.619)	(-0.064)	(-0.328)	(-0.247)	(-1.102)	(-1.232)	(-1.304)
Adjusted R^2	**0.473**	**0.324**	**0.051**	**0.067**	**-0.002**	**0.433**	**0.041**
LR χ^2	**< .001**	**< .001**	**0.582**	**0.002**	**0.507**	**< .001**	**0.024**
F statistics	**17.092**	**9.595**	**0.904**	**2.284**	**0.963**	**14.665**	**1.757**
Observations	**343**	**358**	**151**	**104**	**246**	**366**	**366**
df	**20**	**20**	**20**	**20**	**20**	**20**	**20**

Notes: *p < 0.05, **p < 0.01 and ***p < 0.001

Appendix 6: Results of the 2021 model

	Eikon22	CSRhub22	MSCI22	S&P22	Sust22	SUS-AVG-22	SUS-SD-22
Variables				**Coefficients (t-statistic)**			
(Intercept)	18.443	37.944**	67.758***	41.092***	90.547***	28.229***	18.146**
	(-1.861)	(-2.883)	(-8.506)	(-3.857)	(-19.519)	(-2.587)	(-2.87)
DM-Frq	**-1.969**	**-2.175**	**-1.346**	**0.130**	**-0.279**	**-1.354**	**-0.274**
	(-1.543)	(-1.283)	(-1.312)	(-0.095)	(-0.467)	(-0.963)	(-0.337)
MAT-Div	1.279	3.009*	1.239	1.367	0.580	2.261	-0.266
	(-1.141)	(-2.022)	(-1.376)	(-1.135)	(-1.106)	(-1.833)	(-0.372)
TAR-Frq	0.026*	0.013	0.007	0.004	0.000	0.015	-0.006
	(-2.441)	(-0.915)	(-0.804)	(-0.357)	(-0.015)	(-1.278)	(-0.834)
TAR-Div	0.972	0.092	-1.285	-1.262	0.163	-1.100	0.573
	(-0.923)	(-0.066)	(-1.519)	(-1.115)	(-0.332)	(-0.949)	(-0.853)
MAT-Fre	0.024	-0.089	0.021	0.085	0.022	0.001	-0.064*
	(-0.531)	(-1.478)	(-0.574)	(-1.738)	(-1.053)	(-0.024)	(-2.19)
FW-Frq	**-0.004**	**0.000**	**-0.001**	**-0.004**	**-0.001**	**-0.003**	**0.002**
	(-1.594)	(-0.082)	(-0.399)	(-1.538)	(-0.635)	(-1.078)	(-1.091)
FW-Div	**0.479**	**0.903**	**-0.615**	**0.293**	**0.205**	**0.737**	**0.012**
	(-0.996)	(-1.414)	(-1.592)	(-0.568)	(-0.911)	(-1.392)	(-0.039)
SPE-VIS-Div	0.207	0.593	0.360	-0.534*	-0.248*	0.525	0.224
	(-0.838)	(-1.807)	(-1.81)	(-2.008)	(-2.145)	(-1.927)	(-1.417)
SPE-VIS-Frq	0.000	0.000	0.000	0.0007948*	0.000	0.000	0.000
	(-0.137)	(-0.354)	(-0.373)	(-2.08)	(-0.312)	(-0.674)	(-0.841)
TOPIC-Fin	0.199	0.251	0.012	0.370	-0.077	0.188	0.143
	(-0.431)	(-0.408)	(-0.033)	(-0.744)	(-0.356)	(-0.369)	(-0.483)
TOPIC-Gov	-0.599	-0.637	-0.203	-0.002	0.437*	-0.131	-0.207
	(-1.321)	(-1.056)	(-0.556)	(-0.003)	(-2.058)	(-0.262)	(-0.716)
TOPIC-Imp	0.779*	1.032*	0.026	0.712	-0.147	0.679	-0.065
	(-2.297)	(-2.29)	(-0.096)	(-1.954)	(-0.929)	(-1.819)	(-0.3)
READ-Ind	-0.002	-0.013**	0.233*	0.092	-0.088	-0.021	0.022
	(-0.017)	(-0.077)	(-2.236)	(-0.663)	(-1.45)	(-0.149)	(-0.272)
RATE-INC	0.838*	1.174	0.458	1.191***	0.455**	0.994**	-0.191
	(-2.518)	(-2.658)	(-1.711)	(-3.329)	(-2.918)	(-2.712)	(-0.898)

LEV	13.077**	-6.940	1.118	9.447	1.916	2.108	-8.398**
	(-2.762)	(-1.104)	(-0.294)	(-1.856)	(-0.864)	(-0.404)	(-2.78)
LIQ	-0.558**	-0.635*	-0.026	0.057	-0.009	-0.528**	-0.215
	(-3.017)	(-2.583)	(-0.173)	(-0.288)	(-0.105)	(-2.59)	(-1.824)
LOG-TA	2.2***	1.437**	-0.244	0.502*	-0.325	1.547***	-0.272
	(-6.395)	(-3.146)	(-0.882)	(-1.358)	(-2.019)	(-4.085)	(-1.239)
ROA	0.083*	0.126**	0.005	-0.036	0.014	0.063	0.024
	(-2.018)	(-2.315)	(-0.155)	(-0.81)	(-0.731)	(-1.384)	(-0.901)
ROE	-0.002	-0.004	0.000	0.001	0.000	-0.004	0.001
	(-0.623)	(-1.187)	(-0.091)	(-0.319)	(-0.062)	(-1.225)	(-0.562)
INDUS	-0.00075*	0.000	-0.001	0.000	0.000	0.000	0.000
	(-2.504)	(-0.819)	(-0.263)	(-0.915)	(-0.104)	(-1.308)	(-0.929)
Adjusted R^2	**0.39**	**0.315**	**0.018**	**0.167**	**0.08**	**0.32**	**0.098**
LR χ^2	**< .001**	**< .001**	**0.151**	**< .001**	**0.078**	**< .001**	**0.014**
F statistics	**11.948**	**7.942**	**1.34**	**4.652**	**1.499**	**9.58**	**1.866**
Observations	**260**	**363**	**151**	**225**	**189**	**366**	**366**
df	**20**	**20**	**20**	**20**	**20**	**20**	**20**

Notes: *p < 0.05, **p < 0.01 and ***p < 0.001

Appendix 7: Results of the 2022 model

Variables	Eikon23	CSRhub23	MSCI23	S&P23	Sust23	SUS-AVG-23	SUS-SD-23
	Coefficients (t-statistic)						
(Intercept)	17.087	52.224***	74.824***	38.325***	87.009***	40.883***	18.624***
	(1.834)	(4.509)	(10.187)	(3.961)	(17.14)	(5.095)	(3.873)
DM-Frq	**-1.059****	**-0.506**	**-0.068**	**-1.008****	**-0.111**	**-0.699***	**0.241**
	(-2.656)	(-1.022)	(-0.217)	(-2.435)	(-0.512)	(-2.037)	(1.17)
MAT-Div	1.346	1.387	-0.591	-0.804	0.120	0.691	0.204
	(1.539)	(1.275)	(-0.858)	(-0.885)	(0.251)	(0.917)	(0.451)
TAR-Frq	0.018	0.002	0.009	-0.007	0.002	0.007	-0.008
	(1.792)	(0.177)	(1.137)	(-0.681)	(0.433)	(0.775)	(-1.428)
TAR-Div	1.830	1.418	0.572	-0.438	0.159	1.374	-0.029
	(1.702)	(1.061)	(0.675)	(-0.392)	(0.271)	(1.484)	(-0.053)
MAT-Fre	-0.028	-0.089	0.011	0.132**	0.031	-0.013	-0.042
	(-0.622)	(-1.6)	(0.314)	(2.848)	(1.289)	(-0.332)	(-1.818)
FW-Frq	**0.000**	**0.002**	**-0.001**	**0.000**	**0.001**	**0.000**	**-0.002**
	(-0.13)	(0.474)	(-0.363)	(0.113)	(0.358)	(0.13)	(-0.88)
FW-Div	**0.957***	**1.355***	**-0.013**	**1.236***	**0.361**	**1.008***	**-0.189**
	(2.005)	(2.285)	(-0.035)	(2.495)	(1.389)	(2.452)	(-0.768)
SPE-VIS-Div	-0.099	0.098	0.284	-0.623*	-0.346*	0.064	0.227
	(-0.39)	(0.311)	(1.425)	(-2.379)	(-2.518)	(0.296)	(1.745)
SPE-VIS-Frq	0.001	0.000	-0.0006696*	0.0008906*	0.000	0.000	-0.0004521*
	(1.392)	(0.506)	(-2.277)	(2.299)	(-0.371)	(0.375)	(-2.348)
TOPIC-Fin	0.059	0.503	-0.176	0.386	0.025	0.302	-0.092
	(0.12)	(0.824)	(-0.453)	(0.756)	(0.095)	(0.715)	(-0.364)
TOPIC-Gov	0.357	-0.300	-0.537	0.060	0.57*	0.189	-0.278
	(0.737)	(-0.499)	(-1.408)	(0.119)	(2.163)	(0.454)	(-1.114)
TOPIC-Imp	0.365	0.453	0.498	0.632	-0.485*	0.313	-0.253
	(1.018)	(1.016)	(1.761)	(1.697)	(-2.481)	(1.013)	(-1.368)
READ-Ind	-0.022	0.040	0.132	0.210	0.062	0.073	0.034
	(-0.207)	(0.299)	(1.546)	(1.858)	(1.048)	(0.778)	(0.598)
RATE-INC	1.473***	1.377**	0.456	0.959*	0.651**	1.18***	-0.240
	(4.069)	(3.061)	(1.598)	(2.552)	(3.299)	(3.786)	(-1.287)

LEV	8.464	-5.380	-0.312	9.223	3.535	-1.562	-7.185**
	(1.802)	(-0.922)	(-0.084)	(1.891)	(1.381)	(-0.386)	(-2.964)
LIQ	-0.633**	-0.948**	0.010	0.064	-0.128	-0.702***	-0.170
	(-2.69)	(-3.242)	(0.053)	(0.26)	(-1.002)	(-3.467)	(-1.398)
LOG-TA	2.321***	0.764	-0.250	0.339	-0.644*	0.819**	-0.141
	(6.432)	(1.703)	(-0.879)	(0.906)	(-3.279)	(2.634)	(-0.756)
ROA	0.063	0.204**	-0.013	-0.026	0.026	0.127**	-0.019
	(1.253)	(3.237)	(-0.324)	(-0.502)	(0.936)	(2.907)	(-0.733)
ROE	-0.003	-0.010	0.002	0.010	0.01*	-0.007	0.001
	(-0.379)	(-1.068)	(0.36)	(1.282)	(2.426)	(-1.004)	(0.17)
INDUS	-0.00095**	0.000	0.000	0.000	0.000	0.000	0.000
	(-3.044)	(-0.696)	(0.204)	(-1.088)	(0.935)	(-1.113)	(1.365)
Adjusted R^2	**0.479**	**0.253**	**0.012**	**0.166**	**0.126**	**0.346**	**0.138**
LR χ^2	**< .001**	**< .001**	**0.228**	**< .001**	**< .001**	**< .001**	**< .001**
F statistics	**17.803**	**7.196**	**1.228**	**4.641**	**2.486**	**10.643**	**3.921**
Observations	**348**	**362**	**147**	**231**	**324**	**365**	**365**
df	**20**	**20**	**20**	**20**	**20**	**20**	**20**

Notes: *p < 0.05, **p < 0.01 and ***p < 0.001

[i] *EFRAG's mission is to serve the European public interest in both financial reporting and sustainability reporting by developing and promoting European views in the field of corporate reporting and by developing draft EU Sustainability Reporting Standards. In January 2022, EFRAG published its "European Sustainability Reporting Guidelines 1 Double materiality conceptual guidelines for standard-setting", a 31-page document dedicated to the Double materiality perspective.*

[ii] *ESG rating & Climate Search tool - MSCI, https://www.msci.com/our-solutions/esg-investing/esg-ratings-climate-search-tool*

[iii] *Company ESG Risk Rating - Sustainalytics, https://www.sustainalytics.com/esg-rating*